## CAMEROON MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT

## CAMEROON PREPARATORY SURVEY OF RURAL INFRASTRUCTURE IMPROVEMENT PROJECT IN CAMEROON

# FINAL REPORT

## Annex

## FEBRUARY 2017

## JAPAN INTERNATIONAL COOPERATION AGENCY

NTC INTERNATIONAL CO., LTD. EARTH AND HUMAN CORPORATION CO., LTD.

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CAMEROON MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT

## CAMEROON PREPARATORY SURVEY OF RURAL INFRASTRUCTURE IMPROVEMENT PROJECT IN CAMEROON

FINAL REPORT

## Annex

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JAPAN INTERNATIONAL COOPERATION AGENCY

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_		en Milieu Rural MINADER-Cellule des Projets &			
_	UNDUA MANGA Tobie	Programmes			
	Louisette Clémence Bamzok	MINADER Cellule des Projets & Programmes			
		MINADER-Direction du Génie Rural			
	ZUE MINT SA OFFRE	en Milieu Rural			
	TETKA UUES	Centre National d'Etudes et			
	TETRA JULES	Agricole			
	Emost Polond EL & E\/INA	Centre National d'Etudes et			
	Emest Roland EEA EVINA	Agricole			
_	CHIN Richard	UNVDA UNVDA-Direction du Génie Bural			
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	ZAMBO Simon Crépin	Parc National de Matériel de Génie Civil			
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_	TANDONG VICTOR NJOH	Civil Agence Régionale du Sud			
	AMOUGUI AHANDA Timothée	Civil Agence Régionale du Sud			
	NGOULMA Josaphat René	Parc National de Matèriel de Génie			
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_	TANG ANANDA Bamabe	de la Programmation et des Normes MINTP-Direction Générale des			
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		des Routes Rurales			
_	Alexis Christian EWOLO	MINT- Direction de Metro			
	MPELE ONANA Serge	MINT-Service de la Climatologie et de la Banque des Données			
IINE	PDED				
	KAMGUEM DIEUDONNE	MINEPDED-Direction de la Promotion du Développement			
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		MINEPAT-General Department of			
	MISSI Augustine Annette	Cooperation and Regional			
	Mme NOAH Epouse OBAMA	MINEPAT-Direction Générale de la			
_	Albertine Liliane	Cooperation			
	Nekemé Issac	PNDP(MINEPAT)			
	NBOLO Rostan	PNDP(MINEPAT)			
AINE	PIA Ekeme née Ndome Lobe				
	Esther Désirée	ACEFA(MINADER+MINEPIA)			
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		Coodination du Projet			
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	François KWONGANG	EU-Section Développement Rural,			
		Environnement et Société Civile Islamic Development			
	AWADOU Fotouogboun Kou	Bank(MINADER)			
RO	DERIP	Tarassileia Project(BAD)			
	SOKEI Yoshimi	PRODERIP			
_	NO NEIMINA NAZUTOSHI				
	SHIINA Suguru	PRODERiP			
	MATSUMOTO Shunsuke	PRODERIP			

## 1. List of the persons to be interviewd

2. Minutes of Meeting (Inception Report)

## MINUTES OF MEETING ON THE INCEPTION REPORT

FOR

## THE PREPARATORY SURVEY

ON

## RURAL INFRASTRUCTURE IMPROVEMENT PROJECT

IN

## THE REPUBLIC OF CAMEROON

Yaoundé, FEBRUARY 23, 2016

Mr. Mvondo Nna Patrick Director of DEPC, Ministry of Agriculture and Rural Development (MINADER) anames e OCDération vondo Nna Patrick Ingénieur Agro-Economiste

Dr. Takashi KOTEGAWA Sub-Team Leader, JICA Study Team

The Study Team for the Preparatory Survey on Rural Infrastructure Improvement Project in Cameroon (hereinafter referred to as "the Study Team") organized by Japan International Cooperation Agency (hereinafter referred to as "JICA"), headed by Dr. Akira IWAMOTO as Team Leader, and the Ministry of Agriculture and Rural Development (hereinafter referred to as "MINADER") headed by Mr. Mvondo Nna Patrick as Director of MINADER, held a kick-off meeting and discussed on the Inception Report explained by the Study Team.

The list of participants is attached in Annex.

### 1. Submission of the Inception Report

The MINADER received 10 copies of the Inception Report submitted by the Study Team on February 23, 2016.

### 2. Kick-off Meeting

A kick-off meeting was held between the Study Team and the MINADER at the Conference room of the MINADER in Cameroon on February 23, 2016 to discuss on the Inception Report.

### 3. Presentation

The JICA explained the direction of cooperation of MINADER-JICA which is consisted of the technical cooperation named as Upland Rice Development of the Tropical Forest Zone in Cameroon (hereinafter referred to as "PRODERIP" and the Project for the Development of Irrigated and Rainfed Rice Cultivation (hereinafter referred to as "PRODELIP") and the Ioan project named as Rural Infrastructure Improvement Project in Cameroon. Moreover, the Study Team explained to the MINADER the Inception Report that contains the objectives, approaches and methodologies of the Preparatory Survey on Rural Infrastructure Improvement Project in Cameroon.

#### 4. Discussion

Based on the discussion, the MINADER and the Study Team confirmed their agreement on the contents of the Inception Report. Meanwhile, the following matters were discussed between both the parties.

- (a) MINADER and the Study Team agreed that the coordination mechanism with PRODERIP and PRODERIP would become a key for the success of the project.
- (b) MINADER and the Study Team agreed that the MINADER would nominate Counter Parts for each expert of the Study Team in order to conduct the survey smoothly.

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Cam	eroon	JAPAN						
Name	Title	Name	Title					
Henri Eyebe Ayissi	Minister / MINADER	Shinji Umemoto	Reperesentitive / JICA					
EKO'O A. Jean Claude	Secretary General / MINADER	Yuumi Ushiro	Country Officer / JICA					
Mvondo Nna Patrick	DEPC / MINADER	Ryosuke Moritaki	Senior Advisor / JICA					
Viveng Pauline Inspector General / MINADER		Takayuki Muraoka	Sub-representitive / JICA					
Nka Charles Noël	CT2 / MINADER	Gaston Galamo	Program Officer /JICA					
Voundi Jacquinot	I1/IGDR / MINADER	Sokei Yoshimi	Expert / PRODERiP					
Bedoung Gisele	12/IGDR / MINADER	Akira IWAMOTO	Leader of Consultant					
Mbili Oloume Jean Pierre	DDA / MINADER	Takashi Kotegawa	Sub-leader of Consultant					
Mohamadou Saoudi	DRFP/ MINADER	Shigeru Takagi	Consultant					
FALAINA DGRCV / MINADER		Yusuke NAKAYAMA	Consultant					
Ondoa Manga Tobie	CCPP/DEPC / MINADER	Hiroshi ISHII	Consultant					
Vundi Fidele Magloire	Cadre Technique / MINADER	Hiroyuki KURONUMA	Consultant					
Chin Richard	DG / UNVDA	Ayako MORISHIMA	Consultant					
Francis Fonayi Waindim	DGR / UNVDA	Do	nors					
Mathias Mawo Lon	DAP / UNVDA	Name	Title					
Olinga O.Vitalis	IP/ Cellule RAD/BM / MINTP	CADILLA FALCO JORDI	Gestion de Programmes Infrastructures / EU					
Obama Albertine Liliane	IE/DNS / MINEPAT	FERNANDEZ OSUMA juan	Gestion de Programmes Infrastructures / EU					
Monono Absalom Woloa	Secretary General / North West Governor's office	Ndimi Luc	Secretary General / PIDMA					
Keyantio Augustin	Inspector General / East Governor's office							

## Annex : LIST OF ATTENDANTS

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## 3. Minutes of Meeting (Interim Report)

## MINUTES OF MEETING ON THE INTERIM REPORT

FOR

## THE PREPARATORY SURVEY

ON

## RURAL INFRASTRUCTURE IMPROVEMENT PROJECT

IN

## THE REPUBLIC OF CAMEROON



Mr. Mvondo Nna Patrick Director of DEPC, Ministry of Agriculture and Rural Development (MINADER) Yaoundé, JUNE 22, 2016

Dr. Akira IWAMOTO Team Leader, JICA Study Team

Mr. Shinji UMEMOTO

Representative, JICA Camerood Officeroon

The Study Team for the Preparatory Survey on Rural Infrastructure Improvement Project in Cameroon (hereinafter referred to as "the Study Team") organized by Japan International Cooperation Agency (hereinafter referred to as "JICA"), headed by Dr. Akira IWAMOTO as Team Leader, and the Ministry of Agriculture and Rural Development (hereinafter referred to as "MINADER") headed by Mr. Mvondo Nna Patrick as Director of MINADER, held a meeting and discussed on the Interim Report explained by the Study Team.

The list of participants is attached in Annex.

#### 1. Meeting

A Meeting was held between the Study Team and the MINADER at the Conference room of the MINADER in Cameroon on JUNE 22, 2016 to discuss on the Interim Report.

#### 2. Presentation

Dr.Kotegawa from the Study Team made a presentation for the contents stated below.

- A. The following topics were introduced:
- 1. Overall objectives of the need to increase rice production in the country
- 2. Objectives and zones of the studies
- B. The various components of the project was elaborated as follows :
- 1. Component of Irrigation Development
  - Explanation of the identified problems and the proposed solutions.
  - Explanation of the 4 options proposed and the costs.
- 2. Component of Road Access Improvement
  - · Explanation of the basic criteria for the selection of the candidate roads.
  - Explanation of the methodology of the road selection.
  - Presentation of the selection list in terms of prioritization and the site located maps.
  - Explanation of advantages of using a stabilizer to reinforce groundworks compared to conventional methods used locally.
  - · Proposition of road dimensions.
  - Presentation of 2 costing options for selected road list.
- 3. Component of Installation of Agricultural Machinery and Equipment
  - Presentation of the concerned machines.
  - Explanation of the identified problems and the proposed solutions.

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- Presentation of the Japanese fabricated machinery and its rice-polishing potentiality to improve the quality of rice.
- Explanation of the Proposed Installation Site.
- Presentation of the 3 costing options for the type and number of machines to be acquired.
- 4. For Soft Component
  - Explanation of how training programs can be organized for the various components.
- C. Explanation for the most advantageous option combination amongst the components and its costs
- D. Presentation of the special terms and conditions for applying the STEP scheme to the Japanese Loan Projects.
- E. Presentation of the Preparatory Study Calendar
- F. Invitation of the attendees to a question-comment session.

#### 3. Discussion

### Comment 1:

Mr Mvondo expresses his appreciation for the Study Team who has always carried out the studies in a participative manner. He reminds the attendees that the Study Team has always worked closely with the various members of MINADER and UNVDA in the last months.

### Comment 2 :

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### Mr Falaina's first question

- For the road component, he wonders if it is necessary to use the stabilizer to upgrade the inland farm roads. He thinks that if the existing laterite would be compacted on site the results should be good enough for such roads.
- Reply from Mr Sato from the Study Team

The stabilization machine is only applicable to roads with heavy traffic and the on-site laterite will be combined with cement to strengthen its base capacity. This method will not be used on internal farm roads.

Mr Falaina's second question

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 As for the promotion of fully polished rice production, he wonders if this would not deprive the consumers from its nutritive value as it is often considered as less nutritional than brown rice.

#### Reply from Mr Nagaoka from the Study Team

Basically, the milling machine to be used is adaptable to the needs of the markets. Should the market require less polished rice, the degree of the polishing process can be adjusted as per the demand requires.

Mr Chin of UNVDA adds that the most important factor in the rice-polishing process lies in the rice seed that is to be planted. The actual problem why the rice polishing process has been unsuccessful is because various rice originating from different seeds have been combined together during the process. As a result, the whiteness of the rice reacts differently after the process. Thanks to the technical team (PRODERIP), this problem will be solved basically with the plantation of a single rice seed at the origin.

#### Comment 3 :

Mrs Bamzok is very impressed by findings of the Study Team and thinks that the propositions made by the Study Team are very reasonable. She would like to know though for the STEP scheme how the 30% of the tied loan works; that is, if Cameroonian candidate companies would have to go to Japan to obtain Japanese products.

#### Replies from Dr Kotegawa and Mr Umemoto

Basically, more than 30% of the project costs will be allocated to Japanese companies for the supply of Japanese products. Nevertheless, the rest of the project costs will be used on locally obtainable products and services.

Mrs Bamzok finds this tied loan is very reasonable compared to loan projects offered by other donors.

#### Comment 4 :

Mr Mvondo asks if the maintenance of the concerned roads after rehabilitation has been taken into consideration. Will the construction machines be left to the disposal of the local authorities?

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#### Reply from Dr Iwamoto of the Study Team

Dr Iwamoto explains that this is where the importance of the Soft Component comes in place. Training will be provided to the various staff for not only maintaining the roads, but also the construction and agricultural machines.

#### Reply from Mr Umemoto

Mr Umemoto stresses that Japan is 'together' with Cameroon on this project. Hence, if the training is judged not sufficient when the time comes, other solutions may be proposed should the need arise.

#### Mr Mvondo shares two news:

• The UNVDA Development Plan now figures as part of the Triennial Urgency Development Plan thanks to the Cameroonian Prime Minister.

The candidate road list has been approved by the Minister of MINADER.

Mr Mvondo concludes that all attendees appreciates the good works proposed by the Study Team and confirms that the propositions made are acceptable and reasonable.

On this note, Mr Mvondo thanks all the attendees for their presence and ends the meeting session.

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Can	ieroon	JAPAN						
Name	Title	Name	Title					
Mvondo Nna Patrick	DEPC / MINADER	Shinji Umemoto	Reperesentative / JICA					
FALAINA	DGRCV / MINADER	Takayuki Muraoka	Sub-representative / JICA					
Mbili Oloume Jean Pierre	DDA / MINADER	AGNES OKODOMBE	Chargée Programmes Agriculture, Pêche et Environement /JICA					
Bamzok Louisette	DEPC/CPP	Akira IWAMOTO	Leader of the Study Team					
MBALLA ONANA Maigueite	CEAA/CPP	Takashi Kotegawa	Sub-leader of the Study Team					
Mbock Clestin	Cellule de Suivi des MINADER	Shigeru Takagi	Member of the Study Team					
Chin Richard	DG / UNVDA	Fusashige Sato	Member of the Study Team					
Francis Fonayi Waindim	DGR / UNVDA	Akihiro Fukuda	Member of the Study Team					
Mathias Mawo Lon	DAP / UNVDA	Hirokazu Nagaoka	Member of the Study Team					
Olinga O.Vitalis	IP/ Cellule RAD/BM / MINTP	Hiroyuki KURONUMA	Member of the Study Team					
Ngou Tamdem Gilbete	Chef Service de la Coopération Bilatérale /SDC	Ayako MORISHIMA	Member of the Study Team					
MEYOMESSE ENGOLO Calvin	Consultant	Polly Le MOIGNE	Coordinator of the Study Team					
		SOPTCHOM Victor	Civil Engineer of the Study Team					
		NOAH Taustin	Interpreter of the Study Team					

## Annex : LIST OF ATTENDANTS

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## 4. Minutes of Meeting (Japan Visit)

## MINUTES OF MEETING ON THE JAPAN VISIT

FOR

## THE PREPARATORY SURVEY

ON

## RURAL INFRASTRUCTURE IMPROVEMENT PROJECT

IN

THE REPUBLIC OF CAMEROON

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H.E. Mr. Eyebe Ayissi Henri Minister, Ministry of Agriculture and Rural Development (MINADER) Tokyo, JULY 17, 2016

Ør. Akira IWAMOTO Team Leader, JICA Study Team

The Study Team for the Preparatory Survey on Rural Infrastructure Improvement Project in Cameroon (hereinafter referred to as "the Study Team") organized by Japan International Cooperation Agency (hereinafter referred to as "JICA"), headed by Dr. Akira IWAMOTO as Team Leader held the visit program in Japan for Ministry of Agriculture and Rural Development (hereinafter referred to as "MINADER"). The three delegations, H.E. Mr. Eyebe Ayissi Henri, Minister of MINADER, Mr. MVONDO NNA Patrick, Director of Department of Studies, Programmes, Cooperation and Mr. VOUNDI Jacquinot, Inspector general, Rural Development came to Japan. They visited the Japanese companies which can provide the proposed machines such as tractors, rice milling machine, country elevator, etc. Through the visit they discussed on the Preparatory Survey which is being carried out by the Study Team.

The executed scheo	lule of program	is following;
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No	Date	Time	Activity
1	7/10 (sun)		21:05 Dept. from Yaoundé (AF909)
2	7/11 (mon)	AM	07:10 Arrival at Paris
2		PM	13:55 Dept. from Paris (AF276)
		AM	8:30 Arrival at Tokyo (Narita airport)
3	7/12 (tue)	DM	14:30-16:30 Visit KUBOTA factory (Tractor and etc.) at
			Tsukuba city, Ibaraki Pref.
			10:00 -11:00 Courtesy call to Cameroon Embassy
			11:30 -12:30 Courtesy call to JICA HQ
4	7/13 (wed)		13:30-14:30 Courtesy call to Ministry of Agriculture, Forestry
17	7713 (wed)	PM	and Fisheries
			17:25 Dep. from Haneda airport
			18:45 Arrival at Hiroshima airport
<b></b>		AM	10:00-11:30 Visit SATAKE HQ at Higashi Hiroshima City
5	7/14 (thu)		13:00 Dep. from Hiroshima airport
		PM	14:35 Arrival at Haneda airport
			18:00-18:30 Courtesy call to Ministry of Foreign Affairs
		ΔΜ	10:00-11:30 Visit Country Elevator of JA Utsunomiya at
6	7/15 (fri)		Utsunomiya city, Tochigi Pref.
	1710 (11)	РМ	15:00-16:30 Visit rice milling plant of ITAMI SANGYO at
			Tsurugashima city, Saitama Pref.
7	7/16 (sat)		Off Day
8	7/17 (sun)	PM	22:55 Dept. from Tokyo (AF293)
		AM	04:30 Arrival at Paris
9	7/18 (mon)	РM	14:15Dept. from Paris (AF900)
L		1 141	19:40 Arrival at Yaoundé

Contents of the visit

A. Courtesy calls:

- 1. JICA Head Quarters
- 2. Cameroon Embassy
- 3. Ministry of Agriculture, Forestry and Fisheries
- 4. Ministry of Foreign Affairs



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- B. The tours at the factories and the facilities of Agricultural Machinery:
- 1. Kubota

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- Observation of the assemblage at tractors factory
- Explanation of the advantage of Japanese tractor compared with other country's one
- 2. Satake
  - Explanation of Satake products
  - Demonstration of Optical Sorter
- 3. Country Elevator
  - Explanation and observation of the facility
- 4. Rice Milling Plant
  - Explanation and observation of the plant

During the program, the following points have been discussed:

- i. The Cameroonian side requests to introduce the Agricultural Machinery which meets meteorological and geological condition in Cameroon.
- ii. Japan will continue to support Cameroon for the agriculture development especially for rice farming sector as the one of most important countries for the development in Central Africa area.
- iii. The Cameroonian side requests to increase the loan volume for the project being prepared by the Study Team.

Future Programs are shown below:

- The presentation of Draft Final Report (The beginning of October)
- The fact finding mission of JICA (The beginning of October)
- The Submission of Final Report (December)

After the submission of Final Report, JICA will execute the following events:

- The appraisal mission
- The signing Exchange of Note
- The signing Loan Agreement

H.E. Mr. Henri Eyebe Ayissi expresses his appreciation for the Study Team who organized this visit program in Japan. He reminds all members that the Study Team and MINADER will continue to work together to finalize the Preparatory Survey and realize the Yen Loan project.





## 5. Minutes of Meeting (Draft Final Report)

## MINUTES OF MEETING ON THE PRESENTATION OF DRAFT FINAL REPORT

FOR

## THE PREPARATORY SURVEY

ON

## RURAL INFRASTRUCTURE IMPROVEMENT PROJECT

IN

### THE REPUBLIC OF CAMEROON

Yaoundé, December 14, 2016

JIC Cameroon

Office

Mr Shinji UMEMOTO Director of DEPC, Ministry of Agriculture and

Rural Development (MINADER) Le Directeur des Etudes des Programmes et de la Cooperation A 360 Mondo Nna Patric .6 Ingénieur Agro-Economiste 00

Mr Mvondo Nna Patrick

Representative, JICA Cameroon Office

Dr Akira IWAMOTO Team Leader, JICA Study Team

The Study Team for the Preparatory Survey on Rural Infrastructure Improvement Project in Cameroon (hereinafter referred to as "the Study Team") organized by Japan International Cooperation Agency (hereinafter referred to as "JICA"), headed by Dr Akira IWAMOTO as Team Leader, and the Ministry of Agriculture and Rural Development (hereinafter referred to as "MINADER") headed by Mr Mvondo Nna Patrick as Director of MINADER, held a meeting and discussed on the Draft Final Report explained by the Study Team.

The list of participants is attached in Annex.

#### Minutes of Presentation-Meeting on 14 December 2016

15H35 Opening Speech by Mr. Mvondo (Director of DEPC) welcoming and thanking everyone's presence at the meeting

15H40 Introduction Speech by Mr Umemoto (Director of JICA Cameroon) thanking all the Cameroonian parties' support to the study team and asking for continued support to the Japanese Team for the realization of the Project. He emphasized that all questions and comments, if any, should be made this meeting as this is the last occasion to do so.

He also introduced Mr Furukawa (First Secretary of Japan Embassy in Cameroon) who just arrived in Cameroon recently.

15H50 Presentation of the Draft Final Report by the study team: Mr Iwamoto, Mr Sato and Mr Fukuda

### Contents of the Presentation

- A. The following topics were introduced:
- 1. Significance of the project implementation for Cameroon and Japan
- 2. Progress of the preparatory survey
- 3. Objectives and target area for the project

B. The following components of the project were elaborated :

- 1. For Irrigation Component
  - Explanation of the identified problems and the proposed solutions
- 2. For Access Road Component
  - Explanation of procedures for target road selection
  - Presentation of summary of selected target roads
  - Explanation of the identified problems and the proposed solutions

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- 3. For Agricultural Machinery Component
  - Explanation of the identified problems and the proposed solutions
  - Presentation of the Japanese fabricated machinery and its rice-polishing potentiality to improve rice production capacity
  - Presentation of drawings relating to the country elevator and the transformation unit
- 4. Explanation of how training programs (soft component) can be organized for the various components (Irrigation, Access Road, Agricultural Machinery and Marketing)
- C. Explanation of the Overall Concept of the Project
- D. Explanation of the Project Implementation Schedule and Organization
- E. Explanation of the procurement system
- F. Invitation of the attendees to a question-comment session.

16h35 Opening of the Question-Comment Session

#### **Comments and answers**

#### Question 1 :

During the Fact Finding Mission, the request to modify the name of the project was made and was approved. Mr Mvondo wondered why this change has not been taken into account in the draft final report.

#### Answer from the study team :

Dr Iwamoto explained that the draft final report is based on the contract made between the study team and JICA office in Japan since the beginning of the year. Hence, the team has to abide to this project name for the submission of all the output documents related to this contract.

### Question 2 :

Mr Mvondo would also like to know why the costs of the project are not mentioned at all in the presentation.

#### Answer from the study team :

Dr Iwamoto explained that the study team has been contracted by JICA to formulate the technical aspect of the project. As far as the costs of the project are concerned, the details were discussed between the Cameroonian authorities and the Fact Finding Mission dispatched by JICA headquarters in October 2016 and a consensus was reached between both parties.





Mr Ondoa also thinks that the Ministry of Commerce should be included in the steering committee as the rice produced will have to be sold on a national basis.

#### Answers:

1. Mr Iwamoto explained that the annual harvest of 15 000 t is not only based on the paddy rice to be collected from the 918 ha of the selected site but also includes the 3000 ha actually owned by UNVDA.

As for annual double rice crop production, Mr Iwamoto thinks it may be socially and economically difficult for farmers to plant only rice and not other crops which they may need for personal consumption or economic purposes as well.

As for the steering committee, the organization of the steering and implementation committees was clearly agreed upon during the Fact Finding Mission by both Cameroonian and Japanese sides. The study team suggests that MINADER discuss this matter directly with the JICA Appraisal Mission next year.

2. Mr Chin explained that in the past, rice crops were produced twice a year but It is no longer the case especially with the existence of cattle farming. The Ndop valley is a grazing area for the cattle and until there is another option, there is a need to respect this.

Mr Chin also reminded everyone that the NDOP valley is often known for its rice but in reality, the other crops like tomatoes and corns produced in the zone are also very important sources of income for the farmers.

As for the need to install a levy system to be paid by the farmers, Mr Chin thinks that it is an important issue to be discussed internally. Many years ago, the levy system existed but it was abolished due to the economic crisis.

3. Mr Mvondo agrees that this levy issue concerns basically the Cameroonian side and needs to be discussed internally in the near future.

17h00 Mr Mvondo thanked all the attendees for their presence and ended the meeting session.

After the presentation, MINADER received 10 copies of the Draft Final Report submitted by the study team.

MINADER has been requested to submit all comments, if any, concerning the draft final report before 20<sup>th</sup> December 2016. No comments will be taken into account after the mentioned-date.

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## Annex : LIST OF ATTENDANTS

Cam	eroon	JICA					
Name	Title	Name	Title				
Mvondo Nna Patrick	vondo Nna Patrick DEPC / MINADER		Reperesentitive / JICA				
Chin Richard	DG / UNVDA	Takayuki Muraoka	Sub-representitive / JICA				
Francis FONAYI Waindim	DGR / UNVDA	OKODOMBE Agnes	Program Officer /JICA				
FALAINA	DGRCV / MINADER	Japan E	mbassy				
ONDOA Tobie	CCPP/DEPC / MINADER	Hiroshi FURUKAWA	First Secretary				
VESSAH Daouda	SDMA/ MINADER	JICA Study Team					
MESSIA MESSIA Georges Cheistien	CS / MINADER	Akira IWAMOTO	Leader of consultant				
Mme Ngou Tamdem G.A	CS/ MINADER	Fusashige SATO	Consultant				
TSANGUE poul yves	Cardre MINADER	Akihiro FUKUDA	Consultant				
ZUE	CS/DGRCV/MINADER	Hiroyuki KURONUMA	Consultant				
EONE NSOGA OSCAR	Cadre/MINEPAT	Ayako MORISHIMA	Consultant				
DJAKOU Dagobert	DOPA/MINADER	Polly Le MOIGNE	Local Staff				
		SOPTCHOM T. Victor	Local Staff				
		ZAMBOU Djibril	Local Consultant				

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## 6. Annex of Irrigation Component

## Result of Soil Profile Survey (1)

Upper Site of Upper Bumenda

Date of Soil Survey : 14th/Mar/2016 Surveyor : Takashi KOTEGAWA Location : 5°58'38.30"N、10°24'37.99"E Altitude : 1,179 m Soil Classification :

Remarks : The soil pit is located in the rice seed producing farmland managed by the UNVDA. Since the farmland belongs to UNVDA, the cultivation activities are rarely conducted in dry season. The farmland was reclaimed approximately 40 years ago. The clear horizons are observed between each layer. The soil texture is assumed to be high in clay contents in the soil. Moreover, the viscosity, plasticity and compactness are also high indicating that the amount of vertical drainage of the water would be low, while the soil could retail the soil nutrients for the favourable growth of rice. The mottles of iron are observed from the upper layer to lower layer though its abundance is different depending on the layers.



Horizon	Range(cm)	Profile
Ар	0-14/16	[Horizon] : Smooth, Abrupt、 [Color (Wet)] : 5YR 3/4、 [Mottles] : Irregular, Few、 [Soil Texture] : Light Clay、 [Gravel] : Fine gravel, Sub-angular, Few、 [Structure] : Week, Fine, Sub-angular blocky、 [Viscosity] : Sticky、 [Plasticity] : Plastic、 [Compactness] : Medium (20-24mm)、 [Hardness] : Slightly Hard、 [Plant roots] : Fine, Common、
Ad	14/16-30	[Horizon] : Smooth, Clear、 [Color (Wet)] : 5YR 3/4、 [Mottles] : Irregular, Few、 [Soil Texture] : Clay Loam、 [Gravel] : Fine gravel, Sub-angular, Few、 [Structure] : Week, Fine, Sub-angular blocky、 [Viscosity] : Sticky、 [Plasticity] : Plastic、 [Compactness] : Compact (25-28mm)、 [Hardness] : Hard、 [Plant roots] : Fine, Very few、
В	30-45/50	[Horizon] : Smooth, Clear 、 [Color (Wet)] : 5YR2/3、 [Mottles] : Irregular, Common、 [Soil Texture] : Clay Loam、 [Gravel] : Fine gravel, Sub-angular, Few、 [Structure] : Massive、 [Viscosity] : Sticky、 [Plasticity] : Plastic、 [Compactness] : Very compact (>29)、 [Hardness] : Hard、 [Plant roots] : Fine, Very few
C1	45/50-68	[Horizon] : Smooth, Clear 、 [Color (Wet)] : 5YR3/3、 [Mottles] : Irregular, Common、 [Soil Texture] : Light Clay、 [Gravel] : None 、 [Structure] : Massive 、 [Viscosity] : Sticky、 [Plasticity] : Plastic、 [Compactness] : Very compact (>29)、 [Hardness] : Hard、 [Plant roots] : None
C2	68-85+	[Color (Wet)] : 5YR4/4、[Mottles] : Irregular, Common 、[Soil Texture] : Clay Loam、 [Gravel] : None 、[Structure] : Massive 、[Viscosity] : Sticky、[Plasticity] : Plastic、[Compactness] : Very compact (>29)、[Hardness] : Very Hard、[Plant roots] : None

## **Result of Soil Profile Survey (2)**

Middle Site of Upper Bumenda

Date of Soil Survey : 14th/Mar/2016 Surveyor : Takashi KOTEGAWA Location : 5°58'17.39"N、10°25'2.84"E Altitude : 1,170 m Soil Classification :

Remarks : The soil pit is located in the farmland managed by the local farmer. The farmland is cultivated for maize, beans etc. in dry season while paddy cultivation is conducted in rainy season. The farmland was reclaimed approximately 40 years ago. The soil clay contents are assumed to be high in the soil of each layer. The mottles of iron in the lower soil layer are more abundant than that of Upper site. Moreover, the accumulation of iron is observed in the B horizon indicating that the permeability of surface layer could be low and the reduced condition of the soil in the lower layer might be affected by the ground water.



Horizon	Range(cm)	Profile
Ар	0-15/18	[Horizon] : Wavy, Claer、 [Color (Wet)] : 5YR 3/1、 [Mottles] : Irregular, Few、 [Soil Texture] : Clay Loam、 [Gravel] : Fine gravel, Sub-angular, Few、 [Structure] : Week, Fine, Sub-angular blocky、 [Viscosity] : Sticky、 [Plasticity] : Very Plastic、 [Compactness] : Medium (20-24mm)、 [Hardness] : Slightly Hard、 [Plant roots] : Fine, Common,
Bdgir	15/18-20/22	[Horizon] : Wavy, Clear、 [Color (Wet)] : 5YR 4/4、 [Mottles] : Irregular, Common、 [Soil Texture] : Light Clay、 [Gravel] : Fine gravel, Sub-angular, Few、 [Structure] : Massive 、 [Viscosity] : Sticky、 [Plasticity] : Very Plastic、 [Compactness] : Compact (25-28mm)、 [Hardness] : Slightly Hard、 [Plant roots] : Fine, Very few
Cg1	20/22-50	[Horizon] : Smooth, Clear 、 [Color (Wet)] : 5YR 5/1、 [Mottles] : Irregular, Abundant、 [Soil Texture] : Clay Loam、 [Gravel] : None 、 [Structure] : Massive、 [Viscosity] : Sticky、 [Plasticity] : Plastic、 [Compactness] : Very compact (>29)、 [Hardness] : Very Hard、 [Plant roots] : Fine, Very few
Cg2	50-80+	[Color (Wet)] : 5YR 6/1、 [Mottles] : Irregular, Abundant 、 [Soil Texture] : Light Clay、 [Gravel] : None 、 [Structure] : Massive 、 [Viscosity] : Sticky、 [Plasticity] : Very Plastic、 [Compactness] : Compact (25-28mm)、 [Hardness] : Very Hard、 [Plant roots] : None

## **Result of Soil Profile Survey (3)**

Lower Site (1) of Upper Bumenda

Date of Soil Survey : 14th/Mar/2016 Surveyor : Takashi KOTEGAWA Location : 5°58'22.02"N、10°25'51.79"E Altitude : 1,161 m Soil Classification :

Remarks : The soil pit is located in the farmland managed by the local farmer. The farmland is cultivated for maize, beans etc. in dry season while paddy cultivation is conducted in rainy season. The farmland was reclaimed approximately 40 years ago. The soil clay contents are assumed to be high in the soil of each layer. The ground water are observed in this soil pit. The height of ground water is around 60 cm from the surface. The mottles of iron are found in the lower layer, but most of soil colors in this pit are greyish, indicating the strongly reduced condition of the soil.



Horizon	Range(cm)	Profile
Ар	0-15/22	[Horizon] : Irregular, Clear、[Color (Wet)] : 5YR 3/1、[Mottles] : None、[Soil Texture] : Light Clay、[Gravel] : Fine gravel, Sub-angular, Few、[Structure] : Week, Fine, Sub-angular blocky、[Viscosity] : Sticky、[Plasticity] : Very Plastic、[Compactness] : Compact (25-28mm)、[Hardness] : Slightly Hard、[Plant roots] : Fine, Common
BC	15/22-42/45	[Horizon] : Wavy, Diffuse、 [Color (Wet)] : 5YR 3/2、 [Mottles] : Irregular, Few、 [Soil Texture] : Heavy Clay、 [Gravel] : Fine gravel, Sub-angular, Few、 [Structure] : Massive、 [Viscosity] : Sticky、 [Plasticity] : Very Plastic、 [Compactness] : Compact (25-28mm)、 [Hardness] : Slightly Hard、 [ Plant roots] : None
Cg1	42/45-68/70	[Horizon] : Wavy, Diffuse、 [Color (Wet)] : 5YR 6/1、 [Mottles] : Irregular, Common、 [Soil Texture] : Light Clay、 [Gravel] : None 、 [Structure] : Massive、 [Viscosity] : Sticky、 [Plasticity] : Very Plastic、 [Compactness] : Compact (25-28mm)、 [Hardness] : Hard、 [Plant roots] : None
Cgir2	68/70-85+	[Color (Wet)] : 7.5YR 6/6 (Mottles] : Irregular, Common, [Soil Texture] : Heavy Clay, [Gravel] : None (Structure] : Massive (Viscosity] : Sticky, [Plasticity] : Very Plastic, [Compactness] : Compact (25-28mm), [Hardness] : Hard, [Plant roots] : None

## **Result of Soil Profile Survey (4)**

Lower Site of Upper Bumenda 2

Date of Soil Survey : 15th/Mar/2016 Surveyor : Takashi KOTEGAWA Location : 5°58'10.84"N、10°26'50.50"E Altitude : 1,161 m Soil Classification :

Remarks : The soil pit is located in the farmland managed by the local farmer. The farmland is cultivated for maize, beans etc. in dry season while paddy cultivation is conducted in rainy season. The farmland was reclaimed approximately 7 years ago, which is different from the other soil pits. The agricultural machines such as tractor are not utilized in this area since the suitable internal road for the machines are not well constructed. The ground water are observed in this soil pit. The height of ground water is around 90 cm from the surface. The mottles of the iron are observed in B horizon, indicating the low water permeability.



Horizon	Range(cm)	Profile
Ар	0-10/15	[Horizon] : Wavy, Diffuse、 [Color (Wet)] : 5YR 3/1、 [Mottles] : Root-like, Few、 [Soil Texture] : Clay Loam、 [Gravel] : Fine gravel, Sub-angular, Few、 [Structure] : Week, Fine, Sub-angular blocky、 [Viscosity] : Sticky、 [Plasticity] : Plastic、 [Compactness] : Medium (20-24mm)、 [Hardness] : Slightly Hard、 [Plant roots] : Fine, Common
AB	10-15/20-25	[Horizon] : Irregular, Diffuse、[Color (Wet)] : 5YR 3/1、[Mottles] : Root-like, Few 、 [Soil Texture] : Light Clay、[Gravel] : Fine gravel, Sub-angular, Few、[Structure] : Week, Fine, Sub-angular blocky、[Viscosity] : Sticky、[Plasticity] : Plastic、 [Compactness] : Compact (25-28mm)、[Hardness] : Hard、[Plant roots] : Fine Few、
Bg	20-25/45-53	[Horizon] : Wavy, Clear 、 [Color (Wet)] : 7.5YR 5/1、 [Mottles] : Root-like & Irregular, Common、 [Soil Texture] : Heavy Clay、 [Gravel] : None 、 [Structure] : Massive、 [Viscosity] : Sticky、 [Plasticity] : Very Plastic、 [Compactness] : Compact (25-28mm)、 [Hardness] : Hard、 [Plant roots] : Fine, Very few、
C1	45-53/70	[Horizon] : Smooth, Clear 、 [Color (Wet)] : 5YR 5/1、 [Mottles] : Irregular, Common、 [Soil Texture] : Heavy Clay、 [Gravel] : None、 [Structure] : Massive 、 [Viscosity] : Sticky、 [Plasticity] : Very Plastic、 [Compactness] : Compact (25-28mm)、 [Hardness] : Hard、 [Plant roots] : None
C2	70-85+	[Color (Wet)] : 7.5YR 4/1、 [Mottles] : Irregular, Few 、 [Soil Texture] : Heavy Clay、 [Gravel] : None、 [Structure] : Massive 、 [Viscosity] : Sticky、 [Plasticity] : Very Plastic、 [Compactness] : Compact (25-28mm)、 [Hardness] : Hard、 [Plant roots] : None

## Results of the calculation of Irrigation Requirement

## **1.ETc&Irrigation Requirement**

Beneficiary area: 91	8 ha											
Description	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
ETo on Modified Penman	(mm/month)	125.70	129.62	140.07	125.74	121.78	105.20	99.5	8 99.72	101.58	111.67	116.24
Ļ												
Selected Eto	(mm/month)	125.70	129.62	140.07	125.74	121.78	105.20	99.5	8 99.72	101.58	111.67	116.24
ETC=ETO*Kc*Area												
Dry Season (Mar. to End of May)	Crop Area (ha)											
1. Maize	597 Kc			0.55	0.85	0.88	0.28					
	ETC	0	0	45,992	63,809	63,979	17,585		0 0	0	0	0
2 Beans	311Kc			0.56	0.83	1.00	0.63					
2. Deans	ETC	0	0	1 976	2.65	2.001	1.094		0 0	0	0	0
	EIC	- 0	0	1,620	2,302	5,091	1,964		0 0	0	0	0
3. Poteto	31 Kc			0.57	0.91	0.82						
	ETC	0	0	1,859	2,809	2,535	0		0 0	0	0	0
				0.45	0.75	1.15	0.00					
4. Tomato	30 KC			0.45	0.75	1.15	0.80					
	EIC	- 0	0	1,420	2,240	3,440	2,438		0 0	0	0	0
Rainy Season (Jun. to End of Dec.)												
1. Paddy	459 Kc							1.1	0 1.10	1.05	1.00	0.18
	ETC	0	0	0	0	0	0	50,27	7 50,346	48,955	51,255	9,604
Adding for pre sowing (Special needs)												
Total consumptive use in the month		0	0	51,097	71,421	73,045	22,006	50,27	7 50,346	48,955	51,255	9,604
Net Irrigated area (ha)		0	0	665	665	665	665	56	8 568	568	537	475
Net Irrigation reqd. mm/ha		0	0	77	107	110	33	8	9 89	86	95	20
Effective Rainfall in mm (Koundja)		0	0	62	105	122	129	22	6 242	237	182	22
Net Irri. Required per month		0	0	15	2	-12	<b>-</b> 96	-13	7 -153	-151	-87	-2
Net Irri Required in cum		0	0	148	24	-122	<b>-</b> 959	-1,37	5 -1,534	-1,508	<b>-8</b> 66	-18
Net Irri Required per day		0	0	5	1	-4	-32	-4	6 -51	-50	-29	-1
Gross Irri Regd. inclusive losses		0	0	11	2	-9	-68	-9	8 -109	-107	-62	-1
Irrigation required for whole area		0	0	7,028	1,137	-5,758	-45,426	-55.62	1 <b>-</b> 62,044	-61,012	-33,104	-603
Design discharge lps/dav		0	0	81	13	-67	-526	<b>-</b> 64	4 -718	-706	-383	-7

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## 2. Kc per Growth Stage

## DURATION OF GROWTH STAGE FOR FIELD CROP

Approximate Duration of Growth Stages for Various Field Crops

Crops	Initial Stage	Crop Developme nt Stage	Mid Season Stage	Late Season Stage	Total	Remarks
Maize (grain)	20	30	30	25	105	*UNVDA hearing
Beans	20	30	50	20	120	*UNVDA hearing
Paddy	30	30	45	30	135	*UNVDA hearing
Poteto	20	25	25	20	90	*UNVDA hearing
Tomato	30	30	40	20	120	*UNVDA hearing
JamJam	N.A.	N.A	N.A.	N.A	N.A.	

Source : FAO Irrigation and Drainage Paper No.24, 56, "Crop evapotranspiration", published 1998

## **Crop Factor (Kc)** Values of the Crop Factor (Kc) for Various Crops and Growth Stages

Crops	Initial Stage	Crop Developme nt Stage	Mid Season Stage	Late Season Stage	Remarks
Maize (grain)	0.45	0.75	1.05	0.55	*FAO24 p.60, 61
Beans	0.47	0.74	1.00	0.45	*FAO24 p.60, 62
Paddy	1.10	1.10	1.05	0.95	*FAO24 p.71。但し、 Late season 後半は 0.95から大幅に減少 し、0.35と仮定した。
Poteto	0.47	0.76	1.05	0.70	*FAO24 p.60, 61
Tomato	0.47	0.76	1.05	0.60	*FAO24 p.60, 62
JamJam	0.47	0.74	1.00	0.45	同期間に育成可能 で、必要水量の少な いBeansと同等とみ なした。

### <u>3. Kc per month</u>

Maize													
Month	1st Month		2nd Month		3rd Mo	onth	4th M	Month			5th Mo	nth	
Groth Stage	5 10 15 20	25 30	5 10 15 20	25 30	5 10 15	20 25 30	5 10 15	20 25 3	0 5	10	15	20	25 30
Groth Duration	20		30		30		25						
Kc per Groth stage	0.45		0.75		1.05		0.55						
	$\leftarrow \rightarrow$	$\longleftrightarrow$	<>	$\leftrightarrow$	←	$\rightarrow \longleftrightarrow$	$\longleftrightarrow$						
Calculation I	20/30*0.45	10/30*0.75	20/30*0.75	10/30*1.05	20/30*1.05	10/30*0.55	15/30*0.55						
	а	b	а	b	а	b	а						
Calculation II	(20/30*0.45+10/3	0*0.75)	(20/30*0.75+10/30	)*1.05)	(20/30*1.05+1	.0/30*0.55)	(15/30	0*0.55)					
Kc per month (a+b)	0.55 0.85				0.88		0.	28					

#### Paddy

Month	1st Month	2nd Month	3rd Month	4th Month	5th Month
Groth Stage	5 10 15 20 25 30	5 10 15 20 25 30	5 10 15 20 25 30	5 10 15 20 25 30	5 10 15 20 25 30
Groth Duration	30	30	45	15	15
Kc per Groth stage	1.1	1.1	1.05	0.95	0.35
	$\longleftrightarrow$	$\longleftrightarrow$	<>	$\longleftrightarrow$	$\leftarrow \rightarrow$
Calculation I	30/30*1.1	30/30*1.1	30/30*1.05	15/30*1.05 15/30*0.95	15/30*0.35
	а	а	а	a b	a
Calculation II	(30/30*1.1)	(30/30*1.1)	(30/30*1.05)	(15/30*1.05+15/30*0.95)	(15/30*0.35)
Kc per month (a+b)	1.1	1.1	1.05	1.00	0.18

#### Beans (Redbeans/Blackbeans)

Month			lst Mo	nth				2nd Month							3rd M	onth					4	th Mo	onth					:	5th M	onth		
Groth Stage	5	10	15	20	25	- 30	5	10	15	20	25	30	5	10	15	20	25	30		5	10	15	20	2:	5 30	)	5	10	15	20	25	30
Groth Duration		20					30	)							50	)							20	)								
Kc per Groth stage		0.47					0.7	4							1.0	)							0.4	15								
	Ļ			<b>→</b>	$\leftarrow$	+	$\leftarrow$			$\rightarrow$	<u> </u>	Ļ	←					Ŷ	$\leftarrow$		$\times$					>						
Calculation I		20/30*(	0.47		10/30*	0.74		20/30	*0.74		10/30	*1.00			30/303	1.00			10/3	0*1.0	00	1	20/30°	*0.45	5							
		а			b			ź			b				a					a			b									
Calculation II	(	(20/30*	0/30*0.47+10/30*0.74) (20/30*0.74+10/			10/30	*1.00)				(30/30*	1.00)				(10	/30*1	.00+2	20/30*	*0.45	5)											
Kc per month (a+b)	0.56 0.83		3					1.0	)						0.63	3																

#### Poteto

Month	1st Month		2nd	Month		3rd Month	n			4th Mo	onth				5th N	íonth	
Groth Stage	5 10 15 20	0 25 30	5 10 1	5 20 25 30	5 10	15 20	0 25 3	0 5	5 10	15	20	25	30 .	5 10	15	20	25 30
Groth Duration	20		25	25		1	20										
Kc per Groth stage	0.47		0.76	1.05		(	0.7										
	<→	$\leftarrow \rightarrow$	<del>&lt;</del> :	×	$\rightarrow$	<		≯									
Calculation I	20/30*0.47	10/30*0.76	15/30*0.76	15/30*1.05	10/30*1.05	20/3	30*0.7										
	a	b	а	b	а		b										
Calculation II	(20/30*047+10/30	0*0.76)	(15/30*0.7	5+15/30*1.05)	(10/3	0*1.05+20/3	30*0.7)										
Kc per month (a+b)	0.57		0	.91		0.82											

#### Tomato

Month			lst l	Month					2n	d Mo	nth					3rd I	Mont	th					4	th M	onth				5	th M	onth		
Groth Stage	5	10	1:	5 20	25	30	5	- 10	)	15	20	25	- 30	5	10	15		20	25	- 30	4	5	10	15	20	2	5 30	) 5	10	15	20	25	30
Groth Duration				30						30								40							20	)							
Kc per Groth stage			0	).45						0.75								1.15							0.	8							
	ł					ł	$\leftarrow$						ļ	Ļ						¥	Ţ		×				Ţ	•					
Calculation I			30/3	0*0.45					30	/30*(	).75					30/3	)*1.1	15			10/3	0*1.1	5		20/30	*0.8							
	a a								a					a			b																
Calculation II	(30/30*0.45) (30/30*0.75)						(30/3	)*1.:	15)				(10	/30*	1.15+	20/30°	*0,8)	)															
Kc per month (a+b)	th (a+b) 0.45					0.75						1.	15							0.92	2												

## 4. Irrigation efficiency

migunen ennene) (2P		0.2001	
a. Conveyance Efficier	ncy (Ec)		
Continuous supply w	vith no substantial change in	flow	0.9
Rotational supply in	projects of 3000 - 7000 ha a	and rotation areas of 70 - 300 ha,	
with effective mana	agement		0.8
Rotational supply in	large schemes (> 10000 ha)	based on predatormined schedule	0.7
and		based on predetermined schedule	0.7
small schemes (< 10	00ha) with respective	based on advance request	0.65
b. Field Canal Efficien	cy (Eb)		
		unlined	0.8
BROCKS larger than 2	to na:	lined or piped	0.9
Diastra yra ta 20 hay		unlined	0.7
Blocks up to 20 ha:		lined or piped	0.8
c. Distribution Efficier	ncy (Ed = Ec * Eb)		
Average for rotation	al supply with management	adequate	0.65
Average for rotations	al supply with management	sufficient	0.55
anu		insufficient	0.4
communication		poor	0.3
d. Field Application E	fficiency (Ea)		
	light soils		0.55
	medium soils		0.7
	heavy soils		0.6
Surface methods	graded border	0.60 - 0.75	0.53
Surface methods	basin and level border	0.60 - 0.80	0.58
	contour ditch	0.50 - 0.55	-
	furrow	0.55 - 0.70	0.57
	corrugation	0.50 - 0.70	-
Subsurface		up to 0.80	_
	hot dry climate	0.6	-
Sprinkler	moderate climate	0.7	0.67
	humid and cool	0.8	-
Rice			0.32

Irrigation efficiency (Ep) = Ea\*Eb\*Ec=0.32\*0.8\*0.9=0.2304

Reference: FAO Irrigation and Drainage Paper 24 (Revised 1977) Crop Water Requirements

### 5. Eto Penman Montieth

Table Crop Evapotranspiration

Method: Penman-Montieth equation Place: Ndop									Longitud Latitude Altitude	e: :	10 0 1,160	) E° 5 N° ) m above	sea level		
Data and elements		Unit	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	_
			1	2	3	4	5	6	7	8	9	10	11	12	
1. Monthly average daily maximum temprature	Tmax	°C	29.2	30.5	29.6	28.0	26.7	25.7	24.7	24.8	25.2	25.9	27.2	28.4	
2. Monthly average daily minimum temprature	Tmin	-C	14.7	15.9	17.2	17.5	17.0	16.4	16.2	16.7	16.0	16.2	15.3	14.3	
3. Wind speed	uz	m/sec	1.30	1.60	1.60	1.40	1.20	1.10	1.10	1.00	1.10	1.20	1.30	1.20	
4. Mean relative humidity	RHmean	%	61.0	60.0	64.0	70.0	71.0	73.0	74.0	74.0	74.0	72.0	68.0	63.0	
5. Sunshine hour	n	hour	7.8	8.0	6.8	6.5	6.8	5.8	4.5	4.3	4.6	5.8	7.5	8.2	_
Parameters															
Mean monthly temprature	Tmean	°C	22.0	23.2	23.4	22.8	21.9	21.1	20.5	20.8	20.6	21.1	21.3	21.4	
Slope of saturation vapour pressure curve	$\Delta$	kPa/° C	0.16	0.17	0.17	0.17	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.16	$\Delta = 4098*(0.6108*EXP((17.27*T)/(T+237.3)))/(T+237.3)2$
Altitude [atmospheric pressure]	Р	kPa	88.3												P=101.3*((293-0.0065z)/293) <sup>5.26</sup>
Latitude [radian]	φ	rad	0.1												
Psychrometric constant	γ	kPa/° C	0.059	-											γ=0.665/1000*P
Hight of wind speed measurement	z	m	10												
Windspeed at 2 m above ground surface	u <sub>2</sub>	ms	0.97	1.20	1.20	1.05	0.90	0.82	0.82	0.75	0.82	0.90	0.97	0.90	u2=uz*4.87/ln(67.8z-5.42)
1+0.34u <sub>2</sub>			1.33	1.41	1.41	1.36	1.31	1.28	1.28	1.25	1.28	1.31	1.33	1.31	
$\Delta/(\Delta + \gamma * (1 + 0.34 * u_2))$			0.67	0.68	0.68	0.68	0.68	0.67	0.66	0.67	0.67	0.67	0.66	0.67	
$\gamma/(\Delta + \gamma^*(1+0.34^*u_2))$			0.25	0.23	0.23	0.24	0.25	0.26	0.26	0.26	0.26	0.26	0.25	0.25	
$(900/(1 \text{ mean} \pm 273)^* \text{u}_2)$			2.97	3.04	3.03	5.19	2.74	2.32	2.32	2.29	2.32	2.15	2.97	2.74	
Vapour pressure dericit	(Company)	l-D-a	4.05	4 27	4.15	2 70	2 50	2 20	2.11	2 12	2 21	2.24	2 61	2 07	
Saturation vapour pressure for Thiax	e <sup>o</sup> (Tmin)	kra kPo	4.05	4.57	4.13	2.00	1.04	1.87	5.11	1.00	3.21	3.34	1.74	3.67	$e^{(1)=0.6108*EXP((17.27*1)/(1+257.3))}$
Saturation vapour pressure	es (Thimi)	kPa	2.86	3.00	3.05	2.00	2 72	2.58	2.48	2.52	2.51	2.50	2.67	2 75	$ee = (e^{0}(Tmax) + e^{0}(Tmin))/2$
Actual vapour pressure	ea	kPa	1 24	1.32	1 49	1.63	1 59	1.57	1.55	1 59	1.55	1.53	1 40	1 24	ea=Rhmean/(30/e <sup>o</sup> (Tmax))+70/e <sup>o</sup> (Tmin))
Vapour pressure deficit	es-ea	kPa	1.62	1.77	1.56	1.26	1.13	1.02	0.92	0.92	0.97	1.06	1.27	1.51	en runnens(sore (runs) - ore (runs))
Radiation															
Number of the day in the year	J	days	15	45	76	106	137	167	197	228	258	289	319	349	J=INT (30.4*Month,i-15)
Inverse relative distance Earth-Sun	dr	rad	1.032	1.024	1.009	0.992	0.977	0,968	0,968	0.977	0.991	1.009	1.023	1.032	dr=1+0.033*COS(2*PI()*J/365)
Solar declination	δ	rad	-0.37	-0.24	-0.03	0.17	0.34	0.41	0.37	0.23	0.04	-0.18	-0.33	-0.41	δ=0.409*SIN(2*PI()*J/365-1.39)
Sunset hour angle	ωs	rad	1.530	1.546	1.567	1.589	1.608	1.616	1.612	1.596	1.575	1.552	1.534	1.525	$\omega s=ACOS((-TAN(\phi)*TAN(\delta)))$
$sin(\phi)sin(\delta)$			-0.038	-0.024	-0.003	0.018	0.035	0.041	0.038	0.024	0.004	-0.018	-0.034	-0.041	
$\cos(\phi)\cos(\delta)$			0.927	0.967	0.994	0.980	0.939	0.913	0.927	0.968	0.994	0.979	0.939	0.913	
Extraterrestial radiation	Ra	MJm <sup>2</sup> day <sup>1</sup>	33.7	35.7	37.5	37.6	36.5	35.6	35.9	36.9	37.3	36.0	34.1	32.9	$Ra=24*60/\pi^*Gsc^*dr^*(\omega s^*sin(\psi)sin(\delta)+cos(\psi)cos(\delta)sin())$
Maximum possible duration of daylight hours	N	hours	11.7	11.8	12.0	12.1	12.3	12.3	12.3	12.2	12.0	11.9	11.7	11.7	
Solar radiation	Rs	MJm <sup>2</sup> day <sup>1</sup>	19.66	21.04	20.01	19.45	19.21	17.28	15.54	15.74	16.43	17.83	19.42	19.82	Rs=(0.25+0.5*n/N)*Ra
Clear-sky solar radiation	Rso	MJm <sup>2</sup> day <sup>2</sup>	26.05	27.63	28.97	29.05	28.20	27.55	27.77	28.55	28.80	27.87	26.34	25.46	Rso=(0.75+2*(Altitude)/100000)*Ra
Net solar radiation	Rns	MJm "day "	15.14	16.20	15.41	14.98	14.79	13.30	207.0	12.12	12.65	13.73	14.95	15.26	Rns=(1-0.23)*Rs
Monthly average daily maximum temprature	Tmax	K V	302.4	203.7	302.8	200.7	299.9	298.9	297.9	298.0	298.4	299.1	200,4	301.0	$1 \max(K) = 1 \max(C) + 273.16$
$\pi^{T}$ may $V^{2}$	1 111111	MIm <sup>2</sup> dav <sup>1</sup>	207.9	41.7	41.2	40.7	290.2	209.0	209.4	209.9	209.2	209.4	200.5	207.5	1  mm(K) = 1  mm(-C) + 273.16
$\alpha$ Tmin K <sup>2</sup>		MIm <sup>2</sup> day <sup>1</sup>	33.7	34.2	34.9	35.0	34.8	34.5	34.4	34.6	34.3	34.4	33.9	33.5	
$(\sigma T \max K4 + \sigma T \min K4)/2$		within any	37.3	38.0	38.0	37.7	37.2	36.8	36.5	36.6	36.6	36.8	36.9	37.0	
0 34-0 14*√ea			0.18	0.18	0.17	0.16	0.16	0.16	0.17	0.16	0.17	0.17	0.17	0.18	
1.35*Rs/Rso-0.33			0,67	0,68	0,58	0.55	0.57	0,50	0.41	0.39	0.42	0.51	0.65	0.70	
Net longwave radiation	Rnl	MJm <sup>2</sup> day <sup>-1</sup>	4.6	4.6	3.7	3.4	3.5	3.0	2.4	2.4	2.5	3.1	4.2	4.8	Rnl=o(Tmax,K4+Tmin,K4)/2*(0.34-0.14*√ea)(1.35*Rs/Rso-0.35)
Net radiation	Rn	MJm <sup>2</sup> day <sup>1</sup>	10.5	11.6	11.7	11.6	11.3	10.3	9.5	9.8	10.1	10.6	10.8	10.5	Rn=Rns-Rn1
Soil heat flux	G	MJm <sup>2</sup> day <sup>1</sup>	0.08	0.18	0.03	-0.09	-0.13	-0.11	-0.08	0.04	-0.02	0.06	0.03	0.01	Gmonth,i=0.014*(Tmonth,i-Tmonth,i-1)
Rn-G		MJm <sup>2</sup> day <sup>1</sup>	10.46	11.41	11.64	11.71	11.45	10.40	9.60	9.72	10.13	10.51	10.77	10.47	
0.408*(Rn-G)		mm/day	4.27	4.65	4.75	4.78	4.67	4.24	3.92	3.97	4.13	4.29	4.39	4.27	*0.408
$(\Delta/(\Delta+\gamma^*(1+0.34u_2)))^*(0.408(Rn-G))$			2.87	3.14	3.22	3.24	3.16	2.85	2.60	2.66	2.75	2.86	2.92	2.86	
$(\gamma/(\Delta+\gamma^*(1+0.34u_2)))^*(900/(T+273))^*u_2(es-ea)$			1.18	1.49	1.30	0.95	0.77	0.66	0.61	0.55	0.64	0.74	0.95	1.05	
Grass reference evapotranspiration	ETo	mm/day	4.05	4.63	4.52	4.19	3.93	3.51	3.21	3.22	3.39	3.60	3.87	3.91	-
		mm/month	126	130	140	126	122	105	100	100	102	112	116	121	
Source + E40 Invication and Dusinger Depart No. 56 "Cu		nination" nub	lichad 1000											. 1209 07	-

Source : FAO Irrigation and Drainage Paper No.56, "Crop evapotranspiration", published 1998

mm/year 1398.07

## 7. List of Drawings (Irrigation Component)

Title	Nos	Page
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		39,40
Tractor Passage	1	A-41
Farm Road Crossing	2	A-42, 43
Irrigation Canal	1	A-44
Bridge	2	A-45, 46, 47, 48



RASTRUCTURE IMPROVEMENT PROJECT			
	SCALE	APPROVED BY	SERIAL NO.
GENERAL PLAN			



A-31









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- 1158.798	1158.719 1158.701 1157.201	- 1157.157 +	- 1157.101	1157.045	1156.989	- 1156.932	- 1156.876	- 1156.820 -	
1159.418	1159.325	1159.160	1159.252 -	1159.696	1159.012	1158.873	1158.933	1158.992	
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	SCALE	APPROVED BY	SERIAL NO.
MAIN DRAINAGE 4 PLAN AND PROFILE			
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## Tractor Passage



**TREE NTC INTERNATIONAL CO., LTD.** 

NOTE: Construction of Tractor Passage Type F @20m along Farm Road in upstream area.

PROJECT TITLE	DATE	DESIGNED BY	DWG NO.
			1
RURAL INFRASTRUCTURE IMPROVEMENT PROJECT			
DWG. TITLE	SCALE	APPROVED BY	SERIAL NO.
TRACTOR PASSAGE	1:100		



Farm Road Crossing Type C Farm Road Crossing Type D Farm Road Crossing Type E Fa C W2.0xH2.0 W2 (Double) (D W1.0xH1.5 W2.0xH1.0 W2.0xH1.5 W2.0xH2.0

Cross Section A-A



A-42

rm Road	Farm Road
rossing	Crossing
Гуре F	Type G
2.5xH2.5	W2.5xH2.5
Double)	(Triple)



PROJECT TITLE	DATE	DESIGNED BY	DWG NO.
RURAL INFRASTRUCTURE IMPROVEMENT PROJECT			
DWG. TITLE	SCALE	APPROVED BY	SERIAL NO.
Farm Road Crossing Type A~G	1:100		







Cross Section



<b>MINISTRY OF AGRICULTURE AND RURAL DEVELOPMEN</b>	T	PROJECT TITLE	DATE	DESIGNED BY	DWG NO.
		RURAL INFRASTRUCTURE IMPROVEMENT PROJECT			
	-	DWG. TITLE	SCALE	APPROVED BY	SERIAL NO.
STITE NTC INTERNATIONAL CO., LTD.		Farm Road Crossing Type H~I	1:100		

Farm Road	Farm Road
Crossing	Crossing
Type H	Type I
D800	D1000

## Cross Section A-A



## Irrigation Canal



	Irrigation Type A	Irrigation Type B
B:	0.4	0.5
B':	0.66	0.76
H:	0.4	0.5
H':	0.53	0.63
b:	0.86	0.96



Cross Section A-A



<b>MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT</b>	REVISION	PROJECT TITLE
		RURAL INF
JICA JAPAN INTERNATIONAL COOPERATION AGENCT		DWG. TITLE
TTC INTERNATIONAL CO., LTD.		

![](_page_47_Figure_8.jpeg)

![](_page_48_Figure_0.jpeg)

![](_page_49_Figure_0.jpeg)

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1

![](_page_50_Figure_0.jpeg)

![](_page_50_Figure_1.jpeg)

ABUTMENT SECTION

![](_page_50_Figure_3.jpeg)

MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT	REVISION	
		RURAL INF
JAPAN INTERNATIONAL COOPERATION AGENCY		DWG. TITLE
TTE NTC INTERNATIONAL CO., LTD.		1

![](_page_50_Figure_6.jpeg)

![](_page_51_Figure_0.jpeg)

		-			
MINISTRY OF AGRICULTURE AND RURAL DEVELOPMEN MINISTRY OF AGRICULTURE AND RURAL DEVELOPMEN JAPAN INTERNATIONAL COOPERATION AGENCY	JT REVISION	PROJECT TITLE RURAL INFRASTRUCTURE IMPROVEMENT PROJECT DWG. TITLE BRIDGE No.2 (2/2)	DATE	DESIGNED BY APPROVED BY	DWG NO. SERIAL NO.