MARKETING 2

SIMON BOLIVAR FOUND

PROGRESS REPORT
POST-HARVEST LOSSES
THE CASE OF BLACKEYE

MINISTRY OF AGRICULTURE - INTER-AMERICAN INSTITUTE OF AGRICULTURAL SCIENCES

GEORGETOWN, GUYANA
FEBRUARY 1978

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TABLE OF CONTENTS

1. Introduction:

1.1 General Consideration:

Losses in food may occur any time between the actual planting of the crop and the consumption of the final product. Broadly, however, these losses may be considered under three headings, namely:-

(1) Pre-harvest Losses.

(2) Harvest Losses.

(3) Post-harvest losses.

Pre-harvest Losses - are those which occur before the process of harvesting begins. Losses at this point may occur because of a number of reason, e.g. flooding or insect infestation.

Harvest Losses - occur during harvesting and these mat be the result of inadequate labour, bad weather, poor handling or inefficient machinery.

Post-harvest Losses - occur after harvesting and may result from inadequate storage, bad transportation or faulty packaging.

Harvest losses and Post-harvest losses are sometimes grouped together under the heading "Post Production Losses".

Professor Malcom C. Bourne of the Food Science and Technology Department of Cornell University defines losses as "any change in the quantity of the food that prevents it from being consumed by people". The definition, though simple and appropriate needs amplification if areas of confusion are not develop. It should therefore, be interpreted with some degree of caution.

In a paper entitled "Reduction of Post-harvest Food Losses in the Caribbean and Central America", Post-harvest Food Losses are considered under four headings:-

Quantitative:- Loss in product weight and volume; this is the type of loss easiest to determine and evaluate.

Qualitative:- All the changes that tend to detract from the physical characteristics of the product, and, therefore, from its acceptance by the consumer, as expressed price-wise.

Nutritional:- Demonstrated in a lower nutritional value of the product (vitamins, proteins, minerals, etc).

Germination:- Refers to losses in the germinating power of the seeds. Its value is understood when we consider that the following harvest depends on this factor.

Some data complied from the "Pre Feasibility Study of the Food Crop Production/ Marketing Project" with respect to quantitative food losses in Guyana are given on Table I. The table gives an estimation of the current level of quantitative food lossed in Guyana.

It is useful to observe that the data quoted above gives only the quantitative losses and, therefore, inevitably underestimates the true value of the losses since they fail to take account of such other losses as qualitative, nutritional and germination. Further, since the losses are calculated using a farm gate prices they are again underestimated. An example may better illustrated this second point.

With reference to plantains, if 200 pounds are reaped on the farm but only 100 pound finally get to consumers, then the loss is calculated as 100 pounds times the farm gate price of 12¢ given a loss of $12.00. If, however, the 200 pounds reaped on the farm were transported to Georgetown and the 100 pounds lost during storage

TABLE I. AN EVALUATION OF THE QUANTITATIVE FOOD LOSSES IN GUYANA

COMMODITY	QUANTITY OF PRODUCE PASSING THROUGH THE MARKET SYSTEM	PERCENT AND EQUIVALENT QUANTITATIVE SPOILAGE		Farm Gate Price	Total Value of Losses G.
A. TUBER & SIMILAR PRODUCE	Million lb.	%	Million Lbs.	¢	
1. Plantains	17.1	15	2,565,000	18	461,700
2. Eddoes	4.9	15	735,000	16	117,600
3. Sweet Potatoes	.88	20	176,000	25	44,000
4. Sweet Cassava	1.4	25	350,000	8	28,000
5. Yams	5.3	10	530,000	25	132,500
6. Other Tubers	2.1	10	210,000	7	14,700
B. FRUITS					
7. Bananas	10.6	10	1,060,000	10	106,000
8. Citrus	15.2	25	3,800,000	10	380,000
9. Pineapples	5.4	30	1,620,000	12	194,400
10. Other Fruits	6.1	20	1,220,000	10	122,000
C. GREENS AND OTHER VEGETABLES					
11. Tomatoes	3.9	15	585,000	71	415,350
12. Peppers	.7	10	70,000	60	42,000
13. Cabbage	1.2	20	240.000	43	103,200
14. Vines	8.0	15	1,200,000	14	168,000
15. Other Greens	21.4	10	2,140,000	56	1,198,400
D. OTHER FIELD CROPS					
16. Blackeye Peas	.5	15	75,000	53	39,750
17. Corn	4.0	10	400,000	18	72,000
18. Peanuts	.3	15	45,000	80	36,000
19. Others	.03	15	4,500	63	2,835
E. OTHER CROPS					
20. Coconuts	56.4	2	1,128,000	21	236,880
21. Ginger	.2	5	10,000	11	1,100
TOTAL					3,916,415

SOURCE: Pre-Feasibility Study of the Food Crop Production/Marketing Project: Georgetown - June, 1977

in Georgetown then the loss is not only $12.00 but the cost of the transporting that 100 pounds from the farm to the warehouse in Georgetown. In other words, the valuation of this same 100 pound loss may be $15.00 instead of $12.00. Similarly, if a cost was incurred to store all the plantains and the loss of 100 pound occurred after storage, that is, during final distribution to consumers then the cost of storage must be added making the loss probably $20.00 instead of $15.00.

Post Harvest Losses usually occur at several points along the marketing channel. However, by adding this type of analysis of quantitative losses, the magnitude of these losses can be estimated and evaluated.

It was in fact the gravity of the problem which caused the United Nations General Assembly meeting in New York in September, 1975 to pass the following resolution:-

> "The further reduction of Post Harvest Food Losses in developing countries should be undertaken as a matter of priority, with a view to reaching at least a 50% reduction by 1985".

There is little doubt that the achievement of this noble objective can have significant impact on the economics of developing countries.

The effects of Post-Harvest Losses are numerous and varied. In the first place it represents an area of loss which the world can ill affort to bear in the light of such international problems of starvation and malnutrition. Secondly and particularly for developing countries, it represents an area of capital outflow to purchase replacement food stock for those lost. Every one is sadly aware of the problems of inadequate foreign reserves. Thirdly and finally such losses inevitably caused a rise in the cost of living under the pressure of which developing countries are already buckling. Although less glamorous it should be evident that the reduction in Food Losses is as important as achieving significant break-through in yield improvement.

1.2.1.2 The Approach to Measure Post-harvest Losses:

Because of the critical importance of food losses in the Guyanese economy, research work in this area is currently being undertaken with a pilot project, aimed at identifying areas of losses associated with the production and marketing of the product. The research work is primarily directed to identify and measure Post-harvest Losses in blackeye peas. However, the finding could be extended in the form of a methodology to other crops and food products.

The approach used to measure Post-harvest Losses in blackeye peas was based on a Case Study and had as its main objectives, the following:-

(1) To assess the possibility of reducting Post-harvest losses in blackeye peas by -

(a) Developing a basic methodology to quantify post-harvest losses; and

(b) By making preliminary evaluation of the type of losses that occurred after harvest of the bean.

The conclusion of this part is a preliminary report (this one) aimed at presenting in orderly way, the results obtained so far. A set of proposals dealing with the manner of reducing the losses and the methodology to study and measure post-harvest losses is included.

The second part, not yet implemented, will use the results of the case study as a basis for measuring losses in blackeye peas and for proposing remedial actions.

1.2.1 The Case Study:

The operational programme for the development of the Case Study consisted of the following activities:-

1.2.1.1.2.1.1 Team discussion and review of existing information to

- outline problem definition;
- define terms of reference;
- determine need of information;
- draft basic questionaire.

1.2.1.2 A work-shop for participants from major areas of production to discuss the questionaire and the collection of the required information.

1.2.1.3 Visits to local market and storage facilities.

1.2.1.4 Collection of the required information by the survey method,

1.2.1.5 Evaluation and analysis of the data,

1.2.1.6 Writing the report.

The information collected consisted of data at the farm level, obtained through personal interview by the use of a questionare and data obtained from samples of the products and analysed in a laboratory. Both types of data were collected from the following sources:-

(i) Small farms and State farms.

(ii) Processers and wholesalers.

(iii) Retailers.

In addition, a parallet activity consisted of the development of the methodology to be applied in the final study. This was done by the technical assistance given from a Consulting Speialist. The result of his activity is the document " A METHODOLOGY TO STUDY POST-HARVEST LOSSES: The case of Blackeye Peas". 1.

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1. "A Methodology for the Evaluation of Post-harvest Losses - The case of Blackeye Peas", George Mansfield, I.I.C.A., Georgetown, Guyana 1977.

2. Data Collection:

In order to undertake the pilot project, it was first necessary to obtain relevant data. To ensure that adequate and appropriate information was selected, a questionaire was prepared.

This questionaire sought to obtain from producers of blackeye peas all information relating to the production, and to a limited extent, the marketing of the product. At the farm level the emphasis was on production as it is believed that farmers are not too deeply involved in the marketing of blackeye peas to the final consumer. It was also thought more useful to concentrate on a few farmers and study their operations meticulously rather than attempt to interview a large number of farmers. Answers with respect to details of on-farm activities, e.g. land preparation, planting, harvesting, drying and storing, etc., were sought at this level.

Having prepared a questionaire, a group of Research Assistants comprising mainly of Crop Reporters and Agricultural Field Assistants was identified to undertake the on-farm interviews. At a seminar which was organised for them as well as their Supervising Agricultural Officers, all aspects of the questionaire were discussed and sections changed as was considered necessary.

Along with the Research Assistants and their Supervising Agricultural Officers the team visited a few farms and conducted interviews so as to demonstrate the manner in which they should be undertaken.

In addition to the descriptive information, sections of the questionaire sought to obtain data on potential yields, actual yield, spillage during harvesting and threshing, moisture content of grains during harvesting, etc. As a result, estimates of yields etc., had to be done in the fields and samples of harvested products had to be obtained. Details with respect to how these should be done were explained at the seminar and demonstrated in the fields.

The collection of the descriptive information was straight forward as it was obtained from the interviews with the farmers. However, there were three sets of field operations -

(1) Estimating potential yield;

(2) Estimating reaping loss; and

(3) Estimating moisture content at reaping time: - which were a little more complicated and, therefore, needed additional care in their collection. A description of how these operations were done is given below.

In estimating potential yield, assuming a one-acre plot - a number of sample spots, of a square yard in area were identified at random in the field. All the pods within the identified spots were reped by hand, shelled and then weighted. Also a measure of the moisture content of the seed was later obtained at the laboratory. Total weight was obtained and this was expressed as potential yield per acre. The assumption here is that harvest loss associated with carefully-done hand reaping was zero.

Quantitative loss assoicated with reaping was estimated for hand harvesting as well as combine harvesting. The method used is similar to the one utilized to measure potential yield. In this case, however, the sample spots were identified immediately after reaping had taken place and then all the fallen pods and scattered grains within the identified spots were collected and weighted. This was then expressed as harvest loss per acre.

To measure the moisture content of the product at reaping time, samples were selected immediately after harvesting and these were sent within forty-eight hours to the Central Agricultural Station Seed Laboratory at Mon Repos, where they were tested.

Subsequent samples from the parent stock are then taken and analysed so as to be able to make comparisons over the time in which the product moves from the producer to the consumer.

In order to obtain data at the market level a number of visits were paid to some of the municipal markets (Stabroek, Bourda and La Penitence) within the city as well as (4) of the main wholesalers and retailers of the product. Samples were taken from all these organizations and were analysed in order to make comparison with the other samples taken at the farmer level.

3. The Production of Blackeye Peas:

Blackeye pea is produced on the costal-land and in the intermediate savannahs. The crop has been cultivated in Guyana for quite some time, but, recently, its growth has been expanding rapidly, due to the restriction on the importation of grain-legume. This expansion is supported by the import substitution phenomenon that has risen internal prices; and by the Government who has launched a special programme - "The Grain-Legume and Cassava Programme". The latter provides subsidised production inputs, and, therefore, supports that expansion.

There are, at least, three types of production units identified as producing blackeye peas. The farmers of various farm sizes, the State farms in the intermediate savannahs and the State-owned sugar plantations on the coastland. Farmers are usually cropping in a small scale and represent independent decision-making units. On the other hand, the State-owned farms in the intermediate savannahs are large and extensive operations linked to the Government decision-making mechanism. Finally, production is done under the plantation system of the sugar State Corporations.

An exploratory survey was conducted for farmers in several producing areas and also the State farms at Kibilibiry. However, the purpose of the survey was to gather information on farming practices, marketing and farmers awareness of the problems of post-harvest losses.

3.1 Analysis of the Survey

Given the exploratory objective of the survey, farmers were hand-picked by Ministry Field Staff rather than selected on a statistical basis. Therefore, the findings will be used as a basis for developing work hypothesis that will have to be empirically proven by another survey.

There were fifteen questionaires collected from the following producing areas:

Parika ..... 1 questionaires

Pomeroon River..... 2 questionaires

Essequibo Coast ..... 2 questionaires

Berbice - 63 Village ..... 1 questionaire

Berbice - 66 Village ..... 1 questionaire

Black Bush Polder -

Mibikuri North ..... 3 questionaires

Lesbeholden North ..... 1 questionaire

Johanna South ..... 1 questionaire

Yakusari South ..... 1 questionaire

Yakusari North ..... 2 questionaires

TOTAL ..... 15 questionaires

Besides the questionaires, there were visits to two farms in the intermediate savannahs where the harvesting operations were under-way. All the farmers, except one, on savannah land, were settled on flat terrain.

The mixed of crop ranged from fruit trees, cassava and blackeye to green vegetables (see Table No. 2). However, the Table shows that besides blackeye peas which was the basis for selection of farmers, that cassava and vegetables are a typical product mix for the farmers in those areas. However, the rice and coconut mixed is not accurately represented, and will probably need a more detailed study. The product mix is often used as a way to classify farms under different types of farming conditions, taking into account that the different types will react differently to different policy measures. This classification has not been made here and only the product mix can give basis to infer about the possible ways of farmers reaction.

The question that is directly related to product mix is size of the farm. Given the experimental objective of the questionaire, this question was not answered for all farmers, but most of them were of a small scale, varying from 6 to 15 acres with one of the 87 acres.

On the question of ownership, there was a large variation of answers from several forms of leasing arrangement and ownership of land. It seems that this will be an important fact,sinee the combination of owned land with leased land makes variable the size of the farm and, therefore, the farmers have more flexibility in adjusting to changing conditions. The question that is then relevant to the possibility of expanding the blackeye pea crop is if additional land can be brought in as crop land. The restricting factor will then be the farmers financial and capital position to face any additional activity.

An activity that was more or less well covered by the questionaire, was the size of the blackeye crop and the cropping practices.

The average size of the blackeye crop can be seen on Table 3 distributed by region. The rather small size of the cropping area is one of the main characteristics of the production of this grain. Even though these results cannot be generalized to the entire farming population, it is a characteristic that results from the fact that farmers have considered the legume crop as a sort of vegetable crop and used it mainly for home consumption. On the other hand, being this used, the technology employed in its production is strictly manual.

The smallest plot found was 0.07 acres and the largest 1.25 acres. Production is done in two crops in the year, except for one farmer that did three crops, because he lost the first one. Table 3 shows the different size of the crop as per region.

Relative to the mechanization of the operation of the crops, it was seen that only four of the fifteen farmers did all the operations manually (26%), but 40% of them had tractors and implements, 13% did not have tractors but prepared the land with a rototiller, and 3% prepared it by hiring in the complete land preparations. However, the rest of the work on the crop, planting, weeding, fertilizing, harvesting was done manually.

Therefore, 27% of the farmers prepared the land by manual labour, generally himself and the family and 73% had some sort of mechanical help in land preparation; however, the rest of the operations were done by hand.

TABLE 2 Crop mix for the 15 farmers interviews

Crop	Parika	Pomeroon				Black Bush Polder								Berbice 63	Berbice 66	Total	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Number	% relative order of importance
Blackeye	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	15	100 (1)st
Cassava	+															1	7
Sweet Potato	+								+	+						3	20 (4)th
Tomatoes				+										+		2	13
Ochro														+		1	7
Bora						+			+	+				+		4	27(3)rd
Water Melon														+	+	2	13 (5)th
Cucumber									+	+						2	13
Cabbage	+										+					2	13
Boulanger							+									1	7 (6)th
Green Veg.									+			+	+			3	20 (4)th
Legumes						+										1	7
Carambola		+														1	7
Oranges		+														1	7
Plantains		+														1	7
Cassava		+				+	+	+		+	+				+	7	47 (2)nd
Coconut														+		Not Conclusive	
Rice														+			
Number of crops for farmer	4	5	1	1	2	4	3	3	4	5	3	2	2	7	3		
Average																3.2	
Maximum																7	
Minimum																1	
S^2																1.5	

TABLE 3 Average Size of Blackeye Pea crop in acres, by region, for the year 1977, and by season.

REGION	1st CROP	2nd CROP	TOTAL
	.....	ACRES	.....
Par-ka		0.07	0.07
Berbice No. 66 - 63		1.125	1.125
Black Bush Polder	[illegible]	[illegible]	[illegible]
- Mibikuri North	1.25	.5	1.75
(Lesbeholden North)	1.	0.5	1.5
(Johanna South	0.5	0.75	1.25
(Yakusari South		1.	1.00
(Yakusari North	0.5	0.25	0.75
Essequibo		.35	.35
Pomeroon		.44	.44
Average	0.81	1.05	.915
Smallest			.07
Largest			1.25

TABLE 4.

Mechanization of the Farm Operations - Land Preparation.

METHOD	No.	%
All hand operations	4	27
Only a rototiller	2	13
Tractor and implements	6	40
Custom work	3	20
TOTAL	15	100

All the other operations were done manually, either family or hired.

A brief description of each operation is as follows:-

Land preparation was done by tractor and plow by 60% of the farmers; only with a rototiller for 13%; and all by hand, either with a fork or just a cutlass, by 27% of the farmers.

Planting is done by hand, usually by digging a hole and lining the seeds in a row.

Only one farmer reported liming and seven of them (47) fertilized. The application of fertilizer is done in all the cases by hand. The fertilizer used were sulphate of amonia, urea, mariate of potach; one farmer applied trace elements (T.T.E.)

Weeding is done by hand with the cutlass. Only in one case the farmer used the rototiller for that purpose. 73% of the farmers did some weeding operation and 27% did nothing about it.

The control of pest and diseases were done by 87% of the farmers and the chemical used were, by its commercial name, Disimac 25, Dithane, Malathion, Agrocide, etc. The application was done with spray cans in all the cases.

As related to irrigation, 5 (33%) of the farmers reported the operation and two of them 13% have a pump set up to irrigate their plots.

The harvesting operations were done by hand-picking the mature pods in a two week period. The farmers let the pod dry out after picking and when these were sufficiently dried they were shelled by hand or beaten - (the pods are put into bags and beaten with sticks). Once shelled there might be some additional drying before bagging the peas.

Marketing practice of the farmers were related to how they dispose (sell) the peas. On the question of selling, 13% of the farmers sold to G.M.C. and 87% sold to others; 40% to consumers, 33% to hucksters and 14% sold to the hucksters and consumers.

About 60% of the farmers did not consider grading the peas after harvest, although 53% of them related the grading to obtaining a better price.

The grading operation is done by picking out the damaged grains or the discoloured ones, however, this is more related to the cleaning operations than to an actual grading system of quality.

There is, also, some confusion in the answer to this section, especially on that of the interpretation of the word "grading".

TABLE 5. Preparation of the peas before selling

Operation	Yes		No	
	No.	%	No.	%
Cleaning	12	80	3	20
Drying	14	93	1	7
Pest Control	3	20	12.	80
Grading	4	27	11	73

TABLE .6. Grading of Blackeye Peas.

Observation	No. of Farmers	%
No grading has been done	9	60
Product has been graded by farmers	4	27
Don't know about grading	2	13

TABLE 7. Relation of Grading to prices.

Observation	No. of Farmers	%
Grading of peas is related to price for blackeye	8	53
Grading is not related to price of blackeye	1	7
Don't know or don't Answer.	6	40

TABLE 8 Characteristics used for Grading by farmers.

Characteristic	No. of farmers	% (out of 9)
Colour of the bean	7	77
Health	1	11
Shape	5	55
Moisture content	1	11

TABLE 9 Combination of Grading Characteristics as proposed by Farmers.

Combination of Characteristics	No. of farmers	% (out of 9)
Colour, health and shape -	1	11
Colour and health	1	11
Colour and shape	3	33
Only colour	4	44
Only shape	2	22

Despite existing problems, and, notwithstanding the fact that grading was done by a small percentage of the farmers, the question of grading was fully considered. The farmers propose a series of characteristics for the grading of beans and in some cases, a combination of them. This is shown in Tables 5 to 9.

Product preparation before selling was done by most of the farmers; 80% cleaned the grain and 93% dried them. Few of the farmers did pest control, and, as pointed out earlier, little grading.

Of the preparation, all other activities were done manually cleaning by hand-picking and winnowing; drying in the sun either at the road side or on some specially designed trays; (this method is used for drying coffee in the Pomeroon); grading by hand-picking the defective grains.

After the product is harvested and properly prepared, the farmers may either sell it right away or store for some time. All the farmers dispose of their blackeye in less than two months. Practically, no one kept it for so long; the main problems encountered were fungus and weavils, grain discoloration, etc. These problems were magnified during the rainy season, because of the humidity and the bad condition of the routes. Apart from a common shed or the house to store the product, there were no other provisions made. Although 33% of the farmers thought that these facilities were appropriate, they were referring to the storage needs for very short periods of time.

While in storage, the farmers dry the product as often as was necessary, checking the moisture content by biting the grains.

An indication of farmers awareness of the losses is their feelings about the need for additional facilities. They have no equipment to prepare any type of product, and, therefore were not even aware that the product could be stored for long periods of time. In this sphere of reference, 53% of the farmers answered "yes" to indicate the need for additional facilities, and 20% answered a clear "no"about these facilities.

From the ones that saw the need for additional facilities, 47% included drying, 27% storage, 20% grading and only 6% fumigating facilities. These figures are a good indication of the magnitude of the problems of handling the peas after harvest.

Drying is ranked the hightest, especially when they harvest in the rainly season followed by storage, grading and fumigating facilities. The high-ranking of drying may be due to the fact that this element controls the attack of insects and fungus and, therefore, it is the critical factor for keeping the grain.

The farmer, was thenasked to classify the product, as to its difficulties in handling after harvest. The answers were related to their own farming experiences. Since there are different product mixes in different regions, the answer varied accordingly. From the 53% who gave answers, 62.5% mentioned blackeye as a difficult to handle. The rest were concerned about fruits and vegetables, like carambola, tomatoes, water-melon, because of rats; green vegetables and cassava

TABLE 10 Availability of Storage facilities.

Facility	No. of farmers	%
Silo	-	-
Shed	2	13
Farmhouse	13	87
Refrigerated Room	a	

[a] One of the farmers had a refrigerated room, although it was used for water-melons.

TABLE 11. Appropriationess of the Storage facilities.

	No. of farmers	%
Appropriate	5	33.3
Not appropriate	2	13.3
Don't know	3	20
No answer	5	33.3
TOTAL	15	99.9

To solve the problems in the handling of the product after harvest, they propose a series of measures as shown on Tables 12 and thirteen (13).

The last set of questions were directed to get farmers ideas about the losses on blackeye and the reasons for them, this is shown on Table 14. There were 60% no-response to the questionss about the reasons for the loss, but of the rest, 7% indicated no loss, 26% mentioned the wet weather and discoloration[1] as a reason for the loss, while 7% mentioned the attack by weevils and rats.

1. Discoloration is due to fungal attack that is directly related to the high moisture content of the seed.

In relation to the amount of loss, Table 15; the farmers estimated an average total loss of 7.66% of which 1.97% occurred during harvest, 1.36% because of shattering, 1.12% during drying and the largest loss 3.20% accurred while in storage.

TABLE 12 Measures to reduce Post-Harvest Losses as proposed by farmers.

Measures	No. of farmers	%
1. Adequate transportation, drying and storage	1	6.6)
2. Better drying facilities	1	6.6)
3. Timely harvest and quick disposal	1	6.6)=39.6
4. Harvest in cool weather	1	6.6)
5. Better harvest and transport	1	6.6)
6. Adequate transport,storage and harvest facilities	1	6.6)
7. No answer	5	33.3
8. Don't know	4	26.6
TOTAL	15	100.-

TABLE 13 Measures to Reduce Post-Harvest Losses grouped as of main activity.

Measures	No. of farmers	%
Transport	3	30
Drying	2	20
Storage	2	20
Harvest	3	33
	10	100

TABLE 14 Reasons for Losses in Blackeye Pea.

Reasons	No. of farmers	%
Wet weather, discoloration	4	26
Weevils and rats	1	7
No loss	1	7
No answer	9	60

TABLE 15 Farmers estimation of Losses in Blackeye Peas.

	No. of farmers	%	Average Loss %
Harvesting	6	34	1.97
Shattering	8	44	1.36
Transporting	-	-	-
Drying	2	12	1.12
Storage	1	5	3.20
Bulk Loss	1	5	-
			7.66%

Difference in the sume is due to rounding off the figures.

4. Analysis of the results

4.1 Flow Analysis

A basic and very important primary consideration in any effort to study Post-harvest losses is that of identifying and analysing each step involved in the flow of the produce from the time of production to the time of consumption.

This step by step identification and analysis is called "flow analysis" and provides an easy route to the improvement of produce flow since it readily points out transactions that can be combined or eliminated in the handling of the product.

In keeping with the methodology developed and presented in Santo Domingo at the August 7-11 seminar on Post-harvest losses, we have classified all activities of the flow into the following categories:

Operation
Inspection or grading
Transportation
Storage and
Delay

Three geographic areas have been identifide: areas Geographically Pomeroon, Kibilibiri, and Corentyne, and the product flow was examined separately in each of these three areas. The three flows are presented in the following pages, along with some preliminary observations made at different stages in the flow.

4.2 Pomeroon Flow

The basic information was obtained on a small farm in the Pomeroon river, Jacklow village. However, three other farmers were visited. The size of the blackeye pea crop was 0.2 acres and the condition of the crop at the time of the visit was fairly good. Harvesting was done by the farmer and members of his family. Samples of the peas were taken from the shelled pods for

seed analysis, and the bags which were used to store the peas were tagged. These bags were later taken at the wholesaler's storage bond where a sample of peas were also taken. The results of the analysis of these samples are presented in Section No. 5.

The construction of the flow was done on the basis of a questionaire taken from the producers in the area and other interviews with local agriculture officers and wholesalers.

The description of the flow has been done as detailed as possible trying to describe a more general condition even though at some point it was obvious that no losses would occur. The flow is as follow:

4.2.1 Harvesting

Harvesting is done manually by picking the pods as they mature. The harvest period lasts for two to three weeks until most of the pods have matured. The harvester places the pods into a basket or clothsack which he uses as the container throughout the harvest.

The type of losses to be measured ar the following:

(a) Mechanical damage to the pods caused by container, spilling, bruising, etc.

(b) Contamination of the pods by the container.

(c) Pods and/ or peas left in the field during the harvesting operation (shattering and left overs).

(d) Harvest immature pods because of harvesting at a non optimum stage of maturity.

In terms of these types of losses it was observed in the field that this was a carefully done operation. Also it was observed that the pods were at the "full Stage" of maturity.

4.2.1.2 Measurements and observations which may be done with respect to possible losses are:

(a) Describe the physical and sanitary condition of the containers.

(b) Observed the care taken by the harvesters.

(c) Determine which are the factors influencing the decision of the farmer to harves.

(d) Measure moisture content and preferably obtain a sample of the pea to be analysed in the laboratory.

4.2.2 Transfering peas from harvesting to carrying container.

From the clothsacks previously used, the pods are transferred to a bigger container, usually a basket that is then used to transport the pods to the drying place.

4.2.2.1 The types of loss to be measured at this point are the same as the ones described previously for the harvesting activity. It was observed that very little losses are associated with these operations performed by hand.

4.2.2.2 Measurements and observations required to measure losses are:

(a) Outline the method of handling the transfer.

(b) Describe the type of container and it conditions.

(c) Specify the weight of the pods at the beginning and end of the activity.

4.2.3 Delay in moving pods from the fiedl.

The existance of long delays may require a reclassification of this operation to read "storage" and therefore will require a more careful study. It requires determination of average delay time. No delay was observed during the visit, and given the size of the plot it was not expected.

4.2.4 Moving pods to drying facilities.

The basket or other container is transported to the drying place where the peas were unloaded.

4.2.4.1 The types of loss that can be expected during transport are mainly spillage. However, on a small farm because the distance to the drying facilities is short no spillage was observed. The basket was transported by walking from the field to the drying place.

4.2.4.2 Measurements and observations for this point of the flow are:

(a) Measure the distance and delay in transporting.

(b) Observe if any damage or spillage is done and if so, weight the container at departure and arrival.

4.2.5 Unloading carrying container into drying facility.

The baskets are emptied onto the drying surface. The type of losses expected are: spillage and damage to the pods, so that the general procedure of observation is required.

4.2.6 Sun Drying

The pods are emptied onto the drying surface and are spread about 1½ inch thick layer. This activity is critical not because of the losses that can occur during the operation but because it is one of the causes of future losses. In the case observed, the drying operation lasted for 3 days. This period, however, was dependent on the weather. The drying surface is usually a flat one made of tarapulin, wood etc, or on the road, when there is one. In the Pomeroon river, where there are no roads, some large wooden trays were used with a cover that can be used in case of rain.

4.2.62. In terms of measures and observation required, the following is suggested:

(a) Measure the length of the drying period,

(b) Describe the drying equipment,

(c) Check moisture and also grain analysis at the end of drying period by collecting a grain samples.

4.2.7 Loading into bags.

From the drying facailities (trays) the pods are loaded into jute bags or woven polyethylene sacks. The type of losses to expect are contamination and/ or spillage (shattering can be a source of loss at this point). The type of bags should be described and also fallen pods or peas left over in the trays should be collected and measured.

4.2.8 Moving bags to shelling area

This activity is also done manually and the occurance of spillage, it can be expected to cause loss. Therefore, the way of handling the bags should be described

4.2.9 Shelling

Shelling can be performed in two ways by the small farmer. They can either shell by hand, pod by pod, or put the dry pods into a jute bag and beat the bag with a stick.

4.2.9.1 The type of losses that can occur during this operation are mechanical damage and spillage. Also, the increase in moisture content, and so discoloration or fungal infestation can occur on account of the delay in the operations.

4.2.9.2 Measurements and observation proposed in this activity are the following:

(a) Observed and describe the operations,

(b) Determine total weight of the shelled peas, determine actual yield of the crop.

(c) Collect the spilled pods or peas on and weigh them.

(d) Determine moisture content of the seed and collect grain sample for analysis.

(e) Measure the delay between drying and shelling.

4.2.10 Winnowing

The separation of the grain from the shaff and other material is done by sifting the grain in the wind. This is manually operation that is more important if the shelling is done by beating the pods in a bag.

4.2.10.1

During this activity the grain can suffer mechanical damage and spillage may become an important source of loss. There is also the possibility of insect and fungal infestations.

4.2.10.2 Measurement and observation proposed to evaluate the losses at this point are:

(a) Observe and describe the operations.

(b) Collect a grain sample at the end of the activity to determine mechanical damage, the health condition of the peas, degree of infestation and moisture content,

(c) Collect all the peas spilled on the ground and look for possible source of infestations.

4.2.11 Loading peas into bags and closing.

This operation is done by hand afer the cleaning is completed. The peas are loaded into either jute or woven polyethylene bags.

4.2.11.1 The main source of loss in this operation is the spillage, however, by the use of used bags or dirty surrounding, the peas can be contaminated.

4.2.11.2 Measuras and observation proposed are the following:

(a) Observe and describe the operation,

(b) Weigh the bags or a smaple of bags,

(c) Describe the type and condition of the bags used,

(d) Collect spilled peas,

(e) Observe and describe the surroundings

4.2.12. Moving bags to on-farm storage

This operation was done manually and no losses were observed. However, depending on the condition of the bags spillage may occur. It is proposed that a description of the operation should be done.

4.2.13 On-farm storage

The bags are stacked generally at the farm house in the kitchen or under the house in the open if the amounts of bags justify it. These types of storage facilities are also used for other grains so that usually a mix of grains are found in the same place.

The condition in which the grain is stored will determine future losses and,therefore, the critical significance of this activity

4.2.13.1 The grain at this point can suffer attack from rats, insects, (weevils, flies, etc , or by being in a moist environment be fungal infected. If the grain is not properly dried the extent of these losses can be very large. The same can happen if it is kept for long periods of time since the peas absorb moisture.

4.2.13.2 Measurements and observation proposed are the following:

(a) Observe and describe the stacking operation and the condition under which the peas are stored.

(b) Determine the length of the storage and collect a sample of the peas, if possible one sample should be collected at the beginning of the storage period and another at the end of it.

(c) Determine the level of rodent attack by counting the number of holes in the bags and weighing the surrounding peas.

(d) Determine relative humidity of the storage place.

4.2.14 On-Farm Loading of the boat.

In this area the farmers transport their products with boats. They either own a small boat or hire one when it is needed to transport the product. The loading area at the farm in most cases is a rustic wharft. Some of the big farmers have a more elaborate structure and sloops.

4.2.15 Transport of Peas to Selling point.

Considerations about measures and observations are the same as for those activities at 4.2.2

4.2.15.1 The types of losses that can be expected to occur are spillage, contamination, weting the peas etc. Normally the distance between farm and selling point is not very long and, therefore, loss is minimal.

4.2.15.2 Measurement and observation required to evaluate loss at this point are:

(a) Determine the average delay time.

(b) Describe stacking the procedure and the occurance of vibration.

(c) Determine the moisture content of the seed at the end of the activity.

4.2.16 Unloading boat at Selling Point.

This activity consists of the manual operation of the transfer of the bags from the boat to the wharf.

4.2.17 Inspection, weighing and storage at selling point (after sale).

The procedure is sold to the wholesaler who inspects the peas visually to decide whether to accept them or not. Assuming the wholesaler decides to buy the peas are weighed and then set apart to wait for transportation to the central warehouse point. Here the handling of the peas by the farmer ends and the first change in property of the peas takes place.

In general the types of loss expected are the same as those in 4.2.10 and 4.2.13 are also the measurements and observations required.

4.2.18 Loading Transport to boat or truck.

The same considerations as in activity 4.2.2.

4.2.19 Transportation to Storage Selling Point.

The means of transport could be truck, sloop or steamer. In cases where a truck is used, a shorter time will be required to transport the product. Also the possibilities of contamination are smaller. In all instances the transport is not just for blackeye, but is used for other produce as well. Consideration regarding losses and measurements are the same as for 4.2.15.

4.2.20 Delay to unload transport vehicle.

Once the transport vehicle arrives at the central storage point, a delay occurs in waiting for the produce to be unloaded. In the case of truck, given the smaller size of the cargo, there is practically no delay. This delay time becomes important for the bigger cargoes transported by sloop or steamer.

4.2.20.1 In terms of measurements and observation, the following is required.

(a) Observation and description of the operations,

(b) Observation and description of the condition of the transport vehicle in terms of possible infestation.

(c) Determine the length of average delay

(d) Determine relative humidity and temperature inside transport vehicle.

4.2.21 Unloading transport vehicle.

Same consideration as 4.2.2

4.2.22 Delay after unloading.

This activity refers, especially, to the produce which is transported by boat, since during the waiting period before being remove from the wharf, spillage or contamination etc, can occur.

Consideration, measurements, and observation are the same as those in 4.2.20.

4.2.23 Loading transport vehicle.

Measurements and observation as in 4.2.2.

4.2.24 Transportation to Storage or Selling Point.

The same consideration as in 4.2.15.

4.2.25 Unloading at Storage or Selling Point.

The same consideration as in 4.2.2.

4.2.26 Storage at wholesaler's bond.

Up to this point the product is normally handled by G.M.C. acting as a wholesaler. However, the flow may be lenghtened if another wholesaler buys the product from G.M.C. and keeps it for storage and latter selling to retailers.

These additional stages will be similar to the ones just described and therefore they are not repeated.

The considerations on measurements and observation for the wholesaler-storage are the same as those on the farm storage activity 4.2.13.

4.2.27 Loading vehicle for transport to retail point.

The same as activity 4.2.14

4.2.28 Transport to retail point.

The same as activity 4.2.15.

4.2.29 Unloading at retail point.

The same as activity 4.2.2.

4.2.30 Storage or delay before consumer purchase

The produce is now ready for consumer purchase and can be on exhibition either in the market place or in storage at the retailer's house. The huckster plays a leading role in the distribution of the produce since he has the facilities - truck or van, small storage bond, and capital to finance the operation to perform this function. On the other hand, a vendor handles small quantities of a wide range of products, usually a few pounds, which he can sell in less than a week. Whenever the supplies of the vendor is exhausted he or she goes back to the huckster in the same market and buy more of the needed item.

The considerations regarding measurements and observations of these activities are the same as the storage activity previously described in 4.2.13.

4.2.31 Inspections of product by consumer.

While the produce is on display on the shelves of the market stall, it deteriorates quickly because of the environment and the manner in which it was previously handled. This necessitates further hand cleaning of the defective peas (broken, discolorated etc). The produce, up to now would have received no additional preparation except for the one that the farmer would have given it, and, therefore, depending on the condition, it may require some further cleaning before putting up for sale. The wholesaler or the huckster will not do anything to preserve the product and therefore the operation is left to the vendors. There was only one huckster that claimed, he keeps the product for more than 3 years. In order to store the peas for so long a time he said he uses as storage bin, a plastic container (11 - 20 gallons) and added, after a well done drying process same chemical before sealing the bin, to preserve the grain.

4.2.31.1 At the market stall besides collecting information about the general condition of the selling operation, sample of the rejected peas from the cleaning operation, and of the ones on exhibition should be obtained in order to perform the corresponding seed analyses.

4.2.32 Weighing and bagging for consumer.

In the process of bagging the seeds for consumers and spillage should be measured. During the visit to the municipal market no spillage was observed.

4.2.33 To consumer house.

4.2.34 Storage at consumer's house and final consumption of the peas.

Although mentioned these last two points were not included as part of the observation and collection of information. It is noted, however, that they could be a source of significant loss if the produce is bought in large quantities and not properly dried and stored in the home.

4.3 Intermediate Savannah

The characteristics of the farming activities in the intermediate sawannah are quite different from the ones on the costal lands. The soils are mainly sandy (brown or white) and the cultivated areas lend themselves to mechanized operations. The Terrain is either flat or slightly hilly. Access to the farm is either by boat from the Berbuce river or by truck via a sand trail. One of the farms had all the necessary equipment for drying and cleaning. The crop is new to the area. The machinery used for harvesting is also new and therefore, some of the losses described were larger than they would be in normal operations.

The isolation of the area makes critical the storage and transporting activities. The flow is then as follow.

4.3.1 Harvesting

This operation is performed mechanically with a rice combine. Because the reaping of a more delicate grain was involved there was the obvious necessity to regulate the machine. The small size of the blackeye plant made it difficult to adjust the level of the cutting bar fast enough to take care of uneveness of the terrain. Given the amount of losses observed, this is consider a critical operation.

4.3.2 Loading vehicle for transport from the field.

The grain is handled in bulk with the use of tractor-drawn trailer. Significant losses could occur due to spillage if the trailer is overloaded and drives too fast through the fields.

4.3.3 Transport from field to farmstead.

4.3.4 Unloading from field to farmstead.

4.3.5 Drying.

These operations are performed with a mechanical field operated dryer. There was no temperature control and, therefore, damage was done to the viability of the seeds. However, the grains were fit to human consumption.

4.3.6 Unloading dryer into cleaner

4.3.7 Cleaning.

Cleaning was done mechanically with a blower. The "sweeping" resulting from the operation wad used for livestock feed.

4.3.8 Unloading cleaner and bagging

4.3.9 Storage .

On one of the farms the dryer and the cleaner were inside a large bond, which was also the storage place for the produce. On the other the facilities for cleaning and drying were far apart from the bond and the field. The grain was transported in bulk to these facilities and substantial spillage of grain occured given, the uneveness of the sand trails. In this case the bond which was utilized for storing the grain consisted of a construction with only a roof high above ground with no walls and only dirt floor. In these conditions the grain was not expected to last very long. It was appreciated, at that time, that a sizable amount of the grain that was kept in those condition would not be fit for human sonsumption.

4.3.10 Loading bags onto truck for transportation to Georgetown wholesalers.

The grains were shipped directly to wholesaler bonds in Georgetown via trucks.

4.3.11 Transporting the peas.

4.3.12 Unloading at wholesaler.

Most of the wholesalers have facilities to load and unload incoming and out-going produce so this is usually a quick operation.

4.3.13 Storage at Wholesalers' Bond.

There was storage in cold rooms ($42^{o}F$) in a high humidity environment with viaible signs of rodent attack. Immediately that the peas were taken out of there, they started discoloring very quickly. This process was observed during the visit to the Municipal market. Some of the peas which were stored under these conditions were identified and inspected at the vendors' stall. Other types of storage included an air-condition room, where signs of rodent entries were observed but the grains were in fairly good condition. These grains were later identified at the markets.

The peas were kept for several months in these two temperature control bonds. Other storage places did not have environment control and therefore did not keep the peas for long periods.

The deterioration of the peas is shown in section 5 dealing with the analysis of the grain samples.

4.3.14 Loading vehicle to retailer (Huckster)

4.3.15 Transportation to retailer

4.3.16 Unloading at retailer

4.3.17 Packing

4.3.18 Storage or delay before consumer purchase.

The retailers were handling quantities of peas from a few pounds to two or three bags.

The retailing system here is composed of the intermidaries- hucksters and vendors. The type of operation involved consists of a huckster having a small vehicle (van, pick-up, etc.), or transporting with taxi, bicycle, cart, donkey or just walking and disposing of his produce along the route he travels or at some central marketing point. The vendor buys from huckster or from some other source and sells at a central marketing point. The huckster is often better equipped to handle larger quantities than the vendor. At the market place the huckster will have a small storage space in the cover area of the market and from there he sells to consumers in small quantities or vendors in large volumes.

Some sizable amount of the peas go through the supermarket or food store system. In this case, the peas are transported with trucks or vans and put in a specially designed storage place and then bagged in small bags to be sold to the consumers. In none of the places that were visited the peas were kept for more than a month and this was on very special occasions.

4.3.19 Inspection of product by consumer.

4.3.20 To Consumers house

4.3.21 Storage at consumer house.

4.4 Corentype Flow

Several farmers were visited in order to obtain an average description of the on-farm operations. All of the farmer had very small crops, usually less than an acre. One of them was a rice farmer with a good farming experience operating a 50 acre plot. Another was a school teacher with some farming experience but just starting to farm. Marketing information was collected from the farms, agricultural officers, hucksters and wholesalers.

One of the characteristic of the area is that it constitutes a self sufficient market for most food products. This was the case of blackeye pea which was sold in bulk in the Corentyne area. The bags that were tagged at the time of the investigation were not found in Georgetown and the reports on the follow-up activities confirmed that the produce was consumed in the area.

In recent months, the accelerated production drive has brought new acres of blackeye peas under production. It is understood that in case of a large production the excess will come to Georgetown.

The flow description for this area is as follows.

4.4.1 Harvesting. The operation is performed manually in the same manner as in the Pomeroon area, that is by picking the mature pods.

4.4.2 Emptying harvesting container in to carrying container.

4.4.3 Moving container to drying area.

4.4.4 Emptying container onto drying surface.

4,4.5 Drying.

Like the Pomeroon area sun drying is utilized,but instead of a wooden or tarapaulin surface the public road is used. This activity is considered critical in the flow.

4.4.6 Bagging. Jute bags were used.

4.4.7 Moving bags to Shelling areas.

4.4.8 Shelling. This operation was done manually in the same way as in the Pomeroon.

4.4.9 Cleaning or winnowing.

4.4.10 Loading peas into bags and closing them.

4.4.11 Moving bags to storage (on-farm)

4.4.12 Storage. As in the Pomeroon, storage of the grains were done in the farmer's house.

4.4.13 Loading vehicle for transport to local selling point.

In many cases of the farmer himself will retain his produce. Only if he is in need of urgent cash will be sell his product in bulk. In this case the grain is sold by bags to other retailers. The retailers will generally pick the product from the farmer's house and transport it with their vehicle or taxi.

4.4.14 Transporting to local selling point.

4.4.15 Unloading at local selling point.

4.4.16 Storage at either local retailer or huckster.

4.4.17 Inspection and purchase by consumer.

4.4.18 Transport to consumer house.

4.4.19 Storage at consumer house.

In this way a chart can be constructed showing all the methodological steps that are required at each of activity in order to assess the losses.

The basic analysis of the activity is now presented as alos the requirement of the overall study of "measures and observations".

4.5 Analysis of the flows

After completion of the flow charts it becomes apparent that the activities described and the proposed measures and observations could be condensed into general statements. This would simplify and improved the analysis, and allows for comparison among the flows or among different points on the flow.

It is possible to describe the activity and then define the need for observation to be made on the field for each of them.

In this way a chart can be constructed showing all the methodological steps that are required to each of activity in order to]asses the losses.

The basic analysis of the activity is now presented as also the requirement of the overall study or "measures and observations".

4.5.1 Activities

<u>Harvesting:</u> Collecting the produce from plants in the field. I can be done manually or mechanically.

Drying: Extracting artifically the moisture from the seed; either by sun drying or with the use of mechanical driers.

Shelling: Mechanical separation of grain from shaft. Most of the farmers do the shelling by hand, but it could be done mechanically with a thresher or via a movable combine in larger operations.

Cleaning: Extracting the shaft and other inert material from the grain. The farmers does it by hand, however, for larger quantities it could be done mechanically.

Bagging: Putting the grain into jute or woven polyethelene bags.

Loading: Putting grain into transport unit.

Transporting: Moving the grain with a transport unit. There is a large variety of transport means from manually carried baskets, or small canoes to large boats (sloops, steamer) or a truck.

Unloading: Getting the product off the transport unit to the unloading area as the end of the transport activity.

Storage: Keeping the produce intentionally for a period of time in one place.

Delays: Unintentional storage cause between two activities.

Grading: Process by which grades are separated. As it is in most cases for blackeye grading is the separation of the bad and unacceptable grains from the good ones.

Selling: Involve the process of preparing the produce for sale, like bagging it in small quantities, weighing exhibition etc.

4.5.2 Measurement and observations.

For each of the preceeding activities it is require to identify either literally or quantitatively the nature of the losses. From the experience on the Pomeroon and the other two regions that have been described, it was possible to analyse the requirement in measurements and observation. There are classfied and condensed in the following paragraphs.

Observations and Description of the Operations: It is required, to produce a description as detail as possible of the activities in order to understand the working of elements which cannot be measure but can still contribute to losses. This description should also take note.

of there sources of losses that have been taken into account.

Sampling of grains: The purpose of the sample is to generate information about the condition of the grains, damage, discolorated insert attack etc. A sampling procedure as outlined before in this report was followed.

Field Samples of Grains: These samples were used for the purpose of seed analysis. However, the main intention was the estimation of the actual and potential yield of the sampled farm and the estimation of the amount of grain left over in the field. An statistical procedure was utilize to collect these samples.

Measurements of Spillage: These in a non standardize operation, and is therefore, a matter of common sense and eye estimation. However, the following guideline should be taken into account.

Any quantity of spilled grain collected for instance collecting the grains from the floor in the shelling area should be related to a specific amount of total grain, so that the amount spilled could be refer to in relative terms (% of total harvested grain or % of total shelled grains etc).

Samples of rejects: Rejects are condiser those grains separated from the main bulk in a cleaning and/or grading activity. If the amount is large enough the same procedure, as that utilized in the sampling of grains, should be followed so that the collected grains can be considered as an Statistical Representation of the total grains rejected in that particular operation.

Qualifications of the Environment Conditions: The environment condition under which the grain is found, is important in providing information on the possible reason for the condition of the grains. Therefore, the following, not exclusive, measures and observations are set out for this purpose.

Measures of relative humidity and temperature, once or several times as may be required in order to asses the effect of these variables on the conditions of the grains.

Contamination should be measured by direct observation of the presence of insects and eye estimation of the degree of the infestations. The same goes for rodents, however, in this case, the number of holes in the bags can be counted as also the number and size of entry points to the place were the grains are.

Describe the fitness of the storage area in terms of fulfilling the storage requirements of the grains. The following items are proposed as a guideline for this description.

Air Flow: Description flow of air inside the bond. Is the air flow controlled by opening and closing outlets or is it stationary? Are there any fans, extractors etc.

Humidity Control: Is there any system for the control of humidity,? Are there moisture proof floors, wooden pallets, dehumidifiers or systems for closing and opening of outlets to central humidity?

Temperature Control: Is there any means to control temperature? like air condition, fans, ventilation system, specially designed building structure of the bond in terms of the type of walls, ceiling etc.

4.6 The Market Channels.

The flow are just the description of the movemements of the product along the market channels. A preliminary outline of the channels using as primary information the data collected for the flows in the three study areas is presented.

A description of the marketing channels is shown on Diagram No. 1

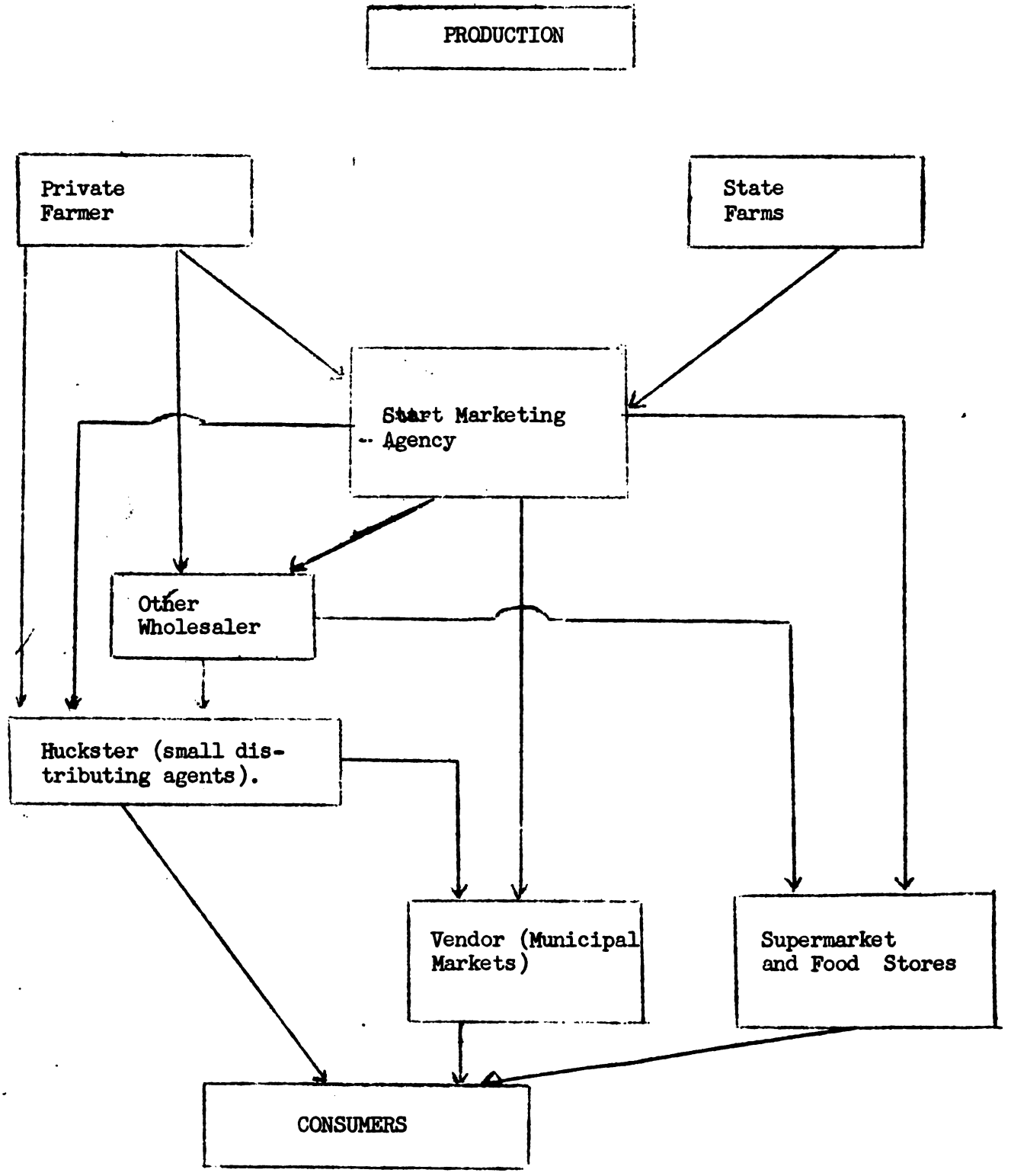
The participants of this marketing channels are the farmers, the state operated farms, the state marketing agency other wholesalers, the hucksters, the vendors at Municipal markets, supermarkets and food stores and finally the consumer.

The functioning of this system, it is not known because there is not enough information about it at this time. Also each of the channels is not yet known.

On the other hand, the marketing system is well developed in the traditionally farming areas. In other areas with small local demand for the product and difficult land access, the market system has

to be developed and therefore, there are problems in marketing the peas.

DIAGRAM No 1 DESCRIPTION OF BLACKEYE PEAS MARKETING CHANNELS.



5. Analysis of Grain Samples:

Analysing the condition of the grains was accomplish on the basis of the collection of grain samples from various points of the flow. The procedure, explained earlier in the report, involves the collection of samples of blackeye peas for purpose of determining -

(a) Potential yield per acre;

(b) Left-over in the field after harvest;

(c) Variation, in seed quality from the time of retailing and

(d) Samples of rejected seeds from the cleaning operation - (grading).

With regard to the possibility of drawing inference from the results, the idea was to obtain reliable samples from the specific points so that they represent fairly well the condition of the seeds for that specific point. On the other hand, the number of samples to represent cross-section condition, will not be enough fpr some points to grant full generalization of the results.

5.1. Definition of Losses:

The whole prupose of grain sampling and of this pilot study was to shed some light on the question of the losses that occur after the product is harvested. This is done, however, not with the academic interest but with the idea of providing some solution that can improve the handling of the product at their most critical point and increase the amount of it that reaches the consumer.

In the case of blackeye peas, which is a non-perishable product, the definition of the losses becomes the critical aspect of the research, since this definition will by itself guide the whole process of measuring the losses.

For perishable products like tomatoes or fruits, the appearance of the loss is quite evident to the eye. The fruits can be crushed, or rot or smell bad or have a bad shape not appealing to the consumers eyes, etc.

In the case of grain, however, apart from the losses that occur because of spillage or left-overs in the field, the losses that occur after harvest are not evident.

The criterion on which looses can be define and measured is that -

"Loss is all that product that becomes unacceptable to the consumer".

This means that only the portion that is inedible and the amount that is wasted or unacceptable to the housewife, will be considered a lost.

Since this criterion is highly affected by the consumers income, some type of income classification should be established. The reason being that the lower income group may accept a product of lower quality on account of a lower price. (Blackeye is a relatively low priced product and one of the most important food items in the everyday food diet of Guyanese).

Problems will arise because of the fact that in some cases, people will consume a product that is below acceptable food standards, either because of need or ignorance. This factor will tend to reduce the relative amount of losses and will, therefore, need a professional opinion on the definition of food standards - (grades).

This in turn, will lead us to the need for a more precise definition of the losses and into the question of "what type of product or minimum quality can be accepted to be sold to the consumer". This is not an easily answered question, since it involves the "nutritional and qualitative aspects of the grains", and will not be dealth in depth in this report.

The relevant question to this research work whether a classification criterion, based on consumer acceptance and product quality can be used to select appropriately remedial action that can be utilized to increase the amount of product at the market level and also that this product be of a higher quality.

The answer to this question was the whole purpose of the pilot study, so that a proper methodology to measure losses can be established.

The following sections deal with the establishment of the criteria of losses and the possibility of measuring them.

Another question which was looked into on and have basis, since it does not involve a food loss, is the loss in the germinating power of the seed. The purpose of this is to establish some basic information on the quality of the grain for seeding purposes.

5.2 Losses in Quantity:

Attempts are made to quantify the amount of grain that is left over on the field on account of not being harvested, either because of shattering or, beaaae the combine spills it or is left by the farmer because he decides to discontinue harvesting. Besides measuring the loss in quantity the samples were analysed and a count were made of the proportion of pure seed, foreign matter, small seeds, badly discolored seeds, splits, damaged and moisture content. Besides this, a germination trial was conducted and a report of the proportion of normal germination, abnormal germination and dead seeds were made.

The estimation at the farm level was done following a sampling procedure to represent whatever was left after the farmer completed the harvest. The test is not conclusive because of the number of samples, but it serves the prupose of this first inquiry.

For a hand-harvesting operation, the procedure was that the interviewer identified a farmer who was about to start harvesting. Since harvest by hand-picking involves several visits to the field, an attempt was made to obtain an estimate of the potential yield of the plot. At least, five blocks of one square yard were randomly located in the field, then they were marked with sticks and string and the harvesting of these blocks were handled separately, though in the same way as the farmer did. Every time the farmer decide to hand-pick the blackeye, he notified the interviewer in advance, so that he in turn could harvest the selected blocks.

The harvesting lasted for about two to three weeks and after the farmer decided not to continue the harvesting, the interviewers by a similar technique as that just describedm proceeded to collect all that was left by the farmer. This last measurement provided an estimate of spillage, loss because of non-maturity, and grains left because of bad conditions. It could also give a measure of shattering but given the method of harvesting, there was practically no loss attributable for this.

For this farmer, it was measured thus, the actual amount that he harvested from the plot at 700 lbs/acre. (The estimation of potential yield could not be done). This means that he could have harvested (700 + 35.5), a total of 735.3 lbs. The left-over in the field then amounted to 4.8% of the total. Looking at the seed analysis (Table 16), it is possible to understand that the farmer just could not harvest any more because of the condition of the grains (84% badly discolored). This was due to a high fungal infestation, of the plant, because of humidity, and the length of the harvest.

The case of mechanical harvest involve the same sampling procedure, however, all was done at the same time. While the combine was harvesting, a sampling procedure of the amount that was left behind, by randomly selecting samples in the harvested field. A similar sampling procedure was conducted on the non-harvested crop to determine potential yield. The results are presented on Table 17. In this case, the harvest was delayed because of the maturity problems of the pods and to make further adjustment to the combine. Meanwhile, some sizable amount of rain fell in the area and, therefore, increased the proportion of discolored grains. Also the operators of the machine were handling the combine for the first time and though this measure was taken at the end of the harvest period, there were still some problems with the adjustments.

TABLE 16 Left-over by Farmer when hand-picking blackeye peas.

- Pomeroon, Jacklow -

ITEM	MEASUREMENT
Weight of all sample	10 g.
No. of samples in the field	3 samples of 1 sq yard each
Estimated loss per acre (left-over)	35. 5 lb/acre
Seed Analysis of left-over	
Pure Seed	0
Damaged	13%
Splits	1%
Badly discolored	84%
Small Seeds (Not matured)	2%
Amount of good grain harvested by farmer	140 lbs.
Size of the field	0.2 acres
Actual yield	700 lbs./acre
Lost per acre over 735.5 lbs.	4.8 %

TABLE 17 Left-over in the field and Potential Yield - Combine harvested.

- Intermediate Savannahs -

Left-over:	
Weight of all Samples	205 gr.
No. of Samples collected	5 of 1 sq. yard ea.
Estimated lost per acre	437.5 lb/acre
Potential Yield:	
Weight of all samples	580 g.
No. of samples collected	5 of 1 sq yard ea
Estimated Potential Yield	1237.7 lb/acre
Proportion of grain left over	35.3%

TABLE 18 Seed Analysis of left-over and Potential Yield Samples for Intermediate Savannahs farmer.

Category	Potential Yiedl %	Left-over %
Pure Seed	77.92	58.8
Damaged	5.97	7.8
Splits	-	1.35
Badly discolored	10.62	28.7
Moisture Content	18.1	18.1
Small Seeds	4.4	4.7

TABLE 19 Comparison of rejected and clean peas. (Cleaning was done with a Blower)

Category	Clean Peas	Rejects or sweeping	Before Cleaning
Pure Seed	67.07	20.02	43.5
Damaged	17.75	15.2	17.4
Splits	2.05	30.06	16.0
Badly dis-colored	9.06	30.52	19.89
Small Seed	2.05	2.62	2.34
Foreign matter	0.15	1.52	0.53
Moisture Content	13.9	11.1	12.54

A second measure was adopted for the losses in the mechanical cleaning operation. However, the results are not totally conclusive. Even though no specific figures are available, any time that the product is cleaned, a sizable amount of good seed is lost. This can be estimated using the results of seed analysis made of the clean seeds and of the rejected ones. This comparison is shown in Table 19.

As can be seen in Table 19, the cleaning operation improved, largely, the conditions of the grains. However, a sizable portion of the sweepings (35% = pure and damaged) is fit for marketing. In 10,000 pounds of rejects, at least 3,500 pounds could have been sold. The improvement in the handling of the seeds seems important so that the deterioration of the seeds could be avoided.

5.3. Losses in Quality:

The analysis of the samples of peas, was the next measure of losses. The analysis is based on the quantification of pure seeds, damaged, splits, badly discolored, small seeds, foreign matter and moisture content.

For the purpose of seed quality, it would be necessary to go deeper into the chemical contents of the seeds. However, giving and owing to the constraint of time and the exploratory objective of the pilot study, the measure outlined above was selected as proxy for seed quality. For the purpose of consumption, pure seed and damaged are the same, since a damaged seed is one with a small crack in its tissue. The measure is important in the consideration of seed quality, since the damaged seed may cause abnormal germination. The next important measure was the proportion of badly discolored seed. Discoloration is directly connected with fungal infestation and therefore, one of the main problems of seed quality. The mositure content of the seed is an indication of the present condition of the seed though it does not give an indication of previous condition.

The presentation of the results, therefore, will be done along three lines:

(1) The analysis of the same group of seeds at different points of the marketing channel. (2) Comparison among the participants and finally, (3) A relation between quality and price is presented.

5.3.1 Losses along the channel:

The first experiment was to follow the production of blackeye pea from the intermediate savannah to the retained market by the use of tagged bags. So that the same peas could be identified at all of this points. Results of this is presented in Table 20.

Table 20 shows a clear trend in the deterioration of the seeds, with the exception of the proportion of discolored seed which appears to increase first for then to decline. This is most probably, the results of cleaning by hand-picking the discolored peas, small seed and any foreign matter that could be seen.

On a visit to Bourda Market a sample of rejects from this type of cleaning operation was collected and analysed. The results are presented in Table 21.

As can be seen on this Table, the sample consisted mostly of discolored seeds and splits, two of the categories that have actually decreased in going from the wholesaler to the retailer.

It is also important to note that in the time lapse between the sampling at the production site and the sampling at the wholesaler storage bonds - 38 days - the amount of badly discolored seeds have risen by 19.33% with a relative increase in the moisture content of 11.08% or 0.3% per day. The moisture content also increased relatively, at the retail level by 3.17%, however, both samples were taken at the same day (wholesaler and retailers). (1) and so the relative increase from production to retailing was 14.6% or 0.38% relative increase in moisture content per day. Therefore, in a humid environment, the moisture content of the seed increase rapidly until it reaches its equilibrium. However, this moisture content is enough to produced

TABLE 20 Results of Seed analysis for Blackeye peas produced at the intermediate savannahs and sold in Georgetown at retail markets. (A total of 12 samples were taken of the same bunch of peas from production to retailing).

Category	At production Site after cleaning	At Whole-saler	Relative % change	At Retail Market	Relative % Change
Pure Seed	67.07	65.26	-2.69	59.96	-8.12
Damaged	19.75	17.99	-8.91	25.57	42.13
Splits	2.05	2.31	12.68	1.9	-17.74
Badly discolored	9.26	11.05	19.33	9.13	-17.37
Small Seed	2.05	1.61	-21.46	-	
Foreign matter	.15	.05	-66.66	-	
Moisture	13.9	15.44	11.08	15.93	3.17
Date Sample Taken	12.10.77	19.11.77	38 days	19.11.77	

TABLE 21 Seed Analysis of Rejects of Cleaning operation at the market.

Category	Results in Percentage
Pure Seed	0
Damaged	3.8
Splits	25.6
Badly discolored	66.6
Foreign matter	3.8

TABLE 22 Results of seed Analysis of samples taken at Pomeroon and in Georgetown.

Category	At farmer's house	At Wholesaler Georgetown	Relative % Change
Pure seed	68.7	67.75	-1.38
Damaged	18.4	16.7	-9.24
Splits	-	0.3	-
Badly discolored	7.0	7.65	9.28
Small seed	5.1	4.85	4.90
Foreign matter	0.3	-	-
Moisture content	15.02	17.0	13.18
Date sample Taken	22.10.77	5.11.77	14 days

considerable damage to the qualitative aspects of the grain.

The next experiment involved a farmer in the Pomeroon River, who sold his produce to the Guyana Marketing Corporation outlet at Charity.

The bag of blackeye peas that was tagged at the farmer's house was found and sample at Georgetown fifteen days later. The results are shown in Table 22.

In the short time lapse (14 days), the moisture content rose relatively, 13.18% and the badly discolored seeds by 9.28% showing a trend to the deterioration of the seed. Part of this deterioration is indicated by the decrease in the proportion of pure seed and damaged seed by 1.38% and 9.24% respectively.

5.3.2 Comparison among the Participants:

Several samples (10) were taken at farmers storage. These samples cover the Pomeroon River, Essequibo Coast, Corentyne, Parika and the intermediate savannahs.

The results are presented in Table 23.

Except the ones in the intermediate savannahs, all the others were hand harvested and either shelled by hand or beaten inside a bag. All of these correspond with samall farmers operation, while the ones in the intermediate savannahs were larger plots (larger than 200 acres) and machine harvested.

At the market level, samples were collected from four wholesalers, twelve stalls at Bourda, Stabroek and La Penitence Markets and three hucksters located in these same markets. The results are presented in Table 24.

Even though the results of the Table are not conclusive, it appears that the grains are in the process of deterioration from wholesaling to retailing. The amount of pure seed is less at the hucksters level than at wholesalers level, probably because of the cleaning operation, the grains at retail increase in quality - (measured by the indicated variables). One of the problems that was omitted in the seed analysis, but will be included in the next

TABLE 23 Results of Seed Analysis from several regions.

Category	Pomeroon	Essequibo Coast	Corentyne	Parika	Intermediate Savannahs
Pure Seed	68.7	71.4	66.46	69.75	41.47
Damaged	18.4	11.5	20.62	13.35	18.86
Splits	-	7.33	.6	-	15.76
Badly discolored	.7.	10.4	6.33	14.85	20.13
Small Seed	5.1	.0	2.12	1.9	1.89
Foreign matter	3	-	.22	0.15	.59
Moisture content	15.2	n.a.	14.29	14.45	14.77

TABLE 24 Result of Seed Analysis for Samples taken from wholesalers, retailers and hucksters in Georgetown.

Category	Wholesalers	Hucksters	Retailers	Trend
Pure seed	65.26	50.25	57.6	-3.83
Damaged	17.99	25.31	27.53	4.77
Splits	2.31	3.42	1.53	-0.39
Badly dis-colored	11.05	17.44	9.42	-0.815 6.39
Moisture Contents	15.44	15.3	15.50	0.03

Not considering retailers

analysis is the level of insect attack and that done by rats. They were both visually observed at the wholesale and retail level, in some cases, the samples were totally infested with weevils and other insects. In one stall, there were all kinds of reaches, ants and other insects walking over the exhibited commodities, one of them was blackeye peas.

5.3.3 The relation with price:

Although results are not totally conclusive, and owing to the size of samples, it appears that a relationship exist between price and some of the variables selected from the seed analysis. The data is presented on Tables 25, and represent the samples taken at retail level for which information on prices were obtained.

A multiple regression equation was fit to the data of Table 25, in an attempt to establish if there exist a relation between price and conditions of the seed. That is if there is an informal grading system.

The results are the following:-

Market Price = \$ 1.02 + \$ 0.005 (% good grains) -
(0.228)
-\$ 0.009 (% discolored grains) +
(-0.384)
+\$ 0.025 (%splits) -
(0.766)
-\$ 0.197 (% Moisture)
(- 0.3071)

The number in brackets underneath each different is to the "t" value; the test is not significant for any of the variables. Covrrelation between the quality variables and market price is R = 0.6252 and F = 2.56.

The signs of the coefficient correspond to what it can be the hypothesis of the relations. That is 0.9¢ is decreased in the price for every percent increase in the amount of discoloration grains; 0.5¢ will be increased in the average price for every percent increase of good grains and 19.7¢ will be decreased in the price for

TABLE 25 Price and selected variables fro samples taken at retain in Georgetown.

Sample No.	Categories				Price In $$$ per lb (pint)
	Pure Seed	Badly Discol-ored	Splits	Moisture Content	
	..... Percentage				
1	79.2	14.2	3.45	15.	1.15
2	88.39	9.72	0.95	15.2	.75
3	87.72	8.8	1.1	16.35	1.10
4	83.3	8.05	2.15	15.6	1.
5	80.0	14.15	2.55	15.9	1.
6	87.85	6.85	1.6	15.1	1.25
7	75.6	20.35	1.2	15.1	1.
8	81.97	12.52	2.55	15.02	1.
9	78.07	11.42	6.97	15.3	1.20
10	88.85	5.1	4.1	15.75	1.40
11	91.62	6.32	0.1	13.5	1.25
12	80.05	13.5	0.5	15.7	1.
13	65.25	29.65	0.75	16.75	0.9
14	88.5	3.8	1.75	15.8	1.2
15	91.55	4.7	0.6	15.02	1.4
16	87.9	10.8	1.1	15.4	1.2
Average	83.4606	11.2456	1.96	15.4056	1.1125
Standard diviation	6,9762	6.5516	1.7279	0.7153	0.1765

every percent increase in the moisture content of the seed. The relation with the percent of split grain in not clear. The whole equation is presented just as a methodological development in terms of future analysis with a larger amount of data.

However, these results do grant the conclusion about the existence of a grading system and its relation with price at the retail level. In order to establish the relations more clearly, it is necessary to increase the number of samples and also expand the seed analysis to include "damage" by insects.

5.4 Analysis of Germination Losses:

Of the four areas of post-harvest losses, germination loss is probably the most difficult to estimate. The difficulty arises partly from the fact that it is uncertain what portion of production is used directly as food and what portion is used as planting material and hence subjected to this type of loss. As emntioned previously, however, the significance of this area of loss is recognized when one cpnsiders that production and productivity for the following crop season relates directly to it. For this reason alone, therefore, it is worthwhile to attempt an evaluation of germination loss.

In the context of Guyana and with specific reference to blackeye peas, it is useful to point out here that the main portion of blackeye peas used as planting material is imported. As a corrolary, therefore, Guyanese farmers use very little of their blackeye production for replanting. Given even these conditions, however, it is useful to evaluate germination loss as the result of the analysis can provide insights as to the nature and type of rational decision relating to this area of agricultural activity.

As an example we wish to find out from which country we can obtain the 'best' seed material, 'best' meaning seeds with the greatest potential for germination. With such knowledge, given other factors as costs, Guyana can better evaluate the best external sources from which it should purchase its supplies.

In addition to being able to make this type of decision, it is possible to quantify - in monetary terms - the losses associated with these transactions. One part of this loss is easily measurable but the other part presents some amount of difficulty. Since the seeds are imported for planting purpose, if there is a germination ratio of 75% then it can be concluded that the loss is 25%. This can then be easily expressed in monetary terms when the total cost of the seeds is known. There is, however, an additional area of loss associated with these very seeds which fail to germinate. To quantify this loss in monetary terms will require much more thorough investigation.

To bring this loss into more direct focus we can assume that a farm purchases 100 pounds of seed material (for $100.00) to plant on four acres of land. With a germination ratio of only 75% the farmer would have lost $25.00 because one-quarter of the seeds he purchased did not germinate. Presumably, however, the farmer would have prepared all his land (four acres) for the planting acticity. Because only three quarters of the seed germinated he may well have prepared only three quarters of his land space (three acres). The preparation of the four acres, but effective utilization of only three acres represents an important area of loss. This type of loss will be associated - in varying degrees- with some other of his activities.

In the few instances where farmers use their own production, or that of their neighbour, as planting material, it may be useful to determine the germination ratio, if we are to minimize this important area of loss. As a starting point, a comparison of the germination ratio of locally produced planting material with that of the ratio of the imported planting material, will help to decide whether nor not we should import our seed material

If a decision is taken to use locally produced planting material it is necessary to examine the critical factors which influence the potential for germination. Although this pilot project was not specifically designed to answer questions of this pilot project hypothesized that germination potential will be influenced by such factor as :-

(1) Method of harvesting e.g. mechanical or manual.

(2) Method of drying e.g. mechanical or natural (sun).

(3) Degree of fungus or other forms of infestation.

(4) Method of storage.

(5) Splits or other forms of damage to the seeds.

(6) Percentage of pure seeds.

From some of the samples which were taken at the farm and market level, tests on germination potential were done. At the farm level some factors which may affect potential yield are:-

(1) Method of harvesting:

(2) Method of Drying, and

(3) Quantity of damaged seeds, (splits or cracks).

At the market level, we may examine such factors as-

(1) Percentage of pure seeds.

(2) Quantity of damaged seeds, (splits or cracks).

The results of the sample analyses are tabulated in tables 26 and 27.

TABLE 26 Data on Germination Potential - Farm Level

ORIGIN	Normal %	Abnormal %	Germination %	Dead %	Factors Affecting Germinatio.I		
					Method of harvesting	method of drying	% of Seeds Damage
Intermediate Savannags	26	16	42	58	Machine	Machine	21.1
- do -	30	9.5	39.5	60.5	Machine	Machine	22.5
Pomeroon	34	35.5	69.5	30.5	Hand	Sun	18.4
Corentyne	60	30.5	90.5	9.5	Hand	Sun	9.
Corentyne	38.5	53.5	92	8	Hand	Sun	18.8
Intermediate Savannahs	15	10.5	25.5	74.5	Machine	Sun	9.15
Intermediate Savan-	11	15.5	26.5	73.5	Machine	Sun	5.97

(1) Normal: Perfect germination takes place.

, Abnormal Germination takes place but abnormalties are observed in the young plants.

Dead: These seeds fail to germinate.

(2) Germination is obtained by adding normal plus abnormal germination.

(3) To facilitate this exercise we use only two classifications i.e. Germinate and dead.

It is very important to emphasize that because of the smallness of the number of samples, especially at the market level, conclusive statements cannot be made about germination potential. However, an attempt is made to present indications of the type of information which may be generated in investigations of this sort.

From Table 26, where Mechanical Harvesting was utilized, the average germination ratio is 33.4% as compared with 84% when harvesting is done by hand. One is led to conclude, therefore, that if the harvested seeds are to be replanted then hand harvesting rather than Mechanical harvesting should be utilized.

In examining the effects of the final variable "Damaged Seed" on the germination ratio - (Table 27) the data shows that when there is a high percentage of damaged seeds, germination is low. In this situation, however, there is need to proceed with added caution when it is recognized that where there is the lowest percentage of damaged seeds (5.97%) there is the second lowest level of germination (26.5%) when intuitively the opposite should occur.

One must however analyse the problem of auto-correlation between harvesting and drying if one is not to arrive at misleading conclusions.It may also be necessary to examine the problem of multi-collinearity among all the variables. The preliminary conclusions are arrived at by using Simple Regression Analysis but in order to analyse the effects of various combinations of the variables used, or even to extend the number of variables, it will be necessary to use Multiple Regression Analysis and utilize a computer.

Table 26 is probably two limited to be very useful. Only two variables are considered at the market level, and these are-

(1) Percentage of pure seeds; and

(2) Percentage of damaged seeds.

TABLE 27 Data on Germination Potential - from samples at MarketLevel

Origin	Normal	Abnormal	Germin-	Dead	Factors Affecting Germination	
					% of Pure Seed	% of damaged Seeds
Wholesale	37	16	53	47	79.2	11.8
Stabroek Market	3	4.5	7.5	92.5	12.8	73.7

From the data, it appears that germination is directly and highly correlated with percentage of pure seeds. Similarly, germination is indirectly but highly correlated with percentage of damaged seeds. This data tells a farmer, therefore, that he should not buy as planting material blackeye which contains a high percentage of splits and other forms of damaged seeds.

In comparing Tables 26 and 27 it is interesting to observe that the germination ratio at the Market level seems much lower than that at the farm level. In other words, if a farmer is to buyhis planting material from the market rather than from another farmer, he is likely to receive many "dead" seeds.

As was said before, this preliminary investigation was not geared for higher levels of sophisticated analysis of germination loss. However, research in this area can provide useful inferences on a number of important issues. Some of these are outlined below.

(1) Should Guyana import its planting material or should it produce it locally.

(2) Assuming planting material is produced locally. How should -

(a) the crop be harvested;

(b) Storage be done for maximum germination.

(3) Should one area rather than another specialize in the production of planting material.

5.5 Nutritional Loss:

Another important area of Post-harvest food loss occurs in the form of Nutritional Loss. It is known that the nutritional value of most foods; especially fruits and vegetables; deteriorate as ageing of the food takes place. In fact, the rate of deterioration is positively correlated with the ageing process. Nutritional loss is, therefore, defined as any decrease in the nutritive value of a food which occurs between the points of production and consumption.

To avoid difficulty, it is useful to note that Nutritional Loss is distinct from Qualitative Loss. While Nutritional Loss can be considered as reduction in the value of nutrients in the food - and is not necessarily observable with the naked eye - qualitative Loss can be seen as visible changes of the foods, thus making it less acceptable by the consumer.

To clarify this distinction further, an example is used. Assume a ripe orange picked from a tree today and is eaten almost immediately, then the consumer is likely to obtain all the nutritional value of the fruit. The same fruit, eaten under those very conditions can suffer from Qualitative Loss if it suffered physical damage during the picking activity. Alternatively, if that very orange is eaten the following day, or worse still, two days after the nutritional value will deteriorate and thus there will be a nutritional loss. However, if the fruit suffered from no physical damage, then there may be no Qualitative loss.

The importance of the nutritional status of a nation cannot be over emphasized. Malnutrition in a nation can reduce its capacity for physical effort and consequently result in lower level of national production..

In outlining a Food and Nutrition Policy for Guyana, Julia Mubi - Nutrition at the Ministry of Health - writes "malnutrition is one of the most serious health and social problem affecting a large section of the Guyanese population". A deficiency state is indicated when less than 80% of nutriment requirements are consumed.

To support her observation, Julia Mubi presented the data which is reproduced in Table 28.

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a. A deficiency state is indicated when less than 80% of nutrient requirements are consumed.

TABLE 28 % of Guyanese Consuming less than 80% of the nutrients listed.[a]

Nutrient	%
Protein	39.0
Calories	47.0
Riboflavin	71.4
Vitamin A	43.9
Niacin	42.8
Ascorbic Acid	26.4
Calcium	18.9

Source: " 1977 National Food and Nutrition Survey.

From the above-mentioned Table, it will be observed that 39% of all Guyanese consume less than the required quantity of protein. Blackeye is a legume and as such is most important in the diet as an alternative source of protein.

The composition of blackeye pea is presented in Table 29, while Table 30 give some information on blackeye as a substitute food.

As a source of clacium, iron and thiamine, blackeye is a good substitute for milk cheese, and meat, and the fact that these foods are in short supply make this legume an excellent food for the Guyanese population.

Besides protein, blackeye provides large amounts of at least three other important nutrients, i.e. calcium, iron and potassium. This food also has a favourable calorie/protein balance.

As a pre-requisite for measuring nutritional loss, one must be able to determine the time period between production of a food and its consumption. In order words, it is necessary to find out when this period is, on the average, two weeks or two months. Assuming the period is two months, the researcher can, undertake the necessary tests and determine the nutritional value of the food immediately after harvesting. Two months later the same samples of food can be analysed to determine the new levels of food nutrients. The difference will represent the nutritional loss and this loss can be expressed in monetary terms.

In this pilot project, no attempt was made to determine nutritional loss in blackeye. In terms of the inadequacy of information and time constraint.

For Guyana however, this area of loss is critical and should be undertaken as part of a more comprehensive study of post-harvest food losses.

TABLE 29 Composition of 100 g. Edible Portion - Raw, mature, dry Blackeye Seed.

Nutrient	Quantity
Water	10.5%
Food energy	343.0 Calories
Protein	22.8 gr.
Fat	1.5 gr.
Carbohydrate (total)	61.7 gr.
Carbohydrate (Fiber)	4.4 gr.
Ash	3.5 gr.
Calcium	74.0 mgr.
Phosphorus	426.0 mgr.
Iron	5.8 mgr.
Sodium	35.0 mgr.
Potassium	1,024.0 mgr.
Vitamin A value	30.0 i.u.
Thiamine	1.05 mgr.
Riboflavin	0.21 mgr.
Niacin	2.2 mgr.
Ascorbic Acid	-

Source: Agriculture Handbood No. 8 + Agricultural Research Service U.S.D.A.

TABLE 30 Blackeye as a Substitute Food:

Nutrient	RDA (a)	Food	Nutrient Content (b) of 100 g. Food
Food energy	2,000 - 3,000 cal.	Blackeye Beef	343.0 calories 263.0 calories
Protein	44 - 56 grams	Blackeye Beef	22.8 grams 18.5 grams
Calcium	800 - 1200 mg.	Blackeye milk Cheese Beef	74.0 milligrammes 118.0 milligrammes 750.0 milligrammes 11.0 milligrammes
Iron	10 - 18 mg.	Blackeye Beef " Liver - (Raw)	5.8 milligrammes 2.8 milligrammes 6.5 milligrammes
Potassium		Blackeye	1,024.0 milligrammes
Thiamine	0.3 - 1.5 mg.	Blackeye Beef Pork	1.05 milligrammes 0.08 milligrammes 1.93 milligrammes

A study of nutritional food loss can provide useful guide to such questions as -

(1) What is the maximum time for storing a food without causing significant reduction in its nutritional value and -

(2) What are the conditions under which blackeye should be stored for lengthier periods of time than the actual maximum storage period of two months.

6. Preliminary Conslusions:

Based on the previous analysed results, the problem of Post-harvest losses of blackeye peas involves several aspects. The exercise had an exploratory objective to develop and test a methodology to measure post-harvest losses. Information relating to the nature of such losses were also produced, and will be used for further studies on the same subject.

The methodology was tried and tested, its results and description are part of another document. Basically, it draws from the analysis and development of the flow of the product from producer to consumer, making a detailed description of every aspect of handling of the product. After the completion of the flow, a sampling procedure is designed to quantify the amount of losses, and the amount of product that goes through each of the flow.

The nature of the losses that occur in blackeye pea for consumption are of three types:-

(a) Quantitative: These are the losses that are accounted for by weight.

(b) Qualitative: These are related to a grading system and its relation to the value of the product.

(c) Nutritional: These refer to the losses in terms of its value for human consumption.

For peas that are intended for seed purposes, the losses in germinating power are also important.

The losses in quantity are measured as spillage, or "left-over"; i.e. what remains on the ground after the harvest is completed. Mechanical harvesting produces a sizable amount of loss.

Harvesting can be a source of many problems. The major problem areas being the time of harvest and secondly, the method of harvest,

The time of harvest related to the type of end product that is desired. If in the case of Blackeye peas, a green product is desired, then the pods are harvested at various stages of physiological maturity, as consumer tastes demand.

If, however, as in the majority of cases, the dry pea is the desired end product, then it is the normal practice to allow the pods to dry on the plant before the pods are harvested. The grain achieves functional and physiological maturity at moisture levels too high for safe storage. Therefore, the period of drying off in the field, that is storage in an environment which even at its deal is generally very poor in terms of what are the requirements for proper storage. The crop is at the mercy of the environment and lodging, shattering, pest and disease attack, all take their toll resulting in varying degrees of quantitative and qualitative loss.

The objective is to harvest as early as possible after the grains have attained maturity. How early this is done is dependent on the harvesting method to be used.

The ideal method, taking blackeye peas as an example, is to harvest each pod by hand, subsequently hand shelling the pods one at a time. This method ensures that each pod is harvested at the right time and shelled with such care as to preserve the quantity and quality which prevailed when the pods were removed from the field. Spillage in the field should be minimal or even non-existent, and mechanical damage experienced during machine threshing would not occur.

This method while applicable to the small farmer becomes unrealistic as acreage increases. It is highly labor-intensive and excessively time consuming and often rewards obtained for maintaining excellent quality are uneconomical.

At the other end of the spectrum is total mechanical harvesting by a self propelled combine, which simultaneously harvests green and dry material. This method of harvest incurs varying levels of mechanical damage; and depending on the type of machine used, the skill of the operator, the adjustments and/or modifications to the machine and the moisture content of the material to be harvested. Since no machine is 100% efficient, some pods would remain unharvested. Some shattering would take place and there would be spillage.

It is essential to remember that in machine harvesting, the drier the material, the greater the possibility of mechanical damage (broken and splits). But if the material is too moist, the greater the likely-hood of incomplete threshing (pods passing through the machine unthreshed).

It is necessary that regular checks be made to determine the condition of the product and required adjustments done to maintain as high a standard as possible.

Shelling by hand eliminates the possibility of mechanical damage but is time consuming and uneconomical for large operations. Speedier methods include placing dry pods in bags and beating with a stick or against a wall, mashing with animals or with a tractor or using a mechanical thresher. As the speed of the threshing operation increases, so does the frequency of mechanical damage and unshelled material. Again as in combine harvesting, the moisture content of the material directly relates to the level of mechanical damage and the amount of unshelled pods.

Shelling is normally followed by cleaning, the process of removing the unwanted chaff from among the grain. Simple cleaning is done by allowing air to blow the chaff away then the threshed material is separated into chaff and whole grain. More sophisticated methods

of cleaning involves the use of fan mills which clean by using an air blast along with one or a number of screens of varying perforation sizes. The design and/or the number of fan mills used is determined by the size of the operation and the level of cleaning desired. Some degree of grading or upgrading can accompany shelling. In this process the majority of undesired grain is removed from the mass, either by hand or by machine. Both cleaning and grading incur some level of loss. In machine operations, spillage is unavoidable, and while grading improves the quality of the product the discarding of some amount of good material along with unwanted grains is inescapable,

Drying i.e., the removal of moisture, is a critical operation. High moisture is one of the major causes of qualitative and seed loss which occur in storage. It is sufficient only to point out that certain ranges of moisture content closely control the physiological processes in grain. For instance -

- At moisture contents greater than 45 - 60%, germination can occur.
- Respiration rates are dangerously high from 18 - 20% up to 45 - 60% moisture content.
- At 45 - 60% moisture content there is rapid growth and multiplication of micro-organisma and heating is inescapable.
- Mould (fungus) growth can occur at 14 - 20% moisture and respiration is high enough to cause heating.
- Moulds and heating are seldom problems below 8% moisture.
- Below 8% moisture insects cease to be a problem.
- Grain must be dried to 4 - 8% moisture if it is to be packaged in air-tight containers.

Losses in storage are the ones that are most readily observed since it is often the practice of inspecting and weighing the grain before storage and any changes in quantity and quality is usually reflected in the weight and condition of the product as it is marketed.

Qualitative loss in storage can be brought about through insect and rodent attack, spillage and larceny. Insects and rodents are also responsible for qualitative and nutritional loss. However, the majority of problems which arise during storage are often caused by improper drying. Grain is hygroscopic; that is, it will accept or give up moisture to the environment until a state of equilibrium is reached. All grain in storage should be inspected every five to seven days to observe signs of damage.

6.1 Critical Points in the Flow:

The three flows outlined in earlier sections represent two operations - one completely manual, and one mechanised, and, as such, critical points differ for the two operations.

From the analysis of the flows and the observations made, it is clear that harvesting (mechanical), threshing, drying, storage, and transportation are the critical points in the flow of the product.

6.1.1 Mechanical Harvesting :

Time of harvesting proved to be critical especially where mechanical harvestors were in use. Those pods too dry shattered, and those too green were easily crushed and damaged by the rollers,

Harvesting during or after the rainy season posed problems. Pod rot or fungus infestation affected large parts of the crop, thus reducing severely, the quality of beans realized.

For the farmer who harvests manually and dries naturally in the sun, it is important that the beans are harvested when "full", since sun-drying is usually a lengthy and sometimes uncertain process. The "full" beans contain less moisture and dry faster than beans harvested before maturity, thus reducing the occurrence of discoloration due to fungus infestation.

6.1.2 Type of harvestors used:

The mechanical harvestors used in the two cases of harvesting mechanically were rice combine harvestors adapted for use with blackeye pea. Losses during harvesting were very high indeed and could undoubtedly be attributed to mal-adjustments of the harvestors used.

The latter needed to be adjusted and adapted for use with blackeye peas since both the size and texture of rice are different from blackeye peas. Losses due to spillage, peas left unharvested, crushing, splits and broken peas occurred.

6.1.3 Threshing:

Threshing operations were of three types -

(1) threshing combined with harvesting, (rice combine).

(2) threshing at storage bond in mechanical thresher.

(3) threshing by hand - beating bags with stick.

Of the three operations, the first one proved to be responsible for the most losses. The second operation, from observation, was responsible for some losses due mainly to spillage and to split and broken peas to a lesser extent. Threshing by hand gave rise to very little losses, but this exercise is time consuming.

6.1.4 Drying:

Another critical point in the three flows in drying. Sundrying proved to be insufficient, especially if the product was held for a long period in storage. Mechanical drying was efficient, but too harsh for peas to be used for seed purpose. Sundrying could perhaps be improves by use of surfaces designed to trap the energy from the sun and more small portable dryers are needed to service adequately the number of blackeye farmers in production.

6.1.5 Storage:

Of the factors responsible for post-harvest losses, poor storage was an important one. There were no storage facilities in use, either on or off-farm, especially designed for the storage of blackeye or any other grains. Most, or all farmers (small to medium scale) used their homes (bottom house or kitchen) for storage. The two larger producers used a large, well enclosed bond in the one case, and an open shed in the other. None of these facilities were temperature controlled, humidity controlled or rodent proof.

Off-farm storage presented the same picture with places used as bonds generally being quite unsuitable for storage. In a few cases, peas were put into cold storage where humidity was far too high, and the incidences of rodent attack alarming. The peas on removal from cold storage, deteriorated rapidly and a high proportion was unfit for human consumption.

6.1.6 Delays:

Delays between steps in the flow are critical only because of the poor storage and drying facilities in use at present. A delay between storage on-farm and sale to a consumer for example, should present no real difficulties if the peas were properly dried, and stored under proper conditions. Since peas can be classified as a non-perishable or stable food, then it is expected that shelf life should exceed a year, if handled properly

6.2 Conclusions:

In the case of blackeye peas, it is assumed that the grains are at the peak of its condition, as it leaves the plant at the moment of harvest. After this, and more precisely, during it a deteriorating process is started that is caused by environment conditions (humidity and temperature); seed conditions (moisture content - mainly - and vital characteristics). These direct causes open the doors to attack by insects, fungi and other pests that alter the content of the seed and its appearance by consuming part of it by

or by adding excreta or other foreign substances such as the aflotoxins. Humidity and temperature also start the physiological process of resporation germination and aging.

However, moisture content of the seed also affect the process of harvest by either broken grain, if it is too dry or crushed grains if it is too moist. Therefore, in mechanical harvesting lossed in quantity by unthreshed or harvested pods, shattering, broken, splits or crushed grain, all directly relate to the moisture content of the seed. In hand harvest, all of these pods are minimized because eahh pod is picked at its best stage. However, in the threshing which is usually done by beating the grain inside the bag, then cleaned by sifting or winnowing the grain, the first level of losses start appearing.

It is clear, that any improvement must relate to the farmer's practices and attitudes.

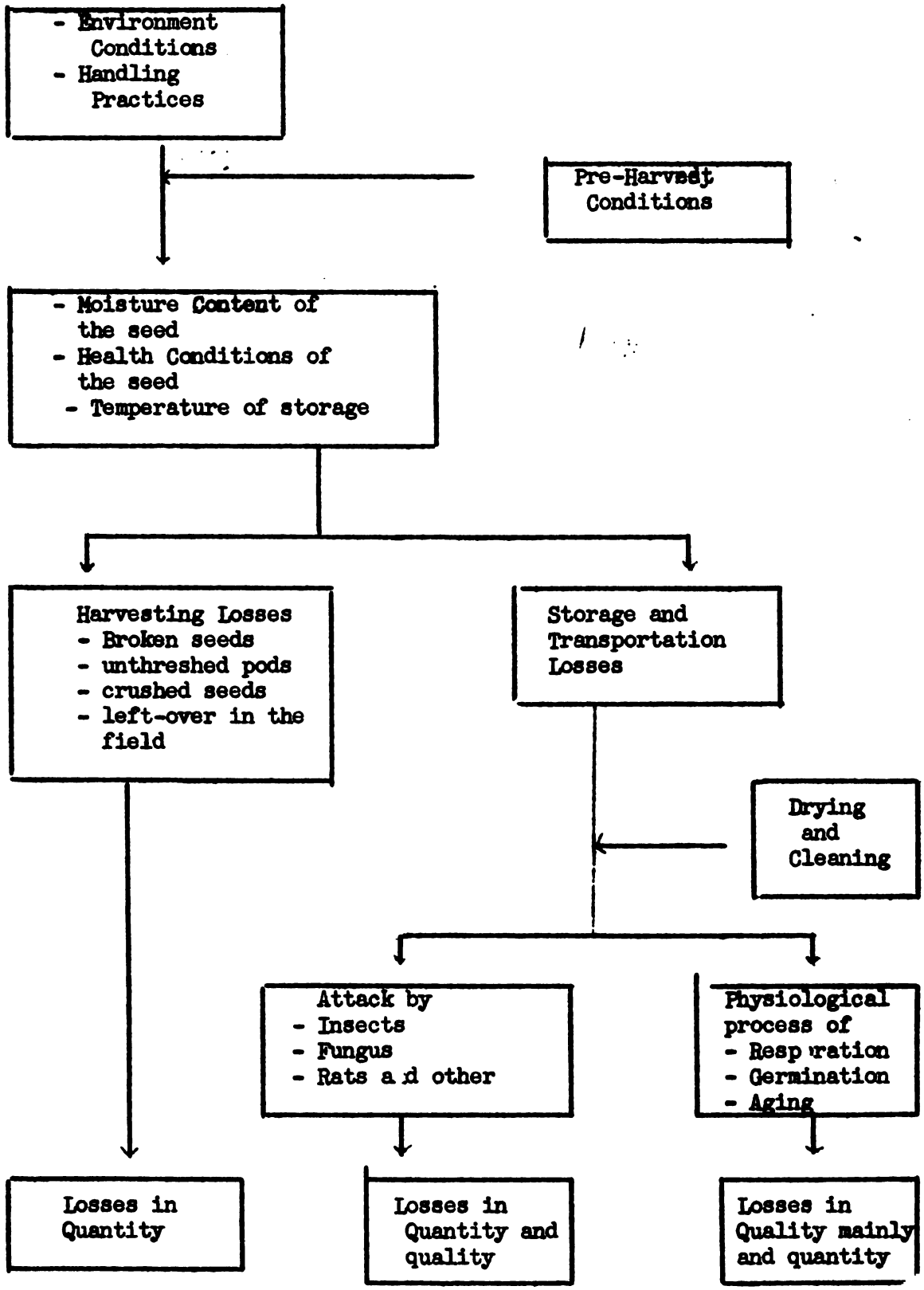
While the emphasis here rests on post-harvest losses, it must be accepted that a number of factors which may occur prior to harvest can also result in serious loss. Factors such as time of planting, fertilizer, management, pest and disease control ,weed control, unfavourable weather, etc., can have their adverse effects felt during harvest or still later, at the post-harvest stage.

In Diagram No. 2 a sequential description of the hypothesis on the causes of losses is presented. These deteriorating processes as reflected in the diagram are to be modified if reduction of the losses are to be obtained.

These diagram stresses the fact about the interrelations among the several factors and also the couse-effect relations that exists among them. It is made very clear the existance of a chain of relations that is accelerated or not depending on how the grain is treated.

On the other hand, it should be noted that every action to reduce losses have a cost and therefore, will not only influence the amount that actually reaches the consumer but alos the cost of getting the product to the market.

DIAGRAM No. 2: The Occurrence of Losses in Blackeye Pea



These are some of the more frequent avenues along which post-harvest losses occur. It is important to be aware of and concerned about their existence. All too often, simple remedial action such as use of proper machines, correct adjustments to machines (both harvesters and threshers), efficient drying, general sanitation and constant watchfulness are overlooked.

Post-harvest losses are classified as such because these losses are observed during post-harvest operations. However, many of these problems have their roots in farmers attitudes and practices which prevail long before the harvest begins and in the practices and attitudes of the peoples and institutions involve in the marketing of this peas as also other products.