A SURVEY OF EGYPTIAN POTATO PRODUCERS' STORAGE PRACTICES

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Summary

This study examines Egyptian potato producers' storage practices and experience with both Nowlat and refrigerated storage of summer crop potatoes in a sample covering the important potato production districts. The 164 producers included in the sample were from 24 villages located in the Minufia, Gharbia, and Behera governorates.

The sample covered a range of farm sizes varying from just over 1 feddan to 50 feddans, with average landholdings of 9.2 feddans. Almost all respondents produced both summer and Nili potatoes. Land area devoted to the summer crop ranged from .1 to 15 feddans, with an average of 2.29 feddans. Land area devoted to Nili potatoes ranged from .08 to 20 feddans with an average of 3.04 feddans. Average yields were 8.64 tons per feddan for summer potatoes and 7.36 tons per feddan for Nili potatoes. The largest and smallest producers enjoyed above average yields for both crops.

A total of 143 respondents (87.2 percent of the sample) indicated that they stored summer potatoes to use as seed for their Nili crop. Just over 61 percent of these same respondents also stored summer potatoes for sale on the local market to take advantage of price movements. Four respondents who did not store seed potatoes did store potatoes for the local market. A total of 97 (66.4 percent) respondents stored some of their crop in home Nowlat storage, 52 (35.6 percent) utilized refrigerated storage, and 24 (16.4 percent) used Nowlat storage located in the village. The respondents who stored the largest amounts of potatoes tended to use a combination of Nowlat and refrigerated storage. Respondents reported that they stored 54.8 percent of their summer potato crop, and of this amount, 34.7 percent were stored for seeds and 65.3 percent for sale on the local market.

Respondents reported that the potatoes they stored were sold at the farm gate (17.6 percent), at a village market (15.3 percent), at a wholesale market (55.8 percent), or through a middleman or broker (11.8 percent). Those respondents with small quantities tended to sell at the farm gate or village market and the producers with large quantities tended to use middlemen or brokers.

Length of storage of potatoes for the local market varied from 1.5 to 4 months with 26.3 percent of the respondents storing 48.4 percent of the potatoes for 1.5 to 2.5 months, 41.4 percent of the respondents storing 36.9 percent of the potatoes for three months, and 32.3 percent of the respondents storing 14.7 percent of the potatoes for 4 months. Respondents reported price increases for stored potatoes ranging from LE 15 to LE 130 per ton with an average of LE 50.09 per ton. Average price increases during the storage period were: 1.5 to 2 months, LE 47.92; 2.5 to 3 months, LE 65.41; and 4 months, LE 32.08. The price pattern observed, with prices decreasing from 3 to 4 months, is probably explained by both supply-demand relationships and decreases in quality during storage.

The capacity of home Nowlat storage facilities ranged from 2 to 150 tons with an average of 13.5 tons. Reported construction costs averaged LE 24.86 per ton of capacity. Storage costs ranged from LE 2 to LE 10 per ton with an average of LE 5.58 per ton. Costs remain fairly constant regardless of length of storage, and there are no economies of size for home Nowlat storage. The capacity of village Nowlat storage ranged from 3 to 250 tons with an average of 32.2 tons. Average construction costs were LE 24.59 per ton. Storage costs ranged from LE 2.5 to LE 9 per ton with an average of LE 4.10 per ton. Costs of storage did not increase with length of storage, and there are no economies of size.

Costs of storing potatoes in refrigerated storage ranged from LE 18 to LE 45 per ton with an average of LE 28.17 per ton. Transportation costs to move potatoes to refrigerated storage averaged LE 2.95 per ton and did not appear to vary with distance. Refrigerated storage costs did vary with length of storage. They averaged LE 23.33 to 3 months and LE 33.10 for 4 months.

Respondents' listed sales prices of stored potatoes by end use. The prices of Nowlat stored potatoes sold for seed ranged from LE 90 to LE 200 per ton with an average of LE 148.16 per ton. The prices of Nowlat stored potatoes sold for local consumption ranged from LE 100 to LE 140 with an average of LE 116.37 per ton. Refrigerated potatoes were not sold for local consumption. Prices of refrigerated potatoes sold for seed ranged from LE 130 to LE 210 with an average of LE 167.87 per ton.

There is a significant difference in storage waste between Nowlat and refrigerated storage. Average waste in Nowlat storage increased from 8.4 percent for 2 months storage to 9.4 percent for 3 months to 12.6 percent for 4 months storage. Average waste in refrigerated storage increased from 1.4 percent for 3 months to 2.3 percent for 4 months storage.

Losses during the storage period are significantly lower for refrigerated than for Nowlat storage but costs are much higher. Many producers find refrigerated storage difficult to justify on an economic basis when only waste and storage costs are considered. Under typical conditions, the price of potatoes would have to be very high to justify the extra expenditure for refrigerated storage. However, if there are price differentials due to quality differences, as survey results indicate, then refrigerated storage can be justified. Seed potatoes stored in refrigerated storage were priced an average LE 19.71 per ton higher than seed potatoes stored in Nowlat. Using average costs and the loss experience for 3 months storage reveals that

returns would be LE 10.70 per ton greater in refrigerated storage than in Nowlat storage. The examples utilized indicate that there may be economic advantages from expansion of refrigerated storage facilities but that these advantages depend on the loss experience of individual producers and price movements during the storage period. Further work on quality and price differentials by type of storage by production district would be helpful in formulating plans and recommendations.

A SURVEY OF EGYPTIAN POTATO PRODUCERS' STORAGE PRACTICES

By

Nabil T. Habashy and Hoy F. Carman

Egyptian potato producers often store a portion of their crop to use as seed or for later sale at improved prices. Storage may be in home or village Nowlat storage or in a central refrigerated storage facility. Nowlat (unrefrigerated) storage is a relatively inexpensive and convenient method of storage but it can have comparatively high losses. Loss rates in refrigerated storage are small but the use of such storage may involve additional transportation and handling expenses as well as the higher storage charges.

This report summarizes the results of a survey of potato producers in eight important production districts conducted during Fall 1983. Farmers were asked questions regarding their production of potatoes, storage practices, costs of storage, loss experience, and reasons for choosing the storage method utilized. A copy of the questionnaire is included as Appendix A.

The Sample

A multistage sampling procedure was utilized. Approximately 70-80 percent of potato production in Egypt is concentrated in the Minufia, Gharbia, and Behera governorates. Three districts in each of the governorates (a total of nine districts) were selected and checked against the following criteria:

- production of summer and/or Nili crops.

- the existence of Nowlat and/or refrigerated storage facilities.

- storage of potatoes for both seed and the local market.

- variation in distances from the refrigerated storage facilities.

One district's production was concentrated in early summer potatoes which were exported without storage. It was dropped from further consideration and the sample villages were selected from the remaining eight districts. The selection of villages included six from the Minufia governorate, nine from Gharbia governorate, and nine from the Behera governorate. A random sample of 164 producers was selected from the 24 villages and interviews were conducted with each producer.

Farm Size and Potato Production

The sample covered a range of farm sizes varying from just over 1 feddan to 50 feddans. A distribution of farm sizes and total area of land holdings is shown in Table 1. The total land area tends to be relatively concentrated, as is often the case. Note that producers with 20 or more feddans made up just 15.8 percent of the total sample but held 53.4 percent of the total land. At the other end of the scale, the 54.9 percent of the farmers with less than 5 feddans held only 17.1 percent of the total land area in the sample. The average landholdings for all producers in the sample was 9.2 feddans.

Table 1. Distribution of Total Landholdings
for the Potato Producer Sample

Category	Number of Farms	Percent of Farms	Area for Category	Percent of Total Area
Number of feddans	Number	Percent	Feddans	Percent
0- 1.99	19	11.6	27.91	1.9
2- 4.99	71	43.3	225.60	15.2
5- 9.99	28	17.1	180.26	12.2
10-19.99	20	12.2	255.12	17.3
20-29.99	15	9.1	337.88	22.8
30 and more	11	6.7	452.00	30.6
Total	164	100.0	1478.77	100.0

Source: Survey data.

Summer Potato Production

Almost all respondents produced both summer and Nili potatoes. The average area devoted to summer potatoes by the 163 respondents who produced the summer crop was 2.29 feddans with a range of .1 to 15 feddans. The proportion of total land area devoted to summer potato production ranged from 3 percent to 85 percent with an average of 22.3 percent. Regression results on the proportion of land devoted to summer potato production are consistent with the simple average. The estimated equation is:

$$SPF = .2299 + .2269TF \qquad R^2 = .76$$
$$\quad (1.64) \quad (22.71)$$

where SPF is the number of feddans devoted to summer potatoes, TF is total feddans of land area and the figures in parentheses are the t-statistics.

As expected, and as shown in Table 2, the total area devoted to summer potato production is quite concentrated. The largest 15.2 percent of the summer potato producers accounted for 50.7 percent of total area. At the

Table 2. Distribution of Land Area Devoted to Summer Potato Production

Area Category	Number of Producers	Percent of Producers	Total Area For Category	Percent of Total Area
			---feddans---	
0- .99 feddans	38	23.2	18.4	4.9
1- 1.99	61	37.2	70.7	19.0
2- 2.99	29	17.7	60.6	16.3
3- 3.99	11	6.7	33.8	9.1
4- 4.99	5	3.0	20.5	5.5
5- 9.99	11	6.7	58.5	15.7
10-16	9	5.5	110.0	29.5
Total	164	100.0	372.5	100.0

Source: Survey data.

other end of the scale, 60.4 percent of the smallest producers accounted for only 23.9 percent of the total summer potato area in the sample.

Total production of summer potatoes is also quite concentrated. Respondents who produced 30 or more tons of summer potatoes made up 15.3 percent of the sample but accounted for 57 percent of total production (Table 3). Producers with less than 15 tons of summer potato production made up 63.4 percent of the sample but accounted for only 23.5 percent of total production. Production was slightly more concentrated than area because the largest producers also enjoyed above average yields. Average summer potato yields for the total sample were 8.64 tons per feddan with a range of 3 to 15 tons per feddan. Producers with an area of 10-16 feddans of summer potatoes had average yields of 10.67 tons per feddan. Note that the other group of producers with above average yields were producers with less than one feddan of summer potatoes. This group had average yields of 9.36 tons per feddan.

Table 3. Distribution of Total Summer Potato Production by Selected Categories

Total Production Category	Number of Producers	Percent of Producers	Total Production for Category	Percent of Total Production
			------tons------	
0- 4.99 Tons	25	15.2	72.1	2.1
5- 9.99	43	26.2	312.8	9.3
10- 14.99	36	22.0	410.0	12.1
15- 19.99	20	12.2	321.5	9.5
20- 29.99	15	9.1	338.2	10.0
30- 49.99	11	6.7	406.8	12.0
50- 99.99	7	4.3	424.0	12.5
100-226	7	4.3	1097.0	32.5
Total	164	100.0	3382.4	100.0

Source: Survey data.

Nili Potato Production

The average area devoted to Nili potatoes by the 160 respondents who produced the Nili crop was 3.04 feddans with a range of .08 to 20 feddans. The proportion of total land area devoted to Nili potatoes ranged from 6.8 percent to 93 percent with an average of 29.6 percent. The regression equation for land area planted to Nili potatoes is:

$$NPF = .4216 + .2862TF \qquad R^2 = .74$$
$$(2.20) \quad (21.10)$$

where NPF is the number of feddans planted to Nili potatoes, TF is total feddans of land area and the figures in parentheses are t-statistics.

Respondents planted more Nili potatoes than they did summer potatoes but the concentration of total area for the largest producers was similar for the two crops. Table 4 shows that 18.3 percent of the respondents (those producing 5 or more feddans) accounted for 55.7 percent of the area devoted to

Table 4. Distribution of Land Area Devoted to Nili Potato Production

Area Category	Number of Producers	Percent of Producers	Total Area For Category	Percent of Total Area
			--feddans--	
0- .99 Feddans	33	20.1	16.2	3.3
1- 1.99	49	29.9	60.8	12.5
2- 2.99	27	16.5	56.0	11.5
3- 3.99	19	11.6	58.3	12.0
4- 4.99	6	3.7	24.0	5.0
5- 9.99	17	10.4	94.5	19.5
10-20	13	7.9	176.0	36.2
Total	164	100.0	485.7	100.0

Source: Survey data.

the Nili crop. Note that 30 respondents produced 5 or more feddans of Nili potatoes (Table 4) but only 20 respondents had a similar area planted to summer potatoes (Table 2). One-half of the respondents planted less than 2 feddans of Nili potatoes and those respondents accounted for only 15.8 percent of the total area of Nili potatoes in the sample.

A comparison of Tables 3 and 5 reveals that total production of Nili potatoes was greater than total production of summer potatoes because of the larger area devoted to Nili potatoes by sample respondents. Total production of Nili potatoes was also quite concentrated. The smallest 27 producers (16.5 percent of the sample) accounted for 2 percent of total production while the largest 27 producers accounted for 61.4 percent of total production.

Table 5. Distribution of Total Nili Potato Production by Selected Categories

Total Production Category	Number of Producers	Percent of Producers	Total Production for Category	Percent of Total Production
			------tons------	
0- 4.99 Tons	27	16.5	76.9	2.0
5- 9.99	39	23.8	264.9	6.8
10- 14.99	33	20.1	393.9	10.2
15- 19.99	16	9.8	259.0	6.7
20- 29.99	22	13.4	500.5	12.9
30- 49.99	10	6.1	361.5	9.3
50- 99.99	10	6.1	671.0	17.3
100-285	7	4.3	1350.5	34.8
Total	164	100.0	3878.2	100.0

Source: Survey data.

Average yields for Nili potatoes were 7.36 tons per feddan which was 1.28 tons per feddan less than summer potatoes. The range of yields was also larger, from 1.5 to 43.75 tons per feddan. The average sample respondent

produced 20.75 tons of Nili potatoes. Again, the largest producers (those with 10 to 20 feddans of Nili potatoes) and the smallest producers (those with less than 1 feddan of Nili potatoes) enjoyed the highest average yields, 9.73 and 8.54 tons per feddan, respectively.

Potato Storage Practices

Survey respondents were asked to describe whether or not they stored summer potatoes, types of storage utilized, proximity of storage to their farm, amount of potatoes stored, length of time stored, markets utilized and price changes during the storage period.

Types of Storage

A total of 143 respondents indicated that they stored summer potatoes to use as seeds for their Nili crop. Four respondents indicated that they stored summer potatoes to take advantage of price movements but did not store seed potatoes, and 16 respondents (9.8 percent) indicated that they did not store any of their summer potato crop. These latter producers were much smaller than average with 15 of the 16 devoting 1 feddan or less to summer potatoes. Just over 61 percent of the respondents who store summer potatoes for use as Nili seed also store summer potatoes to take advantage of price movements.

Survey respondents who stored summer potatoes utilized three types of storage, either alone or in combination. As shown in Table 6, a total of 97 (66.4 percent) respondents stored some of their crop in home Nowlat storage, 52 (35.6 percent) utilized refrigerated storage, and 24 (16.4 percent) respondents used a village Nowlat. The respondents who stored the largest quantities of potatoes tended to use a combination of Nowlat (home or village) and refrigerated storage. Those who utilized a combination of storage facilities

made up only 18.5 percent of sample respondents who stored potatoes but accounted for 47.1 percent of the potatoes stored.

Table 6.   Type of Facilities Utilized for Summer Potato Storage

Type of Storage	Number of Respondents	Percent of Respondents	Quantity Stored	Percent of Total Quantity
		--percent--	--tons--	---percent----
Home Nowlat only	80	54.8	620.10	33.4
Village Nowlat only	14	9.6	116.15	6.3
Refrigerated only	25	17.1	243.75	13.2
Home Nowlat and refrigerated	17	11.6	440.00	23.7
Village Nowlat and refrigerated	10	6.9·	434.00	23.4
Total	146	100.0	1854.00	100.0

Source: Survey data.

Quantities of Potatoes Stored

Sample respondents stored a total of 1,854 tons of potatoes, 643.9 tons (34.7 percent) for seeds and 1,210.1 tons (65.3 percent) for sale on the local market.   The distribution of respondents by quantity of potatoes stored for seed is shown in Table 7.   The seed potato storage of 643.9 tons was just over 19 percent of total summer potato production reported by sample respondents. The proportion of the summer crop stored for seed by individual respondents varied significantly and was related to summer potato production.   For example, respondents with less than 5 tons of total production stored an average of 52 percent of their summer crop for seed.   Percentages stored for seed by other production categories were: 5-9.99 tons, 26 percent; 10-19.99 tons, 25 percent; 20-49.99 tons, 20 percent; 50-99.99 tons, 19 percent; and over 100 tons, 10 percent.

Table 7. Distribution of Quantities of Summer Potatoes Stored for Seeds

Quantity Stored Category	Number of Producers	Percent of Producers	Total Quantity Stored	Percent of Total Quantity
		-percent--	-----tons-----	---percent----
.1- .99 Tons	8	5.6	6.4	1.0
1 - 1.99	17	11.9	20.5	3.2
2 - 2.99	41	28.7	86.5	13.4
3 - 3.99	20	14.0	60.0	9.3
4 - 4.99	14	9.8	56.5	8.8
5 - 5.99	12	8.4	60.0	9.3
6 - 9.99	14	9.8	99.0	15.4
10 -15	13	9.1	155.0	24.1
16 -30	4	2.8	100.0	15.5
Total	143	100.0	643.9	100.0

Source: Survey data.

The distribution of quantities of summer potatoes stored for sale on the local market is shown in Table 8. Overall, 35.8 percent of the summer crop was stored for later sale. The simple average of percentage stored by individual respondents was 38 percent. There was not a clear relationship

Table 8. Distribution of Quantites of Summer Potatoes Stored for Sale on the Local Market

Quantity Stored Category	Number of Producers	Percent of Producers	Total Quantity Stored	Percent of Total Quantity
		-percent--	-----tons-----	---percent----
.1- 4.99 Tons	30	31.6	69.1	5.7
5 - 9.99	32	33.7	195.0	16.1
10 - 19.99	15	15.8	209.0	17.3
20 - 30	13	13.7	332.0	27.4
31 - 50	3	3.2	125.0	10.3
51 -150	2	2.1	280.0	23.2
Total	95	100.0	1210.1	100.0

Source: Survey data.

between percentage of crop stored and production, but the smallest producers did tend to store a higher percentage of their crop than did the largest producers. As expected, the largest producers stored the largest quantities of potatoes and a relatively small proportion controlled the majority of potatoes stored for later sale. Eighteen respondents (19 percent) had almost 61 percent of the crop in storage (Table 8).

Refrigerator Ownership and Location

Respondents who utilized refrigerated storage were asked for the name and ownership of the facilities. Of the 57 who responded to the question, 16 (27 percent) reported that they stored their potatoes in privately owned facilities and 43 (73 percent) utilized publicly owned facilities.

The proximity of refrigerated storage to respondents' farms varied from .25 kilometers to 40 kilometers with an average of 16.86 kilometers. The distribution of distances between farms and refrigerators for respondents who utilized refrigerated facilities for potato storage is shown in Table 9.

Table 9. Distribution of Distances Between Respondents' Farms and Refrigerated Storage Facilities Utilized

Distance Category	Number of Respondents	Percent of Respondents
.1- 4.9 Kilometers	14	26.9
5 - 9.9	5	9.6
10 -19.9	13	25.0
20 -29.9	2	3.8
30 -39.9	12	23.1
40	6	11.5
Total	52	100.0

Source: Survey data.

Note that just over two-thirds of the respondents had to transport their potatoes between 10 and 40 kilometers to refrigerated facilities.

Markets, Storage Periods and Price Changes

Respondents were asked for the market outlet where they sold the summer potatoes they stored. Their responses are summarized in Table 10. The majority of respondents who answered the question reported that they sold their potatoes through a wholesale market. Note that this market outlet also accounted for the majority of the potatoes sold out of storage. The smallest average quantities (6.75 tons per respondent) were sold at the farm gate while the largest average quantities (20.8 tons per respondent) were sold through middlemen and brokers.

Table 10. Distribution of Market Outlets for Stored
Summer Potatoes and Total Quantities Sold

Market Outlet	Number of Respondents	Percent of Respondents	Quantity Sold	Percent of Total Quantity
		--percent--	--tons--	---percent----
Farm Gate	15	17.6	98.5	9.8
Village Market	13	15.3	125.2	12.5
Wholesale Market	47	55.3	573.0	57.0
Middlemen or Brokers	10	11.8	208.0	20.7
Total	85	100.0	1004.7	100.0

Source: Survey data.

The length of storage and amounts stored for sale are shown in Table 11. The most popular storage period was three months followed by four months and two months. Average and total quantities stored, however, were greatest for two months and average quantities stored were smallest for four months.

Table 11. Distribution of Storage Periods and Total
Quantities Stored for Sale

Storage Period	Number of Respondents	Percent of Respondents	Total Quantity Stored	Percent of Total Quantity
		--percent--	-----tons-----	---percent----
1.5 Months	2	1.5	20	1.7
2	28	21.0	536	44.5
2.5	5	3.8	26	2.2
3	55	41.4	444.9	36.9
4	43	32.3	177.2	14.7
Total	133	100.0	1204.1	100.0

Source: Survey data.

Survey respondents reported that potato prices increased from £E 15 to £E 130 per ton with an average increase of £E 50.09 per ton during the storage period. Average prices increased through three months to £E 65.41 per ton and average price increases then decreased to £E 32.08 per ton. The price pattern observed is probably explained by both supply-demand relationships and quality changes during storage. The percentage of waste in Nowlat storage increases with the storage period. Thus, the average quality of potatoes decreases with the length of storage. The quality decrease which occurs between three months and four months of storage appears to have outweighted the impact of reduced supplies available four months after harvest.

Table 12. Average Price Increases for Stored Potatoes by
Length of Storage Period

Storage Period	Average Price Increase
----months----	------£E per ton------
1.5- 2	47.92
2.5- 3	65.41
4	32.08

Price changes realized during the storage period were also related to the market outlets utilized. Producers who sold their output at the farm gate realized the smallest price increases which averaged £E 29.00 per ton. Note that 14 of the 15 respondents who sold potatoes at the farm gate after storage held their potatoes in storage for four months. The price increase for producers who sold potatoes at the village market averaged £E 51.92 per ton while the increase for those who utilized middlemen and brokers averaged £E 62.22 per ton. Five of the 13 producers who utilized the village market stored their potatoes for four months while none of the producers who utilized middlemen or brokers stored four months and five of the ten had a storage period of three months. The largest average price increase of £E 81.70 per ton was realized by producers who sold their potatoes at a wholesale market. Among this group, only three of the 43 producers stored their potatoes four months and 34 reported a storage period of three months.

Storage Capacity and Costs

Survey respondents were asked for information on capacity and costs for the storage facilities utilized. They provided data on capacity, estimated construction costs, and storage costs per ton for home and village Nowlat storage. They also provided costs of transportation and storage costs per ton for refrigerated storage.

The capacity of home Nowlat storage facilities ranged from 2 to 150 tons with an average of 13.5 tons. The distribution of capacities reported is shown in Table 13. Note that the 17 (17.6 percent) respondents with the largest facilities accounted for just over 50 percent of home storage capacity. Total construction costs for home Nowlat storage ranged from £E 30

to £E 1000. Construction costs per ton of capacity ranged from £E 3 to

£E 93.3 with an average of £E 24.86 per ton.

Table 13. Distribution of Capacities for Home Nowlat
Potato Storage Facilities

Capacity Category	Number of Respondents	Percent of Respondents	Total Capacity	Percent of Total Capacity
			--tons--	
.1- 4.99 Tons	21	21.6	68.5	5.3
5 - 9.99	25	25.8	148.0	11.3
10 - 14.99	21	21.6	221.0	16.9
15 - 19.99	13	13.4	198.0	15.2
20 - 30	11	11.4	255.0	19.5
40 -150	6	6.2	415.0	31.8
Total	97	100.0	1305.5	100.0

Source: Survey data.

The costs for storing summer potatoes in home Nowlat storage ranged from

£E 2 to £E 10 per ton with an average reported cost of £E 5.58 per ton. The

distribution of costs is shown in Table 14. The costs reported by each

Table 14. Distribution of Costs Per Ton for Storing Potatoes
in Home Nowlat Storage

Cost Category	Number of Respondents	Percent of Respondents
£E 2.0- 2.9	3	3.1
3.0- 3.9	7	7.2
4.0- 4.9	27	27.8
5.0- 5.9	14	14.4
6.0- 6.9	8	8.3
7.0- 7.9	23	23.7
8.0-10	15	15.5
Total	97	100.0

producer were related to the length of the storage period, which ranged from two to four months. Costs of home Nowlat storage do not increase with time as occurs with refrigerated storage. Average costs per ton by length of storage were: two months, £E 6.78; three months, £E 5.88; and four months, £E 3.96. There are no economies of size for home Nowlat storage. Instead, costs per ton of potatoes stored tends to increase with the size of the facility.

The capacity of village Nowlat potato storage facilities ranged from 3 tons to 250 tons with an average of 32.21 tons. The distribution of reported capacities is shown in Table 15. Six (25 percent) of the village Nowlat facilities accounted for 71.1 percent of total capacity. Total construction costs of the village Nowlats ranged from £E 150 to £E 3000. Construction costs per ton of capacity ranged from £E 4 to £E 66.67 with an average of £E 24.59. Note that this is very close to the reported cost for home Nowlat capacity.

Table 15. Distribution of Capacities for Village Nowlat Potato Storage Facilities

Capacity Category	Number of Respondents	Percent of Respondents	Total Capacity	Percent of Total Capacity
			--tons--	
3- 4.99 Tons	3	12.5	10	1.3
5- 9.99	4	16.7	23	3.0
10- 14.99	4	16.7	40	5.2
15- 19.99	3	12.5	45	5.8
20- 30	4	16.7	105	13.6
50-250	6	25.0	550	71.1
Total	24	100.0	773	100.0

Source: Survey data.

The costs of storing potatoes in village Nowlat ranged from £E 2.5 per ton to £E 9 per ton with an average of £E 4.10 per ton. Ten of the 24 respondents reported storage costs of £E 3 per ton. As was the case with home Nowlat storage, costs of storing potatoes do not increase with the length of the storage period. Likewise, there are no economies of size present for the range of sizes examined.

Respondents were asked whether or not they could store potatoes in other farmers' Nowlat facilities and, if so, the cost per ton. Only 18 respondents indicated that they could store potatoes in other farmers' Nowlat and the costs reported demonstrated considerable variation. Costs reported ranged from £E 2 per ton (four responses) to £E 25 per ton (one response). The average cost was £E 6.16 per ton for all 18 respondents but this reduced to £E 5.06 per ton when the £E 25 per ton observation was excluded.

Respondents who utilized refrigerated storage were asked to report transportation and storage costs. Refrigerated storage costs ranged from £E 18 to £E 45 per ton with an average of £E 28.17. Over half of the respondents (27 of 49) reported costs in the £E 25 to £E 30 per ton range and 12 respondents reported costs of £E 35 and £E 40 per ton. Refrigerated storage costs did vary with the length of the storage period. Only three respondents reported a storage period of two months and they had an average cost of £E 21 per ton. The respondents who stored potatoes for three months (21) had an average cost of £E 23.33, while those who stored for four months (25) reported average costs of £E 33.10.

Costs of transportation from the farm to the refrigerated storage facility ranged from £E 1 to £E 8 per ton with an average of £E 2.95 per ton. A total of 36 of 49 respondents (73.5 percent) reported a transportation cost of £E 2 to £E 3 per ton. Regression analysis revealed no relationship between

reported transportation costs per ton and distance. For the range of distances observed, it appears that transportation costs are essentially constant. Perhaps this is due to various methods utilized which may be related to the distance the potatoes were moved.

Potato Prices After Storage

Respondents were asked for the selling price of potatoes stored in Nowlat and refrigerated storage when sold for seed and local consumption. The price of Nowlat potatoes sold for seed ranged from £E 90 to £E 200 per ton with an average of £E 148.16 per ton. A total of 55 of the 117 respondents (47 percent) who responded listed a price of £E 140 or £E 150 per ton. The price of Nowlat potatoes sold for local consumption was lower than the seed price. Prices for local consumption ranged from £E 100 to £E 140 with an average of £E 116.37. Of the 35 responses, 12 (34 percent) listed a price of £E 110 and 15 (43 percent) listed a price of £E 120.

None of the respondents listed a price for refrigerated potatoes sold for local consumption implying that summer potatoes stored in refrigerated storage were all used for seed. The price of potatoes stored in refrigerated storage and sold for seed ranged from £E 130 to £E 210 per ton with an average of £E 167.87. A total of 40 of the 68 respondents (59 percent) listed a price of £E 150, £E 160 or £E 170 per ton. Note that prices reported must have reflected opinions, as well as, experience since only 43 of the 69 respondents who listed a price reported that they utilized refrigerated storage. In addition, only 8 respondents stated that they did not store seed potatoes and purchased seeds from either the private sector (3) or the public sector (5). Since the prices reported were not associated with actual sales

we were unable to relate prices to length of storage or make other comparisons.

Storage Waste

Respondents were asked the length of time they stored potatoes and the percentage of waste experienced during that time period for both Nowlat and refrigerated storage. The waste reported for Nowlat storage was much greater than for refrigerated storage for each period.

The percentage waste experienced in Nowlat storage by length of storage is shown in Table 16. Individual producers reported waste ranging from 3 to 15 percent for two months storage in Nowlat with an average of 8.4 percent. When weighted by quantity stored, average waste for two months Nowlat storage increased to 9.1 percent. The waste reported for three months Nowlat storage ranged from 4 to 20 percent with an average of 9.4 percent. The waste reported for four months storage in Nowlat ranged from 3 to 80 percent with a simple average of 12.6 percent and a weighted average of 9.7 percent.

Table 16. Distribution of Storage Waste for Nowlat Storage by Length of Storage

Length of Storage	Number of Respondents	Simple Average Waste	Weighted Average Waste*
		----------percent----------	
2 months	38	8.4	9.1
3	56	9.4	9.4
4	32	12.6	9.7

*Weighted by quantity stored.

Source: Survey data.

The percentage waste experienced during refrigerated storage by length of storage is shown in Table 17. Note that only three respondents reported refrigerated storage of two months. Individual producers reported losses ranging from 1 to 3 percent for two months storage in refrigerated storage with an average of 1.4 percent. Waste reported for three months refrigerated storage ranged from 1 to 6 percent with a simple average of 2.3 percent and a weighted average of 2.6 percent waste.

Table 17. Distribution of Storage Waste for Refrigerated
Storage by Length of Storage

Length of Storage	Number of Respondents	Simple Average Waste	Weighted Average Waste*
		------------------percent------------------	
2 months	3	1.6	1.7
3	17	1.4	1.5
4	26	2.3	2.6

*Weighted by quantity stored.

Source: Survey data.

Refrigerated vs. Nowlat Storage

Losses during the storage period are significantly lower for refrigerated than for Nowlat storage but costs are much higher. Many producers find refrigerated storage difficult to justify on an economic basis when only waste and storage costs are considered. However, it can be shown that price differentials due to quality differences are important and can favor refrigerated storage.

An example, based on survey data, illustrates the importance of considering waste, prices and price differentials over time in analyzing the economics of refrigerated vs. Nowlat storage. The average reported cost for

three months storage in home Nowlat was £E 5.88 per ton; the similar figure for refrigerated storage was £E 23.33 per ton. There was also an average transportation charge of £E 2.95 per ton for refrigerated storage. Thus, the total cost for refrigerated storage was £E 26.28 per ton, £E 20.40 per ton greater than home Nowlat storage. Average waste realized for three months storage was 9.4 percent in Nowlat and 1.4 percent in refrigerated storage. Thus, the producer is able to realize a 8.0 percent reduction in waste at a cost of £E 20.40 per ton through refrigerated storage. If the value of the potatoes was equal for each type of storage, the potatoes would need a price of £E 255 per ton to pay the differential for refrigerated storage. Since the highest price reported was £E 210 per ton, it appears that Nowlat storage is the best economic alternative. However, if there is a premium for potatoes stored in refrigerated storage, as survey results indicate, then the breakeven price may be much lower than £E 255. The average price of Nowlat stored potatoes sold for seed was £E 148.16 per ton, while that of refrigerated potatoes sold for seed was £E 167.87, a differential of £E 19.71 per ton. The average prices reported above can be used to show the advantage of refrigerated storage. Total revenue realized by a producer is the sales price minus storage costs adjusted for the proportion of salable product. This calculation for Nowlat storage is:

$$(£E \ 148.16 - £E \ 5.88) \ .906 = £E \ 128.91$$

The similar calculation for refrigerated storage is:

$$(£E \ 167.87 - £E \ 26.28) \ .986 = £E \ 139.61$$

Thus, refrigerated storage returns £E 10.70 per ton more than Nowlat storage, given the differential in prices reported.

Increasing waste and quality differences occurring in the movement from three to four months storage would appear to increase the advantage of refrigerated storage. However, using the average waste and storage costs developed earlier with the same average prices used above results in a decreased advantage for refrigerated storage. The calculation for Nowlat storage is:

$$(£E\ 148.16 - £E\ 3.96)\ .874 = £E\ 126.03$$

A similar calculation for refrigerated storage is:

$$(£E\ 167.87 - £E\ 36.05)\ .977 = £E\ 128.35$$

Note that use of the weighted average waste figures would reverse the advantage for four months storage to be slightly in favor of Nowlat storage.

The examples above indicate that there may be economic advantages from expansion of refrigerated storage facilities but that these advantages depend on the loss experience of individual producers and price movement during the storage period. Further work on quality and price differentials by type of storage by production district would be helpful in formulating plans and recommendations.

Storage Preferences

Survey respondents were asked to list reasons why they preferred to store potatoes either in Nowlat or refrigerated storage. Some responses are based on comparisons of the two types of storage while others refer to just the one type of storage. There were 581 responses for Nowlat storage, an average of

3.5 per respondent and 433 responses for referigerated storage, an average of
2.6 per respondent.

Reasons for preferring Nowlat storage and the number of respondents who
listed the reasons are: (1) The storage is located in the village,
103 respondents; (2) Potatoes which are stored are marketed at an increased
price, 16 respondents; (3) Low storage costs, 107 respondents; (4) The
producer can withdraw any quantity of potatoes at any time, 102 respondents;
(5) The refrigeration is too far from the village, 74 respondents; (6) Can
cultivate early Nili potatoes, 73 respondents; (7) Avoids electrical problems
which sometimes occur in refrigerated storage, 39 respondents; and, other
reasons, 67 respondents.

Reasons given for preferring refrigerated storage and the number of
respondents who listed the reason are: (1) It guarantees that the potatoes
will not get rancid, 95 respondents; (2) Decreases the percentage of waste,
82 respondents; (3) It is near the village, 47 respondents; (4) Do not need
to perform operations such as adding powder, turning the crop, etc.,
88 respondents; (5) Other reasons, 69 respondents; and, (6) Cannot withdraw
any quantities before the end of September and consequently have late Nili
cultivation, 52 respondents.

Crop Loans

Respondents were asked whether or not they received crop loans and, if
so, whether it involved an obligation to handle the crop. Among those
respondents answering the questions, 101 said they received no loans or
prepayments on their crop and 28 replied that they had received a loan from
their village bank. Of these 28 respondents, 12 stated that the loan involved
an obligation to deliver the crop to the lender.

Respondents obtained crop loans on amounts ranging from one to 30 tons of summer potatoes with the average being 3.6 tons. The value of the loan per ton ranged from £E 39 to £E 100 with the amount appearing to depend on the village bank involved. Nine respondents received a loan of £E 39 or £E 40 while 19 received loans ranging from £E 80 to £E 100. Prices received for the potatoes under loan were equal to or greater than the loans in all cases. Two respondents stated that the price they received for their crop was less than the market price but neither of these reported that they had an obligation to deliver their crop to the lender.

APPENDIX A

Potato Nowlat and Refrigerator Questionnaire

Respondent No: _____ Village: _____ District: _____

Date: _____

	Feddan	Kerat	Sahm

1. Total Area Holding _____ _____ _____

2. Area of Summer Potatoes _____ _____ _____ and yield (ton/feddan)

3. Area of Nili Potatoes _____ _____ _____ and yield (ton/feddan)

4. Where do you store your potato needed as seeds for Nili cultivation or for storage to be marketed in the local market in the future?

   Do not store ___ Nowlat at home ___ Nowlat at the village ___ Refrigerator ___

   Name of refrigerator _____ Distance between the refrigerator and the

   village _____ Km.

   How much quantities are stored as seeds? _____ tons

   How much quantities are stored to be marketed in the local market? ____ tons

   In what market do you sell your crop _____ and

   How long is the storage period? (_____ month/months)

   If you store potatoes to be sold during the shortage period of the crop in

   the market how much more price do you get per ton? _____

In case of nonstorage:

   From where do you get your seeds? How much is the purchasing price per ton?

   I got my potato seeds from _____ and I pay £E _____ per ton.

5. Nowlat and refrigeration information and storage costs.

   A. Nowlat at home: squared _____

                       cubic meter _____

                       its capacity _____ ton

                       construction costs _____ £E

                       storage cost of one ton _____ £E

B. Nowlat at the village: squared _____

                            cubic meter _____

                            its capicity _____ ton

                            construction costs _____ £E

                            storage cost of one ton _____ £E

C. Refrigerator with capacity of _____ ton and the cost of storing one

    ton is _____ £E and distance from the village _____ K.M.

6. Can you store your potatoes in Nowlat belonging to other people?

                    _____Yes   _____No

In the case of <u>yes</u>

How much do you pay to store one ton in other farmer Nowlat?

            I pay £E _____ ton   Do not pay _____

7. Which of the following reasons makes you prefer to store your potatoes
    either in Nowlat or in the refrigerator?

    A. <u>Nowlat</u>: ___ 1. Exists in the village itself.

                ___ 2. Potatoes stored could be marketed at a better price.

                ___ 3. Storage costs are cheap.

                ___ 4. Can withdraw any quantity at any time.

                ___ 5. The refrigerator is far away from the village.

                ___ 6. Can cultivate early Nili potato.

                ___ 7. Avoid electricity problems sometimes occurring in
                         refrigeration.

                ___ 8. Others

    B. <u>Refrigeration</u>: ___ 1. Guarantee that the crop will never get rancid.

                ___ 2. Decreasing the percentage of waste.

                ___ 3. Near the village.

                ___ 4. Do not need any preparing operations such as adding
                         powder, turning the crop from time to time, etc.

    ___ 5. Others

    ___ 6. Cannot withdraw any quantity before the end of September and consequently late Nili cultivation.

8. What is the selling price of one ton of potatoes stored in Nowlat or in the refrigerator for the local market?

The price of one ton potato stored in Nowlat is _____ £E.

The price of one ton potato stored in refrigerator is _____ £E.

a. Waste resulting from storage _____ months in Nowlat is _____ percent

cost of transporting one ton from the farm to Nowlat is _____£E, cost

of sorting, powder and turning over is _____ £E per ton.

b. Waste resulting from storage _____ months in refrigeration is _____%

cost of transporting one ton from the farm to refrigeration is _____£E

other costs (such as tip ___ etc.) for storage in refrigeration is

_____£E per ton.

9. Do you get any prepayments or loans conditioned by handling your crop?

      _____Yes   _____No

In the case of <u>yes</u>?

What is the source/sources you get your loans from? _____

How much of a loan would you get for one ton? _____£E

How much is your total loan and for how many tons? _____£E _____ tons

Is there any obligation by the lender to handle the crop?

      _____Yes   _____No

In the case of yes?

How much is the selling price for the quantities handled? _____£E

Is such a selling price less than the market price? _____Yes ____No

In the case of yes?

By how much? _____£E

In case of nonhandling what are the penalties? _____