A proposal on the assessment of rice post-harvest losses [On-line]

Tantawi Badawi A.

in

Chataigner J. (ed.).
The new development in rice agronomy and its effects on yield and quality in Mediterranean areas

Montpellier : CIHEAM
Cahiers Options Méditerranéennes; n. 58

2001
pages Available

A proposal on the assessment of rice post-harvest losses

A. Tantani Badawi
Agricultural Resources Center (Egypt)

Introduction

Traditionally, rice has been the staple food and main source of income for million of people, and it will continue to be a main stay of life for future generations. In many countries, essential development efforts are concentrated on rice to meet domestic need for food. In the developing countries including Egypt, rice is an important item of exportation.

Post harvest losses present one of the main problems not only in rice but also in all grain production. Losses in food crops, occurring during harvesting, threshing, drying, storage, transportation…etc have been estimated to be between 30 and 40% of all food crops in developing countries. If post harvest losses are reduced, the world supply can be increased by 30-40 % without cultivating additional hectares of land or increasing any additional expenditure on seed, fertilizer, irrigation and plant protection measure to grow the crop. Backhop (1980) stated that post-production losses and deterioration of food quality have areas of major concern in many developing countries of the world.

Harries and Linblad (1976), defined losses as any change in the ability, edibility, wholesomeness or quality of food that prevents it from being consumed by people. Food losses may be direct or indirect. The direct loss is the disappearance of food by spillage, or consumption by insects, rodents and birds. The indirect loss is the lowering of quality to the point where people refuse to eat it. They also identified three periods of time, preharvest, harvest and post harvest, during which food may be lost and stated that each period has its own characteristic problems and means of overcoming these problems. Preharvest losses are those, which occur before the process of harvesting begins, for example, losses in a growing crop due to insects, weeds and rusts. Harvest losses occur between the onset and completation of the process of harvesting, for example, losses due to shattering during harvesting of grain. Post-harvest losses occur between the completion of harvest and the moment of human consumption. The reduction of grain losses, especially those caused by insects, microorganisms, rodents and birds can increase the available food provisions.

Egypt was considered one of the most important rice exporting countries until the late seventies. The exported amount decreased gradually to be 300.000 ton in 1999 due to many factors i.e. population increasement ,increasement of rice consumption and finally the large post harvest losses. The first causes of the two factors are difficult to be controlled; however identifying losses during the different post-harvest processing stages could control these losses.

In Egypt, many investigators determined the post harvest yield losses of rice.

Sabbah et al, (1979) estimated that, saving 50 % of the food losses in Egypt is equivalent to adding one million Fadden to the cultivated land. He also stated that yield loses of rice in Egypt may reach a level of 40% of the total yield in some production systems.

Abd-El-Bary et al, (1981) declared that, the total losses, during harvesting, transportation and threshing varied between 0.318 ton/fed. and 1.24 ton/fed. With an average loss of 0.687 ton/ fed. In terms of percentage, the average loss varied between 14.35% in El-Gharbyia Governorate and 33.08 in Alexandria Governorate. The average loss on the national base was 25.3%.

Abd El-Motaleb (1982) showed that, the pre-harvest losses were affected by the grain moisture content, weather conditions and maturity of the crop. The losses were 0.6% and 3.2% of the total yield on the 7th & 29th days of October respectively.

Published results by FAO (1982) about on farm rice production losses from three years of work in Kafr El Sheikh and Dakahlia governorates, indicated that, the camel shattering losses about 0.9 % and cart shattering losses was about 4.35% for a distance of 1 and 2 km respectively.

Ramos (1982) found that threshing by using tractors (treading) caused 3.6% losses, besides it increased the presence of mud-balls and the broken percentage of the milled rice.

El- Hissewy (1999) concluded that during harvest and post harvest operations, the largest amount of losses was determined as large as 28.52 % when manual harvesting + threshing by tractor (Treading) + transferring by men + traditional mills, were used. In general, the harvest and post harvest losses were ranged between 8.16 % and 28.52% and differs according to the methods used during this step. However, most of these losses were due to the use of the traditional mills.

Apparently, there is no complete information of the post-harvest losses in rice in Egypt. However it is very essential to determing the yield losses of rice at different stages to minimize losses. Keeping in view the lack of information about this important subject, the purpose of the presented research project could be summarised as follow:

I – Objectives

The determination of post harvest losses during different stages:

1- the determination of the post harvest yield losses during field operations, i.e.; harvesting, drying, transportation, threshing and winnowing, and find out the solution for reducing these losses.

2- the assessment of storage losses and ways of grain protection during storage.

3- the determination of losses during processing stage in both small and large-scale rice mills.

4- the determination of the effect of post harvest processing including storage on rice grain quality and suggesting the suitable methods to minimize losses.

5- Extension, publication and dissemination the obtained results through opening seminars, symposium.... etc for local and worldwide study and trainee to improve the ability of rice processing workers.

II – Materials and methods

The two main points of losses determination are:

1- Quantity losses
2- Quality losses.

Quantity losses:

Should be determined through out techniques based on a weight of measured volume of rice per unit area compared to a pre-loss standardized weight.

Quality losses:

Should be determined by the separation of damaged kernels and through the different stages starting from harvesting passing by the different operation, in farm, collecting centres, sorting, transportation and ending with rice milling. The quality losses percentage will be measured based on weight of raw rice.

1. Quantity losses

A. Harvesting (Traditional)

a] Pre-harvest losses

1. Carefully cut the paddy in all border lanes between selected plots.
2. Carefully pick up all grains on the ground with in the sample plot. Care must be exercised not to lodge the crop.
3. Place the recovered grains in the cloth bag and properly label the bag. Repeat the same procedure as in the other plots.
4. Clean the grain thoroughly.
5. Weight the clean grains and record it.
6. Take moisture contents reading and record it.

b] Post-harvest losses

1. Lay out the canvas on the cleared boarder. Make sure the canvas in securely fastened to the ground.
2. Harvest normally the paddy with in the plot.
3. Lay down the harvested crop in the canvas sheet.
4. Collect carefully and thoroughly all the grains on the ground as a result of shaking during harvesting.
5. Clean the collected grains.
6. Weight the clean grains and record it.
7. Take moisture reading and record it.
8. Repeat the same procedure as in the other plots.

c] In-field staking losses

1. Leave the harvested paddy in the field as the normal practice of the farmer.
2. Allow the farmer to remove the harvested paddy on the canvas for threshing and place it in other canvas.
3. Collect all the grains remaining in the sheet.
4. Place the grains in a cloth bag.
5. Clean the paddy
6. Weight the clean grains and record it.
7. Take moisture reading and record it.

d] Transport losses

1. Take the initial weight of the grains and the straw before transporting to the threshing floor. Record it.
2. Take moisture content of the straw and the grains record it.
3. Allow the farmers to transport the materials to the area for threshing. The normal manner and method of transport must be made.
4. after reaching the threshing floor, take immediately the weigh of the grain and the straw and record it.
5. Take the moisture reading of straw and grain and record it.

6. The difference in weight is the amount of loss due to transport.

B. Threshing

a] Traditional methods (tractor treading)

1. Laid a piece of canvas measuring 5 x 10 m on the ground. This ground must be the same ground used by farmers for threshing paddy.
   Spread the paddy n the threshing floor and on the canvas with the same thickness and the same manner the farmers used to do it. The technician must ensure that the canvas will not move or any part of it folded.
   Any operation done on the paddy at the threshing floor must also be done on the paddy at the canvas.

2. a. Fill the tractors fuel tank to the top.
   b. Check oil level of engine. Fill it to the desired level. Use dipstick as gage.
   c. Alert the operator. The operator must be skilled and have experienced tractor threshing for at least 2 seasons.

3. The test is ready. The operator may now start running the tractor on top of the paddy, which was spread, on the canvas and on the threshing floor employing the same procedure as they use to do it. If possible count the number of passes at a certain point. No rest period is required. The operation will stop only when he feels that the operation is complete.
   The moment the tractor starts operation, simultaneously start the stopwatch. Time the operation until threshing is completed. Record the time.

b] Mechanical Threshing:

1- Pre-test the machine - check the engine for motor oil. Motor oil must be at the desire level. Refer to dip stick. Use motor oil no. Prescribed by the manual.
   Rotate the threshing drum by your hand to ensure that no hard objects left inside the threshing chamber.
   If possible, rotate also the blower and the oscillating screen and auger to ensure that they are operational. Carefully check the peg tooth of the threshing drum for loosened peg tooth. Tighten them on the threshing drum.
   Start the engine at idle speed. Slowly increase RPM to reach the required speed. Refer to engine catalogue for operation speed rating. When the engine has attained its operating speed, slowly engage the threshing drum first and then engage likewise one at a time the blower, oscillating screen, and the auger if they are independently driven. Operate for one to two minutes. Stop the machine and counter check for parts that loosen as a result of operation.

2- Fill the fuel tank to the top. Check motor oil again. Do not operate the machine after the final check has been made.

3- Check belt and pulleys. The belts must be tight enough not to have excessive slippage. Very tight belt on the other hand will reduce belt life or you will damage the bearing of the rotating shaft. How to check correct belt tension? Simply push the slack side of the belt at the centre between two pulleys. The belt deflection must be about one inch from the original position of the belt. Most threshers are provided with belt tensioners especially at the threshing drum. Adjust this to obtain correct belt tension.

Check pulley alignments. It must be secured with setscrew, keyway and key stacks. Align the pulley by simply loosening the setscrew and sliding it to the desired alignment. Belt alignments become very necessary to ensure longer belt life and for belt not to trip-off.

4- Spread the canvas. The canvas must be wide enough to accommodate the whole threshing unit, big stack of paddy and space for bagging. The canvas should measure about 5 x 5 meters in size.

5- Station the machine on the top of the canvas. Make sure the machine is level. If the thresher is not properly levelled grain flow will concentrate on one side of the oscillating screen. Likewise the axial movement of the material in the threshing drum will be affected.
Position the thresher so that the straw is thrown with the direction of the wind. This will eliminate the blowback towards the operator and threshed grain.

6- Place the separate canvas on the blower and oscillating tray outlet. The canvas should measure about 3 x 3 meters. This is collecting all the grains and chaff carried by the blower and falling off the oscillating tray. Extra care must be exercised not to spill any filled grain out of the canvas.

7- Place another canvas on the straw thrower outlet. The canvas must be wide enough to collect all materials coming out of the straw thrower. Usually all heavy and large materials come out of the straw thrower. Sometimes there are filled grains coming out with the straw. The canvas should be wide enough to accommodate large volume of straw. It should at least measure 5 x 10 m. in size.

C. Winnowing

Winnowing is one of the post harvest operations that incur high amount of loss. Test in the Philippines have been that winnowing incur a loss of about 4%. These losses were attributed to improper handling and inefficient machine.

D. Test procedure

1- Spread 2 canvasses on the floor, one of the winnowing unit and the other for the chaff outlet. The canvas must be wide enough to accommodate the threshing unit and chaffs.

2- Position now the unit on the canvas. Always place the winnower so that the straw and chaffs are blown in the direction of the wind, otherwise you will blow back the impurities to the operator and to the cleaned grain.

3- Take samples of about 3 kg from the paddy to be cleaned. Thoroughly mix the paddy before collecting sample. Use cloth bag for the sample.

4- Weigh all the materials for cleaning. The amount of test material should be at least one ton.

5- Pre-test the machine. Rotate the fan until the desired speed is attained. Determine the speed by using the Tachometer. After the desired speed is attained take air-velocity reading by using the velometer. Take reading at 3 different points in the outlet. Two at the extreme sides and one at the centre.

6- Start feeding the winnower. Simultaneously start the stopwatch to the time of feeding until one ton of input materials have been cleaned. Stop the time after one ton is completed.

2. Quality losses

1. Determination of the effect of harvesting methods on quality characters.
    a) Manual harvesting
    b) Mechanical harvesting

2. Determination of the effect of threshing methods on quality characters.
    a) Traditional method
    b) Mechanical method

3. Determination of the effect of winnowing methods on quality characters.

4. Determination of the effect of storage conditions on quality characters
    a) Storage bags
    b) Storage period
    c) Moisture content upon storage

5. Determination of the effect of processing methods on quality characters.
    a) Traditional mills
    b) Small scale mills
    c) Large scale mills

A. The studied characters

1. Yield losses

2. Grain quality
    a) Milling characters according to Khush et al (1979)
        - Hulling %
        - Milling %
        - Head rice %
        - Yellow grains %

    b) Cooking & eating quality %
        - Kernel elongation according to Azeez and Shafi (1966)
        - Gel consistency according to Cagampang et al (1973)
        -Amylose content according to Juliano (1971)
        -Gelatinization temperature according to Little et al (1958)

B. Statistical analysis

According to Gomez and Gomez (1983)

3. Materials requirements and test equipment

A. Grain Testing Equipment

	Units
Data Acquisition system	1
Tachometer	2
Stopwatches	4
Moisture meter & tensiometer	4
Balance	
3-50 kg platform type	2
3-10 kg 1 gram. Sensitivity	2
Canvas	
5m x 10m	5
3m x 3m	5
Nylon fish net 3m x 3m	5
Cloth bags	
No.12	5 000
Plastic bags No.12	10 000
Jute bags	10 000
Paper bags	10 000
Masking type 2 "	10
Markers	10
Data sheets	20
Tin Can - 20 lit cap.	5
Winnowing pan.	4
Meter scale	1
Psychometric	1
Vacuum	1
Calculators	5
Dust mask	10
Laboratory Rice Husker	1
Laboratory rice whitening machine	1
Laboratory rice cleaner	1
Rice inspection device	1

B. Training

- Short-term training course at IRRI in grain quality laboratory.
  - Subject: Grain quality determination
  - No. of trainees: 2-3 rice quality specialists
  - Period of training: 2-3 weeks

- Short-term training course at Rice Technology Training Center (RTTC)
  - Subject: Collecting samples and Data
  - No. of trainees: 12 - 18 extension specialists from 6 rice governorates
  - Period of training: 2-3 weeks

C. Facilities For Transportation and Communication Systems Needed for Field Surveys and Applied Research Work.

D. **Duration**: two growing seasons

E. **Location:** Rice Technology Training Centre, (RTTC)
Field Crops Research Institute

Agricultural Research Center

F. Cost Estimates: Approximate $ 0.5 million

G. Area That Will Benefit From The Project

- Egypt
- Mediterranean countries
- African countries

References

- **Abd El-Bary, A.A; A.E. Aly and A.H. El-Asdoudi** (1981). A National Survey of Rice Harvest Losses. Rice Technology Training Center, Alex. Egypt.
- **Abd El-Motaleb, I.A.** (1982). A Study On The Optimum for Harvesting Rice and Wheat Crops by Small Harvesters. M. Sc. Agrioc. Mech.; Fac. Agric. Univ. Tanta.
- **Azeez, M.A. and Shafi, M.** (1966). Quality of Rice Dept. of Agriculture Bulleting, Pakistan 50 pp.
- **Backhop, C.W.** (1980). Rice Post Harvest Losses in Developing Countries, U.S.D.A. Agric. Review and Measuals. ARM-W-12 April 1980.
- **Cagampang, B.G., Perez, C.M. and Joliano, B.O.** (1973). A Gel Consistency Test for Eating Quality of Rice .J. Sci. Fd. Agric. 24:1589-1594.
- **El Hissewy, A.A.** (1999). A Study on the Yield Losses of Rice Due To the Use of Tradional Rice Mills And Their Effect on the National Rice Production in Egypt. Agricultural Research Center & Academy of Science & Technology (in press).
- **El-Nwasani,H.H.** (1975). Engineering Studies On Determining Harvesting On Threshing Losses For Rice Crop. M.Sc. Agric. Mech. Agric. Univ. Mansoura.
- **Gomez, S.S. and A.A. Gomez** (1983). Statistical Procedure for Agricultural Research. IRRI Philippines 2nd ed. pp. 680.
- **Harries,K.L. and C.J. Lindbled** (1976). Post Harvest Grain Loss. Assesment Methods UK. pp.129
- **Juliano, B.O.** (1971). A Simplified Assay for Milled Rice Amylose. Cereal Sci. Today 16:334-338.
- **Khush,G.S.; C.M. Perez and N.Del Cruz.** (1979). Breeding for Grain Quality in Rice. Chamical Aspects of Rice Grain Quality. IRRI.Los Banos, Laguna,Philippines.
- **Little,R.R.; Hilder,G.B.; and E.H. Dawson**. (1958). Differential Effect of Dilute Alkali on 25 Varieties of Milled Rice. Cereal Chem. 35:111-126.
- **Ramos, B.M.** (1982). An Assessment Of Rice Post Harvest Losses in Egypt. Rice Technology Training Center, Alex. Egypt.
- **Sabbah, M.A., A.M. Matouk and H.El-Nwasani**. (1979). on-Farm Rice Production Losses in Egypt. Alex. J. of Agricultural Research, Vol 29 No.3.
- **Sabbah, M.A.** (1986), Estimating Quantitative Losses of Paddy Rice in Bag-Storage in Egypt. Proceed 3rd International Rice Research Group. Rice Technology Training Center, Alex. Egypt.

TABLES

Table 1. The effect of threshing methods on some grain quality characters of rice

Method	Purity %	Broken %	Yellow grains %
Tractor	93.69	6.67	1.75
Local thresher	97.88	2.95	2.04
Combine	98.95	1.68	6.37
L.S.D 5 %	4.48	2.98	2.76

Table 2. Yield losses of rice due to different harvesting and threshing methods

Methods	Losses %
Manual harvesting & tractor Th.	2.49
Manual harvesting + local thresher	2.03
Combine harvesting	1.35
L.S.D 5 %	0.56

Table 3. The effect of storage time on rice milling characters

Time	Milling character		
	Hulling %	Milling %	Broken %
3 Months	81.31	71.42	2.89
6 Months	81.65	69.87	3.57
9 Months	79.52	68.92	4.11
12 Months	77.36	67.41	5.36
L.S.D. 0.05	2.29	3.64	3.51

Table 4. The effect of storage places on rice milling characters

Place	Milling character		
	Hulling %	Milling %	Broken %
Open store	76.96	67.24	6.66
Under shed	78.72	67.36	5.34
Well airated store	77.36	67.41	5.36
L.S.D. 0.05	N.S.	N.S.	5.79

Table 5. The effect of moisture content on rice milling characters

Moisture content	Milling character		
	Hulling %	Milling %	Broken %
14 %	77.36	67.41	5.36
16 %	77.02	66.98	6.29
18 %	76.58	65.36	8.18
20 %	74.13	64.17	9.25
L.S.D 5 %	2.12	1.84	7.25

Table 6. The interaction between moisture content and storage time on rice milling characters

Moisture Content (A)	Storage time (B)	Milling Character		
		Hulling %	Milling %	Broken %
14 %	3 months	80.15	71.56	1.65
	6 months	79.67	70.82	2.72
	9 months	79.12	69.47	4.93
	12 months	77.36	67.41	5.36
mean		**79.02**	**69.82**	**3.67**
16 %	3 months	80.46	71.13	2.74
	6 months	78.95	70.41	2.82
	9 months	78.17	69.07	4.72
	12 months	77.02	66.98	6.29
mean		**78.65**	**69.40**	**6.39**
18 %	3 months	78.23	69.47	4.99
	6 months	76.12	68.34	6.83
	9 months	75.31	65.94	8.73
	12 months	76.58	65.36	8.18
mean		**75.98**	**67.15**	**6.85**
20 %	3 months	77.15	66.52	6.35
	6 months	74.81	65.44	7.12
	9 months	74.16	64.87	8.46
	12 months	74.13	64.17	9.27
mean		**75.02**	**64.74**	**7.8**
(A) LSD 5 %		3.62	2.16	1.94
(B) LSD 5 %		2.47	1.95	0.77
AxB LSD 5 %		2.08	1.11	0.44

Table 7. The interaction between storage places and moisture content on rice milling characters

Places (A)	Moisture Content (B)	Milling Character		
		Hulling %	Milling %	Broken %
Open store	14 %	77.61	66.64	6.32
	16 %	77.94	66.35	6.92
	18 %	76.66	64.29	7.23
	20 %	75.18	62.09	10.51
mean		**76.86**	**64.87**	**7.65**
Under shed	14 %	78.82	66.27	6.84
	16 %	77.34	75.84	6.18
	18 %	76.66	64.29	7.23
	20 %	75.18	63.29	9.83
mean		**77.00**	**64.92**	**7.52**
Airated store	14 %	77.36	67.41	5.36
	16 %	77.02	66.98	6.29
	18 %	76.58	65.36	8.18
	20 %	74.13	64.17	9.25
mean		**76.02**	**65.98**	**7.27**
L.S.D. 5% (A)		N.S.	N.S.	N.S.
LSD 5 % (B)		2.64	3.08	3.41
LSD 5 % AxB		1.33	1.54	1.02