

(DRAFT)

**Summary of Final Report
On JICA Sorghum Project¹²**

September 24, 2019

Applied Natural Products Co., Ltd.

¹ Official name of the project is entitled "Dissemination and Verification Project relating to Sorghum Cultivation, Silage Production and Its Sale in Cambodia".

² This document has been prepared as the last report to the Third Operating Committee of JICA Sorghum Project, to be held on October 10, 2019. All descriptions in this report, which are based on the draft of final report of the Project as of September 17, 2019. A number of descriptions may be modified or new description may be added to reflect any changes in the final report. The updated report is due to be dispatched to the parties concerned of JICA Project, after the final report of the Project is submitted to JICA headquarters in October 2019.

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1. Development Challenges

This JICA project is aiming at exercising dissemination and verification activities relating to sorghum cultivation, silage production and its sale in Cambodia. Silages are made of sweet sorghum ("Sorghum") and are designed as cattle feed (fermented feed) especially for the use in dry season when feed shortage become serious. As a matter of fact, neither sorghum cultivation nor silage production have not been recognized and undertaken in Cambodia.

This project is composed of the following operations: (A) Sorghum cultivation; (B) Production of roll-bale silages, and (C) Trial sale. Whether or not this project can be successful is heavily dependent on the performance of sorghum cultivation except for silage sale. Thus, basic nature of this project can be described as "agriculture business", though its contribution is assumed to make for livestock industry.

Since there exist no silage producers in Cambodia and nobody has a fair knowledge of sorghum and silage, it is so important to conduct various knowledge/know-how dissemination activities introducing sorghum to local farmers. Therefore, trial sale means that through workshop, seminar or field school held for local farmers, basic information is required to give them and the limited number of farmers who show their interest in using silage tentatively may become potential purchasers.

Currently, Cambodian livestock industry accounts for 10 percent of Agriculture GDP and accounts for 3 percent of national GDP. Because of potential economic growth, it is expected that meat and milk consumption may continue to have rapid increase in years to come. Cambodian government has placed the development of livestock industry in the priority list of national policies. On the other hand, having looked at the reality of the industry, there are non-negligible obstacles which make it difficult to grow. Among them, the matter of feed shortage in dry season has been pointed out by scholars and practitioners.

In the light of the above considerations, this project is going to provide a solution to the issue of feed shortage with which many livestock farmers have faced for many years.

2. Outline of Business

2.1 Business Purposes

Main aims of this project are, amongst others, to test the possibility and effectivity of sorghum cultivation, silage production in Battambang and trial sale across the country.

2.2 Assumed Effects

Assumed effects of this project is:

- (A) to confirm the effective way of sorghum cultivation and silage promotion;
- (B) to find out the good way of dissemination of silage knowledge; and
- (C) to make a policy recommendation to the MAFF on subject matter of this project.

2.3 Implementation

✓ Assumed effect (A) comes out from the following activities:

- 1) Making sorghum cultivation plan;
- 2) Holding a cultivation preparatory meeting prior to start of field operation;
- 3) Undertaking sorghum cultivation;
- 4) Undertaking silage production;
- 5) Conducting feeding test; and
- 6) Making the manual of sorghum cultivation, silage production and sale.

✓ Assumed Effect (B) comes out from the following activities:

- 1) Making market survey re sorghum cultivation;
- 2) Making market survey to find out potential purchasers;
- 3) Making analysis of market demands and silage sales price;
- 4) Holding a seminar on sorghum cultivation and silage production;
- 5) Conducting market survey relating to existing feeds and their supply chain as well as analysis of possible value chain of silages;
- 6) Considering the effective way of silage sales promotion; and
- 7) Considering establishment of economic entity to succeed JICA project.

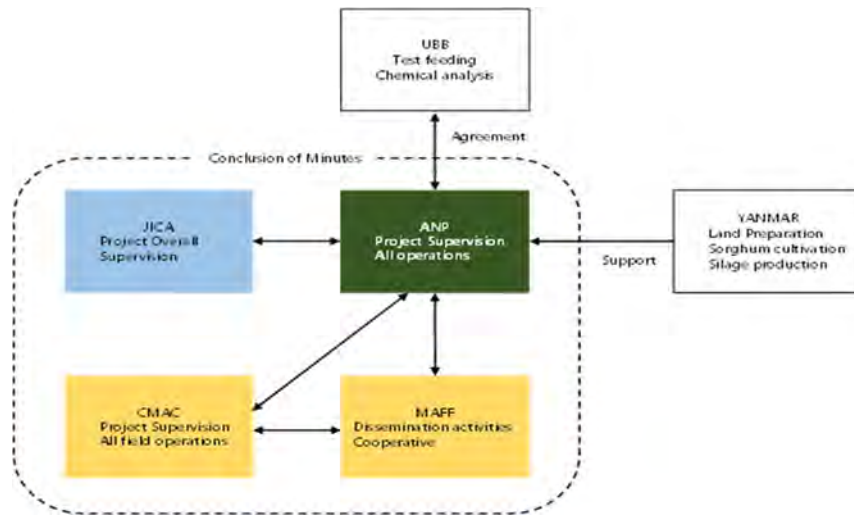
2.4 Applied Agricultural Machineries

See the list of agricultural machineries used for JICA project, PP 9-11 of this report.

2.5 Implementation System

Following diagram 1 shows team members of this project and their respective function allocated by the project.

Diagram 1: Project Formation



(Source) sorghum project team

3. First Year’s Business Performance

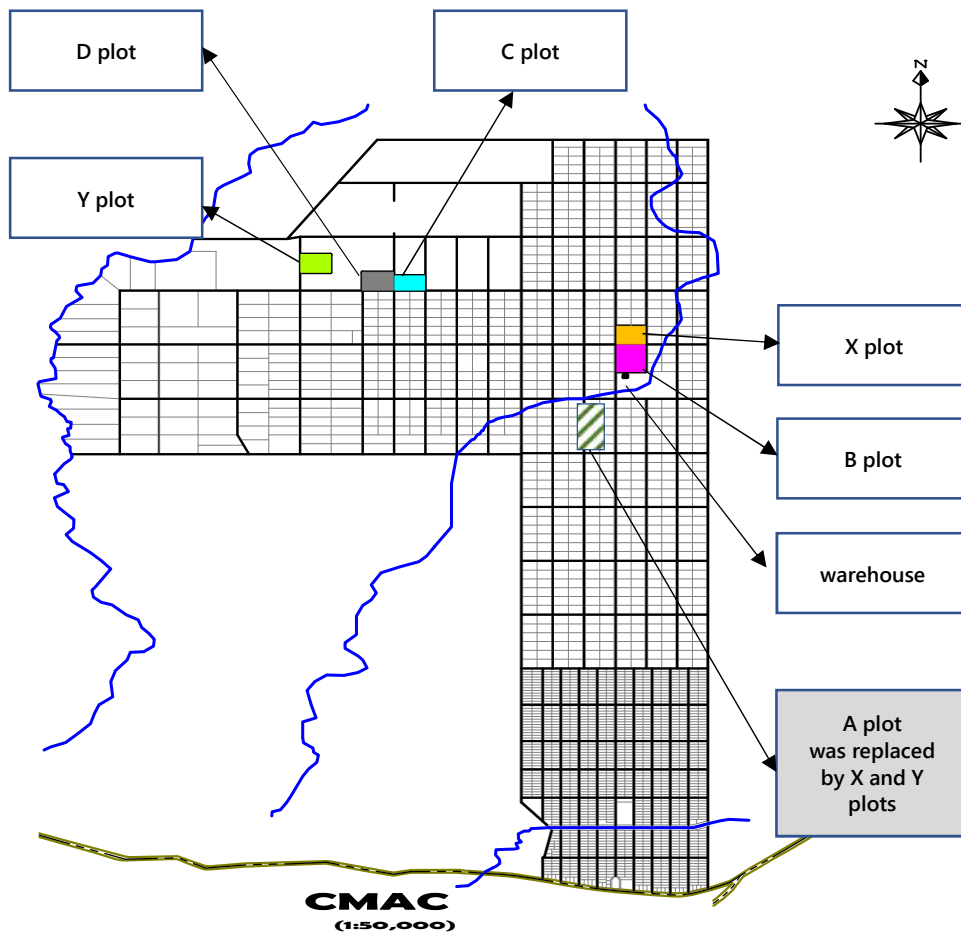
3.1 Cultivation Land

Total area of cultivation land is 20.06 ha, net of which is 16.12 ha. The remaining 3.94 ha is specifically designed for the use of efficient movement of vehicles in the field.

As indicated Diagram 2, below, A plot, which was originally allocated for the use of JICA project since its location is close to the warehouse, was replaced by X and Y plots, prior to the commencement of cultivation, because some parts of these fields were badly drained and indeed, partially flooded with a heavy rainfall.

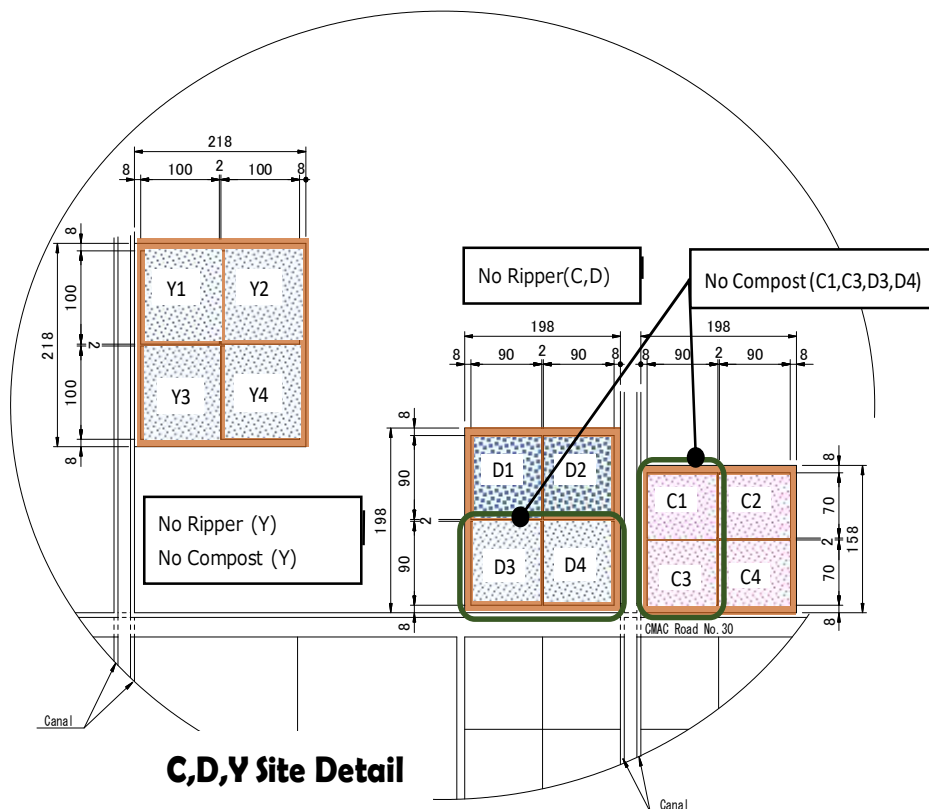
Because of experimental nature of JICA project, each plot was differently designed. For instance, ripper operation was made in some plots to improve their drainage and air flow in the ground and some were not made for analytical comparison. Furthermore, compost was applied to some plots and the remaining plots were not applied.

Diagram 2: Location of Each Plot in the CMAC CDC



(Source) sorghum project team

Diagram 3: Detailed information of C, D, Y Plots



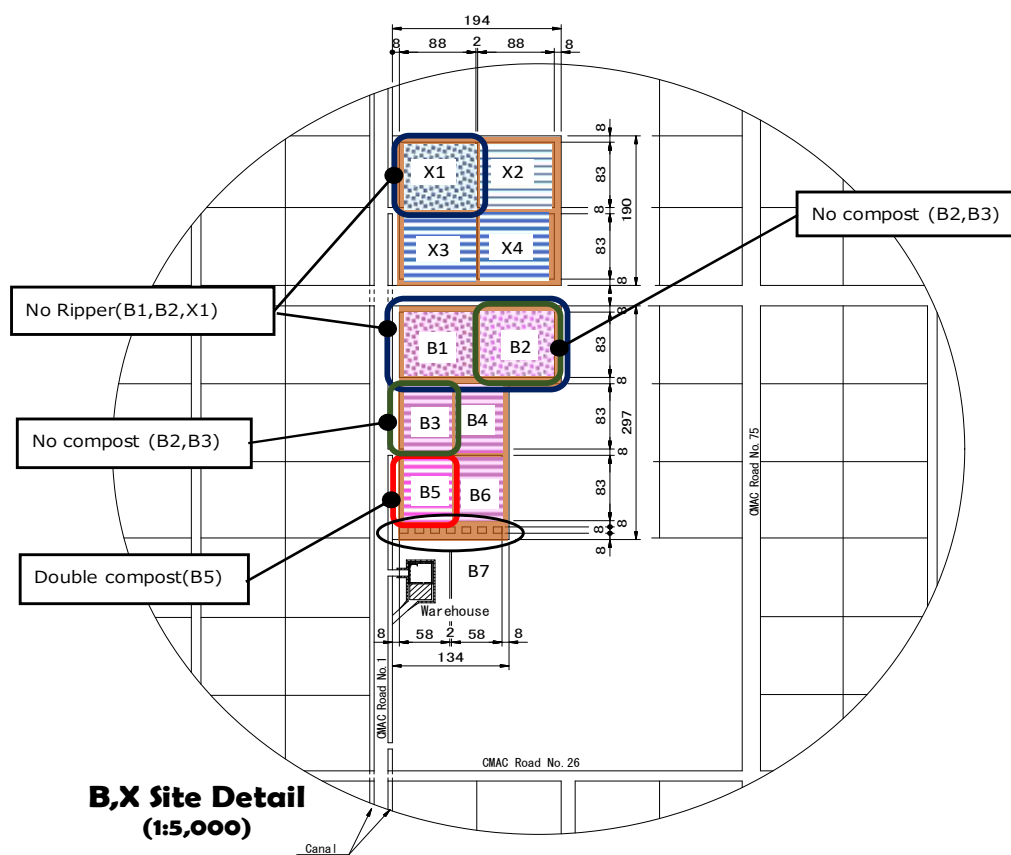
C,D,Y Site Detail

Field design

	Field No.														
	Y1	Y2	Y3	Y4	Y	C1	C2	C3	C4	C	D1	D2	D3	D4	D
Field size (ha)					4.75					3.13					3.92
Cultivated area (ha)	1.00	1.00	1.00	1.00	4.00	0.63	0.63	0.63	0.63	2.52	0.81	0.81	0.81	0.81	3.24
Ripper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Compost	-	-	-	-	-	-	✓	-	✓	-	✓	✓	-	-	-
Compost (t)	-	-	-	-	-	-	14.4	-	14.4	28.8	18.4	18.4	-	-	36.8
(t/ha)	-	-	-	-	-	-	23.0	-	23.0	-	23.0	23.0	-	-	-
Seed (kg)-0050	14.7	14.7	14.7	14.7	58.8						16.2	16.2	8.1	8.1	48.6
-othre						9.3	9.3	9.3	9.3	37.2					
Basal fertilizer															
20-20-15+TE (t)	0.20	0.20	0.20	0.20	0.80	0.175	0.175	0.175	0.175	0.70	0.20	0.20	0.20	0.20	0.80
(t/ha)	0.20	0.20	0.20	0.20	-	0.28	0.28	0.28	0.28	-	0.25	0.25	0.25	0.25	-
UREA (t)	0.10	0.10	0.10	0.10	0.40	0.10	0.10	0.10	0.10	0.40	0.10	0.10	0.10	0.10	0.40
(t/ha)	0.10	0.10	0.10	0.10	-	0.16	0.16	0.16	0.16	-	0.12	0.12	0.12	0.12	-
Topdressing															
UREA (t)	0.10	0.10	0.10	0.10	0.40	0.10	0.10	0.10	0.10	0.40	0.10	0.10	0.10	0.10	0.40
(t/ha)	0.10	0.10	0.10	0.10	-	0.16	0.16	0.16	0.16	-	0.12	0.12	0.12	0.12	-

(Source) sorghum project team

Diagram 4: Detailed information of B plot and X plot



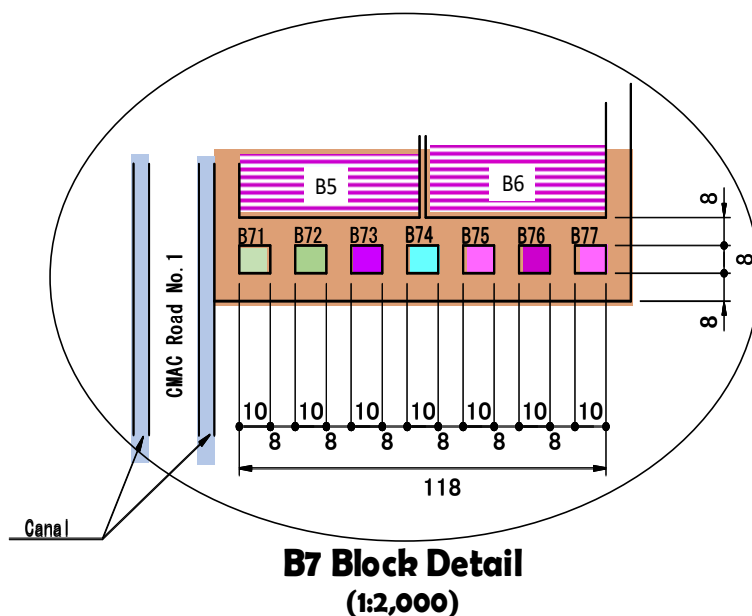
**B,X Site Detail
(1:5,000)**

Field design

	Field No.														Total
	B1	B2	B3	B4	B5	B6	B7	B	X1	X2	X3	X4	X		
Field size (ha)								4.57						3.69	20.06
Cultivated area (ha)	0.73	0.73	0.48	0.48	0.48	0.48	0.06	3.44	0.73	0.73	0.73	0.73	2.92	16.12	
Ripper	-	-	✓	✓	✓	✓	✓		-	✓	✓	✓	✓		
Compost	✓	-	-	✓	✓	✓	✓		✓	✓	✓	✓	✓		
Compost (t)	9.6	-	-	6.0	20.8	10.4	2.4	49.2	16.8	16.8	16.8	16.8	67.2	182.0	
(t/ha)	13.0	-	-	13.0	43.0	22.0	43.0	-	23.0	23.0	23.0	23.0	-	-	
Seed (kg) - 0050									10.7	10.7	21.5	21.5	64.4	171.8	
- othre								67.6						104.8	
- othre							1.0	1.0						1.0	
Basal fertilizer															
20-20-15+TE (t)	0.20	0.20	0.13	0.13	0.13	0.13	0.03	0.93	0.20	0.20	0.20	0.20	0.80	4.03	
(t/ha)															
UREA (t)	0.10	0.10	0.05	0.05	0.05	0.05	0.05	0.45	0.10	0.10	0.10	0.10	0.40	2.05	
(t/ha)	0.14	0.14	0.10	0.10	0.10	0.10	0.89	-	0.14	0.14	0.14	0.14	-	-	
Topdressing															
UREA (t)	0.10	0.10	0.05	0.05	0.05	0.05	0.05	0.45	0.10	0.10	0.10	0.10	0.40	2.05	
(t/ha)	0.14	0.14	0.10	0.10	0.10	0.10	0.89	-	0.14	0.14	0.14	0.14	-	-	

(Source) sorghum project team

Diagram 5: Detailed information of B-7 plot
(cultivation test of different crops)



B7 Block							
	B71	B72	B73	B74	B75	B76	B77
Cultivated area (ha)	0.008	0.008	0.008	0.008	0.008	0.008	0.008
breed	corn1	corn2	0070	Sudan	sorgo1	sorgo2	sorgo3
Seed (kg)	0.08	0.08	0.08	0.08	0.08	0.08	0.08

(Source) sorghum project team

3.2 Warehouse

A warehouse (see P.10, photos) was constructed in June 2018, in the CMAC CDC, as the base of the entire operations of silage production business, which includes silage making, storage of silages and storage of machineries.

Size of warehouse is 750m² (25m×30m) with a parking space (about 500m²) in front of warehouse, which was used as a parking lot of machines/trucks and occasionally as a place of agricultural inputs. In addition, as for silage sale to the purchasers, silage weight was normally measured within the warehouse and silage loading on trucks was made in the parking space. The following photos show the overall appearance of the warehouse and a scene of loading a truck with silages which were put in a flexible container bag:



(Source) sorghum project team

3.3 Import of Agricultural Machineries

The following machines were procured³ through KNG (local machinery dealer) from Japan and other countries and supplied to JICA project. KNG has had no difficulties or obstacles in so doing getting support from the government. Among these machines which have brought into Cambodia, it is to note that silage production and its related machines were introduced for the first time in Cambodia, which include (1) Roll Baler, (2) Lapping Machine, (3) Roll Grab.

The following is the list of machines used for cultivation and silage production:

(Cultivation)

- 1) Ripper (1)
- 2) Manure Spreader (attached to tractor) (1)
- 3) Power harrow (attached to tractor) (1)
- 4) Disc plow (attached to tractor) (1)

³ Agricultural machineries were procured by bidding which was undertaken in Phnom Penh in cooperation with JICA Cambodia. Furthermore, warehouse was constructed by the local construction company, a winner of bidding which was made separately.

- 5) Sowing machine (attached to tractor) (1)
- 6) Boom sprayer (attached to tractor) (1)
- 7) Forage harvester (attached to tractor) (1)
- 8) Broadcaster (attached to tractor) (1)
- 9) Tractor (4)

(Note) Number within bracket shows the number of machines to introduce.

(Silage Production)

- 1) Wheel loader (1)
- 2) Roll Baler (1)
- 3) Lapping Machine (attached to tractor) (1)
- 4) Roll Grab (1)
- 5) Pallet Fork (1)
- 6) Bucket (1)
- 7) Tine Bucket (1)
- 8) Counter Weight with Extension (2 set)
- 9) Rear Wheel Weight
- 10) Warehouse (1)

(Note) Number within bracket shows the number of machines to be introduced.

(Roll Baler; harvesting)



(Roll Baler; roll making)



(Lapping Machine)



(Roll Grab)



(Source) sorghum project team

3.4 Training of CMAC Operators

JICA project aims at the realization of mechanized agriculture and sorghum cultivation, taking into account “sustainable” agriculture in Cambodia, in terms of the following:

- (A) Proper operations must be maintained with good operators;
- (B) Maintenance of machineries needs to be essential;
- (C) Mechanized agriculture must be supported with adequate cashflow; and
- (D) Mechanized agriculture needs to have spillover effects on local farmers and rural economy.

In relation to (A) referred to above, operators’ training program was undertaken twice in June (at sowing) and September 2018. Most of training were made, in the form of “on the job training” (“OJT”) in September, at the time of harvest and silage making. Instructors of machineries were dispatched by YANMAR (Japanese machine manufacturer), TAKAKITA (Japanese manufacturer of silage production machines) and KNG (Cambodian supplier of all machines).

CMAC assigned 13 staff as trainees of this training program, half of whom had experience in operating tractor and/or excavator (backhoe). After (A) five days’ OJT training and (B) additional five days’ training over which was kept watch by instructors, it was observed that all trainees quickly learned how to operate them.



(Source) sorghum project team

3.5 Farmers' Field School

Farmers' field school ("FFS") was held on September 1 (Saturday), 2018 in the CMAC CDC, in collaboration with PDA, to invite 10 local farmers located in the adjacent to or near CMAC CDC so as to disseminate basic information on sorghum cultivation and handmade silage production, hoping that some of them may show interest in participating in commercial business (commercial entity to be set up after JICA project ends) of silage production and sale or in "self-sustaining" silage production for their cattle. Actual activities in FFS are as follows:

- 1) Observation of sorghum harvest by machines;
- 2) Lecture on sorghum and sorghum silage;
- 3) Observation of sorghum cutting by simple cutter;
- 4) Participation in production of hand-made silages; and
- 5) Meeting on the subjects of JICA project and farmers' future business chance.

Participants of FFS produced hand-made silages (weight of one bag: 20kg), total amount of which is about one ton and total number of bags is about 50. After sorghum in bag is fully fermented (3-4 week later), these silage bags were equally distributed to each participant.

As for the dissemination of information on sorghum cultivation, silage production and sale, a seminar was hold at UBB in August 2019, for marketing purposes, to invite local livestock companies and farms. Main topics at the seminar were, amongst others: 1) what is sorghum, 2) what is silage, 3) value of silage as cattle feed, 4) chemical analysis of silage, 5) retail price of silage and so forth.

Following photos show main activities of farmers' field school:





(Source) sorghum project team

3.6 Market Survey of Sorghum Silage

Market survey (“UBB survey”) was conducted, in the period of October-December 2018, by UBB to confirm the potential market of sorghum silage, which was indeed the second attempt on this subject after Y2016 Market survey. This survey was made by Royal University of Agriculture (“RUA survey”) in 2016. Major findings of two survey are summarized below and these surveys are closely interrelated:

(A) RUA Survey

RUA comes to the following hypothetical conclusion⁴, based on macro statistical data prepared by MAFF and subordinated institutions and actual information collected, in the form of reply to questionnaire, from livestock farms throughout the country and their analysis. Then, it was suggested that JICA project should look at commercial livestock farms as prime marketing targets, taking into account their financial ability to purchase silages:

⁴ Neang Malyne et al, Livestock (Cattle) Market Survey Report, November 2016

1. Potential market of sorghum silage (commercial farms): USD 2,613,651
2. Potential market of sorghum silage (household): USD 199,287,231
3. Total size of potential market of sorghum silage: USD201,900,882
4. Estimated average cost of feed/head (commercial farms): USD 245.85
5. Estimated average cost of feed/head (household): USD 92.26

(B) UBB Survey

Main aims of UBB Survey are to confirm the current status of livestock market in Cambodia, focusing on the issues of feeds and manure treatment. Based upon analysis and evaluation of official data and information corrected from governmental offices with respect to livestock industry in 25 Provinces in Cambodia, general situation on these topics was observed and 16 relatively large farms were selected from Provinces such as Battambang (6), Siem Reap (5) and Pursat (5) for detailed information gathering in the form of interview based on the questionnaire.

Main findings⁵ are as follows:

1. Most of farms, with which UBB interviewed, have no experience of purchasing feeds in the past. Only one of 16 farms have purchased rice straw and used as supplementary feeds when feed shortage comes out.
2. Although the shortage of cattle feed happens more frequently in dry season. Actual situation on shortage of cattle feed depends on the location of a farm. cattle feed industry has not yet been established in Cambodia.
3. According to an interviewee farm, roughage price is said to be USD 70/t in rainy season and USD 125/t in dry season.
4. In addition, as for the retail price of a number of cattle feeds and cattle manure, it was told by a farm's manager that:
 - ✓ Retail price of corn (without stems and leaves): USD150/t
 - ✓ Retail price of soybeans: USD550/t
 - ✓ Retail price of beer lees: USD70/t
 - ✓ Retail price of rice bran: USD300/t
 - ✓ Retail price of cattle manure (sun drying): USD6-10
5. When interview was made with local livestock farms, a number of interviewee farms showed their interest to purchase sorghum silage after our presentation on sorghum and sorghum silage and further, they wished to participate in the "sorghum silage" workshop which was held at UBB in May, 2019.
6. Based upon the result of interviews, mentioned above, it was fairly observed that there must exist potential purchasers of sorghum silage in Battambang or neighboring

⁵ Dr. Pao Srean, University of Battambang, "Market Survey on Salability of Sorghum Silage in Cambodia", 2018

Provinces which is not distant from our silage production site.

3.7 Results of Sorghum Cultivation and Silage Production

(A) Land allocation, land preparation and sowing

As described earlier, all cultivation lands allocated for JICA project are located in the CMAC CDC, Battambang. Most of these lands were “unused lands” which has no truck record of cultivation in the past and thus, additional preparatory works prior to normal land preparation was required to make with respect to removal of trees and stones.

A number of originally allocated lands (Plot-A) were replaced by new fields (Plot-X and Y) since these were flooded by unexpected heavy rain falls. It was in late May of Y2018 that ordinary soil making (such as leveling, use of ripper, plowing, compost application) and sowing were made with machineries. Initial sowing activity continued by the end of July.

Land preparation 1: landscape of unused land prior to project operations



Land preparation 2: ripper in operation



Land preparation 3: agricultural ripper



Land preparation 4: harrowing



Land preparation 5: compost application



(Source) sorghum project team

(B) Performance of Y 2018 sorghum cultivation

Yield of the first year's cultivation (20 ha. but 16ha net) is about 14t, which is much lower than our initial target. (see: Diagram 6, P. 20), which was 50-70t/ha/p.a. for the first year and 100t/ha/p.a. for the second year. Main reason why 1st year's yield was lower than our expectation may be found in the following facts. Countermeasures must be considered as basic issues to tackle for the second year of the project:

- 1) No rainfall for a certain period after sowing; especially, Plot-C was heavily damaged by (A) shortage of rainfall and (B) no canal water for irrigation near to Plot-C;
- 2) Leveling operation seems to be not enough for cultivation. it seems possible to say that when sowing was made with machine, proper sowing was not undertaken in some places in a number of plots because of irregularity of land, in other words, uneven land condition. Sowing machine did not work properly in these areas.
- 3) "Creepers" made it difficult to harvest; it was not possible to harvest sorghum in Plot-Y because creepers coiled around stems and leaves of sorghum. Indeed, our harvester

was deemed not to have enough power to harvest them under these circumstances, although the growth level of this plot was considered as good. This situation was only observed in Plot-Y.

- 4) Most of cultivation lands are “unused” lands, which may be required to have more efforts for years to make soil improvement, though the project team did reasonable efforts such as using ripper, harrowing and compost application;

(C) Performance of Y2018 silage production

Total amount of produced silage rolls will be 858 rolls and total weight of rolls is 223t ($223t=858 \times 260\text{kag}$). Most of the products were sold, on a trial basis, to a dairy farm located in Phnom Penh, except for 40 rolls that were delivered to UBB for test feeding.

Silage production was made, either within the warehouse or in the cultivation field. When silages are made in the warehouse, all machineries such as roll baler, rapping machine and tractor with roll grab are placed in the warehouse, and silage material which is cut in piece is transported by a dump truck from cultivation field to the warehouse. After silage material is unloaded, this is invested in the input port of roll baler. Roll baler discharges a shaped roll with net within a few minutes and then, a shaped roll is wrapped by wrapping machine. All wrapped rolls are taken and placed by a tractor with roll grab in designated areas, inside or outside warehouse, for storage purposes for at least 3-4 weeks.



(Source) sorghum project team

Diagram 6: performance of 1st year of JICA project

Y2018 Yield and Performance Analysis (as of Jan 24, 2019)																	
plots	size (ha)	Ripper	Compost	Seeds (kg)				Fertilizer (kg)		Number of Rolls Produced (1st crop)		Number of Rolls Produced (2nd crop)		1st +2nd		yield/ha/pa (t)	
				50	big	other	Total	20-20-15	UREA	Number of Rolls	Tons	Number of Rolls	Tons	Total Rolls	Total Yield (t)		
Total X Plot	2.92			64.4			64.4	16.0	8.0	218	56.7	7	1.8	225	58.5	20.0	2
X-1	0.73		✓	10.7				4.0	2.0	72	18.7	0	0.0	72	18.7	25.6	
X-2	0.73	✓	✓	10.7				4.0	2.0	52	13.5	0	0.0	52	13.5	18.5	
X-3	0.73	✓	✓	21.5				4.0	2.0	64	16.6	7	1.8	71	18.5	25.3	
X-4	0.73	✓	✓	21.5				4.0	2.0	30	7.8	0	0.0	30	7.8	10.7	
Total Y Plot	4.00			58.8			58.8	16.0	8.0	80	20.8	0	0.0	80	20.8	5.2	5
Y-1	1.00			14.7				4.0	2.0	2	0.5	0	0.0	2	0.5	0.5	
Y-2	1.00			14.7				4.0	2.0	0	0.0	0	0.0	0	0.0	0.0	
Y-3	1.00			14.7				4.0	2.0	47	12.2	0	0.0	47	12.2	12.2	
Y-4	1.00			14.7				4.0	2.0	31	8.1	0	0.0	31	8.1	8.1	
Total B Plot	3.44				67.6	1.0	68.6	18.5	8.1	183	47.6	18	4.8	201	52.4	15.2	3
B-1	0.73		✓		14.6			4.0	2.0	54	14.0	0	0.0	54	14.0	19.2	
B-2	0.73				14.6			4.0	2.0	31	8.1	0	0.0	31	8.1	11.0	
B-3	0.48	✓			9.6			2.5	1.0	18	4.7	0	0.0	18	4.7	9.8	
B-4	0.48	✓	✓		9.6			2.5	1.0	24	6.2	0	0.0	24	6.2	13.0	
B-5	0.48	✓	✓		9.6			2.5	1.0	32	8.3	6	1.7	38	10.0	17.3	
B-6	0.48	✓	✓		9.6			2.5	1.0	24	6.2	12	3.1	36	9.4	19.5	
B-7	0.06	✓	✓			1.0		0.5	0.1	0	0	0	0	0	0	0	
Total C Plot	2.52				37.2		37.2	14.0	8.0	94	24.4	0	0.0	94	24.4	9.7	4
C-1	0.63				9.3			3.5	2.0								
C-2	0.63		✓		9.3			3.5	2.0	54	14.0	0	0.0	54	14.0	11.1	
C-3	0.63				9.3			3.5	2.0								
C-4	0.63		✓		9.3			3.5	2.0	40	10.4	0	0.0	40	10.4	8.3	
Total D Plot	3.24				48.6		48.6	16.0	8.0	243	63.2	15	3.9	258	67.1	20.7	1
D-1	0.81		✓		16.2			4.0	2.0								
D-2	0.81		✓		16.2			4.0	2.0	116	30.2	0	0.0	116	30.2	18.6	
D-3	0.81				8.1			4.0	2.0								
D-4	0.81				8.1			4.0	2.0	127	33.0	15	3.9	137	36.9	22.8	
Grand Total	16.12			160.4	116.2	1.0	277.6	80.5	40.1	818	212.7	40	10.5	858	223.2	13.8	

(Source) sorghum project team

3.8 Result of Silage Sale

(Rational of Trial Sale)

It would not be a common practice for JICA project to conduct a trial sale of the products in the past. However, our JICA project was decided to make trial sales, since one of main objects of the project clearly includes paving the way for value-chain of the products (sorghum silage), in other words, finding out a potential purchaser in the life of JICA project.

(Looking for Purchasers)

One dairy farm was discovered, in Phnom Penh, as a potential purchaser of sorghum silage. Purchase agreement was concluded, on September 5th, 2018, between ANP on behalf of JICA project and this farm with the following conditions:

- 1) Unit price: USD 60/t; unit price for each year may be changed to reflect a prevailing transportation cost in the market;
- 2) Amount of silage: 1,200t/pa, depending on actual yield;
- 3) Number of rolls: 3,000; depending on actual yield;
- 4) Term: one year (delivery is based on silages produced in Y2018); and

- 5) Renewal of agreement: each year.

(Delivery Procedure)

The following procedure was established and taken at each time of carrying-out from the warehouse:

- 1) To confirm the number of rolls for delivery;
- 2) To conduct quality inspection (quality and outer damage); inspection method is sampling. Inspection of outer damage means an inspection of outer appearance of rolls to find holes or other type of films' damage. Further, quality inspection is made by "direct touching and "direct smelling";
- 3) Issuance of "Carrying-out Inspection Report" (predetermined form) to be signed by CMAC and ANP;
- 4) To make a "Delivery Note" to be signed by the Purchaser to confirm the number of rolls and good condition of silages delivered;
- 5) To issue invoice to the Purchaser based on the Carrying-out Inspection Report and Delivery Note; and
- 6) To transfer the amount described in the Invoice to bank account of JICA project.

(Sales Performance of Y2018)

Diagram 7, described below, shows the performance of trial sales in Y2018. There has been no troubles or accidents in the transaction since the commencement of this transaction in October 2018. In addition, it was reported by the Purchaser that sorghum silages gains dairy cattle's strong favor, compared with traditional feeds.

- 1) Number of deliveries: 6 time for Y2018
- 2) Number of Delivered Rolls: 813
- 3) Total Weight of Delivered Rolls: 211t
- 4) Total Amount of Payment for USD 14,328

Diagram 7: Performance of Trial Silage Sale (2018)

No of Delivery	Delivery			Silage			Bank Account	
	Date of Delivery	Date of Arrival	Date of QT	Number of delivered Rolls	Ave. Weight (kg)	Total Weight (t)	Sales Price (USD)	outstanding (USD)
DEPOSIT								1,000
No.1 (Y2018)	2018/10/17	2018/10/18	2018/10/16	153	258	39.474	2,368	3,368
No.2 (Y2018)	2018/11/6	2018/11/7	2018/11/3	136	258	35.088	2,105	5,474
No.3 (Y2018)	2018/11/20	2018/11/21	2018/11/20	59	258	15.222	913	6,387
No.4 (Y2018)	2018/12/6	2018/12/7	2018/12/3	139	259	36.001	2,160	8,547
No.5 (Y2019)	2019/1/6	2019/1/7	2019/1/6	160	260	41.6	3,328	11,875
No.6 (Y2019)	2019/2/5	2019/2/6	2019/2/5	165	218	36.0	2,880	14,755
総合計	na	na	na	812	na	203.36	13,755	14,755

(Note 1) initial sales price (No.1-No.4) is USD 60/t.

(Note 2) as from January 2019, sales price is amended to USD 80/t.

(Note 3) Average weight of one roll is decided by 3 times sampling measurement.

(Note 4) Amount of silage rolls to UBB (44 rolls) is excluded in the above table.

(Note 5) Transportation cost is USD 28/t for the first to fourth delivery (Y2018). Thereafter, it is amended to USD 25/t.

(Note 6) Transportation cost includes a handling charge(5%) for payment to truck company.

(Note 7) As for rolls delivered to UBB described below, these are not included in the table:

(Note 8) As for No.7 delivery, it is assumed that the number of rolls is 33 and average weight is 180kg and no transportation cost but

delivery to UBB	Date of Delivery			Number of Rolls	Ave. weight (kg)	Total Weight (t)
No.1 Delivery	2018/10/17			29	258	7.482
No.2 Delivery	2018/12/6			15	260	3.9
Total				44		11.382



(Source) sorghum project team

4. Second Year's Business Performance

4.1 Overview of Operational Plan

It was considered as appropriate by project team that we should have the following two new attempts relating to business and technical aspects for the improvement of performance of the second year of the project.

4.2 Business Aspects⁶

- ✓ In addition to sorghum cultivation, JICA project is going to procure corn from local farms, the amount of which is, say, produced from 5 ha. Corn is harvested by harvester and transported to the warehouse of JICA project for silage production. This type of silage is called to as "whole crop (corn) silage", which is composed from all parts of plant (fresh corn, stem and leaves).
- ✓ According to our investigation, fresh corn is usually transacted at the level of USD 160/t (USD 0.16/kg).
- ✓ Yield of fresh corn is said to be about 6t-7t/ha in Battambang. It is normal for a local farmer to have twice harvest in a year. Thus, annual yield of fresh corn will be 12t-14/ha. Furthermore, since this is a yield of only "fresh corn", total weight which includes fresh corn, stems and leaves can be assumed to be 2.5-3 times larger than fresh corn. Therefore, total yield of corn (fresh corn, stems and leaves) can be assumed to be 36t/ha (36t=12×3times).
- ✓ Purchase cost of corn (whole crop) can be assumed based on the above formula: USD 1,920/ha=12t/ha×USD 160/t. This purchase cost (USD 1,920/ha) will be much lower than cultivation cost of sorghum, because current sorghum yield is low (15t/ha)
- ✓ For the above consideration, it is possible to say that purchase of corn from local farms can be deemed to be not only profitable to JICA project but also beneficial to local farmers as well, where purchase price is fair and reasonable.

4.3 Technical Aspects

- ✓ Land preparation (leveling)

More attention needs be given to the issue of leveling of cultivation land when preparatory works are made prior to sowing, for the purpose of the proper use of sowing machine. In

⁶ This Idea on whole crop (corn) silage was not exercised in 2019 after all, though idea itself was deemed as workable and effective in terms of profitability of the project, because the idea seems to be outside the original scope of this JICA project. Instead, small area was allocated in B7 to undertake comparative study of sorghum and corn cultivation.

this connection, it should be pointed out that sowing machine did not work well in 2018 because the existence of bumpy parts in the field might have affected negatively.

✓ Soil Improvement (plowing and compost application)

As for plowing of cultivation fields, it is required for us to secure a soft layer which is 25cm in depth from the surface of land in order to enable sorghum to grow up. The clod of soil is desirable to be within 2 cm. Furthermore, composts need be applied to each plots of cultivation field from the viewpoint of water retention, drainage and keeping of nutrients.

✓ Irrigation (Watering)

Timely irrigation is required to make. It was pointed out that right after sowing operation in June 2018, there was almost no rainfall. Though watering was made when no rainfall was observed, it seems to be rather late or not enough for certain parts of cultivation field.

For the 2019 operation, "Rain Gun" (see a photo described below) is going to be introduced to enable watering operation to be flexible and maneuverable.

Photo: one type of "Rain Gun" (image photo)



✓ Soil Analysis

It was observed in 2018 performance that although yield of first year operation was 14t/ha, which was much lower than our expectation due to the fact that most of fields are waste and unused land for many years. Among 5 Plots, performance of Plot-C and Plot-Y were found to be extremely poor. Soil analysis (chemical analysis) is going to be made for 2019 cultivation to confirm actual soil condition of each plots.

✓ Herbicides

The growing period of 2nd generation of sorghum is considered to be within the rainy season and thus, fields can be easily overgrown with weeds. Herbicides are going to be used for 2019 operation. "Basagran" (name of product) was decided to spray onto fields, right after the germination of sorghum is observed.

4.4 Business Targets

Firstly, JICA project aims at **30t/ha** as sorghum yield target for the second year" and **40t/ha** for the third year (first year of commercial activity), with the understanding that it takes about at least 3 years to clear unused lands.

Secondly, as mentioned earlier, whole crop (corn) silage is to be produced for the second year of the project, as far as corn is obtainable near to or within CMAC CDC. It seems no doubt that the production of whole crop (corn) silage will be profitable to both JICA project and local farmers⁷.

4.5 Cultivation Plan for Y2019

4.5.1 Comparison of Cultivation Plan (Y2018 and Y2019)

As described earlier, yield per ha for T2018 was 14t/ha, which was very far from our target yield(70t/ha). It is rather difficult to identify the single cause since it may be multiple causes. However, overall analysis was required to make for Y2019 operation. Cultivation plan for Y2019 was indeed made based on these considerations.

First of all, it must be pointed out that the size of cultivation land for Y2018 was 20 ha (net area: 16ha) and all of them included a factor of "experimental" cultivation. On the other hand, it was decided to use the same land for Y2019 as in Y2018 except for Y Plot (4 ha), which "old" Y Plot was replaced by "new" Y Plot (4 ha) due to the request for return from the land owner. Comparative Outline of cultivation plan for Y2018 and Y2019 is as follows:

⁷ As described earlier, this idea was postponed as one of future attempts which should be considered t the time when commercial operation starts.

Diagram 8: Comparison of cultivation land for Y2018 and Y2019

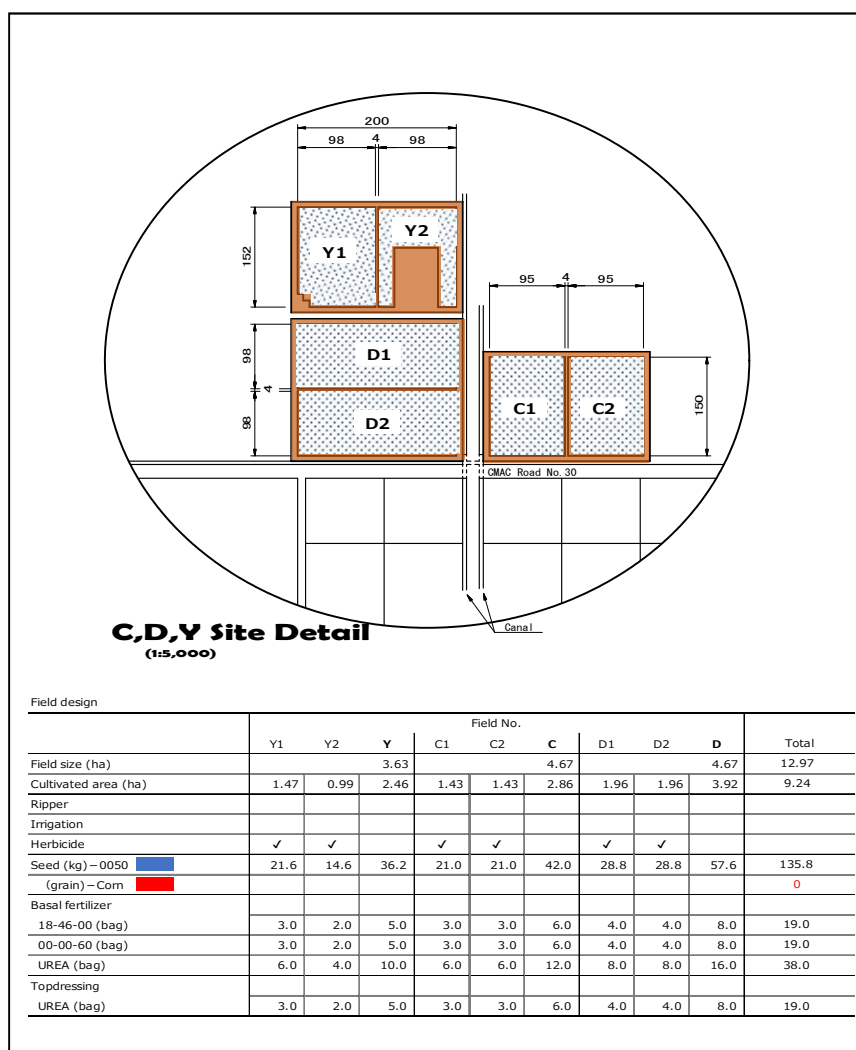
	Y2018	Y2019
Cultivation area	16.12ha (including test field)	15.92ha (a part is excluded from Y Plot and this includes test field)
Sorghum variety (Note)	Sorghum 1 Sorghum 2	Sorghum 1
Applied amount of seeds	10kg/ha, 20kg/ha	10kg/ha
Applied amount of Fertilizer	N : 100kg/ha P: 50kg/ha K : 37.5g/ha	Same as the left

(Source) sorghum project team

(Note 1) Sorghum 1 was imported from Australia. Applied amount of seeds was adjusted, in 2019, because of rather low germination rate: 10kg/ha(2018)→15kg/ha(2019), 20kg/ha(2018)→30kg/ha(2019)

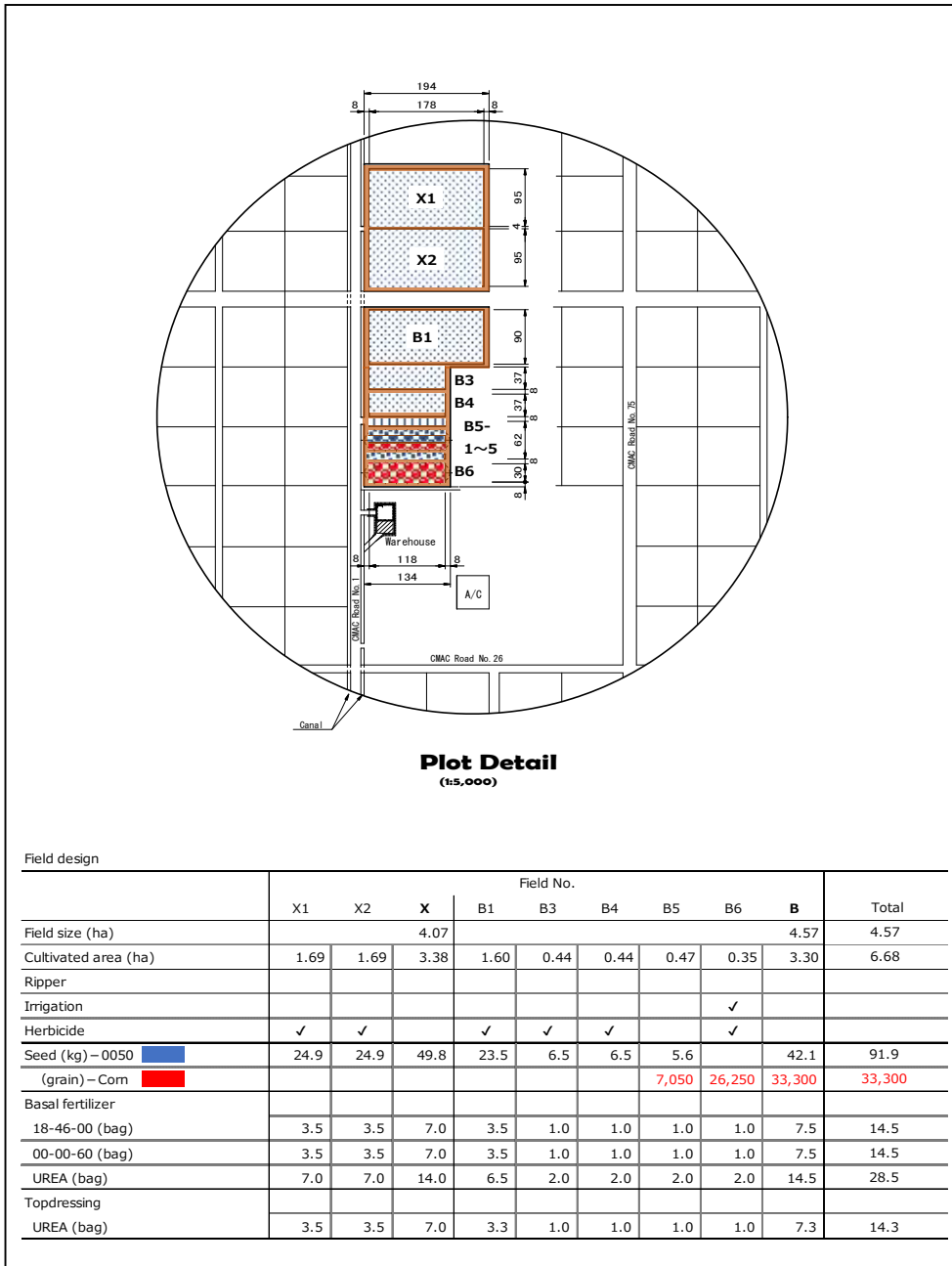
(Note 2) Sorghum 2 was imported from Brazil.

Diagram 9: Y 2019 Cultivation lands (C·D·Y Plots)



(Source) sorghum project team

Diagram 10: Y 2019 Cultivation lands (B·X Plots)



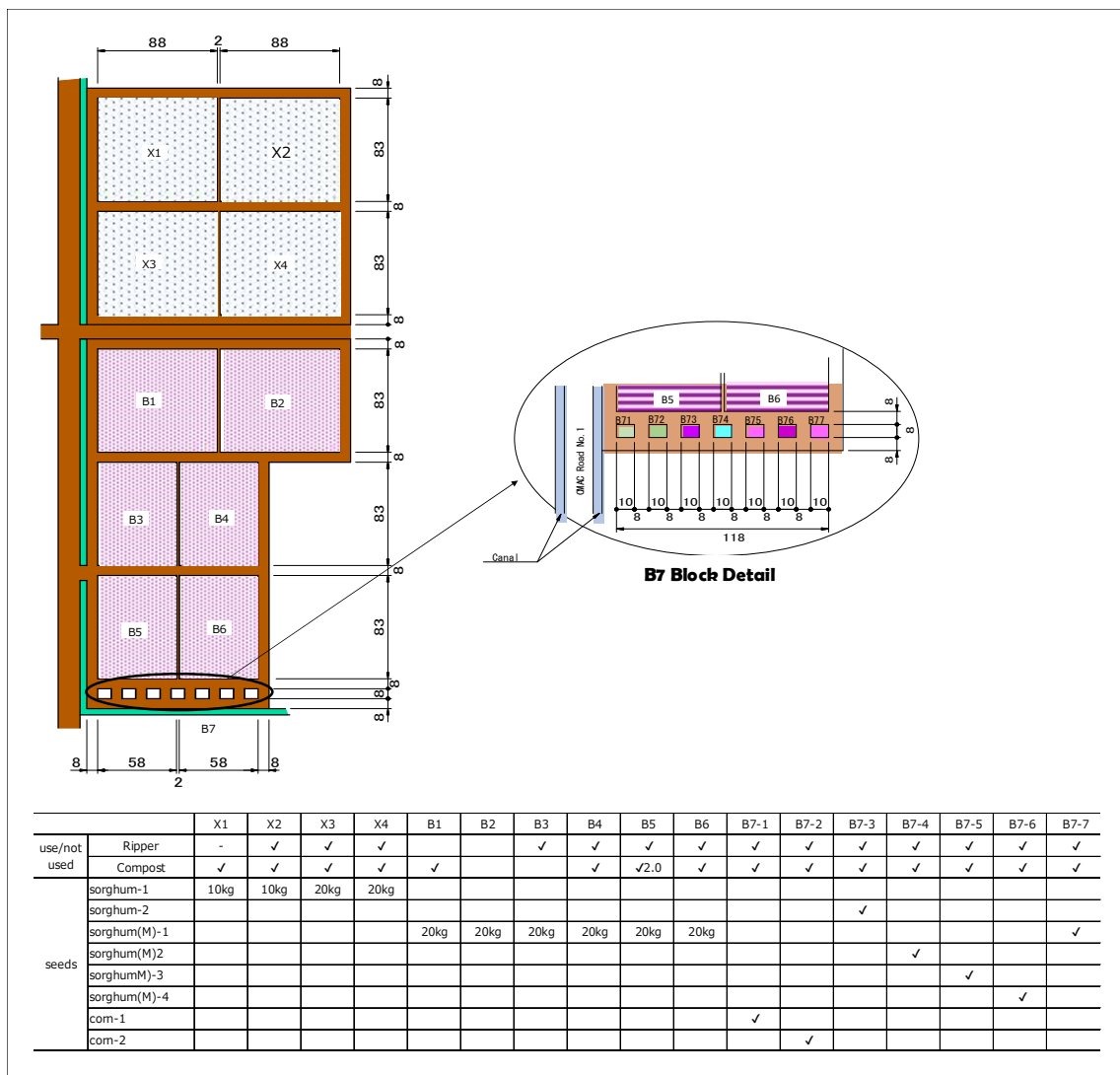
(Source) sorghum project team

4.5.2 Comparison of Test Cultivation (Y2018 and Y2019)

In 2018, cultivation plan was made to focus (A) the use of “ripper” to improve soil physical property (destruction of hard soil) and water retention, (B) the use of “VS compost” to make soil improvement, (C) comparative study of different seeds, (D) relationship between yield and sowing with different amount of seeds. As a result, it was found that:

- A) No good effect.
- B) Effect of compost application can be expected.
- C) Sorghum productivity is higher than corn, under water shortage situation.
- D) No close relationship between yield and sowing with different amount of seeds.

Diagram 11: location of Y 2019 cultivation lands

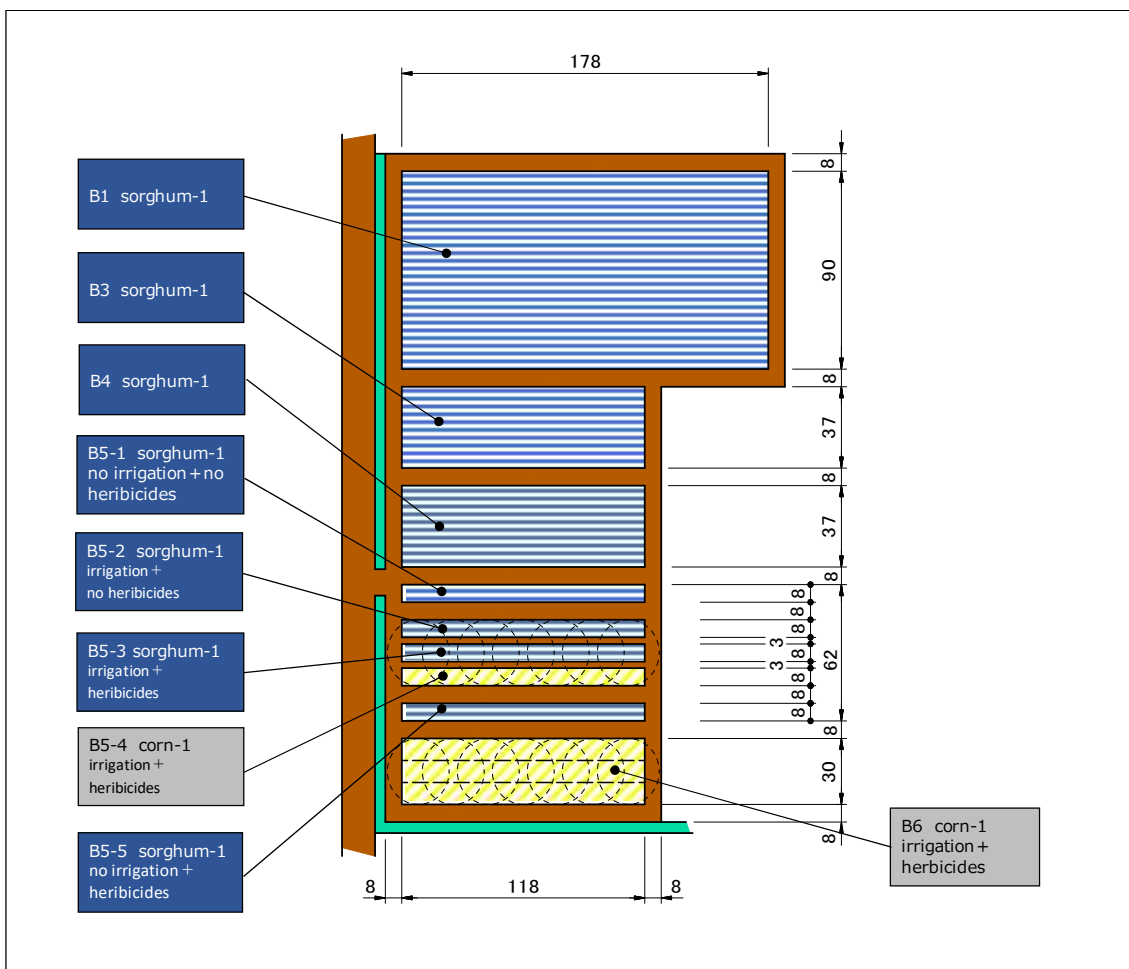


(Source) Sorghum project team

Y2019 test cultivation plan has been prepared based on the following issues:

- A) To confirm the impact of irrigation which constituted a critical cause to low yield in 2018;
- B) To confirm the influence of herbicides;
- C) To evaluate nutritional value of corn silage (yield nutritional value=yield× nutritional value), in comparison with sorghum silage;
- D) To evaluate difference of nutritional value based on different time of harvest.

Diagram 12: location of Y 2019 test fields



(Source) sorghum project team

4.6 Estimate of Sorghum Cultivation for Y2019

Yield estimate is required to make for Y2019 sorghum cultivation, in order to foresee the course of action as well as preparatory works to be undertaken for future commercialization of the project, after JICA project ends in December 2019.

4.6.1 Methodology of Growth Estimate and Yield Estimate

- A) Identification and measurement of defective parts (the place where sorghum has not grown or it has not shown healthy growth);
- B) Crop yield estimate is made by unit acreage sampling to identify and measure (a) cultivation area which can be expected to harvest;
- C) In addition to the above B), same unit acreage sampling method is applied to test areas to calculate (b) "unit yield" (t/ha) and "standard height" of sorghum;
- D) Unit yield for Y2019 is calculated by the formula (Cultivation Area × Unit Yield × Correction Value);
- E) Corn yield estimate is calculated based on the assumption that yield of second crop which started in September 2019 in B5-4 and B6 is assumed to be the same as actual yield in 2018.

4.6.2 Results of Estimate

- 1) As of August 24, 2019, cultivation growth area for Y2019 is as follows:

Diagram 13: Cultivation growth area

Area	Total (ha)	Deficient part (ha)	Healthy part (ha)	Deficient part (%)	Remarks
B1	1.60	0.66	0.95	40.9	sorghum
B3	0.44	0.15	0.29	34.6	sorghum
B4	0.44	0.12	0.31	27.9	sorghum
B5-1	0.09	0.03	0.07	30.0	sorghum
B5-2	0.09	0.04	0.06	40.0	sorghum
B5-3	0.09	0.04	0.06	40.0	sorghum
B5-4	0.09	–	–	–	corn
B5-5	0.09	0.03	0.07	30.0	sorghum
B 6	0.35	–	–	–	corn
X1	1.69	0.01	1.68	0.8	sorghum
X2	1.69	0.08	1.61	4.5	sorghum
C1	1.43	0.42	1.00	27.1	sorghum
C2	1.43	0.71	0.71	50.0	sorghum
D1	1.96	0.53	1.43	27.1	sorghum
D2	1.96	0.20	1.77	9.9	sorghum
Y1	1.47	0.22	1.25	15.0	sorghum
Y2	0.99	0.15	0.84	15.0	sorghum

(Source) sorghum project team

- 3) Estimate of unit yield (t/ha) was derived by unit acreage sampling, as described below, which was conducted in B5-1, B5-2, B5-3, B5-5

Diagram 14: Unit yield for Y2019

Unit yield (t/ha)	Standard height (m)
8.40	1.5

Diagram 15: Estimated yield for Y2019

Area	first generation		second generation		annual	
	yield (t)	number of rolls	yield (t)	number of rolls	yield (t)	number of rolls
B1	4.71	20	12.77	56		
B3	2.44	11	3.90	17		
B4	2.60	11	4.17	18		
B5-1	0.59	3	0.94	4		
B5-2	0.50	2	0.81	4		
B5-3	0.50	2	0.81	4		
B5-5	0.59	3	0.94	4		
Sub-total	11.93	52	24.33	106	36.26	158
X1	28.22	123	22.58	98		
X2	27.05	118	21.64	94		
Sub-total	55.27	240	44.22	192	99.49	432
C1	16.80	73	–	–		
C2	11.93	52	–	–		
Sub-total	28.73	125	–	–	28.73	125
D1	24.02	104	–	–		
D2	29.74	129	–	–		
Sub-total	53.76	234	–	–	53.76	234
Y1	21.00	91	–	–		
Y2	14.11	61	–	–		
Sub-total	35.11	153	–	–	35.11	153
Total	184.80	1,607	137.09	597	253.35	1,102

(Source) sorghum project team

- 4) It is estimated that total yield for Y2019, including second generation, is 253t and the number of silage rolls produced is 1,130 rolls (230kg/roll). Assuming that the size of cultivation land is 15.46ha and total yield is 253t, yield will come to 16.4t/ha/pa, which means slightly higher than yield in 2018.

Assumptions which were applied for yield calculation are as follows:

Assumption 1 : B1 is intended to make sowing again and yield of B1 is assumed to be double of unit yield.

Assumption 2 : Yield of second generation in plots except for corn cultivation in B3~B5 is estimated as double of unit yield×0.8% (regeneration rate)

Assumption 3 : Yield of X plot is assumed to be double of unit yield ×0.8% (regeneration rate, since sorghum was observed as good and its height was over 1.5m as of August 22, 2019.

Assumption 4 : As for C,D,Y plots, they were observed to be widely varied as of August 22, 2019, and their height were, on average, at the level of 1m. it was decided to extend cultivation in these plots for one or two months longer and to be one harvest per annum. Average height at harvest is assumed to be over 3m.

Corn yield in test areas is assumed to be as follows:

Diagram 16: Estimated corn yield for Y2019

Area	first generation		second generation		annual	
	yield (t)	number of rolls	yield (t)	number of rolls	yield (t)	number of rolls
B5-4	0.26	1	0.26	1	0.52	2
B 6	1.03	4	1.03	4	2.06	8
計	1.29	5	1.29	5	2.58	10

(Source) sorghum project team

Estimated corn yield is projected to be 2.6t and number of rolls is assumed as 10 rolls (257kg/roll). Assuming that size of cultivated is 0.44ha, yield is 5.9/ha.

4.6.3 Considerations

Second year's cultivation will result in Y2019 goal unachieved, followed by 2019, due to another shortage of rainfall after sowing. At this moment, it has been estimated that Y2019 yield will be 16t per annum against 14t for Y2019, though countermeasures were considered and undertaken, amongst others, as described below

- 1) Taking into account the result of Y2018 cultivation, special attention was paid to the countermeasure of defective areas and poor growth areas. Soil pH test was conducted in 11 areas including defective parts in last October and it was found that soil pH shows normal level (over pH5). Therefore, this risk factor was excluded in the list of countermeasures.
- 2) Next subject to be tackled was the matter of deficient area which sorghum germination cannot be clearly observed in the field. It was assumed that one cause can be considered as malfunction of sowing machine which is not able to drop seeds in the case that the surface of soil in some parts of the field is uneven. In order to remove this hypothetical cause, plowing and harrowing operations were made twice for decrease clumps of earth. However, as far as it was observed one month after sowing, the problem of deficient area was found as unsolved.
- 3) Furthermore, a rain gun was introduced for countermeasure of shortage of rainfall. However, the issue was not solved since reservoirs (a kind of water channel) was dried

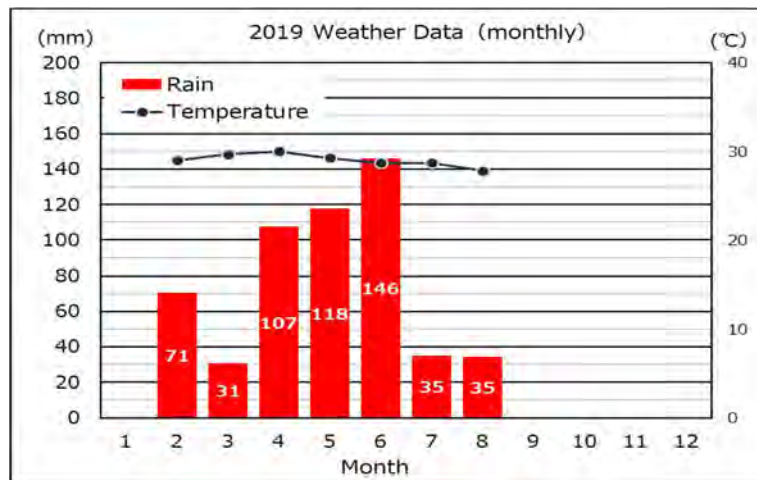
up a few weeks after sowing and thus, irrigation was not possible. As a result, again, water shortage caused severe damage to sorghum. The following diagram shows weather data (rainfall and temperature), which was collected by weather data system installed by the project.

Diagram 17: Weather data 1 (Jan-Aug 2019) at CMAC CDC

Month	Wind speed (m/s)		Wind direction		Temperature (°C)				Humidity (%)	Pressure (hPa)	Rain (mm)				
	average	max	deg	way	average		Highest	Lowest	average	average	Total	Max			
					average	Highest						Day	1 h	10 min	
January															
February	1.9	7.4	199.7	SSW	29.0	30.4	28.0	38.0	21.0	62.8	1,006	71	24	24	10
March	2.3	6.3	229.5	SW	29.7	31.5	26.4	39.7	22.1	63.1	1,004	31	14	9	4
April	1.8	9.2	224.0	SW	30.0	31.9	26.3	38.9	23.0	67.0	1,003	107	52	43	13
May	1.7	6.8	207.8	SSW	29.3	31.3	25.7	38.9	23.1	71.2	1,002	118	56	46	13
June	2.3	7.8	231.3	SW	28.7	30.6	26.0	37.1	23.2	72.1	1,002	146	35	33	11
July	3.1	7.5	255.7	WSW	28.7	30.4	25.4	35.1	23.2	68.0	1,002	35	13	11	17
August	3.4	7.1	253.4	WSW	27.8	29.7	26.4	34.8	23.2	73.3	1,001	35	8	5	9

(Source) sorghum project team

Diagram 18: Weather data 2 (Jan-Aug 2019) at CMAC CDC



(Source) Sorghum project team

- 4) Sowing for Y2019 started on May 25 in B plots and proceeded to X plots, C plots, D plots. As for Y plots, sowing took rather a longer period and continued by the end of July. Monthly average precipitation (rainfall) in July and August, which can be called as early growing period of sorghum, was at the level of 35mm respectively. This level seems to be obviously much smaller than usual.
- 5) Soil in CMAC CDC, generally speaking, cannot be considered as good soil which is well drained. Because of the shortage of water, some parts of sorghum field seem to have gone below the surface of water and thus have caused serious damage to their roots. Furthermore, some seems to have had a difficulty of absorbing moisture from

underground soil.

- 6) Moreover, it should be noted that machineries trouble was frequently occurred both in 2018 and 2019. Especially, these troubles arise from the following: (a) vertical harrow, (b) sowing machine and (c) harvester. Main causes seem to be divided into 2 different categories. First category will be in relation to an attribute of soil in CMAC CDC, most of which are so-called "unused land" and thus, heavy load was placed on these machineries. Second category will be different cultivation circumstances with respect to soil quality, weather, moisture and so forth, which are quite different from in Japan. Third category will be in close relation to human error of operators. Apart from a mistake of machine selection, there exist some troubles which would have avoided to occur if an operator is careful enough to operate it. Once machine trouble arises, it normally takes one week or sometimes more than two weeks to get spare parts from manufacturer. "Time loss" is critical and cannot be negligible especially for mechanized agriculture. More attention would be required to pay for machine operation, maintenance and prior procurement of spare parts.

4.6.4 Conclusion

The following issues need to be noted amongst others to improve cultivation yield for future commercialization.

- 1) How to secure stable yield

It will be essential for commercial operation to secure stable target yield⁸ of crops. JICA sorghum project has not yet solved this problem. It may be a prime importance for us to find out main causes and seek appropriate measures to secure stable yield, unless cultivation land is intended to change. In this project, sowing technique and other technical issues were discussed and undertaken. However, the project has not yet solved the issue of how to secure stable yield. Key subject matters to be discussed might include: Identification of countermeasure to the matter of a deficient part of land and shortage of water to make them better for sound agriculture.

- 2) Suitable period of sowing

With regard to the shortage of water, rain gun did not work because of no water in reservoirs. As long as rainfall is sole water source, stable expected yield cannot be attained. JICA project was stricken by drought continuously both 2018 and 2019. However, it is not necessarily correct to say that another drought will be in 2020. According to weather data which JICA project has collected from weather data collector installed by us, it can be possible to say that sowing should be better to make at the end in April and first harvest should be made in July or August, when rainy

⁸ 50-60t/ha is assumed as stable target yield.

season is temporarily stopped, since it was found that if sowing is made at the end of May, you may be obliged to take the risk of non-performance of machines in the field, due to rainfall in June and the risk of poor growth because of shortage of water in July and August.

3) Treatment of machineries

It should be reminded once again to treat machineries. For instance, every day, after field operation ends, all machineries need to be cleaned, inspected and refueled if possible and further, it should be obligated to make record with respect to maintenance and use of spare parts in order to save future cost of maintenance and decrease time-loss which may occurs from machines troubles.

5. Future Commercial Activity

JICA sorghum project is due to end at the end of December 2019 and this project is expected to be continued by a succeeding institution, which is most likely an agricultural cooperative to be set up in Battambang, in cooperation with CMAC.

In this Chapter, a number of issues will be referred with respect to market analysis (potential market size), actual market demands, business development, establishment of commercial entity and its value-chain, financial simulation (spreadsheet) and comparison of profitability of sorghum silage and corn silage, as additional discussion.

5.1 Market Analysis (Potential market size)

- 1) As described earlier⁹, potential market size of sorghum silage can be assumed, at this moment, as USD 2,613,651. This market size means that it accounts for 1.3% of total size of potential market size of sorghum silage (100%), which includes both household (98.7%) and commercial farms (1.3%).
- 2) It is the first important point to note from a marketing point of view that as a commercial entity which is intrinsically required to make a profit, it is an essential action for the entity to identify potential silage purchasers. Perhaps, buyers to be qualified as silage purchasers may be not only relatively large-scale livestock farms which possess, say, more than 100 cattle, but also managed by educated owners, since (a) such owners are able to quickly understand what is silage and its advantages and (b) wealthy enough to purchase rather expensive silages¹⁰.

⁹ See: Market Survey of Sorghum Silage, P. 14 and P. 15.

¹⁰ Although the first target of silage sale may be relatively large-scale livestock farms, the second target should be ordinary livestock farms which keep 20-50 cattle. The size of silages to be sold to ordinary livestock farms needs to be much smaller (20-30kg: hand-made silage) than roll bale silage (weight: 260kg).

- 3) Second issue to which you are required to pay attention is in relation to the basic nature of mechanized silage production business. This is a kind of golden rule for doing silage production business, "locally made and locally consumed". If you follow this rule, you are required to make marketing focusing on the region of Battambang where the economic entity is set up, in order to avoid high transportation cost from the production site to the place designated by a purchaser.
- 4) Lastly, it should be pointed out that because of expected rapid economic growth in Cambodia, market survey¹¹ is required to be made frequently for identifying potential purchasers. Otherwise, it will not be possible for you to get updated and detailed market information re livestock industry from other sources¹² in the rapidly changing industrial circumstances.

5.2 Market Demands

- 1) As you know, silage have not been well-known cattle feeds in Cambodia. Thus, it is required for you to make information dissemination activities, as a first step for marketing, with respect to what is silage and its advantages/disadvantages. Act of selling any products means that firstly, market demands needs to be identified and secondly, you are needed to learn what is the requirement for purchase of silages through the above-referred market analysis.
- 2) The way of marketing varies respectively based on each characteristics of the product. In the case of silages, they cannot be sold in the market place because of non-existence of common knowledge on silages at this moment in Cambodia. Therefore, marketing method of silage sale will be, generally speaking, confined to "arm's length transaction". In this connection, it is of prime importance for you to collect data and information re the names and addresses of "qualified" livestock farms.
- 3) To whom your sales efforts need to be made is one of important points that have been found by JICA project in the course of market survey. Prime sales targets¹³ on which you should focus are relatively large-scale livestock farms which keep more than 100 cattle. This will be true without question. On the other, it should be also recognized that if the owner of such a farm is keen on financial and strategic aspect of business, no time will be required for him to reach one idea. That is the idea of purchasing of a set of machineries for silage production, which will be deemed to be more rational and strategic than simple purchase of roll bale silages. In this connection, it is realistic for economic entity to think about actual and realistic way of sales promotion prior to your contact, taking account the reality that some qualified farm owners is likely to

¹¹ Local university will be your good partner for marketing because they have local networks to do academic works.

¹² MAFF and its subordinated organizations do not have such information.

¹³ See P. 14 and p.15, (A) RUA survey.

place his priority on the purchase of roll baler and other related machines rather than the simple purchase of silages.

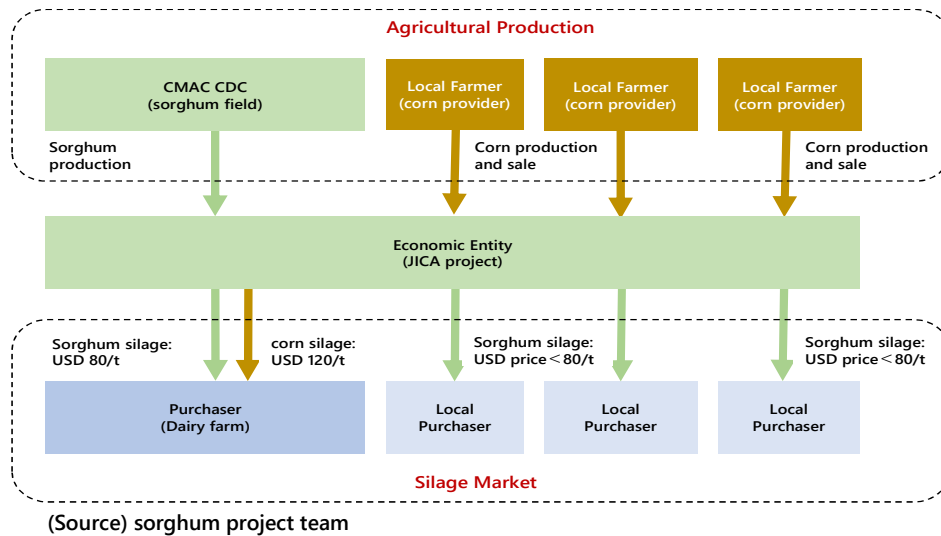
5.3 Business Development

- 1) JICA project started its trial business with 20ha cultivation land in the CMAC CDC and a set of machineries which can cover this size of operation. CMAC is now under consideration of business plan to succeed JICA sorghum project. In making a business plan, it is needed for CMAC to pay attention to the aspect of basic difference in terms of management between public administration and commercial institution. That is, it will be essential for a “merchant” to learn and identify market needs and market demands on the product that are required to get. In this connection, it must be carefully considered in a business world that only a representation from supply side (makers) can be easily defeated by demand side (consumers) opinions.
- 2) Business development and business expansion will also be one of the major subjects of commercial entity after a few years of successful performance. Discussion on business development must be dependent on “business plan”. When you make a business plan at any stage of commercial entity, you should consider first that any kind of corporate action needs to have a “healthy plan” and otherwise success cannot be expected.
- 3) Business plan can be sometimes described as an “implementing” and/or “structured” plan of economic entity relating to the new project, if it is so decided within the entity. Therefore, the content of business plan must be thoroughly and realistically considered and described from the legal (governance and compliance), financial (accountability) and economic (profitability) point of view, in addition to the discussion of economic profitability which is discussed based on the detailed analysis of costs and expenses as well as profit reflecting actual market situation.

5.4 Establishment of commercial entity and its value-chain

As of September 24, 2019, CMAC is under consideration of agricultural cooperative as a succeeding organization of JICA sorghum project. As an example, conceptual value-chain is described below for the ease of reference:

Diagram 18: Value-chain of silage production and its sale



5.5 Financial Simulations

Assuming that a commercial entity (agricultural cooperative) is set up after JICA project ends, the spreadsheets (See: next page) are required to prepare for discussion among the parties concerned to look at the business plan from all directions. Sample spreadsheets are described in next page, which covers the 2nd year of JICA project and then 10 years commercial activity of the proposed agricultural cooperative.

For your preparation of the spreadsheets, the following is the points to note:

- a) Basic assumptions must be set firstly, in relation to cost and expenses and revenue;
- b) "Profit allocation" scheme to shareholders must be described in addition to profit after tax.
- c) Agricultural machineries and a warehouse are not capitalized in the spreadsheets due to the fact that the legal titles of these machines and a warehouse will belong to MAFF. On this issue, It is required for the parties concerned to make an agreement between MAFF and CMAC, and, CMAC and the agricultural cooperative regarding the use of machineries by the agricultural cooperative.
- d) In the future development, it will be important to note that the current capacity of machineries which were provided by JICA for the use of project is limited to cover less than 20 ha sorghum cultivation. Therefore, when the proposed agricultural cooperative is successful and intends to expand its operation, say, more than 30ha, there will be no question that the agricultural cooperative needs to procure the new set of machineries and the amount of investment on machineries must be capitalized in financial statements.
- e) Finally, it will be important issue for the stakeholders of the agricultural cooperative that "internal rate of return" must be presented in the business expansion plan (financial spreadsheets) based on "free cash flow" in the spreadsheets.

Diagram 19: financial simulation/spreadsheet

Economy of future JICA project (as of 2019/01/28)												
General Assumptions												
A) Assumptions (operation)						B) Assumptions (other)						
1. Sorghum Annual Yield	Yield=40t/ha(20 & 21), 50t/ha (22 & 23),70t/ha(from 24)					1. Fixed Asset Investment	to make in 2022, 2024, 2026, 2028					
2. Amount of Silage Production	Amount of silage production is same to sorghum yield.					2. EBITDA	Amortization has not yet been calculated.					
3. Retail Price of Silage	USD 80/t					3. Number of buyers	South and North: 50% : 50%					
4. Sorghum Seeds	15kg/ha; Price=USD 4.0/ka(local seeds are used).					4. business entity	Assumed to be a/c.					
5. Fertilizer	USD100/ha					5. Relationship with ANP	Under consideration					
6. Transportation Cost	USD 25/t (Phnom Penh)and USD 15 (Battambang)					6. Exchange Rate	USD 1=JPN 113					
7. Fuel	USD276/ha											
8. Corporate Tax	20%											
9. Amount of Silage/head/year	3.65t=10kg×365days+1000kg											
10. Dividend	no dividend for 3 years. From 4th, 40% of PAT is distributed.											
11. Rent for office	50m ² ×monthly ren t(USD 5)×12 months											
12. Land leasing contract	5 years (USD 180/ha/pa)											
13. Fresh corn purchase price	USD 160/t											
Spreadsheet												
	(Unit : USD)											
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	
	Y0 (JICA2)	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	
1. Total revenue	69,600	107,200	139,200	246,400	286,400	465,600	521,600	620,800	676,800	776,000	832,000	100%
1.1 Revenue (sorghum silage)	48,000	64,000	96,000	160,000	200,000	336,000	392,000	448,000	504,000	560,000	616,000	74%
Net cultivation land (ha)	20	20	30	40	50	60	70	80	90	100	110	
Land growth rate	na	na	50%	33%	25%	20%	17%	14%	13%	11%	10%	
Sorghum yield (t)	600	800	1,200	2,000	2,500	4,200	4,900	5,600	6,300	7,000	7,700	
Amount of silage production (t)	600	800	1,200	2,000	2,500	4,200	4,900	5,600	6,300	7,000	7,700	
Number of silage rolls	2,308	3,077	4,615	7,692	9,615	16,154	18,846	21,538	24,231	26,923	29,615	
1.2 Revenue (whole crop silage)	21,600	43,200	43,200	86,400	86,400	129,600	129,600	172,800	172,800	216,000	216,000	26%
Net farmer's land (ha)	5	10	10	20	20	30	30	40	40	50	50	
Land growth rate	na	50%	0%	50%	0%	33%	0%	25%	0%	20%	0%	
Corn yield (t) : 61×2×3 = 36/ha/pa	180	360	360	720	720	1,080	1,080	1,440	1,440	1,800	1,800	
Amount of silage production (t)	180	360	360	720	720	1,080	1,080	1,440	1,440	1,800	1,800	
Number of silage rolls	692	1,385	1,385	2,769	2,769	4,154	4,154	5,538	5,538	6,923	6,923	
1.3 Total number of rolls (1.1+1.2)	3,000	4,462	6,000	10,462	12,385	20,308	23,000	27,077	29,769	33,846	36,538	
2. Costs	56,565	106,419	126,410	197,869	221,318	323,896	354,260	422,262	452,625	520,627	517,491	62%
2.1 Personnel expenses (manager)	8,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	2%
2.2 Personnel expenses(operator)	8,000	8,000	8,000	10,000	10,000	12,000	12,000	14,000	14,000	16,000	16,000	2%
2.3 Wages for field workers	2,400	2,400	2,400	3,000	3,000	3,600	3,600	4,200	4,200	4,800	4,800	1%
2.4 Sorghum seeds	1,200	1,200	1,800	2,400	3,000	3,600	4,200	4,800	5,400	6,000	6,600	1%
2.5 Nets/Films	0	19,809	26,640	46,449	54,988	90,166	102,120	120,222	132,175	150,277	162,231	19%
2.6 Fertiliser	2,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	11,000	1%
2.7 Transportation cost	19,500	23,000	30,000	53,000	61,750	100,500	112,750	134,000	146,250	167,500	146,250	18%
2.8 Fuel	5,865	6,210	8,970	12,420	15,180	18,630	21,390	24,840	27,600	31,050	33,810	4%
2.9 Insurance	0	0	0	0	0	0	0	0	0	0	0	0%
2.10 Rent for office	0	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	0%
2.11 Car rental (for office use)	0	0	0	0	0	0	0	0	0	0	0	0%
2.12 Lent for land	0	3,600	5,400	7,200	9,000	10,800	12,600	14,400	16,200	18,000	19,800	2%
2.13 Fresh corn purchase price	9,600	19,200	19,200	38,400	38,400	57,600	57,600	76,800	76,800	96,000	96,000	12%
3. Operating profit	13,035	781	12,790	48,531	65,082	141,704	167,340	198,538	224,175	255,373	314,509	38%
4. EBITDA	not yet calculated											
5. Corporate Tax (20%)	0	156	2,558	9,706	13,016	28,341	33,468	39,708	44,835	51,075	62,902	8%
6. Profit after-Tax	5,880	625	10,232	38,825	52,066	113,363	133,872	158,831	179,340	204,298	251,607	30%
	(conversion to JPN)	664,440	70,582	1,156,216	4,387,182	5,883,441	12,810,028	15,127,536	17,947,877	20,265,385	23,085,726	28,431,634
7. Dividend	0	0	0	0	20,826	45,345	53,549	63,532	71,736	81,719	100,643	
8. Retained earnings	5,880	625	10,232	38,825	31,240	68,018	80,323	95,298	107,604	122,579	150,964	
9. Cumulative retained earnings	na	625	10,857	49,681	80,921	148,939	229,262	324,560	432,164	554,743	705,708	
10. Dividend/ha	na	0	0	0	417	756	765	794	797	817	915	
11. Amended Dividend/ ha	na	0	0	0	597	936	945	974	977	997	1,095	
Detailed Assumptions												
	(Unit : USD)											
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	
	Y0 (JICA2)	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	
2.1 Personnel Expenses	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	
(A) Executive manager	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	
Remuneration (1 person)	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	
(B) Field manager	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	
Remuneration (1 person)	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	
(C) Manager of Administration	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	
Remuneration (1 person)	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	
2.2 Personnel expenses (operators)	8,000	8,000	8,000	10,000	10,000	12,000	12,000	14,000	14,000	16,000	16,000	
Number of operator	4	4	4	5	5	6	6	7	7	8	8	
Remuneration (1 person)	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	
2.3 Wages for field workers	2,400	2,400	2,400	3,000	3,000	3,600	3,600	4,200	4,200	4,800	4,800	
Number of workers	4	4	4	5	5	6	6	7	7	8	8	
Wage for 1 person	600	600	600	600	600	600	600	600	600	600	600	
2.4 Sorghum seeds	1,200	1,200	1,800	2,400	3,000	3,600	4,200	4,800	5,400	6,000	6,600	
Amount of seeds required (kg)	300	300	450	600	750	900	1,050	1,200	1,350	1,500	1,650	
2.5 Nets/Films	0	19,809	26,640	46,449	54,988	90,166	102,120	120,222	132,175	150,277	162,231	
2.5.1 Nets/Films (sorghum)	0	13,662	20,492	34,154	42,692	71,723	83,677	95,631	107,585	119,538	131,492	
2.5.2 Nets/Films (corn)	0	6,148	6,148	12,295	12,295	18,443	18,443	24,591	24,591	30,738	30,738	
Assumed cost per roll (USD)	na	4.44										
2.6 Fertilizer	2,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	11,000	
USD100/ha												
2.7 Transportation costs	19,500	23,000	30,000	53,000	61,750	100,500	112,750	134,000	146,250	167,500	146,250	
2.7.1 Transportation costs (sorghum)	15,000	14,000	21,000	35,000	43,750	73,500	85,750	98,000	110,250	122,500	134,750	
50%/USD 25/t (Phnom Penh)	na	10,000	15,000	25,000	31,250	52,500	61,250	70,000	78,750	87,500	96,250	
50%/USD 10/t (Battambang)	na	4,000	6,000	10,000	12,500	21,000	24,500	28,000	31,500	35,000	38,500	
2.7.2 Transportation costs (corn)	4,500	9,000	9,000	18,000	18,000	27,000	27,000	36,000	36,000	45,000	45,000	
100%/USD 25/t (Phnom Penh)	na	9,000	9,000	18,000	18,000	27,000	27,000	36,000	36,000	45,000	45,000	
2.8 Fuel	5,865	6,210	8,970	12,420	15,180	18,630	21,390	24,840	27,600	31,050	33,810	
2.8.1 Fuel (sorghum)	5,520	5,520	8,280	11,040	13,800	16,560	19,320	22,080	24,840	27,600	30,360	
litter/ha	na	345										
USD /ha	na	276										
2.8.2 Fuel (corn)	345	690	690	1,380	1,380	2,070	2,070	2,760	2,760	3,450	3,450	
1/4 of sorghum fuel (USD /ha)	345	690	690	1,380	1,380	2,070	2,070	2,760	2,760	3,450	3,450	
2.9 Insurance	0	0	0	0	0	0	0	0	0	0	0	
2.10 Rent for office	0	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	
2.11 Car rental	0	na	na	na	na	na	na	na	na	na	na	
2.12 Lent for land (USD180/ha/pa)	0	3,600	5,400	7,200	9,000	10,800	12,600	14,400	16,200	18,000	19,800	
2.13 fresh corn purchase price (USD 160/t)	9,600	19,200	19,200	38,400	38,400	57,600	57,600	76,800	76,800	96,000	96,000	

(Source) sorghum project team

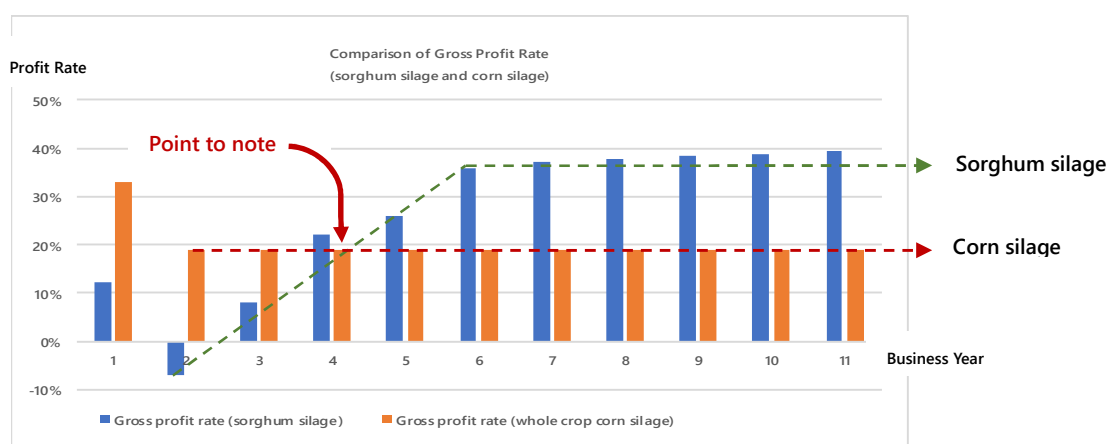
5.6 Additional discussion: Comparison of Profitability of Sorghum Silage and Corn Silage

The following diagram shows comparison of changes in a profit rate of “sorghum silage” and 5.6 “whole crop corn silage”. As you can see, profit rate of sorghum silage is very low at the beginning stage because: Firstly, yield of cultivation lands are assumed to be still low due to the fact that soil improvement efforts are under way. Secondly, low profitability is based on high cost of organizational establishment including “personnel expenses” for a number of senior managers’ remuneration.

It is to be noted that in 4th year (3rd year of commercial operation) in the diagram, profitability of sorghum silage becomes higher than one of corn silage. This contribution is derived from improved yield of sorghum cultivation. Sorghum yield is assumed to be improved as follows: 30t (2019), 40t (2020), 50t (2022), 70t (2024). As a side note, it can be said that sorghum yield in Japan is about 100 t/ha. Therefore, it should not be unrealistic to say that JICA project aims at sorghum cultivation yield of 70t/ha.

For the above reason, it will be important for JICA project to project a corn silage production at least by Y6. Subsequently, the importance of corn silage production for a business entity (agricultural cooperative) remains unchanged in the spreadsheet. It should be taken into account by the management of agricultural cooperative that because of high price (assumed as USD 120/t) of corn silage compared with sorghum silage (assumed as USD 80/t), “purchaser” farms seem to be restricted in terms of financial power and it seems rather hard to find out such a purchaser in Battambang Province. Therefore, a purchaser farm is assumed, in the spreadsheet, to be the same farm located in Phnom Penh and its product of this farm must be value-added.

Diagram 20: Comparison of profitability of sorghum silage and corn silage



(Source) sorghum project team

(Note 1) Gross profit rate is calculated with gross profit/revenue×100.

(Note 2) 1st year in the diagram means 2019 (2nd year of JICA project).

Diagram 21: Comparison of Revenue (sorghum and corn)

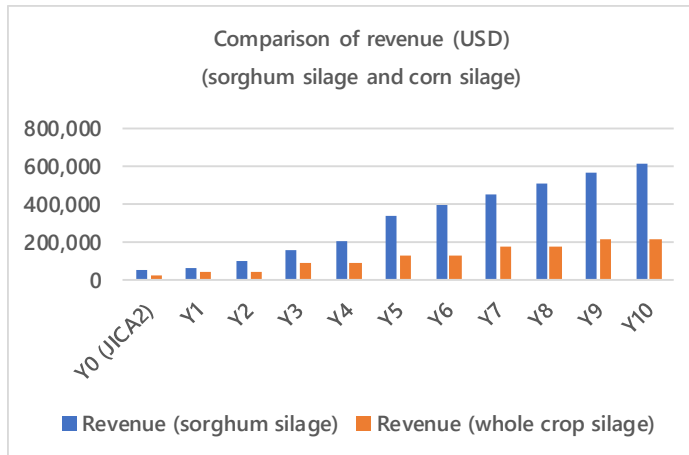


Diagram22: Comparison of Size of Cultivation Land (sorghum and corn)

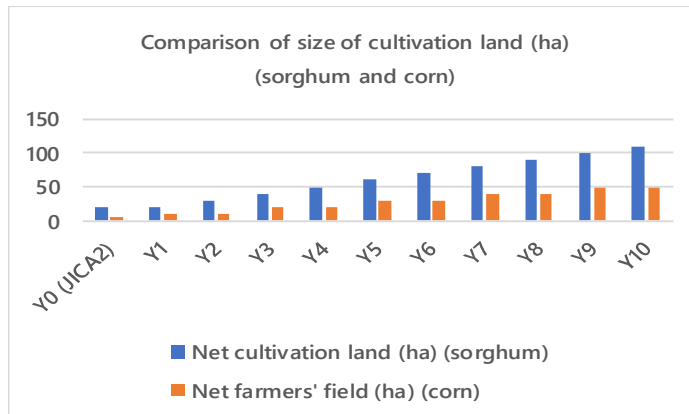
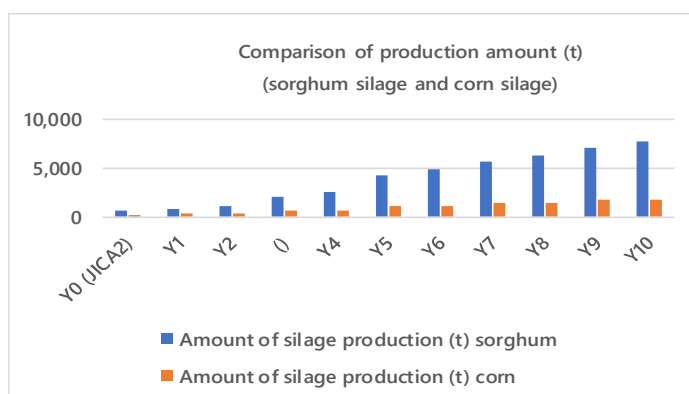


Diagram 23: Comparison of Production Amount (sorghum and corn)



(Source) sorghum project team

添付資料 A-6
第三回運営委員会配布資料（マニュアル）

(DRAFT)
Manual
on
mechanized sorghum cultivation
and silage production in Cambodia¹

October 10, 2019

JICA Sorghum Project

¹ This document has been prepared, in accordance with BASIC AGREEMENT and the subordinate agreement made between JICA and ANP, for the use of MAFF and CMAC, assuming that CMAC and local farmers may start commercial activities as a successor of JICA sorghum project. This document focuses on technical and practical aspects of sorghum cultivation and silage production and does not specifically refer to how to operate machineries and their maintenance.

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1. Sorghum Cultivation

1-1 Sorghum seeds

Generally speaking, sorghum can be classified into the following 5 categories. It was Sorgho type that JICA project has used for the life of the project. It is normally said that sorgho type, Dual purpose type and Sudan type can be suited for the production of silages. Among them, sorgho type is of highest yield.

(Table 1) Types and characteristics of sorghum

Categories	Main Characteristics	Usages			
		Hay	Fresh	Silage	Grain
1. Sorgho	1) Hight: Long length culm (>2.5 m) 2) Feature: Thick stem		●	●	
2. Dual purpose	1) Middle length culm (\approx 2m) 2) Feature: Used for silage, fresh or grain			●	●
3. Grain	1) Short culm (1.5 m) 2) Feature: High percentage of grain				●
4. Sudan	1) Hybrid of grain type and sudangrass 2) Feature: High regrowth ability		●	●	
5. Sudangrass	1) Thin stem, many tillers 2) High re-growth ability	●	●		

(Photos)



Sorgho type



Dual purpose type



Grain type



Sudan type



Sudangrass

1-2 How to get sorghum seeds

It is possible for the business entity to purchase sorghum seeds in the market place in Phnom Penh. These sorghum seeds are imported mainly from Australia and Brazil. It is generally observed that Australian seeds are of high yield and expensive and Brazilian seeds is of modest and cheapest. There seems to be no large difference between the two.

You are required to make a purchase order for next year cultivation to one of seeds import company, at the latest, in July/August each year, about 6 months earlier than sowing in April. Seed company which you may contact is as follows:

《Seed company》

Company name	Natural Farm Kirirom Co., Ltd
Address	#209 Sisowath Quay, Phnom Penh,
Contact person	Mr. Vira Leng
Contact no.	(855)12 321 568
Note	Variety: Sorghum Bicolor (IRAT 203) Price: US\$3/kgs (2019)

(Photo: A bag of sorghum seeds: IRAT203)



1-3 Soil Preparation

A) Selection of cultivation land and soil preparation

- Sorghum is rather delicate to moisture damage and thus, if possible, it will be better not to choose such lands as drainage is bad.
- It is advisable to set up water canal or reservoir, if possible.
- Small trees in cultivation lands need to be completely removed prior to machines' operation. Otherwise, these would become one of causes of machine's trouble.
- If there are many weeds in a cultivation land, firstly, cut down weeds or destroy them by application of herbicide and plow-in after weeds are well blasted

B) Soil Improvement

《Use of composts》

- It is advisable to use composts in order to increase of yield based on good effects of making soil improvement and prevention of replant failure
- Appropriate amount of compost application will be 30-50 t/ha.
- Use manure composts and if “immature” composts are applied, it may damage to roots of sorghum to consume nitrogen in the soil.
- Compost application must be made and be plowed in, at least one month prior to sowing operation.

《Control of soil pH》

- Appropriate soil pH for sorghum cultivation might be in the range of pH 5.0 and 8.5.
- Sorghum cannot grow up in highly acidic soil. If soil pH of your land is highly acidic soil, Alkaline materials (Calcium carbonate, Magnesium lime, Slaked lime etc.) must be applied to increase the pH level of soil.
- Appropriate amount of lime to be applied to land to increase pH 1 is said to be 1-4 ton per ha, though it is different, needless to say, based on soil condition and the kind of material applied.
- Adjustment of soil pH must be made at least two weeks earlier than sowing operation.

《Plowing》

- Plowing needs to be made at least twice. In the case of “uncultivated” land or hard soil, about 5 times plowing is required to make.
- Land leveling is important, especially in the case of mechanized cultivation, to avoid to have puddles and to attain smooth operation of machineries.
- After plowing, harrowing is required to make soil fine earth.
- In the case of land that drainage or air permeability is poor, ridges must be made by plowing machine.

《Schedule of land preparation》

	Preparatory work	Timing of operation	Remarks
1	Removal of trees/grass	Before plowing	If necessary
2	Land leveling	Before compost is applied	To implement
3	Compost application	One month prior to sowing	If necessary
4	pH control	two weeks before sowing	If necessary
5	Plowing and harrowing	One/two weeks before sowing	To implement

(Photos: land preparation)



(Photo: germination test)



1-4 Sowing

- Amount of seeds:15-30 kg/ha
- Interrow:50-70 cm
- Sowing depth: 2-5 cm
- Cultivation density: 20 plants/m²
- It is advisable that before sowing, germination rate is checked and the above-mentioned amount of seeds is adjusted.
- Planting distance:10 cm
- Appropriate cultivation density: 20 /m²
- If you use a press roller machine after sowing, germination rate will be improved.

(Photo: sowing distance)



(Photo: press roller machine in operation)



- Sowing is advisable to be made in rainy season when day length is long and rainfall is secured.
- Sorghum seeds must be stored in a cool and dry place. Furthermore, seeds must be protected from insects and wide rats.
- Number of harvests can be 1-3 times per annum.
- Time required for 1st crop harvest is 3-4 months and time required for 2nd and 3rd crop takes about 2 months.
- The most appropriate cultivation period will be in the period of May-November when enough rainfall can be expected.

(Example of Cultivation Schedule)

Cultivation pattern	Harvest times	3	4	5	6	7	8	9	10	11	12	1
May sowing	2~3	Land preparation	Sowing				1st harvest			2nd harvest		(3rd harvest)
August sowing	1~2				Land preparation		Sowing				1st harvest	(2nd harvest)

1-5 Fertilizer application

- Fertilizer is required to be applied in accordance with the following plan. In addition, it may make an application of additional fertilizer during the growth period of first crop, if you find it necessary.

(Fertilizer application)

Unit: kg/ha

	Application time	N	P	K
Basal fertilizer	At the time of sowing	100	150~200	100
Topdressing*	30 days after sowing (8-10 leaves)	50	—	50
Topdressing	After harvesting	50	—	—

* if necessary.

(Photos: Fertilizers and application of fertilizers by broadcaster)



1-6 Maintenance of cultivation field

《Irrigation》

- Sorghum is said to be resistant to drought. However, a minimum of irrigation is required for reasonable growth.
- Cultivation yield can be affected on whether enough irrigation is provided or not. Especially, it is advisable to secure irrigation timely in the period of 20-25 days after sowing to foster root spread.

《Weed control》

- If weeds grow up, sorghum growth will be easily hampered and it will negatively affect on cultivation yield. Thus, it is recommended to use "herbicides" at least 30 days prior to harvest in view of chemical residue.

《Use of herbicides》

- It is recommendable for sorghum cultivation to use "Basagran" (see photo below)
- Herbicides must be used 30 days before harvest.
- In the case that herbicides are used, field worker must wear long sleeve shirt, long pants, shoes, goggles, mask, to avoid any health problem arising from chemical agent.

(Herbicide application)

Application timing	Herbicide name	Note
Land preparation	Roundup	In the case that there is a lot of weeds.
After 14 days sowing	Basagran	Once In the case that there is a lot of weeds.
After 1 st harvesting	Basagran	In the case that there is a lot of weeds.

- Usage example of "Basagran® 48 SL"
 - Use 1-1.5 liters of Basagran® 48 SL per hectare.
 - Mix 1 liter Basagran® 48 SL with 123-267 liters water.

(Photo: Basagran® 48 SL)



《Trading company (A) to contact to purchase》

Company name	Agrotrade Investment Co., Ltd
Contact person	Mr. Kim
Contact no.	(855)17 726 727/90 560 000
E-mail	agrotradeiph@gmail.com

《Trading company (B) to contact to purchase》

Company name	Jebsen & Jessen CAMBODIA Co., Ltd
Contact person	Mr. Piseth Try
Contact no.	(855)10 888 001/12 681 881
E-mail	Piseth_try@jjsea.com

1-7 Harvest

- Harvest must be made in the period between boot stage and dough-ripe stage from the viewpoint of yield and nutritional value.

(Photo: sorghum by growth stage)



(Note: From left: boot stage, heading stage, grain-filling stage, dough-ripe stage)

- Sorghum contains toxic ingredients at the early stage of growth and therefore, sorghum should not be harvested by the time when sorghum grows up at the height of 100 cm.
- If soil is included in a sorghum roll, it may give a negative impact on the quality of silage. Thus, as for sorghum harvest, sorghum harvest must be made at 10-15cm high from the surface of soil to avoid inclusion of soil into silage.
- Harvest is advisable to undertake when the surface of soil has become dry to avoid the decrease of regeneration power of sorghum (second crop).
- After harvest, additional fertilizer can be applied to promote the regeneration of sorghum (second crop).

1-8 Others; risks and coping in cultivation

《Lodging》

- When sorghum grows at the height of 250 cm, lodging risk increases because of heavy rainfall or strong wind. In the case of height of 200 cm, sorghum can have the potential power to recover after falling down.
- lodging risk may be minimized by (A) root spread based on soil improvement and/or (B) sorghum stem is thickened by decrease of planting density.

《Pest/other disease control》

- It is important to note that pesticides should not be used for sorghum cultivation. Moreover, pesticides for corn cultivation should not be applied to sorghum because it may cause chemical hazard, since appropriate pesticides may not be available in Cambodia.
- In the case that disease becomes critical, affected sorghum should be cut down to prevent spreading disease and mowed sorghum should be destroyed.

《Birds damage》

- When grain-filling season comes, generally speaking, bird damages increase and thus, if cultivation field is located in such a place where birds damage have been reported, when the ears of sorghum appear, it will be better to start harvest soon.

2. Silage Production

2-1 Silage production system

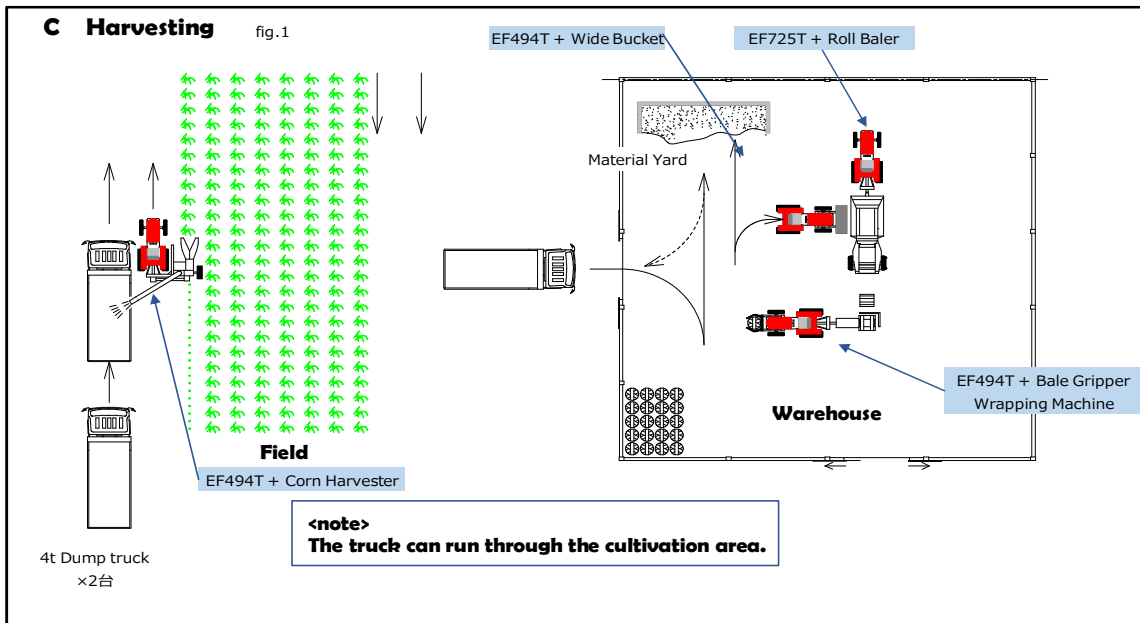
Two different kinds of silage production system have been taken by JICA project. That is, (1) Warehouse production type and (2) Field production type. It is the field manager's decision which system should be taken, today or tomorrow, based upon latest weather forecast, taking into consideration the fact that it is not possible to operate "roll baler" in a rainy day.

A) Warehouse production type

This type of silage production is composed of the following activities:

- 1) Harvest;
- 2) Sorghum transport by dump trucks from field to warehouse;
- 3) Roll-making in the warehouse;
- 4) Roll-rapping.

(Diagram: process of silage production)

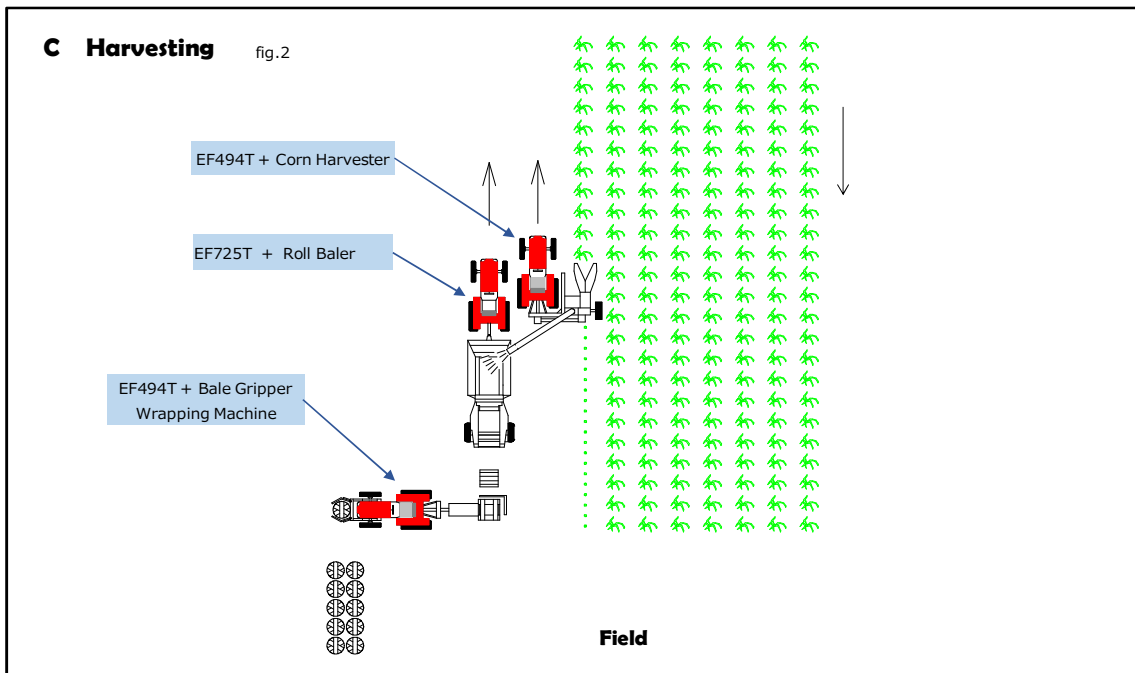


B) Field production type

This type of silage production is composed of the following activities:

- 1) Harvest;
- 2) Roll-making in the field;
- 3) Roll-rapping in the field;
- 4) Roll transport by trucks from field to storage.

(Process of silage production)



2.2 Advantages and disadvantages re silage production system

Following table shows advantages and disadvantages of 2 systems.

(Advantages and disadvantages)

Type	Advantage	Disadvantage
Warehouse type	<ul style="list-style-type: none"> • Higher material recovery • Little soil contamination in the roll 	<ul style="list-style-type: none"> • Required multiple dumps for raw material transport
Field type	<ul style="list-style-type: none"> • Fewer tractors and operators • No need to have a work space for making silage 	<ul style="list-style-type: none"> • Crop harvest loss due to small hopper size of roll baler • Soil is easy to mix into the roll*

(Photos: Warehouse production type)



(Photos: Field production type)



2.3 Points to note for silage production

- 1) In order to enhance sorghum density in rolls, harvester should be set for 1-2cm as shred length.
- 2) Wrap film should be wrapped at least 6 time per one roll to maintain good anaerobic condition. If the number of wrapping is fewer than 6 time, it may be difficult to maintain good anaerobic condition and thus, it may happen that rolls will be damaged during silage transportation and delivery.
- 3) It is advisable to use lactic acid bacteria additives to facilitate fermentation in rolls,

2.4 What is the function of Lactic Acid Bacteria Additive?

- 1) Main function of Lactic Acid Bacteria Additive is to enhance and keep good fermentation in rolls.
- 2) In order to enhance fermentation, it is required to add more than 10^5 (Lactic Acid Bacteria Additive) per 1g (material)
- 3) Usage example of lactic acid Bacteria additive (JICA project)
 - Products name: BPS / Made in Japan

- Additive amount: 0.1 litter BPS + 1 litter water per 1ton row material
- For your information, see the following information relating to ingredients of BPS:

(Specification of lactic acid bacteria additives (BPS))

Item		genus	species
1. Lactic acid bacteria	bacillus	Lactobacillus	casei-1
		Lactobacillus	casei-2
		Lactobacillus	acidophilus
		Lactobacillus	plantarum
	coccus	Streptococcus	Lactis
		Streptococcus	cremoris
		Streptococcus	thermolilus
		Streptococcus	diacetiactis
		Enterococcus	faecalis
		Leuconostoc	cremoris
		Leuconostoc	mesenteroides
		Pediococcus	halophilus
	2. Yeast	Saccharomyces	fragilis
Saccharomyces		florentimus	
Saccharomyces		cerevisiae	
Candida		arborea	
Rhodotorula		Spp.	
3. Others	Bacillus	spp.	
	Bacillus	subtilis-1	
	Bacillus	subtilis-2	
	Clostridium	butyrium	
	Cblorella	bulgaris	

2.5 Procurement of Lactic Acid Bacteria Additive

You are required to make contact with the following company to procure lactic acid bacteria additive.

(Trading company to contact)

Company name	Kong Nuon Group Co., LTD
Address	No. 220 Oknha Tep Plan Street 182 Sangkat Phsar Depo 1, Khan Touk Kork 12153
Contact person	Mr. Sarun/ Mr. Bunnath Pha
Contact no.	(855) 89 555 766
Note	<ul style="list-style-type: none">➤ Import of Lactic Acid Bacteria is required first to obtain import permit from MAF. In order to contact the trading company, you are required to contact the following person to get an advice:➤ <u>Ms. Milleth Tortal</u> MD-Trading and Business Solution Co., Ltd Room 503 No. 106 Street 432, Toul Tom Pong2, Chamkarmon, Phnom Penh Telephone no.: +855 17669071

2.6 Self-made FJLB

- 1) It is possible to make fermented juice of epiphytic lactic acid bacteria ("FJLB") from your familiar grass that can easily be seen in Cambodia such as Napier grass or King grass.
- 2) It is needed to apply 0.5-1 kg (FJLB) to silage material per 1 ton.
- 3) How to make it:
 1. Mix 0.5 kg fresh grass with 1L water;
 2. Filter mixed juice with gauze;
 3. Add 10 g sugar to the bottle of juice and mix it;
 4. Seal the bottle to prevent outside air from entering;
 5. Incubate in the bottle, keeping temperature at 30°C for 3 days.
 6. After the completion of the above processes, retains it in refrigerator.

(Photos: process of FJLB production)



Before incubation



1st day



2nd day

2-7 Procurement of nets and films

(Specifications of net and wrap films used in JICA project)

Items	Specification	Note
Net	W1.05m*L2,000m	175 rolls/net 4.5 layers, silage size ϕ 85cm×85cm
Wrap Film	W500mm*L1,800m*25 μ m	34 rolls/wrap film 6 layers, silage size ϕ 85cm×85cm

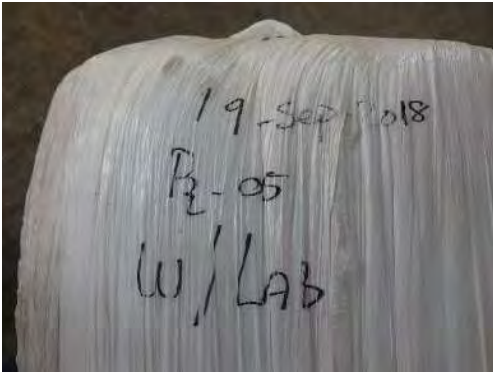
(Trading company to contact)

Company name	Kong Nuon Group Co., LTD
Address	No. 220 Oknha Tep Plan Street 182 Sangkat Phsar Depo 1, Khan Touk Kork 12153
Contact person	Mr. Sarun/ Mr. Bunnath
Contact no.	(855) 89 555 766
Note	<p>Make contact with the following to get advice on nets and films.</p> <ul style="list-style-type: none"> ■ <u>Ms. Milleth Tortal</u> MD-Trading and Business Solution Co., Ltd Room 503 No. 106 Street 432, Toul Tom Pong2, Chamkarmon, Phnom Penh Contact no. +855 17669071 ■ <u>Mr. Chem Sambath</u> CMAC JICA Project manager

2-8 Storage and transport of silages

- 1) It is important to describe the date of harvest and identification of field on the surface of roll after fermentation, to identify the order of roll delivery.
- 2) If one roll is damaged in the storage or during truck transportation, the damaged part must be removed and sealed by tape immediately to prevent outside air from flowing into.
- 3) It is not unusual that silage rolls are sometimes deformed due to high moisture content. For safety, compilation of silage rolls is advisable to be limited to 2 tears.

(Photo: storage of silage roll)



(Photo: piled rolls)



2-9 Fermentation and storage period

- 1) Fermentation is normally complete, 3 weeks after rolls are made.
- 2) A good quality of silage can maintain its freshness for 6-12 months.

2-10 Shipment procedure

A) Quality Inspection at the time of shipment

Quality check is usually made by random sampling method. That is, one roll per every 30~40 is selected and quality check is undertaken. In fact, sensory evaluation is made by making a small hole on the side of roll and collect a small amount of silage. After evaluation, the hole is sealed by tape.

Second check is to observe whether or not appearance of roll is damaged by sight. If a hole is found, it must be sealed by tape.

(Photo: quality check of silages)



(Photo: appearance of good silage)



(instant evaluation of the quality of silage)

Category	Grade	Color	Smell	Textures	pH	Feeding
Safety	A	Pale yellow, olive color	Pleasant light sweet-sour	Appropriate moisture and feels smooth	3.6~3.8	Can be fed in large quantities
	B	Brownish yellow	Sweet-sour smell with slightly stimulative smell	Water content is high, and exudate comes out when holding it tightly	3.9~4.2	Can be fed in large quantities
Danger	C	Dark brown	Ammonia smell, putrid smell	The water content is high, and exudate comes out even when gently grasped	4.2~4.5	Be careful in feeding
	D	Dark brown and dark green	Strong pungent smell	There is mold and it feels sticky.	> 4.6	Stop feeding to cattle

B) Quantity control

- Number of delivery rolls is checked at the time of shipment.
- A roll weight is measured by random sampling, say, one per every 30~40rolls.
- Calculate the total amount of silage delivery.
- the total amount of silage delivery = average value of rolls x number of delivery rolls.
- **Inspection report** is made.

(Photos: weight measurement)



(Photos: Silage Delivery (loading and unloading))



(Sample of Inspection Report)

JICA Project
ATTN: Mr. Taku Yonekura

**Trial Sale of Sorghum Silage
Carrying-out Inspection**

1. The following carrying-out (quality) inspection was made on the date indicated in the diagram described below for the use of MOO MOO FARMS, a dairy farm located in Kandal Province. Total number of rolls, which is dispatched MOO MOO FARMS is 139
(Note 1).

Date of harvest and silage roll production	Date of expected completion of fermentation	Date of inspection	Number of rolls	Serial no.
Nov/2-9	Nov/30	Dec/03	127	D3 + D4 = 1-27
Nov/11	Dec/03	Dec/03	12	D1 + D2 = 1-12
Total			139	

(Note 1) Rolls (139) were delivered to MOOMOO FARMS.

2. Quality inspection (quantity, quality and outer damage) of silage was conducted prior to carrying-out from warehouse and other designated place and loading onto a truck, and it was found that all silage was in good order.
3. Method of inspection is as follows:
- (A) Method: sampling: 3 silage rolls of 139;
 - (B) Inspection of outer appearance of rolls to find films' damages; and
 - (C) Quality inspection; silage appearance, touching, and smell.

Date of Inspection:

Chem Sambath (CMAC)/ Milleth Tortal

C) Receipt of silage rolls

- The Purchaser is requested to check the number of rolls and quality of silages at the time of arrival at the designated place.
- After the Purchaser's check, the following **Delivery Note** must be signed by the Purchaser for supplier's record keeping.

Sample of Delivery Note

JICA Silage Production Project
 CMAC CDC,
 Battambang
 Attn: Ms. Milieith Tortal
 Phone: + 855 17 669 071
 E-mail address:
 Milieithortal79@gmail.com

DELIVERY NOTE

To: MOO MOO FARMS Your Order Number: No.6 (2019)
 Address: Arey Khat Village Date of Delivery: February 07, 2019
Arey Khat Commune, Our Contact Person: Ms. Milieith Tortal
Lvea EM District, Telephone: + 855 17 669 071
Kandal Province
 Attention: Mr. Kenneth Matthews e-mail address: milieithortal79@gmail.com

The following delivery of the Goods (Sorghum Silages) was made based on Purchase Agreement of Sorghum Silage dated September 5, 2018 between Moo Moo FARMS ("Purchaser") and Applied Natural Products Co., Ltd. ("ANP" or "Supplier") on behalf of JICA Project.

As for the terms of payment, the Purchaser is expected to pay the Supplier by bank transfer within fifteen (15) days upon the receipt of sales invoice issued by ANP on behalf of JICA Project. The amount of payment is calculated based upon the actual amount of delivered silage and agreed price (USD 80 per ton) in the said Agreement.

Number of Rolls Delivered	Description
165	Fully wrapped rolls of sorghum silage

Goods received in good order

Name: Mr. Try Youn Signature:  Date: 9-2-19

D) Issuance of invoice

- Invoice must be issued to the Purchaser based on the Inspection Report and Delivery Note.

2-11 Unsealing of silages and precaution

- 1) It is recommended that the quality of silage will be deteriorated with the lapse of time after silage roll is unsealed. Therefore, it is advisable to consume it within 2 days.
- 2) In the case of storage of an unsealed roll, it must be sealed by tape to prevent outside air from flowing in it.
- 3) If you find mold a bit, get the mold off from a silage roll.
- 4) If you find that silage is obviously decayed or covered by a lot of mold or silage, don't consume the silage and destroy it.
- 5) Pay due attention not to allow cattle to eat nets and/films of silage rolls. Nets and films must be clearly removed from a mass of silage feeds.

End//

添付資料 A-7
事業計画作成に関する CMAC/MAFF 向けレクチャー

Lecture to CMAC senior staff
concerning draft business plan
for the proposed agricultural cooperative¹

November 19, 2019

Yuji SEGOSHI
Applied Natural Products Co., Ltd.

¹ This document has been prepared for the purpose of lecture to CMAC senior staff who participated in JICA sorghum project for the past two years. This document includes two materials used for respective lecture (SECTION 1 and 2) held in October and November, 2019 respectively. All views and opinions expressed in this document are only the writer's views and do not necessarily reflect ANP's official opinions.

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 3. “Implementers” of business plan
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SECTION 2

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-

SECTION 1

1. Starting Balance Sheet

1.1 When an agricultural cooperative (“AC”) is established by a group of people, capital contribution is made from each participant as a result of the admission of new member. Such a capital contribution is referred to as “share subscription” by each member of the AC. The following is the “starting” balance sheet” which shows financial position of the AC, after the payment of subscribed share is made by each member of the AC and before any costs and expenses occur:

Diagram S1-1: Starting Balance Sheet

Unit: USD			
Assets		Liabilities	
Cash & Bank Deposit	20,000	Shareholders' equity	20,000
Total Assets	20,000	Total Liability	20,000
(Note) Number of AC member is assumed to be 20, and price of one share is assumed as USD 1,000.			

2. Available Fund for Operational Costs and Expenses

2.1 As you see in Diagram S1-1 (hypothetical), described above, the fund available for the operation of the AC is limited to the amount of USD 20,000, which is deposited at the AC’s newly opened bank account. This amount of money is deemed to be not enough to cover the projected amount of expenditure for the full period of the first year, unless the AC obtains loans from a bank or the third party or a subsidy is granted by the government or others.

2.2 According to the draft business plan, the total amount of expenditure for the first year is projected as about USD 80,000, including personnel expenditure and operating costs and expenses. The difference between USD 80,000 and USD 20,000 needs to be discussed and filled in, anyway, even though some profit arises from the second year’s operation of JICA project and this can be reserved and used for the first year’ operations. An appropriate explanation is required to be made on this issue in the final business plan.

3. “Implementers” of Business Plan

3.1 The following names are described as “implementers”, amongst others, in the draft business plan². In fact, the expression of “implementers” appears to be rather unusual and irrelevant and it is not clear whether or not the drafter of this business plan has intended to show something special by using this word, “implementers”:

- 1) CMAC Senior Staff and Management Team;
- 2) CMAC-AC Board of Directors, Supervisory Committee, and Executive Manager;

First of all, it should be pointed out that it will not be appropriate for the drafter to describe, first, who will be an actual “implementer” of this business as a project promotor, in addition to the internal organs of the AC, all of which are described by the Law on Agricultural Cooperatives (“Law”). It is obvious that if the implementer means the “doer” of this business, “implementer” is deemed to be the AC and its members from the legal point of view.

3.2 You should refrain from mixing-up of legal positions of the AC and CMAC and others in the business plan, when you touch upon the subject of organizational and operational structure of the AC. The relationship between CMAC and the AC should be defined clearly and separately to refer to the Law, taking into account ordinary discussions on the concept of “Governance”, which is discussed rather in detail in the Section 8. The AC must be the doer or business entity which is defined by the Law. On the other hand, CMAC will be the supporter to the AC.

3.3 Indeed, CMAC’s involvement and participation in the operation of the AC needs be described in clear terms under the heading of “legal relationship with the AC”. Doer of this business must be the AC itself and the AC must be “independent” from CMAC and others. Thus, you should identify what kinds of supports CMAC keeps in mind in its cooperative activity for the AC. These includes technical, operational and/or financial supports?

3.4 If you fail to describe the legal position of these names, the application on the AC establishment, which include the current description on its organization and structure, is likely to be rejected by the pertinent office of MAFF or you would be asked to make amendments to avoid a conflict with the pertinent provisions of the Law and the spirit of Governance implied in the Law on the sound management of agricultural cooperatives.

3.5 For the above consideration, your attention is invited to pay to and discuss about the following issues, all of which are required to show in the final business plan:

- (1) To identify the legal instrument which describes the right of the AC to use the machineries and warehouse, legal titles of which is scheduled to be transferred by

² CMAC/CMAC-AC Draft Business Plan, p.4.

JICA to MAFF;

- (2) Whether or not financial support is kept in mind by CMAC; and
- (3) As for the medium and long-term management plan and the vision of the AC, how deeply CMAC intend to cooperate with the AC.

4. Cultivation Periods

4.1 It would be better for the AC to make sowing in April rather than in June and harvest in July when rainy season tends to have a short break in recent years. As for harvest of the second generation, it will be advisable to be made in October or November, based on the two years' experience of JICA project. After all, the main advantage of this choice should be found to be an avoidance of shortage of rainfall.

5. Fixed Asset Investment

5.1 It was observed in the draft business plan that the size of cultivation land is projected to expand gradually in five years, without any explanatory note on the necessity of fixed asset investment in machineries for five years to come. Current assumption of cultivation expansion plan is as follows: Y1 (20ha), Y2 (30ha), Y3 (40ha), Y4 (50ha), Y5 (60ha).

5.2 As mentioned often before, according to the specifications of our machineries, it may be possible to say that the capability of our existing machineries can cover, only, 20ha for sorghum cultivation and silage production, which means that you are required to project to purchase at least one additional harvester in Y2 and one roll baler and one wrapping machine, say, in Y3. In addition, one full set of machineries will be required to get in Y4 or Y5. It will be one of the critical points to note that our harvester sets a capacity limit in view of on the limit of cultivation capacity.

5.3 All these considerations are required to make from the financial point of view, paying attention to the amount of cumulated retained earnings (profit and loss account and balance sheet). Otherwise, draft business plan will be a "castle in the sky", if you fail to show the realistic plan supported by source of funds.

6. Depreciation

6.1 It is natural to say that when fixed asset investment is planned in line with projected business expansions, "depreciation" on these investments and its impact on the "operating profit" appeared in the profit and loss account is needed to be discussed in the business plan. On this issue, kindly see attachment³ as a sample relating to the schedule

³ This sample is shown as a sample spreadsheet and has no connection with the current draft business plan.

of depreciation and its supporting breakdown information: see P.7 and P.8.

7. Profit distribution

7.1 Profit distribution is described in P. 5 of your draft business plan, referring to Article 59 of the Law. However, it should be said that dividend payment is not referred in the draft and it will be advisable that the willingness of AC regarding dividend payment is clearly mentioned in the business plan, in addition to the payment of land leasing fee, even though payout ratio will be determined at the later stage, since most of Cambodian nationals have not yet been familiar with dividend payment.

8. Governance

8.1 As mentioned earlier, the description in relation to “Governance” or “Good Governance” of the AC seems to be not enough in the draft business plan, which focuses only the formalism aspect of Governance, described in the national legislation, such as “General Meeting”, “Supervisory Committee”, “Board of Directors”, “Executive Manager”.

8.2 Your attention should be paid to the more basic and realistic aspect of the AC’s management, most of which may be derived from your imagination on what kinds of support AC is actually required to get from outside sources, including CMAC and others (“CMAC”). This will be closely connected with the issue of “Governance” or “Good Governance”.

8.3 It is usually described when a business organization is discussed in view of its good management and growth possibility of organization, irrespective of nationality, that the effectiveness of commercial companies and agricultural cooperatives heavily depends on the existence of pillars of “Good Governance”, which is composed of (a) participation, (b) accountability, (c) transparency, and (d) rule of law.

8.4 In addition, having referred to a number of academic writings relating to performance of agricultural cooperatives in developing countries, it is often revealed that the following issues were found to be major causes for weak performance of ACs:

- A) “inadequate participation”
- B) “poor responsiveness”
- C) “lack of awareness about management”
- D) “lack of democracy”
- E) “corruption”
- F) “poor sense of ownership”
- G) “double responsibility”
- H) “lack of member’s awareness”

8.5 In order to improve and strengthen the potential capability of the ACs, the following issues should be found to be significant impacts on the performance of agricultural cooperatives.

- A) "Participation";
- B) "Accountability";
- C) "Transparency"; and
- D) "Rule of law".

8.6 When an agricultural cooperative is discussed on its set-up among parties concerned, the first matter to be touched on the organizational structure is how to be "independent" from its owner, shareholder and other influential institution which intend to keep close operational relationship with the ACs.

8.7 All these relationships must be evaluated and defined carefully from the "legal" point of view and clearly described in the business plan. Especially, the principle of cohesion of a cooperative should be referred to participation of members, monitoring the management and expressing their interest. Strengthening participation, feeling of property belonging and representativeness will be crucial for Good Governance of ACs.

8.8 For the consideration of Good Governance, it should be the focal point for you to consider and accurately describe the legal relationship between the AC and CMAC for the pursue of the way for Good Governance of the AC in accordance with the pertinent provisions of the Law.

End//

APPENDIX-(A)

Financial Projections (JV company) 1/3											
P/L	(Unit : USD)										
	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	
Revenue	707,786	1,061,679	1,415,572	1,769,465	2,123,358	2,477,251	2,831,144	3,185,037	3,538,931	3,892,824	100%
Total Expenses A=B+C+D	321,192	371,638	434,408	570,073	615,245	671,861	799,809	845,757	906,954	959,876	25%
1. Personnel Expenses B	95,300	95,300	104,500	114,250	114,250	121,250	126,250	129,250	140,250	140,250	4%
(A) Managemnet (1 staff)	35,000	35,000	35,000	38,000	38,000	38,000	41,000	41,000	41,000	41,000	1%
(B) Senior management Staff	35,000	35,000	35,000	38,000	38,000	38,000	38,000	41,000	41,000	41,000	1%
(C) Senior factory management staff	8,000	8,000	8,000	10,000	10,000	10,000	12,000	12,000	12,000	12,000	0%
(D) Administratve staff (2 staff at the begining)	4,800	4,800	9,000	9,000	9,000	10,500	10,500	10,500	16,000	16,000	0%
(E) Factory workers (3 staff at the begining)	7,500	7,500	10,000	11,000	11,000	13,750	13,750	13,750	16,500	16,500	0%
(F) Warehouse workers (2 staff at the begining)	5,000	5,000	7,500	8,250	8,250	11,000	11,000	11,000	13,750	13,750	0%
2. Operating Expenses C	160,892	223,838	286,783	354,729	417,675	480,621	548,567	611,513	676,708	740,879	19%
(A) Electricity	36,000	54,000	72,000	90,000	108,000	126,000	144,000	162,000	182,250	200,475	5%
(B) Fuel Expenses	27,273	40,910	54,546	68,183	81,819	95,456	109,092	122,729	136,365	150,002	4%
(C) Purchase cost of MCM	39,026	58,539	78,052	97,565	117,077	136,590	156,103	175,616	195,129	214,642	6%
(D) Transportation cost	23,593	35,389	47,186	58,982	70,779	82,575	94,371	106,168	117,964	129,761	3%
(E) Machinery maintenance expenses	6,000	6,000	6,000	7,000	7,000	7,000	8,000	8,000	8,000	9,000	0%
(F) Casualty insurance expenses	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	0%
(G) CPA expenses	9,000	9,000	9,000	10,000	10,000	10,000	11,000	11,000	11,000	11,000	0%
(H) Counsel	3,000	3,000	3,000	4,000	4,000	4,000	5,000	5,000	5,000	5,000	0%
(I) Office Lental	5,000	5,000	5,000	6,000	6,000	6,000	7,000	7,000	7,000	7,000	0%
(J) Others (miscellaneous expenses)	9,000	9,000	9,000	10,000	10,000	10,000	11,000	11,000	11,000	11,000	0%
3. Depreciation D	65,000	52,500	43,125	101,094	83,320	69,990	124,993	104,995	89,996	78,747	2%
Operating Profit	386,594	690,042	981,164	1,199,392	1,508,113	1,805,390	2,031,335	2,339,280	2,631,976	2,932,947	75%
Sales Commission (20% of Total Revenue)	141,557	212,336	283,114	353,893	424,672	495,450	566,229	637,007	707,786	778,565	15%
Operating Profit (including Sales commission)	245,037	477,706	698,049	845,499	1,083,441	1,309,940	1,465,106	1,702,273	1,924,190	2,154,382	60%
EBITDA	310,037	530,206	741,174	946,593	1,166,762	1,379,930	1,590,099	1,807,267	2,014,186	2,221,105	62%
Corporate Tax (20%)	49,007	95,541	139,610	169,100	216,688	261,988	293,021	340,455	384,838	429,272	12%
Profit after Tax	196,030	382,165	558,440	676,399	866,753	1,047,952	1,172,085	1,361,818	1,539,352	1,771,833	48%
(yen conversion)	22,151,364	43,184,606	63,103,668	76,433,134	97,943,095	118,418,576	132,445,597	153,885,474	173,946,791	212,110,760	
Dividend (30%)	0	114,649	167,532	202,920	260,026	314,386	351,625	408,546	461,806	563,126	14%
Undistributed Profit (70%)	196,030	267,515	390,908	473,480	606,727	733,566	820,459	953,273	1,077,546	1,313,960	34%
Cumulated Undistributed Profit	200,030	467,545	858,453	1,331,932	1,938,659	2,672,226	3,492,685	4,445,958	5,523,505	6,837,465	176%
(yen conversion)	22,603,364	52,832,588	97,005,155	150,508,349	219,068,516	301,961,519	394,673,437	502,393,269	624,156,023	772,633,554	

APPENDIX-(B)

depreciation method	initial investment	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y0	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20	Y21	Y22	Y23	Y24	Y25	Y26							
	%	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046							
total annual depreciation	150,000	65,000	52,500	43,125	101,094	83,220	69,990	124,993	104,995	89,996	76,147	52,495	46,871	42,653	21,674	20,006	18,754																		
1 outstanding	50,000	65,000	52,500	43,125	36,094	30,920	26,865	23,899	21,674	20,006	18,754																								
2 outstanding	50,000			65,000	52,500	43,125	36,094	30,920	26,865	23,899		21,674	20,006	18,754																					
3 outstanding	50,000						65,000	52,500	43,125	36,094		30,920	26,865	23,899	21,674																				
NO.1 fixed asset investment	500,000	100%	485,000	382,500	339,375	303,281	272,461	245,596	221,697	200,023	180,007	161,263																							
annual amount of depreciation		65,000	52,500	43,125	36,094	30,920	26,865	23,899	21,674	20,006	18,754																								
declining balance method (25%)	15,000	3%	11,250	8,438	6,328	4,746	3,560	2,670	2,002	1,502	1,126	845	634	475	356	267	0																		
declining balance method (25%)	50,000	10%	37,500	28,125	21,094	15,820	11,865	8,899	6,674	5,006	3,754	2,816	2,112	1,584	1,188	891	0																		
declining balance method (25%)	100,000	20%	75,000	56,250	42,188	31,641	23,730	17,998	13,348	10,011	7,508	5,631	4,224	3,168	2,376	1,782	0																		
declining balance method (25%)	35,000	7%	25,000	18,750	14,063	10,547	7,910	5,933	4,449	3,337	2,503	1,877	1,408	1,056	792	594	1,782																		
declining balance method (25%)			8,750	6,563	4,922	3,691	2,769	2,076	1,557	1,168	876	657	493	370	277	208	624																		
straight line depreciation (5%)	300,000	60%	285,000	270,000	255,000	240,000	225,000	210,000	195,000	180,000	165,000	150,000	135,000	120,000	105,000	90,000	75,000	60,000	45,000	30,000	15,000	0													
			15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000					
NO.2 fixed asset investment	500,000	100%				485,000	382,500	339,375	303,281	272,461	245,596	221,697	200,023	180,007	161,263																				
annual amount of depreciation						65,000	52,500	43,125	36,094	30,920	26,865	23,899	21,674	20,006	18,754																				
declining balance method (25%)	15,000	3%				11,250	8,438	6,328	4,746	3,560	2,670	2,002	1,502	1,126	845	634	475	356	267	0															
declining balance method (25%)	50,000	10%				37,500	28,125	21,094	15,820	11,865	8,899	6,674	5,006	3,754	2,816	2,112	1,584	1,188	891	0															
declining balance method (25%)	100,000	20%				75,000	56,250	42,188	31,641	23,730	17,998	13,348	10,011	7,508	5,631	4,224	3,168	2,376	1,782	0															
declining balance method (25%)	35,000	7%				25,000	18,750	14,063	10,547	7,910	5,933	4,449	3,337	2,503	1,877	1,408	1,056	792	594	1,782															
declining balance method (25%)						8,750	6,563	4,922	3,691	2,769	2,076	1,557	1,168	876	657	493	370	277	208	624															
straight line depreciation (5%)	300,000	60%				285,000	270,000	255,000	240,000	225,000	210,000	195,000	180,000	165,000	150,000	135,000	120,000	105,000	90,000	75,000	60,000	45,000	30,000	15,000	0										
						15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000				
NO.3 fixed asset investment	500,000	100%				485,000	382,500	339,375	303,281	272,461	245,596	221,697	200,023	180,007	161,263																				
annual amount of depreciation						65,000	52,500	43,125	36,094	30,920	26,865	23,899	21,674	20,006	18,754																				
declining balance method (25%)	15,000	3%				11,250	8,438	6,328	4,746	3,560	2,670	2,002	1,502	1,126	845	634	475	356	267	0															
declining balance method (25%)	50,000	10%				37,500	28,125	21,094	15,820	11,865	8,899	6,674	5,006	3,754	2,816	2,112	1,584	1,188	891	0															
declining balance method (25%)	100,000	20%				75,000	56,250	42,188	31,641	23,730	17,998	13,348	10,011	7,508	5,631	4,224	3,168	2,376	1,782	0															
declining balance method (25%)	35,000	7%				25,000	18,750	14,063	10,547	7,910	5,933	4,449	3,337	2,503	1,877	1,408	1,056	792	594	1,782															
declining balance method (25%)						8,750	6,563	4,922	3,691	2,769	2,076	1,557	1,168	876	657	493	370	277	208	624															
straight line depreciation (5%)	300,000	60%				285,000	270,000	255,000	240,000	225,000	210,000	195,000	180,000	165,000	150,000	135,000	120,000	105,000	90,000	75,000	60,000	45,000	30,000	15,000	0										
						15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000			
1) Machine																																			
2) machine																																			
3) machine (x 2)																																			
4) machine																																			
5) construction																																			
NO.1 fixed asset investment	500,000	100%				485,000	382,500	339,375	303,281	272,461	245,596	221,697	200,023	180,007	161,263																				
annual amount of depreciation						65,000	52,500	43,125	36,094	30,920	26,865	23,899	21,674	20,006	18,754																				
declining balance method (25%)	15,000	3%				11,250	8,438	6,328	4,746	3,560	2,670	2,002	1,502	1,126	845	634	475	356	267	0															
declining balance method (25%)	50,000	10%				37,500	28,125	21,094	15,820	11,865	8,899	6,674	5,006	3,754	2,816	2,112	1,584	1,188	891	0															
declining balance method (25%)	100,000	20%				75,000	56,250	42,188	31,641	23,730	17,998	13,348	10,011	7,508	5,631	4,224	3,168	2,376	1,782	0															
declining balance method (25%)	35,000	7%				25,000	18,750	14,063	10,547	7,910	5,933	4,449	3,337	2,503	1,877	1,408	1,056	792	594	1,782															
declining balance method (25%)						8,750	6,563	4,922	3,691	2,769	2,076	1,557	1,168	876	657	493	370	277	208	624															
straight line depreciation (5%)	300,000	60%				285,000	270,000	255,000																											

SECTION 2

1. Issues to note in view of “Cooperative Governance”⁴

1-1 What is “**Cooperative Governance**”? This can be considered in the same context of “Corporate Governance” and “Public Governance”. Cooperative Governance is said to be a set of internal and external mechanisms and controls enabling the members to define and ensure attainment of cooperative objectives, securing their continuity and cooperative principles.

1-2 This lecture focuses on the aspect of the relationship between the proposed agricultural cooperative and CMAC, which may be required to be clearly described in the business plan in accordance with internationally recognized “**Cooperative Principles**” that can be said as the guidelines which cooperatives put their value into practice irrespective of their nationality.

2. What are internationally recognized “Cooperative Principles”

2-1 Internationally recognized Cooperative Principles means the statement on the “Cooperative Identity” adopted by International Cooperative Alliance, Brussels, in 1995, which contains (a) the definition of a cooperative, (b) the values of cooperatives and (c) seven cooperative principles, listed below, all of which are shared by the Government of Cambodia and formally amalgamated in the provision of Article 1 of Cambodian Law on Agricultural Cooperatives 2013.

《Cooperative Principles》

- 1) Voluntary and open membership;
- 2) Democratic member control;
- 3) Member economic participation;
- 4) Authority and independence;
- 5) Education, Training and information;
- 6) Cooperation among cooperatives; and
- 7) Concern for community.

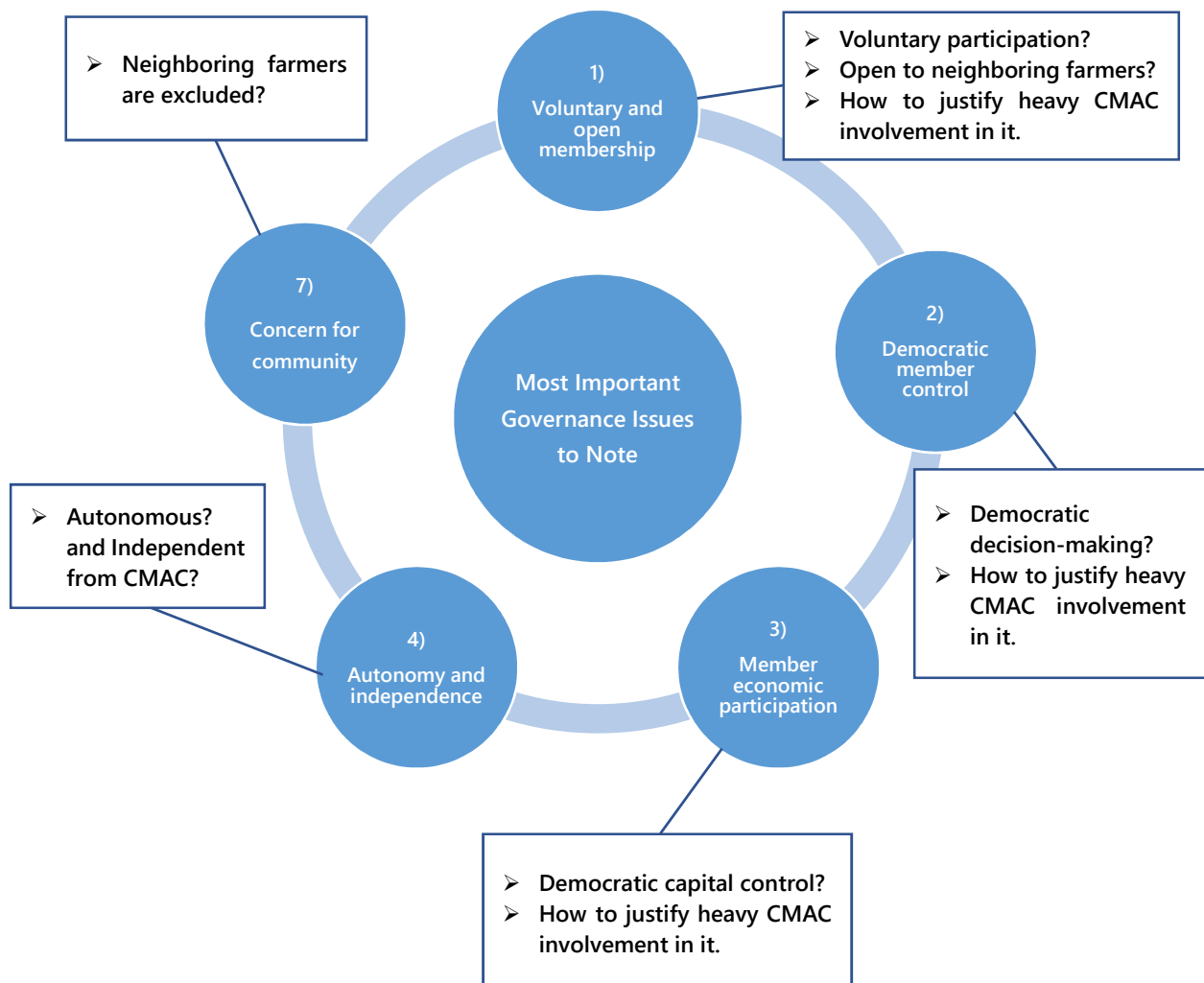
⁴ For reference on basic information relating to cooperative principles and cooperative governance, the following academic articles and publications were mainly referred to in this document: 1) International Cooperative Alliance, “Cooperative Governance fit to build resilience in the face of complexity”, 2015; 2) Banco Central do Brasil, “Cooperative Governance-Guidelines for Good Practices of Financial Cooperative Governance”, October 2008; 3) R. Dayanandan, “Good Governance Practice for Better Performance of Community Organization-Myths and Realities”, Journal of Power, Politics & Governance, Vol.1, December 2013, pp.10-26; 4) COOPERATIVE UK, “Corporate governance code for agricultural cooperatives”, 2013; 5) Campbell et al, “The Governance of Agricultural Cooperatives: Evidence from Spain”.

Of seven principles referred to above, 1) Voluntary and open membership, 2) Democratic member control, 3) Member economic participation and 4) Authority and independence and 7) Concern for community are to be touched on, one by one, later in this lecture.

3. Identification of critical issues for preparation of business plan

3-1 For discussion on structure of the proposed AC, the relationship between CMAC and the AC may be described as one of the most critical issues in view of Cooperative Governance. The following points, indicated in the Diagram below, fall within the scope of critical issue⁵.

Diagram S2-1: Important Issues to Note



⁵ It is natural that different cooperatives may take their own approach to Cooperative Principles mentioned on p.9. However, all cooperatives are required to disclose whether they have complied with these principles and where they have not done so, it must be needed to describe an fair explanation of the decision that they have taken instead.

4. Voluntary and open membership

4-1 Primarily, agricultural cooperatives must be voluntary organizations. However, as far as the CMAC-AC (“the AC”) is concerned, as a matter of fact, this project has been initiated by CMAC itself, including preparation of business plan. Therefore, in order to avoid unnecessary doubts relating to voluntary participation of the members, it would be better for CMAC to disclose explicitly its thought in the business plan that even though CMAC initiates the project for certain obvious purposes, the AC should be qualified as a voluntary organization, specifying the clear reason and explaining voluntary participation of former CMAC’s staff.

4-2 Furthermore, as for membership of the proposed AC, membership is deemed to be restricted to former CMAC staff excluding involvement of neighboring local farmers at the infant stage of development. In order for CMAC to show its openness relating to membership, an appropriate description should be added in the business plan relating to membership.

5. Democratic member control

5-1 ACs must be democratic organizations controlled by the members, who actively participate in setting policies and making decisions. On the other hands, in the case of CAMC-AC, its vision, strategy and other basic plans need to be described expressly in the business plan, though due process is ready to be taken by legitimate internal organs of the AC, after the AC is established. In this connection, it is advised that CMAC should make it clear on this issue, specifically declaring that CMAC has no intention to take action which is deemed to be harmful or defiant to democracy of the AC.

6. Member economic participation

6-1 The members of the AC is assumed, in Cooperative Governance, to contribute to and democratically control the capital of the AC. As for the capital of the AC, according to your draft business plan, the Government or possibly CMAC is expected to make capital contributions to the AC. In order to eradicate any doubt that the Government or CMAC may have the power to intervene in AC’s ordinary transactions, it may be better to describe the legal right of the members (one voting right per one member, irrespective of number of shares held) to control the AC through internal decision-making process and make it clear the legal meaning of capital contributions from the Government or CMAC.

7. Autonomy and independence

7-1 The AC must be an autonomous and self-help organization controlled by the members. On the other hand, as a matter of fact, CMAC is going to render its full support to the AC, hopefully, on a contract basis. If the AC enters into agreement with other organization, including the Government or raises fund from external sources, it can do so on terms that

ensure democratic control by the members and maintain its cooperative autonomy.

7-2 In this connection, CMAC is required to explain its thought in the business plan with respect to autonomy and independence of the AC. If CMAC fails to do so, one can say that the AC's autonomy and independence may be jeopardized by heavy supports from CMAC. This type of problem will never happen in ordinary cooperatives and further, this will be one of major characteristics of the proposed AC so that adequate information needs be disclosed with respect to the relationship between the AC and CMAC. Further, it would be appropriate for CMAC to make the following agreements and/or legal instruments with the AC:

- A) Business Plan for the AC which will be attached to the application relating to establishment of cooperative;
- B) Basic Agreement to conclude with the AC with respect to the legal relationship between the two and clarification of actual supports in general terms, including preparation of business plan/policies, administrative support, manpower support, machinery-related supports including machine operation and maintenance, financial support and so forth;
- C) Individual (Implementing) Agreement to conclude with the AC after Basic Agreement is concluded, which stipulates actual and respective support, one by one, in more detail. Additionally, it will be important for CMAC to mention (a) the reason why CMAC renders such supports to the AC and (b) that it has no intention to take any action harmful to the AC's good governance.

8. Concern for community

8.1 The following descriptions can be found in current business plan. It appears to be implied that CMAC have no keen interest in local community:

- ✓ Purpose of this business is to improve living for CMAC-AC members····· (Business Plan, P.1,"Purpose")
- ✓ The land owned by the member of CMAC-AC and other CMAC staff within CMAC CDC ···(Business Plan, P.2,"Sorghum Cultivation").

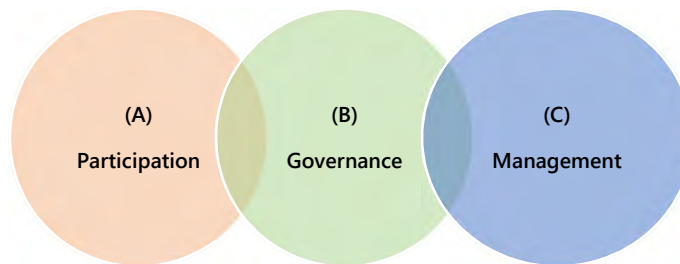
As referred to above, current draft business plan implies that all members of the AC are assumed to be former or incumbent staff of CMAC and draft business plan itself is fully dependent on CMAC's existing strategy on development of CMAC-CDC. Therefore, it appears that as a whole, draft business plan needs be modified to reflect your believed additional concern for development of rural area (local community) in Battambang, even though membership of the AC is limited to former or incumbent staff of CMAC at the initial stage⁶.

⁶ It is described in draft business plan prepared by CMAC that the composition of the AC members is of "provisional" and CMAC implies that the neighboring farmers who shows their interest in the activity of AC and is/are qualified to do so after the provisional period ends, they will be allowed to join the AC .

9. Dynamism of Governance

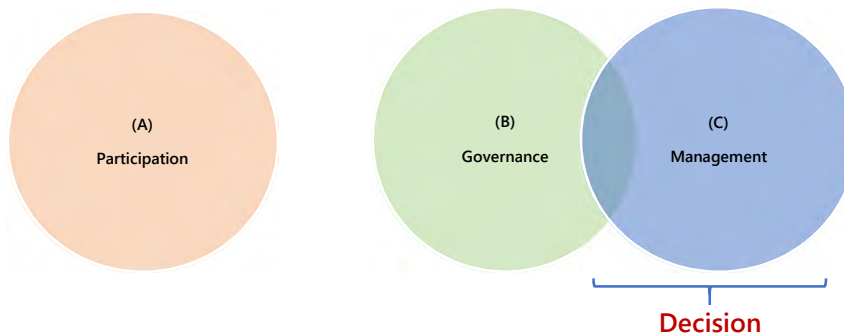
9-1 Cooperative Governance (B), indicated in Diagram S2-2 to S2-4 in the following page, provides the Board of Directors (“Board”) in which representatives from the members (A) can discuss, make decision and instruct the Management to take steering and coordination functions on important subjects, based on information which has been provided by the Management (C).

Diagram S2-2: Cooperative Governance in relation to Participation and Management



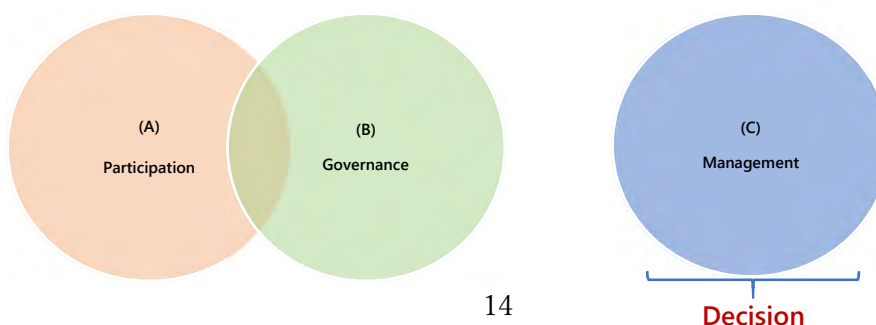
9-2 In the case of occurrence of **real-and-present danger** that there is little time for consultation, the Board and the Management will take action on “Command and Control” approach to solve the problem on behalf of the members consultation with them. The following is an illustration of these interactions.

Diagram S2-3: “Command and Control” Approach in Cooperative Governance



9-3 In the case of **tame and non-immediate danger** that may be complex but are ultimately solvable with technical expertise, it can be expected that the members will take managerial approach to the problem and the Management will take action with respect to information sharing with other stakeholders for its long deliberation.

Diagram S2-4: “Managerial” Approach in Cooperative Governance



9-4 Typical examples are shown below and these cases are classified into two categories:

Category (A): Cases which “Command and Control” approach is applied;

- ✓ The AC received a number of complaints from the purchasers with respect to quality of the product.
- ✓ It is reported that trucks have been involved in an accident during silage transport to the purchasers.

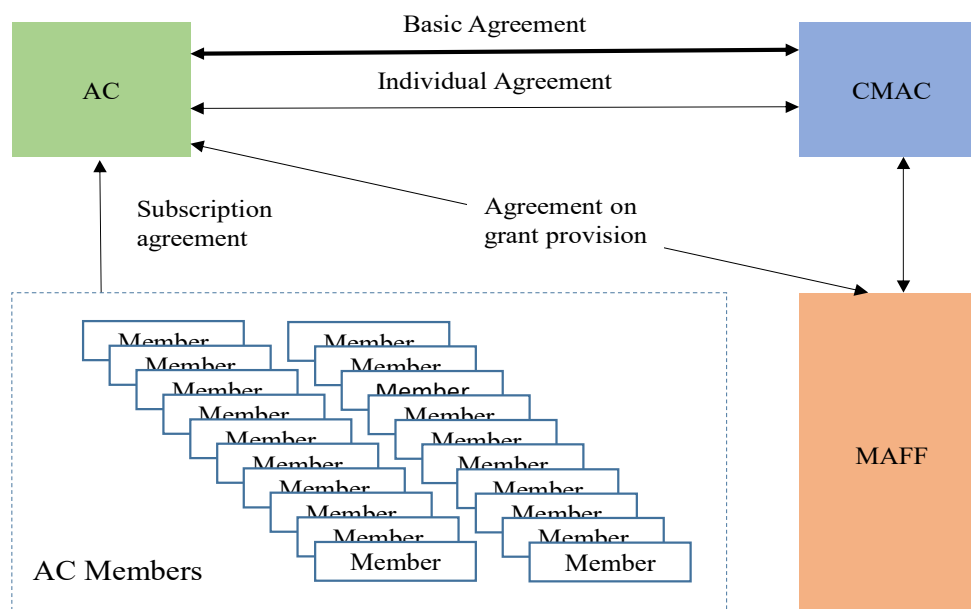
Category (B): Cases which “Managerial” approach are applied;

- ✓ The AC received an instructive request from MAFF to form an industrial association of silage production and sale for the purposes of quality control and setting-up of model contract relating to silage sale and silage labeling for the ease of consumers’ reference.

10. Legal instruments required in view of governance

10-1 As mentioned earlier, the legal relationship between the AC and CMAC is one of important issues in view of Cooperative Governance and thus, it is recommendable that appropriate agreements should be made between the two after all direct transactions are characterized and clarified. According to the current business plan, it can be envisaged that two different kind of agreements are required to prepare. The first will be “Basic Agreement” and the second will be “Individual Agreement” which refers to actual support from CMAC.

Diagram S2-5: Legal Instruments required to create sound relationship with stakeholders



10-2 The following Diagram shows the outline of the AC’s contractual relationship with CMAC with respect to possible supports from CMAC. Taking into account the nature of supports, each support must be categorized as either (A) or (B). Where it is classified as (A), this support should be dealt with in the Basic Agreement and then, where it is classified as (B), this should be dealt with in the Individual Agreement.

Diagram S2-6: Legal Instruments to be made with CMAC

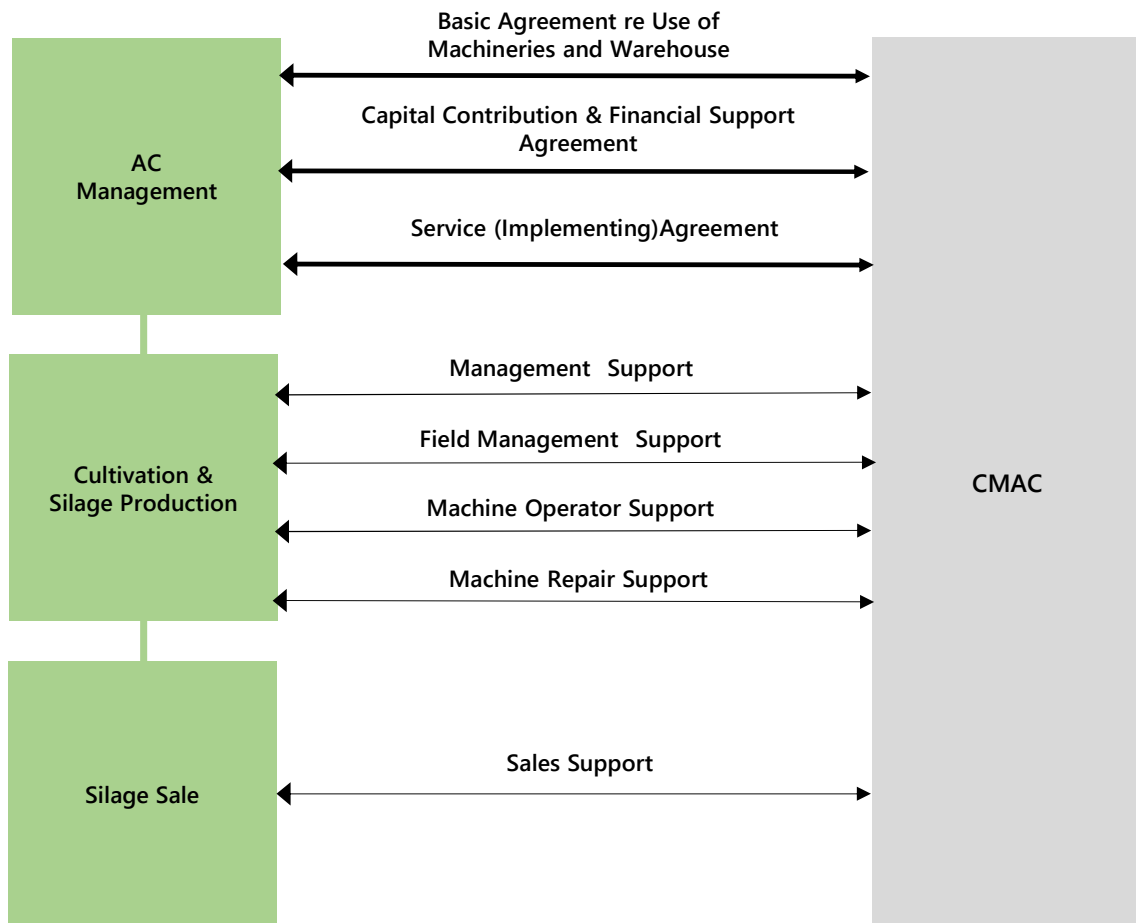


Diagram S2-7: List of legal instruments to be made with CMAC

	Support	Legal Instrument	Remarks
1	Capital contribution from CMAC	(A)	This means investment at the time of AC establishment. If it is made, CMAC will be one of shareholders of AC.
2	JICA machines provision by MAFF/CMAC	(A)	This agreement must be based on the agreement to be made between CMAC and MAFF.
3	Financial support from CMAC	(A)	Financial support will be provided by CMAC, without charge, in relation to payment to a third party.
4	Financial support from MAFF	(A)	Financial support will be provided by MAFF, Legal nature of which must be confirmed.
5	Management support from CMAC	(B)	Management support will be provided by CMAC without charge.
6	Machine repair support from CMAC	(B)	Machines repair works will be provided by CMAC without charge.
7	Operational (Sales) support from CMAC	(B)	Marketing support will be provided by CMAC without charge.
8	Business plan support from CMAC	(B)	Planning works, including business plan and expansion plan is supported by CMAC without charge..
(Note 1) Legal Instruments are divided into 2 categories: (A) basic agreement and (B) individual agreement. As for individual agreement, respective support items can be integrated in a single agreement.			

11. Concluding Remarks

11-1 Indeed, it is not easy to respond to the question of whether or not the proposed AC should be categorized as an independent AC or a kind of subsidiary organization of CMAC. If it is formed as an autonomous and independent organization from a legal point of view, all relationships with CMAC will be obligated to be described in clear terms in the basic document for establishment of the AC, which needs to be submitted to the pertinent office of MAFF and disclosed to the members of the AC prior to their decision to participate in and become the member of the AC.

11-2 On the other hand, it is possible to say that if the proposed AC is an autonomous and independent organization, the proposed AC possesses, without doubt, some features as a subsidiary or subordinated organization under the umbrella of CMAC, which may be one of JICA's concerns to which it continues to place its emphasis on the matter of how to set-up the succeeding project entity after the JICA project ends.

11-3 To sum up discussions so far made, the following are key issues to note:

- 1) To describe the legal relationship with CMAC in the business plan;
- 2) To consider who should take the position of “Executive Manager” who might function as the *de facto* CEO of the AC;
- 3) To identify and prepare the legal instrument of the AC for the use of JICA assets;
- 4) To describe how to protect the legal right of the members of the AC relating to their participation and management of AC’s capital in connection with CMAC.
- 5) To empower cooperative members to play their active role in the AC, since there exists an ambiguity or doubt that the proposed members may have lack of awareness on importance of governance of the AC.

End//