

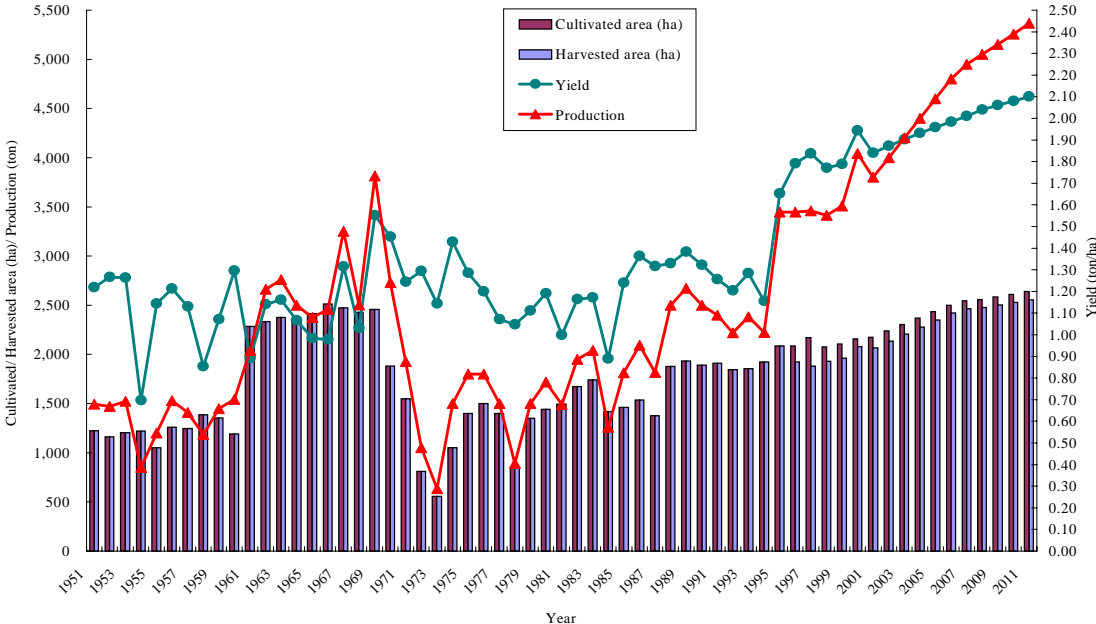
3.4 Post-harvest Processing

3.4.1 Situations surrounding the Post-harvest Processing of Rice

(1) Situation of Production

It is said that over 2,000, paddy varieties have been cultivated in Cambodia. Certainly, there is no systematic classification of varieties. Even the varieties that are recommended by the Cambodian government have not been distributed thoroughly. On the other hand, some varieties may have been mixed with other varieties during the cultivation and/ or storage after complete drying; this reduces the efficient use of agricultural machinery and/ or the quality of rice. It will take a long time for farmers to produce uniform quality rice and to improve purity of the varieties. Seeds of 34 varieties are recommended, maintained and controlled by, Cambodian Agricultural Research Development Institute (CARDI) under the MAFF. However, CARDI has been unable to establish the distribution system for farmers. Diffusion of foundation seed of improved varieties to progressive farmers has not been very successful.

The ratio of the harvested area in wet season and dry season is 89% to 11%. The largest production of medium and late maturing varieties in ecosystem accounts for approximately 60% of the harvested area. Therefore, production at its peak is in the middle of December and the middle of January. Lately, production of dry season crops tends to increase slightly and securely. (Refer to Appendix B of the Supporting Report)



Production, Yield, and Cultivated/harvested Area

Annual situation of Area for Planted/Harvested area, Production and Yield

Year	Planted area (ha)	Harvested area (ha)	Production (ton)	Yield (ton/ha)	Recovery rate to the peak before 1970			Remaining quantity after reduction 17% of production	Converted quantity to white rice	Population	Rice consumption kg/person/year	Necessary quantity for self consumption	Balance of supply and demand
					Cultivated area	Harvested area	Production						
1951 ~ 1952	1,225.0	1,225.0	1,494.0	1.22	48.7%	48.7%	39.2%	1,240.0	768.8	4,510,009	149.0	672.0	96.8
1952 ~ 1953	1,161.0	1,161.0	1,471.0	1.27	46.2%	46.2%	38.6%	1,220.9	757.0	4,609,229	149.0	686.8	70.2
1953 ~ 1954	1,205.0	1,205.0	1,523.0	1.26	47.9%	47.9%	39.9%	1,264.1	783.7	4,710,632	149.0	701.9	81.9
1954 ~ 1955	1,221.0	1,221.0	850.0	0.70	48.6%	48.6%	22.3%	705.5	437.4	4,814,266	149.0	717.3	279.9
1955 ~ 1956	1,050.0	1,050.0	1,200.0	1.14	41.8%	41.8%	31.5%	996.0	617.5	4,920,180	149.0	733.1	115.6
1956 ~ 1957	1,260.0	1,260.0	1,528.0	1.21	50.1%	50.1%	40.1%	1,268.2	786.3	5,028,424	149.0	749.2	37.1
1957 ~ 1958	1,247.0	1,247.0	1,410.0	1.13	49.6%	49.6%	37.0%	1,170.3	725.6	5,139,049	149.0	765.7	40.1
1958 ~ 1959	1,385.0	1,385.0	1,183.0	0.85	55.1%	55.1%	31.0%	981.9	608.8	5,252,108	149.0	782.6	173.8
1959 ~ 1960	1,353.0	1,353.0	1,449.0	1.07	53.8%	53.8%	38.0%	1,202.7	745.7	5,367,655	149.0	799.8	54.1
1960 ~ 1961	1,191.0	1,191.0	1,544.0	1.30	47.4%	47.4%	40.5%	1,281.5	794.5	5,485,743	149.0	817.4	22.8
1961 ~ 1962	2,286.0	2,286.0	2,039.0	0.89	90.9%	90.9%	53.5%	1,692.4	1,049.3	5,606,430	149.0	835.4	213.9
1962 ~ 1963	2,332.8	2,332.8	2,662.0	1.14	92.8%	92.8%	69.8%	2,209.5	1,369.9	5,729,771	149.0	853.7	516.1
1963 ~ 1964	2,376.6	2,376.6	2,760.0	1.16	94.5%	94.5%	72.4%	2,290.8	1,420.3	5,855,000	149.0	872.4	547.9
1964 ~ 1965	2,344.4	2,344.4	2,500.0	1.07	93.3%	93.3%	65.5%	2,075.0	1,286.5	5,984,000	149.0	891.6	394.9
1965 ~ 1966	2,414.0	2,414.0	2,376.0	0.98	96.0%	96.0%	62.3%	1,972.1	1,222.7	6,165,000	149.0	918.6	304.1
1966 ~ 1967	2,513.8	2,513.8	2,457.0	0.98	100.0%	100.0%	64.4%	2,039.3	1,264.4	6,250,000	149.0	931.3	333.1
1967 ~ 1968	2,473.0	2,473.0	3,251.0	1.31	98.4%	98.4%	85.2%	2,698.3	1,673.0	6,402,200	149.0	953.9	719.0
1968 ~ 1969	2,427.2	2,427.2	2,503.0	1.03	96.6%	96.6%	65.6%	2,077.5	1,288.0	6,543,048	149.0	974.9	313.1
1969 ~ 1970	2,458.0	2,458.0	3,814.0	1.55	97.8%	97.8%	100.0%	3,165.6	1,962.7	6,686,995	149.0	996.4	966.3
1970 ~ 1971	1,880.0	1,880.0	2,732.0	1.45	74.8%	74.8%	71.6%	2,267.6	1,405.9	6,834,109	149.0	1,018.3	387.6
1971 ~ 1972	1,548.0	1,548.0	1,926.0	1.24	61.6%	61.6%	50.5%	1,598.6	991.1	6,984,460	149.0	1,040.7	49.6
1972 ~ 1973	811.0	811.0	1,050.0	1.29	32.3%	32.3%	27.5%	871.5	540.3	7,138,118	149.0	1,063.6	523.2
1973 ~ 1974	555.0	555.0	635.0	1.14	22.1%	22.1%	16.6%	527.1	326.8	7,295,156	149.0	1,087.0	760.2
1974 ~ 1975	1,050.0	1,050.0	1,500.0	1.43	41.8%	41.8%	39.3%	1,245.0	771.9	7,455,650	149.0	1,110.9	339.0
1975 ~ 1976	1,400.0	1,400.0	1,800.0	1.29	55.7%	55.7%	47.2%	1,494.0	926.3	7,300,000	149.0	1,087.7	161.4
1976 ~ 1977	1,500.0	1,500.0	1,800.0	1.20	59.7%	59.7%	47.2%	1,494.0	926.3	7,150,000	149.0	1,065.4	139.1
1977 ~ 1978	1,400.0	1,400.0	1,500.0	1.07	55.7%	55.7%	39.3%	1,245.0	771.9	7,000,000	149.0	1,043.0	271.1
1978 ~ 1979	853.0	853.0	893.0	1.05	33.9%	33.9%	23.4%	741.2	459.5	6,860,000	149.0	1,022.1	562.6
1979 ~ 1980	1,350.0	1,350.0	1,500.0	1.11	53.7%	53.7%	39.3%	1,245.0	771.9	6,720,000	149.0	1,001.3	229.4
1980 ~ 1981	1,441.0	1,441.0	1,717.0	1.19	57.3%	57.3%	45.0%	1,425.1	883.6	6,589,984	160.0	1,054.4	170.8
1981 ~ 1982	1,493.0	1,493.0	1,490.0	1.00	59.4%	59.4%	39.1%	1,236.7	766.8	6,758,029	160.0	1,081.3	314.5
1982 ~ 1983	1,674.0	1,674.0	1,949.0	1.16	66.6%	66.6%	51.1%	1,617.7	1,003.0	6,930,358	160.0	1,108.9	105.9
1983 ~ 1984	1,740.0	1,740.0	2,039.0	1.17	69.2%	69.2%	53.5%	1,692.4	1,049.3	7,107,082	160.0	1,137.1	87.9
1984 ~ 1985	1,418.0	1,418.0	1,260.0	0.89	56.4%	56.4%	33.0%	1,045.8	648.4	7,288,313	160.0	1,166.1	517.7
1985 ~ 1986	1,462.0	1,462.0	1,812.0	1.24	58.2%	58.2%	47.5%	1,504.0	932.5	7,474,165	160.0	1,195.9	263.4
1986 ~ 1987	1,535.0	1,535.0	2,093.0	1.36	61.1%	61.1%	54.9%	1,737.2	1,077.1	7,803,920	160.0	1,248.6	171.6
1987 ~ 1988	1,378.0	1,378.0	1,815.0	1.32	54.8%	54.8%	47.6%	1,506.5	934.0	8,006,822	160.0	1,281.1	347.1
1988 ~ 1989	1,879.0	1,879.0	2,500.0	1.33	74.7%	74.7%	65.5%	2,075.0	1,286.5	8,214,999	160.0	1,314.4	27.9
1989 ~ 1990	1,932.0	1,932.0	2,672.0	1.38	76.9%	76.9%	70.1%	2,217.8	1,375.0	8,428,589	160.0	1,348.6	26.4
1990 ~ 1991	1,890.0	1,890.0	2,500.0	1.32	75.2%	75.2%	65.5%	2,075.0	1,286.5	8,647,733	160.0	1,383.6	97.1
1991 ~ 1992	1,910.0	1,910.0	2,400.0	1.26	76.0%	76.0%	62.9%	1,992.0	1,235.0	8,872,574	160.0	1,419.6	184.6
1992 ~ 1993	1,844.0	1,844.0	2,221.0	1.20	73.4%	73.4%	58.2%	1,843.4	1,142.9	9,103,261	160.0	1,456.5	313.6
1993 ~ 1994	1,856.6	1,856.6	2,383.0	1.28	73.9%	73.9%	62.5%	1,977.9	1,226.3	9,339,945	160.0	1,494.4	268.1
1994 ~ 1995	1,924.0	1,924.0	2,223.0	1.16	76.5%	76.5%	58.3%	1,845.1	1,144.0	9,870,000	160.0	1,579.2	435.2
1995 ~ 1996	2,086.0	1,924.0	3,447.8	1.79	83.0%	76.5%	90.4%	2,861.7	1,774.2	10,500,000	151.2	1,587.6	186.6
1996 ~ 1997	2,170.9	1,882.0	3,458.0	1.84	86.4%	74.9%	90.7%	2,870.1	1,779.5	10,702,329	151.2	1,618.2	161.3
1997 ~ 1998	2,076.0	1,928.7	3,414.9	1.77	82.6%	76.7%	89.5%	2,834.4	1,757.3	10,934,334	151.2	1,653.3	104.0
1998 ~ 1999	2,104.0	1,962.6	3,509.9	1.79	83.7%	78.1%	92.0%	2,913.2	1,806.2	11,746,760	151.2	1,776.1	30.1
1999 ~ 2000	2,157.6	2,079.4	4,040.9	1.94	85.8%	82.7%	105.9%	3,353.9	2,079.4	12,028,681	151.2	1,818.7	260.7
2000 ~ 2001	2,175.0	2,065.0	3,800.0	1.84	86.5%	82.1%	99.6%	3,154.0	1,955.5	12,317,369	151.2	1,862.4	93.1
2001 ~ 2002	2,240.0	2,136.0	4,000.0	1.87	89.1%	85.0%	104.9%	3,320.0	2,058.4	12,612,986	151.2	1,907.1	151.3
2002 ~ 2003	2,305.0	2,207.0	4,200.0	1.90	91.7%	87.8%	110.1%	3,486.0	2,161.3	12,915,698	151.2	1,952.9	208.5
2003 ~ 2004	2,370.0	2,278.0	4,400.0	1.93	94.3%	90.6%	115.4%	3,652.0	2,264.2	13,225,675	151.2	1,999.7	264.5
2004 ~ 2005	2,435.0	2,349.0	4,600.0	1.96	96.9%	93.4%	120.6%	3,818.0	2,367.2	13,543,091	151.2	2,047.7	319.4
2005 ~ 2006	2,500.0	2,420.0	4,800.0	1.98	99.5%	96.3%	125.9%	3,984.0	2,470.1	13,868,125	151.2	2,096.9	373.2
2006 ~ 2007	2,544.0	2,462.6	4,949.8	2.01	101.2%	98.0%	129.8%	4,108.4	2,547.2	14,200,960	151.2	2,147.2	400.0
2007 ~ 2008	2,557.3	2,475.5	5,050.0	2.04	101.7%	98.5%	132.4%	4,191.5	2,598.7	14,541,783	151.2	2,198.7	400.0
2008 ~ 2009	2,583.9	2,501.2	5,152.5	2.06	102.8%	99.5%	135.1%	4,276.6	2,651.5	14,890,786	151.2	2,251.5	400.0
2009 ~ 2010	2,611.2	2,527.7	5,257.5	2.08	103.9%	100.6%	137.8%	4,363.7	2,705.5	15,248,165	151.2	2,305.5	400.0
2010 ~ 2011	2,639.2	2,554.8	5,365.1	2.10	105.0%	101.6%	140.7%	4,453.0	2,760.9	15,614,121	151.2	2,360.9	400.0

Source: MAFF, Population census of Cambodia and Developing Economics

The last figure and table show the transition of cultivation/ harvested-area and production from the late 1950's up to the present with an estimate up to 2010. They illustrate that, in the late 1960's in Cambodia, the cultivated area (approximately 2,510,000ha in 1966/67) and production (approximately 3,810,000ton in 1969/70) of paddy were at their peak. The cultivated area and production of paddy have been increasing gradually since 1980; the harvested quantity in 1999/ 2000 exceeded the peak of 1960's. During 1999/ 2000, the harvested area was approximately 2,000,000ha.

According to the next 5 year plan of MAFF (2001 ~ 2006), the yield would increase to 2.00ton/ha from 1.84ton/ha (based upon average increases of past 4 years) in the coming years. The MAFF plan deliberately used the conservative lower yield figure for calculation of balance for demand and supply in order to play it safely. The increased production quantity is enough to cover an annual population increase of 2.4%, with an in stable surplus quantity of milled rice (200,000 to 400,000 ton); it could be maintained with keeping 4.5 to 6.5% annual increase of production.

Annual production for each province and co-system for 1998/ 99 and 1999/ 2000 is shown in appendix B1. The peak of harvesting season is December/ January. It fluctuates within a range of about one-month due to climatic conditions in the planting and harvesting season. Annual production of 1999/ 2000 shows less monthly fluctuation in the harvested quantity than in 1998/ 1999 due to increase of dry season crops. If early or late maturing varieties are planted intentionally, harvest in September to November or February should increase and more equalize monthly production can be expected. By utilizing annual production data, it would be possible to regulate monthly supply/demand balance for each province.

(2) Paddy Prices

According to the Study Team's comprehension research, the proper selling price of farmer would be 350 to 380 Riel/kg, which is value to keep farmer's living expense and to manage continuous paddy cultivation. However the paddy-selling price during the Study fell below the price farmers expected. When drying and cleaning of paddy is insufficient, the price lowers further. The farmers sell paddy for cash income even at low price as indicated in the following table, which is defection for any imposed-improvement by them not to have surplus budget. The abundant harvest does not increase income, instead that the farmers are suffering from falling price. Moreover, the farmers are unable to find any new market and have any technical background to improve the quality of their paddy.

(Refer to Article 3.3.4 (1) of Chapter 3)

(3) Variety and Seed

1) Variety

A list showing varieties for each province and each ecological characteristic are attached in Appendix. Several varieties do not appear in ordinary markets or even if they do, mixed with other varieties. It seems that there is no tendency to increase purity of the variety, taking advantage of the vague and

imprecise preference/ its indefinite criterion of the consumers requirement, which have no care to varieties/ broken by mixture. Popular conventional varieties have been planted for as long as 50 to 80 years to have natural cross breeding at the field, which CARDI assumes that its crossing rate has been 30 to 50% (purification: 50 to 70% only).

2) Seed

Besides seeds are not cleaned well, their purity and uniformity of the quality by natural crossing and mixing mainly during the storing are insufficient. There is a bad influence from the mechanization of post-harvest process including rice milling. More attention should be paid to cleaning of the seed rather than to selecting of famous varieties.

3.4.2 Situation of Post-harvest Processing of Rice

(1) Harvesting (reaping)

Reaping is conducted manually in Prey Veang, Takaev, Bat Dambang, Bateay Mean Chey, Siem Reab, Pusat, Kandal, Kampong Spueu, Kampong Cham, and Kampong Chhnang where the Study Team assessed (surveyed). Their sickle handle is 50cm long (blade: 25 to 30 cm long). Sufficient length of stems (panicle) is necessary to make bundles. One bundle weighs about 1.5 to 2.5 kg and the diameter at the band is about 130mm. The bundles of paddy are dried on the stubble for about 2 to 5 days before threshing. The paddy is carried to farmer's house for threshing or threshers are brought to the rice field for threshing works.

Some wet season varieties (mainly early or late maturing varieties) have high shattering quality, yielding quite a large loss during the harvesting works or during drying and transportation. Such easy-shattering varieties have the characteristics that they do not cause much loss in the threshing process.

(2) Manual threshing

In the case of local manual threshing, bundles of paddy are beaten on the wooden plate placed aslant about 15 to 20 times when feet are sued, bundles are trod like kneading; beating board threshing. Besides that method, feet's treading threshing as traditional threshing method is present. Lastly, threshed paddy grains are made to fall from head height to the ground for separation of immature grains, empty husks, straws, etc. by wind.

(3) Mechanical threshing

The custom threshing or threshing on commission is the main practice. The threshers are mainly axial flow types. The original type was brought from Vietnam but now they are made in Cambodia. Prime

movers are diesel engines; most of them are made in China. The machine length is about 210 cm and width is about 210 cm. The machine has three outlet ports each for sound grains, immature grain and straws. The straws are blown out from upper part of the machine 5 to 6m away. And a mixture of paddy grains and straws are discharged from one lower end of the machine. This mixture is returned to the machine again.

Polyethylene sheets of fine mesh (material for mosquito net) are spread below the machine so as to make it easy to recover the sound grain fell on the periphery of the machine. The majority of the scattered grains are collected except the grains mixed into the discharged straw and/ or unthreshed remaining grains in rachis branches.

In Takaev, 90% of dry season crop is mechanically threshed, in Prey Veang over 85%, in Kandal, it is 70%. In Kampong Cham, it is about 60%. Most of the threshing is done in the vicinity of farmer's house.

(4) Drying

After threshing the paddy is dried before storing. Sun drying is usually completed in one or two days. These drying works are usually conducted in front yard of farmer's houses. Paddy is spread on the mat or sheet for drying. If the ground is wet, it may cause uneven drying • over-drying • temporary absorbing of moisture, etc... and result in cracked grain.

In Takaev, almost all farmers use polyethylene sheet. In this case, often paddy is dried excessively. In Prey Veang, Kandal, Kampong Chhnang and Kampong Cham, they use mats made of hemp palm. Often uneven drying and moisture absorbing phenomena are observed.

(5) Transportation

The transportation from rice field to farmer's house is usually by oxcart (buffalo). Sometimes paddy is transported by trucks or by small trailers with engines for irrigation pumps. Transportation of bundled paddy is usually by ox carts; in this case, it yields a large loss. Threshed paddy grains are usually transported in polyethylene bags. Therefore, if the bags are new and in good conditions, loss is small but if the bags are old and have many holes, it may cause a large loss.

(6) Storage

Method of storage employed by Cambodian farmers is roughly divided into two. One is the bulk storage in the space/room partitions made of hemp palm leaves or bamboo under the floor of their houses or in the raised floor cottages. The other is the storage of paddy in the polyethylene bags of 50 to 60 kg, kept in their houses or under the raised floor. If grains of higher moisture content are bagged, it may spoil the quality.

Recently some farmers store paddy of different varieties separately. But most farmers store only the seeds of different variety separately. In case of careless storage, damages by moisture absorption, insects are observed, which will result in lower germination ratio.

(7) Custom milling

The custom milling or commission milling is quite popular and easily available in each village. Usually farmers bring a quantity of paddy, which is necessary for his family's consumption for 7 to 10 days. In most cases, the quantity is 30 to 60 kg. The reason why they mill a small quantity each time is because transportation is easier and quality of milled rice does not last for a long time due to incomplete bran removal.

Paddy is finally dried again before milling for 4 to 6 hours. In most cases, the moisture content at the time of milling is low, 8 to 10% w.b... If low quality paddy is milled with only a milling machine without a husking process (any husking machines), very low quality milled rice will be produced with the milling degree of 75% and a broken rice ratio of 70%. Generally, it is said that farmers are not much concerned in the quality of milled rice but it is judged that they are only ignorant about the quality.

The nominal capacity of the milling machines used in the custom mills is nominally 200 to 300kg/hr. But if milling quality is taken into account it is 150 to 240kg/hr. Further, if machine (operation) efficiency of 80% was taken into account, actually it is about 120 to 160 kg/hr. The custom mills usually operate 4 to 6 hours a day, concentrated in the afternoon. The number of custom mills is supposed to be 13,000 throughout the country. Aggregate total milling capacity of the whole Cambodia is annually over 4,000,000 ton in paddy base, almost equals to the quantity of production. There are three kinds of rice milling machines mentioned as A, B and C in the following list.

Kinds of Custom Rice Mills

Kind of machine		Content
A	Satamar type	Made in Vietnam. The milling section is equipped with an aspirator and a rubber roll type husking section is mounted.
B	Noda type	Made in Vietnam. Husker is a copy of Yanmar make. Milling machine is a copy of Noda type
C	Engerberg type	Made in China. Originally it is a coffee mill. The milling chamber acts as husking and whitening of rice simultaneously

Besides the above, there are various other types with different combination of machines such as a combination of two milling machines in a series, maximum four pass whitening system, etc. Further, because wearing degree of rubber rolls is adjustable in the above A and B type machines, some type is

without husking function and very close to C type. There are a few numbers of plant type mills, which have big size of separating machines. More than 30 types of custom mills, therefore, are present.

(8) Commercial rice mill

The capacity of commercial rice mill is small 0.7 to 2.0 ton/hr (mainly 1.0 to 1.2 ton/hr). Therefore, monthly production of milled rice per a rice mill is 200 to 300 ton/month. There are about 500 rice mills of average hourly capacity of 1ton in whole Cambodia. If they operate 10 hours a day and 300 days a year, total milling capacity of whole country is supposed to be over 1,500,000 ton annually.

The rice mill comprises following functions.

- Receiving and pre-cleaning
- Husking
- Paddy and paddy/ husk separation
- Whitening (milling)
- Grading, weighing

However, although the quality of paddy is admittedly poor, the machinery and equipment of the rice mill are not sufficiently complete to produce uniform quality of milled rice. Simple type rotary sifters are used in many rice mills in their cleaning section. The length grader is not generally used except in some rice mills in northwestern part of Cambodia such as Bat Dambang.

(9) Transportation from commercial rice mills

Milled rice is mostly bagged in 50kg polyethylene bags for transportation. In most cases new bags are used. Therefore, there is almost no loss during transportation.

3.4.3 Result of the Loss Assessment

(1) Quantitative loss

1) Loss in the farmers level

The loss assessment both in dry season and wet season in rice milling process were conducted in Takaev, Prey Veang, Kandal, and Bat Dambang. The results of post-harvest loss assessment including the loss in rice milling process are shown in following table on the next page.

Result of the Loss Assessment

Results of loss assessment (1999–2000 dry season crops, 2000–2001 wet season crops)

Unit: %

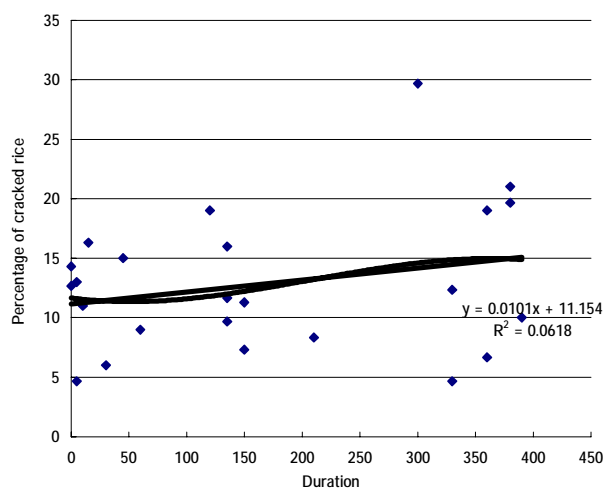
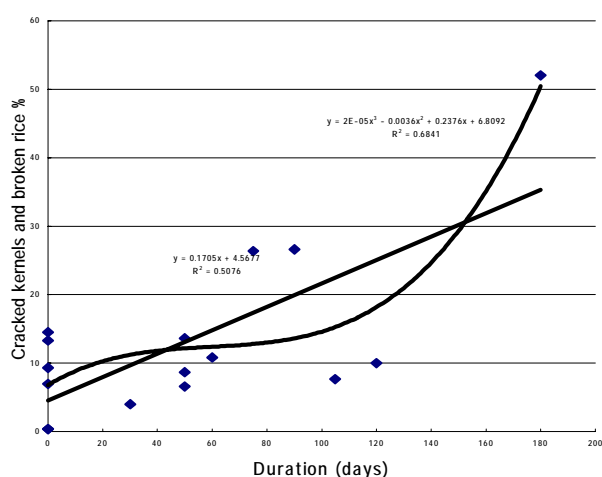
Province	Crop -ping sea- son	Losses on total commercial sector work (excluding custom milling)														
		Losses on the farmer level									(Custom milling)			(Stage of commercial sector job)		
		Harvest- ing	Drying before threshing	Transport- ation before threshing	Threshing by hand	Threshing by mach.	Finishing drying	Other transport- ation	Storage	Transport- ation for milling	Custom mills	Commerci- al mills	Storage in white rice	Transport- ation		
Average	Dry	0.88	0.28	0.23	4.95	1.95	1.61	0.12	2.00	0.01	2.13	0.06	0.03	0.01		
Average	Wet	1.72	0.38	0.83	0.89	0.45	0.80	0.12	1.90	0.01	0.45	0.06	0.09	0.01		
Average		1.57	0.36	0.73	1.60	0.71	0.94	0.12	1.92	0.01	0.74	0.06	0.08	0.01		
		Accumulative ratio of losses in the field work (including storage) on the farmer level work					4.62	Accumulative ratio of losses on all the stages of farmer level work			7.15	Accumulative ratio of losses on the job of commercial sector only			0.15	
												Accumulative Ratio of losses on all the stage of commercial sector work			6.59	
												Total losses			6.98 alter to 7%	

- Note: 1. The loss sub-total was obtained by accumulating the remaining quantity (deducting the loss portion) in each process. (Example) About working loss at farmer's field sub-total: $4.62\% = 100 - \{100 \times (1 - 0.0157) \times 0.9964 \times 0.9927 \times 0.9902 \times 0.9906 \times 0.9988\}$
2. Ratio of the handling quantity of dry season crop and wet season crop was set as 1.75:8.25 from the ratio of production of both seasons. Weighted average was obtained as follows:
(Example) Harvesting loss; $1.57\% = (0.88 \times 1.75 + 1.72 \times 8.25) / 10$
3. Obtained the weight average loss from the ratio of mechanical threshing and manual threshing, 7:3.
4. An weighted average was obtained from the ratio of handling quantity at farmer's level and at commercial base level, 7:3. Total loss at farmers' level work is 7.15%, that of commercial base level is 6.59%. Therefore, weighted average loss of both will be 6.98%.

The result of the loss assessment is as follows: (Refer to figures on Appendix B, Supporting Report)

- The harvesting (reaping) loss was 0.88% for dry season crop and 1.72% for wet season crop. In case moisture content of the paddy is below 21%w., the harvesting loss will be over 1% in most cases. On the other hand, the larger the yield/ha of the field, the less is the rate of loss.
- 1.5 to 3 days are taken for drying before threshing. Although it differs by the weather, daily drying rate is 0.5 to 2.5% w.b. There is a tendency observed that less is the moisture content, the more is the loss of drying before threshing.
- There are more easy shattering varieties grown in rainy season. The transportation loss of bundled paddy of wet season crop is four times the loss of bundled dry season crop.
- In the case of mechanical threshing, considerable loss can be saved by spreading a sheet in the periphery of thresher. Also as the peripheral speed of threshing drum is increased, the loss will also increase regardless of the moisture content of grain.
- The loss in the mechanical threshing was 0.4 to 3.6% when peripheral speed of the threshing drum is 8.5 to 17 m/s but it increased to 7.7% when the peripheral speed was 34 m/s.

- Both in mechanical and manual threshing, there was a tendency that the loss is less in wet season crop of easy-shattering variety.
- In the finishing drying after threshing, the paddy is usually dried excessively to prepare for the following storage. Farmers have no means of measuring the moisture content of paddy and conduct the drying with their experience. Therefore, they tend to stay on safe side in the drying of paddy. They often dry the paddy of 14% w.b. up to 9 to 11%. The drying shall be completed in one or two hours exposing the grain under direct sunshine but they tend to dry longer time than necessary. The cooling (tempering) time after drying also is insufficient causing over-drying or cracked grain by absorbing moisture. Here, excessively dried portion was calculated as the loss in final drying.
- Insects and rats in the warehouse of farmer's house or commercial rice mill cause the storage loss. It seems that there are also cracked grain caused by absorption of moisture although its quantification is difficult. (Following two figure at the next page)



Relation between storing duration and increasing situation of cracked rice and broken grains

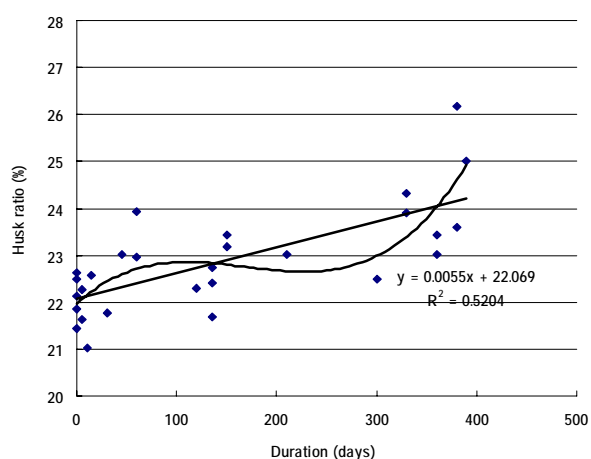
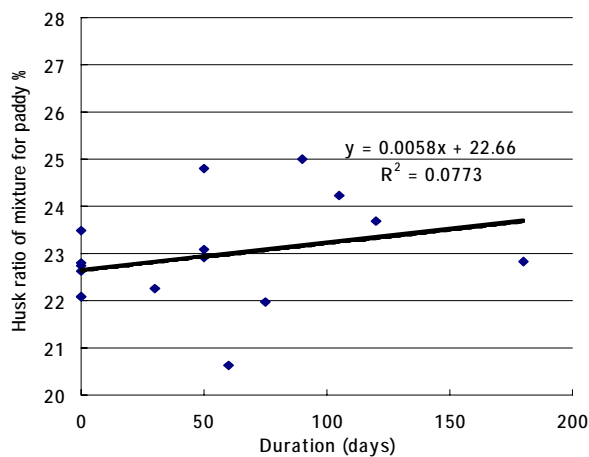
Left figure: IR varieties of dry season crops

Right figure: Wet season crops

- 0.8 to 1.0% (point) increase of husk weight ratio (due to kernel damage by insect) was observed in the IR varieties stored for six months (the next two figures).

After 180 days of storage, the difference of husk weight ratio with that of new rice was $0.0058\%/day \times 180 \text{ days} = 1.044\%$ ($=23.70\% - 22.66\%$).

Therefore, total weight reduces in 180 days to 95.61% ($= (0.2266/0.237) \times 100$). The loss of 4.39% should result in 2% of whole quantity, suppose 45% of all quantity was stored for half year in average ($= 4.39\% \times 0.45 \times 1/2 \times 12/6$).



Husk ratio for mixture during the storing for dry season crops

Left figure: Dry Season Crops

Right figure: Wet Season Crops

Even in wet season crops, same tendency as that of dry season crops was observed. The changes of husk weight ratio in a grain depending upon the storage period were slightly slow (about 5 point) and there was a close correlation. The loss during the storage was supposed to be about 1.9% here.

However, cracked grain ratio did not increase as rapidly with the lapse of time as that in dry season crop and correlation between the cracked grain ratio and the period of storage was low. The generation of cracked grain is supposed to be due to the influence of climatic conditions. Immediately after drying (after starting of storage) there were many rainy days with environment of high temperature and high humidity. It was thought that all affected on the grain to absorb moisture and resulted in the generation of cracked grains.

- The loss during transportation is mainly caused by the holes in the bags. PP bags made in Vietnam are often used. Those old bags are thin and easily broken and result in the loss by spilling. It should be about 50% of the loss during transportation from the field. The loss is about 500g to 800g for each 10 bags (60 or 70kg bag).

2) Custom milling

Partly because of the poor quality of paddy, it generates much broken rice, in turn; it increases the pressure inside the milling chamber partly more than necessary causing uneven degree of milling. As for quantitative loss, it was found that the separation of bran and husks from sound/broken rice was insufficient, 2.13% rice in dry season crop and 0.45% rice in wet season crop were mixed in husks and bran.

- The causes of broken rice are
 - Insufficient husking,
 - Uneven milling in the type of machine that conducts the milling and husking at the same time.

- Some rice mills although equipped with rubber roll type husker, lower the pressure between the two rubber rolls in order to save expenses. The low husking ratio of below 10% was often observed. In this condition, there would be no effect of using the husker.
- There are a variety of machines, their combinations and ways of operations (number of passes) in whole Cambodia. But in the limited area, there is a tendency to use same machines. It seems there is an invisible force to avoid competition by dealers.
- Engerberg type machine produces most unevenly milled rice; the higher rate of broken rice reduces the milling recovery. In the case of NODA type machine, some screens are not suited for milling long grain rice resulting in the low milling recovery. In Stammer type, milling recovery is equally low if husker is not used.
- The input capacity of many custom mills is said to be 200 to 300kg/hr. There was a tendency observed that if the machines are operated at the capacity higher than 150 to 200kg/hr, the milling recovery becomes lower.
- The milling yield was measured; the average for dry season paddy was 62.57% and that of wet season crop 63.61%.

From harvesting up to their own consumption, the total loss at farmer level was 7.15%.

3) Commercial mills

- Generally the quality of the material paddy is somewhat lower than the one brought to the custom mills. Many are insufficiently dried and cleaned. This was more observed in dry season crop.
- Rice mills themselves measured the milling recovery in their ordinary operation. It was 63.85% for dry season crop and 69.94% for wet season crop. Generally in Cambodia, the average milling yield is supposed to be low 62%. Therefore, it may be necessary to revise the average milling yield after conducting the test again and also considering the milling yield of custom mills.
- Presently preplanning process after material was fed is not functioning due to poor conditions of the machine and unskilled technology. Although it is possible to recover separately if there is any commercial value in the separated stuff, at present, the rice millers are reluctant to separate immature grains and empty husks and do not utilize the potential value and effect of the preplanning process (specially aspirator function).
- The rice mills in Cambodia increasingly use rubber roll type huskers. The expense required for rubber rolls (made in Vietnam) are quite large in the total cost of rice mill operation.
- In the husking process, if they try to increase the husking rate of the under-runner type sheller, it would cause the generation of broken rice. Therefore, husking rate is being kept low. In the rubber roll type husker also, husking rate is kept low, below 50%, which increases the recirculation times of the paddy to the husker causing reduction of efficiency and yield of broken rice.
- The ratio of return paddy from paddy separator to husking machine is below 50%, which is rather

low efficiency. In the husking process, aspiration of husks is performed somewhat effectively. Although the husking process may become critical point of whole processes, rice millers do not seem to pay sufficient attention to the husking process.

- Most of the rice mills consist of 2 to 3 units of rice whitening machines in a series. In a series of 2 units, the milling ratio of No.1 and No.2 machines is set at 7:3, an appropriate ratio. When the milling rate of No.1 machine is high, generation of broken rice seemed to increase,
- It was mentioned that the losses are due to the mixture of sound grain and broken rice into husks and bran. However, it was not mixed with the husk. The average loss was 0.03% for dry season crop and 0.09% for wet season crop.
- Input capacity of many rice mills is supposed to be 700 to 1,200kg/hr. It is possible to increase this capacity by 20 to 30% by making efficient pre-cleaning to separate immature grains and empty husks and to improve the efficiency of the husking process. However, it was confirmed that if we try to increase only the throughput capacity (processing quantity), it would reduce the milling yield and quality of the rice.

(2) Result of analysis of other samples

1) Result of quality analysis of dry season crop

Quality of Paddy (dry season crops)

Kind of rice	Mixture of paddy %							Cracked grain & broken grain
	Sound grain	Colored grain (mainly red kernel)	Damaged kernel	Foreign grains	Immature grain	Empty husk	Husk	
Average of all varieties	63.86	3.95	1.18	0.06	3.44	0.94	23.66	11.62
S.D.	8.39	7.61	1.73	0.14	2.56	1.46	1.32	12.00
Average of IR	62.02	3.01	2.38	0.05	6.31	1.80	23.18	9.65
S.D.	7.34	6.38	2.21	0.06	2.40	1.68	1.43	12.62

Note: **S.D.** : Standard deviation

- Always minimum 10% of foreign varieties were mixed. Wet season crops contain somewhat lower than the dry season crops.
- Ratio of husk was 23.7%.
- Ratio of cracked grain mixed in sound grain was about 15%.
- Immature grain ratio was 3.4%. IR varieties contain 3% more than the average of all.
- Mixture rate of foreign matter was about 0.2%.

2) Result of quality analysis of the material paddy in the commercial rice mills

Quality of Material Paddy at Commercial rice mills

(Comparison between dry season crops and wet season crops)

Kind of rice	Mixture of paddy %							Cracked grain & broken grain	Ratio of dust removed in the rice mills
	Sound grain	Colored grain (mainly red kernel)	Damaged kernel	Foreign grains	Immature grain	Empty husk	Husk		
Average of all varieties for Dry season crops	76.81	6.56	2.23	0.14	8.07	2.06	23.36	23.91	0.90
S.D.	6.76	3.09	2.29	0.09	2.64	1.23	1.90	9.54	0.57
Average of all varieties for Wet season crops	84.56	7.43	0.33	0.13	5.00	1.11	22.56	21.49	0.51
S.D.	7.46	5.84	0.34	0.21	2.35	0.86	1.13	8.27	0.84

- Quality of wet season crops is somewhat better than that of dry season crops. It is considered due to less amount of damaged and immature grain that affects in the result of milling yield.
- Many samples of paddy yielded over 20% of cracked grain (it was about 14% in average in the custom rice mills)
- Considerable quantity of other variety is mixed and is reducing the machine efficiency, resulting in the lower quality.
- As shown in the table below, irregularity in grain size is small.

Size of rice processed in commercial rice mill

	Dimensions	Length (mm)			Thickness (mm)			Width (mm)		
		Kind of rice	Paddy	Brown rice	Milled Rice	Paddy	Brown rice	Milled rice	Paddy	Brown rice
Dry season crop	Dimensions	9.23	6.72	6.51	1.95	1.71	1.65	2.49	2.13	2.06
	S.D.	0.15	0.09	0.11	0.03	0.04	0.02	0.04	0.05	0.03
Wet season crop	Dimensions	8.82	6.44	6.13	1.97	1.75	1.67	2.58	2.19	2.10
	S.D.	0.32	0.25	0.21	0.05	0.06	0.04	0.12	0.10	0.08

Note: The above data are the average of the data obtained in each test.

(3) Qualitative loss

- 1) Quality of paddy affects the broken rice ratio of milled rice in the rice milling process, and also its milling yield. If the rate of broken rice especially small broken rice is increased, it reduces the machine efficiency, increases irregularity of mixing ratio of broken rice in the milled rice, which in turn, lowers the commercial value of the milled rice. Further, if cracked grain and broken rice ratio in the material paddy exceed a certain level, it will cause uneven pressure inside the milling cham-

ber with small broken rice filling the space among sound grains. It will further accelerate the yield of broken rice

- 2) Average milling yield of all was 64%. The milling yield of custom mills is 3% lower than that of commercial mills. It is supposed to be the effect of intensive rice milling. The milling yield of dry season crop is about 1% lower than that of wet season crop in the custom rice mills and about 3% lower in the commercial rice mills. The reason for this is considered to be the difference in the quality of paddy.
- 3) In the case of dry season paddy, the milled rice of 20 to 30% broken rice based on can be produced if small broken rice, about 45% of milled rice (about 32% in wet season crop) is separated.

(Refer to Table B17, Appendix B, Supporting report)

Grain Composition and Mixture of Product in commercial mills

	Grain composition (%)					Mixtures percentage (%)						
	Whole grain	Head rice	Big broken	Broken	Small broken/ Chip (Fine)	Chalky kernels	Yellow kernels	Damaged kernels	Immature	Red/ red streak kernel	Foreign matter	Paddy
Dry season crops												
Ave.	28.60	9.83	5.79	9.41	45.06	19.70	0.83	0.73	-	2.10	-	0.01
SD σ	2.84	3.40	1.27	1.64	4.55	7.14	1.12	0.31	-	1.26	-	0.01
Wet season crops												
Ave.	30.67	23.36	7.59	7.25	32.16	24.22	0.43	8.77	-	1.49	-	-
SD σ	10.46	6.57	3.32	5.86	8.50	9.46	0.36	28.60	-	2.05	-	-

Note: Range of length: Whole grain: 100%, Head rice: 80~<100%, Big broken: 50~< 80%, Broken: 25~<50%
Small broken: <25%

- 4) There are about 7% of damaged grain, empty husks and immature paddy in the material. They are considered to be the cause of broken rice. It is presumed that there is also a mixture of varieties over 10%, which reduces efficiency of machines. It will increase the ratio of small broken rice and reduce husking rate and efficiency of paddy separation. The low quality of material paddy is increasing the cost of milling.
- 5) As the other cause of qualitative loss, rice mixed with paddy of low commercial value (quality) is being milled. Separation of empty husks and immature grains is not conducted in the pre-cleaning (of paddy) after receiving and in the husking process (from husked rice), even though it will lead to the improvement of milling yield and machine efficiency.
- 6) Yield of cracked grain in the drying process is one of the causes of lower quality of milled rice.

(4) Coefficient for calculation of annual demand/supply balance

Taking analyzed co-efficiencies into consideration not to shortage of rice surplus, it should round off/round up each decimal fraction to the nearest whole number in order to use it efficiently.

- 1) The total loss is revised from 6.98% to 7%.
- 2) According to the answers to the additional questionnaire on rice consumption, the consumption

against the quantity of seed broadcast was calculated. The quantity of broadcast seed was 40 to 100kg/ha (mainly 70 to 90kg/hr) against the average yield/ ha of 2 tons. The mean of 80kg was taken to meet 4% for the rate of seed broadcast according to the average yield, 2.00ton/ha, taking a future increase in yield into consideration.

- 3) Presently, bran mixed with paddy or husks is given to domestic animals and fowl. Therefore, it is quite difficult to decide the method of calculating the consumption quantity. Here, the conventional value used up to the present 2% is used as stated in the next table. Milling recovery is shown in the next table, which was in consideration of handling quantity between custom mills and commercial mills.

Milling Recovery at Custom mills and Commercial rice mills

		Custom Mills	Commercial mills	Weighted Average
	Ratio	0.7	0.3	
Dry season crop	0.175	62.57	64.85	63.0
Wet season crop	0.825	63.61	66.94	64.6
		63.4	66.4	64.5
				Altered to 64%

- 4) Annual per capita consumption was set according to the data (number of samples 6,000 households) of 「Cambodia Socio-Economic Survey 1999」 (compiled by National Institute). This survey was for the household economy. The rice consumption rate was not directly surveyed but calculated based on the price of rice to be 142.2 kg/capita/year. It was 143 kg/capita/year according to the analysis of the study team. (Refer to Appendix B.4.2)

Coefficient to be used in the Calculation of Demand/supply Balance

Item		Losses and requirement to use			Milling yield of milled rice	Per capita Average annual consumption
		Loss after harvest	Seeding	Feed for domestic animals, fowl & fish		
Coef-ficient	Value currently used	17%			62%	151.2 kg
		10%	5%	2%		
	Result of this study	13%			64%	143.0 kg
		7%	4%	2%		

If the above coefficient was used for calculation, there will be a surplus of approximately 500,000ton of milled rice (800,000ton of paddy), which was approximately 260,000ton surplus of milled rice by existing coefficient. Hereafter, it would be necessary to revise the value at the interval of 3 to 5 years by conducting study and make sure of the current conditions. And the value should be effectively used for chalking out government plans.

(5) Cost performance

See appendix B

3.4.4 Problems in Post-harvest Processing

(1) Qualitative loss

The qualitative loss was about 7% in total in the result obtained in the loss assessment in this study, which is lower than the loss coefficient 10% used by Cambodian government, Ministry of Agriculture, Forestry and Fisheries (MAFF) in calculation and making demand/supply balance. Mechanical threshing is quite popular in Cambodia and heavy labor in manual threshing has been avoided although small quantity produced by each farmer. This change in processing method resulted in reducing the loss of over 2%, although farmers may not be aware of this.

Improvement of post-harvest processing with the full knowledge about the characteristics of each variety is not being carried out. In the custom milling, a large quantity of broken rice is lowering the milling yield.

The milling yield is low even though they are lowering the degree of milling in order to increase the edible portion nominally. It would be motive action to mix the broken rice into the bran/husk in order to prepare bran/husk of different broken rice content because of payment system for milling fee. However, it should be effective to display commercial value of the bran, husk, broken, and product by milling degree each with different content of broken rice clearly, as the bran/husk are treated as the milling charge, if by-product and product would be used for milling fee. If rubber rolls are used in husking process and husking rate is increased, milling yield and generation of broken rice were improved.

It is necessary to increase the number of samples in future. It was found out that the same problem exists in commercial rice mills although there is a difference in the degree in rice whitening process. Both in custom rice mills and commercial rice mills, small broken rice and fine broken rice are mixed with bran to increase the added value of by-product of milling. Also husk is mixed in bran to increase the quantity of feed to livestock and fish. There is a situation that improvement points should be proposed more in details by confirming the appropriateness of the milling recovery in consideration of increasing quantity of the by-product etc.

(2) Quantitative loss

Generation of broken rice is the largest problem. In other words, quality of material paddy (brown

rice) is the most serious problem. Broken rice is almost produced in drying and storage. There is also a problem when high rate of broken grain and cracked grain exist in a brown rice in a paddy. The problems are also in the original shape and quality, cultivation. The broken rice in brown rice will multiplicatively make extra broken rice in milled rice because of extra pressure causing from block of broken in the gap among rice grains. Moreover, The ratio of damaged grain, foreign grain, chalky kernel and immature grain that causes broken rice in whitening stage is also higher. If there is much broken rice, the broken grain will fill the space among sound grains and increase the milling pressure, which will in turn increase the broken rice further. More broken rice content in-put to milling machine could not make well milling with higher milling degree. In the custom rice mills, if there is much broken rice, milled rice recovery rate will be less and consequently higher milling charge shall be paid.

Further, if broken rice ratio is high, efficiency of length grader will reduce, and uniformity of the quality of finished product will be difficult to achieve regardless of the high or low quality of milled rice. It must make machine efficiency lower to affect running cost. The most serious subjects/ problems is to solve lack of quality control from reaping in the field till milling and distributing. The activities for improvement of qualitative loss should lead to the better results for improvement (reduction) of quantitative loss.

3.4.5 Basic Conditions for Chalking out Improvement Plan

Regarding the post-harvest processing loss assessment, the basic conditions for chalking out improvement plans on quantitative and qualitative loss and on the quality of rice is summarized as follows:

- 1) In the agricultural works at farmer's level, moisture control at the time of harvesting, drying, transportation and threshing is most important. Keep the crops under optimum moisture content at each stage of above-mentioned process.
- 2) Plan to reduce over-drying and cracked grain due to moisture absorption, which are caused by adverse weather and failures in drying control, etc...
- 3) Encourage changes from manual threshing to mechanical threshing.
- 4) In the farmer's work, pay more attention to paddy cleaning before sales and storage.
- 5) Realize the importance of proper rpm for each machine in the mechanical threshing and customs mills.
- 6) In the custom milling, Engerberg type machines should be replaced with other type machines. In that case, try to install rubber roll type husker.
- 7) Introduce a basic idea of paddy quality inspection and grading system.

- 8) Promote to improve paddy quality and introduce suitable machinery for bringing the total milling yield including broken rice to 65 to 66%, average of Southeast Asian countries.
- 9) Improve rice mills so that they can produce a certain specified quality product. Simultaneously, decide the mill facility and its scale to improve operation methodology, capacity and efficiency of the machines.
- 10) When quality is decided through using the quality standard or specifications in the contract, reduce the unevenness of quality divisions of each product and of the content.
- 11) Remove impurities such as stones, sands and earth.
- 12) Improve the quality of rice bags.

3.5 Milling Process

3.5.1 Milling Facilities

Rice mills in Cambodia are classified into Custom Mill (Village Mill) and Commercial Mill (Large Mill). Custom Mill is with power of 10 to 20 PS, milling capacity of 0.2 to 0.3 ton/hr and working for only processing not buying or selling the rice. Commercial Mill is with power of 20 to 200 PS, capacity of 0.3 to more than 1.0 ton/hr and conducting for processing, buying and selling the rice. On the other hand, some rice millers who have large milling capacities do conduct as the Custom Millers in Bat Dambang and Phnom Penh.

The Ministry of Industry, Mines and Energy (MIME) and the Provincial Departments conduct the registration of rice mills. As the registration is not compulsory, a lot of rice millers are not registered. Numbers of rice millers based on the data from provincial departments of industry are shown below.

Numbers of Rice Mills by Province

Type	Kandal	Prey Veaeng	Kg. Cham	Svay Rieng	Takaev	Kg. Spueu	Kg. Chhn.	BTB	Siem Reab	Phnom Penh	Total
Com.	87	50	49	3	23	59	11	207	23	6	518
Cus.	1,688	2,495	2,363	1,447	1,113	830	1,090	153	956	63	12,198
Total	1,775	2,545	2,412	1,450	1,136	889	1,101	360	979	69	12,716

Source: (1) Provincial Department of Industry, Year2000; K. Cham in 1998, K. Spueu in 1999

Most of the rice mills have storage facility and adjust the seasonal fluctuations of rice demand and supply. The number of large-scale rice mills is increasing yearly in Takaev, Kampong Spueu, Prey Veaeng, Siem Reab.

3.5.2 Custom Mill

Typical equipment used for custom milling are identified as; a) Engerberg type, b) compact type, such as Satamar type and Noda type, which equip rubber roll husker on top of the milling machine with one common base and c) small plant type. Besides those, there are various other types with different combination of machines.

According the result of questionnaire survey, average processing capacity of custom mill is 0.3 ton/hr, processing volume per year is 67 tons. It means that the machine is operated only one hour a day. Milling rates are 15.77% for husk, 17.51% for bran and 66.22% of white rice including broken rice. Milling rate of rice recovery is higher than 63.4% which is a result of the loss assessment survey. It is supposed that rice mill owners are not clearly aware of the milling rates, because they don't use the weighing instrument.

Many of the custom mills (61.5%) surveyed were installed after year 1995, and the number of custom mills is still increasing. About 80% of the custom mills have investment cost for less than US\$1,000. About 70% of them are funded by own budget, and 10% are supported by relatives or acquaintance. Only one (1) out of 53 surveyed custom mills used a loan from the bank.

Management of business and operation of machine is both made by owner of the machine. Customers are residents nearby and bring paddy by themselves for processing. Usually, customers obtain white rice and owner obtains the by-products such as husk and bran as a milling fee. Although cash payment is introduced in recent years, still the payment by the by-products is main style.

3.5.3 Commercial Mill

(1) Milling facilities

Typical commercial mill in Cambodia is a plant type composed of following functions:

- 1) Pre-cleaner (sifting type)
- 2) Husker (stone type or rubber roll type or both)
- 3) Paddy separator
- 4) Milling machine (2 stages to 4stages)
- 5) Grader (sieve type or indent type)
- 6) Scale
- 7) Packing machine

It is found that the vertical type is more suitable for a long grain variety, durable and easy to operate. However, this type grinds the grain to remove bran, it damages the surface of white rice and quality of white rice becomes low. It is necessary to add the refining milling machine. It is found that a part of rice millers in Bat Dambang, Banteay Meanchey, Siem Reap and Takaev use length graders in order to meet the customers' demand for high quality rice. De-stoner and color sorter machine are rarely installed; only 9 rice millers installed the de-stoner and one rice miller installed the color sorter out of 131 rice millers according to the questionnaire survey.

According the result of questionnaire survey, average capacity of commercial mill is 1.1 ton/hr and average processing volume is 1,611 ton/year. Number of employees is 5 to 7. It is found that rice mill in Kandal, which has 120 HP machine and process approximately 10,000 ton/year. On the other hand, one rice miller in Siem Reap has 350 HP machine but process only 1,000 ton/year.

Many of commercial rice mills were installed after the year 1995 and it shows the increment of rice mill number. Investment cost of rice mill is US\$37,499 in average. One of the rice millers in

Kandal invested US\$ 120,000.

About 80% of rice millers established their facility by own budgets. Some borrowed from the relatives or acquaintance. No one borrowed any fund from the government and only three (3) out of 69 rice millers used loan from the banks according to the questionnaire survey.

(2) Management

The owner usually conducts management of commercial mill. Paddy is bought from the farmers and/or middlemen. White rice is delivered to rice shops, after that the owner go to the shops to collect money. Operating and maintaining the rice mill machine are carried out by the owner and/or by the experienced hired operator.

(3) Fund

Commercial rice millers are in need of the fund, however, few borrow it at present. Present situation of available rural credit is summarized as follows.

There are 50 credit institutions for farmers and small and medium scale business enterprises, according to the Bureau of Supervision of Specialized Bank and Micro Finance Institutions under the NBC. 10 institutions have more than 1 billion Riels outstanding, 16 institutions are between 100 million and 1,000 million Riels, 17 institutions are between 10 million and 100 million Riels and 7 institutions are less than 10 million Riels outstanding. RDB controls these credit institutions and it is lending to them. Lending amount as of the end of October 2000 is US\$595,000 for three commercial banks and two small-scale credit institutions.

ACLEDA is the largest among the micro credit institution and operating in 12 provinces. E.M.T, the third largest, is operating the loan programs for farmers in 9 provinces at the central-south of Cambodia, borrowing the fund from RDB. The lending procedures are similar to each other due to the instructions of the controlling bank. There are two types of lending procedures; one is the loan for individuals and the other is for groups. An individual loan requires the collateral, value of which is approximately three times of the loan. Group loan requires the group member's guarantee and/or famous guarantor. Interest rate is 3 – 5 % per month with 1 to 2 years period at present. There are no long-term loan schemes except business loan. Number of clients of larger scale credit institutions is 260,443, 76.6% of the total number of clients for 50 institutions, 339,944.

(4) Trend of Commercial Mill

It is said that rice mill is the largest industry in whole Cambodia. Enterprise Development Cambodia (EDC) is actively supporting the development of this industry. EDC became one of

NGO since 1999 after renamed from PSD Unit, which had been supporting the private sectors under the UNDP/CAREERE Project. PSD Unit/EDC provided technical and funding support to newly created business associations and undertook collection and analyses of relevant research data, established market contact and began training of business management to upgrade members' operation and advance the potential. EDC operates from head quarters in Phnom Penh and from regional services center in Banteay Meanchey for North-West Region and Kandal for South-East Region since 1999. EDC supported to establish 9 Rice Millers Associations (RMA) in 8 provinces and one national level federation. EDC held technical and training tours by the members of rice mill associations to Vietnam, Thailand and Singapore. Further, EDC are planning to provide loan or fund to the members of rice mill associations in the future.

Meanwhile, a private enterprise, Ankor Kasekam Roogroeung Co., Ltd, is planning to export Cambodian rice with newly built modern rice mill at the highly convenient place. Ankor Kasekam Roogroeung Co., Ltd. planed to complete building of modern rice mill and to commence operation from October-2000, but it was delayed to the year 2001. This enterprise is setting up a complete system from production to export for the selected fragrant rice. The enterprise entered into contract with 2,488 farmers in 1999 in three selected provinces of Kandal, Kompong Spueu and Takaev. The enterprise is planning to collect the raw paddy of 63,750 tons in 2001 from 25,550 ha field where 22,822 contract farmers grow fragrant rice with the seeds given at free of charge. While providing the know-how of cultivation, application of fertilizer, etc. to the contract farmers by his own trained 60 staff, the local authorities support the enterprise when enter into contract with farmers. The enterprise should give a great impact to the people concerning the rice industry, not only rice millers but also farmers and traders, in whole Cambodia in near future.

3.5.4 Warehouses and Milling Facilities of the Government and GTC

(1) Warehouses

Warehouses used in the rice marketing are classified into 3 by its owner; owned by rice millers, GTC and MOC. Warehouses owned by rice millers are effectively used and average storage capacity is 1,367 ton according to the questionnaire survey. Rice millers like in Bat Dambang, who are in far away places, who have large-scale rice mill machine and producing high quality rice to sell to Phnom Penh are eager to utilize the warehouses. On the other hand, most of warehouses owned by MOC were constructed around the year 1985, and they are old and less utilized. However, they are dispersed in whole provinces, having a good accessibility locating along the National Road or main roads or near main cities. It would be more effective to use. These warehouses are built with the concrete or wood walls and slate roofs. Some are concrete floors. Most of them are necessary to renovate to be utilized because the damages on doors, walls, floors and roofs.

Warehouses owned by MOC

Province	Number	Capacity (ton)	Usage (Number)	Building Conditions (Nr)		
				Good	Fair	Poor
Bat Dambang	13	43,438	1	N.A	N.A	N.A
Kg. Cham	17	36,369	0	2	10	5
Kg. Chhnang	7	12,703	0	2	1	4
Kg. Spueu	3	1,040	0	0	0	3
Kandal	5	10,783	0	0	1	3 + (N.A)
Siem Reab	15	21,154	0	9	6	
Svay Rieng	12	161,400	0	N.A	N.A	N.A
Takeav	7	11,300	1	2	5	0

Source: Provincial Department of Commerce

(2) GTC and Warehouses & facilities owned by GTC

GTC was established based on Sub Decree No.72 dated on November 23 1998, and formed by combining three companies, one of which is under the MAFF and two the MOC. GTC is controlled by the Board of Director, which consists of representatives of MOC, MAFF, Council of Ministers, MEF, Ministry of Planning, General Director of GTC and Representative of Employees. It aims at the private company's activities, but completely controlled by the government. GTC has 174 staff members at the end of November 2000.

Roles

- (a) Purchase and selling of rice in order to maintain market stability and support the production cost of farmers,
- (b) Take part in controlling the import and export of rice from Cambodia,
- (c) Take part in the storage strategy of reserve stock of the Royal Government,
- (d) Take part in the supply of the needs of the Royal Government, and
- (e) Other activities mentioned in the Statutes of Green Trade Company.

Facilities owned by GTC

(a) Warehouse

- Phnom Penh : 27 warehouses, 50,000 ton (34,750 ton: vacant)
- Others : 10 warehouses, approx. 20,000 ton

(b) Rice Mill

- Phnom Penh & Bat Dambang : 3 plants
- Kampong Cham : under construction

Activities

GTC activities are just started. Performances in 1999 and 2000 are as follows:

	<u>Year 1999</u>	<u>Year 2000</u>
(a) Buying and selling paddy:	3,000 ton	3,175 ton
(b) Rice reservation for National Committee for Disaster Management:	1,173 ton	1,272 ton

	<u>Year 1999</u>	<u>Year 2000</u>
(c) Paddy reservation for MOC:	None	1,000 ton
(d) Rice supply to WFP:	None	2,700 ton

3.5.5 Problem of Milling Process and Warehouse

(1) Problem of milling process

Custom Mill

According to the result of questionnaire survey, problems of custom millers are “There are many competitors near around”, “Milling machine is of old type”, “Milling technology is poor”, etc. At present, operating hour is very short, approximately only one hour a day. Custom millers are straggling to try to defeat the competitors by means of producing better quality rice than others but they are facing with a lack of fund to procure better machines.

Commercial Mill

According to the questionnaire survey, commercial millers have many problems such as “lack of fund”, “heavy tax”, “lack of market”, “fluctuation of paddy/rice prices”, etc. Commercial millers always procure the material paddy for processing by cash payment from farmers or traders thus they need a large fund. On processing volume, commercial millers are straggling to obtain sufficient quantity of paddy suitable for running the milling machines for one to two months.

Points of problems for material paddy are as follows:

- 1) Fund is insufficient.
- 2) Difficult to procure large quantity of good quality paddy.
- 3) Paddy sold by farmer is of small volume, mixed variety and contains immature/impurities and uneven moisture contents.

Points of problems for milling technology are as follows:

- 1) Milling machine is of old type and better quality rice cannot be produced.
- 2) Rice millers don't have systematic knowledge of milling technology
- 3) A lack of quality standards of rice (i.e. lack of target for quality improvement) hinders improving the technology because rice millers don't know clearly:
 - What kind of machine is suitable to produce better quality rice?
 - What processes are necessary and how much degree of milling is required?

(2) Problem of warehouse

Warehouses owned by rice millers are well utilized, problems are for the method of usage but not

for the warehouse itself. Rice millers do not carry out regular maintenance, which causes damage of paddy bags and spillage, mixture of different varieties and wet paddy.

Many of warehouses owned by GTC and the government are not well maintained and vacant most of the time. Warehouses were built with tin walls and roofs or wood walls, old and heavily damaged. Although there are some warehouses built with concrete floor in Phnom Penh and Takaev, storage condition is inadequate for paddy/rice due to roof damages.

3.5.6 Direction of Development of Rice Milling Industry

(1) Custom Mill

Custom mill is widely spread throughout the country and meeting with the needs of rural residents; it can process any time and any small quantity for household consumption. Considering the fact that farther you go from cities/towns, the road network becomes scarce and the traffic becomes more inconvenient, custom mill is indispensable for people's life in the rural area. Most of the custom millers are farmer and some of them are operating a small-shop as side business. Thus the custom milling is an additional income source of farmers, although its scale is not so large.

The importance of the custom milling business in the rural area, as an additional income source and as a service agent for milling in the remote area, remain unchanged. When the road conditions and the network are improved, activity range of the rural residents would be expanded and better quality milled rice would be demanded. Judging from the trend being observed that the compact type rice mills with rubber roll huskers are becoming popular instead of Engerberg type rice mills along the main (good paved) roads.

(2) Commercial Mill

Commercial mills are active in the main rice production area such as 9 provinces in the study area except Phnom Penh as well as Banteay Meanchey, Kampong Thum, Kampot and Pousat. Phnom Penh is a largest rice-consuming place, and commercial millers are targeting at this market. Medium and low quality rice are coming into Phnom Penh from neighbor provinces and high quality rice are coming from Bat Dambang or imported from the Thailand. As the rice production and the rice consumption (i.e. population) are expected to continue to increase, commercial mills around the cities and/or along the trunk roads with good accessibility would increase its scale in near future. For that, it is necessary that the problems of rice mills should be solved:

- (a) Quality of paddy collected should be improved. It should be overcome in the aspect of the farmers' rice production as well as rice millers' technologies. On rice production, it is necessary that MAFF, DAFF, CARDI and seed growers should coordinate and distribute effectively. Rice millers should conduct the inspection of paddy from farmers, select the

varieties, make more uniform moisture contents and remove the impurities.

- (b) Rice miller should operate the machine effectively, maintain and repair them periodically as well as develop the machine. At present, necessary points of improvement would be changing the pre-cleaner to air screen cleaner type, adding the refining milling machine up to four-stages, changing the sifting grader to length grader, adding the de-stoner.

However, supports to rice millers by the Government, NGOs and agencies concerned would be necessary. Up to now, EDC, which is one of NGOs, is supporting rice millers, and established the Rice Millers Associations and National Rice Millers Federation. At present, 9 associations are established in 8 provinces. And similar associations in 6 provinces are expected near future. EDC is searching the technology improvement, better management and lending schemes.

Cambodia is sandwiched by Thailand and Vietnam, who are largest rice exporting countries. Paddy produced in the northwest such as Bat Dambang, Banteay Meanchey is shipped to Thailand and paddy produced in the south such as Takaev, Prey Veang, Svay Rieng and Kampong Cham is shipped to Vietnam. Rice millers in Cambodia are eager to process those paddy in the country. These outflows are not likely to change, unless the purchasing power in the country would be strengthened.

Now Cambodian Government pursues the free market system and does not have an intention to intervene the rice marketing. However, considering the recent movements of establishment of Rice Millers Associations/Federation and of establishment of a modern rice mill facility by Ankor Kasekam Roongroeng Co., Ltd. improvement of the milling technology would be enhanced to supply the better quality rice to the domestic as well as international market.

(3) Warehouse

Warehouse is an essential facility for rice marketing and rice milling activities. Rice millers who handle a large quantity of rice for processing are eager to use the warehouses effectively. Government and GTC warehouses would be suitable for their intentions. As the rice millers want to have enough storage capacity for paddy to operate the mill for one to two months and operate steadily, but they are struggling with the lack of fund to hire the warehouses. The government warehouses would be effective solution to this.

Many of the government warehouses in the provinces locate along the main roads with quite good accessibility. As larger scale rice mills are developed, larger capacity of warehouses will be required. If the government would like the rice millers to store paddy as a part of National Food Reserve for disaster or emergency, the government should support the rice millers by providing the fund with preferable interest rate and/or the warehouses with preferable rental fee.

3.6 Rice Quality Control

3.6.1 Present Quality Control

There is no quality standard for rice in Cambodia. There was a quality standard for rice in 1960s. However, it disappeared during the time of political instability and civil war. Although the rice industry has developed gradually since 1980, the quality standard has not been enacted yet. This is because when the rice is consumed in Cambodia, its physical properties are not a problem as far as the variety is identified and nobody questions quality. Even if the Cambodian government tries to improve the marketing system properly, not only farmers but also traders and rice millers will take a passive attitude in the sales of rice. There is a feeling of expectation in the public for change; however, an immature system with false idea for market-oriented (market economy) precedes it, and the people are not sure what to do.

Followings are the opinions often expressed by rice millers, wholesalers and government officials.

1. There is no large-scale market for rice (no places to sell rice).
2. There is not any sufficient market information about rice and others available for wholesaler (including paddy middlemen and rice trading companies).
3. There is no attempt at improvement by the government.
4. There are cost increases because of the increase in informal expenses due to corruption of government officials and due to an immature/ relaxed/ informal system of government.
5. Rice quality standard would be established so that the rice market should be active.
6. Rice millers tend to hide inferior quality aspects of their rice.
7. High quality milled rice is not expected, due to low-level rice milling equipment.
8. There is not any good quality material (paddy) for milling.
9. There is not any good quality seed paddy.
10. Wish to export but do not know how.

On the other hand, private companies expect too many results, without any imposed actions for improvement. In reality, investments by rice millers and trading firms are just as important. Without those, it is hard to make any improvement. In the process of the improvement, some targets would be necessary for improvement of quality and mode of transactions.

3.6.2 Problems in Quality Control and Inspection

(1) Contradictions between expectation and reality

Misunderstanding that foreign assistance can solve every issue and all problems must be purged. There must be exertion by self-reliance, as is required. There is a perplexed situation not to under-

stand them.

However, uniform quality milled rice can not be produced even if specifications are made without trying to create the situation where high quality milled rice are needed. Presently, people just cover up the situation temporarily with inferior quality. Later, they will have to deal at the lowest price regardless of the quality. This kind of situation has been repeated itself many times. It is not that they can not find a buyer for high quality rice. They should realize that the buyers know the present inferior (uneven) quality very well and are trying to avoid them. This reduces the reliability on the present quality of the product.

It is necessary to persuade farmers and middlemen to improve their quality simultaneously. The activities of the rice millers and the pivot of rice marketing are indispensable for disseminating the feedback information. In this case, quality standard is necessary so the people concerned can exchange opinions on the basis of common cognition about the quality.

(2) Quality of milled rice

Present quality of milled rice is very low as it contains a lot of broken rice and immature rice. It is true that there are problems in the materials, paddy and milling machinery. But they are of secondary importance in discussing the quality of milled rice. Firstly, it is important to realize the present quality of milled rice.

Actually the quality of milled rice and the conditions of milling machinery are not so bad as the people of Cambodia think. By removing only small broken rice and immature grain, it is possible to adjust the presently marketed milled rice to the level of 20% or 25% to meet the quality standard of Thailand and Vietnam. It seems that there are a lot of preconceived opinions, concerning this issue. Therefore, commercial transactions of a large quantity of a certain quality have not yet been made in Cambodia. Consequently, quality improvement has been delayed and therefore delaying.

In spite of the fact that there would be a large fluctuation in the quality if the present material paddy is milled. People often think that it would automatically be milled rice with 35% of broken rice. It is important to understand that the quality is something that people should make themselves and maintain daily.

(3) Technology

It is a fact that there is no system with which technical information is available to the public. The rice millers do not have much experience and are not in a position to conduct a trial and error method sufficiently. Furthermore, the technical level of the machinery and equipment is low. They do not seem to adjust the quality as a part of rice milling process.

However, in neighboring countries, they maintain a market using the rice exported from Cambodia after some processes whose technical level is about same as those in Cambodia. It is necessary to analyze their actual cost and study the situation to see whether the technical level would be improved under the situation.

(4) Coping with the quality control

In ordinary international trade for rice, business transactions can be practiced without any samples or confirmation of actual quality. But in Cambodia, sample transactions are still practiced, which are inefficient and are the cause of increased expenses. Because of the fluctuation in the quality, it is difficult to extend the market through maintaining buyer's trust. They have to produce milled rice according to their own quality specifications. In other words, problems of maintaining market (buyer) are nothing but to recognize the structural problem of present trading pattern, collecting of illegal expenses and attributing the cause of inferior quality to others, etc.

On the other hand, there must be a quality standard and inspection methodology to make fair dealing (trading) and development of the rice business. Otherwise, the quality control system will never improve.

3.6.3 Quality of Milled Rice

(1) Quality of milled rice on the market

At present, the quality standard is not used as far as physical properties are concerned. In urban area, there is a sign of the work done for removing broken rice but it is not by a fixed method of quality control. The result of the analysis of milled rice samples collected mainly from retailers in Phnom Penh is shown in appendix E. There are large fluctuations in the quality.

(2) Quality of officially distributed milled rice

The quality is not uniform. There is still a quality fluctuation. It can not be an object of fair commercial transactions. Although the rice distributed by WFP is seldom resold, it is changed for different (higher) quality rice. A part of milled rice distributed by WFP seems to be at the edge of an edible or resalable range.

Quality of rice distributed through World Food Program Scheme

The Sample for accepted lots				Grain composition (%)					Mixtures percentage (%)								
Province	Warehouse name (Destination)	Sampling date	Net weight contracted ton	Whole grain	Head rice	Big broke	Broken	Small broken/ chip	Moisture content %w.b.	Chalky kernels	Yellow kernels	Damaged kernels	Immature	Red/ red streak kernel	Foreign matter	Paddy	Milling degree
				100%	80~<100%	50~<80%	25~<50%	<25%									
Prey Veang	Peam Ro	8 May-15 May 2000	70,000	19.78	38.55	8.51	21.44	11.05	13.30	5.31	1.02	0.24	0.00	0.70	0.00	0.00	80.00
Kampong Thom	WFP's Kampong Thom WH	27 Jul-8 Aug 2000	500	13.58	41.52	8.13	12.47	23.26	13.70	3.80	1.15	0.29	0.00	4.75	0.00	0.00	85.00
Kampong Thom	WFP's Kampong Thom WH	27 Jul-8 Aug 2000	500	15.17	38.40	11.79	19.18	15.44	13.40	3.11	0.81	0.87	0.00	3.33	0.00	0.00	85.00
Siem Reab	WFP's Siem Reap WH	24 Aug-31 Aug 2000	1,250	21.81	32.20	7.00	13.98	24.49	13.60	4.51	0.88	0.52	0.00	4.86	0.00	0.00	85.00
Prey Veang	Peam Ro	22 Feb 2001		39.27	20.49	5.84	7.32	26.74	12.60	15.70	0.46	1.15	0.00	1.74	0.00	0.00	85.00
Phnom Penh	km 6	16 Feb 2001		35.63	19.76	4.75	9.53	28.17	13.10	18.34	1.14	0.91	0.00	2.34	0.00	0.00	85.00
Average				24.21	31.82	7.67	13.99	21.53	13.28	8.46	0.91	0.66	0.00	2.95	0.00	0.00	84.17
Standard deviation				10.75	9.56	2.46	5.46	6.78	0.40	6.72	0.26	0.37	0.00	1.67	0.00	0.00	2.04

The Sample for rejected lots				Grain composition (%)					Mixtures percentage (%)								
Province	Warehouse name (Destination)	Sampling date	Net weight contracted ton	Whole grain	Head rice	Big broke	Broken	Small broken/ chip	Moisture content %w.b.	Chalky kernels	Yellow kernels	Damaged kernels	Immature	Red/ red streak kernel	Foreign matter	Paddy	Milling degree
				100%	80~<100%	50~<80%	25~<50%	<25%									
Siem Reab	WFP's Siem Reap WH	24 Aug-31 Aug 2000	1,250	37.78	21.76	3.69	11.90	24.02	14.20	15.82	8.27	0.30	0.00	11.69	0.00	0.00	85.00
Prey Veang	Peam Ro	22 Feb 2001		22.52	13.14	6.91	8.13	48.49	13.90	22.51	3.83	3.06	0.00	5.06	0.00	0.00	85.00
Phnom Penh	Km 6	16 Feb 2001		25.09	13.29	3.24	6.67	49.46	15.70	7.63	11.74	1.30	0.00	7.10	0.00	0.00	85.00
Average				28.46	16.06	4.61	8.90	40.66	14.60	15.32	7.95	1.55	0.00	7.95	0.00	0.00	85.00
Standard deviation				8.17	4.93	2.00	2.70	14.42	0.96	7.45	3.96	1.40	0.00	3.40	0.00	0.00	0.00

The milled rice distributed by police and army is of even lower quality. Therefore, they are mostly resold.

Quality of rice for police and army

Province	Grain composition (%)					Moisture content %w.b.	Mixtures percentage (%)						
	Whole grain 100%	Head rice 80~<100%	Big broken 50~<80%	Broken 25~<50%	Small broken/ chip <25%		Chalky kernels	Yellow kernels	Damaged kernels	Immature	Red/ red streak kernel	Foreign matter	Paddy
Kandal	20.95	13.14	10.46	17.74	37.53	14.4	12.73	2.07	0.78	0	1.37	0	0
Kandal	8.24	24.67	15.25	22.29	28.90	15.3	9.68	1.91	1.15	1.04	1.31	0	0.04
Kandal	22.19	17.06	9.68	15.80	34.01	14.1	11.49	1.09	2.00	0.29	2.66	0	0
Kandal	9.51	22.44	12.78	15.68	33.73	13.5	13.89	0.41	0.06	0	0.55	0	0
Kandal	14.07	7.47	8.28	12.82	55.84	14.6	20.62	3.06	0.61	0	3.90	0	0
Takeo	20.31	14.00	8.83	11.56	42.96	15.3	30.98	1.69	2.37	0	0.97	0	0.03
Average													
Standard deviation													

Note: Standard deviation is the square root of average value of dispersion; $\{ (X-E(X)) \}^2 / (n-1)$

3.6.4 Quality Control System

(1) Quality control system

The quality control in this case means only achieving two of following targets.

- 1) Targets for improvement of quality
- 2) Promotion of fair transaction with specified quality of rice (there is price information for each quality)

In order to achieve the above, a quality standard is required. Also it requires chalking out inspection standards.

1) Rice quality (target for improvement)

The words “rice quality” in most cases mean high quality. But in this case, they cover all classes of rice including medium and low grades. The majority of the rice marketed is medium and low-grade rice. The entire rice industry can be improved by implementing a uniform process to ensure medium and low-grade rice as requested by the buyer. Each dealer pursues the (specified) target quality according to the set quality standard. Also in the quality improvement, this quality standard can be targets and they can act under the common cognition.

2) Marketing (Preparation for fair transaction)

As mentioned in 3.4.1 (2), a large quantity of paddy is flowing out to neighboring countries. But the rice is traded at one price regardless of the quality. By-product of milling, rice bran, etc. goes out of the country without any merit to Cambodia and it is not likely to be improved in the near future. The feedback from neighboring countries to urge quality improvement can not be expected. Only by enacting the quality standard, it is possible to strengthen the bargaining power of Cambodian dealers indirectly. Simultaneously, it may lead to transactions by milled rice specifications.

(2) Problems in quality control

Organizations and individuals concerned in the rice marketing are as follows:

Ministry of Commerce (MOC), Ministry of Agriculture, Forestry and Fisheries (MAFF), Ministry of Industry, Mines and Energy (MIME), Camcontrol, Green Trade Company (GTC), farmers, paddy middlemen, custom rice millers, commercial rice millers, wholesalers, retailers and trading companies.

Utilization of proper quality control system (Enactment of Quality Standard) is the key for stabilizing production and for increasing income of any industry. It is considered to be an effective instrument for economic development and stabilization of the whole of Cambodia. Concerning the quality control in post-harvest processing, dissemination of inspection standard as well as the common language to be owned by many people in the rice industry for transactions is very effective.

In introducing the quality standard and the inspection standard based on it, fundamental tasks are as follows:

- 1) Must disseminate and propagate the fact that the value (price) of paddy and milled rice can be judged by the quality standard.
- 2) Utilize the quality standard for procurement and distribution of paddy and milled rice for and by the government of Cambodia (example: Rice distribution for police/army and WFP)
- 3) Explain the contents and purpose of the Quality Standard through TV/ radio/ newspaper/ Internet-network/ seminars, etc. (example: Sensory taste test by consumers, etc.)

- 4) The quality standard must be a guideline for developing low-grade rice that can be purchased by a low-income group of people.
- 5) Prepare the qualifying system to produce rice of low quality specified in the quality standard.
- 6) The Cambodian government should set up an information window as a part of extension services for quality standard to answer questions raised by its users.
- 7) The government of Cambodia should designate rice sale shops to act as their monitors to collect and announce the information on the price for each quality as a part of market information.
- 8) Standard inspection methodology makes rice millers and traders do self-imposed inspection clearance of specified quality as part of their job through the training the government conducts periodically.

Based on the law, “Law on the Measurement of Quality and Safety of Products and Services”, which has been enforced since June 2000, the quality standard of rice shall be enacted.

3.6.5 Utilization of Quality Standard and Future Trend of Rice Industry

Following is a summary of the future trend of rice industry expected by the utilization of the quality standard.

Utilization of quality standard and future trend of rice industry

	2000	2005	2010	2015 (expected)
Population	12.0 million	13.6 million	15.6 million	17.0 million (reach the ceiling)
Paddy Production	4.04 million ton	4.40 million ton	5.36 million ton	6.00 million ton
Present demand and supply	Some losses in post-harvest processes reduce, milling yield will increase and per capita consumption shall decrease			
Marketing	No activity (expectation for enactment of quality standard)	Sufficient understanding on quality. Some of commercial transactions begin to smoothen.	Can find buyers for a niche business.	Dealers can be trustworthy/ creditworthy and a niche business is established. A group for large transactions can be organized/ self-stood. Whole rice industry is stabilized and develops.
Equipment	Old and incomplete facility	Improvement in pre-cleaning and cleaning.	Improvement in polishing and husking processes and dexterity in cleaning.	Re-milling equipment becomes popular.
Quality	Unfavorable progress in transactions and in quality control due to no quality standard. Enactment of quality standard.	Active study on quality and classification of qualities.	Capable of producing milled rice of designated quality	Capable of producing milled rice according to the quality specifications

3.7 Rural Society / Farmers Organization

3.7.1 Structure of Rural Society

Since French colonial rule, artificially created “KHUM” (or Commune) has been functioning as the most basic unit for regional administration. But this actually consists of several PHUM (or Village) that are headed by Village Chiefs. And it is a PHUM that a Cambodian always maintains a traditional sense of belonging to. The chief of a KHUM or Commune Chief is supposed to be elected (but is in many cases done so through de facto appointment by the Government), while a Village chief who assists the Commune Chief at PHUM level is appointed by the Commune Chief. The first national election for the Chiefs was scheduled to be held in 2001, but has been postponed until 2002.

Ministry of Rural development (MRD) is currently organizing Local Development Committees (LDC) at each Province (PDC), Commune (CDC), and Village (VDC) nationwide, to promote people’s participation in the rural development process, but the rate of coverage is lagging far behind the target of 100% by the end of 2000 (actual figures are 26% for the villages, 2% for the communes). Even these limited achievements were made possible mainly through the assistance of hardworking NGOs. As some LDCs in the SEILA project are already demonstrating, a good LDC has the potential to be a driving force in decentralized rural development and transform local decision making structure completely, provided that some funds are available for the LDC’s disposal and the LDC is managed democratically.

Apart from administrative records, there are not many documents available regarding Cambodian rural society in the past. But a Cambodian farmer seems to have lived a simple life with relatively rich natural resources, including vast rain-fed farmland and flood plains with minimum artificial irrigation that usually requires close social organizations as seen in other Asian countries. There still exists a traditional labor exchange system called “PROVAS DEI” or “Pagoda Committee” that looks after religious/cultural/social welfare aspects of rural life. But Cambodian rural society has been loosely knit in comparison with many other Asian counterparts in the absence of strong solidarity, communal institutions or coercion among its members. It may be also true that 30 years of warfare destroyed the basis of ‘the community’, and the Khmer Rouge system of spying spread distrust and suspicion among the people. Therefore it may require special cares and/or additional efforts for Cambodians to rebuild the required organizations for their social and economic development.

The basic unit of a PHUM is a nuclear family. The functions of groups based on kinship or marriage are weak, and other kind of social relationships such as patron-client relation are generally sporadic and insignificant except the ones mentioned above. While there is no clear rule/customs regarding property inheritance, as indicated by the absence of lineage, there is a tendency for female

children to inherit land. Married children usually have independent houses. A son tends to move to the wife's village with some financial assistance from his parents on the occasion of their wedding, while a daughter tends to build a house in the parental homestead and cultivate land allocated to her. This allows her to take better care of aging parents and eventually takes control of their house and movables. It is said that Cambodian farmers are by nature quite free to migrate to try their luck in new places, probably illustrating its loose social structure, weak solidarity and availability of unoccupied land.

In this context, it is remarkable to find some success of the cooperative movement in the 1960's. Credit coops in 13 provinces, initiated by the government and named as OROC (Office Royal de Cooperation), were followed by a chain of consumer, production and multi-purpose cooperatives including such services as saving and marketing of paddy. The number of cooperatives increased to 482 and their membership reached as many as 206,625, a quarter of the total farms. However as the approach was top down and the movement was caught in the unlucky political turmoil; the coops were soon crushed and forgotten in the war. But this may indicate the Cambodian's capacity for adopting new institution as long as they are useful.

Apart from the past, a contemporary Cambodian farmer is poor and looks too alienated or preoccupied with daily chores to plan to reorganize his life in long term. The mistrust once wide spread among them seems to linger on. People still tend to react to the word of "SAHAKO"(Co-operative) with memories of coerced collectivism. This seems to be why many NGOs prefer the word "SAMAKUM" (association) when referring to a possible Farmer Organization. However there are some signs of change now. According to DAE of MAFF, in recognition of a legal framework to strengthen Farmer Organizations, a sub-decree for Agricultural Cooperatives will be issued shortly. And MAFF has been organizing many workshops in the 13 provinces since 1999 as part of the groundwork. And as much as 90% of the participants of the workshops (mostly farmers and MAFF/DAFF staff) answered yes to the question if Agricultural coops could be organized in their localities.

3.7.2 Farmer Organizations (FOs)

(1) Introduction

Many international organizations, both official and non governmental, have been trying to promote farmer organizations (FOs) as the vehicles to implement their humanitarian/ development projects at grass roots level, in areas such as Micro-credit, Income generation, Food security, Agriculture, Irrigation, Forestry, etc. The total number of such FOs initiated by the numerous NGOs is unknown, as there is no law to regulate their activities. According to MAFF's sample survey on 83 FOs, the approximate number of FOs in Cambodia was estimated as 1,065 (" Report of the National Workshop on Farmer Organization", MAFF, 1999). This figure may be too modest and

3,000 ~ 4,000 might be more realistic figure. For the village banks alone were estimated around 1,000 in ADB's "Rural Financial Study" of 1996 when the number of beneficiaries were about 80,000 and now beneficiaries exceeds 330,000 (the average number of members per Credit FO or Village Bank is 50).

The same MAFF report reported the varieties of FOs' activities. According to it, the most popular activity is the Rice Banking (engaged by 20% of FOs) followed by Credit (16%), Irrigation (16%), Crop cultivation (15%), Animal Husbandry (14%), Forest protection (5%), Animal bank (4%), and Rice seed production (2%). Others include Fertilizer procurement, Fish raising, Integrated farming systems, Planting material and Rice milling. Credit is mainly for food production, small trade or other small business.

Average membership is about 250 per FO, of which 43% are women. 55% of FOs have memberships more than 100. The FOs with membership more than 200 (30% of total FOs) are mainly multi-village based, while FOs with less than 50 members are single-village based.

(2) Present status of Farmer Organizations

Since there is neither legal framework nor clear policy for FOs, donors did not have to follow any formality or standards and enjoyed freedom to try their own models of development (a registration system with Ministry of Interior exists but is non-compulsory). As few FOs were self-initiated, the problem of ownership originated right from the beginning. Many FOs do not have a constitution (statute), or even if they did the members do not know about its contents.

Excepting NBC who monitors rural financial schemes, there is no official tracking system. As a result, apart from an NGO called Cooperation Committee for Cambodia (CCC) that coordinates NGOs' activities, no one keeps a record or statistics about NGOs and FOs. (CCC's latest directory includes 296 NGOs of which 163 are Cambodian and 133 international, excluding 100 more NGOs who are unregistered with the Government).

Participants of MAFF Workshops on Farmer Organizations, consisting of FO representatives and extension department staff of MAFF, expressed hope that the following functions/aspects of the FO's be strengthened. Namely Credit (61) Technical Assistance (47), Recognition by Govt. (27), Fertilizer supply (23), Supply of good seed (20), Irrigation repair (19), Infrastructure (15), Marketing (14) Irrigation Water (12), Equipment (7), etc. (The figures in the bracket are the number of the persons that mentioned). The two weakest points of FOs were listed as:

- 1) Insufficient training of staff
- 2) Management

These problems may have to be taken care of by reinforced training programs under the revised policies.

3.7.3 Rural Credit Associations

(1) Introduction

Until the formation of the Rural Development Bank (RDB) in 1998, there was no formal rural credit system except NBC's loan, most of which were made to SOEs, agricultural enterprises. After the deregulation, formal rural credit services ended, while the commercial banks' rural branches are concentrated in a few large urban centers as farming was not supposed to be credit worthy. To fill the gap, the NGOs and IOs provided grants to help small farmers and woman-headed households who constituted the main body of the rural poor. This may be classified as semi-formal credit against informal sector consisting of moneylenders, traders etc. As such NGO's intervention was basically for poverty alleviation. And their financial services were mainly for micro-enterprises as most of them, especially women, had too little land to invest. Some NGOs introduced compulsory deposit schemes to introduce the habit of saving and also to make the system sustainable.

RDB provides formal rural credit as the wholesaler, and finances the rural population through retailers such as Micro-finance Institution (MFI)s and Commercial banks who have licenses issued by the NBC. Most of the beneficiaries were members of micro-credit associations in various forms, organized and assisted by large NGOs who were registered at Ministry of Interior and chosen by RDB as the retailers, but they are not yet formal MFI (or LFI= Licensed Financial Institutions) except ACLEDA, the largest retailer, because they do not have the NBC licenses yet. Since Oct. 2000 ACLEDA has grown out of an NGO to be a BANK with several branches in key Provinces. More NGOs, who are already retailing RDB loans, are going to receive the licenses shortly.

The amount of RDB loan in 1999 was US\$2,041,579 (including some large loans for agro-processors/traders) and was provided for 17,182 households. Since RDB has signed up for ADB's fresh loan of US\$ 20 millions for its 5 years Rural Credit project, the formal sector rural credit, together with expected IFAD loan of US\$ 1.2 million, may rise dramatically and eventually shoulder almost half of the rural credit supply in 5 years depending on how many NGO operators will be LFIs.

According to NBC who monitors NGOs' financing activities, there are 72 NGOs and 2 IOs that are engaged in credit operations in Cambodia. 49 NGOs out of 72, including almost all of the major operators, had outstanding loans of US\$23millions at the end of 1999, benefiting 334,145 families in 18 Provinces. This constitutes 19% of rural households (Average size of loan is USD 68). This is a significant figure in view of ADB's 1996 prediction of 256,000 beneficiaries for 1999 or 15% of rural households.

According to the QUESTIONNAIRE survey of this study, out of 845 respondents, 370 (43.8%) have borrowed money either often or sometimes and 168 (19.9%) relied on micro-credit

organizations. This is 34.6% of all the lenders mentioned by them and the highest, and followed by Relative/friend (31.5%), and Middleman (13.8%), moneylender/pawn broker (10.8%), Rice miller (2.1%) etc. In the same data, the reasons for borrowing are shown as 1) Agricultural inputs (32.4%), 2) Health/Illness (21.1%), 3) Food (13.8%), 4) Educational costs (8.8%), 5) Daily necessities (7.5%), 6) Investment in Agriculture (other than inputs)(4.4%), 7) Wedding/Funeral (4.4%), etc, Average size of loans outstanding is Riel 375,000 (=USD96), but most of the borrowers (67%) have loans up to Riel 30,000 (=USD77).

Organizations like Rice/Paddy banks and Animal banks may be classified in the same category of rural credit, although they finance in kind. But we shall deal with them separately as they have different structures, methods and scope for development.

(2) IO/NGOs in Rural Micro-credit Schemes

The extent of the rural credit operated by major IO/NGO is shown in the following table.

Major Operators in Rural Micro-Credit

Organization	Started in	Loans outstanding		No. of borrowers		Av. Loan (USD)	Saving		No. of Savers	
		million Riel	Share	Person	Share		million Riel	Share	person	Share
ACLEDA	1993	51,790	60%	58,355	17%	234		0%		0%
PRASAC	1995	5,229	6%	22,291	7%	136	1,719	27%	43,729	33%
EMT	1991	6,967	8%	56,646	17%	32	34	1%	26	0%
CRS/TTP	1994	5,121	6%	31,589	9%	43	1,553	24%	21,448	16%
CCB	1992	3,099	4%	13,631	4%	66	601	9%	13,631	10%
HK	1994	2,299	3%	3,741	1%	162	121	2%	4,100	3%
WVI-C	1990	2,172	3%	17,303	5%	33	41	1%		0%
SELANITHIH	1993	2,156	2%	11,725	4%	48	527	8%	11,725	9%
ADC/ANS	1994	1,154	1%	7,737	2%	39		0%		0%
MOWVA	1988	1,494	2%	37,425	11%	39	400	6%	3,015	2%
Total of above		81,480	94%	260,443	78%	82	4,998	78%	97,874	73%
Others		5,212	6%	73,702	22%	19	1,387	22%	36,476	27%
Total (Riel)		86,693	100%	334,145	100%		6,385	100%	134,350	100%
(USD)		22.8				68				

Source: National Bank of Cambodia, "Rural Credit in Cambodia", 2000

Among 49 operators who reported, the largest 10 operators including 2 IOs (EU/PRASAC and UNICEF/MOWVA) are lending US\$21.4 million (94%) out of US\$22.8 million. As ADB estimated, the total rural credit supply in 1998 was US\$27million; these semi-formal credits' share has reached almost 80% of the total. Most of the large operators receive seed money and grants for the operational cost from International Donors (IO/NGO).

The largest by far, ACLEDA is assisted by UNDP, ILO and EU/PRASAC, has outstanding loans of

US\$13.6million that is about 60% of total for 58,355 borrowers. Average loan size at ACLEDA is US\$234 and much larger than other operators, as individual dollar loans for US\$300~2,000 are included. These are meant for larger scale enterprises and traders who can provide collateral. Others apply for group loans by organizing solidarity groups to guarantee repayments like most other NGOs' micro credit schemes.

The second largest operator EMT is a Cambodian NGO that took over operations from GRET, the French NGO who pioneered rural credit here, who receives grants from AFD and assists EMT. It has a similar number of clients but the loan amount is US\$1.83million, and the average loan is only US\$32.

EU/PRASAC and CRS/TPP had similar loan balances (US\$1.38, and 1.34 million), as EMT but the borrowers numbering 22,291 and 31,581 are less. The former originally had an ambitious plan to reach to 33,000 beneficiaries by 1997 with original fund of US\$2.4million, but it started using other NGOs such as ACLEDA. An American NGO, CRS, with grants from USAID, is also linking with several Cambodian NGOs such as TPP by providing training and management assistance to them. CCB and HK are also local counterparts of International NGOs of World Relief and OXFAM-QUEBEC. So is SEILANITHIH for CARE, an American NGO. MOWVA is Ministry of Women and Veteran Affairs and linked up with UNICEF.

3.7.4 Other Organizations Related to Rice Marketing

There are many more organizations related to Rice Marketing, such as Rice/Paddy bank, Associations for Seed production, Fertilizer distribution, Rice mill users, etc. As other associations are still few and numbers negligible, we will focus on the Rice/Paddy banks as they are the most numerous.

(1) Paddy/Rice Bank

The main objective of a Rice/Paddy bank is for poor villagers to secure food, but it can also supply seed paddy. And it serves the producers and the consumers as both parties, bypassing a middleman, can get better prices than in the market. There also exist some Rice banks that buy and distribute fertilizer for the members who contribute paddy in order for the banks to generate capital to finance their activities. Those that play important roles in marketing are still isolated cases, but can grow into coops given appropriate supports.

Since international assistance was initially aimed at humanitarian relief, food security has been one of the main activities for them. As the rice bank is a system to secure the supply of staple food through group activity, it became a popular program for various NGOs. It supplies seeds in the planting season and generates income when the surplus is sold to the market. Until recent years,

the gap in rice prices in the lean season and the main harvest season used to be quite large. Therefore deficit farmers were suffering when they relied on moneylenders to survive and had to repay the debt soon after the harvest with high interest. The QUESTIONNAIRE survey indicates that about 10% of rice farmers who borrow money did so to buy food, mainly rice. This figure may look insignificant as the survey didn't target at non-rice farmers, non-farmers as well as farmers in main deficit areas.

As there are no statistics about Rice banks, it is difficult to know their numbers or geographical distribution. But according to MAFF study quoted earlier, it was the most popular FOs in Cambodia, even more than micro-credit organizations. A Rice Bank is also called a Paddy bank, as people don't handle rice but paddy. The concept of financing in kind is similar to that of an Animal bank such as a cow bank, a pig bank, a poultry bank etc, which are also quite popular in villages where NGOs are active. And financing in kind has advantages where bookkeeping is beyond the capability of people with high illiteracy rates.

In an average case, a Rice bank starts with 40~50 (in some cases 100~150) members when they met and agreed with the idea shown by NGO organizers. They adopt rules and elect a committee of about 5 executives. They survey the supply and demand of food in the village, organize collection and distribution of paddy, keep all records of deposit and withdrawal/loan, and monitor the whole activity. Members contribute paddy according to their surplus and usually the NGO also contributes to the initial stock (of paddy) and sometimes provides fund for a storage construction. In the latter case the scheme also functions to reduce storage loss and demonstrates better storage technology. In the lean season members can borrow paddy depending on demand and availability, and pay back after harvest with 10~20% interest. Some banks lend paddy to non-members as well, at higher interest rates.

In 1994, Rice Bank in Bat Dambang distributed fertilizer (50kg per household) among members as a loan. They repaid with paddy (200kg) equivalent to 150% of the value of the fertilizer. Later some members borrowed the paddy and repaid with 50% interest after harvest. So this bank, in a way, functioned as a marketing coop, to buy and sell input to members, in addition to generating capital through interest. Some rice banks organize other activities such as the introduction of kitchen gardens, compost, etc that are useful for food self-sufficiency.

All the activities above strengthen solidarity among the villagers and encourage other community development activities.

In 1994~96, there were some cases of failure in the early trials of Rice banks. Since NGOs chose the most severe, deficit areas with poor soil, chronic damage through natural disasters etc., often the borrowers were left with little harvest to repay. They are usually prepared to withstand one such year, but if there were two consecutive bad years the scheme cannot sustain itself.

Since these 5 ~ 6 years the food supply has been improving and there are reports that the number of borrowers as well as borrowed quantity per family is decreasing, while the number of Rice banks is increasing. This may be the result of the recent market trend due to higher production. But one cannot deny the fact that the increased number of rice banks and their members also had some favorable impact for food security as well as rural household economy. Rice banks may be unnecessary if there are no more seasonal rice shortages. But as the population is still growing, while the risks of floods and droughts are always there, the concept of rice banks as well as animal banks will remain useful. They need to learn to help each other from falling into the “debt trap”, and to improve their livelihood. Besides a Rice bank can be a good starting point for the rice farmers to learn how to market their rice in more favorable terms.

When we look at the aspect of seed, it has another important dimension. There are strong needs for seeds, with high quality and/or of the varieties popular in the market, in all the rice farming areas, but there are few channels to produce and distribute such seeds. It is not appropriate for a rice bank to distribute seeds out of the paddy repaid by borrowers unless the quality of the paddy is proven to be high. There should be an opportunity for the rice bank to act as a distributor of quality seeds from which all the members will benefit.

3.7.5 People’s Participation (PCM Workshop)

PCM is an abbreviation of “Project Cycle Management.” This is one of the participatory planning methods. The workshop proceeded by this method is called “PCM workshop” (herein after W/S).

In the Master Plan Study on Improvement of Marketing System and Post-harvest Quality Control of Rice in Cambodia, three-day PCM workshop on rice growing, farmers were asked to formulate a project design based on their opinions and needs in Kampong Cham, Bat Dambang, and Takeav Provinces. The more precise details of the workshops are mentioned in the following table. Another W/S was held in Phnom Penh on rice mills, inviting the members of major Provincial Rice Mill Associations in November.

For each W/S, forty (40) farmers including one (1) village chief, two (2) male farmers, two (2) female farmers from eight (8) villages in each province were listed up by DAFF and Commune Chief to be invited. The criterion was “the rice growing farmers who are eager to operate farming and have some motivation to improve the present situation of rice growing and/or rice marketing.” Commune Chiefs, Provincial Governors or Deputy Governors, and Directors or Deputy Directors of DAFF in each venue, participated as observers.

The Date and Venues of the PCM Workshops

Order	Date	Province	District	Commune
1	9, 10, 11 of October	Kampong Cham	Prey Chor	Somraong
2	18, 19, 20 of October	Bat Dambang	Tmor Kouk	Kork Kunun
3	7, 8, 9 of November	Takeav	Samraong	Soeng

The goals of the W/S were:

- 1) To understand the present conditions of the rice farmers,
- 2) To find solutions to their problems,
- 3) To understand the actual needs and priorities for strategies to solve the problems.

So as to promote active discussion among them and hear honest opinions from the participants, the whole process of the W/S was conducted in Khmer. Our trained counterparts through the training course provided by the Study Team were appointed as the moderators.

Almost all the people who were invited to the W/S participated. It is generally said that Cambodians are quiet, shy and do not like to voice their ideas in front of other people. Nevertheless, gradually they started to talk during the three-day W/S. At the stage of voting to select the strategies and give them priorities, their discussion became very active unexpectedly. This might be because of difficulties in grasping the concepts used in the sessions on “Problem Analysis” and “Objective Analysis”, while the voting was simple enough. The results of the voting are presented in the table below:

The Results of voting (the first prioritized approach/ strategy)

Province	Name of Approach (Strategy)
Kampong Cham	Establishment of Farmers’ Association
Bat Dambang	Reasonable Prices for Agricultural Inputs and Equipment
Takeav	Higher Paddy Price

Only the participants in Takeav Province selected the approach that the participants should do something to achieve the objective due to the effect of the Study Tour before the W/S. During the Study Tour, they met the rice farmers who had organized the Seed Producers’ Association and Water Users’ Association by themselves with the help from DAFF Takeav Province in the same district (Choeng Koun Commune, Samraong District). The participants in the other two provinces selected the approaches related to organize the farmers’ associations/ farmers’ groups. They started to recognize the benefits of organizing farmer associations/ farmers groups but had no idea on how to organize by themselves.

So as to change this behavior of the rice farmers, the following measures can be applied:

- (a) Holding a PCM Workshop on the participants (as many as possible) of the same commune and requesting them to discuss implementing the projects themselves,
- (b) Applying the other participatory planning methods such as Participatory Rural Appraisal and

Participatory Learning and Action, and
(c) Implementing Study Tours more efficiently.

After applying such measures successfully can it be assumed that farmers may be able to get themselves organized more confidently and comfortably.

3.8 Transportation Infrastructure

3.8.1 Transportation Network

(1) Means of transportation

Before 1993, shipping vessels and railways played more important roles than trucks in transporting goods. However, inland transportation by trucks has recently become the major mode of transportation. The volume of 3.2 million tons by inland transportation in 1999 was 85 times that of 1993 and is 66 percent of all transportation as shown in the table below. Inland transportation volume by road is increasing with the help of up-graded road conditions. Transportation by vessels is increasing (except 1999), through port rehabilitation for imports and exports. Volume at Sihanoukville port is exceeding that of Phnom Penh port. Transportation volume by railway is also gaining gradually, but its share is relatively smaller than that of truck or vessel. Old rail works, poor train maintenance and inefficient loading/unloading facilities restrict the expansion of railway transportation.

Annual Transportation Volume

Means	Unit	1993	1994	1995	1996	1997	1998	1999
Road	1,000 ton	38	1,246	2,115	2,563	2,823	2,685	3,214
	1,000 ton-km	3,930	133,070	214,672	269,164	293,450	284,180	308,158
Railway	1,000 ton	130	61	48	76	169	294	270
	1,000 ton-km	34,000	14,100	7,797	9,700	36,095	75,785	77,386
Vessel	1,000 ton	991	1,118	1,273	1,326	1,452	1,505	1,391
	Phnom Penh	517	571	566	585	658	620	459
	Sihanoukville	474	547	707	741	794	885	932

Notes: Transportation volume of inland river ports is not included.

Source: (1) Report on Annual Transportation 1999, Ministry of Public Works and Transport

(2) Phnom Penh Port Yearly Operation Statement, Ministry of Public Works and Transport

Transported rice volume by railway and vessels are shown in the following table. In the case of railway, transportation volume on the North line, which runs from Phnom Penh to Bat Dambang, was more than that on the South line except in 1998. Peak volume was 21,296 and 7,040 tons in North and South line, respectively. Before 1996, both the import and export of rice was conducted from Phnom Penh port and Sihanoukville port. Statistical data in the table shows that rice had been exported up to 1996. Recent rice importation volume would be considered WFP rice.

Transportation by Railway: and the Volume of Rice Imports and Exports

Description		Unit	1992	1993	1994	1995	1996	1997	1998	1999
Railway	North	Tons	160	9,930	1,105	4,602	21,296	8,513	320	7,780
	South	Tons	-	235	-	520	1,500	1,040	7,040	305
Phnom Penh	Export	Tons	21,014	18,640	11,622	6,573	-	-	-	-
Sihanoukville	Import	Tons	5,970	10,449	18,867	36,685	23,540	6,952	16,615	10,889
	Export	Tons	-	-	-	-	2,611	-	-	-

Source: (1) Historical Background of the Royal Cambodian Railway, Feb. 2000; International Relation Office

(2) Phnom Penh Port Yearly Operation Statement, Ministry of Public Works and Transport

(2) Transportation law and Checkpoints

1) Decree/declaration on transport

A Law on Transport is under preparation for submission to the parliament. Currently transport is regulated according to the following decrees:

- Ministry of Public Works and Transport
 - Sub-decree on Maximum Limitation of Vehicle Weight on National Routes
 - Declaration on Maximum Limitation of Vehicle Weight on National Routes
- Ministry of the Interior
 - Declaration on Money Fine of Over-loaded Truck Weight on Route

2) Checkpoints

Sub-decree on “Demobilization and Creation of Posts Inspection along Border Check Point” established various kinds of checkpoints to control entry and exit along border check points by roads, ships, railways and airways. The Agencies responsible are National Police Armies, CAMCONTROL Agent, Customs and Excise Agents, Sanitary Vegetation Agents, Armies and Police Agents and Medical Inspection Agents. These checkpoints established at borders and cities are to monitor movement of goods and human beings. Excessive obstruct smoothly to transport of goods sometimes.

3.8.2 Present Conditions of Infrastructures of Transportation

(1) Road conditions

1) Road class and length

The roads in Cambodia are classified as National roads, Other National roads, Provincial roads and Rural roads including farm roads. National road works are the responsibility of the Ministry of Public Works and Transport. Some of these are designated as Asian highways: National roads RN-1 and RN-2 run to Vietnam, RN-5 to Thailand and RN-7 to Laos. The total length of the National roads is 4,165 km and its density is 22.9 m/sq.km; and that length of National and provincial roads is 12,220 km and its density is 67.3 m/sq.km. The average density of National roads and Provincial roads in the Study Area is 632.8 m/sq.km and maximum density is 126.3 m/sq.km in Takaev except Phnom Penh and minimum 28.4 m/sq.km in Bat Dambang.

Length of Road in the Study Area

Province	Area (sq.km)	National Road (km)	Other Ntl. Road (km)	Prov. Road (km)	Total (km)	Density (m/sq.km)
Kandal	3,669	188.987	143.464	47.083	379,534	103.4
Prey Veang	4,847	42.505	55.254	200.622	298,381	61.6
Kampong Cham	6,538	235.620	137.636	158.176	531.432	83.6

Province	Area (sq.km)	National Road (km)	Other Ntl. Road (km)	Prov. Road (km)	Total (km)	Density (m/sq.km)
Svay Rieng	4,847	69.606	37.684	332.636	439.926	90.8
Takaov	3,430	297.384	14.423	121.245	433.052	126.3
Kampong Spueu	6,756	264.765	131.381	313.996	710,142	105.1
K. Chhnang	5,278	94.259	34.963	146.813	276.035	52.3
Bat Dambang	12,501	114,043	83.943	156.496	354.482	28.4
Siem Reab	15,726	132.967	204.238	160.990	498.195	31.7
Phnom Penh	402	70.186	3.262	15.513	88.961	221.3
Total	63,814	1,510.322	846.248	1,653.570	4,010.14	62.8

Source: Ministry of Public Works and Transport--- Cambodian Road Network

Provincial capitals in the Study Area are connected with National roads from RN-1 to RN-7 and locations are convenient for transportation of goods. Most of the National roads are paved with asphalt-concrete or laterite; however they are damaged or broken in numerous sections of the road, with big and small potholes. Most of the roads were reconstructed in 1994. But at present, the average driving speed of cars is only 20 to 50 km/hour, excluding RN-4 and some portions of RN-6 & RN-7. Most of the other National roads and Provincial roads paved with laterite are often not drivable after heavy rains.

2) Transportation goods on each National Road

Depending on a traffic counting survey on the National roads carried out by ADB in 1994, volume of transportation shows that RN-4, which runs from Phnom Penh to Sihanoukville, has the highest share and RN-5 the next. Major goods transported were construction materials such as cement, steel bars, (26%); agro-products (25%); petrol (16%) and timber (10%).

(2) Railway conditions

1) Royal Railway

The Royal Railway of Cambodia belongs to the Ministry of Public Works and Transport. The railway in Cambodia with a total length of 648 km consists of the Northern line (L=385km) and the Southern line (L=263km), both originating in Phnom Penh. The Northern line has a longer history and runs to the Thai border. The Southern line leads to Sihanoukville and the international seaport. Both of them are single-tracked-railroads and operated by diesel locomotives. Railroad structures such as embankments and bridges have been damaged by civil war. They are aged and in poor condition due to lack of maintenance. Restoration programs are planned and are seeking supporting budgets.

2) Transportation volume

From 1993 to 1999, the northern line transported more goods and passengers than the Southern line, as shown in table below. Transportation volume of goods is gradually increasing from 1995, while the number of passengers is decreasing in the Southern line.

Railway Transportation Volume Unit: 1,000 tons; 1,000 persons

Item	1993	1994	1995	1996	1997	1998	1999	Average
Northern								
Goods	114.2	48.2	33.3	50.2	102.2	208.0	189.3	106.5
Passenger	611.0	294.0	236.2	200.2	383.2	219.5	301.9	335.1
Luggage	12.0	7.6	7.2	12.5	10,996.8	6.6	3,472.7	2,73.6
Southern								
Goods	15.6	12.6	16.5	25.8	67.1	86.4	80.3	43.5
Passenger	270.0	220.0	287.5	396.0	147.1	118.1	127.2	223.7
Luggage	1.8	4.6	5.9	5.4	4.3	1.8	0.7	3.5

Source: Royal Railway of Cambodia

(3) Waterways and Ports

Mekong River and Bassak River as well as the Tonle Sap Lake are located at the center of Cambodia, and their tributaries have been used for inland transportation for many years. Downstream of Mekong River and Bassak River is the border to Vietnam, and many goods have been traded through large and small river ports/piers. Vietnamese boats are found at some ports/piers near the border. Vietnamese small boats with a capacity of 10 to 30 tons transport paddy from small river ports to Vietnam. Checkpoints for boat transportation are established same as for land transportation.

Both Phnom Penh and Sihanoukville ports, which are the international ports, are active for the import and export of goods. Renovation works of Phnom Penh port was conducted with the assistance of the Japanese government, and Sihanoukville port renovations are underway.

3.8.3 Problems of Transportation and Traffic

(1) Road

Inland transportation of goods faces many limitations due to the poor condition of roads and bridges. The following are the main problems:

- There are many portions heavily damaged and with potholes despite of paved roads.
- This slows the speed of vehicles and makes road transport ineffective during the rains. It cuts down the number of vehicles using road transport.
- More losses in quantity and quality of rice through damaged roads,
- Higher traffic accidents, damages and maintenance costs,
- Ignorance of traffic rules, signals, illegal turning and parking cause traffic jams and blockages,
- Over load truck and non-licensed vehicles are using roads,
- Therefore, they cause heavier road damage and result in higher transportation fees.

Most unpaved provincial roads are damaged easily by the flood rains. Provincial road density is only

19.6 m/sq.km in average, and restricts resident to act effectively as well as to obtain the necessary information.

Village / farm road are very poor in quantity and quality. Farm roads are not found in the paddy fields, even in irrigated areas. Paddy transportation is conducted manually or by bullock carts from field to field. There are many restrictive factors, such as lack of labor, long distances for transporting, and inadequate access to paddy fields. Recently, there have been requests for the construction and rehabilitation of farm roads, due to the increase of farm machines, such as small tractors and harvesters. Proper farm roads contribute to better transportation of paddy and assist farmers to increase rice production and better their standard of living.

(2) Railway

Railway problems are longer transportation time and un-punctual time schedules. This is caused by poor maintenance of old railway facilities, railway lines, bridges, wagons, locomotives, etc., which lower train speeds. Trains are operated only twice a day for both lines and the number of wagons and coaches are few.

(3) Waterways and Ports

Regulations and monitoring for the waterways and ports used by many small vessels and ships over the years, have not been conducted regularly. Illegal vessels and ships pass through keeping away from the checkpoints. Although the Cambodian government sets regulations for licensing and registering, illegal vessels and ships belonging to domestic as well as foreign owners sail around conducting paddy trade at the border of Vietnam.

3.8.4 Direction of Development of the Transportation Network

(1) Road

Rehabilitation works are planned or being implemented with the assistance of ADB, World Bank and the Japanese government. ADB will take charge of National Road RN-1,5, 6 and 7 which are called Asian high way A-1, 11 and A-13 with high quality standard having a 12.5-meter road width.

Rehabilitation Programs

Route	From	To	Present	Length	Implementation	Fund
RN-1	P. Penh	Mekong River		56km	Planning	ADB
	Mekong River		Ferry		Planning	Seeking
	Mekong River	Vietnam border	Constructing	106km	Started	ADB
RN-2	Takaev	Vietnam border	Constructing	53km	Constructing	Local
RN-3	Kampot	RN-4		21.5km	This year	W. Bank

Route	From	To	Present	Length	Implementation	Fund
RN-5	P. Penh	Pousat		229km	Planning	ADB
	Pousat	Sisophon		105km	This year	ADB
RN-6	Skun	Kapong Thom		48km	This year	ADB
	Kapong Thom	Province border		70km	This year	ADB
	Province border	Roluos			This year	W. Bank
	Roluos	Siam Reap		17.5km	This year	Japan
	Siam Reap	Air port			This year	W. Bank
	Siam Reap	Sisophon			Planning	Seeking
RN-7	Mekong River Bridge		Ferry		Constructing	Japan
	K. Cham	RN-11			Planning	Japan
	RN-11	Krache			Planning	ADB
	Krache	Vien Kham			Planning	Seeking
RN-11	RN-1	RN-7		70km	Planning	Seeking

Source: Planning and Statistics; Ministry of Public Works and Transport

(2) Railway

Royal Railway of Cambodia has plans of rehabilitation of the Southern line, Northern line, rolling stock, track maintenance & equipment, signaling & communication and building stations. Considering the effectiveness of railway transportation for large volume handling at low cost, railway transportation would be more important in the future, as economic activities become more aggressive. If the current railroad could be connected to the Thai railway, this railroad would contribute to the economy of many Asian countries

(3) Waterways and Ports

Rehabilitation of Sihanoukville international seaport, where transportation volumes would increase in the near future, is on going, with assistance of the Japanese government. Other rehabilitation plans for inland waterways are not planned. As the volume of vessels and ships in inland waterways are comparatively small, the rehabilitation of waterways and ports is not so urgent. However, it is proposed the strengthening of controls and operation of existing ports, the setting-up of inland waterway regulations, strengthening of vessel & ship registrations, and the improvement of operations technology.

3.9 Policy and Support System for Rice Marketing

Government measures and support system described above in each field are summarized as follows:

(1) The basis of Economic Policy

Cambodia is furthering economic development under free market economy as national policy. Therefore, food policy concerning rice is also being promoted under market mechanism based on the market economy policy of the government. Although legislation to carry out market economy is progressing, an agricultural field shows very large asymmetry from various kinds of restriction factors and the market mechanism has not come to demonstrate its functions sufficiently. Under such situation, the government is required to remove the restrictive factors against market mechanism and to practice complementary functions for market mechanism.

(2) Policy on Rice Production

Self sufficiency policy

In the National Socio-Economic Development Plan and Agricultural Development Plan, self-sufficiency of food by domestic production is given the highest priority. In response to this, agricultural production policy also places importance on food self-sufficiency. In other words, Cambodia has not taken import policy for food.

Policy on agricultural input

There is no policy of a scale that gives a direct big impact on increasing production, although there are some grant aid for irrigation and seed grant at the time of disaster. Company of Material, Equipment and Transport (COCMA) affiliated with MAFF handles fertilizer, agricultural chemicals, agricultural machines, etc. but they are generally regarded as object of privatization as a part of transition into market economy. Although multiplication and distribution of high quality seed gets high priority, a real means is not accompanying it. The CARDI under MAFF is conducting paddy seed multiplication and distribution under assistance from Australia but its quantity is rather limited. The seed multiplication policy is shifting from production increasing nature to production increase and quality improvement trend after achievement of self-sufficiency in 1995. Plural number of NGO and banks are giving loans to farmers, traders, rice millers, etc. Generally, banking facilities are available. Although general conditions for loan (specially interest rate) are severe due to low agricultural productivity, there is not stable political loan specific to rice marketing. The system where the central bank evaluates NGO, as lender and approves their qualification is being introduced.

Policy on producer's price

Rice price is completely under market mechanism and there is no system of support price and

minimum guarantee price, etc. There are no insurance institutions to protect farmers from natural disaster. The market operation on the market price is under control of GTC. But actually nothing is done by them.

Policy for organizing farmers

Depending on the area, some small-scale groups are formed by NGO. The government is planning to organize farmer's groups but the MAFF is yet in the stage of drafting the agricultural cooperative act.

(3) Policy on Rice Marketing

Food management policy

After liberalization (1989) of sale of surplus agricultural produce by farmers and abolition (1992) of government procurement system, present rice marketing is left to market mechanism. The government does not have the means of concrete intervention. From the actual conditions, we can not say that the government is performing food security politically and synthetically. Recently, MOC is beginning to study the government functions in the rice marketing under market economy system. Although Cambodia abolished food control system, many countries have adopted food control system even in the market economy if demand/supply condition become tight. It is based on the idea that to some degree national control is necessary because the food is important to the management of a country.

Export/import policy

Although export of processed agricultural produce is regarded as most important policy in the development of national economy, there is no concrete measure for export promotion about rice. The quantity restriction about export/import trade has been basically abolished. Regarding the duty, export duty on milled rice is 0%, import duty is 7% and Vat 10%. However, license is necessary both for export and import. And license actually is not given for exporting paddy even if there is application but paddy is flowing out in quantity as informal border trade. The tariff reduction is expected in future according to AFTA plan but the rice is supposed to be the most sensitive item with the latest application schedule.

Border management policy

Trade treaties with the adjoining countries have been concluded and official gates are designated. But there is a historical tie among the inhabitants in both sides of the border. The border control is quite loose for informal trade. On the other hand, the long international border, the mountain border and the border transgression have been the cause of troubles on border.

Transportation policy

Although some improvement plans for roads and ports were implemented, transportation

infrastructure is in an undeveloped situation. International transportation by river is decreasing. It is said that the river transportation in Vietnamese territory is hindering. But most of the informal border trade of paddy to Vietnam is by river transportation. There is a large merit in truck transportation without transshipment through the border. But it has not been practiced due to management problem for trucks. In order to improve physical transportation of goods policy negotiation between both countries are required.

Industrial policy

Export of processed agricultural produce is most important national policy. Therefore, improvement of the processing facilities may be handled as an important part of industrial policy. As the rice milling facilities are the processing facilities for important item rice, it should be modernized based on the support policy for private facility. But there is no industrial policy for improving rice milling facilities. There should be many policies such as inviting foreign capital factories, giving loans for improvement of facility, electrification, introduction of technical know-how, etc. that can be considered.

(4) Food Security Policy

Basic policy

How to interpret the food security is not necessarily fixed in the situation that each country is placed. The food security policy of Cambodia is premised on the self-sufficiency of a country as a whole. Production policy (previously stated) for self-sufficiency, export and import policy (previously stated), reserve policy and further social welfare policy (safety net) for distribution are related. Specially the food security for the weak, poor group of people and disaster stricken people exists as a problem of distribution. Although, the food security is regarded as important in the Socio-economic Development Plan, there are few concrete policies to achieve it.

Reserve policy

Although the food reserve policy is the foundation of food security, except for urgent rice reserve by ASEAN, there is no measure accompanied by the clear numerical target as a national reserve by the Cambodian government.

Social welfare policy

The food distribution measures against poverty and support measures against calamity sufferers correspond to this item. Although measures for the poverty are carried out in various forms, poverty measure by rice itself is the "Food for Work" by WFP. As for the calamity sufferers, Council of Ministers, serving as a responsible organization, is distributing the rice given by donors.

(5) Commerce and Financial Policy

Commercial policy

Since market economy is undeveloped, necessary policy and system have not been established. There are many tasks to tackle with such as means of settlement of accounts, bank remittance, management of foreign exchange, warehouse business, etc.

Financial policy

In Cambodia, where capital accumulation is not developed, needs for capital is large. Although liberalization of banking system progressed and the banks are open to public, some banks who have not reached to the standard set by the government policy were made to close recently. NGO is bearing the end of the systematic giving of loans. Interest rate is at severe level for borrowers in the fields of agriculture, processing and marketing of agricultural produce. It serves as restricting factor for borrowing by too many people. It is desirable to work out the means of introduction of low interest loan system for specific purposes i.g. for modernizing rice milling facilities, for procuring paddy, etc. Repayment for the loans (cash, fertilizer, agricultural chemicals, etc.) given to farmers by middlemen and rice millers are made by crops (paddy). Therefore, slumps of paddy price cause stagnation of repayments.

(6) Policy on Quality Standard System

The quality standard is important not only for quality improvement and safety but also as a means of modern business transactions. In June-2000 “Law on the Management of Quality and Safety of Products and Services” was enacted as sub-decree but the quality standard as a measure is not enacted yet. Although Camcontrol under MOC is charged to conduct inspection of rice, there is no need of inspection in the ordinary transactions and therefore they have little opportunity to conduct inspection. For regular export/import of rice and rice domestically procured by WFP, Camcontrol carries out inspections. The improvement of inspection techniques and reliability are needed.

The safety of the food will attract the attention of consumers more and more hereafter and it is necessary to introduce safety standard of food (CODEX) and inspection system as maintenance of food sanitation law.