Japan International Cooperation Agency (JICA)

FINAL REPORT

ON PROJECT FOR PRODUCTIVITY IMPROVEMENT IN CENTRAL HIGHLAND IN THE REPUBLIC OF MADAGASCAR

September 2013

Mr. SUISMONO

Expert from the Republic of Indonesia (Third Country Expert /TCE
Domain of Application Agricultural Post-Harvest Technologies,
April - September 2013)

ACKNOWLEDGEMENTS

I would like to give a special thanks to the Ministry of Agriculture of the Republic of Madagascar, Ministry of Agriculture of the Republic of Indonesia, Japan Embassy, Indonesia Embassy, and Japan International Coorperation Agency (JICA) Madagascar and Staff Member and JICA Indonesia. Special thanks also to all the members of Indonesia Center for Agriculture Postharvest Research and Development (ICAPRD) and Projet d'Amélioration de la Productivité Rizicole (PAPRiz) for giving me the opportunity and support to apply some technologies in Madagascar.

The very importance side is also « le Centre de Formation et d' Aplication du Machinisme Agricole (CFAMA) » which is supporting Training and Application for Postharvest Technology about paddy losses and rice quality and Farm Machineries. Thank you for supporting and giving me some facilities during the development of some postharvest technologies and farm machineries to all the staff, my counterpart Mr. RAKOTOSON Andrianamanalimanana David, as the Directuor of CFAMA, Mr. RAKOTOARISOA Haga Johary, Mr. RAVAOAVY Jean Charles, Mr. RAKOTO Malala Andoniaina as Assistant Jica Expert. A special word of thanks also to all the DRDR staff of Vakinankaratra, Bongolava, Alaotra Mangoro, Itasy and Analamanga regions since the coordination and cooperation of all my activities could be finihed well. And a big thanks to all PAPRiz experts for supporting, helping and directing all my activities during these last six months since August 2012 until February 2013.

Antsirabe, September, 2013

Suismono

Indonesian Expert

LIST OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Pages

.

LIST OF ABBREVIATIONS

MinAgri = Ministry of Agriculture

CFAMA = Agricultural Machinery Training and Application Center

JICA = Japan International Cooperation Agency

Papriz = Projet d'Amélioration de la Productivité Rizicole

DGR = Direction du Génie Rural

DGT = Directeur Général Technique

TCE = Third Country Expert

TOR = Term of Reference

RMU = Rice Milling Unit

MIN = Minimum

MAX = Maximum

STD = Standard Deviation

HP = House Power

B/C ratio = Bennefid Cost

I. THE OUTLINE OF THE PROJECT

1.1. Background and content of technical coorperation

Rice is the staple food Madagascar. Therefore, the Ministry of Agriculture in collaboration with JICA Project Madagascar wants to increase rice production in highland in Madagascar.

JICA Project activities called the « Project for Rice Productivity Improvement in Central Highland areas of Madagascar » (PAPRiz) started in 2009 to 2014 (5 years). The Project target area is five regions in Madagascar's Central Highland areas (Vakinankaratra, Bongolava, Alaotra Mangoro, Itasy and Analamanga). These activities helped Expert third countries (Third Country Expert / TCE) to increase rice production in the area.

There are efforts to increase rice production not only in terms of farming activities (pre-harvest), but there are also efforts to involve aspects of post-harvest activities and the application of appropriate machinery technology. Paddy losses during postharvest handling are very influential on rice production. Expert contribution on this project is to develop and transfer technologies in order to reduce loss during rice post-harvest, and to improve yield and quality of rice, as well as the utilization of by-product of rice milling yield to increase added value. Therefore, it needs postharvest technology improvements and requires mechanical equipment.

1.2. Purpose and content of the project

Productivity of rice product increases at model sites of the project.

1.3. Project name, site and goverment agencies involved

- Project name : Project for Rice Productivity Improvement in the Central Highland areas of Madagascar.
- Project site : Five regions (Vakinankarata, Bongolava, Alaotra-Manggoro, Itasy and Analamanga).
- Goverment Agency : Ministry of Agriculture (MinAgri)
- Counterpart Agency : Agricultural Machinery Training and Application Center (CFAMA), in Antsirabe.

The Indonesian expert visited the five regions to determine the current state of post-harvest grain handling and equipment / machinery being used at the farm level, rice mills, and local

manufacturers at the target location. He analyzed the situation related to post-harvest handling losses, yield and quality, and utilization of by-product of rice milling.

1.4. Scope of Services to be provided by expert

1.4.1. Improvement of postharvest technologies

- Reduce grain loss and increase grain quality with improvement of postharvest management
- Promote utilization of by-product of rice with development of applicable tools.

1.4.3. Collect information

- Collect information on existing machines/ tools
- Assesses needs of farmers in target regions.
- Identify type and specifications of machines/tools to meet their needs.
- Provide technical support on appropriate machinery use for DRDR (region stations of Ministry of Agriculture) staff and extension agents

II. METHODOLOGY

2.1. Making schedule activity and budget planning

- Project activities based on the matrix of activities and TOR of TCE activity.
- Budget planning has begun on April 20th, 2013 to September 14th, 2013.
- Schedule of events ranging from March 20th ,2013- Sept.14th, 2013 as the matrix below.

Table 1. Schedule of TCE Programme

Planning for Third Country Expert from Indonesia (2013), Mr. SUISMONO (Agricultural Postharvest Technology Development), (Maret 20Th, 2012 – September 14Th, 2013)

NO	ACTIVITY	March	April				May				June				July				August				Sept.	
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
	Preparation all activities base on TOR																							
	Coordination with project office in Antananarivo																							
	Coordination with CFAMA, DRDR, FOFIFA Antsirabe																							
	Activty schedule, Budget request making																							
2	**Implementation of postharvest tecnologies :**																							
	- **Reduce paddy grain losses :**																							
	• Measurement paddy losses (survey)																							
	• Implementation of Postharvest technology pakage for reduce grain loss																							
	- **Increase rice grain quality** with improvement of postharvest management (pilot plan of double pass rice milling)																							
	- **Promote utilization of by-product** of rice (separator and charcoal Briquettes pressing machine) with development of applicable tools (training)																							
3.	**Data collection of developed machines (survey):**																							
	- Collect information on existing machines/ tools																							
	- Asses needs of farmers in target regions.																							
	- Identify type and specifications of machines/tools to meet their needs.																							
6.	**Report making :**																							
	- Monthly report of activities																							
	- Monthly report of accounting																							
	- Final report of activities																							

Antsirabe, August 30th, 2012
JICA Third Country Expert assigned to CFAMA,
Antsirabe, Madagascar

2.2. Evaluating present situations of post-harvest of rice in the central hihland areas of Madagascar

- Measure post-harvest losses of rice from each stage of harvesting, transporting, threshing, drying, milling, and storage to find rice post-harvest loss on main season (March – June) in the central highland areas of Madagascar.
- Take sample of rice to determine the quality of grain and rice on each respondent and each region.
- Package postharvest technologies to reduce yield loss and improve the quality of rice.

2.3. Evaluating existing prototype of milling machinery

- Test equipment of capacity, input, output per hour.
- Feasibility and economical tool on rice mill processing configuration in the Rice Milling Unit small scale (improvement of paddy separator and rice polishing machineries).

2.4. Input of the project

Input Japanese side

1. Expert

1.1. Long term expert

- Chief advisor/ Agriculture Development, Project Coordinator, Desiminasi, Rice production, Farm management.

1.2. Short term expert

- Agriculture machinery, Agronomic technic (seed, fertilizer), Postharvest, Agriculture Economic/ Marketing.

1.3. Third Country Expert (ex. Agricultural Postharvest Technology)

2. Training

- Training by Japan and Third Country Expert.

3. Equipment delivery

- Vehicle, office equipment, ETC
- Other necessery input, expenses.

Input Madagascar side

1. Human resources, Counterpart and administrative personal

2. Building, office spaces and necessary facilities for the project activity

3. Local cost (operational cost for the project implementation)

III. RESULT

3.1. IMPROVEMENT OF POSTHARVEST TECHNOLOGY

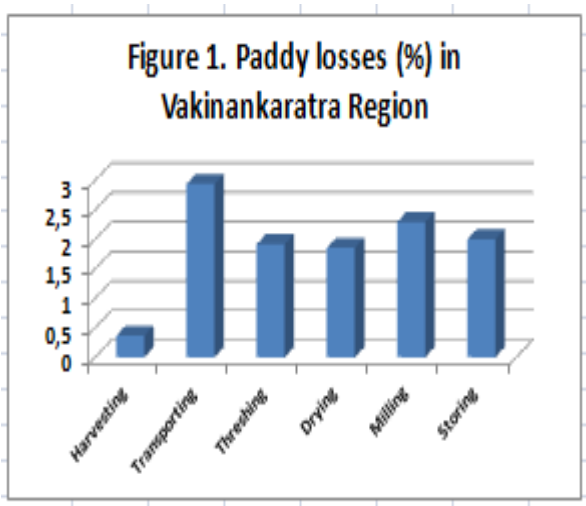
3.1.1. Evaluation of paddy losses

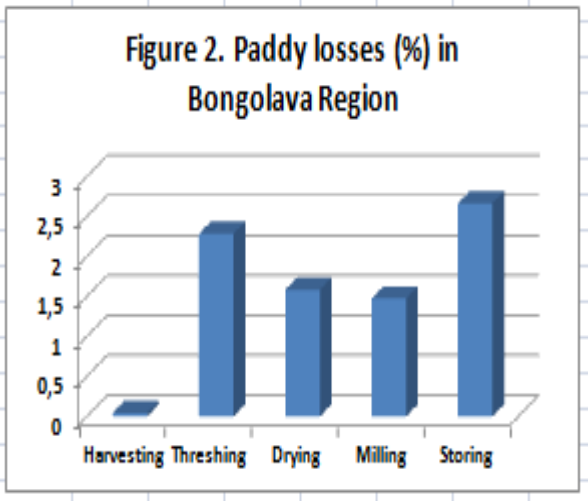
Measurement results of rice yield loss in the 5 regions in the central highland areas of Madagascar are still high at 14.80% (Table 2). Average yield loss from harvest to storage on each stage of postharvest is by 2%, except at the stage of harvesting where the low yield loss of 0.49% and 1.73% is during drying stage ,while the highest yield loss is during the storage phase (2.44%) and transportation (2.95%).

Harvesting stage. The low stage of crop losses is due to harvesters who are paid daily wages according to the orders of the owner of rice and yield losses can be reduced. Paddy harvesting is mostly done manually except in Alaotra Region where some farmers use rice mower (Stripper) because of the large area.

Transportation stage. Farmers need hay to feed livestock, so threshing is done at home and there is no transportation losses. With various types of transportation such as manually transported, with Sarety, car or boat, they will increase crop yield loss. Transport is manually done when the location is close to the rice farmer owner. Harvest is delayed in Alaotra-Mangoro Region and Region Analamanga in the dry season.

Phase of delay. Harvest delay in Alaotra is conducted in rice fields near his farm (called "Tonta"), while the harvest delay in Analamanga is conducted at home.





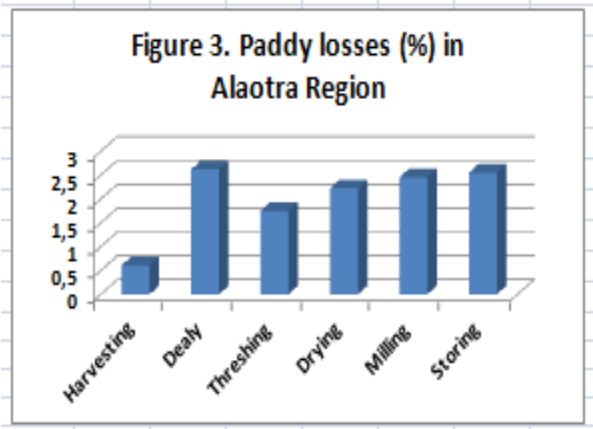


Figure 3. Paddy losses (%) in Alaotra Region
3
2,5
2
1,5
1
0,5
0
Harvesting
Dealy
Threshing
Drying
Milling
Storing

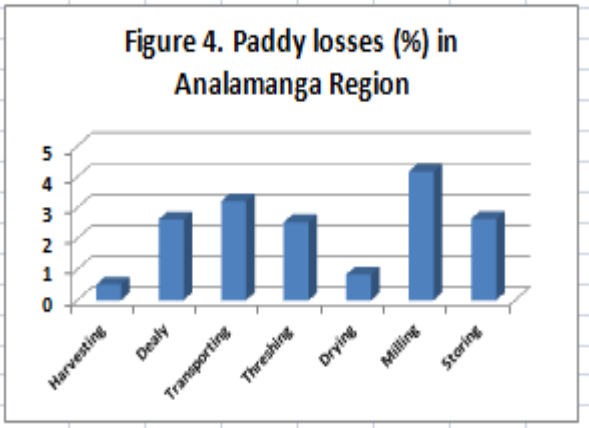


Figure 4. Paddy losses (%) in Analamanga Region
5
4
3
2
1
0
Harvesting
Dealy
Transporting
Threshing
Drying
Milling
Storing

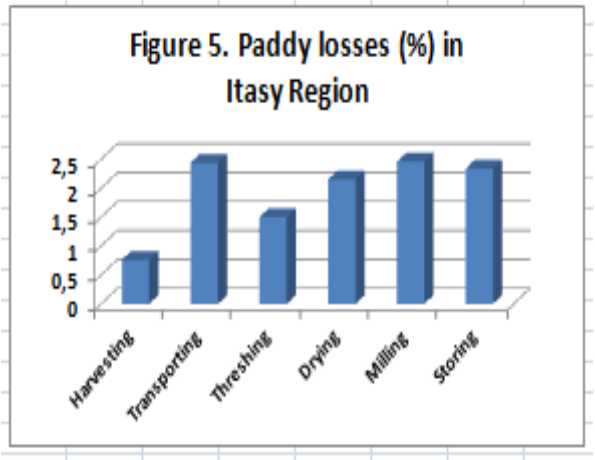


Figure 5. Paddy losses (%) in Itasy Region
2,5
2
1,5
1
0,5
0
Harvesting
Transporting
Threshing
Drying
Milling
Storing

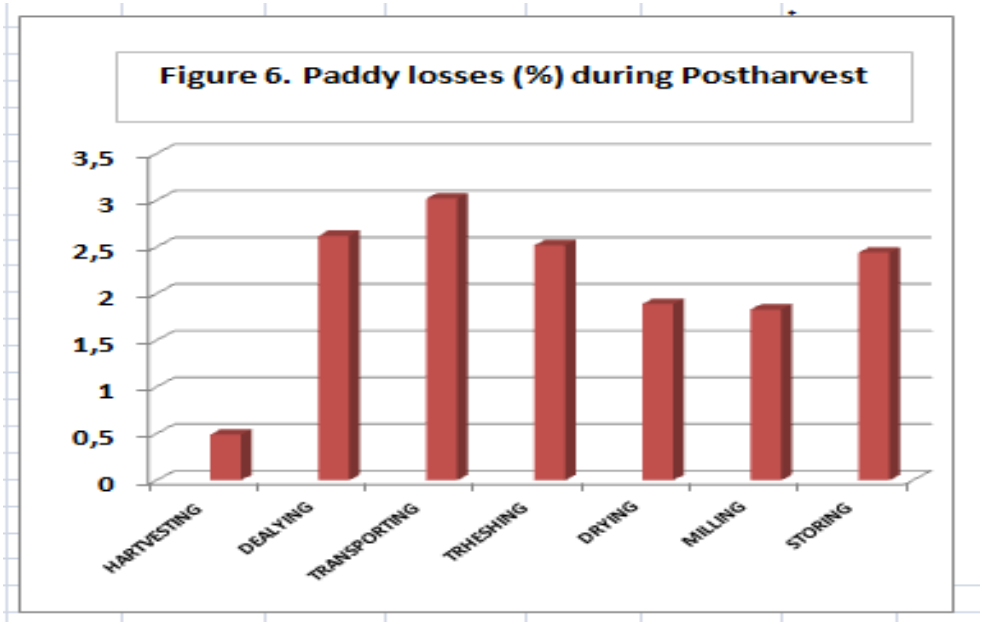


Figure 6. Paddy losses (%) during Postharvest
3,5
3
2,5
2
1,5
1
0,5
0
HARTVESTING
DEALYING
TRANSPORTING
TRHESHING
DRYING
MILLING
STORING

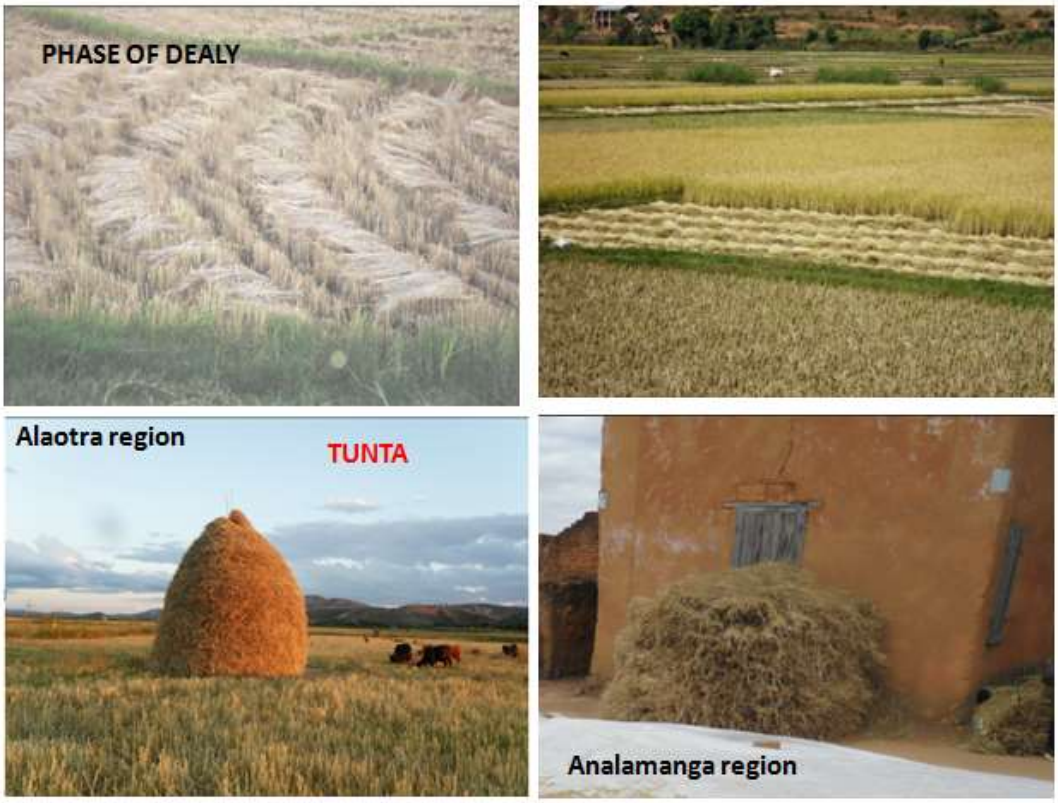
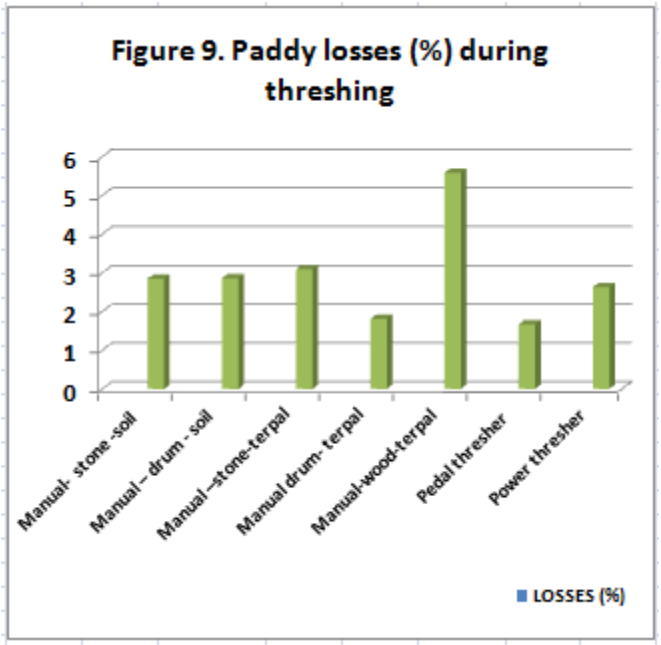


Figure 7. Phase of paddy dealy in Alaotra and Analamanga regions

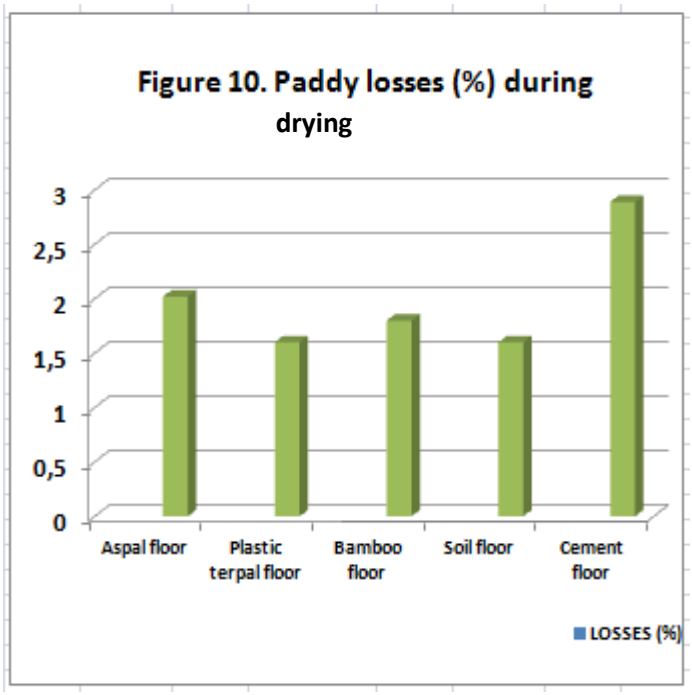
Figure 8. Phase paddy transportation in Alaotra and Analamanga regions

Threshing stage. Threshing rice in Madagascar is generally done manually using stone, drums, wood, while some places like in Bongolava and Itasy use Pedal Thresher. Yield loss is very high (5.5%) when using wood than using drums and stone. The lowest Losses of rice occur when using a pedal thresher (1.5%). Power tool is unused because fuel is still expensive except in the region of Alaotra where rice farmers use tractors or 10-15 oxen depending on the area size. That is the habitual situation because of the vast paddy fields and limited farmers threshing instrument, and that is why delays occur in the fields. This delay is done by making piles of paddy that has dried first and farmers wait for threshing process, called "Tonta".

Threshing method of rice farmers is mostly directly on the ground or on the cement. When the threshing is done in the field, farmers are using plastic sheet.



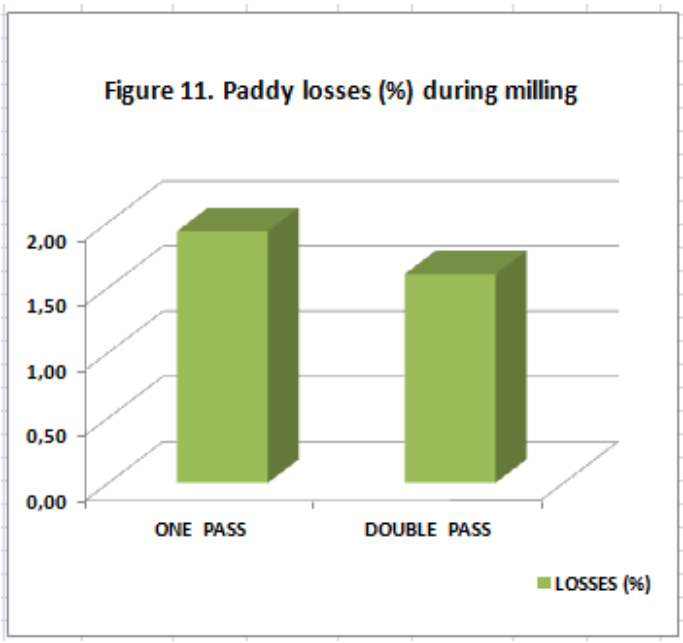
Drying stage. Malagasy farmers dry grain in several ways such as by ironing plastic sheeting, woven bamboo, barefoot (immediately above the ground), drying on the ground or on the side of the road. The lowest losses are by using plastic sheeting drying floor (1.6%) and highest when dried on the lane road (2.02%). Grains drained on the ground still contain other foreign objects. Therefore, to clear foreign objects Winower tool or cleaner machine are required during Paddy rice milling process. Losses during drying on the cement is still high because bold exposing is more than 5 cm (about 10-12 cm).



Milling stage. In Madagascar rice milling (1) in the central highland areas of Madagascar are located only on national roadside(2) Rice milling are mostly small-scale rice milling system (One Engelberg milling and grinding pass). While the rice mill type Double pass are located only on Itasy and Analamanga Region, and partly Alaotra Region. Double pass on grinding on the ground varies configuration process. Such conditions lead to low quality of produced rice. (3) Traders sell rice from the rice milling and grinding Engelberg one pass so low quality is on rice market and (4) consumer preferences do not pay attention to the quality / grade of rice, they are more concerned with quantity. It is therefore necessary learning preferences consumer acceptance of quality rice.

Evaluation results for rice milling losses to 1.83%. Losses milling using a milling system One pass is (1.93%) higher than the milling double pass (1.60%). This is because that one-pass system is not equipped with a sieve, so the system from breaking the skin (husker)

is processed directly (polisher) so broken rice has increased. The use of RMU double pass is necessary to suppress loss of 0.33 to 1.0% compared to RMU one pass.



Central Highland areas of Madagascar have two rice harvests: small-scale rice harvest season in October-December (Small harvest / SH), while large-scale paddy season in April-June (Big harvest / BH). Results of evaluation losses during the rice harvest in 5 regions in the central highland areas of Madagascar are shown in Table 2. Harvest losses of rice at SH (11.84%) is higher than the harvest season SB (8.09%) (Table 3) because the SH is during winter monsoon time with so much water at harvest and harvesting is more difficult than in the BH season with rarely rains. Highest rice losses (14.18%) in the region are in Analamanga because farmers are threshing at home, resulting in losses and transportation delays. Losses in Vakinankaratra and Alaotra are about 9% for some farmers are threshing paddy at home and in the fields. The lowest losses in the region are in Bongolava (7%) (Table 3) because most of the farmers are working in the fields (big distance between the fields and farmhouses), so there is no transport losses and delays.

Tabel 2. Paddy losses in the central highland areas of Madagascar (2012 – 2013)

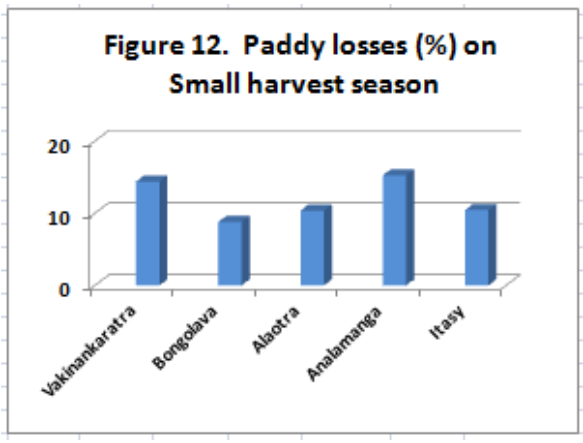
Phase of Postharvest	Vakinankaratra		Bongolava		Alaotra		Analamanga		Itasy		Mean
	SH	BH	SH	BH	SH	BH	SH	BH	SH	BH	
Harvesting	0,64	0,09	0,08	0,01	0,36	0,86	0,6	0,41	0,57	0,95	0,49
Delay	-	-	-	-	-	2,62	-	2,62	-		2,62
Transporting	2,94	-	-	-	-	-	3,91	2,51	2,44		2,95
Threshing	2,6	1,24	2,1	2,47	2,35	1,15	2,14	2,92	2,08	0,91	2,00
Drying	2,64	1,07	2,13	1,04	2,64	1,81	0,35	1,32	2,87	1,43	1,73
Milling	2,31	2,28	1,22	1,73	1,76	3,15	5,01	3,34	2,47	2,44	2,57

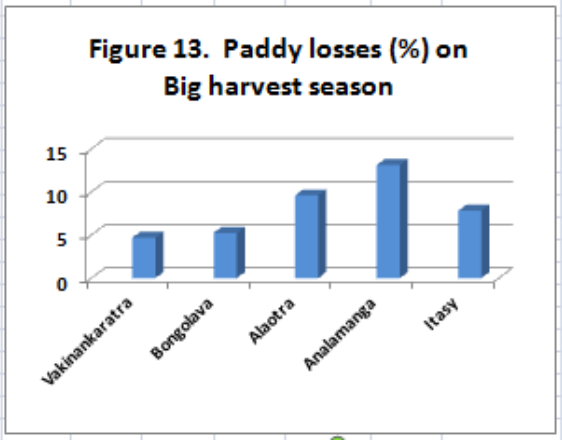
Storing	3,25	0,75	3,25	2,08	3,25	1,86	3,25	2,03	3,25	1,42	2,44
Totals	14,38	4,68	8,78	5,25	10,36	9,59	15,25	13,12	10,43	7,81	14,80

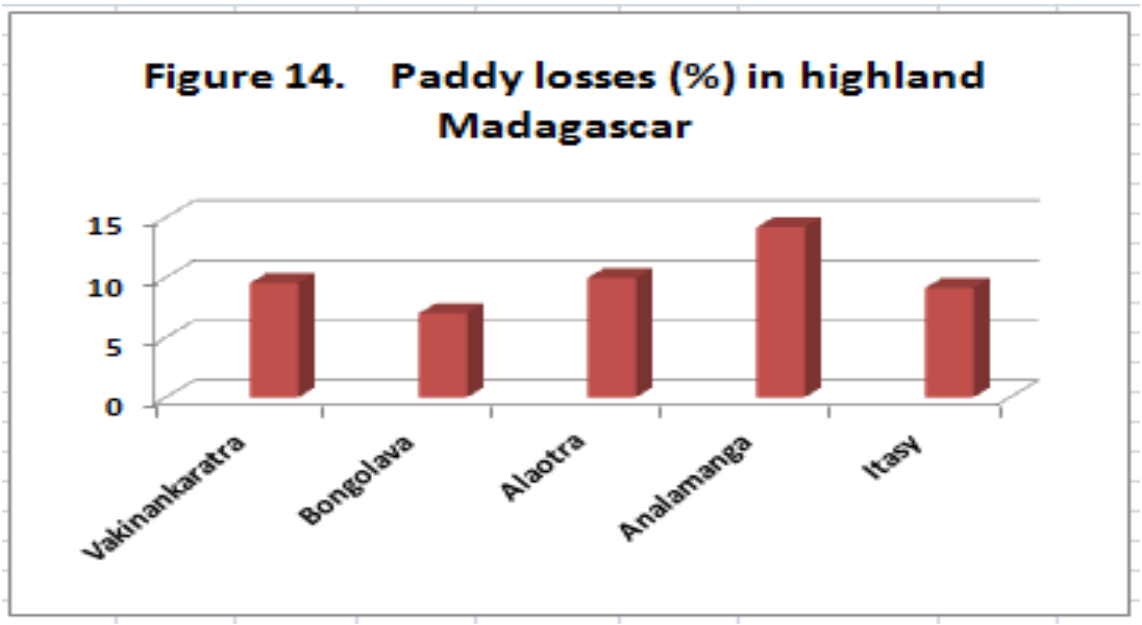
Remarks :
SH = Small harvest season, BH = Big harvest season, (-) = no treatment

Table 3. Paddy losses on Small harvest season and Big harvest season in the central highland areas of Madagascar

Region	Small harvest season	Big harvest season	Average
Vakinankaratra	14,38	4,68	9,53
Bongolava	8,78	5,25	7,015
Alaotra	10,36	9,59	9,975
Analamanga	15,25	13,12	14,185
Itasy	10,43	7,81	9,12
Average	11,84	8,09	







3.1.2. Technology package to reduce paddy losses

Based on the evaluation of paddy losses in the field a package of post-harvest technologies can be recommended to reduce paddy losses in the central highland areas of Madagascar. Paddy losses through the farmers postharvest technology are about 14.80% and paddy losses through recommended technology package is about 7,27% so it can suppress 7,53% paddy losses (Table 4 and 5).

Recommended technology package to reduce losses of rice can be done by:

- Regularly harvesting manually with sickle
- Threshing is done in the field / fields (do not phase delays and transportation)
- Drying with either plastic sheeting Events
- Using a milling system with a double-pass configuration process CHSPP (Paddy Cleaner-Husker-Separator-Polisher-Polisher)

Table 4. Effect of post-harvest losses of rice by farmers in the central highland areas of Madagascar

PHASE OF PADDY POSTHARVEST	LOSSES (%)				
	n	Max (%)	Min (%)	Average	STD
PHASE OF HARVESTING	30	1,34	0	0,49	0,417
Manuel					
PHASE OF PADDY DEALY	2	4,57	0,66	2,62	2,764
Manuel					
PHASE OF TRANSPORTATION	14	5,86	1,13	3,02	1,297
Manuel					
PHASE OF THRESHING	33	5,75	0,12	2,52	1,32
Manuel- stone -soil	7			2,85	
Manuel – drum - soil	7			2,86	
Manuel –stone-terpal	4			3,09	
Manuel drum- terpal	9			1,81	
Manuel-wood-terpal	1			5,58	
Pedal thresher	6			1,67	
Power thresher	1			2,63	
PHASE OF DRYING	23	3,31	0,16	1,89	0,924
Aspel floor	2			2,02	
Plastic terpal floor	13			1,60	
Bamboo floor	1			1,80	
Soil floor	6			1,60	
Cement floor	1			2,89	
PHASE OF MILLING	20	4,59	0,24	1,83	1,103
One pass	13			1,93	
Double pass	7			1,60	
PHASE OF STORING	3	3,77	2,88	2,44	0,465
TOTALS OF PADDY LOSSES				14,8	

Table 5. Postharvest technology to decrease paddy losses in the central highland areas of Madagascar

No	Phase of postharvest	Postharvest Technology			
		Farmer technology		Recomended technology Package	
		Component	Losses (%)	Component	Losses (%)
1	Harvesting	Manual	0,49	Manual	0,40
2	Delay	Manual	2,62		-
2	Transporting	Manual	3,02		-
3	Threshing	Manual-stone/drum-soil	2,52	Pedal thresher-terpal	1,67
4	Drying	Floor of aspel/ soil/ mat	1,89	Floor of Plastic terpal	1,60
5	Milling	One pass/engleberg	1,93	Double pass	1,60
6	Storing	Storage without pallet (not good aeration)	2,44	Good Storage Practices (GSP)	2,00
	Totals of paddy losses		14,80		7,27

3.1.3. Evaluation of rice quality

Rice quality evaluation is conducted on respondents milling and grain merchant in the 5 regions in the central highland areas of Madagascar. The dominant components of rice

quality is head rice, broken rice and groats through visits in rice milling (milling degree). The level of consumer preferences still like broken rice which is less than 20% or head rice which is more than 90%. It means that the quality of rice is low (Figure 15 and 17). Similarly, the degree of milling shows that consumers preferred more than 90% of head rice. It also indicates that the quality of rice is low (Figure 16 and 18).

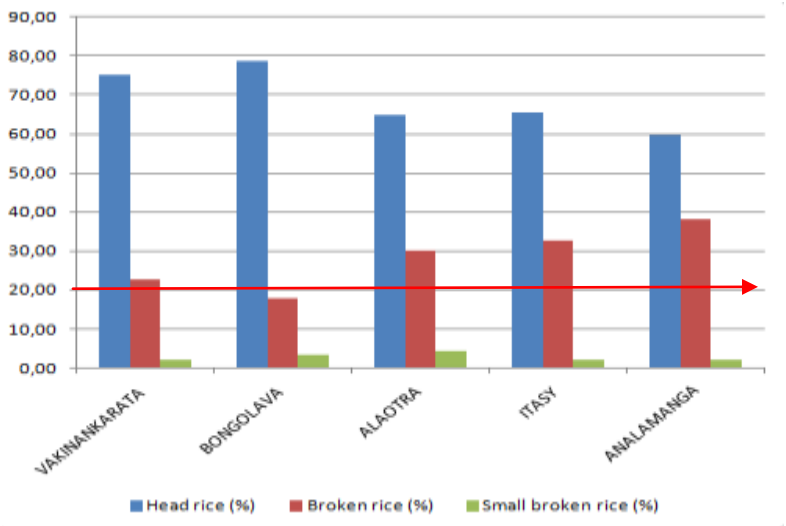


Figure 15. The percentage of head rice, broken rice and small broken rice in each Rice Milling Unit Region highland Madagascar

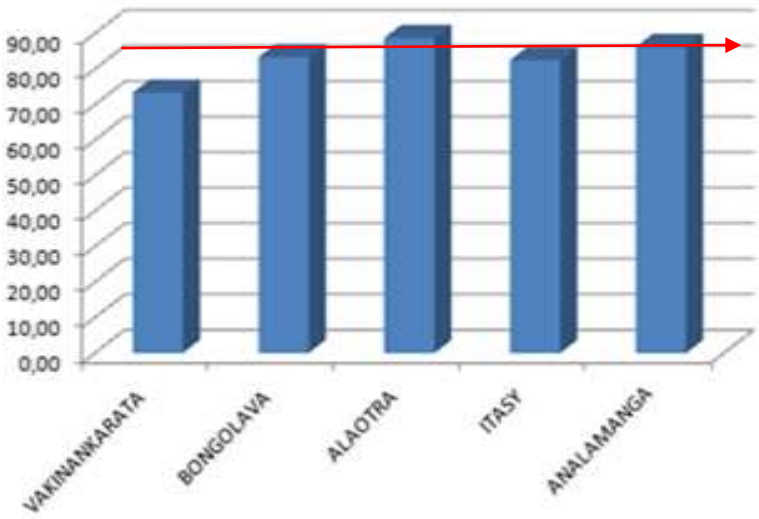


Figure 16. Milling degree for rice in Rice milling unit

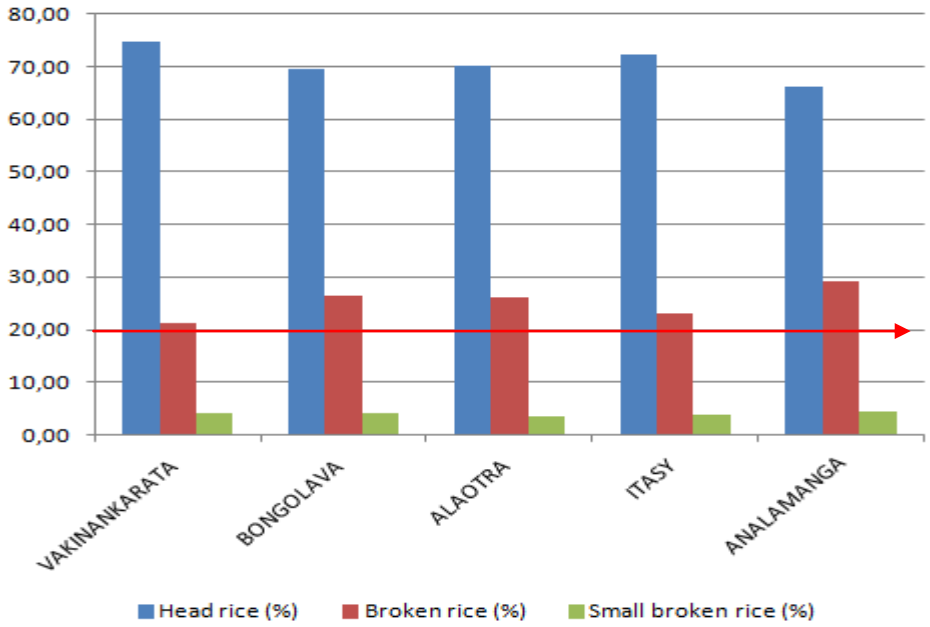


Figure 17. The percentage of head rice, broken rice and small broken rice in each Rice seller in the Region of the central highland areas of Madagascar

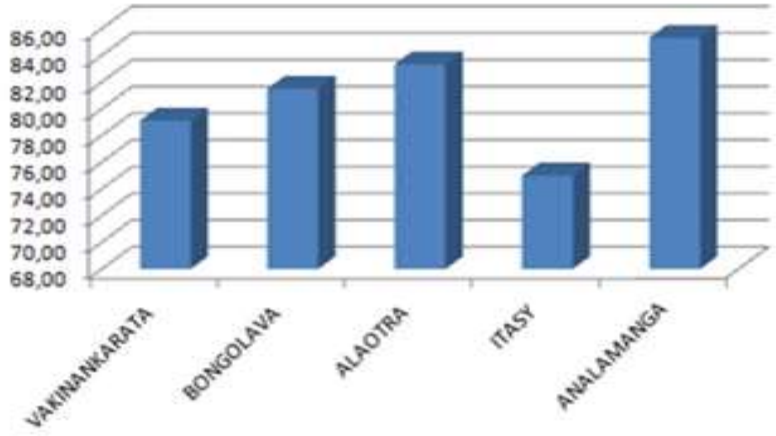


Figure 18. Milling degree for rice in Rice seller

3.1.4. Technology Package to increase Rice Quality

The improvement of the quality of rice can be done by (1) developing a double-pass milling and (2) improving the milling process configuration. Double pass rice mill (DP) is widely grown in the region of Analamanga and Itasy, but the result is low-quality rice because the configuration process does not meet the requirements. Standard milling is the milling of rice paddy cleaner process configuration (C) - husker (H) - paddy separator (S) - Polisher (P) 1 - Polisher (P) 2.

Configuring the rice milling process in highland Madagascar can be divided into 7 groups, namely: (1) manually, (2) system engelberg (PK and milling processed

simultaneously), (3) one-pass system (husker machine and tool penyosoh in 1 unit) , (4) DP: HP, (5) DP: HPP, (6) DP: CHSP, and (7) DP: CHSPP. The results show the influence of the configuration of the grinding process quality and yield of rice as shown in Figure 20, 21 and 22. Configuring the milling process significantly affect the percentage of head rice. Percentage of head rice in long grain varieties (varieties makalioka) and short grain varieties (varieties Chomrong Dhan) is still below 80% for all treatments, except the treatment of DP: CHSP and DP: CHSPP. Lowest percentage of head rice is manually in treatment (less than 50%) and highest in the treatment of DP: CHSP (over 80%) (Figure 23). Short grain varieties (varieties Chomrong Dhan) head rice percentage is higher than the long grain varieties (varieties makalioka). Similarly, the percentage of broken rice and groats vice versa (Figure 24 and 22).

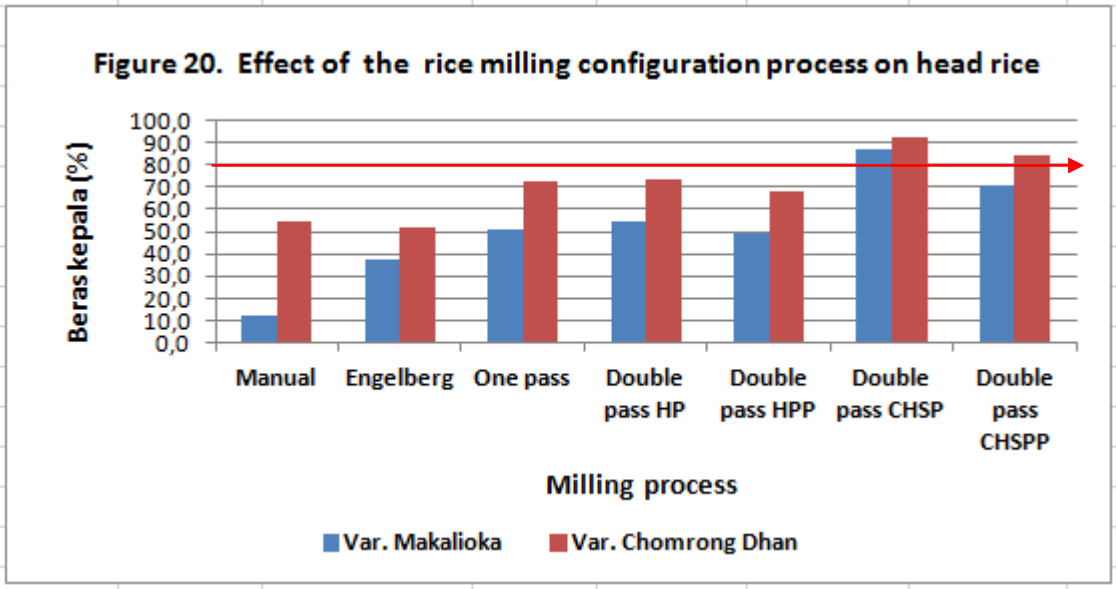


Figure 20. Effect of the rice milling configuration process on head rice
Beras kepala (%)
100,0
90,0
80,0
70,0
60,0
50,0
40,0
30,0
20,0
10,0
0,0
Manual
Engelberg
One pass
Double pass HP
Double pass HPP
Double pass CHSP
Double pass CHSPP
Milling process
Var. Makalioka
Var. Chomrong Dhan

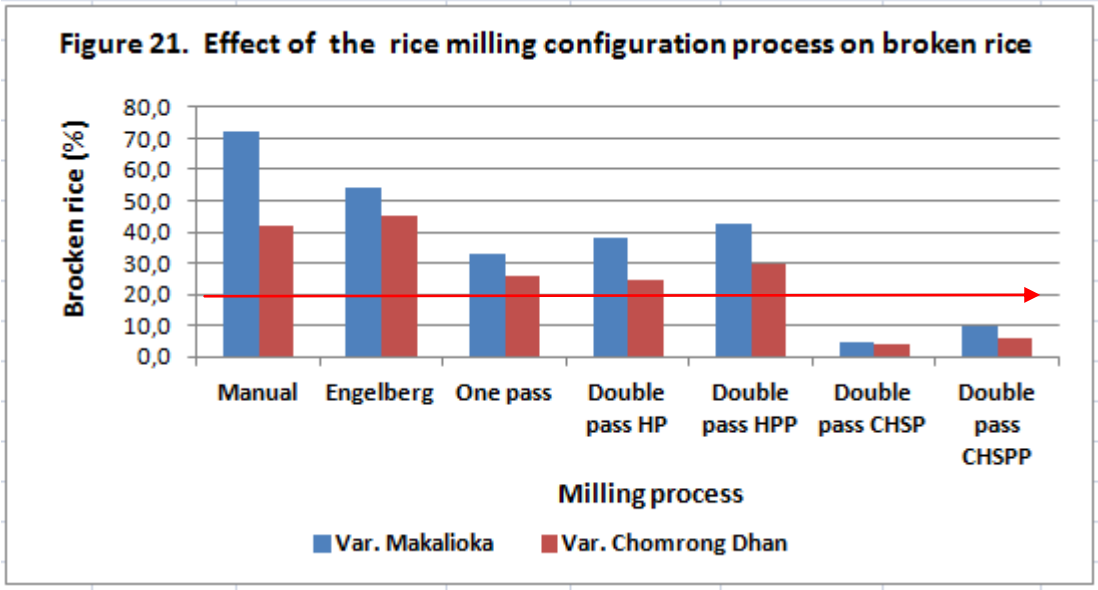
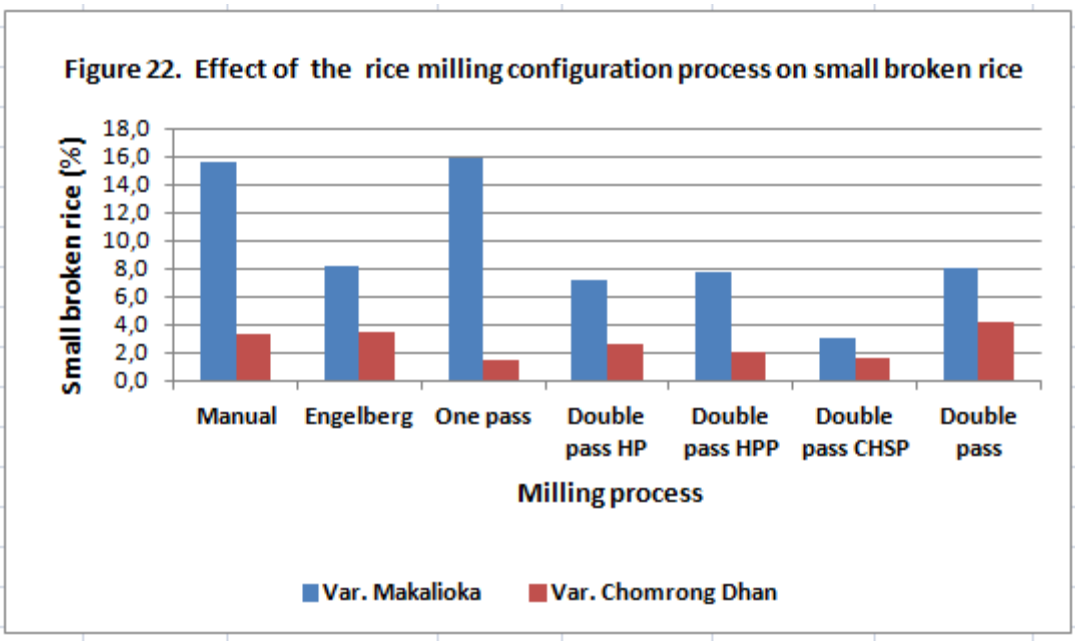


Figure 21. Effect of the rice milling configuration process on broken rice
Brocken rice (%)
80,0
70,0
60,0
50,0
40,0
30,0
20,0
10,0
0,0
Manual
Engelberg
One pass
Double pass HP
Double pass HPP
Double pass CHSP
Double pass CHSPP
Milling process
Var. Makalioka
Var. Chomrong Dhan



The trial results showed that the configuration of the grinding process using manually grinding, fitting engelberg and one degree of milling yield is still less than 90%. This means that the quality of rice is low due to substandard quality of rice. While all treatment process configuration with double pass milling milling degree produce more than 90% (Figure 23). Milled rice yield results is influenced by variety of factors and configuration of the grinding process. In general, the yield of short-grain rice varieties (varieties Chomrong Dhan) was 60-74% higher than the long grain varieties (varieties Makalioka) of 57-67%. Yield rice varieties milled at Makalioka with the configuration process manually, one pass and engelberg milling yield of 64-67% higher than the double dovetail milling yield by 57-63%. While the varieties Chomrong Dhan with manual configuration of the grinding process, and one result engelberg yield of 61-62% lower than the double-pass milling yield by 60-67%. This means double-pass system can improve the quality and yield of short grain varieties (varieties Chomrong Dhan) and for long grain varieties (varieties Makalioka) only improves quality, but did not increase the yield of milled rice (Figure 24). The CHSP configuration can improve the quality and yield of milled rice.

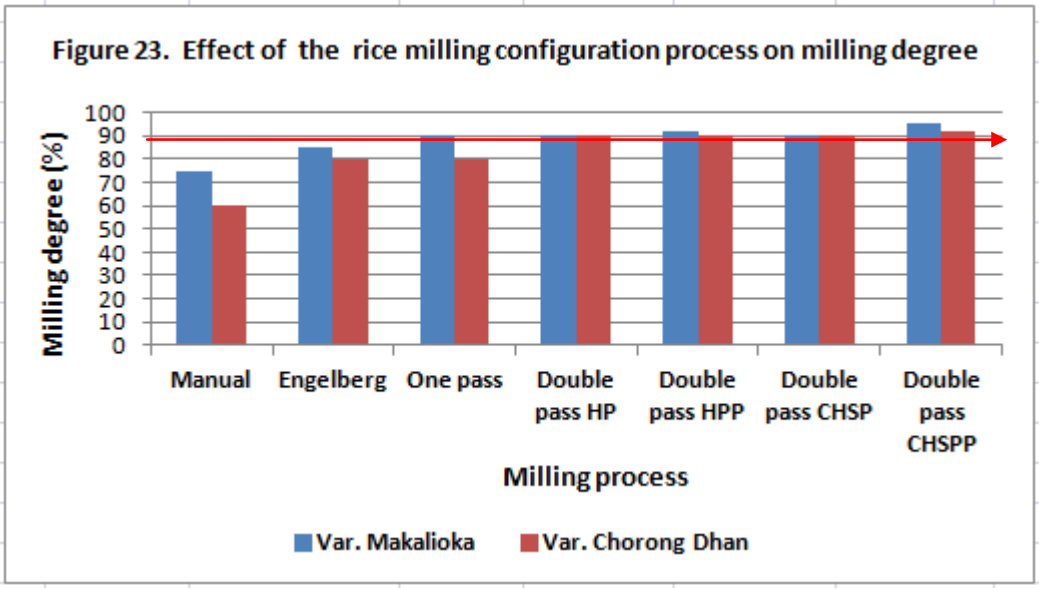


Figure 23. Effect of the rice milling configuration process on milling degree
Milling degree (%)
100
90
80
70
60
50
40
30
20
10
0
Manual
Engelberg
One pass
Double pass HP
Double pass HPP
Double pass CHSP
Double pass CHSPP
Milling process
Var. Makalioka
Var. Chorong Dhan

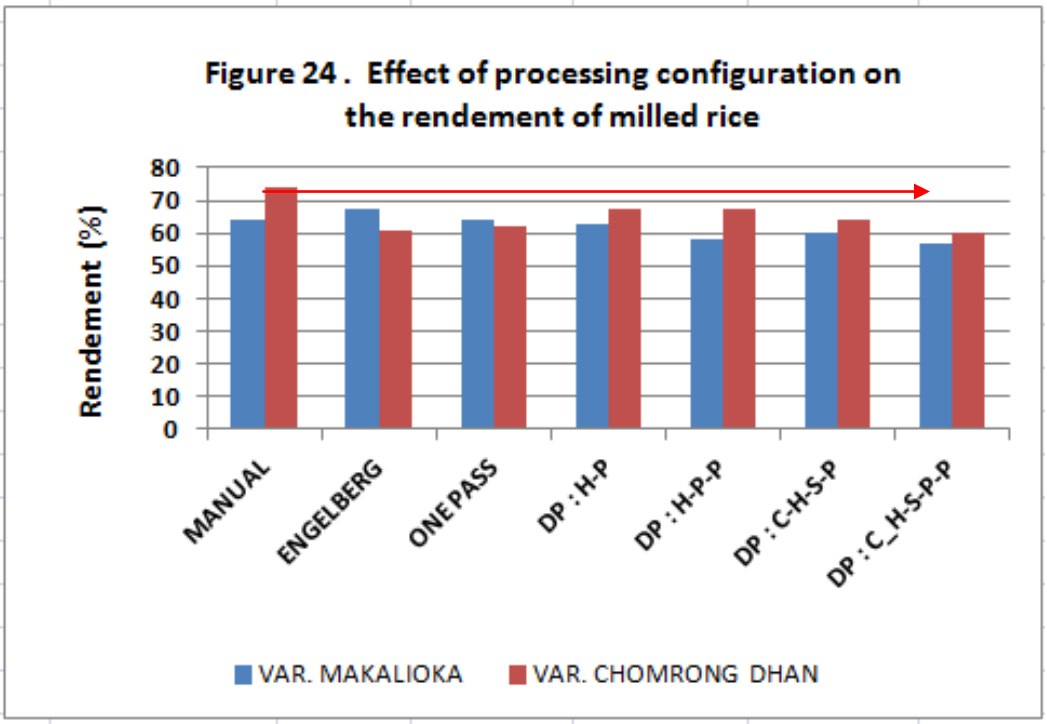


Figure 24 . Effect of processing configuration on the rendement of milled rice
Rendement (%)
80
70
60
50
40
30
20
10
0
MANUAL
ENGELBERG
ONE PASS
DP : H-P
DP : H-P-P
DP : C-H-S-P
DP : C_H-S-P-P
VAR. MAKALIOKA
VAR. CHOMRONG DHAN

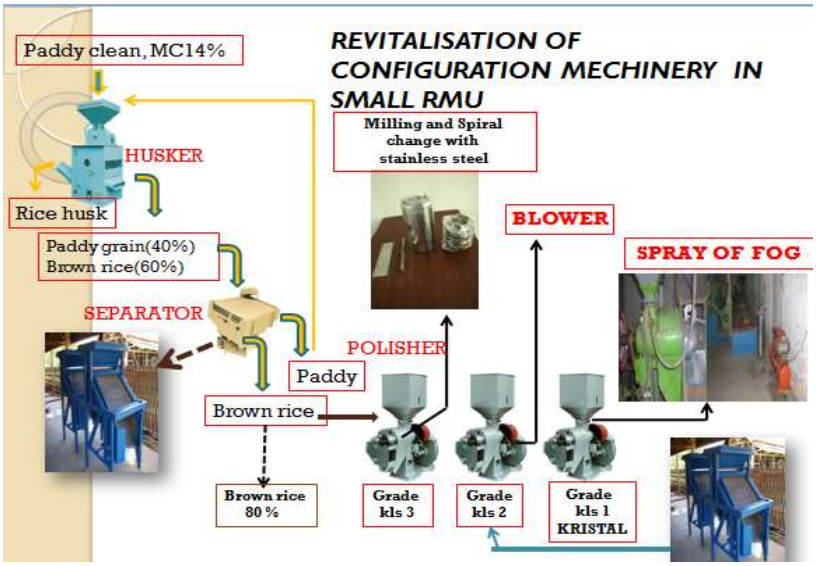


Figure 25. Line process of The rice milling system configuration

Figure 26. Pilot plan of the double pass system configuration small scale

To improve the quality of rice has been tried by replacing metal components with polisher of stailess steel material (Figure 27 and 28). With stailess steel materials on rice polishing process will be faster because it is more slippery than with metal. Experimental results show that the use of stainless steel perlakuaan on polish tool produces rice milling degree 95% higher than the use of metal materials (90% milling degree) (Figure 29).

Figure 27. Penggantian komponen penyosoh beras dengan bahan stailess steel

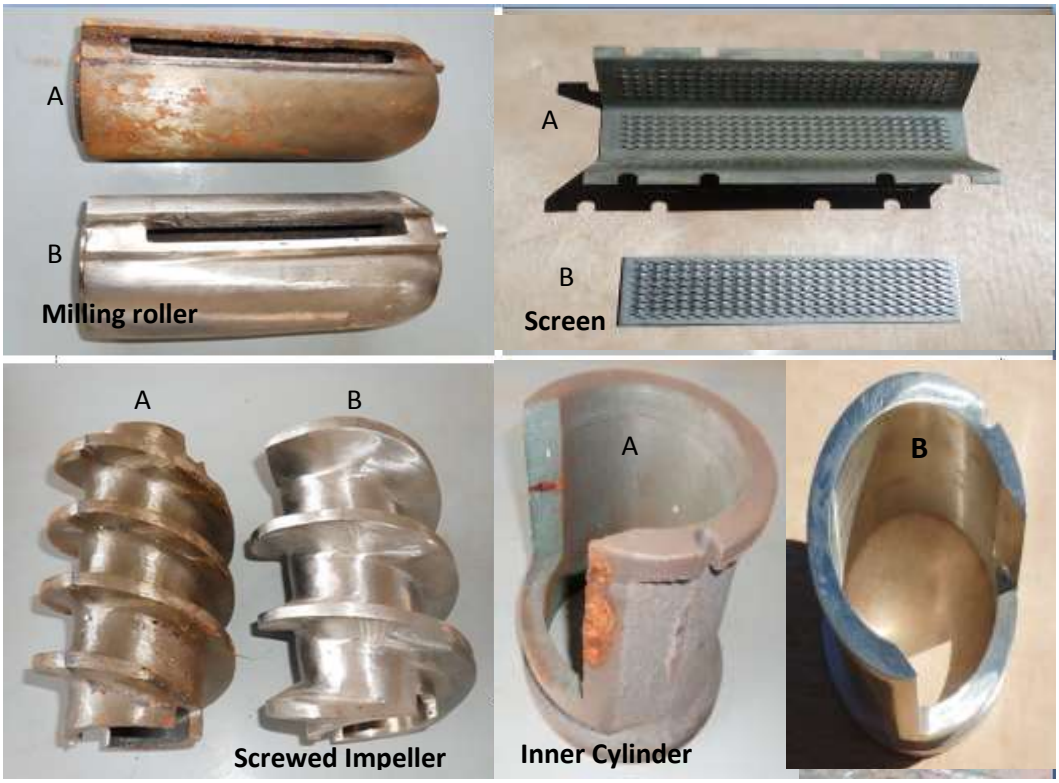


Figure 28. Komponen penyosoh dari bahan metal (A) dan bahan stailess steel (B)

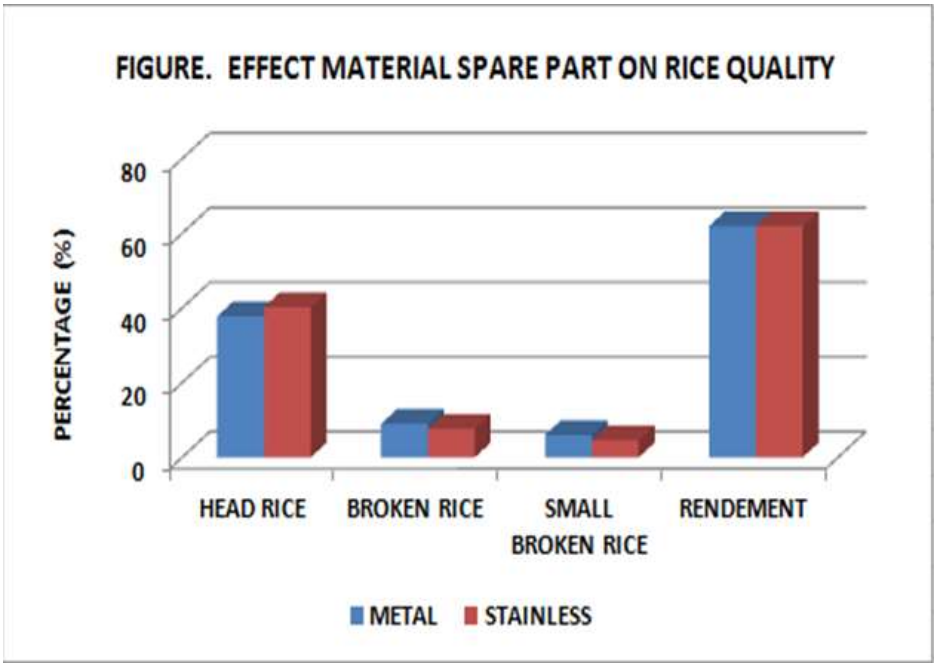


Figure 29. Effect of polishing materials (metal and stainless steel) on the quality and rendement of milled rice

Rice polishing results often produce less harsh white appearance, making it less preferred by consumers. It can be caused by (1) a tool used penyosoh not eligible, as a tool to grow rice by hand, polish engelberg type, type one pass old appliance conditions, (2) the bran still attached to the surface of the rice penyosahan results using the tool penyosoh abrasive type. Abrasive polish type use the polish tool of rough stone materials, (3) the consumer-who want a high yield of rice yield, regardless of the quality that is doing penyosohan without pressing. To produce more clean and shiny surface by using technology shining (washing rice bran surface with water fogging takes place during the process of rice polish).

Shining process (water fogging) can use 2 methods: using Gravitation injectors (gravity system) and use the injector compressor (water pressure system) (Figure 30). The things that must be considered in the process of fogging are:

(1) The moisture content of paddy / rice 14%,

(2) Water demand generated by the ratio nozle venture 10 holes: 05 mm / mm will produce a droplet / particle mist of water is good for rice polishing.

(3) The water efficiently and effectively in water fogging when given teknan 50 psi will produce particles evenly and smooth water of 1000 points / cm 2, with an average water consumption of 0.19 liters / min. Water demand with volumes from 0.3 to 0.4% of the weight of the material used to soften and bind the fine dust from the surface of the rice, and reduce the pressure and temperature at the friction surface during a rice polishing, so that the yield and better quality.

(4) round cylindrical Speed 800-1000 rpm optimum polishing.

(5) Type milling tool used is a combination of abrasive type - friction - shining.

Experimental results show that the milling degree on rice crystal higher (white and shiny) than the non-crystalline rice on the same variety, while the percentage of broken rice and the yield was not significantly different (Figure 31).

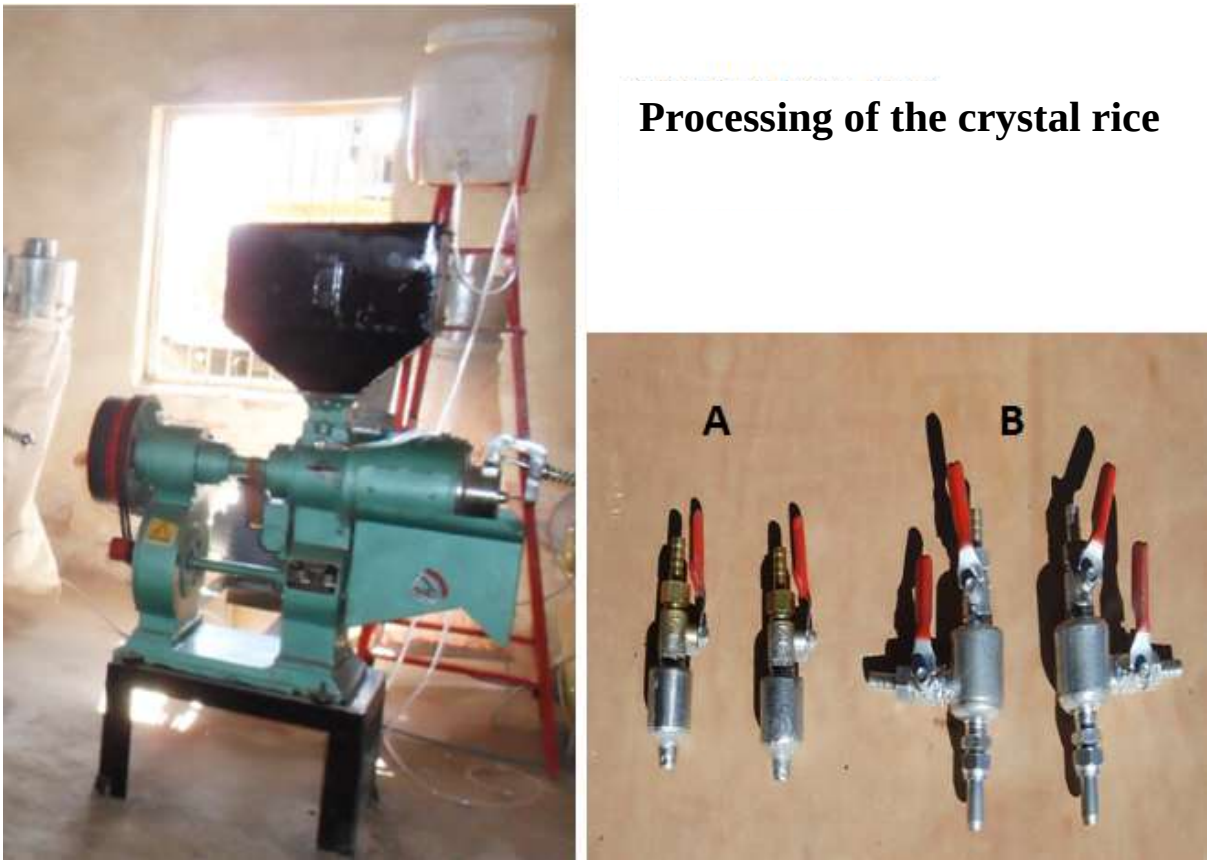


Figure 30. Gravitation injector (A) and Compresor Injection (B)
in the shining process of cystal rice

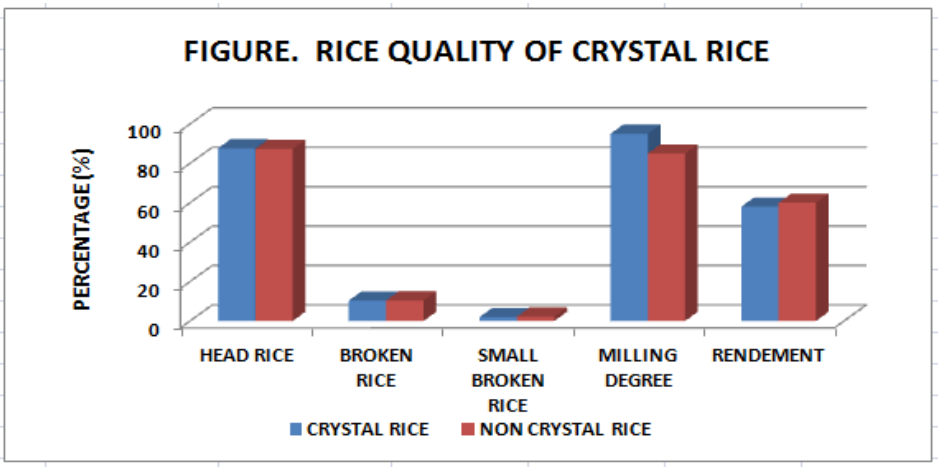


Figure 31. Effect of the shining process onthe quality and rendement of crystal rice

3.2. EVALUATING EXISTING PROTOTYPE OF MACHINERY

3.2.1. Prototyping Farm Machineries

(1) Paddy cleaner

Figure 32. Prototype of paddy cleaner

Tabel 6. Spesifikasi Prototype mesin paddy cleaner

Name of machine	Paddy cleaner machine
Model	Vibrating system
Capasity	1,0 -1,2 t/hour
Weight	kg
Dimension :	
• Long	1700 mm
• Wind	800 mm
• High	2100 mm
Diameter screen :	
• Screen 1	7 mm
• Screen 2	2,5 mm
Material	Metal and wood

(2) Paddy Separator

Table 7. Spesifiction of the Manual Paddy Separator Prototype

Name of machine	Paddy Separator manual
Model	Gravitation system operated manual
Capasity	1-1,2 ton/hour
Power (electrical motor)	1,5 HP (elect
Resolution : • Motor • cremer	 1730 rpm 804 rpm
Weight	61 kg
Dimension :	
• Long	1400 mm
• Wind	1000 mm
• High	1775 mm
Material	metal

(3) Modified rice polisher

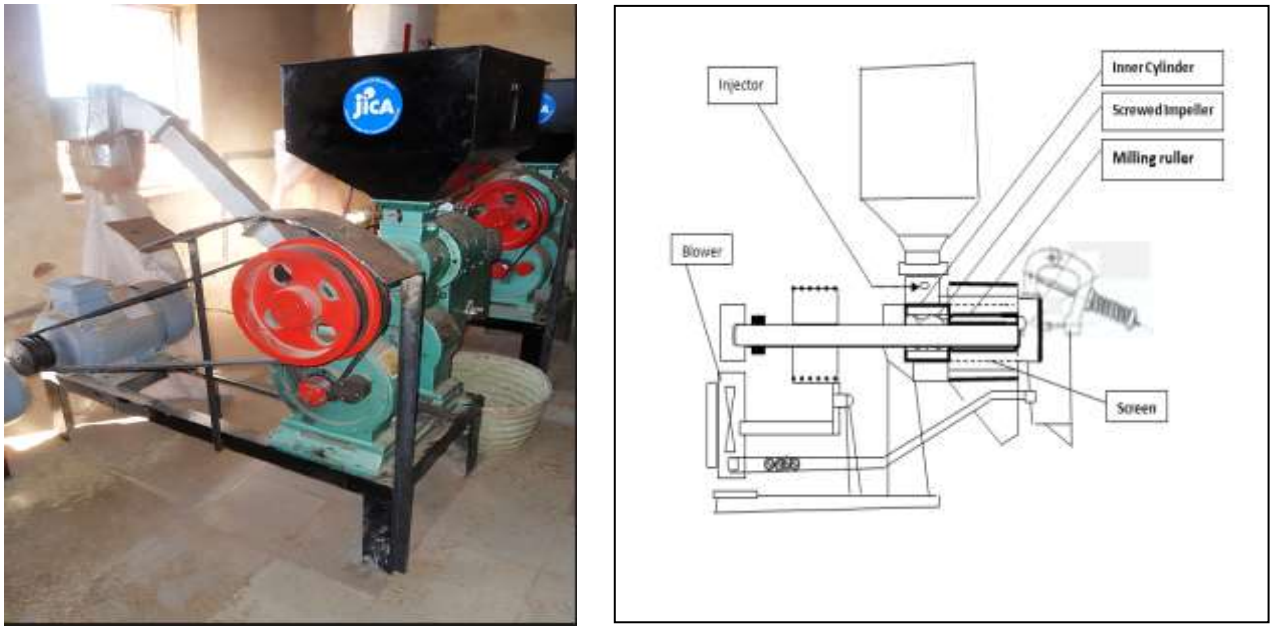


Figure 34. Prototype of Modified rice polisher

Tabel 8. Specification of the Modified Rice Polisher machine

Spesification		Modified Rice Polisher machine
Model/ type		6 NF-11.5
Output (kg/h)		1100 - 1500
Power (kw)		11 - 15
Resolution (rpm)	The main shaft	940 - 1000
	Fan	4200 - 4400
Dimension :		
• Long (mm)		1400
• Width (mm)		1200
• High (mm)		1500
• Weight (kg)		240
Part of the machine component :		
• Milling roller	Long (mm)	240
	Diameter (mm)	90
• **Inner Cylinder**	Long (mm)	130
	Diameter (mm)	150
• **Screwed Impeller**	Long (mm)	140
	Diameter (mm)	120
• **Screen**	Long (mm)	22
	Width(mm)	6,5
• **Blower**	Diameter (mm)	400
Materials		Metal dan stainless

(4) Press machine for the rice husk charcoal briquettes

Table 9. Specification of the manual press machine Prototype for rice husk charcoal briquettes

Name	Manual pressing machine for charcoal briquittes
Model	Operated manual
Capasity	25 pc briquittes/process
Weight	37 kg
Dimension :	
Long	540 mm
Wind	480 mm
• High	1450 mm
Materials	metal

Figure 35 Prototype of Press machine for the rice husk charcoal briquettes model A1.

Figure 36. Prototype of Press machine for the rice husk charcoal briquettes model A2.

3.2.2. Testing and performance of prototype

(1) Testing of Paddy Cleaner machine

The trial results showed that the saline paddy cleaner More than 95% paddy grains successfully separated from impurities in the form of pieces of rice straw weed, soil and empty grains (Table 10). This means the prototype machine is eligible for use in the rice milling process.

Table 10. Testing of Paddy cleaner machine

Code sample (variety)	Before process, paddy grain	After process with paddy cleaner							
		Paddy grain		Dirty straw		Dirty grass and soil		Dirty empty grain	
	kg	kg	%	kg	%	kg	%	kg	%
CD -1	18	17,14	95,22	0,05	0,28	0,51	2,83	0,3	1,67
CD -2	20,5	19,15	93,41	0,1	0,49	1	4,88	0,25	1,22
Makalioka	20,5	20,1	98,04	0,05	0,24	0,15	0,73	0,2	0,98

(2) Testing of Paddy Separator

The most important factors are (1) the size / diameter screener, (2) the number of screener used, (3) measuring grains and brown rice (long grain varieties or short grain), (4) the angle / elevation of the sieve. Test results paddy separator will separate the grain (on the front / A) and brown rice (on the back / B) and (5) how many times do on the same sample.

Observations were made on how the materials separate comparison towards the front and towards the rear. Observed as well, the percentage of each part (A and B) content of paddy grains and brown rice.

Table 11. Testing of paddy separator used var. chomrong dhan

TREATMENT	Sum of separate	Time	Weight of sample	Weight of Front/A	Weight of Back/B	Brown rice di A	Brown rice di B
		(minute)	(g)	(kg)	(kg)	(g/g)	(g/g)
I - 29°	1	4’02’’	18500	3050	15450	0,2828	0,5221
II 31°	1	4’27”	17500	5500	12000	0,3936	0,6815
III 31°	1	1’56”	11700	2800	8900	0,5806	0,8387

Table 12. Testing of paddy separator with Newton eficiency

Experience			Input		Output at A,B		Ratio of Brown rice at B	Recovery of Brown rice at B	Retention of paddy at B	Newton's efficiency	Ratio of Brown rice at A	Loss (return) at A	Overall recovery
			F=A+B (g)	$AX_A+BX_B)/$	A (g)	B (g)	X_B (g/g)	$\eta_r=BX_B/FX_F$	$m=B(1-X_B)/F(1-X_F)$	$\eta_N=\eta_r-m$	X_A (g/g)	AX_A/FX_F	B/F
	CD												
I	29°	1	18500	0,4826	3050	15450	0,5221	0,9034	0,2065	0,6969	0,2828	0,0225	0,8351
II	31°	1	17500	0,5910	5500	12000	0,6815	0,7907	0,0893	0,7013	0,3936	0,0731	0,6857
III	31°	1	11700	0,7770	2800	8900	0,8387	0,8211	0,0274	0,7938	0,5806	0,1080	0,7607

Test results report Rice Milling Unit (RMU) on rice varieties indicate that Dhan Chomrong output ratio based on A and B and also the value of Newton's highest efficiency on the third repetition of 0.7938 (Table 12). This means that the use of paddy separator at an angle of slope (elevation) and 31o sieve size 5mm x 5 mm square-shaped, 4 pieces can be used to separate brown rice and grain was husker machine to process the results of short grain varieties (varieties Chomrong Dhan). As for the long grain varieties (such as varieties Makalioka) with a tilt angle of 34o and a sieve size of 2.5 mm x 6 mm with sieve menggati, sebnyak 4 pieces can separate brown rice and paddy husker machine processing.

(3) Testing of Modified Rice Polishing Machine

To improve the quality of rice has designed a prototype machine polisher rice by replacing components from metal with stainless ssteel, derta equipped shining water system. Modified engine test results showed that the yield of milled rice (91.29%), capasitas ground (479.3 kh / h), and milling degree (93%) is still high, and broken rice (7.49%) less than 10 % means this machine qualifies for operations (Table 13, 14 and 15).

Table 13. Performance test results of the modified polisher based on the initial weight of the material

No.	Contents of brown rice (kg)	Weight of milled rice (kg)	Rendement (%)
1	6,50	6,30	96,02
2	10,00	8,60	86,00
3	8,60	7,90	91,86
Average	8,36	7,60	91,29
SD	1,76	1,18	5,03

Table 14. Performance test results of the modified polisher based on time

No.	Milling time (min)	Weight of milled rice (kg)	Capacity (kg /h)
1	0,80	6,30	472,50
2	1,05	8,60	491,40
3	1,00	7,90	474,00
Avarage	0,95	7,60	479,30
SD	0,13	1,18	10,50

Table 15. Results of analysis of rice milling

No	Sample of Grain	Head rice		Broken rice		Small broken rice		Milling degree
	g	g	%	g	%	g	%	%
1	100	35,5	70,6	9,2	8,4	5,6	11,1	9955
2	100	37,8	74,9	8,2	7,6	4,5	8,9	90
3	100	41,5	82,8	6,4	6,5	2,2	4,4	

Avarage		38,27	76,09	7,93	7,49	4,108,9	8,15	93,33
SD		3,03	6,22	1,42	0,95	1,734,4	3,44	2,89

(4) Testing of Rice husker briquette pressing machine

Procedure:

1. Make a solution of adhesive (glue) with concentrations: clay / caly: water = 1: 9
2. Glue mix with rice husk with concentration: glue: Charcoal = 2: 7
3. The resulting mixture is filled into each hole mold pressing machines to the brim.
4. A screw presses do with the body and lift the mold with screw B.
5. then the husk charcoal briquettes prints taken and dried to dry moisture content 12-14% (for approximately 2 days) with drying.

Figure 37. Testing of the briquittes pressing machine for the rice husk charcoal

Table 16. Testing result of the press machine for the rice husk charcoal briquittes

No	Parameter	Replication			
		I	II	III	Average
1	Weight of dray charcoal per process per 25 pc (gr)	1250	1220	1220	1230
2	Time per process (menit)	9,11	9,57	10,16	9,61
3	Sum of labour (person)	1	1	1	1
4	Size of charcoal briquettes :				
	a. Diameter (mm)	55	55	55	55
	b. High (mm)	75	90	90	85
5	Weight charcoal (gr/pc)	45,49	55,32	50,91	50,57
6	Weight charcoal Briquettes per process (gr/ 25 pc)	1137,4	1383,2	1272,9	1264,5
7	Rendemen charcoal briquettes (%)	90,99	113,37	104,33	102,89
8	Moisture content of rice husk (%)	10,8	11,0	11,2	11,0

9	Moisture content of rice husk charcoal (%)	11,6	10,6	11,3	11,1
10	Moisture content of rice husk charcoal briquettes (%)	11,6	12,0	11,9	11,8

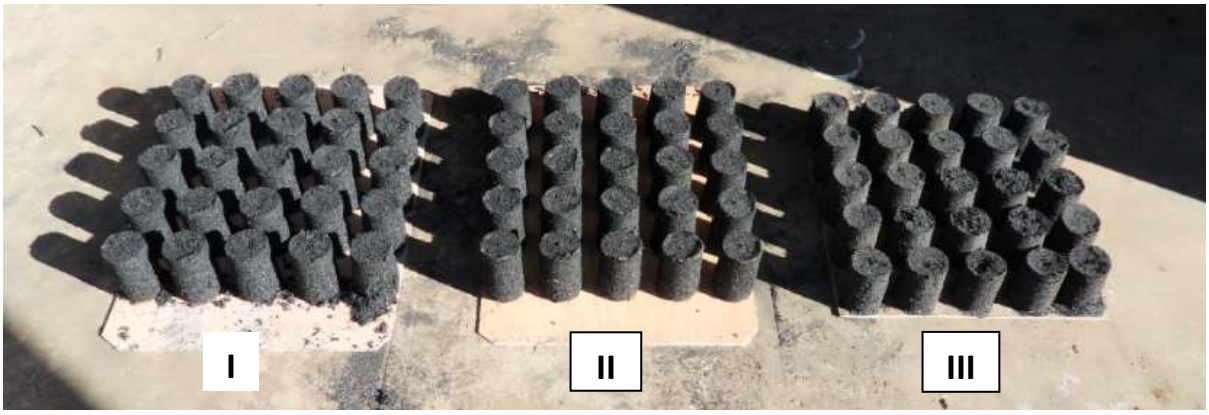


Figure 38. Testing result of the rice husk charcoal briquittes

Tablel 17. Economic analysis of rice husk charcoal briquettes

Discription	Rice husk charcoal	Briquettes of rice husk charcoal with tapioca glue	Briquettes of rice husk charcoal with cassava flour glue	Briquettes of rice husk charcoal with clay glue	Wood chrcoal
Price (Ar / kg)	85,53	150	150	150	200
Capacity (kg/hour)	280	296	296	296	112,5
Cost of labour (Ar/procces)	3.000	3.000	3000	3000	18.000
Cost production (Ar/kg)	40,9	116	104	75,70	153
Processing time (days)	5 hours	2	2	2	4
B/C ratio	2,09	1,28	1,44	1,98	1,30

3.3. Transfer Technologies

3.3.1. Training of Paddy losses measurement to Government

Selama pengukuran losses padi di 5 region (region Itasy, Vakinankaratra, Alaotra, Analamanga dan Bongolava) highland Madagascar juga dilakukan demonstrasi pengukuran losses padi terhadap petugas DRDR setempat.

During the measurement of losses of rice in the 5 regions (regions of Itasy, Vakinankaratra, Alaotra, Analamanga and Bongolava) of the central highland of Madagascar demonstrations of losses measurement are conducted to local officials of DRDR.

Itasy Region


Vakinankaratra Region


Alaotra-Mangoro Region


Analamanga Region

Bongolava Region

Figure 39. Demonstration of the paddy losses measurement in Highland (5 regions), Madagascar

3.3.2. Promote utilization of by-product of rice with development of applicable tools to Artisan and consumer

Demonstration of rice husk charcoal briquette to artisans and consumers

Artisan and consumer-Itasy Region


In DRDR -Alaotra region


Artisan and consumer-Alaotra region


Figure 40. Demonstration of rice husk charcoal briquette to artisans and consumers in Alaotra and Itasy Region

3.3.3. Training of Rice mill processing configuration to the RMU small scale

This training is an activity of Papriz project, which aims to improve the quality of rice in Madagascar through remedial RMU configuration milling process at small scale. The training was conducted on 6 September 2013 in CFAMA Antsirabe. Participants were 30,

consisting of farmers (3 people), artisan (5 people), small-scale entrepreneurs of rice (5 people), DRDR (5 people), CFAMA (8 people) and Papriz (4 people). Training Schedule was as follows (Table 18):

Table 18. Training Schedule of Rice mill processing configuration to the RMU small scale

Time	Agenda	Presentator
8.00 – 8.15	Registration	
8.15 – 8.20	Opening	DRDR Director
8.20 – 8.30	Introduction of participants	CFAMA Director
8.30 – 9.45	Rice Milling Technology	Mr. Suismono
9.45 – 10.00	Break	
10.00 – 11.00	Visit to Rice milling visit to Engelberg Rice milling	Expert Assistant
11.00 – 12.00	Demonstrasi Penggilingan One pass dan Double pass di CFAMA	Expert Assistant
12.00 – 13.00	Lunch	
13.00 – 14.50	Discussion	Mr. Suismono and Prof. Shoji
14.50 – 15.00	Closure	DRDR Director

3.3.4. Workshop of Paddy Losses, Rice Quality and By-product of RMU in the central Highland areas of Madagascar

Workshop report on the activities carried out as Expert / TCE Papriz-JICA Project for the period of April to September 2013. Workshop was held on 12 September 2013 in the Building of the General Direction of Rural Engineering in Nanisana, Antananarivo. Training Schedule was as follows (Table 19):

Table 19. Workshop Schedule of Paddy Losses, Rice Quality and By-product of RMU

Waktu	Topik	Presentator
14.00 – 14.15	Opening (5min)	Papriz
13.45 – 14.15	Presentation "Handling of the losses, and by-product quality for Rice in Highland Madagascar" (30 min)	M. Suismono
14.15 – 15.00	Discussion (45min)	DGT and Mr.Kabaki
15.00-15.05	Closure (5min)	Papriz

3.3.5. Seminar Programme of PAPRiZ Pre-JCC

Pre JCC activities were held on 6-7 June 2013 in Nanisana, Antananarivo, which was attended by all implementing field activities of PAPRiz: DRDR, FOFIFA, CFAMA, FIFAMANOR, SOC Central, CMS Sakay, JICA, with the following schedule: (Tables and

Figure a). The results of the meeting were presented during the JCC in the Panorama Hotel on 20 June 2013. Seminar Schedule was as follows (Table 20):

Table 20. Seminar Schedule of the Programme of PAPRiZ Pre-JCC

Date	Time	Topic	Presentators
Thursday 06 June 2013	09:00-09:30	Opening Introduction of participants Objective of Pre-JCC	Mr DGT
	09:30-09:50	Presentation on technical package activities - Analamanga	DRDR Analamanga
	09:50-10:10	Presentation on technical package activities - Itasy	DRDR Itasy
	10:10-10:30	Presentation on technical package activities – Bongolava	DRDR Bongolava
	10:30-10:50	Coffee break	
	10:50-11:10	Presentation on technical package activities - Vakinankaratra	DRDR Vakinankaratra
	11:10-11:30	Presentation on technical package activities – Alaotra Mangoro	DRDR Alaotra-Mangoro
	11 :30-12:00	Question and answer on the activities in the 5 regions	
	12 :00-13:00	Lunch	
	13 :00-13:20	Presentation on technical package activities – Atsinanana	DRDR Atsinanana
	13 :20-13:40	Presentation on technical package activities – Analanjirofo	DRDR Analanjirofo
	13 :40-14:00	Question and answer on the activities in the 2 eastern coast regions	
	14 :00-14:20	Presentation on the survey result on the « Voly varin-dRajao » film	ITEM
	14 :20-15:00	Presentation on the agricultural machinery and the artisans training Presentation on the post-harvest activities	CFAMA Mr Suismono
	15 :00-17:00	Coffee break | Explanation on the interview by the final evaluation consultant	Ms. Okata
		Interview in group (all the participants)	
Friday	09:00-9:20	FOFIFA CALA Presentation	Mrs Charlotte
07	09 :20-9 :40	FOFIFA Kianjasoa Presentation	Mr Pierre
June 2013	09 :40-10 :00	FOFIFA Mahitsy and Antsirabe Presentation	Mr Xavier
	10 :00-10 :20	FIFAMANOR Presentation	Miss Seheno
	10 :20-10 :40	CFAMA Anosiboribory Presentation	Mrs Néné
	10 :40-11:00	Question and Réponse on the FOFIFA presentations	
	11 :00-11:45	Discussion	
	11:45-12 :00	Closure	Mr DGT
	12:00-12:30	Cocktail	

3.3.6. Certification of Agricultural Machine Product

To provide quality assurance of agricultural machinery products, it is necessary to make an accredited Laboratory Testing Equipment and Agricultural Machinery. The testing laboratory is used to conduct testing of agricultural machinery products produced by Artisan. With the Testing Laboratory Equipment and Agricultural Machinery in CFAMA, then CFAMA entitled to select, develop, and provide certification to artisans qualified to manufacture farm machinery with guaranteed quality.

To support the accreditation program in CFAMA, the PAPRiz Experts have helped to prepare the accessories in the form of (1) Quality Document (Manual Guide / GM, Work

Procedure / WP, Work Instruction / WI, form, recording), (2) Laboratory of Machine testing, (3) Field Laboratory for testing machine, (4) Showroom of Agricultural machine product made in CFAMA and (5) Training of ISO 17025 testing Laboratory for Acreditation about CFAMA staff.

4.1. Impact

- TCE activities support facilities in the development of a prototype of CFAMA agricultural machinery.
- Good cooperation from all staff CFAMA Director, Assistant TCE and TCE Technician for carrying out activities in CFAMA.
- Good coordination with PAPRiz Project always supporting Budget from JICA for the success of the TCE activities. Coordination with DRDR and Coordinators in each region is very helpful for TCE Papriz activities in the field.
- The TCE assists DRDR (goverment) in measuring paddy losses and rice quality analysis, as well as trying to give the technology package to reduce post-harvest losses, and improvement of rice quality.
- Farmers become a consumer and artisans become producer of appropriate farm machinery.

4.2. Sustainability

- The result of the workshop showed that paddy losses during postharvest are large (14.80%) and rice quality is still below the standard (broken rice more 20% and milling degree less than 80%). Socialization measurement of paddy in all regions of the central highland areas (upland and Lowland) in Madagascar is needed.
- To improve the yield and rice quality, a Rice Mill Double Pass pilot (Pilot Plan) to support the revitalization programme of small-scale rice mill is needed (capacity 1-5 tons / day) and intermediate one (production capacity of 5-10 tons / day).
- In providing assurance of product quality from artisan production of agricultural machiner, a Certification of Engineering product is required under the supervision / coordination of CFAMA. CFAMA also needs improved management Workshop (Engineering Laboratory) through the implementation of ISO 17025-2005 for accreditation.

V. CONCLUSION

During the six month period (April - September 2013), TCE activities in Madagascar have resulted in:

- Preliminary data on losses and quality of paddy/rice in the central highland areas (5 regions of Vakinankaratra, Bongolava, Alaotra-Mangoro, Itasy and Analamanga region) of Madagascar.
- Four prototypes of machinery (Paddy cleaner, Manual Metal Separator for Paddy, Modified Rice Polisher and Rice husk briquettes Pressing machine).
- Rice Milling of Double pass system Small scale with configuration C-H-S-P-P- Pilot plan (Paddy cleaner – Husker – Paddy separator – Polisher – Polisher) to improve the rice quality.
- Transfer of technology through training on "Improvement of Rice Quality " with DRDR, Rice Milling Unit (RMU) small scale, artisan and farmers of Vakinankaratra region.
- Dissemination and demonstration of measurement paddy losses in DRDR Bongolava, Vakinankaratra, Alaotra-Mangoro, Analamanga and Itasy and demonstrations of charcoal and charcoal briquettes in Itasy and Alaotra.
- Providing Workshop on "Evaluation of paddy Losses and rice quality and promotion of by-product of Rice mill in the central Highland areas of Madagascar" to the Ministry of Agriculture and PAPRiz / JICA Project Madagascar.
- Preparation of agricultural equipment testing laboratory, quality documents, field laboratory, showroom of Agricultural machinery and training on ISO 17025 testing laboratory.

VI. RECOMMENDATIONS

6.1. To the Ministry of Agriculture

- Application of technology package to decrease paddy losses with using new variety (not threshed), plant condition has 80% of paddy grain with yellow color and dry soil in the field, threshing in the field with pedal thresher and the minimum size of floor is 8 m x 8 m, sun drying with plastic terpal, rice milling with double pass system, and Packaging Storage System and room of paddy grain storage good aeration with pallet and moisture content of 14%.
- Technical Guide of Paddy losses and Technical Guide of Rice Quality can be used with reference of DRDR to measure paddy losses in the field. In the future programme evaluation of paddy losses and rice quality are neededede in the central areas of rice production (upland and lowland area) in Madagascar .
- To increase the yield and rice quality Revitalisation Programme of rice milling with Double Pass system is needed.

6.2. To JICA

- Tecnology Packet with the milling process configuration “Cleaner-Husker-Separator-Polisher-Polisher (C-H-S-P-P) and Double pass system in Rice Milling Unit small scale” can decrease the milling losses and to increase yield and quality for rice.
- To support these activities a Laboratory of Quality Rice "which applies the quality management system is required. Therefore the support of PAPRiz-JICA Project of the facility equipment for laboratoium of rice quality analysis is expected. CFAMA needs coaching workshop management so as it can get standard agricultural machinery products.

VII. FEASIBILITY FOR THE NEXT PROGRAMME

- The dissemination of the Technology Package with the milling process configuration “Cleaner-Husker-Separator-Polisher-Polisher-Grader (C-H-S-P-P-G) and Double pass system in Rice Milling Unit small scale” can decrease the milling losses and increase the yield and quality of rice in Itasy and Analamanga regions because Rice milling of double pass have developed.
- Need to evaluate consumer preferences for quality rice in the central highland areas of Madagascar to improve rice quality.
- It is necessary to follow-up the assessment process in laboratory testing CFAMA agricultural machinery, as well as the guidance of the artisans to produce agricultural

machinery products so as to guarantee the quality. Artisans coaching with training, supervision and certification for artisans who selected meet the requirements.

APPENDIX :

Show room of the promotion agricultural machinery in CFAMA, Antsirabe

Visit to Show room of Agricultural machinery in CFAMA : MinAgri Nadagascar, Indonesia Anbassy, Head of Jica Madagascar, Rusia Ambassy and Directur CFAMA

Field Laboratory of Agricultural machine testing in CFAMA, Antsirabe

Manager Room of Acreditation Testing Laboratory , CFAMA

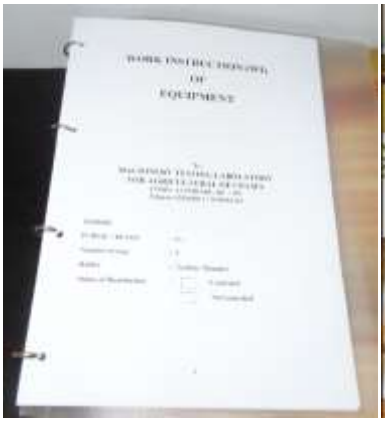
Testing Laboratory , CFAMA

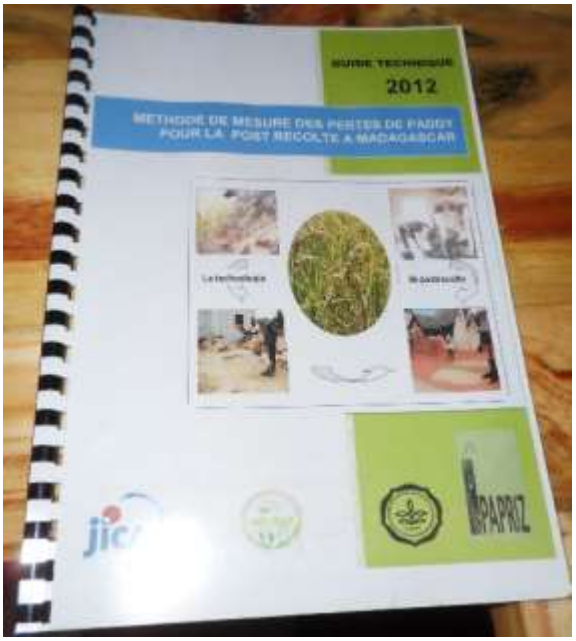
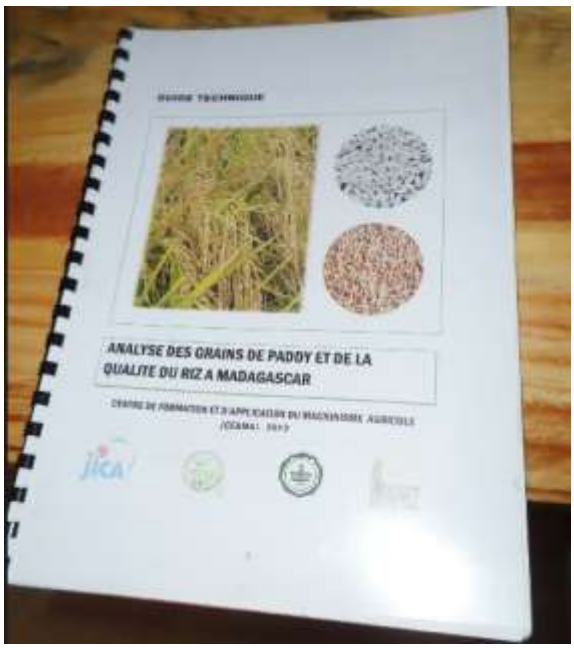
Testing machine room

Testing engine room



QUALITY GUIDE


WORK INSTRUCTION(WI)
OF
TESTING METHOD

WORK INSTRUCTION(WI)
OF
EQUIPMENT

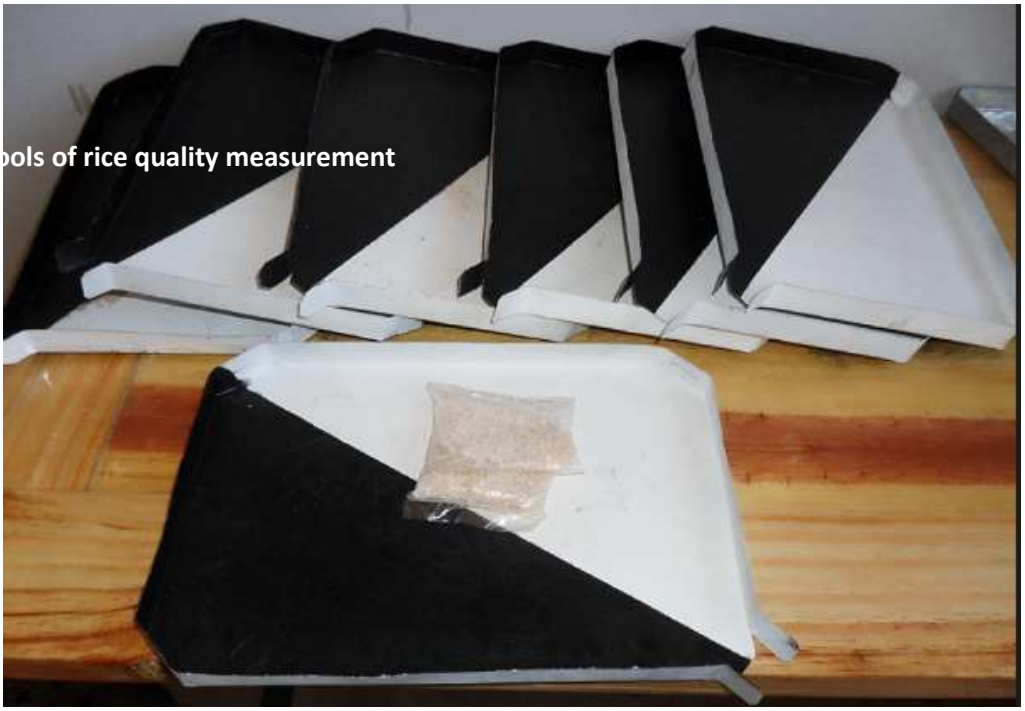
WORK INSTRUCTION(WI)
OF
PERSONNE

GUIDE TECHNIQUE
2012
METHODE DE MESURE DES PERTES DE PADDY
POUR LA POST RECOLTE A MADAGASCAR
JICA
PAPRIZ

GUIDE TECHNIQUE
ANALYSE DES GRAINS DE PADDY ET DE LA
QUALITE DU RIZ A MADAGASCAR
JICA


DAV STARTEST


DIGITAL TACHOMETER
SHIMPO

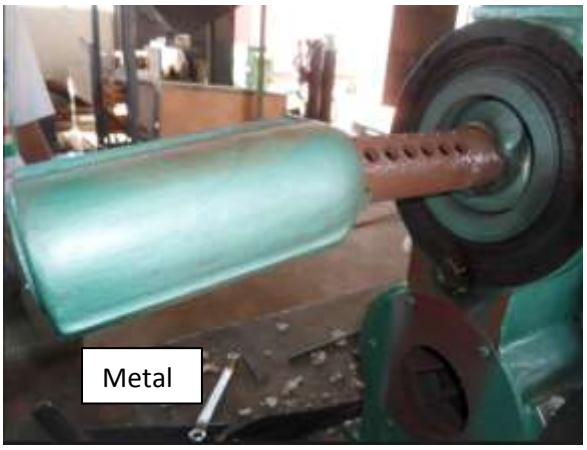

NAVISER LASER

Tools of paddy losses measurement



ools of rice quality measurement

To change the spare part of rice milling unit (RMU) with metal material to stainless steel


Metal


Stainless steel


Klin