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6.1 PRELIMINARY ESTIMATION OF THE ECONOMIC LOSSES DUE TO THE HARD-TO-COOK DEFECT UNDER EXISTING STORAGE CONDITIONS PRACTICED BY SMALL PRODUCERS IN GUATEMALA

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PRELIMINARY ESTIMATION OF THE ECONOMIC LOSSES DUE TO THE HARD-TO-COOK DEFECT UNDER THE EXISTING STORAGE CONDITIONS PRACTICED BY THE SMALL PRODUCERS OF GUATEMALA

Previous data (Table 1) on the bean losses at the small farmer level in three regions of Guatemala (El Peten, Jutiapa and Chimaltenango) showed figures which varied from 6.9 to 31.1% (expressed as percentage of the total beans storage). A significant increase in cooking time was also found for the same regions previously indicated. However, no attempt was made to measure the economic impact due to biodeterioration and changes in their acceptability characteristics.

These regions were choosed for the study because they are located in the most important productive bean areas of Guatemala, as indicated in Table 2. Data on estimation for the postharvest losses in Central America and specifically for Guatemala are shown in Tables 3 and 4 respectively. Estimated figures indicated an average losses of 20% of the total production calculated at the physiological maturity of the plant, which implies an important and significant losses both from the economic as well as from the food security point of view.

Postharvest handling of beans in Guatemala is relatively simple, as shown in Figure 1, and was the base for this study. After been harvested, tne plant or the pods are sun dried; afterward they are placed over a burlap sack matting, and then beaten with a wooden pole, to separate the grain from the plant or the pod. In some cases the grain is further dried by using solar energy. After that, part of the grain is sold, immediately after harvest and part is stored either for consumption or to be sold later through the commercialization channels which generally in the case of the small producers, is the intermediary.

Therefore, in this respect it seems that mainly two aspects should be considered: one related to the steps that goes from harvest to storing, and another concerning with the storage conditions.

The study carried out under this specific objective was an attempt to develop a methodology which can estimate the economic impact of the bean hardening during storage under the conditions used by the small prooucers.

MATERIALS AND METHODS

The present study is now underway in two bean producing areas of Guatemala, namely El Peten and Jutiapa, that have different environmental conditions as shown in Table 5. In this report only data from El Peten will be presented. In this particular region, five case studies were undertaken with five small producers, which also store beans for their own consumption; additional characteristics of the farmers participating in the study are shown in Table 6.

The experimental design used was based on the postharvest system, used by the small farmer in Guatemala which was earlier described; it was considered that as far as the postharvest practices is concerned, the reduction in the moisture content of the grain, was one of the most important problems that contribute to the hardening phenomena during storage. Not only it is important to reduce but also to keep the low moisture content of the grain during storage. Therefore two basic aspects received attention: one related to a system to reduce water content of the grain by the use of a solar energy dryer, and another the selection of different types of containers during storage; both interventions were evaluated from the curative and the economic point of view.

For the study 135 lbs. of beans were bought from each one of the farmers, in order to guarantee the amount of material needed for the study. This amount was divided in five portions: one portion was stored by the traditional system used by the farmer, and the four remaining were dried in a solar dryer to around 12% moisture content of the grain, and then packed by using: a) metalic containers; b) vegetable-fiber sacks; c) paper bags; d) plastic bags and stored under the conditions used by the small producers. Initial samples were taken from each one of the farmers participating in the study and then monthly during the 6 months storage period. The following analysis were undertaken: moisture content of the grain, volumetric weight, germination index, biodeterioration by insects and fungi, cooking time, hardness of the grain and a preliminary estimation of the ecónomic losses due to the hardening phenomenon.

RESULTS

Data on the moisture content and percentage of germination of the samples analyzed are shown in Table 7 and 8 respectively. As it can be seen, samples that were dried to a 12% moisture content showed a tendency to increase their water content, while the opposite was observed for the sample with a 20% initial moisture content, due to the high relative humidity of the environment. It seems that at the relative humidity prevailing in this region moisture equilibrium of the beans is between 16 to 18% at the 6 month storage period. The data also indicates that no effect was observed on the type of package or container in the moisture content of the grain. Values for the percentage of germination showed that the higher

reduction occured in the traditional system of storage (66%) as compared with the samples stored in the paper bags (79%). Loss of the germination capacity is a serious problem for the small producers because they generally rely in the stored seeds for their next planting.

Percentage losses due to biodeterioration are shown in Table 9. Values varied from 1.65% in the beans packed in vegetable-fiber sacks to 9.25% in those samples stored in the metalic containers. In the latter case the high value is due to an abnormal insect infestation in the sample of one of the farmers which participated in the study.

Table 10 shows changes in the cooking time of beans stored in the different containers at the farm level; initial samples showed a cooking time (time necessary to reach a force value of 500 newtons) of 121 minutes. Although differences in the cooking time were not significant among the treatments after six months of storage, beans kept in the metalic containers gave a lower value as compared with other packages used.

On the other hand the traditional system resulted in a significant increase in the cooking time (138 minutes) as compared with the initial sample. From the data obtained it seems that the most important effect in reducing the hardening phenomena in the samples stored in different containers was more related to the initial drying procedure applied, than to the containers itself. This is supported by the fact that beans stored with the traditional system used by the farmers was not previously dried.

EVALUATION OF THE ECONOMIC LOSS DUE TO THE HARDENING PHENOMENA

As it was previously indicated, the technology used to reduce bean losses during storage, consisted in two main interventions: one related to the use of different containers and a pre-heat treatment to decrease the initial moisture content of the grain. If this technology is going to be adopted by the small farmers it is necessary to demonstrate their benefits and advantages. Two approachs were used to demonstrate the economics behind this technology. One related to the bean producer and another to the consumer. Previous survey in the rural area of Guatemala indicated that small producers sell their crop immediately after harvest because they do not have adequate storage facilities. On the other hand, it is a well known fact that the price of bean increases after the harvest season as it can be observed in Table 11 which represents a ten year record. If the small farmer can store their crop for a longer time in good conditions, he will be able to have at least part of the profit which is now being earned by the intermediary. Price can increase up to 2.85 quetzales for each 46 kg of beans in July as shown in Table 11. Therefore, this economic benefit justify the use by the small producers of an adequate technology to prevent bean loss during storage.

As far as the consumer is concerned that most obvious problem is the increased energy consumption to soften the grain during cooking. As it was shown in Table 10, initial cooking time of beans dried to a 12% moisture content was 121 minutes, and after 6 months period of storage, the following cooking time values (in minutes) were obtained: 133 for the vegetable

fiber sacks and paper bags,-127 for the metal containers and 144 for the polipropilene bags. Beans stored with the traditional system gave the highest value of 259 minutes. Estimated economic losses due to the increased cooking time is shown in Table 12; these figures were obtained from the energy cost of cooking 500 g of beans stored by the small farmers for six months in the different containers. Energy cost was calculated on the basis of the energy needed during cooking to bring the grains to a hardness value of 500 newtons as measured by the OTMS as shown in Figure 2.

As it can be observed (Table 10) energy cost figures for cook the beans stored with the recommended technology varies from 0.20 to 0.23 cents of quetzal, whereas for the bean sample stored with the traditional method the energy cost was 0.41 cents of quetzal*.

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* Quetzal is the currency of Guatemala. 1 US dollar= 2.50 quetzales.

TABLE 1

TOTAL LOSSES * OF BEAN DURING STORAGE IN THREE REGIONS OF GUATEMALA

	EL PETEN	JUTIAPA		CHIMALTENANGO	
		FIRST **	SEC.**	FIRST **	SEC.**
LOSSES OF GERMINATION (%)	100.0	66.9	71.6	15.9	13.0
LOSSES DUE TO INSECTS (%)	24.9	4.8	2.5	14.4	10.1
LOSSES DUE TO FUNGY	6.2	2.6	4.4	1.9	2.2
TOTAL LOSSES DUE TO INSECTS AND FUNGY	31.1	7.4	6.9	16.3	12.3

* EXPRESSED AS PERCENTAGE OF TOTAL BEANS STORED (EXPRESSED IN WEIGHT BASIS). AVERAGE AMOUNT OF BEANS STORED BY EACH FARMER: 620 POUNDS.

** FIRST = FIRST CROP AND SEC. = SECOND CROP

SOURCE: INCAP

TABLE 2

BEAN PRODUCTION IN GUATEMALA

DEPARTMENT	1984 (M.T.)	%	1985 (M.T.)	%	1986 (M.T.)	%
PETEN	11069	10.1	12906	11.1	13316	10.9
ALTA VERAPAZ	11506	10.5	6529	5.6	10828	8.9
JUTIAPA	14755	13.4	17125	14.7	18654	15.3
CHIQUIMULA	10842	9.8	10808	9.3	10823	8.9
JALAPA	9384	8.5	10179	8.7	5769	4.7
CHIMALTENANGO	6333	5.7	6247	5.3	7195	5.9
REST OF COUNTRY	46037	41.9	52368	45.1	55324	45.3
TOTAL	109926	100.0	116162	100.0	121909	100.0

SOURCE: INSTITUTO DE COMERCIALIZACION AGRICOLA, INDECA

TABLE 3

POST-HARVEST BEAN LOSSES IN CENTRAL AMERICA
(METRIC TONS X 1000)

YEAR	PRODUCTION TO PHYSIOLOGICAL MATURITY	REGISTERED PRODUCTION	AVERAGE LOSSES (20%)	VALUE IN CA $ GUATEMALAN PRICES AT 1982 (X 1000)
1978	208.9	167.1	41.8	29427
1979	254.9	203.9	51.1	35904
1980	269.6	215.7	53.9	37945
1981	299.4	239.5	59.9	42169
		T O T A L		145446

SOURCE: SIECA AND UNIDAD POSTCOSECHA DIGESA

TABLE 4

POST-HARVEST BEAN LOSSES IN GUATEMALA
(METRIC TONES X 1000)

YEAR	PRODUCTION TO PHYSIOLOGICAL MATURITY	REGISTERED PRODUCTION	AVERAGE LOSSES (20%)	VALUE IN CA $ GUATEMALAN PRICES AT 1982 (X 1000)
1977	43.9	35.1	8.8	4623
1978	99.5	79.6	19.9	10454
1979	105.7	84.6	21.1	11085
1980	71.5	57.2	14.3	7512
1981	114.7	91.8	22.9	12030
1982	125.6	100.5	25.1	13186
1983	110.4	88.3	22.1	11610
1984	113.9	91.9	22.8	11978
			T O T A L	82481

SOURCE: SIECA AND UNIDAD POSTCOSECHA DIGESA.

FIGURE 1

POST-HARVEST HANDLING SYSTEM EVALUATED

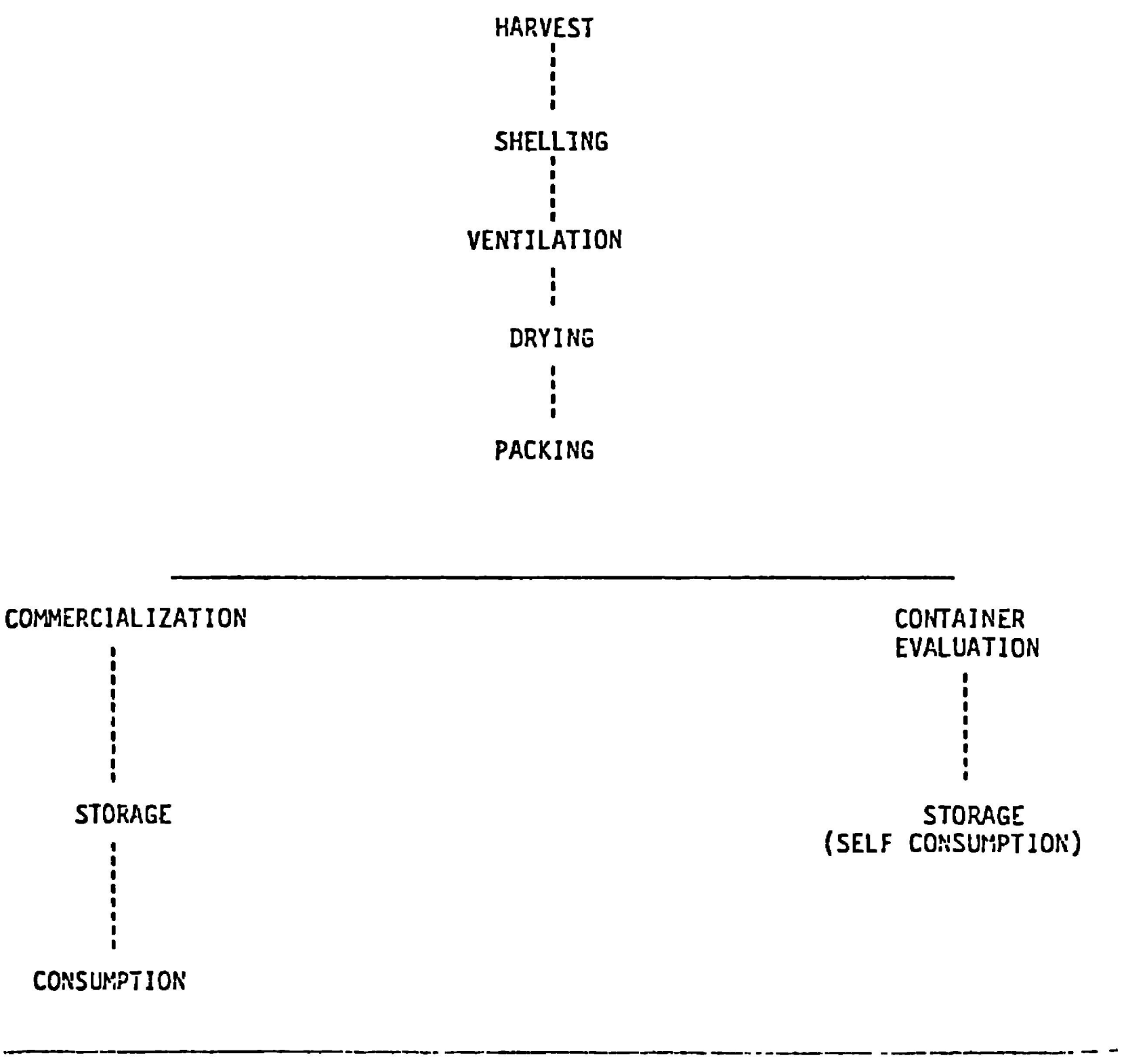

TABLE 5

ENVIRONMENTAL CONDITIONS IN BEAN PRODUCTION REGIONS OF GUATEMALA
AVERAGE YEARS 1980 TO 1986

	PETEN	JUTIAPA	CHIMALTENANGO
TEMPERATURE (°C)	24.3	27.1	17.1
RAINFALL (mm)	1688	1254	1055
RELATIVE HUMIDITY (%)	82	70	79
INSOLATION (hours)	2139	2763	-------

SOURCE: INHSIVUME, GUATEMALA

TABLE 6

DESCRIPTION OF FARMERS PARTICIPANTING IN THE PROJECT
PETEN, GUATEMALA

BEAN EXTENSION, PLANTED (Has)	AVER.: 13.1 RANGE: 1.4 - 28
PLANTING DATE	DECEMBER 10-20
KIND OF BEAN PLANTED	LOCAL VARIETIES
BEAN COLOR	BLACK
HARVEST DATE	MARCH 7 - APRIL 5
TOTAL YIELD, Kgs.	AVER.: 10396 RANGE: 828 - 19550
BEAN STORED, Kgs.	AVER.: 506 RANGE: 92 - 1150
BEAN SOLD, Kgs.	AVER.: 9890 RANGE: 736 - 18400

* AVERAGE VALUES OF FIVE FARMERS

TABLE 7

EFFECT OF CONTAINER ON MOISTURE CONTENT OF BEANS STORED AT FARM LEVEL, (%)

SAMPLE	VEGETAL FIBER SACK	METAL CONTAINER	PAPER BAG	POLIPRO-PILENE BAG	TRADITIONAL SYSTEM
0	12	12	12	12	20
1	13	12	13	13	17
2	14	13	14	14	16
3	15	14	16	16	16
4	17	15	17	16	17
5	17	16	18	17	18

TABLE 8

EFFECT OF CONTAINER ON GERMINATION OF BEANS STORED AT FARM LEVEL, (%)

SAMPLE	VEGETAL FIBER	METAL	PAPER	POLIPRO-PILENE	TRADITIONAL SYSTEM
0	95	95	95	95	92
1	95	95	93	95	92
2	95	95	87	95	83
3	95	95	87	90	83
4	83	74	79	88	81
5	73	69	79	71	66

TABLE 9

EFFECT OF CONTAINER[1] ON BIODETERIORATION OF BEANS STORED AT FARM LEVEL (% weight)

Sample (months)	Vegetal Figer	Metal	Paper	Polipro-pilene	Traditional system
0	1.38	1.38	1.38	1.38	1.61
1	1.49	1.38	1.38	1.38	1.61
2	1.65	1.38	1.52	1.23	1.81
3	1.65	1.68	1.84	2.03	2.70
4	1.65	8.40	2.53	2.76	2.88
5	1.65	9.25	4.25	8.76	2.88

TABLE 10

EFFECT OF CONTAINER ON THE COOKING TIME * OF BEANS STORED AT FARM LEVEL **

CONTAINER	COOKING TIME (Min)	DIFFERENCES IN COOKING TIME (Min)
INITIAL SAMPLE	121	--
VEGETAL FIBER	133	12
METAL	127	6
PAPER	133	12
POLIPROPILENE	144	23
TRADITIONAL SYSTEM	259	138

* BEAN COOKING TIME = TIME NECESSARY TO REACH A VALUE OF 500 NEWTONS

** PERIOD OF STORAGE = 6 MONTHS

TABLE 11

PRICES OF BEANS IN GUATEMALA

MONTH	QUETZALES/ 46 Kg.	INCREASE IN THE PRICE
MARCH (HARVEST)	20.16	--------
APRIL	19.75	-0.41
MAY	20.36	+0.20
JUNE	22.15	+1.99
JULY	23.02	+2.86
AUGUST	21.21	+1.05
SEPTEMBER	20.42	+0.26

* AVERAGE OF TEN YEARS RECORD.

TABLE -12

ESTIMATED ECONOMIC LOSSES (IN QUETZALES) DUE TO THE HARDENING PHENOMENA IN BEANS FROM PETEN

	VEGETAL FIBER	METAL	PAPER	POLIPPO_ PILENE	TRADIT. SYSTEM
INITIAL COOKING TIME, Minutes	121	121	121	121	156
COOKING TIME AFTER STORAGE	133	127	133	144	259
EXPENDITURE OF ENERGY *	0.21	0.20	0.21	0.23	0.41
COST FOR COOKING THE TOTAL BEAN PRODUCTION OF PETEN ** (Q X1000)	5667	5411	5667	6136	11036-
COST OF TECHNOLOGY (Q X 1000)	181	348	340	162	53
ESTIMATED TOTAL ECONOMIC LOSS (Q X 1000)	5241	5330	5081	4790	-----

* USING 460 GRAMS OF BEANS AFTER 6 MONTHS STORAGE

** PRODUCTION OF PETEN: 13316 M.T. .

FIGURE 2

EFFECT OF TYPE OF PACKING ON BEAN COOKING TIME