F.3 Constraints in Post-harvest Processing

F.3.1 General

(1) Lack of adequate market information

The information system is not well established for individuals and organizations concerned who need the proper and accurate market information. The necessary information on quality, quantity and price are not effectively disseminated at various stages.

(2) Lack of fund and proper credit lines

Funds for those who that intend to invest for new business or for improvement of a processing facility are not sufficient. Existing credit program cannot meet the requirement for investment.

(3) Low technology base

The diffusion of the post-harvest processing technology required to respond to market needs and also to pursue economic efficiency is not well organized. There are limited numbers of engineers who are able to introduce improved technology.

Furthermore, there is not a reliable and precise assessment value on post-harvest processing losses that can be the base for estimation of the economic efficiency of each improved technology and measure.

(3) Low level of material supply other than rice

The constraints and obstacles explained above are also applicable to the production stage. The crop diversification is at the initial stage. Therefore, the base of material supply of product for post-harvest processing has not well materialized yet.

(4) Insufficient business management

Business management ability is rather low irrespective of SOE and private enterprise in view of medium to long-term perspectives although the strong effort to respond to market needs for an immediate profit is noted.

(5) Lack of group activities in producers

To obtain the benefit of the economy of scale, it is necessary to collect and process an appropriate quantity of material with uniform quality. Since individual producer cannot enjoy the scale merit, the group activities among producers are one of the options to meet this requirement. So far this movement is at the initial stage.

(6) Insufficient comparative advantages for investment

The Study Area is widely shared by the flood area and the suitable location for processing factory is limited. The infrastructure such as road, electrification and access to market has not been developed well compared to other part of MRD.

F.3.2 Post-harvest Processing of Rice

Producer's Level

(1) Little effect to sale price of paddy by quality improvement

The sale price of paddy is decided by inspection mainly on shape of grain and moisture content. The paddy price here is not reflected the economic effect of the quality of material paddy brought in by the following process such as husking, whitening and polishing effectively. As a result, the producer are not motivated to improve the quality of rice, and to invest for it.

(2) Little stock for marketing

As many of producers have not enough fund and warehouse for storage, they tend to sell their products as soon as possible after harvest.

(3) Lack of handling practice by large volume with uniform quality.

The practice of collecting small amount of material from many individual producers makes it difficult to obtain an appropriate unit of material in uniform quality and variety. This leads to the difficulties in effective and economical processing.

Rice Processing Level

(1) Low recovery rate

Many losses occurr by mixed varieties and low quality of material at the processing.

(2) Many losses by high moisture content material

Rice with higher moisture content of more than 14%, a recommended level for safe storage, is distributed widely. Most of this material is processed without drying before processing. High moisture content of material results in high broken rice generation and low recovery rate, particularly in case of long grain. Additionally, as the product often cannot meet the export requirement of below 14%, they have to install white rice dryer as a last resort with increasing expenditure and losses.

(3) Difficulty in procurement of paddy material

Export rice processing factories procure brown rice and white rice more than paddy from rice mills and traders in the vicinity when they have received export quota. This is due to lack of their own purchasing staff and system, luck of funds and shortage of storage capacity. As most of the processing plants are equipped with husking, whitening and polishing machinery in a complete system, this

procurement system make the plant operations very complicated and difficult ones with lower efficiency.

(4) Lack of fund and low management plan on a long term basis

Such priority machinery as polishing machine and length grader have been introduced to export rice processing factories to meet the requirement for export. However, in other ordinary rice mills, the modernization of machinery has not made progress well due to a lack of fund. It is difficult to judge whether such effort done in export processing factories has been made based on the long-term management plan or it was the result of immediate response to export quota. The layout of the processing line in many factories is not well organized, adding new machinery and transformation of line in a limited area. This results in the difficult condition for proper operation and management.

(5) Many old and old fashioned machinery and equipment

There are many rice processing factories equipped with old and old-fashioned machinery with low efficiency.

(6) Insufficient operation management way

The operation of the processing machinery such as a husker, a whitener and a polisher are carried out by the experience of the operator under the difficult circumstance of no uniform and low quality of material as explained above. Recently, issue of better is given more at tension than quantity especially for export rice production. It can be also said that the factory management shall be given the priority to profitability through technology renovation. However there is not a proper technology and practice yet by that a operation condition can be evaluated and improved scientifically and numerically.

F.4 Development Plan in Post-harvest Processing

F.4.1 Objectives and Strategy

Based on the target of the Study, "To increase the producer's income and improve their living conditions", the Objectives and Strategy for formulating the Development Plan in this field are set up as follows:

(1) Objectives

- Reduction of post-harvest losses
  To reduce post-harvest losses in terms of quantity and quality, and to increase producer's profit.

- Increase a value added of the products.
  To increase value added of products, and increase producer's income.

- To increase job opportunity
  To increase job opportunity, absorb surplus labor, and increase inhabitant's income.

(2) Strategy

a) Producer's Level

- Improve post-harvest practice
  To train producers the post-harvest technology including quality control measure and improve the post-harvest practice, in order to reduce losses and raise sale price.

- Introduction of appropriate post-harvest facilities and equipment
  To spread post-harvest facilities and equipment such as warehouse and dryer in order to reduce losses and raise sale price.

- Support to introduction of new processing business
  To support on the introduction of processing for a value added to the products and to establishment of new processing businesses to increase producer's income, especially in terms of technology.

b) Processing Industry Level

<u>Existing rice processing industry</u>

- Improvement of the factory management including a machinery operation technology
  To train management staff and operators of processing plant or machinery on a modern factory

management and plant operation in the more profit oriented manner. The expected technical subjects are as follows:

Factory management / Profit management / Processing plant and machinery operation / Inspection and quality control / Process control in view of a recovery and losses

- Renovation of facilities, machinery and equipment

  To renovate facilities, machinery and equipment existed especially aged and old fashioned ones and introduce necessary devices for inspection and quality control to improve the factory's efficiency and profitability.

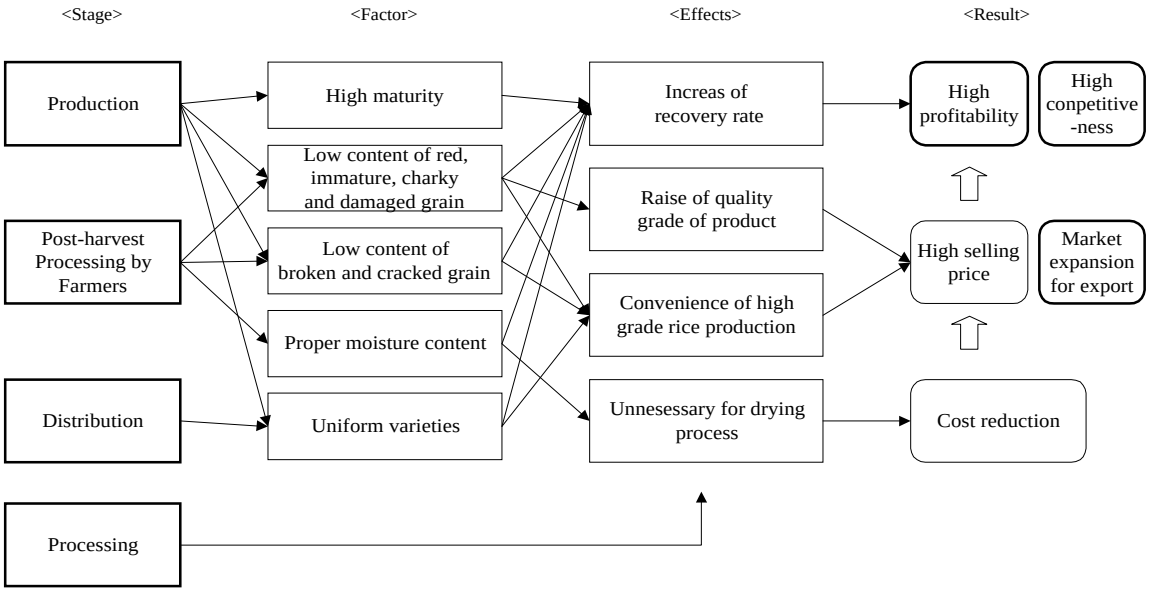
Other processing industry

- Support to the introduction of new processing businesses and expansion of activities in a small industry

  To support the introduction of new processing technologies by a request of an entrepreneur and an enterprise for the purposes of establishment of a new processing business, development of a new product line and to expand a production capacity.

c) Necessity of cooperation and linkage among strategies

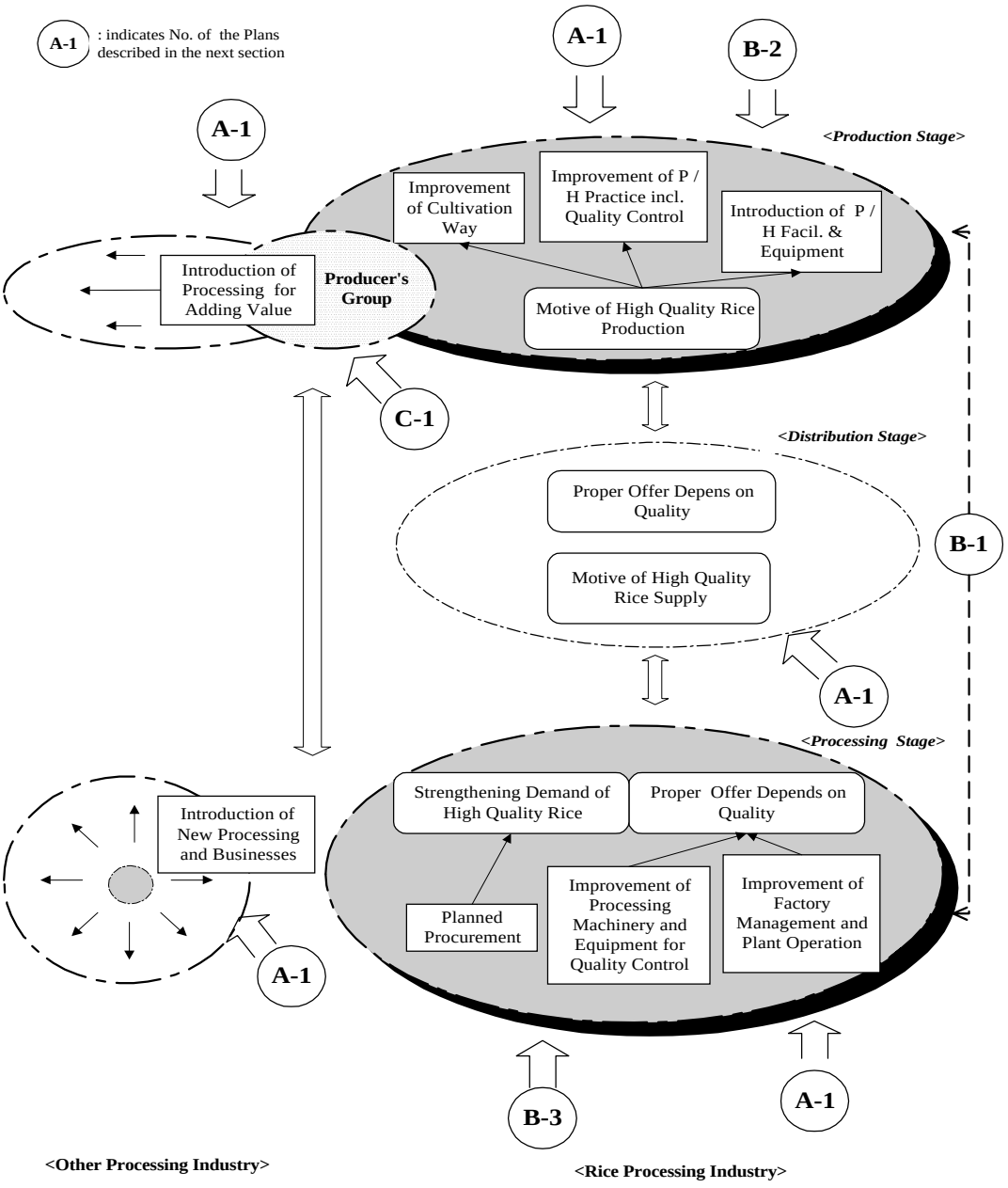
Improvement of post-harvest processing at farmer's level provides the reduction of losses on quantity and quality. The reduction of quantitative losses can bring profits directly to farmers by increase of their selling amount. On the other hand, the improvement of quality can bring economic effects only if this is reflected in the offer price. This will depend on the following processing stage as shown in the chart below. Therefore, it is indispensable the processors firstly must have the capability to precisely evaluate the differences quality of raw materials and to reflect it to the procurement price, and further, the trader must offer proper buying prices to farmers in conformity with the above condition between price and quality. Thus, it will be difficult to achieve the improvement of post-harvest processing if the system where the proper standard between price and quality can go upstream the distribution channels to the production stage will not be realized.



Improvement of Rice Quality and It's Effects in Processing Stage

Therefore, it is necessary to recognize that the improvement of post-harvest processing must be promoted through the implementation by an effective cooperation and linkage among players.

The correlation of each strategy including the development plan described in the next section is shown in the figure below.



F.4.2 Development plan

The outline of the projects that are the components of the Development Plan are classified as follows:

(1) General

A-1 Training and extension of P/H technology including quality control

*The project will introduce a post-harvest technology training and extension facility in Dong Thap Prov. and Tien Giang Prov. The former covers the field of rice the later fruit and vegetable.

Objectives	Activities
1) To improve P/H practice of producers 2) To improve processing factory management 3) To improve quality control technology 4) To support to introduction of new processing technology 5) To foster experts needed for development of P/H industry.	1) To train producers 2) To train management staff and operators of processing machinery 3) To train producers, traders and processors 4) To train and support farmer's group, entrepreneurs & enterprises 5) To train graduates of a high school, college and a university

Input	Implementing Agency	Requirement
Necessary facility for training. Assistance to preparation of a training course design and curriculums	Dong Thap PC Tien Giang PC Assist. Agency: PHTI will recruit and dispatch trainers.	Cooperation and support by PHTI

a) Dong Thap Province

<The part of this project carried out in Dong Thap Province is treated as a component for the " Integrated Project for Rice Quality Improvement">

Place: This project will be located to the Agricultural Extension Center in Cao Lanh Town planed to be introduced by the Integrated Project.

Trainee: Farmers, farmer's groups, traders, processors and graduates

Training subjects:

Subject	Trainee	Content
Post-harvest Processing Technology	Farmers, farmer's groups, traders and processors	Technology such as drying and storage
Quality Inspection and Control Technology	Farmers, farmer's groups, traders, processors and graduates	Inspection and control technology for paddy, brown rice and white rice quality
Factory Management Technology	Farmer's groups, processors and graduates	Factory management and profit control technology
Rice Processing Technology	Farmer's groups, processors and graduates	Milling, recovery control and machinery maintenance technology

Activities:

Subject	Capacity (Trainee)	Period (Day)	Time / Year	Total Trainees / Year
Post-harvest Processing Technology	10	3	50	500
Quality Inspection and Control Technology	10	3	50	500
Factory Management Technology	10	3	5	50
Rice Processing Technology	10	10	5	50

Monitoring of post-harvest losses

The P/H loss assessment technology is including the above training programs through the demonstration method and the assessment data is collected timely by the cooperation of trainees regarding the actual loss generating condition in the Area.

Staffing:

Class	No.	Role	Remark
Permanent	2	To maintain and give a guidance on milling plant and dryer	To be recruited newly
	1	To maintain and give a guidance on equipment for inspection and quality control	
	1	To maintain warehouse	
Temporary	Unspecified	Trainers To give a guidance of loss assessment	PHTI will support to recruit and dispatch staffs.

Facility and equipment: Theoretical training is carried out in the lecture room for multi-purpose use and the following facility and equipment are introduced for practice training.

<Major equipment>	No.	
1.Husking & milling facility	1set	1t / hr
2.Inspection and quality control equipment	3sets	
3.Drying yard	1	
4.Flat bed dryer	1set	Husk fed
5.Warehouse for processing material for training	1set	
6.Tools and equipment for maintenance	2sets	
<Building>		200 ㎡

Construction cost:

	1,000VND
Equipment	1,000,000
Building	1,060,000
Total	2,060,000

b) Tien Giang Province

Place: This project will be attached to the existing Vocational Guidance School in Cai Be District.

Trainee: Farmers, farmer's groups and traders

Training subject: Post-harvest processing technology such as drying, pre-cooling, fumigation and packaging and marketing technology such as selection and grading.

Activities:

Training

Subject	Class	Capacity (Trainees)	Period (Days)	No. / Year	Total No. of Trainees / Year
Fruit	Post-harvest technology such as drying, storage and fumigation	10	4	5	50
	Marketing technology	10	4	5	50
Vegetable	Post-harvest technology such as pre-cooling and storage	10	4	5	50
	Marketing technology	10	4	5	50

Technical support

The support on the application technology development in the above field will be provided to farmer, farmer's group and traders upon their requests.

Staffing:

Class	No.	Role	Remark
Permanent	2	To maintain and operate training facility To manage development activity	Recruited newly
Temporary	Unspecified	Trainers To support and give guidance for development activities	PHTI will support to recruit and dispatch staffs.

Facility and equipment: Theoretical training is carried out in the existing lecture rooms and the facility and equipment for practical training are installed additionally.

<Major facility & equipment>	Q'ty	Remark
1.Ordinery storage	1	
2.Low temp. storage	1	W/t air conditioner
3.Cold storage	1	
4.Drying chamber	1	Shelf type
5.Fumigation chamber	1	
6.Sealer	2	Impulse
7.Quality control equipment	1	
<Building>		100 ㎡

Cost:

	1,000VD
Facility & equipment	1,000,000
Building	530,000
Total	1,530,000

Operational cost: Operational cost is shared and owed by trainees and client.

(2) Post-harvest processing of rice

B-1 Assessment Study of Post-harvest Losses

Objectives		Activities
1) To obtain reliable technical and numerical data can be used for consideration of improvement plans and measures		To carry out a assessment study from a paddy field to rice processing factory at enough numbers of places during a year.
Input	**Implementing Agency**	**Requirement**
Fund and/or technical cooperation.	Agricultural Extension Center Assist. Agency: PHTI	Assessment method will be given careful consideration for obtaining useful reliable data.

<This project is treated in **A-1 a)**, as a component for the " Integrated Project for Rice Quality Improvement">

B-2 Improvement of P/H Facility and Equipment of Producers

Objectives		Activities
1) To reduce P/H losses 2) To improve quality		To provide a credit for producer's procurement of P/H facility and equipment such as a drying yard, a dryer, a warehouse and inspection devices.
Input	**Implementing Agency**	**Requirement**
Credit line with economical condition for producers	Dong Thap PC Tien Giang PC Agricultural Development Bank	To provide training

<This project is treated as a component for the " Integrated Project for Rice Quality Improvement".>

Implementation organization: To formulate the implementation organization within DARD in Dong Thap Province P. C.

Fund: To introduce 1.5 M US$ to an account for the Project in a bank as a revolving fund.

Facility and equipment: Facility and equipment supported by the fund are as follow.

	Kind	Cap.	Cost* (MVND)	Collateral (Example)
1	Drying yard	200 m²	0.5	House etc
2	Bamboo net storage	2t	0.5	House etc
3	Flat bed dryer	4t / 8hrs	30	Field above 0.6ha
4	Flat bed dryer	8t / 8hrs	40	Field above 1ha .

*Including installation cost and training fee.

Credit condition: 3 years period with 0.7%/month of interest.

Method of application: After inspection and judgement of the collateral condition and repayment ability the credit is provided to qualified applicants. This program is carried out continuously through refunding by revolving use of repayment money.

Facility and equipment spreading plan: Planned spreading number of places are as follow, estimated from 2002 as starting year.

	Kind	Cap.	Av. No. / Year	Total No. (to 2010)
1	Drying yard	200 ㎡	40 – 50	400
2	Bamboo net storage	2t	40 – 50	400
3	Flat bed dryer	4t / 8hrs	40 – 50	400
4	Flat bed dryer	8t / 8hrs	80 – 100	800
	Total		200 - 250	2,000

B-3 Improvement of Processing Facility and Equipment

Objectives	**Activities**
1) To reduce losses and increase profitability 2) To improve quality	To provide a credit for processor's procurement of facility and equipment for renovation.

Input	**Implementing Agency**	**Requirement**
Credit line with economical condition for processors	Dong Thap PC Tien Giang PC	To provide training To expand a short term loan for planned procurement.

<This project is treated as a component for the " Integrated Project for Rice Quality Improvement".>

Implementation organization: To formulate the implementation organization within the appropriate bank.

Fund: To introduce 2 M US$ to an account for the Project in a bank as a revolving fund.

Facility and equipment: The fund is used for the renovation and expansion of existing facility and equipment, especially for the followings.

	Old Type	Renovation / Introduction
1	Under-runner type husker	Rubber roll type husker
2	Compartment type husk separator	Shaking tray type husk separator
3	Friction type whitener	Abrasive type whitener
4	Corn type whitener	Abrasive type whitener (vertical flow)
5		Warehouse for raw material
6		Dryer and drying yard
7		Equipment for inspection & quality control

Credit condition: 3 years period with 0.9 – 1.0%/month of interest. Max. 100M VND / credit.

Method of application: After inspection and judgement of the propriety of request, collateral condition and repayment ability the credit is provided to qualified applicants. This program is carried out continuously through refunding by revolving use of repayment money.

Facility and equipment renovated and expanded: Planned number of factories applied to this program are as follow, by the estimation from 2002 as starting year.

Annually: Average 140 factories

Total by 2010: 1,200 factories

(3) Model project

C-1 Model Activities for Producer's Group

Objectives	Activities
1) Option 1 To reduce losses and improve quality	To introduce a facility and equipment such as a warehouse, dryers and inspection devices To inspect quality of their products. To sell their products by a variety bases and inspection results
2) Option 2 To produce high quality rice, reduce losses and improve quality	<The following activities are added to the above.> To produce high quality rice by introduction of a qualified seed and improvement of cultivation way
3) Option 3 To produce high quality rice, reduce losses, improve quality and add a value by milling	<The following activities are added to the above.> To introduce a rice mill.

Input	Implementing Agency	Requirement
Necessary facility and equipment or credit line for introduction of them	A farmer's group under a supervision of Provincial and divisional PC.	To be applied to existing or newly organized producer's group To provide training To provide a cooperation by export rice mills (SOEs).

<This project is treated as a component for the " Integrated Project for Rice Quality Improvement".>

Facility and equipment:

No.	Kind	Q'ty	Capacity	Remark
1	Rice mill	1set	4t / shift (8hr)	9,000t / Year
2	Flat bed dryer	2set	8t / batch x 2	Applied for supplemental use
3	Drying yard	1	600 ㎡	
4	Equipment for inspection & quality control	2sets		

Building:

No.	Kind	Area (㎡)	Remark
1	Office	20	
2	Inspection room	30	
3	Rice mill	200	
4	Storage	30	For consumables, spare parts & tools
5	Flat bed dryer	60 x 2	Independent
6	Drying yard	600	Open air

Staff:

Class	No.	Role	Remark
Permanent	3	Operation and maintenance of a rice mill and dryers	Recruited newly
	1	Operation and maintenance of inspection equipment	
	1	Management and maintenance of warehouse	

Cost:

	1,000VND
Facility & equipment	2,000,000
Building	2,320,000
Total	4,320,000

F.4.3 Recommendation

(1) Importance of National Promotion Measures

As mentioned above, the proper incentive must be provided to the persons and the enterprises concerned to improve the post-harvest processing. It means that this Area needs to proper and effective free market mechanism widely. To ensure such condition, the appropriate promotion measures are strongly expected to be considered and timely provided. It would be noted that, there still remain so many factors such as a quality standards and inspection system, market intervention system of rice and export rice quota which should be considered and treated at national level, rather than regional level.

(3) Necessity of Technical Cooperation

There are many components for introducing machinery and equipment among the development plan. The application technology for the effective use of those machinery and equipment are necessary because the machinery and equipment cannot generate any profits by themselves. Therefore, those technologies must be transferred to the people concerned and the various training programs are also proposed in the development plan. However, there may be some subjects that for the recruiting of the capable trainers will be difficult domestically. The technical cooperation for such subjects will be expected by the developed and experienced countries.

Table F.1 (1) List of Major Food Processing Factories in Mekong River Delta Area

1. Canned products

No	NAME	PRODUCT	LOCATION
1	Futex	Vegetable, fish, meat	Ben Luc - Long An
2	Delta juice	Fruit juice	Tan An - Long An
3	Long Dinh	Vegetable, mushroom	Long Dinh- Tien Giang
4	Meko	Vegetable, fruit, fish, meat	Tra Noc- Can Tho
5	Song Hau	Vegetable, fruit, fish, meat	Song Hau farm, Can Tho
6	KienGiang canned fish	Fish	Kien Giang
7	Vegetex	Vegetable, fruit	Tien Giang
8	Agriculture service of CT	Vegetable, fruit, mushroom	Can Tho
9	Taiwan canned fish	Fish, meat	Tra Noc- Can Tho
10	O-mon Canned mushroom	Mushroom	Omon-CanTho

2. Wine-beer-beverage

No	NAME	PRODUCT	LOCATION
1	Wine-beer consortium	Beer and kinds of beverage	Nguyen Trai- CanTho
2	Beer factory	Bottled- beer	Soc Trang
3	Festi	Soft drink, soya milk	Long Xuyen- An Giang
4	Phong Dinh	Beer- soya milk	3/2 street- Can Tho
5	Truc Giang	Soft drink, soya milk	Ben Tre
6	BGI	Beer, soft drink	My Tho – Tien Giang

3. Frozen products

No	NAME	PRODUCT	LOCATION
1	Long Dinh	Vegetable, fruit, concentrated fruit	Tien Giang
2	Cataco	Vegetable, meat, fish, other	Tra Noc- Can Tho
3	Cafatex	Vegetable , marine products	Chau Thanh- Can Tho

4. Sugar mill

No	NAME	PRODUCT	LOCATION	PROCESS. PLANT	CAPACITY (t/day)	COVERAGE AREA (ha)
1	Hiep Hoa	White sugar	Duc hoa dis. Long An.	French	2000	8000
2	Long An	White sugar	Ben Luc dis - Long An	Indian	3500	12000
3	Ben Tre	White sugar	Chau Thanh dis- Ben Tre	Chinese	1000	6000
4	Soc Trang	White sugar	Long Phu dis - Soc Trang	Chinese	1000	6000
5	Phung Hiep	White sugar	Phung Hiep dis- Can Tho	Indian	1250	5000
6	Vi Thanh	White sugar	Vi Thanh dis- Can Tho	Chinese	1000	5000
7	Giong Rieng	White sugar	Giong Rieng dis- Kien Gaing	Australian	1000	6000
8	Thoi Binh	White sugar	Thoi binh dis-Ca Mau	Australian	1000	6000

* Small sugar mills equipped with conventional machinery are scattered over the sugar cane production area.

Table F.1 (2) List of Major Food Processing Factories in Mekong River Delta Area

5. Feed mill

No	NAME	LOCATION	PRODUCT for
1	PROCONCO	Can Tho	Pig-chicken
2	Animal feed factory	Tan An town Long An	Pig-chicken
3	An Giang animal feed factory	Long Xuyen city- An Giang	Pig-chicken
4	Viinh Long animal feed factory	Vinh Long town- Vinh Long	Pig-chicken
5	Tra Vinh animal feed factory	Tra Vinh town - Tra Vinh	Pig-chicken
6	Soc Trang animal feed factory	Soc Trang town - Soc Trang	Pig-chicken
7	Kien Giang animal feed factory	Rach Gia town - Kien Giang	Pig-chicken
8	Bac Lieu animal feed factory	Bac Lieu town- Bac Lieu	Pig-chicken

* All factories mentioned above using mixing method (mix bran and other nutritious matter) are semi-industry level so that their capacity can not be caught exactly. Especially PROCONCO in Can Tho invested by a foreign company has a processing line of 30,000 t / year by production capacity.

6. Miscellaneous

No	NAME	PRODUCT	LOCATION
1	An Thai Co (Thailand-VN)	Instant noodle, chilly sauce, soya sauce	Long Xuyen town- An Giang
2	Agrifish	Marine product	Long Xuyen- An Giang
3	Agriculture services Co	Frozen vegetable- juice fruit	Long Xuyen
4	Animal feed Co	Animal feed, marine products	Long Xuyen
5	Agro-product Co	Cake, beverage, fresh fruit, salt	Can Tho
6	Bich Chi	Nutritious powder, noodle, shrimp cake	Sa Dec-Dong Thap
7	Sa Giang	Shrimp cake	Sa Dec – Dong Thap
8	Quang Tran	Chinese sausage, shrimp cake, dried fish, beef	Soc Trang town
9	Phong phu	Shrimp cake, dried fish, beef, noodle	Sa Dec – Dong Thap
10	Dat Lanh	Dried coconut meat	Ben Tre town
11	Truc Giang	Products from coconut	Ben Tre town
12	Vegetable oil	Products from coconut	Tien Giang
13	Phu Quoc	Fish sauce	Phu Quoc – Kien Giang
14	Ca Mau	Fish powder	Song Doc - Ca Mau
15	Lavie	Mineral water	Long An

* Many small factories producing various foods such as sauce, soy been cheese, rice noodle, green rice flakes , candy, cake and soft drink are scattered over the Area.

Table F.2 Rice Processing and Storage Facility in the Study Area (Dong Thap Prov.)

	Company / Factory	Storage		Husker		Polisher		Whitener		Dryer	
		No.	ton	No.	t/8hrs	No.	t/8hrs	No.	t/8hrs	No.	t/8hrs
	<State Owned>										
1	Dongthap Agromaterial Food Imp. - Exp. Company (DAGRIMEX)	18	33,700	4	94	20	400	16	353	11	264
2	Dongthap Commerce Imp. - Exp. Company (DOCIMEXCO)	7	28,000	3	80	13	51	12	51	5	15
3	Imp. & Exp. Trading Company (Cty TM XNK)	1	4,000			1	20	2	20		
4	Food Company (Cty LTCI)	3	62,150	1	40	12	240				
5	Irrigation and Rural Development Company (Cty TN & PTNN)	3	4,000			2	56	1	28		
6	XOVI MEX (Out of work*2)	6	13,500	1	15	6	144				
7	Storage Department	13	30,500			6	144	1	16		
8	Companies by the District*3 (Cty TNHH Huyen thi)	7	12,300			4	80				
	Total	58	188,150	9	229	64	1,135	32	468	16	279
	<Private>										
9	Food Processing and Trading Group	3	12,500			7	260				
	Others: 283 factories										

*1: Vietnam Southern Food Company
*2: Stopped by inefficient management and planed to be sold to private sector.
*3: 7 storage in 5 districts (3 for Cao Lanh, 1 each for Thanh Bin, Lap Vo, Thap Muoi and Lai Vung)
Source: DARD, Dong Thap Prov.

Table F.3 Rice Processing and Storage Facility in the Study Area (Tien Giang Prov.)

	Location			Storage		Polisher		Whitener		Dryer	
	Factory	District	Village	No.	ton	No.	t/h	No.	t/h	No.	t/h
1	TAM LONG*1	Cai Lay			15,000	2	6	1	5	1	20
2	PHAN XUONG1	Cai Lay	Phu An		4,500	0		0		0	
3	MY PHUOC TAY	Cai Lay	My Phuoc Tay	1	2,500	0		0		0	
4	PHU CUONG 1	Cai Lay	Phu Cuong	3	9,000	1	3	0		0	
5	PHU CUONG 2	Cai Lay	Phu Cuong	2	4,000	1	3	0		0	
6	HAU MY TRINH	Cay Be	Hau My Trinh	1	3,600	0		0		0	
7	THIEN HO	Cay Be	Hau My Bac	1	4,000	0		1	1.5	0	
8	MY LOI	Cay Be	My Loy	1	3,600	0		0		0	
	Total			9	46,200	4	12	2	6.5	1	20
	Other than above SOE's factories, more then 500 No. of private factories are in Cai Lay and Cai Be Districts.										

*1: JV company with a Malaysia company, under Provincial Government
All facilities from No. 2 to 15 are belonging to Tien Giang Food company under VSFC (VINAFOOD II)
Source: DADO, Tien Giang Prov.

Supplement F.1 The Report on Milling Test for Vietnam Rice

June 2, 1999
January 18, 2000*

Yuji KATSURAGI
Japan Rice Millers Association

Information of Samples

	A	B	C
Kind of Rice Mill	SOE	Private	SOE
Date	May 12, 1999	May 10, 1999	May 11, 1999
Location	Sa Dec Town	Cai Lay	Cao Lanh Town
Kind of sample	Brown rice	Brown rice	Brown rice
Moisture content declared	17%	16-17%	16%
Variety	Unknown	Unknown	Unknown
Production area	Dong Thap Prov.	An Giang Prov.	Dong Thap Prov.
	D*	E*	F*
Kind of Rice Mill	SOE	Private	
Date	Oct. 18, 1999	Oct 18, 1999	
Location	Cao Lanh Town	Cao Lanh Town	
Kind of sample	Brown rice	Brown rice (For export)	Brown rice (For local)
Moisture content declared	16-16.5%	16.5-17%	16%
Variety	Unknown	Unknown	Unknown
Production area	Dong Thap Prov.	Dong Thap Prov.	Dong Thap Prov.

I. QUALITY OF BROWN RICE

Basic characteristics of each Vietnam rice sample A to F are shown in Table I-1 and Table I-2. Vietnamese samples contain high percentage of colored grain, red grain, dead grain and brokens. Proportion of whole rice ranged from 52.4% to 84.4%. Red kernel content rate was conspicuously found. Numbers of broken were also found in the samples. It is considered that there are problems during drying process and husking process. Samples contain a few rough rice and chafed grain too.

Moisture content ranged from 14.7% to 16.6%. Most tropical countries, which produce rice, stipulate its moisture content less than 14.0%. A reason of this moisture control regulation is to keep quality during storing. However, in Japan maximum moisture content are regulated as 15.5% in rough rice and 16.0% in brown rice and white rice, because Japanese consumers favor sticky rice, and low temperature storage is common, which keeps temperature as 15℃ and humidity as 75%. And most rice is stored as brown rice. This system keeps rice quality safely.

Test weights for all samples were 730g/l to 758 g/l. There is no international standard about test weight for long grain, but low test weight means low enrichment of kernels and it would be ranked low quality in a market. Incidentally, test weight of first grade rice in Japan is more than 810g/l, and sample's figures were less than 770g/l.

Whiteness degrees of brown rice were observed from 20.2% to 21.3%, measuring without red kernel. Regarding thickness of grain, 2.8% to 10.9% of total grains had kernels less than 1.6mm. Most of these kernels (thickness less than 1.6mm) were dead grain, immature grain and foreign matters such as husks.

Features of grain size distribution were 7.05-7.67mm as length, 2.18-2.29mm as width respectively, and length/width ratio was 3.08-3.58.

Table I-1 Quality of Brown Rice

Sample Name	Whole Rice	Colored grain	Red grain	Damaged grain (%)		Immature grain (%)		Objectionable Seeds (kernels/100g)		Dead grain	Foreign matters	Whiteness degree	Moisture content	Test weight
	(%)	(%)	(%)	Broken	Other	White immature	Other	Rough rice	Other	(%)	(%)	(%)	(%)	(g/l)
A	60.7	3.8	11.2	11.4	1.6	4.8	1.8	14	0	4.6	0.1	22.9	16.6	730
B	67.3	2.6	6.4	7.6	4.2	3.6	3.8	16	4	4.4	0.1	21.6	14.9	730
C	76.9	1.8	3.2	8.8	2.0	2.2	3.2	22	4	1.8	0.1	23.3	15.3	730
D	68.6	1.2	3.6	12.9	5.0	2.6	4.2	4	4	1.8	0.1	21.7	16.2	741
E	84.4	0.6	2.8	3.8	1.2	1.8	4.2	14	0	1.2	0	20.2	14.7	758
F	52.4	1.0	3.0	32.8	2.4	2.6	3.2	6	0	2.6	0	21.0	16.6	741

Table I-2 Shape of Brown Rice

Sample Name	Grain size distribution (%)					Grain shape (mean, mm)			
	Under 1.6mm	Over 1.6mm	Over 1.7mm	Over 1.8mm	Over 1.9mm	Length	Breadth	Thickness	Length/ Breadth
A	10.2	15.8	33.2	35.4	5.4	7.05	2.29	1.87	3.08
B	10.8	15.8	31.5	36.9	4.9	7.25	2.18	1.88	3.33
C	4.4	7.8	17.1	48	22.7	7.61	2.25	1.87	3.38
D	7.4	15.7	39.2	32.1	5.6	7.31	2.18	1.92	3.35
E	2.8	6.6	36.1	49.1	5.4	7.51	2.15	1.85	3.49
F	6.8	10.2	30.7	46.0	6.3	7.67	2.14	1.86	3.58

1. Features of Each Sample

(1) Sample A

Colored grain content was 3.8%, red grain content 11.2% and dead grain 4.6%. These figures showed as the highest value of all samples. And moisture content was as high as 16.6%.

(2) Sample B

Whole rice content was 67.3%. 4 pieces of foreign seeds were contained in a hundred kernels. Proportion of kernel, with thickness of less than 1.6 mm, was 10.9%, the highest among all samples.

(3) Sample C

This sample had the few damaged grain following the sample E. Whole rice content was 76.9%. 22 pieces of rough rice were found in hundred kernels. Proportion of more than 1.8mm thickness kernel was higher than the other samples.

(4) Sample D

Damaged grain content was 17.9% including broken rice 12.9%. Whole rice content was 68.6 %.

(5) Sample E

The lowest figures among all samples were gained on colored grain, red grain, damaged grain, dead grain and moisture content. Proportion of kernel, with thickness of less than 1.6 mm, was also 2.8%, the lowest among all samples. As the result, whole rice content was 84.4 %.

(4) Sample F

Broken grain content was as high as 32.8%. Moisture content was also high as 16.6%. Whole rice content was only 52.4%. However, immature grain content was low as 5.8% and proportion of kernel, with thickness of less than 1.6 mm, was not high as 6.8%

II. RESULTS OF MILLING TEST

Two types of milling machine were used for a milling test. One was friction type and another was abrasive type. The test was conducted under the same condition for Japanese rice.

1. Milling Test by Friction Type Machine

A result of the test is shown in Table II-1. Test milling machines used for this test are adapted to Japanese rice characteristics. When Japanese rice is milled, recovery rate is usually ranged from 90.0% to 90.5% and brokens comes out 2-4%. A result of milling test for samples under the same condition, recovery rate were observed as from 75.7% to 81.8% and brokens was found 35.5-53.5%. Especially, rate of whole rice and head rice are extremely low (36.5-64.5%). It was caused by high percentage of brokens and low recovery rate.

a) Sample A

Whiteness degree of final product was 40.9% and recovery rate was 75.7%. Only 36.5% of grain remained as whole rice and head rice. High percentage (63.5%) of brokens came out. It is considered that this was caused by high moisture content and low whole kernel content(60.7%) in the material.

b) Sample B

Whiteness degree and recovery rate were 40.1 and 79.2% respectively. Recovery rate was higher and occurrence of total brokens was less than sample A and F. But many small brokens still came out.

c) Sample C

This sample obtained rather good result among all samples. Whiteness degree was 41.5% and recovery rate was 81.8%. But still 35.5% of brokens came out. Quality of brown rice affected to milled rice quality.

d) Sample D

This sample obtained the similar good result as sample C. Whiteness degree was 37.2% and recovery rate was 81.9%. But more 40.2% of brokens came out. Quality of brown rice, higher damaged grain and moisture content affected to such lower milled rice quality.

e) Sample E

This sample obtained the best result among all samples. Whiteness degree was 38.3% and recovery rate was 86.1%. But even 29.8% of brokens came out..

f) Sample F

This sample obtained the worst result as sample A. Whiteness degree of final product was 37.1% and recovery rate was 76.9%. Only 38.2% of grains remained as whole rice and head rice. High percentage (61.8%) of brokens came out. It was slightly better then the result of sample A on recovery rate and whole and head rice rate even though the raw material contained more broken rice with almost same moisture content. It is considered that this was caused by higher colored grain, red grain and dead grain content and higher proportion of kernel, with thickness of less than 1.6 mm in the material of sample A.

Table II-1 Result of Milling Test by Friction Type Machine

Sample Name	Circulated (times)	Recovery rate (%)	Whiteness degree (%)	Temperature (℃)	Moisture content (%)	Whole and head rice (%)	Large broken (%)	Small broken (%)	Brewers (%)	Electric power (J)
A	Brown rice	100.0	22.9	24.3	16.6					
	1	90.7	24.9	28.2						2.21
	2	82.8	30.7	31.8						5.08
	3	78.8	36.4	33.8						7.43
	4	75.7	40.0	35.4						9.75
	Milled rice		40.9		15.6	36.5	21.5	42.0	0	
B	Brown rice	100.0	21.6	24.9	14.9					2.46
	1	91.6	25.0	29.3						5.41
	2	84.9	32.2	33.8						8.31
	3	81.5	36.2	35.8						10.8
	4	79.2	38.8	37.6						
	Milled rice		40.1		14.1	51.5	17.0	31.5	0	
C	Brown rice	100.0	23.3	24.6	15.3					
	1	93.9	24.9	28.9						2.22
	2	87.5	32.6	33.0						5.33
	3	84.1	37.6	35.4						8.22
	4	81.8	40.1	37.5						10.03
	Milled rice		41.5		14.5	64.5	18.5	17.0	0	
D	Brown rice	100	21.7	19.1	16.2					
	1	93.8	23.4	23.5						
	2	87.6	29.5	29.4						
	3	84.3	34.2	31.6						
	4	81.9	36.7	34.2						
	Milled rice		37.2		15.4	59.8	19.8	20.4	0	
E	Brown rice	100	20.2	20.0	14.7					
	1	95.7	22.6	24.6						
	2	90.4	30.1	30.6						
	3	88.1	34.3	32.7						
	4	86.1	37.3	36.5						
	Milled rice		38.3		14.0	70.2	14.8	15.0	0	
F	Brown rice	100	21.0	20.2	16.6					
	1	91.8	23.8	24.9						
	2	84.1	28.6	28.6						
	3	79.8	32.6	31.6						
	4	76.9	34.7	33.6						
	Milled rice		37.1		15.8	38.2	23.2	38.6	0	

1) Milling was done with resistance 3-4-4-5, using a test mill (Model VP-31T , 300W).
2) Testing material was 1 kg for each sample and the rice being circulated 4 times.
3) Whole and head rice : L> 6/8, Large broken : L= 6/8 – 4/8, Small broken : L= 4/8 – 1.4mm, Brewers : L< 1.4mm

2. Milling Test by Abrasive Type Machine

There was no big difference on the recovery rate among samples, comparing with the result of friction type milling test. Reasons are that the kernels of less than 1.6 mm thickness were removed from original materials before the test, and the characteristics of abrasive type machinery. At the result of milling test, recovery rate ranged from 84.0% to 88.2% and occurrence of brokens was 7.6-36.2%. A result of the test is showed Table II-2.

a) Sample A

Whiteness degree and recovery rate was observed 45.9%, 84.0% respectively, and 24.0 % of brokens occurred. The boroken rice rate of sample A was remarkably improved by abrasive type milling test, compared to the result of friction type milling test. It is considered that weak grains such as colored grain, red grain, immature grain and dead grain contained in the material were not broken much by the lower friction of abrasive type milling as kernels with thickness of less than 1.6 mm were removed before the test.

b) Sample B

Recovery rate was 86.3% and 15.2 % of brokens came out. Whiteness degree was 42.8%. The occurrence of brokens was 15.5%.

c) Sample C

Recovery rate was 88.2% and brokens occurred 17.0% as whiteness degree 44.3%. A result of abrasive type milling test for this sample was rather better.

d) Sample D

Recovery rate was 86.6% and brokens occurred 14.6% as whiteness degree 43.1%. A result of abrasive type milling test for this sample was rather better. It shows an average result among samples together with sample B.

e) Sample E

Recovery rate was 88.2% with brokens 7.6% and whiteness degree 42.7%. A result of abrasive type milling test for this sample was good as sample C, but whole and head rice recovery rate was 92.3% that is higher than sample C due to higher rate of whole rice in the material.

f) Sample F

Recovery rate was 84.9% with brokens occurred 36.2% and whiteness degree 43.5%. A result of abrasive type milling test for this sample was the worst among all samples for broken rice rate in the product due to the highest broken grain content of the material.

Table II-2 Result of Milling Test by Abrasive Type

Sample Name	Milling time (min.)	Recovery rate (%)	Whiteness degree (%)	Temperature (℃)	Moisture content (%)	Whole and head rice (%)	Large broken (%)	Small Broken (%)	Brewers (%)	Estimated power (J)
A	Brown rice	100.0	22.9	25.0	16.6					
	1	93.4	28.6	27.2						0.46
	2	89.9	35.3	28.0						0.88
	3	87.1	40.5	29.2						1.24
	4	84.0	45.9	30.0	15.3	75.8	10.5	13.5	0.2	1.70
B	Brown rice	100.0	21.6	25.0	14.9					
	1	94.1	28.7	28.2						0.41
	2	90.9	34.1	29.5						0.81
	3	88.8	39.4	30.5						1.17
	4	86.3	42.8	31.4	14.1	84.3	7.5	8.0	0.2	1.66
C	Brown rice	100.0	23.3	25.1	15.3					
	1	94.4	31.5	29.0						0.40
	2	91.2	38.6	30.0						0.85
	3	88.2	44.3	31.5	14.5	82.9	6.0	11.0	0.1	1.21
D	Brown rice	100	21.7	16.5	15.7					
	1	94.0	29.5	20.7						0.44
	2	91.0	34.1	21.9						0.97
	3	88.5	39.6	22.3						1.35
	4	86.6	43.1	23.7	15.2	85.2	5.4	9.2	0.2	1.73
E	Brown rice	100	20.2	17.4	14.4					
	1	95.3	28.2	22.8						0.41
	2	92.3	33.8	23.7						0.75
	3	90.5	38.7	24.3						1.00
	4	88.2	42.7	25.3	14.1	92.3	3.4	4.2	0.1	1.63
F	Brown rice	100	21.0	20.5	16.2					
	1	93.4	29.6	24.4						0.47
	2	89.8	36.4	25.9						0.97
	3	87.3	40.6	26.9						1.40
	4	84.9	43.5	27.5	15.5	63.6	10.8	25.4	0.2	1.93

*1) Test milling machine used for this test is model TM05 (400W)
*2) Revolution speed was 1226 r.p.m. and mesh size of abrasive roll was #36
*3) Testing material was 100g for each sample and milling time was 1-3 or 4 minutes.
*4) Whole and head rice : L> 6/8, Large broken : L= 6/8 – 4/8, Small broken : L= 4/8 – 1.4mm, Brewers : L< 1.4mm

III. Conclusion

1. Differences in the original materials quality such as degree of whole and head kernel conspicuously affect recovery rate and occurrence of brokens.
2. High percentage of colored kernel and red kernel were observed in the materials. It is considered to depend on the level of planting and cultivation skills. Red kernel causes occurrence of brokens during milling process. Consequently, recovery rate would be lower and then commercial value could be decreased.

3. It is necessary to prescribe moisture content of brown rice less than 14% with quality control. Because, in case of long grain, higher moisture content makes higher percentage of brokens and lower recovery rate during a milling process.
4. To reduce brokens in brown rice, it is recommended to use aspirator and rice grader (1.6 mm width) before milling because almost all the kernels under 1.6 mm width come to bran.
5. High brokens content may be caused by low performance of paddy husker.
6. In order to keep high percentage of recovery rate, abrasive type milling machine is effective.

Supplement F.2 Comparison with Indonesian Rice

Regarding the result of milling test of Vietnamese rice, the comparative evaluation was carried out with the same test of two Indonesian rice[1].

1. Raw material

The result of comparison between Vietnamese brown rice and Indonesian one is shown in Table – 1.

Table－1 Analysis of Brown Rice

	Composition						
	Whole Rice (%)	Colored Grain (%)	Red Grain (%)	Damaged Grain (%)	Immature Grain (%)	Dead Grain (%)	Foreign Matters (%)
Vietnam	52.4-84.4	0.6-3.8	2.8-11.2	5.0-35.2	5.4～7.4	1.2-4.6	0.1
Indonesian	90.0-91.3	0.5-1.1	-	5.2	2.7-3.4	0.3	0

	Whiteness Degree (%)	Moisture Content (%)	Test Weight (g/l)
Vietnam	20.2-23.3	14.7-16.6	730-758
Indonesian	22.0-22.3	13.81-14.1	758-792

Composition of raw material, brown rice

Many differences were identified between Vietnamese rice and Indonesian. Especially the rate of whole rice is above 90% on Indonesian against 52.4 – 84.4% on Vietnamese. Vietnam rice shows high rate of red grain and damaged grain that lower the quality of product. Improvement of seed and cultivation way is required.

Moisture content

The moisture content of Vietnam rice is higher and varies, compared with Indonesian. Insufficient drying causes it and this generates colored grain in storage and reduces the recovery rate in whitening. More precise control of moisture content is necessary.

Test weight

As mentioned in the main report, the test weight of Vietnam rice is lower than Indonesian. Improvement of seed and cultivation method is also required

2. Milling test by abrasive type whitening machine

The test material of Vietnam rice was grains separating those less than 1.6 mm before whitening.

[1] RICE INSPECTION TECHNOLOGY, MARCH 1998, THE FOOD AGENCY, MINISTRY OF AGRICULTURE, FORESTRY AND FISHERIES, JAPAN, P72, 89, 90, 91

Then the recovery rate is recalculated by considering to be moved to bran, and resulted 75.4% to 85.7% for six samples. The comparison of those figures with Indonesian is shown in Table – 2. All test were carried out under the same condition.

Table - 2 Result of Milling Test (Abrasive Type)

Sample Name	Milling time (min.)	Recovery rate (%)	Whiteness degree (%)	Whole and head rice (%)	Large broken (%)	Small Broken (%)	Brewers (%)
A	4	75.4	45.9	75.8	10.5	13.5	0.2
B	4	77.0	42.8	84.3	7.5	8.0	0.2
C	3	84.3	44.3	82.9	6.0	11.0	0.1
D	4	80.2	43.1	85.2	5.4	9.2	0.2
E	4	85.7	42.7	92.3	3.4	4.2	0.1
F	4	79.1	43.5	63.6	10.8	25.4	0.2
IR36	4	90.1	41.3	77.2	15.8	6.9	0.1
IR64	4	88.0	42.6	96.7	2.6	0.6	0.1

*1) Test milling machine used for this test is model TM05 (400W)
*2) Revolution speed was 1226 r.p.m. and mesh size of abrasive roll was #36
*3) Testing material was 100g for each sample and milling time was 1-3 or 4 minutes.
*4) Whole and head rice : L> 6/8, Large broken : L= 6/8 – 4/8, Small broken : L= 4/8 – 1.4mm, Brewers : L< 1.4mm

It is obvious that the recovery rate of Vietnamese rice is very lower than Indonesian one. As colored grain and damaged grain in the product will be rejected additionally for the final product and it is expected that the difference to Indonesian is widened more because Vietnam rice contains them more than Indonesian.

3. Conclusion

Though the evaluation was carried out comparing with only Indonesian rice, it is clear that the quality of brown rice and milling products of Vietnamese rice are low relatively. The countermeasures in the both stages of production and processing are strongly required as follows:

- To improve the quality of rice as raw material for processing by introduction of qualified seed, proper management for cultivation and proper control of moisture content by drying.
- To improve the quality of product by appropriate selection and combination of machinery, and to improve processing and management technology.