National Irrigation Administration (NIA)
The Republic of the Philippines

PREPARATORY SURVEY
ON
MALITUBOG-MARIDAGAO
IRRIGATION PROJECT
(PHASE II)
IN
THE REPUBLIC OF THE PHILIPPINES

FINAL REPORT
(APPENDIXES)

September 2018

Japan International Cooperation Agency (JICA)
Sanyu Consultants Inc. (SCI)

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APPENDIX-I

IMPLEMENTATION ARRANGEMENT

APPENDIX I: IMPLEMENTATION ARRANGEMENT OF THE PROJECT

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APPENDIX I. IMPLEMENTATION ARRANGEMENT

I.1 JICA Team Members and Counterpart Personnel

I.1.1 JICA Team Members

Team Leader/ Irrigation Planning	Kosei HASHIGUCHI
Irrigation Designing	Kosuke HIROTA
Agriculture/ Farming	Harunobu YOSHINO/Ai NAGINO
Institutional Development	Hiroko YASHIKI
Civil/ Road Design	Yoji SAWADA
Meteorology/ Hydrology	Takayuki OISHI
Cost Estimation/ Procurement	Yoji SAWADA
Economic and Financial Evaluation	Ryo INOUE
Environmental Consideration	Rie KITAO
Social Consideration	Hiroko YASHIKI
Satellite Image Analysis (A)	Izumi KATO
Satellite Image Analysis (B)	Taketo EGUCHI
Inundation Analysis (A)	Toru NAKAGAWA
Inundation Analysis (B)	Hajime KITA

I.1.2 Counterpart Personnel

(1) Central Office, National Irrigation Administration (NIA)

Mr. Ricardo R. Visaya	Administrator
Mr. Czar M. Sulaik	Deputy Admin for Eng. And Operations
Ms. Felipa E. Mascariñas	Manager, CMD - Engr. Dept.
Ms. Alma S. Villaluna	Senior Engineer A, CMD
Ms. Andrea P. Pagtulingan	Engineer A, CMD
Ms. Alfonso delos Reyes	Technical Assistant A, CMD
Mr. Reynaldo B. Villanera	DM PPD- Engineering Dept.
Ms. Kit A. Maglangit	Senior Exec. Assistant, Office of Senior Deputy Administrator
Mr. Josias R. Pacolon	DSD, Consultant, DSD
Mr. Ernesto G. Collado	Technical Assistant A
Ms. Lydia S. Esguerra	Department Manager
Ms. Alma S. Villaluna	Senior Engineer A
Ms. Andrea Pagtulingan	Engineer A
Mr. Reynaldo B. Villanera	Project Planning Division Manager
Mr. Hanziel Nonilon de Guzman	Supervising Engineer A

(2) Ministry of Finance

Ms. Megan Barte	Economist

(3) MMIP Project Management Office (PMO) under NIA Region XII

Mr. Reynaldo M. Sarigumba	Manager, Engr. Division
Mr. Abedin L. Hadjisalik	Head Construction
Mr. Ali S. Satol	RM/APM

(4) NIA Cotabato Irrigation Management Office under NIA Region XII

Mr. Saldi P. Serafino	Acting Division Manager, CIMO
Mr. Saleh P. Kabunto	Provincial Engineer A, NIA – MRIS

Person-month: Preparatory Survey on Malitubog-Maridagao Irrigation Proejct (Phase 2)

	Expertise	Name	Firm	2017									2018									Person-Month		
				4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	In Philippines	In Japan	Total
In Philippines	Team Leader/ Irrigation Planning	Kosei HASHIGUCHI	SCI		(6)	(60)			(23)									21 (21)	11		(7)		3.90		3.90
	Irrigation Designing	Kosuke HIROTA	SCI			(56)												4 (38)	11		(7)		3.37		3.37
	Agriculture/ Farming	Harunobu YOSHINO	SCI*			(45)																	1.50		1.50
		Ai NAGINO	SCI															24 (30)	2				1.00		1.00
	Institutional Development	Hiroko YASHIKI	SCI				(30)																1.00		1.00
	Civil/ Road Design	Yoji SAWADA	SCI			(49)																	1.63		1.63
	Meteorology/ Hydrology	Takayuki OISHI	SCI		(47)														18 (24)	11			2.37		2.37
	Cost Estimation/ Procurement	Yoji SAWADA	SCI															24 (49)	11				1.63		1.63
	Economic and Financial Evaluation	Ryo INOUE	SCI		(75)														21 (21)	11				3.20		3.20
	Environmental Consideration	Rie KITAO	SCI			(37)												24 (49)	11				2.87		2.87
	Social Consideration	Hiroko YASHIKI	SCI		(28)	(14)													2 (14)	11				1.87		1.87
	Satellite Image Analysis (A)	Izumi KATO	SCI		(30)																		1.00		1.00
	Satellite Image Analysis (B)	Taketo EGUCHI	SCI		(30)																		1.00		1.00
	Inundation Analysis (A)	Toru NAKAGAWA	SCI						(26)														0.87		0.87
	Inundation Analysis (B)	Hajime KITA	SCI						(26)														0.87		0.87
																						Sub Total	28.07		28.07
In Japan	Team Leader/ Irrigation Planning	Kosei HASHIGUCHI	SCI				(8)																	0.40	0.40
	Irrigation Design	Kosuke HIROTA	SCI				(4)					(12)												0.80	0.80
	Meteorology/ Hydrology	Takayuki OISHI	SCI								(19)													0.95	0.95
	Cost Estimation/ Procurement	Yoji SAWADA	SCI																					0.00	0.00
	Economic and Financial Evaluation	Ryo INOUE	SCI		(4)																			0.20	0.20
	Satellite Image Analysis (A)	Izumi KATO	SCI		(14)	(10)																		1.20	1.20
	Satellite Image Analysis (B)	Taketo EGUCHI	SCI		(14)	(24)																		1.90	1.90
	Inundation Analysis (A)	Toru NAKAGAWA	SCI							(16)	(20)	(20)	(8)	(10)	(10)									4.20	4.20
	Inundation Analysis (B)	Hajime KITA	SCI							(11)	(20)		(14)											2.25	2.25
																						Sub Total		11.90	11.90
Report					△ IcR		▲ ITR												▲ ITR (2)		▲ DFR	▲ FR			
																						Total	28.07	11.90	39.97
Main Activities		国内事前準備		△ Confirmation of Existing Condition, Preliminary Design				National Condtions (Inundation analysis, Geotechncal Condition), Project Outlining, Evaluation of Project Effects, Environ. Social Considerations etc.																		

Legend In Philippines In Japan

SCI : Sanyu Consultants Inc., JAPAN SCI*: Reinforcement (TASK Co., Ltd)

IcR : Inception Report ITR : Interim Report DFR : Draft Final Report FR : Final Report

I.3 Minutes of Meetings Concluded in the Process of the Project

MINUTES OF MEETING
ON
THE INCEPTION REPORT
OF
THE PREPARATORY SURVEY
ON
MALITUBOG-MARIDAGAO IRRIGATION PROJECT
(PHASE II)
IN
THE REPUBLIC OF THE PHILIPPINES

DISCUSSED BETWEEN
NATIONAL IRRIGATION ADMINISTRATION
AND
JICA PREPARATORY SURVEY TEAM,
JAPAN INTERNATIONAL COOPERATION AGENCY

Manila, May 9, 2017

Gen. Ricardo R. Visaya
Administrator,
National Irrigation Administration (NIA)

Mr. Kosei HASHIGUCHI
Team Leader,
JICA Preparatory survey team,
Japan International Cooperation Agency
(JICA)

Gen. Ricardo R. Visaya, Administrator of NIA, opened the meeting on the Inception Report of the Preparatory Survey on Malitubog-Maridagao Irrigation Project (Phase II) (MMIP II), which was held in a conference room of the Headquarters of National Irrigation Administration (NIA) located in Quezon City, on May 9, 2017 at 9:00 AM.

Mr. Katsurai, Deputy Director of the Southeast Asia Division 5 of the JICA Headquarters, thanked the Administrator of NIA for organizing the meeting, and introduced the participants from the JICA side. He also informed the body on the objective of the meeting, the scope of the preparatory survey as well as the time-frame of the preparation for the implementation of MMIP II with possible Japanese ODA Loan provision.

Gen. Visaya, in turn, welcomed the JICA side participants, and expressed the expectation from NIA for the MMIP II. Subsequently, Gen. Visaya asked Mr. Kosei Hashiguchi, Leader of the JICA survey team, to make a presentation on the Inception Report (ICR) of the Preparatory Survey.

Mr. Hashiguchi made a presentation on the ICR. The contents of the presentation were: Survey outline; Survey area; Work schedule; Supposed MMIP II components; Detailed components of the preparatory survey (Natural conditions survey, Topographic/geotechnical survey, Environmental impact survey, Socio-economic survey, Village profiling, Satellite image analysis, Flood inundation analysis, and Project evaluation with operation and effect indicators); Possible impact of MMIP II on farmers; Security measures; and Requests to NIA for collaboration during the survey. Following are the major points discussed:

1) Mr. Hashiguchi informed the body that the survey period is planned practically for four (4) and a half months starting from May up to mid-September 2017. He added however, that the survey would require more time, if the necessities for further field surveys to develop a comprehensive Environmental Impact Assessment (EIA) of the Liguasan Marsh, an abbreviated Resettlement Action Plan (RAP) and/or an Indigenous Peoples Plan (IPP) are confirmed. Mr. Hashiguchi informed the body of the need to conduct a topographic survey of the Pulangi River in order to come up with a Flood Inundation Analysis. He further emphasized the importance of the said analysis.

2) Following the presentation, Gen. Visaya recommended to the survey team to ask for an update on security situation of the areas from the Division Commander of the Philippine Army, as soon as the team moves into Cotabato. Gen. Visaya said that he will coordinate with the Division Commander to ensure the security of the survey team during the survey period. Ms. Sherilyn Aoyama informed the body that the Division Commander would participate in the meeting between the Coordinating Committee on Cessation of Hostilities (CCCH) and the JICA mission/JICA survey team, which was planned in the afternoon of May 10th, and the survey team would be able to get acquitted with the Division Commander in the meeting.

3) Ms. Lydia S. Esguerra, Construction Management Division Manager of NIA, responded to the requests made by the survey team through the presentation by saying that the NIA headquarters in collaboration with the NIA Regional Office would facilitate necessary data to the survey team and introduce the survey team to relevant stakeholders. Further, she also answered to the question from the survey team asking which institution would be more appropriate to be responsible for the implementation of the agricultural component of MMIP II. According to her, it would depend on actual contents of the component. If the component is to promote agricultural mechanization, the PhilRice would be the appropriate institution, while if the component mainly entails capacity building for the farmers, ATI would be more appropriate due to its rich experience in the technical assistance in the area.

4) Mr. Reynaldo B. Villanera, Project Planning Division Manager of NIA, inquired Mr. Hashiguchi if counterpart officers to the survey from both the headquarters and the regional office are needed. Mr. Hashiguchi expressed his expectation to have counterpart officers assigned from the NIA Project Management Office (PMO) which is located in Midsayap, and to this end, he requested for the facilitation by the NIA Headquarters to have at least two focal persons designated by the PMO. Mr. Katsurai proposed that the survey team and NIA headquarters would continue having meetings periodically throughout the

survey period. The request and proposal were agreed by the NIA side as such.

5) Ms. Aoyama wanted to confirm the actual situation of the land ownership of the MMIP II project area, since the issues of multiple land titles hindered the MMIP phase I (MMIP I) from being implemented as planned. In response, Ms. Esguerra told the body that such title issues have already been settled. Mr. Hashiguchi also wanted to confirm with NIA about progress in land acquisitions and Ms. Esguerra answered that the amount required for compensation has been budgeted.

6) Ms. Aoyama also wanted to consult with NIA whether the construction of terminal facilities (on-farm facilities) should be considered as a component for Japanese ODA Loan project or not. Ms. Esguerra recommended to consider it as part of the same project in order to assure that the farmers can benefit from the project. According to her, there have been cases where farmers did not benefit from the existing irrigation facilities, as they could not afford to establish necessary terminal facilities on their farms. She also added that the land acquisition for the construction of terminal facilities seemed to have been already done, although this should be confirmed with the NIA Regional Office.

7) Mr. Katsurai proposed to further analyze this issue, and Mr. Hashiguchi advised to consider the right of way and by doing so, the government of the Philippines would need to budget an amount necessary for the compensation of the land to be acquired for the terminal facilities. Ms. Esguerra proposed to the body to make two different scenarios for the time being: one is to include the component into the project scope, and the other, NOT to include. The final decision could be made based on results of the preparatory survey, including results of the analysis of Internal Rate of Return (IRR) of the project. The threshold of IRR in the Philippines, according to NEDA, should be 10%.

After the discussion session, the meeting was officially closed by at 9:55 with thanks to all the participants.

List of Attendance

No.	Name	Organization	Position
Philippines Side			
1.	Mr. Ricardo R. Visaya	NIA	Administrator
2.	Ms. Lydia S. Esguerra	NIA	Department Manager
3.	Ms. Alma S. Villaluna	NIA	Senior Engineer A
4.	Ms. Andrea Pagtulingan	NIA	Engineer A
5.	Mr. Reynaldo B. Villanera	NIA	Project Planning Division Manager
6.	Mr. Hanziel Nonilon de Guzman	NIA	Supervising Engineer A
Japan Side			
1.	Mr. Taro Katsurai	JICA Headquarters	Deputy Director
2.	Ms. Remi Sekiguchi	JICA Headquarters	Officer
3.	Mr. Jin Hirosawa	JICA Philippines Office	Representative
4.	Ms. Sherilyn Aoyama	JICA Philippines Office	Senior Program Officer
5.	Mr. Kosei Hashiguchi	JICA survey team	Team Leader
6.	Ms. Hiroko Yashiki	JICA survey team	Consultant Member
7.	Mr. Takayuki Oishi	JICA survey team	Consultant Member
8.	Mr. Ryo Inoue	JICA survey team	Consultant Member

Note

JICA	Japan International Cooperation Agency
MMIP II	Malitubog-Maridagao Irrigation Project (Phase II)
NIA	National Irrigation Administration
NEDA	National Economic Development Authority

MINUTES OF MEETING
ON
THE INTERIM REPORT
OF
THE PREPARATORY SURVEY
ON
MALITUBOG-MARIDAGAO IRRIGATION PROJECT
(PHASE II)
IN
THE REPUBLIC OF THE PHILIPPINES

DISCUSSED BETWEEN
NATIONAL IRRIGATION ADMINISTRATION
AND
JICA PREPARATORY SURVEY TEAM,
JAPAN INTERNATIONAL COOPERATION AGENCY

Manila, July 13, 2017

Eng. Czar M. Sulaik
Deputy Administrator
for Engineering and Operations
National Irrigation Administration (NIA)

Mr. Kosei HASHIGUCHI
Team Leader,
JICA Preparatory survey team,
Japan International Cooperation Agency
(JICA)

Eng. Czar M. Sulaik, Deputy Administrator for Engineering and Operations, opened the meeting at 09:47 am. First of all, he asked the meeting to accept the excuse of Administrator for his absence due to an emergency trip to the Leyte Island to deal with damages caused by the earthquake which took place last week. He, assuming the role of chairperson for this meeting, invited Mr. Kosei Hashiguchi, Team Leader of the JICA Survey Team, to make a presentation to inform the meeting on progress in the survey.

1) Mr. Hashiguchi, in response to the chair's invitation, started his presentation on the Interim Report of the Preparatory Survey on the Malitubog-Maridagao Irrigation Project Phase II (MMIP II). First, he briefly reviewed the basic information on the MMIP II project area, especially the ODA target Area of the Lower Malitubog Service Area (LMSA). Then, he explained that an improvement on the crop yields and an increase in the paddy cropping from 1 to 2 cycles per year could be expected with the irrigation services. He also showed the irrigation and drainage networks to be developed as well as the planned dyke and canal alignments. He explained that without the construction of the dykes, 44% of LMSA and 53% of the ODA target area would be lost for the purpose of agriculture, remaining submerged, during the rainy seasons.

2) Mr. Hashiguchi, then, moved to the topic of the foundation for the Ring Dyke (RD) and Protection Dyke (PD), which would be very soft, according to the results of the boring tests previously undertaken for the construction of a siphon between the Maridagao Service Area and the Pagalungan Extension Service Area. According to the calculation done by the Survey Team, the settlement of the foundations for the RD and PD would be 1.5m and 1.0m, respectively, while the time required for the settlement process of RD and PD to reach to its 80% would be 40 to 50 years. He also drew the attention of the meeting, not only on the settlement but also on the sliding risk of the foundation. He showed the results of the comparison of four different methods of foundation treatment to avoid the settlement and the sliding risk. Based on the results of the comparison, he recommended the Sand Compaction Pile Method, since it is the economically most feasible one. Yet this method would still require almost PHP 4.2 billion.

3) Subsequently Mr. Hashiguchi illustrated that the total costs of the construction works, except the costs for the foundation treatment, would be almost PHP 4.1 billion, which would be divided into PHP 3.5 billion to JICA and PHP 0.6 billion to NIA/ATI. If the treatment to the foundation is done, the total amount would be doubled.

4) However, he pointed that the total budget to be left to this project is only around PHP 1.1 billion, after deducting already executed and planned budget from the total budget approved by the National Economic Development Authority (NEDA) on the project: approximately PHP 5.4 billion.

5) Mr. Hashiguchi also reported that NEDA was clear on that the budget allocated to the project would remain the same, even if part of the project, such as the construction of dykes, is transferred to under the responsibility of another government agency, such as the Department of Public Works and Highways (DPWH). To fill the gaps between the remaining budget and the budget that would be required for the project completion, if we drop the construction of the RD and PD, the rehabilitation of the existing facilities in the MMIP I area, the procurement of maintenance machineries, and in addition, if we limit the agricultural extension activities, the total cost would be amounted to nearly PHP 1.0 billion, hence slightly under the budget ceiling approved by NEDA.

6) Mr. Hashiguchi continued informing the meeting with the results of economic analysis of the project. IRR for the project components in LMSA without the foundation treatment would be 9.9%, and that with the foundation treatment would be -0.2%, while IRR for the project components in the ODA target area without the foundation treatment would be 6.3% and that without the foundation treatment would be -1.5%. The threshold in IRR for the Government of the Philippines is 10%, and the IRR for the project only in the ODA target area would not be able to reach to the threshold, unless it is combined with the works in other areas.

7) Lastly, Mr. Hashiguchi presented possible three options to be analyzed, based on the results of the survey so far: the Option 0 is to construct neither the RD nor PD; the Option 1 is to construct the RD and PD as

currently planned and the Option 2 is to construct the RD with the location shift to the Pulangi River bank. He even provided a summary of the results of comparison analysis between a package of the Option 1& Option 2 (namely, the options with the construction of the dykes, somehow) and the Option 0 (the option without the construction of dykes) to help the decision making of the Government of the Philippines side around the construction of the dykes.

8) Mr. Sulaik thanked Mr. Hashiguchi for his presentation on the Interim Report, and commenced the questions and answers session by expressing the importance to find out a way to save already submerged area in LMSA and, therefore, to address the issues of dykes.

9) Ms. Yuko Tanaka informed the meeting that NEDA clarified its position that the option in that the dykes are constructed by another agency is a sort of transferring the cost from one agency to another, so the IRR would not be accepted from the national economic point of view.

10) Mr. Josias R. Pacolor asked whether we could reduce the height of the dykes in order not to thoroughly discard the option of the construction of dykes, and Mr. Hashiguchi answered it would be difficult for the current designs. In addition, Mr. Sulaik also questioned whether there would be any mean to drain or discharge accumulated water in LMSA during the rainy seasons. Mr. Hashiguchi responded that if the irrigation and drainage canals work as planned, accumulated water, which is not only rain water but also irrigated water in future, would be properly drained out to the Pulangi River, according to the 1992 Detail Design. The drainage by pumps would be an ideal solution; however, the costs for the installation, operation and maintenance of pumps would be too expensive.

11) Mr. Reynaldo M. Sarigumba showed the current situation of LMSA, especially of Barangays Punol and Katilacan, by putting the video which had been taken last week on the screen.

12) Mr. Taro Katsurai wanted to confirm whether the area of accumulated water was to serve as reservoir or not, as indicated by the 1992 DD. Mr. Hashiguchi clarified that there was surely an area planned by the 1992 DD to serve as reservoir inside the Ring Dyke, during the rainy seasons. However, we might have more water to be accumulated today.

13) Mr. Reynaldo B. Villanera stated that the threshold of IRR is 10% for the projects to be implemented by the government, and the IRRs shown for all the options in the presentation were below 10%, and therefore, they cannot be implemented. Following to this statement, Mr. Katsurai asked Mr. Hashiguchi how accurate the total costs of the project shown in the presentation. Mr. Hashiguchi assured that all the estimated costs of the construction works shared in the presentation were accurate, except the costs for the foundation treatment.

14) When asked by Mr. Katsurai whether the economic analysis of the project was done based on the Option 1, Mr. Hashiguchi affirmed it. In addition, he suggested the possibility for the total costs to come down, if we go for the Option 2. Especially the costs for the construction of dykes would be reduced up to a half. He added that we would not be able to know the accurate costs until the boring test is done, although the Survey Team could make a tentative estimate of the costs for the option 2. Mr. Hashiguchi requested to allow the Survey Team to come up with such an estimate by the end of next week, since the designing of the dykes on the new alignment should be done first before making an estimate.

15) Mr. Sarigumba put his suggestion of an extension of PD up to the Upper Malitubog Service Area (UMSA). Based on his observation on the ground, the elevation in UMSA is also lower than the surface of the Pulangi River, and if PD is not extended, after the construction of both RD and PD, a major part of LMSA would still remain submerged. He also added that local consultants would confirm the elevation of UMSA. Mr. Hashiguchi responded that the inundation in UMSA cannot be seen in the satellite images and the digital elevation map available so far cannot be much reliable. He wanted to reserve his comments on the necessity of an extension of PD, until the topographic survey is done.

16) Mr. Hashiguchi continued to explain the Environmental and Social Consideration aspects, in response to the request by Mr. Katsurai. Regarding the consideration for Indigenous People's rights, the 2 Ancestral Domains which are located near from the project sites were turned out not overlapped with the project sites, and the project would not affect IPs. With regard to the Right of Way, the land area to be acquired would be 78ha, if the dykes are not constructed, and the project would remain in the Category B for the JICA Guidelines, although a huge volume of embankment would still be necessary. The Ecological Survey for vulnerable spices of birds and fish, the survey is still on-going and the results would be available only at the beginning of the next month, August.

17) Mr. Sulaik proposed to study the timing of excavation of such a huge volume of embankment, and he wanted to confirm whether the dredged soil from the Pulangi River could be applied for the construction of dykes. Mr. Hashiguchi hardly agreed with such an idea due to the quality and type of the soil to be dredged. It would be too silky and would not have necessary concentration.

18) Mr. Sulaik requested more time for NIA to analyze the issues of dykes including discussions with NEDA. On the other hand, Mr. Katsurai also clarified that following the Survey Team's submission of the estimated costs and the results of economic analysis of the Option 2 to JICA by the end of next week, JICA would share the results with NIA.

The meeting was closed at 11:10.

List of Attendance

Government of the Philippines Side

1.	Mr. Czar M. Sulaik	NIA CO	Deputy Admin for Eng. And Operations
2.	Ms. Felipa E. Mascariñas	NIA CO	Manager, CMD - Engr. Dept.
3.	Ms. Alma S. Villaluna	NIA CO	Senior Engineer A, CMD
4.	Ms. Andrea P. Pagtulingan	NIA CO	Engineer A, CMD
5.	Ms. Alfonso delos Reyes	NIA CO	Technical Assistant A, CMD
6.	Mr. Reynaldo B. Villanera	NIA CO	DM PPD- Engineering Dept.
7.	Ms. Kit A. Maglangit	NIA CO	Senior Exec. Assistant, Office of Senior Deputy Administrator
8.	Mr. Josias R. Pacolon	NIA CO	DSD, Consultant, DSD
9.	Mr. Ernesto G. Collado	NIA CO	Technical Assistant A
10.	Ms. Megan Barte	DOF	Economist
11.	Mr. Reynaldo M. Sarigumba	NIA PMO MMIP II	Manager, Engr. Division
12.	Mr. Abedin L. Hadjisalik	NIA PMO MMIP II	Head Construction

Japanese Side

1.	Mr. Taro Katsurai	JICA HQ	Deputy Director
2.	Ms. Remi Sekiguchi	JICA HQ	Officer in charge of MMIP II
3.	Ms. Yuko Tanaka	JICA Philippines	Senior Representative
4.	Mr. Jin Hirosawa	JICA Philippines	Representative
5.	Ms. Sherilyn Aoyama	JICA Philippines	Senior Program Officer
6.	Mr. Kosei Hashiguchi	JICA Survey Team	Team Leader
7.	Ms. Hiroko Yashiki	JICA Survey Team	Member
8.	Mr. Yoji Sawada	JICA Survey Team	Member
9.	Ms. Rie Kitao	JICA Survey Team	Member
10.	Mr. Ryo Inoue	JICA Survey Team	Member

APPENDIX-II

METEOROLOGY AND HYDROLOGY

APPENDIX II: METEOROLOGY AND HYDROLOGY

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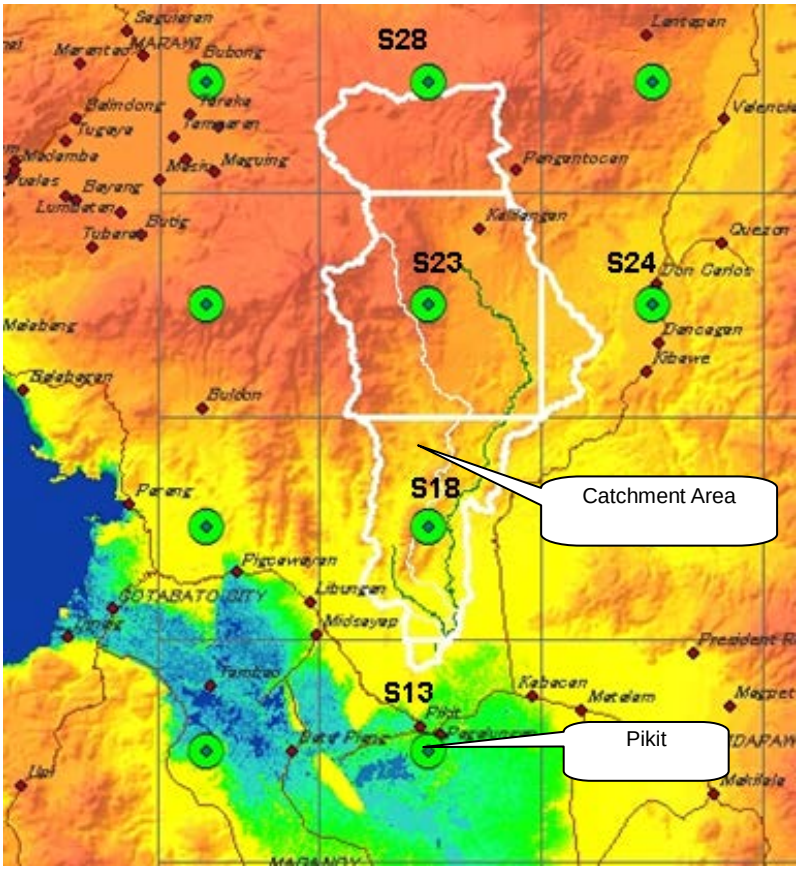
APPENDIX II. METEOROLOGY AND HYDROLOGY

II.1 Climate Station by Satellite Image Analysis

The climate and rainfall data at project area and catchment area are obtained by simulated climate data based on satellite image analysis at a point of each 35 km x 35 km, which are provided by Climate Forecast System Reanalysis (CFSR) operated by the National Centers for Environmental Prediction (NCEP, US).

Below figure and table show the climate stations by CFSR; namely Station No.13 located at Pikit Area and Station No.18, No.23, No.24 and No.28 located within the catchment area.



Station No.	Elevation, m	Longitude	Latitude
S13	10	124.688	7.025
S18	399	124.688	7.337
S23	794	124.688	7.649
S24	321	125.000	7.649
S28	1,277	124.688	7.962

Climate Station Location
Source: NCEP, US

II.2 Temperature at Project Area (Pikit)

(1) Maximum Temperature

Maximum Temperature at Project Area（Station No. 13: Pikit Area） Unit: ℃

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1979	34.2	35.4	34.5	37.0	35.5	34.0	34.7	35.7	35.1	33.3	34.0	33.1
1980	33.2	33.4	35.2	36.0	36.2	33.6	32.7	33.6	34.2	34.8	35.7	34.3
1981	33.3	33.0	35.3	36.4	36.9	35.4	36.2	35.9	36.0	34.0	34.3	33.4
1982	34.1	32.3	35.7	38.0	36.1	32.7	33.2	33.1	35.0	33.8	35.0	36.0
1983	34.4	35.8	37.1	37.0	37.8	35.7	33.7	34.7	28.4	34.1	34.3	33.9
1984	32.5	31.9	34.8	35.2	36.3	35.2	35.7	35.1	35.5	33.9	35.8	33.5
1985	34.2	34.3	36.4	35.6	36.0	34.8	33.9	35.5	33.2	33.7	33.0	32.9
1986	32.6	33.9	33.8	37.2	35.8	35.7	33.7	34.8	34.2	34.3	32.3	33.3
1987	32.8	33.6	35.2	37.2	36.7	36.3	35.0	34.6	36.1	34.6	33.3	35.6
1988	35.6	34.0	35.9	36.2	36.1	35.9	36.6	35.9	35.5	33.3	33.0	33.1
1989	33.7	33.1	32.9	33.7	34.1	33.2	33.5	33.5	35.4	33.5	33.7	-
1990	33.5	35.2	36.2	36.4	36.2	34.5	35.3	34.9	35.4	34.4	32.6	34.4
1991	32.8	33.0	36.2	37.2	35.1	34.8	34.6	35.4	35.7	35.1	35.5	34.0
1992	34.7	34.6	35.8	37.7	37.7	35.1	35.2	35.4	35.6	33.2	33.3	31.5
1993	33.4	35.3	35.1	35.8	36.8	35.1	34.9	34.3	35.3	34.6	35.8	33.2
1994	32.9	33.9	34.9	36.7	35.2	34.3	34.2	35.3	33.0	36.0	35.7	34.3
1995	33.4	34.8	35.2	35.4	36.3	35.7	35.4	36.0	34.0	34.2	34.0	34.3
1996	32.3	32.2	35.3	36.5	35.9	25.9	35.8	36.3	35.8	35.9	32.9	33.6
1997	34.2	31.5	35.5	36.0	35.6	35.8	35.9	36.2	36.6	36.7	35.3	34.4
1998	34.2	35.6	36.8	37.9	36.5	35.6	36.0	37.2	36.4	33.9	33.1	32.7
1999	-	33.4	33.2	32.7	33.1	33.0	33.1	32.6	33.0	34.6	33.0	32.7
2000	31.3	31.3	33.6	33.4	35.0	34.0	33.5	33.6	34.7	33.0	32.1	32.3
2001	32.3	33.9	33.6	35.0	34.9	34.2	33.9	32.7	35.7	33.9	33.1	32.3
2002	31.9	33.7	35.6	37.3	35.0	33.8	33.8	32.9	32.1	33.9	33.8	34.2
2003	33.8	32.8	34.0	37.7	34.3	33.7	33.1	33.3	32.8	32.8	34.2	31.6
2004	32.5	33.6	34.9	36.0	34.7	32.8	33.5	33.2	34.0	32.6	34.2	33.7
2005	33.4	35.7	35.6	36.7	35.1	35.1	33.4	33.4	33.3	34.8	34.4	33.0
2006	32.2	32.4	33.8	35.0	36.0	35.9	34.1	34.7	35.1	33.0	35.0	35.5
2007	33.8	34.3	35.5	36.5	36.4	35.7	34.1	34.6	35.1	35.4	34.2	33.9
2008	33.4	33.2	34.0	35.0	34.3	33.8	34.5	34.3	34.0	34.3	33.0	32.7
2009	33.4	32.9	34.5	33.8	33.0	33.0	31.2	32.8	31.9	32.9	32.8	33.3
2010	32.2	35.3	37.1	35.5	34.8	34.2	32.8	32.8	33.8	32.8	33.4	32.7
2011	32.9	31.9	32.9	33.2	31.9	31.7	32.1	32.4	32.9	33.4	32.6	31.9
2012	32.2	32.8	33.9	33.9	32.8	32.8	31.8	33.4	31.2	32.8	33.2	32.2
2013	31.0	32.7	35.1	34.4	34.2	32.9	31.9	32.7	33.0	31.2	32.2	33.0
2014	31.4	33.1	34.1	34.1	34.0	32.8	31.6	-	-	-	-	-
Max.	35.6	35.8	37.1	38.0	37.8	36.3	36.6	37.2	36.6	36.7	35.8	36.0
Min.	31.0	31.3	32.9	32.7	31.9	25.9	31.2	32.4	28.4	31.2	32.1	31.5
Ave.	33.1	33.6	35.0	35.8	35.3	34.1	34.0	34.4	34.3	34.0	33.8	33.4

Source: Climate Forecast System Reanalysis (CFSR), NCEP, US

(2) Minimum Temperature

Minimum Temperature at Project Area（Station 13: Pikit Area） Unit: ℃

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1979	17.6	18.5	19.4	19.2	20.7	20.5	19.6	19.3	19.9	20.5	19.9	18.9
1980	20.0	19.2	18.7	20.0	20.0	20.7	19.8	20.0	19.7	19.4	20.0	19.8
1981	20.2	19.3	17.9	20.2	20.4	19.7	19.2	18.7	20.5	20.4	20.2	19.2
1982	19.9	19.6	18.4	20.3	19.9	20.1	18.9	19.5	18.7	18.8	18.5	18.5
1983	18.0	17.1	18.2	19.4	19.6	19.8	20.1	20.1	19.2	19.8	19.5	19.9
1984	19.6	19.5	19.0	20.3	20.0	19.9	18.7	19.3	19.2	19.5	18.5	18.8
1985	18.0	19.2	19.1	20.3	20.1	19.0	19.1	19.2	20.2	19.5	19.7	19.5
1986	20.1	19.4	19.7	19.5	19.5	19.3	19.2	18.9	19.5	19.5	19.7	17.4
1987	18.8	19.2	17.7	19.7	20.0	19.7	18.9	19.7	18.9	19.4	20.2	18.8
1988	18.8	19.7	19.5	20.3	21.0	19.8	18.9	19.1	19.3	20.3	20.4	19.4
1989	19.6	20.2	20.2	19.9	20.5	19.6	18.6	19.4	18.8	20.1	19.0	-
1990	19.0	18.0	19.5	20.1	21.0	20.1	18.8	19.5	20.0	20.0	19.6	18.1
1991	19.1	19.5	18.4	20.3	20.6	19.6	19.0	19.8	19.3	19.0	18.7	18.1
1992	18.0	17.3	18.8	19.4	19.9	19.8	18.8	19.1	18.8	19.4	18.8	18.4
1993	17.5	19.1	18.5	19.6	19.7	19.8	19.2	19.3	19.2	19.3	19.2	19.6
1994	18.4	18.6	19.3	20.1	20.5	19.6	19.1	19.1	19.8	18.4	18.5	19.1
1995	18.5	19.6	20.4	19.4	20.5	20.1	19.2	20.1	20.3	20.6	20.3	20.0
1996	20.5	20.4	19.3	20.3	20.5	20.3	19.2	18.9	20.1	20.0	19.8	18.9
1997	19.8	20.4	19.8	20.5	20.0	17.9	19.1	19.0	19.0	19.3	19.0	18.3
1998	17.8	17.9	17.7	19.7	21.5	20.6	18.4	18.7	19.6	20.8	21.3	20.1
1999	-	19.9	21.2	21.6	20.7	20.1	19.1	20.2	19.7	19.7	20.2	20.5
2000	19.4	20.9	20.4	21.1	20.4	19.8	19.6	19.9	19.6	20.5	20.2	20.4
2001	20.5	19.9	20.9	21.2	21.0	20.1	19.9	21.0	20.2	20.5	20.7	19.8
2002	19.6	20.2	20.1	20.3	21.3	20.4	19.8	20.4	20.5	20.4	20.3	19.5
2003	19.7	20.2	20.6	20.7	21.3	19.9	20.3	20.8	21.0	21.1	19.8	21.0
2004	20.4	20.9	20.6	21.5	21.6	20.7	20.3	20.5	20.4	20.1	19.9	20.6
2005	19.5	20.0	20.5	20.3	21.7	20.6	20.8	20.8	20.4	20.4	20.4	21.3
2006	20.1	20.6	20.8	20.1	20.8	20.4	20.5	20.8	20.8	20.6	20.2	20.2
2007	20.9	20.3	19.4	20.7	21.1	21.3	20.6	20.6	21.0	20.7	20.8	20.4
2008	20.2	20.7	20.7	20.4	20.4	20.3	20.2	19.9	20.9	21.0	21.0	19.9
2009	20.8	20.3	20.1	21.7	21.2	19.9	21.0	20.9	21.3	20.5	20.6	18.9
2010	20.3	19.8	20.5	21.3	21.9	20.7	20.5	21.1	20.6	20.9	20.6	20.4
2011	20.3	20.5	20.6	21.1	21.0	20.8	20.1	20.6	20.6	20.2	20.4	20.1
2012	19.7	20.3	19.9	21.0	21.1	20.0	20.3	20.2	20.5	20.5	20.2	19.9
2013	20.8	19.5	21.1	21.3	21.2	21.2	20.3	20.5	20.4	20.4	20.0	20.1
2014	19.8	20.0	20.6	20.7	21.3	20.9	20.5	-	-	-	-	-
Max.	20.9	20.9	21.2	21.7	21.9	21.3	21.0	21.1	21.3	21.1	21.3	21.3
Min.	17.5	17.1	17.7	19.2	19.5	17.9	18.4	18.7	18.7	18.4	18.5	17.4
Ave.	19.5	19.6	19.7	20.4	20.7	20.1	19.6	19.9	19.9	20.0	19.9	19.5

Source: Climate Forecast System Reanalysis (CFSR), NCEP, US

(3) Mean Temperature

Mean Temperature at Pikit (S13: CFSR) Unit: ℃

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1979	25.9	27.0	27.0	28.1	28.1	27.3	27.2	27.5	27.5	26.9	27.0	26.0
1980	26.6	26.3	27.0	28.0	28.1	27.2	26.3	26.8	27.0	27.1	27.9	27.1
1981	26.8	26.2	26.6	28.3	28.7	27.6	27.7	27.3	28.3	27.2	27.3	26.3
1982	27.0	26.0	27.1	29.2	28.0	26.4	26.1	26.3	26.9	26.3	26.8	27.3
1983	26.2	26.5	27.7	28.2	28.7	27.8	26.9	27.4	23.8	27.0	26.9	26.9
1984	26.1	25.7	26.9	27.8	28.2	27.6	27.2	27.2	27.4	26.7	27.2	26.2
1985	26.1	26.8	27.8	28.0	28.1	26.9	26.5	27.4	26.7	26.6	26.4	26.2
1986	26.4	26.7	26.8	28.4	27.7	27.5	26.5	26.9	26.9	26.9	26.0	25.4
1987	25.8	26.4	26.5	28.5	28.4	28.0	27.0	27.2	27.5	27.0	26.8	27.2
1988	27.2	26.9	27.7	28.3	28.6	27.9	27.8	27.5	27.4	26.8	26.7	26.3
1989	26.7	26.7	26.6	26.8	27.3	26.4	26.1	26.5	27.1	26.8	26.4	-
1990	26.3	26.6	27.9	28.3	28.6	27.3	27.1	27.2	27.7	27.2	26.1	26.3
1991	26.0	26.3	27.3	28.8	27.9	27.2	26.8	27.6	27.5	27.1	27.1	26.1
1992	26.4	26.0	27.3	28.6	28.8	27.5	27.0	27.3	27.2	26.3	26.1	25.0
1993	25.5	27.2	26.8	27.7	28.3	27.5	27.1	26.8	27.3	27.0	27.5	26.4
1994	25.7	26.3	27.1	28.4	27.9	27.0	26.7	27.2	26.4	27.2	27.1	26.7
1995	26.0	27.2	27.8	27.4	28.4	27.9	27.3	28.1	27.2	27.4	27.2	27.2
1996	26.4	26.3	27.3	28.4	28.2	23.1	27.5	27.6	28.0	28.0	26.4	26.3
1997	27.0	26.0	27.7	28.3	27.8	26.9	27.5	27.6	27.8	28.0	27.2	26.4
1998	26.0	26.8	27.3	28.8	29.0	28.1	27.2	28.0	28.0	27.4	27.2	26.4
1999	-	26.7	27.2	27.2	26.9	26.6	26.1	26.4	26.4	27.2	26.6	26.6
2000	25.4	26.1	27.0	27.3	27.7	26.9	26.6	26.8	27.2	26.8	26.2	26.4
2001	26.4	26.9	27.3	28.1	28.0	27.2	26.9	26.9	28.0	27.2	26.9	26.1
2002	25.8	27.0	27.9	28.8	28.2	27.1	26.8	26.7	26.3	27.2	27.1	26.9
2003	26.8	26.5	27.3	29.2	27.8	26.8	26.7	27.1	26.9	27.0	27.0	26.3
2004	26.5	27.3	27.8	28.8	28.2	26.8	26.9	26.9	27.2	26.4	27.1	27.2
2005	26.5	27.9	28.1	28.5	28.4	27.9	27.1	27.1	26.9	27.6	27.4	27.2
2006	26.2	26.5	27.3	27.6	28.4	28.2	27.3	27.8	28.0	26.8	27.6	27.9
2007	27.4	27.3	27.5	28.6	28.8	28.5	27.4	27.6	28.1	28.1	27.5	27.2
2008	26.8	27.0	27.4	27.7	27.4	27.1	27.4	27.1	27.5	27.7	27.0	26.3
2009	27.1	26.6	27.3	27.8	27.1	26.5	26.1	26.9	26.6	26.7	26.7	26.1
2010	26.3	27.6	28.8	28.4	28.4	27.5	26.7	27.0	27.2	26.9	27.0	26.6
2011	26.6	26.2	26.8	27.2	26.5	26.3	26.1	26.5	26.8	26.8	26.5	26.0
2012	26.0	26.6	26.9	27.5	27.0	26.4	26.1	26.8	25.9	26.7	26.7	26.1
2013	25.9	26.1	28.1	27.9	27.7	27.1	26.1	26.6	26.7	25.8	26.1	26.6
2014	25.6	26.6	27.4	27.4	27.7	26.9	26.1	-	-	-	-	-
Max.	27.4	27.9	28.8	29.2	29.0	28.5	27.8	28.1	28.3	28.1	27.9	27.9
Min.	25.4	25.7	26.5	26.8	26.5	23.1	26.1	26.3	23.8	25.8	26.0	25.0
Ave.	26.3	26.6	27.3	28.1	28.0	27.1	26.8	27.1	27.1	27.0	26.9	26.5

Source: Climate Forecast System Reanalysis (CFSR), NCEP, US

II.2 Rainfall at Project Area and Catchment Area

(1) Monthly Rainfall at Project Area (Pikit)

Monthly Rainfall at Project Area（Station No. 13: Pikit Area） Unit: mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1979	7	10	41	2	144	195	111	51	92	99	68	69	889
1980	40	29	35	36	24	145	79	98	28	75	76	94	759
1981	81	12	15	27	119	98	77	8	56	141	140	57	831
1982	83	46	31	27	52	81	68	112	26	96	38	38	698
1983	0	0	0	8	18	108	136	121	0	107	65	110	673
1984	55	93	91	52	55	124	107	55	110	53	15	54	864
1985	20	56	12	170	75	26	99	68	100	121	80	40	867
1986	74	63	69	13	43	69	83	35	86	61	71	6	673
1987	5	36	6	7	74	52	58	161	26	53	92	4	574
1988	1	43	128	57	106	149	62	45	74	101	89	63	918
1989	92	92	104	95	227	117	72	110	90	137	39	-	1,175
1990	38	0	7	15	89	105	37	65	394	77	80	0	907
1991	84	22	1	33	103	82	46	15	5	46	35	5	477
1992	9	3	4	5	42	38	132	43	18	100	51	97	542
1993	4	6	81	26	66	66	74	48	47	50	62	53	583
1994	5	14	17	29	94	98	39	67	26	14	3	37	443
1995	40	5	21	19	41	71	115	114	125	140	38	34	763
1996	104	66	17	67	75	0	43	51	50	97	52	21	643
1997	16	124	43	59	47	32	51	3	35	50	25	1	486
1998	0	0	0	0	46	54	21	21	64	81	123	33	443
1999	0	15	120	200	130	153	62	99	66	95	118	44	1,102
2000	74	38	90	121	121	140	84	101	81	137	47	58	1,092
2001	37	22	100	90	146	65	134	55	141	139	78	24	1,031
2002	19	50	26	11	204	84	49	84	75	119	72	19	812
2003	55	13	92	71	94	54	101	108	79	110	59	103	939
2004	34	34	24	44	83	55	111	25	145	79	61	78	773
2005	20	3	40	15	141	101	117	67	72	89	42	53	760
2006	35	15	64	28	79	98	27	50	80	63	52	15	606
2007	71	16	18	20	101	72	83	150	69	84	81	34	799
2008	33	38	39	46	185	70	115	126	99	147	77	42	1,017
2009	73	65	70	150	87	110	132	112	68	82	87	18	1,054
2010	45	10	73	80	83	119	126	160	186	100	105	50	1,137
2011	124	255	229	257	175	157	85	145	95	178	208	136	2,044
2012	112	166	49	319	141	68	182	111	91	151	127	210	1,727
2013	178	85	161	189	276	83	253	148	81	121	149	115	1,839
2014	192	96	169	94	251	206	69	-	-	-	-	-	1,077
Ave.	51.7	45.6	58.0	68.9	106.6	92.9	90.0	80.9	82.3	96.9	74.4	53.4	902

Source: Climate Forecast System Reanalysis (CFSR), NCEP, US

(2) Monthly Rainfall at Catchment Area

Monthly Rainfall at Catchment Area (Station No. 18) Unit: mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1979	11	22	57	5	222	311	215	86	160	201	162	123	1,575
1980	82	44	52	42	34	376	153	175	66	172	138	149	1,483
1981	119	24	26	60	152	165	165	13	150	364	186	91	1,515
1982	132	92	53	43	95	199	132	175	54	194	112	57	1,338
1983	4	0	1	12	28	219	259	207	0	189	103	144	1,166
1984	95	95	119	91	118	231	212	120	232	76	39	114	1,542
1985	60	115	34	266	130	65	197	127	211	255	145	101	1,706
1986	142	95	87	30	83	152	133	61	161	123	145	20	1,232
1987	17	59	2	24	134	84	155	362	47	106	206	9	1,205
1988	5	41	112	94	180	245	112	85	145	187	173	89	1,468
1989	148	186	134	125	378	276	138	139	169	307	106	-	2,106
1990	60	1	8	39	173	264	53	167	462	153	154	1	1,535
1991	92	32	8	59	181	169	115	41	14	107	84	11	913
1992	31	8	7	25	90	81	208	59	43	145	124	139	960
1993	9	29	134	52	63	112	176	133	86	133	157	121	1,205
1994	25	37	35	82	151	217	60	172	43	46	6	54	928
1995	88	11	57	38	110	131	183	260	259	249	101	80	1,567
1996	125	96	29	99	111	0	59	82	99	183	124	49	1,056
1997	23	123	95	114	117	58	96	16	69	148	63	5	927
1998	0	0	1	2	84	114	36	38	90	158	202	85	810
1999	0	34	211	423	267	282	120	221	137	189	225	137	2,246
2000	178	80	160	199	180	264	127	218	118	334	108	147	2,113
2001	69	46	160	146	287	127	232	134	306	288	148	38	1,981
2002	41	82	40	24	303	276	50	147	129	248	143	30	1,513
2003	95	17	173	140	306	147	189	240	217	213	129	157	2,023
2004	59	68	56	125	175	96	258	49	390	129	137	178	1,720
2005	34	11	54	37	288	225	242	145	106	236	93	130	1,601
2006	96	25	114	47	175	191	51	149	134	147	135	26	1,290
2007	51	34	24	72	288	174	165	315	238	172	241	79	1,853
2008	82	74	69	112	307	188	230	304	258	220	151	107	2,102
2009	144	103	142	282	262	259	240	199	130	199	191	22	2,173
2010	64	24	66	71	172	330	353	357	409	310	276	135	2,567
2011	168	328	349	392	428	425	226	385	356	364	312	208	3,941
2012	168	261	135	392	494	154	409	242	322	291	190	304	3,362
2013	266	91	274	328	484	362	472	307	251	378	293	159	3,665
2014	207	113	313	300	598	498	181	-	-	-	-	-	2,210
Ave.	83.1	69.5	94.2	122.0	212.4	207.4	177.8	169.4	173.2	206.1	151.5	97.0	1,764

Source: Climate Forecast System Reanalysis (CFSR), NCEP, US

Monthly Rainfall at Catchment Area (Station No. 23) Unit: mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1979	83	99	175	106	652	821	600	394	646	596	462	340	4,974
1980	317	192	171	192	214	996	461	657	316	606	448	524	5,094
1981	378	129	133	232	600	546	621	120	570	916	517	230	4,992
1982	387	305	210	238	474	732	392	565	269	530	412	296	4,810
1983	42	9	25	64	197	789	811	728	5	660	464	452	4,246
1984	492	250	352	438	665	819	619	394	756	409	305	366	5,865
1985	299	368	169	627	568	381	645	567	797	742	449	399	6,011
1986	474	205	261	109	391	665	614	242	597	475	507	140	4,680
1987	70	190	53	132	500	305	621	894	244	463	554	119	4,145
1988	89	144	223	314	591	693	477	437	576	604	578	342	5,068
1989	356	449	468	318	954	752	524	492	490	783	363	-	5,949
1990	167	32	119	179	691	709	376	477	765	603	496	43	4,657
1991	201	122	62	268	551	502	506	272	243	317	362	48	3,454
1992	159	55	70	141	338	406	713	364	279	501	484	314	3,824
1993	57	281	383	207	227	479	624	414	377	450	461	503	4,463
1994	119	147	198	332	579	679	265	569	317	204	138	154	3,701
1995	185	120	216	162	443	534	634	756	665	709	483	469	5,376
1996	410	352	219	526	560	0	347	398	446	693	516	216	4,683
1997	220	306	179	271	361	272	381	154	333	538	252	61	3,328
1998	19	25	12	46	300	440	246	232	354	569	696	411	3,350
1999	0	152	664	1,002	778	811	570	720	678	601	545	554	7,075
2000	457	347	564	508	594	832	501	635	443	863	477	486	6,707
2001	245	156	507	363	833	478	654	440	863	682	426	194	5,841
2002	149	184	175	363	694	917	237	550	455	746	458	206	5,134
2003	203	82	401	363	778	537	677	821	787	643	411	467	6,170
2004	232	327	250	363	467	405	1,040	246	908	409	391	473	5,511
2005	138	83	175	363	750	833	716	489	421	715	352	542	5,577
2006	330	167	346	363	553	794	337	517	578	479	433	243	5,140
2007	180	135	127	363	915	799	579	840	650	639	690	339	6,256
2008	352	314	343	363	811	712	862	854	818	784	539	456	7,208
2009	522	326	357	363	711	759	711	609	371	543	581	144	5,997
2010	205	85	248	363	550	1,001	1,092	1,047	1,089	885	833	671	8,069
2011	796	885	908	363	1,545	1,652	1,281	1,587	1,532	1,181	1,017	908	13,655
2012	691	843	803	363	1,603	884	1,373	1,092	1,242	959	842	874	11,569
2013	817	368	719	363	1,520	1,499	1,790	1,059	1,100	1,180	955	693	12,063
2014	711	479	750	363	1,607	1,673	1,123	-	-	-	-	-	6,706
Ave.	293.1	242.0	306.5	353.3	682.4	725.2	667.2	589.5	599.4	647.9	511.3	372.9	5,991

Source: Climate Forecast System Reanalysis (CFSR), NCEP, US

Monthly Rainfall at Catchment Area (Station No. 24) Unit: mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1979	43	58	130	74	634	760	525	333	522	367	370	268	4,084
1980	227	141	119	130	140	888	374	562	190	523	332	451	4,077
1981	290	101	93	194	474	518	513	91	451	709	376	199	4,009
1982	326	279	179	165	316	534	356	468	210	416	385	184	3,818
1983	24	5	18	58	169	592	639	589	0	603	382	337	3,416
1984	345	204	278	367	502	764	565	383	633	289	206	302	4,838
1985	178	284	119	563	454	271	498	407	587	638	339	313	4,651
1986	361	201	220	81	346	490	471	174	449	304	359	81	3,537
1987	53	106	41	113	377	290	467	794	201	391	443	82	3,358
1988	64	95	172	244	454	632	314	345	418	492	399	301	3,930
1989	274	377	345	277	825	553	411	408	355	714	286	-	4,825
1990	123	16	85	137	543	536	279	378	590	483	353	18	3,541
1991	191	97	40	214	412	348	353	229	231	286	309	32	2,742
1992	117	37	37	109	262	328	532	269	221	383	400	272	2,967
1993	41	173	309	153	157	377	533	359	278	308	369	448	3,505
1994	106	103	130	227	482	541	204	518	235	145	61	127	2,879
1995	180	70	187	152	361	409	512	550	475	682	321	388	4,287
1996	301	282	157	455	359	0	251	291	338	514	367	148	3,463
1997	136	226	192	208	306	225	291	127	293	376	161	33	2,574
1998	13	14	11	25	253	358	197	140	228	400	559	297	2,495
1999	0	110	520	769	603	627	413	587	503	430	422	425	5,409
2000	421	272	445	419	463	661	367	540	375	717	369	387	5,436
2001	205	108	377	314	718	389	592	405	739	506	352	120	4,825
2002	141	153	134	126	610	687	159	431	327	635	323	101	3,827
2003	183	49	371	263	605	378	551	712	717	470	326	392	5,017
2004	161	282	218	294	346	333	878	192	771	260	331	400	4,466
2005	98	51	131	102	565	636	508	436	370	589	251	383	4,120
2006	277	120	265	109	449	629	246	403	477	360	311	165	3,811
2007	138	72	100	241	709	580	434	703	495	517	504	220	4,713
2008	255	223	222	372	707	432	670	704	637	532	375	344	5,473
2009	370	245	231	575	573	608	535	526	241	483	486	77	4,950
2010	160	61	199	173	395	745	886	864	962	775	614	531	6,365
2011	277	452	329	350	765	652	443	461	581	549	392	271	5,522
2012	239	296	442	340	674	177	329	328	353	357	310	364	4,209
2013	349	135	326	385	693	619	687	299	431	337	293	215	4,769
2014	285	140	373	235	814	708	272	-	-	-	-	-	2,827
Ave.	193.1	156.6	209.6	250.4	486.5	507.6	451.5	428.7	425.3	472.6	355.3	255.2	4,192

Source: Climate Forecast System Reanalysis (CFSR), NCEP, US

Monthly Rainfall at Catchment Area (Station No. 28) Unit: mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1979	133	109	222	229	704	875	649	542	731	531	443	368	5,536
1980	345	240	253	219	293	1,024	467	738	426	651	483	565	5,704
1981	387	187	185	288	691	705	796	247	710	941	496	286	5,919
1982	460	411	344	304	524	736	533	603	373	583	512	345	5,728
1983	62	22	57	99	372	920	969	932	5	751	538	456	5,183
1984	547	311	431	505	760	1,049	766	569	937	674	334	365	7,248
1985	489	419	220	673	656	566	828	789	981	821	487	453	7,382
1986	476	283	318	168	604	955	767	347	821	456	494	209	5,898
1987	122	233	120	181	609	415	696	945	333	541	618	225	5,038
1988	179	186	253	324	641	694	627	515	654	725	552	525	5,875
1989	378	502	534	338	959	719	703	668	645	749	445	-	6,640
1990	172	69	155	158	743	876	559	620	825	769	608	126	5,680
1991	236	147	125	323	554	510	560	440	463	381	496	103	4,338
1992	229	104	94	198	484	463	935	546	458	645	474	362	4,992
1993	95	422	390	261	296	592	734	522	528	521	533	685	5,579
1994	235	169	249	340	693	809	446	721	564	419	225	184	5,054
1995	267	189	298	252	582	584	667	907	812	757	459	574	6,348
1996	441	415	337	567	598	0	443	484	506	758	563	220	5,332
1997	286	360	249	254	446	426	444	266	539	566	265	115	4,216
1998	47	53	33	104	346	493	376	350	478	513	628	512	3,933
1999	0	211	696	968	669	792	605	731	725	602	475	539	7,013
2000	488	360	585	467	594	865	538	746	546	814	453	593	7,049
2001	265	225	541	425	861	550	723	605	1,060	604	384	246	6,489
2002	179	234	240	284	605	946	324	593	453	818	439	240	5,355
2003	266	132	410	400	750	581	715	938	944	626	379	621	6,762
2004	235	472	324	334	516	511	1,247	393	898	382	387	483	6,182
2005	188	142	197	194	729	837	729	584	647	739	367	556	5,909
2006	430	265	360	189	540	868	557	636	737	562	443	307	5,894
2007	300	184	162	423	990	799	650	1,031	778	750	691	338	7,096
2008	334	346	340	612	865	653	1,045	961	1,019	694	504	582	7,955
2009	469	451	331	780	734	809	665	622	407	665	691	191	6,815
2010	256	91	287	233	573	950	1,090	1,017	1,027	902	750	680	7,856
2011	981	999	1,052	700	1,244	1,266	891	1,125	1,224	978	844	808	12,112
2012	699	856	828	727	1,360	477	883	826	591	709	809	883	9,648
2013	874	391	601	704	1,315	1,190	1,412	647	790	711	865	641	10,141
2014	906	489	758	584	1,279	1,269	628	-	-	-	-	-	5,913
Ave.	346.0	296.6	349.4	383.6	699.4	743.7	713.0	663.0	675.3	665.9	518.1	423.1	6,477

Source: Climate Forecast System Reanalysis (CFSR), NCEP, US

APPENDIX-III

AGRICULTURE

APPENDIX III: AGRICULTURE

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APPENDIX III. AGRICULTURE

III.1 Agriculture and Extension Development

III.1.1 No. of YLTA and Government Funded Program Beneficiaries

Table. List of IA and No. of YLTA and Government Funded Program Beneficiaries

No.	NAME OF IA	Total No. of Beneficiaries per Year & by Source of Fund								
		YLTA		Total YLTA	Government Funded				Total Government Funded	Total
		2014	2015		2014	2015	2016	2017		
1	BASBIA	0	60	60	0	0	30	0	30	90
2	MANSAPA	0	60	60	0	0	0	0	0	60
3	MRISIA DIV 5	0	0	0	60	0	0	0	60	60
4	NASFIA	0	0	0	60	0	30	0	90	90
5	KIPAN	65	0	65	0	0	0	0	0	65
6	NASGIA	66	0	66	0	30	0	0	30	96
7	MRISIA DIV 6	63	0	63	0	30	0	0	30	93
8	EDUFIA	0	0	0	0	60	30	0	90	90
9	GAGDANEN BAYA	0	0	0	60	30	30	0	120	120
10	KATINGKONGAN	0	60	60	0	0	0	0	0	60
11	MORNING LIGHT	68	0	68	0	0	0	0	0	68
12	TAFIA	0	0	0	60	0	60	0	120	120
13	DALFIA	0	0	0	0	0	0	60	60	60
14	TAMCIA	0	0	0	0	0	0	60	60	60
15	LAGUNDE PAMBUA	0	0	0	0	0	0	60	60	60
16	MALIGA LUPA	0	0	0	0	0	0	30	30	30
17	SARAPANI PANICUPAN	0	0	0	0	0	0	60	60	60
18	NALAPANI	0	0	0	0	0	0	30	30	30
19	PAIKOL	0	0	0	0	0	0	0	0	0
20	PAMALIAN TALIAWID	0	0	0	0	0	0	0	0	0
21	BAGONABATI	0	0	0	60	0	0	0	60	60
22	BALATIKAN	0	0	0	0	60	0	0	60	60
23	CHRISLAM	0	0	0	0	60	0	0	60	60
24	TAPODOC BANGSAMORO	0	0	0	0	0	0	0	0	0
25	DUNGGUAN-LANGAYEN	0	0	0	0	0	0	0	0	0
26	UBADALA FARMERS IA	0	0	0	0	0	0	0	0	0
27	LAYOG-INUG-UG IA INC	0	0	0	0	0	0	0	0	0
28	PAGALUNGAN TALIAWID IA	0	0	0	0	0	0	0	0	0
29	GLI-GLI LATERAL H & H2 FARMERS IA	0	0	0	0	0	0	0	0	0
30	BULODBULOL IA INC	0	0	0	0	0	0	0	0	0
31	TALITAY INUG-UG GLI-GLI POBLACION IA	0	0	0	0	0	0	0	0	0
32	BATULAWAN GINATILAN LADTINGAN IA	0	0	0	0	0	0	0	0	0
33	MAKAUYAG GLI-GLI LATERAL H3 IA	0	0	0	0	0	0	0	0	0
34	MAGLIB IA	0	0	0	0	0	0	0	0	0
35	MACABUAL KALTAN FARMERS IA	0	0	0	0	0	0	0	0	0
36	KALTAN BALONG FARMERS IA	0	0	0	0	0	0	0	0	0
37	TAMBAK BALONG IA	0	0	0	0	0	0	0	0	0
38	MANAULANAN IA	0	0	0	0	0	0	0	0	0
39	PROPER MACABUAL IA	0	0	0	0	0	0	0	0	0
40	SITIO GALIGAYANEN IA	0	0	0	0	0	0	0	0	0
41	NALKATAN MANAULANAN IA	0	0	0	0	0	0	0	0	0
	8 IAs to be established	0	0	0	0	0	0	0	0	0
	Total	262	180	442	300	270	180	300	1,050	1,492

Source: NIA PMO

III.1.2 Cost for Agriculture Supporting Plan

Table. Summarized Cost for Agriculture Supporting Plan

Sub-component	Items	1st Year (2020 Dry and Wet)	2nd Year (2021 Dry and Wet)	3rd Year (2022 Dry and Wet)	Total (PHP)	Total (JPY)
1) Technical Assistance for Irrigated Rice Production	1-1) Salary and Allowance for Technical Staffs	4,822,600	4,979,250	5,143,733	14,945,583	30,937,356
	1-2) Office Equipment (including motorcycles)	2,121,000	0	0	2,121,000	4,390,470
	1-3) Participatory Demonstration Farm & Farm Production Input Assistance	14,000,000	14,000,000	14,000,000	42,000,000	86,940,000
	1-4) Trainings	5,755,348	5,766,848	7,973,123	19,495,318	40,355,307
	Sub-total	**26,698,948**	**24,746,098**	**27,116,855**	**78,561,900**	**162,623,133**
2) Enhancement of Agriculture Extension Services at the Municipal Level	2-1) Office Equipment (including motorcycles)	2,957,500	0	0	2,957,500	6,122,025
	2-2) Reproduction/Printing & Distribution of Manuals & Posters	1,500,000	0	0	1,500,000	3,105,000
	2-3) Trainings	995,843	247,883	247,883	1,491,608	3,087,628
	Sub-total	**5,453,343**	**247,883**	**247,883**	**5,949,108**	**12,314,653**
3) Development of Seed Production	3-1) Machineries & Equipment	3,780,000	0	0	3,780,000	7,824,600
	3-2) Materials	680,000	0	0	680,000	1,407,600
	3-3) Trainings	455,975	0	0	455,975	943,868
	Sub-total	**4,915,975**	**0**	**0**	**4,915,975**	**10,176,068**
Total		**37,068,265**	**24,993,980**	**27,364,738**	**89,426,983**	**185,113,854**

Table. Detail Cost for Each Sub-component on Agriculture Supporting Plan

1) Technical Assistance for Irrigated Rice Production

1-1) Salary and Allowance for Technical Staffs	**Unit Price (per person and month)**	**Quantity**	**Year 1**	**Year 2**	**Year 3**	**Total**
Technical Staff (10 persons)	19,000	12 month x 10 person	2,280,000	2,394,000	2,513,700	7,187,700
Document/Information Officer (1 person)	19,000	12 month x 1 person	228,000	239,400	251,370	718,770
Support Staff/Administration (1 person)	14,000	12 month x 1 person	168,000	176,400	185,220	529,620
Accounting Clerk (1 person)	18,000	12 month x 1 person	216,000	226,800	238,140	680,940
Travelling Allowance						
Technical Staff & Support Staff (11 persons)	800	192 day x 11 person	1,689,600	1,689,600	1,689,600	5,068,800
Year-end Bonus (one month salary)						
Technical Staff (10 persons)	19,000	1 time x 10 person	190,000	199,500	209,475	598,975
Document/Information Officer (1 person)	19,000	1 time x 1 person	19,000	19,950	20,948	59,898
Support Staff/Administration (1 person)	14,000	1 time x 1 person	14,000	14,700	15,435	44,135
Accounting Clerk (1 person)	18,000	1 time x 1 person	18,000	18,900	19,845	56,745
		Sub-total	**4,822,600**	**4,979,250**	**5,143,733**	**14,945,583**
1-2) Office Equipment (including motorcycles)	**Unit Price**	**Quantity**	**Year 1**	**Year 2**	**Year 3**	**Total**
Motorcycle (125 cc, 4-stroke)	150,000	11	1,650,000	0	0	1,650,000
Photocopying machinery	250,000	1	250,000	0	0	250,000
Mobile phone	10,000	12	120,000	0	0	120,000
Laptop computer	20,000	3	60,000	0	0	60,000
Desktop Computer	25,000	1	25,000	0	0	25,000
Computer Table with Chair	4,000	1	4,000	0	0	4,000
Printer	12,000	1	12,000	0	0	12,000
		Sub-total	**2,121,000**	**0**	**0**	**2,121,000**
1-3) Participatory Demonstration Farm & Farm Production Input Assistance	**Unit Price**	**Quantity**	**Year 1**	**Year 2**	**Year 3**	**Total**
Participatory Demonstration Farm & Farm Production Input Assistance	25,000/farmer	1,680 farmers	14,000,000	14,000,000	14,000,000	42,000,000
		Sub-total	**14,000,000**	**14,000,000**	**14,000,000**	**42,000,000**
1-4) Trainings						
For Farmer Cooperator	**Unit Price**	**No. of Participants**	**Year 1**	**Year 2**	**Year 3**	**Total**
1. Orientation & Briefing of PDF & CSFS Cooperators	-	1,770	258,175	258,175	270,250	786,600
2. Benchmarking and FGD Among Prospective PDF & FPIA Beneficiaries	-	1,770	316,825	316,825	340,975	974,625
3. Season Long Training on Climate Smart Field School	-	1,770	1,520,300	1,520,300	1,618,913	4,659,513
For IA officers						

4. Orientation of IA Officers	-	762	71,357.5	71,357.5	76,187.5	218,902.5
5. Planning Workshop of Implementers	-	376	417,910	417,910	448,960	1,284,780
6. Farmer-Led Extension Approach on Rice Production	-	258	919,310	919,310	972,785	2,811,405
7. Enterprise Development Training	-	258	615,710	621,460	1,595,395	2,832,565
8. Skills Training on Financial Resource Management for the Beneficiaries	-	258	615,710	621,460	1,595,395	2,832,565
9. Soil Sampling Technique and Methodology	-	370	78,200	78,200	82,225	238,625
10. Benchmarking/Field Tour	-	346	422,740	422,740	444,878	1,290,358
11. Value Reorientation & Islamic Culture & Islamic Culture Appreciation Training	-	370	78,200	78,200	82,225	238,625
12. Training Course on Social Mobilization for IA Officers	-	370	78,200	78,200	82,225	238,625
For Project Management Team						
13. Project Management Team Monthly Meeting	-	360	117,300	117,300	117,300	351,900
14. Mid- and Year-End Review & Planning WS	-	276	245,410	245,410	245,410	736,230
		Sub-total	**5,755,348**	**5,766,848**	**7,973,123**	**19,495,317.5**
		Total	**26,698,948**	**24,746,098**	**27,116,855**	**78,561,900**

2) Enhancement of Agriculture Extension Services at the Municipal Level

2-1) Office Equipment (including motorcycles)	**Unit Price**	**Quantity**	**Year 1**	**Year 2**	**Year 3**	**Total**
Motorcycle (125 cc, 4-stroke)	150,000	15	2,250,000	0	0	2,250,000
Desktop Computer	25,000	5	125,000	0	0	125,000
Computer Table with Chair	4,000	5	20,000	0	0	20,000
Laptop Computer	20,000	5	100,000	0	0	100,000
Printer	12,000	5	60,000	0	0	60,000
Internet Accessories (modem & router)	4,500	5	22,500	0	0	22,500
Photocopying Machinery	5,000	5	25,000	0	0	25,000
Overhead Projector	13,000	5	65,000	0	0	65,000
UPS	6,000	5	30,000	0	0	30,000
Digital Camera	40,000	5	200,000	0	0	200,000
Refrigerator	12,000	5	60,000	0	0	60,000
		Sub-total	**2,957,500**	**0**	**0**	**2,957,500**
2-2) Reproduction/Printing & Distribution of Manuals & Posters	**Unit Price**	**Quantity**	**Year 1**	**Year 2**	**Year 3**	**Total**
Printing	150	10,000	1,500,000	0	0	1,500,000
		Sub-total	**1,500,000**	**0**	**0**	**1,500,000**
2-3) Trainings	**Unit Price**	**No. of Participants**	**Year 1**	**Year 2**	**Year 3**	**Total**
1. Training Needs Assessment of AEWs	-	37	29,843	0	0	29,842.5
2. Skills Enhancement on Rice Production Technology	-	50	483,000	0	0	483,000

3. Capability Training on Computer Operation and IT=Based Technology	-	50	483,000	0	0	483,000
4. Refresher Course on the Training of Trainers (TOT)	-	37	0	247,883	247,883	495,765
		Sub-total	**995,843**	**247,883**	**247,883**	**1,491,607.5**
		Total	**5,453,343**	**247,883**	**247,883**	**5,949,108**

3) Development of Seed Production

3-1) Machineries & Equipment	**Unit Price**	**Quantity**	**Year 1**	**Year 2**	**Year 3**	**Total**
Machineries						
Hand Tractor with Trailer	157,000	5	785,000	0	0	785,000
Floating Turtle	168,000	5	840,000	0	0	840,000
Rice Reaper	50,000	5	250,000	0	0	250,000
Rice Thresher	150,000	5	750,000	0	0	750,000
Mechanical Blower	15,000	5	75,000	0	0	75,000
Mechanical Dryer (Solar Bubble Dryer)	150,000	5	750,000	0	0	750,000
Equipment						
Thermometer	8,000	10	80,000	0	0	80,000
Moisture Meter	50,000	5	250,000	0	0	250,000
		Sub-total	**3,780,000**	**0**	**0**	**3,780,000**
3-2) Materials	**Unit Price**	**Quantity**	**Year 1**	**Year 2**	**Year 3**	**Total**
Seed Treatment	1,000	50	50,000	0	0	50,000
Net bag	30	2,500	75,000	0	0	75,000
Foundation/ Registered Seeds	50	2,500	125,000	0	0	125,000
Packaging sacks (laminated)	30	5,000	150,000	0	0	150,000
Fertilizers	1400	200	280,000	0	0	280,000
		Sub-total	**680,000**	**0**	**0**	**680,000**
3-3) Trainings	**Unit Price**	**No. of Participants**	**Year 1**	**Year 2**	**Year 3**	**Total**
1. Seed Production Training	-	40	455,975	0	0	455,975
		Sub-total	**455,975**	**0**	**0**	**455,975**
		Total	**4,915,975**	**0**	**0**	**4,915,975**

III.1.3 Inventory of Agriculture Machineries in the MMIP area

Table. Inventory of Pre- & Post-harvest Facilities in Barangay, Influenced Areas of MMIP I & II in Pikit, Aleosan & Carmen of the Cotabato Province

No.	Municipality	Barangay	Location	Service Area	Corn Sheller	Rice Thresher	Solar Dryer	Floating Tiller	Hand Tractor w/ Trailer	Power Tiller	Shallow Tube Well	Rice Mill	Rice Reaper	Rice Combined Harvester	Flatbed Dryer	Ware-house	Corn Mill	Drum Seeder
1	**Pikit**	Kabasalan	MMIP II	LMSA	6	1	3	0	0	0	0	0	0	0	0	0	0	0
2	**Pikit**	Bulod	MMIP II	LMSA	0	0	1	0	0	1	0	1	0	0	0	0	0	0
3	**Pikit**	Bulol	MMIP II	LMSA	0	1	0	0	0	0	0	1	0	0	0	0	0	0
4	**Pikit**	Rajah Muda	MMIP II	LMSA	1	0	1	1	1	0	0	0	0	0	0	0	0	0
5	**Pikit**	Batulawan	MMIP II	LMSA	3	2	1	1	1	1	1	5	0	0	0	0	0	0
6	**Pikit**	Balatikan	MMIP I	UMSA	2	5	1	8	1	2	0	1	0	0	0	0	0	0
7	**Pikit**	Tinutulan	MMIP I	UMSA	1	5	1	1	4	3	0	1	2	2	1	0	0	0
8	**Pikit**	Nabundas	MMIP I	UMSA	0	1	1	0	2	0	0	0	0	0	0	0	0	0
9	**Pikit**	Balungis	MMIP I	UMSA	1	0	0	0	1	0	0	0	0	0	0	0	0	0
10	**Pikit**	Katilacan	MMIP II	LMSA	0	0	2	0	1	1	2	0	0	0	0	1	0	0
11	**Pikit**	Inug-ug	MMIP II	LMSA	0	1	4	3	0	0	1	1	0	0	0	0	0	0
12	**Pikit**	Gli-gli	MMIP II	LMSA	0	0	2	2	2	0	1	0	0	0	0	0	0	0
13	**Pikit**	Gokotan	MMIP I	UMSA	0	0	2	0	1	0	0	0	0	0	0	0	0	0
14	**Pikit**	Punol	MMIP II	LMSA	3	0	2	0	0	0	0	0	0	0	0	0	0	0
15	**Pikit**	Balong	MMIP II	LMSA	2	1	3	1	0	1	1	0	0	0	0	0	0	0
16	**Pikit**	Calawag	MMIP II	LMSA	0	0	1	0	1	1	1	0	0	0	0	0	0	0
17	**Pikit**	Talitay	MMIP II	LMSA	1	0	2	2	0	0	0	0	0	0	0	0	0	0
18	**Pikit**	Lagunde	MMIP II	UMSA	0	3	5	5	4	1	0	0	0	0	0	0	0	0
19	**Pikit**	Balungis	MMIP II	LMSA	0	1	1	0	0	0	0	1	0	0	0	0	0	0
20	**Pikit**	Ladtingan	MMIP II	LMSA	2	1	7	3	2	0	0	0	0	0	0	2	0	0
21	**Pikit**	Ginatilan	MMIP II	LMSA	1	1	3	0	1	0	0	0	0	0	0	1	0	0
22	**Pikit**	Balabak	MMIP I	UMSA	1	3	3	1	5	1	0	1	0	0	0	0	1	0
23	**Pikit**	Buliok	MMIP II	LMSA	0	3	2	1	5	0	0	0	0	0	0	1	1	0
24	**Pikit**	Pamalian	MMIP II	UMSA	0	0	2	0	0	0	4	0	0	0	0	1	0	0
25	**Pikit**	Bago-enged	MMIP II	LMSA	2	0	0	1	3	0	0	0	0	0	0	0	0	0
26	**Pikit**	Kolambog	MMIP II	UMSA	1	0	9	0	1	1	0	0	0	0	0	0	0	0
27	**Pikit**	Silik	MMIP II	LMSA	1	1	0	0	0	0	0	1	0	0	0	0	0	0
28	**Pikit**	Bualan	MMIP II	UMSA	2	0	4	0	1	0	0	0	0	0	0	0	1	0
29	**Pikit**	Langayen	MMIP II	LMSA	0	0	2	0	0	0	0	3	0	0	0	0	3	0
30	**Pikit**	Poblacion	MMIP II	LMSA	1	1	6	0	0	1	0	0	0	0	0	0	0	0
31	**Pikit**	Nalapaan	MMIP II	UMSA	0	3	4	4	0	1	1	0	0	0	0	1	0	0
32	**Pikit**	Nunguan	MMIP II	LMSA	0	9	3	9	0	0	0	0	0	0	0	0	0	0
33	**Pikit**	Dalengaoen	MMIP II	UMSA	2	19	3	31	18	7	4	4	0	0	0	0	0	0
34	**Pikit**	Takipan	MMIP II	UMSA	0	12	10	8	1	3	7	3	0	0	1	2	0	1
35	**Pikit**	Panicupan	MMIP II	UMSA	1	14	5	25	18	3	0	2	0	0	0	0	0	1
36	**Pikit**	Macasendeg	MMIP II	LMSA	2	0	1	0	1	0	0	0	0	0	0	1	0	0
37	**Pikit**	Damalasak	MMIP II	LMSA	1	0	2	0	1	0	0	0	0	0	0	0	0	0

No.	Municipality	Barangay	Location	Service Area	Corn Sheller	Rice Thresher	Solar Dryer	Floating Tiller	Hand Tractor w/ Trailer	Power Tiller	Shallow Tube Well	Rice Mill	Rice Reaper	Rice Combined Harvester	Flatbed Dryer	Ware-house	Corn Mill	Drum Seeder
38	**Pikit**	Paidu Pulangi	MMIP II	UMSA	2	0	2	0	0	0	0	0	0	0	0	0	0	0
39	**Pikit**	Manaulanan	MMIP II	LMSA	1	0	2	0	0	0	1	0	0	0	0	0	0	0
40	**Pikit**	Macabual	MMIP II	LMSA	0	0	1	2	0	0	0	0	0	0	0	0	0	0
41	**Aleosan**	Dungguan	MMIP II	UMSA	0	0	2	0	0	0	0	0	0	0	0	1	0	0
42	**Aleosan**	Tapodoc	MMIP II	UMSA	0	0	2	0	0	0	0	0	0	0	0	0	0	0
43	**Carmen**	Gen. Luna	MMIP I	MSA	2	7	9	30	0	0	21	1	0	0	0	0	0	0
44	**Carmen**	Kibayao	MMIP I	MSA	5	5	10	15	0	0	2	1	0	0	0	3	0	0
45	**Carmen**	Nasapian	MMIP I	MSA	2	0	3	4	0	0	0	0	0	0	0	1	0	0
46	**Carmen**	Ugalingan	MMIP I	MSA	5	10	9	14	0	0	12	2	0	0	0	10	1	0
47	**Pagalungan**	Galakit	MMIP II	PESA	3	2	1	0	3	0	0	0	0	0	0	0	0	0
48	**Pagalungan**	Kudal	MMIP II	LMSA	2	3	0	0	2	0	0	0	0	0	0	0	0	0
49	**Pagalungan**	Linandangan	MMIP I	MSA	3	0	0	0	2	0	0	0	0	0	0	0	0	0
50	**Pagalungan**	Kilangan	MMIP I	MSA	0	8	2	9	5	7	0	0	2	0	0	0	0	0
51	**Pagalungan**	Layog	MMIP II	PESA	0	3	0	6	2	0	4	1	0	0	0	0	0	0
52	**Pagalungan**	Inug-ug	MMIP II	LMSA	9	0	0	9	4	0	0	0	0	0	0	0	0	0
53	**Datu Montawal**	Maridagao	MMIP I	MSA	0	1	3	0	0	0	0	0	0	0	0	1	0	0
Total					**71**	**127**	**145**	**196**	**94**	**35**	**63**	**30**	**4**	**2**	**2**	**26**	**7**	**2**

III.1.4 Enhancement of Agriculture Mechanization

The agricultural development strategy of the Philippine Development Plan 2017-2022 stresses agricultural mechanization as an important tool to attain improvement of the agricultural productivity. The plan expresses that the government will encourage adoption of farm machineries and equipment to reduce production costs of rice, as well as encouraging custom hiring and machinery pooling to provide alternative livelihood to low-skilled workers in rural areas. The farm mechanization will be accelerated by private service providers as envisaged in the plan. The plan states that the following government supporting measures to facilitate the use of appropriate farm machineries and equipment:

- ✓ Provision of fund to local manufacturers and assemblers,
- ✓ Intensified information, education & communication activities on available local machineries, and
- ✓ Provision of proper training and certification for machinery operation

In the Project site, it is noteworthy that out-migration of people from rural to urban centers results in scarcity of manpower working in the farms. Especially, once the prospective irrigable area of MMIP II is fully developed and operational, a problem on availability of farm workers is expected to rise. Irrigated rice production is more labor intensive than the current livelihood activities of farmers in MMIP II areas, e.g. rain-fed rice, corn farming and fisheries.

As in the results of Household Economic Survey conducted by the JICA team, very limited numbers of farmers own agriculture machineries in the MSA and almost none of them own the machineries in the LMSA. An insufficient number of them would result in reduction of production, post-harvest losses, and poor quality of rice paddy.

YLTA had agricultural machinery intervention, yet it was limited to just leasing a set of floating tiller, rotavator, hand tractor with trailer, thresher and welding machinery to the respective target IAs on the condition that it is returned after a year of utilization. A government project should pay much attention to the promotion of farm mechanization services rather than leasing farm machinery directly to farmers or farmers' group e.g. IA, not as conducted in YLTA. In case of anxious demand for farm machinery from IA members, one of alternative solution is to allow IAs to procure farm machinery and be a reliable provider of farm mechanization services.

1) Objective

The objective is to address a shortage of manpower/labor during synchronized land preparation, planting to harvesting and post-harvest activities on rice production through provision of small farm machineries appropriate to the MMIP II area. Through the provision, the IAs establish a system of farm machinery rental services to their members.

2) Approach

ATI procures and delivers pre- and post-harvest machineries to the IAs and then each IA rents the machineries to their members. First, an updated inventory of existing pre- and post-harvest machineries need to be done to determine a balance to meet the number of insufficient machineries. The minimum number of the machineries is delivered to each IA to attain 100% utilization of machineries per cropping season.

The respective IAs should store, manage and monitor them properly. Uniform policies should be in placed with regards to prioritization of usage by IA members, rental fee and/or wage for an operator, operation and management (O&M), etc. In this regards, ATI provides trainings on O&M of supplied agriculture machineries to IAs' members, those who are selected as a responsible machinery operator.

Regarding types of the machineries, of course machineries for land preparation should be installed, such as hand tractors and floating turtle. Small-size machineries are appropriate because average land owned by farmers is 1.52 ha in the project site according to the Baseline Survey. For the harvesting activity, a rice reaper and a rice thresher, as alternative to manual harvesting, could be more appropriate than a combined harvester-thresher and would lower the cost of the activity.

3) Activities

Following table shows implementation schedule of this sub component:

Table. Implementation Schedule of Enhancement of Agriculture Mechanization

Activity	2020		2021		2022		2023		2024	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Inventory of existing pre- and post-harvest farm machineries owned by IAs and their members										
Calculation of additional machineries necessary for each IA based on the irrigated area and the number of members										
Formulation of uniform policies for O&M of the provided farm machineries										
5-day Intensive training of the O&M for the machinery operators										
Supporting consensus building among IAs' members on the O&M										
Identification of optimal location to store the machineries serving as a central station in each IA										
Construction of machinery storage with fencing and water supply facilities										
Provision of machineries identified by the inventory										
Monitoring of actual O&M of the provided machineries										
Evaluation and report making										

Source: JICA Survey Team

28 IAs that have not availed of YLTA and Government Funded Program will be provided with farm machineries to be procured. Following table indicates the tentative number of farm machineries to be provided to those IAs based on their capacity and results of the aforementioned inventory:

Table. Tentative Number of Farm Machineries to be Procured

Item	No. of IA	No. of Units	Total
Hand tractor with trailer*	28	2	56
Power tiller	28	2	56
Floating tiller/Rotavator	28	2	56
Mechanical planter (6-rows drum type seeder)	28	3	84
Rice reaper	28	2	56
Rice thresher	28	2	56
Solar dryer (15m x 30m dimension)	28	1	28
Rice mill (mobile)	28	1	28

Source: JICA Survey Team

According to an instructor of the College of Engineering of USM, the University is accredited by TESDA (Technical Education and Skills Development Authority) to conduct a 5-days training on the Operation and Maintenance of farm machineries. After trainees take the course, they are issued with NC II (National Certificate II) to operate agriculture machineries. Thus, USM provides the training to potential machinery operators from the respective target IAs in collaboration with ATI.

Following table shows cost for Enhancement of Agriculture Mechanization:

Table. Cost for Enhancement of Agriculture Mechanization

1) Machinery	Unit Price	Quantity	Total
Hand Tractor with Trailers	157,000	56	8,792,000
Power Tiller	150,000	56	8,400,000
Floating Tiller/ Rotavator	168,000	56	9,408,000
Mechanical Rice Seeder (drum type)	10,000	84	840,000
Rice Reaper	50,000	56	2,800,000
Rice Thresher	150,000	56	8,400,000
Solar Dryer (15m x 30m)	500,000	28	14,000,000
Mobile Rice Mill	100,000	28	2,800,000
2) Storage			
Storage (12m x 10m)	250,000	28	7,000,000
3) Tool			
welding machinery	15,000	28	420,000
4) Trainings			
Operation and Management for Agriculture Machineries	-	28	205,965
		Total	**63,065,965**

Source: JICA Survey Team