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A DESCRIPTIVE ANALYSIS OF EGYPTIAN AGRARIAN STRUCTURE

by

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1. Introduction

1.1. Main Purpose of Paper

The main purpose of the paper is to use data from the 1976 Farm Management Survey to answer certain key questions relating to the agricultural sector of Egypt. We are interested in extremely basic questions which have heretofore not been sufficiently studied due to inadequate data availability. This will perhaps be the first time a comprehensive micro-level analysis of these issues is attempted on the basis of detailed farm management data.

1.2. Issues to be discussed

1. To begin, we carry out a cluster analysis to determine whether there seem to be criteria more relevant than size alone in setting up groups of farms to analyze the structure of the Egyptian agricultural sector. The discussion is oriented toward both scientific considerations and practicality of setting up diverse criteria.

2. Then, we turn to a description of yield variations by farm size. We not only examine physical yield, but also look at economic productivity across farm sizes. We then proceed to attempt to explain the variations in yields, by referring to variations in input use intensity and other factors such as land tenure.

3. The next topic for analysis is the variation in the cropping patterns across size classes. We look at relationships between family size, livestock, land availability, and cropping patterns.

4. We turn next to the data on the disposition of the various crops. That is, we study the percentages of the various crops going to the free market vs. the government, in relation to farm size.

5. Levels of income by farm type group is the next topic: here we examine the relationship between level of income and farm size, and the contribution made by the various crops to total family income. Off-farm sources of income are also examined. Further, we measure the degree of income inequality in the rural sector using simple measures, such as the Gini coefficient, and compare them to those of other countries. This also provides the basis for eventual comparison with the 1982 data.

6. Finally, we describe the distribution of land tenure forms.

1.3. Description of the Data

The data recently made available through the cooperation of the Egypt and Berkeley offices of the Egypt-California project are a subset of the 1976 Farm Management Survey. These data contain information about many aspects of Egyptian farm management. (A list and brief description of variables can be found in the appendix.) The data were received in Berkeley in several installments starting in the early fall of 1981. They were then coded, entered into computer media, and checked for consistency and errors, all of which was a laborious and lengthy process. In 1982 it was decided to follow up the 1976 survey with a further survey of four of the villages included in 1976. This survey was done under the direction of Gamal Siam and Osman Gad and was carried out in February and March of 1982. We will use the data from this survey to update our results, in a later paper. This is obviously important given that the original survey was taken in 1976 and that there have been important changes since, especially regarding the labor market.

1.4. Context of this Study

For the sake of comparison with our results, and for locating our area of study within the wider Egyptian context, we present a few tables derived from other sources.

First, we present a breakdown of farms by size and location for the three governorates included in our area, according to Ministry of Agriculture data. In the table below, N refers to number of farms in thousands, while A refers to area in thousand feddans.

Farm Size	Sharquia N	Sharquia A	Dakahlia N	Dakahlia A	Domiata N	Domiata A	Total N	Total A
LE 1 feddan	120	73	110	70	6	4	236	147
1-3	146	264	122	228	15	29	283	521
3-5	244	87	34	116	7	26	65	229
5-10	113	81	13	85	3	21	28	188
10-50	8	119	7	118	2	28	16	265
GT 50	0	8	0	89	-	-	0	97
Total	309	631	286	707	32	108	627	1445

Given that Egypt's total farm area is around 5.8 million feddans, we can see that our sampled area covers some 1/5 of the total area. This is also the most productive area of Egypt. Thus, while the sample covers a large and important area, it can not be claimed to be in any way representative of Egyptian agriculture as a whole.

The following table compares our results with the above data. We calculated the percentages vertically for the last two columns of the table above, and present our own data.

Farm Size	%s from above		Our results	
LE 1 feddan	37.5	10.1	6.9	0.7
1-3	45.1	36.1	47.6	15.2
3-5	10.3	15.8	16.6	10.1
5-10	4.4	12.9	12.8	14.5
GT 10	2.5	24.9	16.0	59.5

Our sample seems to be more heavily weighed toward the larger farmers, and away from the smallest, being right on target for the 1-3 feddan category. There is no way we can be absolutely sure whether our distribution is more realistic than the "official" one. It is possible that the "official" picture is not the real one, and that our data reflect the real situation better than the official data. On the other hand, it is possible that our data simply reflect the distribution of farms-as-businesses, rather than the distribution of farms-as-households, as we will explain below. The official data were derived from lists of cooperative members. But in these official rosters, farms that are in fact one operational unit are registered as various distinct farms, owned perhaps by several farmers. This is in fact a common case, though it is impossible to say <u>how</u> common it is. There are several reasons why this situation is so common. First, there are tax exemptions for smaller farms: farms three feddans or under are exempt from land taxes. Farms in the 3-10 feddan category have some exemptions, and farmers in the greater than 10 feddan category have no exemptions at all. Second, fathers may divide the land their sons will inherit on paper, but keep operating it as one farm until their death. Even after, the land would not necessarily be in fact split into as many pieces as the number of inheritors would indicate. Naturally, farmers divide the farms on paper even when operationally several farms are actually one. The way this situation was dealt with in the surveying procedure tended frequently to reflect this reality even if the sampling framework was based on the official statistics. For example, an enumerator might have gone after a specific farmer, whose farm was -officially- smaller than one feddan, only to find that in fact the farm was operated as a three feddan holding by three brothers. In these cases, the enumerator was instructed to treat this farm as a three feddan farm. Similarly, if two farmers <u>were</u>

in the sample, but turned out to run the same farm, then again the enumerator was instructed to consider it as one farm. In both of these situations our data would therefore tend to show less small farms than the official data. Since the sample was weighted according to the "official" relative frequencies of the various farm sizes, and our data show different relative frequencies, it might be thought that we should use the original sampling weights to produce our results. But if our frequencies differ from the official ones for some systematic reasons such as those we have mentioned, we should not use any weights, and simply point out that our data probably reflect more the distribution of agricultural operations rather than households. One way to see how these differences between the official distribution and ours affect some variable on which we have both official information and information from our own sample is to compare results generated with both sources.

The official land tenure data is as follows.

	Sharquia	Dakahlia	Domiata	Total
Total Area rented	242.8	197.5	40.4	480.7
in cash	150.7	144.9	28.2	323.8
sharecropping	92.1	52.7	12.2	157.0
Own Cultivated	368.8	412.5	61.4	842.7
Total	611.6	610.0	101.8	1323.4

To compare briefly with our own results, we look at the vertical percentages for the last column here and present the equivalent values from our sample data.

	%s from above	Our results
Total Area rented	36.3	37.8
in cash	24.4	21.1
sharecropping	11.9	16.6
Own Cultivated	63.7	62.3

We can see here that in spite of the differences between the samples, these results are apparently not severely affected.

2. Typological Analysis

Until now, most of the analysis of the structure of Egyptian agriculture has been carried out using farm size as the dominant typological variable. Clearly, the fact that it has always been done that way creates a tendency to continue in the same manner, especially if one is motivated by the desire to produce results that have past studies as a basis or that participate in on-going controversies. If one wishes to further a debate, at least part of one's analysis must be in terms of the typologies that are already implicit in the debate. In the specific case at hand, for example, one of the interesting debates is whether crop yields per feddan are affected negatively by farm size. For this reason, even if we conclude that it may be more rigorous or relevant to shift the focus of the debate according to new typologies, we will carry out much of the analysis in terms of the old farm size typologies.

The typological analysis was basically of the cluster type, and proceeded in several steps. First, a set of variables judged a priori to be potentially interesting typologically was picked. The variables were farm size, total agricultural revenue, wage income as a proportion of total agricultural revenue, and hired labor as a proportion of total labor. The first two variables were associated with size considerations, the second two with social relations criteria. The variables were then standardized by subtracting the mean and dividing by the standard deviation. This is necessary so that the variable with the largest absolute size (often determined simply by the units of measurement chosen), which would, all other things being equal, tend to have the largest variance, does not become the main variable influencing the typology. The matrix of euclidean distances between the farms in the variable space was then calculated. A hierarchical clustering method was applied to the distances until the desired number of groups was identified. In order to see how the clustering related to the original variables, the following procedure was used. If there were k groups as a result of the clustering procedure, then k dummy variables were created, and a farm took on the value of 1 for dummy variable i if it belonged to group i. Then each of the original variables was regressed against all of the k dummy variables, forcing a zero origin. In a first trial, with 5 groups created, it was discovered that the fifth group consisted simply of two farms (#90 and #140) that derived more than 90% of their income from the sale of labor power. In a subsequent trial these farms were eliminated, as they were could hardly be considered agricultural enterprises. Naturally, this in itself is, in a sense, a test of the methodology: it was successful at weeding out "unusual" cases. The results, with the sample size reduced to 185 farms, and with k=5, were as follows.

Correlations between the four typological variables:

	Farm Size	Tot Tev	Wage Prop	Hired Prop
FS	1.00	0.88	-0.14	0.57
TR	0.88	0.99	-0.17	0.51
WP	-0.14	-0.17	1.00	-0.14
HP	0.57	0.51	-0.10	0.99

Regression for farm size as dependent variable:

	Coef	Std Err	t Value
dummy1	3.23	0.23	13.91
dummy2	21.73	0.62	34.73
dummy3	1.40	1.28	1.09
dummy4	1.03	1.66	0.62
dummy5	38.87	1.43	27.11

Regression for total agricultural revenue as dependent variable:

	Coef	Std Err	t Value
dummy1	911.87	73.64	12.38
dummy2	4932.37	198.13	24.89
dummy3	267.88	406.05	0.65
dummy4	260.94	524.21	0.49
dummy5	7819.46	453.98	17.22

Regression for wage income as a proportion of total income as a dependent variable:

	Coef	Std Err	t Value
dummy1	0.13	0.027	6.22
dummy2	0.05	0.054	0.98
dummy3	1.87	0.12	15.57
dummy4	4.73	0.15	30.42
dummy5	0.11	0.13	0.88

Regression for hired labor as a proportion of total labor as a dependent variable:

	Coef	Std Err	t Value
dummy1	0.38	0.024	17.94
dummy2	0.83	0.058	14.33
dummy3	0.34	0.11	2.90
dummy4	0.16	0.15	1.10
dummy5	0.98	0.13	7.41

These regressions evidently have no point other than providing a convenient way to find the mean values and the standard errors of the original clustering criterion variables for each group produced by the clustering process, so that we can have clearer idea as to what the groups mean. From these regressions, it is clear that the first dummy variable identifies by far the largest (n_1=154) group of farms, with the following characteristics (these are the coefficients above):

GROUP 1
Mean Size = 3.2 feddans
Mean Tot Rev = 911 LE
Mean Wage Prop = .14
Mean Hired Prop = .38

These farms form what could be called a strongly identified group, in that the t-values of the coefficient for dummy1 is highly significant for all four of the original criteria. These farms are probably fairly typical peasant farms, in that they seem to depend on the sale of family labor for some, but not much, of their income (Mean Wage Prop. = 0.14). They also meet some of their labor needs through the market (Mean Hired Prop. = 0.38), but use the family to satisfy most of the need for this input.

The second dummy is identified with a group of 21 farms of relatively large size, with the following characteristics:

GROUP 2
Mean Size = 21.7 feddans
Mean Tot Rev = 4932 LE
Mean Hired Prop = .83

For this group, there is no particular value of wages as a proportion of total agricultural revenue. These farms could be called upper petty capitalist farms, since they derive most of their labor power from the market, but do use significant amounts of family labor in the field.

The third and fourth dummies are associated almost exclusively with the variable measuring wages as a proportion of total on-farm revenue. They identify two small groups (n_3=5, n_4=3) with mean values for this variable of 1.87, and 4.73, respectively. Clearly, these groups represent a small minority still present in the sample who derive much of their income from the sale of labor power. In terms of social relations, they could be called semiproletarian farms.

Finally, the fifth dummy identifies another small group (n_5=4), this one consisting clearly of very large agricultural enterprises, with the following characteristics:

GROUP 5
Mean Size = 38.9 feddans
Mean Tot Rev = 7819
Mean Hired Prop = .98

These farms, since they derive 98% of their labor needs from hired labor, can be called fully capitalist farms.

In order to reflect other important criteria, and given that a 5 criterion variable procedure seems to have produced reasonable results, we decided to bring in other variables into the clustering. Because so many of even the smaller farms use significant amounts of hired labor, we felt that it was appropriate to include an index of commercialization to complement the use of hired labor as an indicator of capitalist relations. We also decided to bring in explicitly the presence of sharecropping relations by bringing in two variables: land taken in for share and land given out for share, both as a proportion of total managed area.

Since the presence of many criterion variables tends to homogenize the euclidean distances between the farms in the space of the criterion variables, we had to take out some of the variables included in the classification above. We took out both hired labor as a proportion of total labor, and wage income as a proportion of agricultural income, in turn, and found that keeping the hired labor proportion produced a "richer" clustering in the sense that the groupings produced were better defined and made more intuitive sense.

Bringing in the land tenure variables produced remarkably clear groupings of sharecroppers' and tenants' farms. In fact, these were the groups that emerged the most solidly. In order to produce groups of farmers that were different in terms of the other criteria, we therefore had to increase the total number of groups from 5 to 9. Out of these 9 groups, 4 are the tenants' and sharecroppers' groups, which leaves us with 5 which are determined to a larger extent by the other criterion variables.

We then proceeded as above, creating 9 dummy variables. Dummy variable i takes on the value 1 for farm j if farm j is in the ith group. The set of original criterion variables was then regressed on the nine dummy variables, suppressing the intercept, simply for the purpose of finding the mean and standard error for each of the original criterion variables in each of the 9 groups. The results are reported below. In this table, FS is farm size, MS is marketed surplus as a proportion of total output (the index of commercialization), HL/TL is hired labor as a proportion of total labor, Sh-O is land given out for share as a proportion of total managed area, Sh-I is the same for land taken in. While the proportion of labor income to agricultural income was not a criterion variable, we nevertheless calculated its mean level for each group. This is reported in the LI/AI column. Finally, the last column tells us how big each group is.

9 Group Classification Results

Group	FS	MS	HL/TL	Sh-O	Sh-I	LI/AI	n
1	2.90 (1.89)	0.52 (0.08)	0.42 (0.08)	0	0.54 (0.01)	1.50 (0.34	4
2	30.31 (1.26)	0.67 (0.05)	0.89 (0.05)	0	0	0.09 (0.23)	9
3	3.15 (0.48)	0.58 (0.02)	0.41 (0.02)	0	0	0.27 (0.09)	63
4	3.78 (1.69)	0.50 (0.07)	0.69 (0.07)	0.79 (0.02)	0	0.79 (0.30)	5
5	9.76 (0.70)	0.75 (0.03)	0.83 (0.03)	0	0	0.14 (0.13)	29
6	25.08 (1.43)	0.84 (0.06)	0.76 (0.06)	0.86 (0.02)	0	0.03 (0.16)	7
7	2.03 (0.48)	0.32 (0.02)	0.15 (0.02)	0	0	0.27 (0.09)	61
8	3.94 (2.18)	0.33 (0.09)	0.42 (0.09)	0	1.00 (0.02)	0.05 (0.39)	3
9	4.43 (1.89)	0.18 (0.08)	0.95 (0.08)	0	0	0.05 (0.34)	4

The groups engaged in sharecropping relations stand out very clearly. The first group consists of four farmers that get about half their land from others in share. They farm very small amounts of land, and receive more income from labor sales than from their agricultural operations. Another sharecropper group is #8. These farmers get <u>all</u> their land from others in share and also farm very small amounts of land (about the same as group 1); however, they but do not have significant sales of labor on the labor market on the average (though the variance for this is large). These are probably more classical sharecroppers. Groups 4 and 6, on the other hand, consist of farmers that rent out substantial portions of their land in share. But they are very different groups. One is actually composed of relatively small farms, while the other one consists of very large farms, probably corresponding more to actual landlords, while the first group might consist of small owners who for one reason or another can not engage in farming. Beside these groups engaged in sharecropping relations, we get groups much like those already identified in the first clustering procedure above. Group 7 seems to correspond to the really small farms, hiring very little outside labor, having the smallest marketed surplus indicator of all groups, and deriving substantial income from the labor market. Farms in group 3 are not significantly larger, hire much more labor, market more of their output, but seem to derive about as much of their income from the labor market. Finally, groups 5 and 2 are true capitalists, selling large portions of their output, almost exclusively using hired labor, and deriving insignificant proportions of their income from the labor market. There is a difference between these two groups, however: farms in group 2 are much larger than those in group 5, so group 2 is composed of large capitalist farmers, whereas group 5 consists of medium scale capitalist farmers. Group 9 is an odd one, not really yielding to intuitive interpretation, as it markets very small proportions of the output, yet hires a very large proportion of its labor needs, and sells very little labor on the market.

One important point which emerges from these results is that apparently not much statistical discriminatory power is lost by using some of the proposed variables other than farm size as criterion variables, so that if it is deemed methodologically necessary to use them, they can be used without losing the variability which is so important in typological variables. For example, hired labor as a proportion of total labor is clearly an important criterion from the social and economic points of view, and seems to offer significant ability to statistically discriminate between groups of farms in both the 5-cluster and the 9-cluster. Nevertheless, the correlation between this variable and farm size is only 0.57, so that the size itself should not be used as a proxy for such an important indicator of social relations. In other words, while it may be true that capitalist farms are in general larger than peasant farms, it should not be assumed that "large" and "capitalist" are equivalent. In general, it seems that size should be used as a typological criterion under the following circumstances:

1. if the results are meant to be part of an ongoing debate which has already been using this variable as a relevant criterion.
2. if the possible policy uses of the research results will be policies which are themselves oriented on the basis of farm size. (An example would be land reform.)
3. if the data used were collected specifically with this type of analysis in mind.

In what follows we will mostly use farm size as a classificatory or independent variable, largely because we feel that it may make our results more useful as part on an on-going discussion. We will, occasionally, and for the sake of comparison, use an index of capitalist social relations as a classificatory or independent variable or try to use the cluster groups themselves, by means of dummy variables, as explanatory variables.

3. Yields and Land Productivity

Understanding the determinants of crop yields is crucial to the agricultural policy-making process. For example, in spite of some studies, it has not been established with certainty whether yields are affected by farm size, and yet any policy discussion involving the issues of land reform and economic growth must be totally in the dark without knowledge about the effects of farm size on crop yields. The same can be said of the relationship between sharecropping and crop yields. In this section we will present some results that compare land productivity across farm sizes, and will also relate yield to some other criteria.

First, however, it is necessary to show that it may in fact not be possible to explain yield variations, simply because there may not be very much yield variation. As the table below shows, the correlations between planted area and output are extremely high; so high that the variation in output per unit of area must be minimal, and thus barely explainable. Explaining yield variation would be essentially equivalent to explaining that part of output variation not explained by planted area variation.

Correlations between Planted Area and Output

Corn	0.94
Cotton	0.80
Rice	0.94
Wheat	0.91
Aggregate	0.88

A graphical illustration is provided below. Suppose we are interested in the effect of farm size on rice yield. In the figure we show the scatter of points for these two variables. (The numbers refer to the number of points located on the same spot in the space. The symbol $ refers to spots where there are more than 9 points.) Yields are clearly bunched around a horizontal line, so while there is a clear pattern on the scatter, it is a pattern that would yield a small correlation.

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         |*22  *  *
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         |4$85 3 *           *
         *$$$94*3***22   **3 * 2 2  **     * * *      *
         |22  2    2       *                * *
       0.|------*-------------------------------------
         0.                                      45.00
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We will now attempt to explain whatever variation in yields can be explained, but the reader is warned that there simply is not very much variation. In the following table, yields (in kg/fed) of various crops across farm sizes may be compared:

Yields by Farm Size

Sizes	LT 1	1-3	3-5	5-10	GE 10	ALL
Crops						
Wheat	1069	1332	1274	1115	898	1215
SSBers	32*	31*	32*	24	24	29
Maize	2303*	1568	1213	1209	1350	1439
Rice	2320	2670	2623	2855	1914	2541
Cotton	796	883	934	765	779	854
LSBers	91*	82	91*	72	65	85
Potato	0	6035	6009	0	0	6026
Onion	5171	5750	7000	2000	5454	4949
Tomato	0	6973	2271	2350	4118	4292
Fruits	0	860	2927	970	7211	4030

* We are aware that some of these results seem excessively high. Note that in most cases they have almost no statistical validity, as they are produced by very few observations. (See the section on cropping patterns for information on the number of farmers by crop for each size group.)

Not surprisingly, there is no clear evidence of any relation between farm size and yield. But we will explore this relationship in more detail later, after another descriptive table.

The next table gives the per feddan income (including imputed value of home consumption) net of per feddan cash costs except land cost (this source of cost was ignored because of data problems - if land quality requirements are relatively constant across crops then ignoring this cost leaves the profitability ordering of the various crops constant).

Income Net of Cash Costs per Feddan

Sizes / Crops	LT 1	1-3	3-5	5-10	GE 10	ALL
Wheat	-40.74*	53.49	49.33	40.20	39.06	46.19
SSBers	46.52	37.26	21.53	22.06	21.35	29.88
Maize	56.66	60.57	50.04	49.51	30.55	53.73
Rice	97.56	110.11	110.76	98.67	61.00	99.65
Cotton	120.13	121.44	137.57	108.36	122.83	122.34
LsBers	107.42	123.44	164.12	96.50	84.00	120.53
Potato	0.	166.82	137.61	0.	0.	157.09
Onion	89.00	114.54	5.82*	-49.72*	68.36	49.79
Tomato	0.	365.27	62.79	72.10	244.81	212.58
Fruits	0.	128.00	45.10	62.08	470.46	205.36

*Again, we are aware that these are very strange results. In the case of onions they are due to excessively high pesticide costs. In the case of wheat the causes are not clear.

From this table it is clear that on a per feddan basis the most attractive crops are fruits and vegetables (except, apparently, onions - but this could have been a temporary phenomenon in 1976).

In order to explore the yield-size relation in more detail, we fit the following simple linear regression equations, where the dependent variable is yield per feddan and the independent variables are farm size (or total managed area), and a dummy variable for Sharquiya governorate. In equation 1, on the left, the physical yield of the primary crop product is used as the dependent variable, while in equation 2 the monetary sum of the primary and secondary products is used. The last equation refers to the aggregated monetary value of all primary and secondary plant products, so in effect what we have is total gross revenue per feddan.

Regressions for Corn

Eq1

Var	Coef	t-value
Int	1294.4	16.63
Dum	348.8	3.61
Size	-15.7	-2.45
R-sq	.14	

Eq2

Var	Coef	t-value
Int	94.6	20.93
Dum	-2.8	-.51
Size	-.9	-2.45
R-sq	.07	

Regressions for Cotton

Eq1

Var	Coef	t-value
Int	772.6	17.51
Dum	249.0	4.56
Size	-7.8	-2.42
R-sq	.16	

Eq2

Var	Coef	t-value
Int	169.2	16.24
Dum	64.8	5.03
Size	-1.2	-1.57
R-sq	.16	

Regressions for Rice

Eq1

Var	Coef	t-value
Int	2575.4	15.13
Dum	299.9	1.48
Size	-30.6	-2.57
R-sq	.06	

Eq2

Var	Coef	t-value
Int	142.2	14.86
Dum	32.5	2.84
Size	-2.1	-3.12
R-sq	.11	

Regressions for Wheat

Eq1

Var	Coef	t-value
Int	1394.8	18.36
Dum	-149.6	-1.71
Size	-13.9	-2.66
R-sq	.08	

Eq2

Var	Coef	t-value
Int	94.1	18.63
Dum	.16	.03
Size	-.83	-2.4
R-sq	.05	

Regression for All Crops

Eq2

Var	Coef	t-value
Int	110.9	19.49
Dum	29.8	4.33
Size	-.42	-1.00
R-sq	.10	

Several points emerge very clearly. First, it seems as if the hypothesis that crop yields are constant across farm sizes must be rejected, with reasonable levels of confidence. However, as is evidenced by the very low R^2s, farm size is not a crucial determinant of yield. This is naturally not surprising, since as we have pointed out there simply is so little variance to be explained that what remains must be due largely to unmeasured factors. Second, and relatedly, we can also see that, even within the supposedly homogeneous Eastern delta region, regionality is a factor which definitely affects yields, but, again, apparently not in a determinant manner. Thirdly, when all crops are taken together, the factor whose influence on revenue per feddan emerges most strongly is the dummy variable for Sharquiya. In fact, for this aggregate regression the t-value for the regionality coefficient is stronger, and that for the size coefficient weaker, than in most of the individual crop regressions. This must be partly due to the fact that smaller farms grow somewhat more high value crops (but not much, as we will see later). The results on the dummy coefficients give strong support to the idea that inter-regional differences in productivity are more important than social class-based differences, even within regions that are supposedly very homogeneous.

Since regionality seems so important, we decided to study further the effect of this variable by trying to get a finer measure for regional effects. Breaking regionality down to the village level seemed to cause excessive loss of degrees of freedom. In any case, two or more villages could be homogeneous with respect to those variables (e.g., soil quality) that regionality measures would capture, and so the loss of degrees of freedom would buy no important variability in the explanatory variables. Since the agricultural zones are supposed to be homogeneous, we decided this would be an ideal way to break down the sample so as to preserve degrees of freedom and yet produce a conveniently fine identification of regional factors. We had a total of five agricultural zones in our 11 villages. Some governorates included more than one zone, and some zones had more than one governorate in them. Clearly, then, the zonal breakdown is much finer than the governorate breakdown. (For a list of the correspondence between villages, governorates, and zones see the appendix.) The results are presented below. Yields were regressed on dummies for each of the zones, using zone 1 as the "base", and including the size variable.

Regressions for Corn

Eq1

Var	Coef	t-value
Int	1675	17.3
Zone2	-491	-3.4
Zone3	102	0.9
Zone4	-462	-3.3
Zone8	-277	-2.1
Zone9	-380	-1.9
Size	-12	-2.0
R-sq	0.28	

Eq2

Var	Coef	t-value
Int	82.0	14.5
Zone2	-5.3	-0.6
Zone3	19.4	2.8
Zone4	4.8	0.6
Zone8	22.0	2.8
Zone9	6.5	0.6
Size	-0.7	-1.9
R-sq	0.22	

Regressions for Cotton

Eq1

Var	Coef	t-value
Int	981	15.8
Zone2	-271	-2.7
Zone3	170	2.2
Zone4	149	1.7
Zone8	-292	-3.9
Zone9	-374	-4.6
Size	-3	-0.9
R-sq	.43	

Eq2

Var	Coef	t-value
Int	217.0	13.6
Zone2	-72.8	-2.8
Zone3	49.4	2.5
Zone4	14.8	0.6
Zone8	-63.6	-3.3
Zone9	-62.3	-3.0
Size	0	0
R-sq	.34	

Regressions for Rice

Eq1

Var	Coef	t-value
Int	3555	14.2
Zone2	-1668	-4.5
Zone3	-482	-1.5
Zone4	-703	-1.9
Zone8	-969	-3.2
Zone9	-1636	-4.8
Size	-17	-1.6
R-sq	.22	

Eq2

Var	Coef	t-value
Int	246.9	19.3
Zone2	-134.1	-7.0
Zone3	-74.8	-4.5
Zone4	-99.3	-5.1
Zone8	-105.2	-6.7
Zone9	-136.8	-7.9
Size	-1.3	-2.3
R-sq	.40	

Regressions for Wheat

Eq1

Var	Coef	t-value
Int	1285	14.2
Zone2	-452	-3.1
Zone3	52	0.5
Zone4	477	3.4
Zone8	-40	-0.3
Zone9	-174	-1.4
Size	-8	-1.7
R-sq	.29	

Eq2

Var	Coef	t-value
Int	91.4	15.1
Zone2	-27.9	-2.8
Zone3	19.7	2.4
Zone4	11.7	1.3
Zone8	-3.8	-0.4
Zone9	-11.5	-1.4
Size	-0.4	-1.2
R-sq	.25	

Regression for Aggregated Crops
Eq2

Var	Coef	t-value
Int	153.6	20.1
Zone2	-46.8	-3.7
Zone3	-20.4	-2.0
Zone4	-38.4	-3.0
Zone8	-45.7	-4.9
Zone9	-70.5	-6.8
Size	-0.1	-0.3
R-sq	.23	

We can see that whereas when we used only a dummy for Sharquiya governorate the size variable was significant for all crops except for the aggregate case, now it is statistically significant in two cases, and of only borderline significance in the case of wheat. Moreover, the actual values of the coefficients are greater (not as large in absolute terms): they are about half of what they were before. Similarly, the t values for the size coefficients are now much lower. Instead, the differences between zones stand out much more sharply. In all crops the t-values for the zonal dummies are much higher than those for the size variables. Clearly, regionality is of much more importance than size in explaining yield variations across farms. In fact, the last equation shows that the total monetary output per feddan differs markedly from zone to zone, and hardly at all across farm-size classes. Specifically, zone 1, containing villages Kanteer, El Samaana, Kafr El Nosiri, Monshat Radwan, and others, has higher yields. Zone 3, whose yields are not quite as high as those of zone 1, has higher yields than other zones. It comprises the villages Shambret Mankala and

Kafr Danohyia. The lowest yields are associated with zones 9 and 2, containing the villages El Gamaleyia, El Sophia, and Elekhewa. Other zones' yields range in between. It is not unreasonable to conclude that regional differences are more important than class differences. There are many published works on agrarian structure in many countries, where regionality physical factors are not taken into account, or only in a gross way. Many of these studies come to the conclusion that large farm size negatively affects yield, but our results naturally lead to questioning these studies.

The significance of these regional differences in yields suggests that perhaps the weak relation between size and yield has a causal direction opposite to that normally assumed in studies of agrarian structure. Perhaps in areas where yields are lower, lands are of lesser quality; therefore, farms must be bigger in order to support the same level of monetary output. At the same time, land would be cheaper, so larger farms would be possible. Naturally, then, one would expect to see a negative association between farm size and yield, which becomes weaker once one controls for regionality.

Some question might remain as to whether yields are related to intensity of use of factors which could a-priori be judged to be yield-increasing, as well as to social factors such as sharecropping. In order to test for these possibilities, we decided to run one set of regressions encompassing a variety of these factors. The factors used were size, nitrogen per feddan, nitrogen per feddan squared, labor per feddan. Dummies were used for sharecropping, cash rent, land reform lands. Finally an index of capitalist social relations, the share of hired labor in total labor was also used. These were variables which we knew, on the basis of previous analyses, to be of some use in predicting yield.

Yield Equations for Various Crops

	Corn			Rice	
	Coef	t-value		Coef	t-value
Int.	1212.5	5.5	Int.	1795.6	3.9
Size	8.1	0.9	Size	-10.5	-0.6
N	2.3	2.3	N	4.3	1.7
N^2*	-1.7	-1.6	N^2*	-3.9	-1.3
Labor	3.0	0.7	Labor	3.0	0.6
Cropsh.	-19.3	-0.1	Cropsh.	261.1	0.8
Cash rent	-206.3	-1.9	Cash rent	465.6	1.9
Land ref.	-236.3	-2.2	Land ref.	-0.2	0
HL/TL	-481.4	-2.2	HL/TL	-184.1	-0.4
R-sq	0.23		R-sq	0.12	

*This coefficient was multiplied by 10^2.

	Cott			Wheat	
	Coef	t-value		Coef	t-value
Int.	606.4	5.1	Int.	948.2	4.4
Size	-9.4	-2.1	Size	-7.9	-1.0
N	0.7	1.6	N	0.7	0.8
N^2*	-0.3	-0.7	N^2*	-0.4	-0.5
Labor	0.5	1.2	Labor	-4.3	-1.1
Cropsh.	144.9	1.7	Cropsh.	3.2	0
Cash rent	226.4	3.5	Cash rent	186.8	1.9
Land ref.	-136.6	-2.1	Land ref.	192.2	1.9
HL/TL	171.4	1.5	HL/TL	219.6	1.2
R-sq	0.22		R-sq	0.16	

*This coefficient was multiplied by 10^2.

	Aggregated Crops	
	Coef	t-value
Int.	119.1	7.7
Size	-0.2	-0.3
N	0	-0.1
N^2*	-0.1	-0.2
Labor	1.0	2.1
Cropsh.	3.2	0.3
Cash rent	2.5	0.3
Land ref.	-2.8	-0.3
HL/TL	-31.8	-1.8
R-sq	0.04	

*This coefficient was multiplied by 10^2.

Even these equations explain less yield variation than the one with just the regionality dummies and the size variable. This should not be surprising, since, as we have seen, there is little yield variation anyway, and what there is probably must be accounted for in terms of factors for which we do not have information. Several aspects of this table stand out. First, the effect of farm size has almost completely dropped out, except in wheat. Of the two yield increasing factors, nitrogen and labor, nitrogen is only marginally important for corn and rice, and labor is important in the aggregate case. The most interesting results however, are those that pertain to the "social" variables reflecting land and labor relations. Cash rentals are definitely (but not very strongly) associated with yields in all crops. One possible explanation for this phenomenon could be that from the farmer's point of view the payments for cash land rentals come out of their cash crops, and rice and cotton are cash crops to a larger extent than corn. This may stimulate farmers to attempt higher yields. It could also be that cash rental relations are for some unknown reason more (less) common in zones where yields are higher (lower) for agro-ecologic reasons. One other puzzling result is the mildly negative relationship between yields and capitalist labor relations in the aggregated case, and a definite negative relation in the case of corn. A likely explanation is that the index of capitalist relations is positively correlated with farm size, which we have seen is negatively correlated with yields.

In order to further explore the issue of cash rentals and yields, we tried to see whether there were significant differences between the prevalence of cash rental relations in the various zones. The table below reports on the average level of cash rentals as a proportion of total managed area in each zone.

Cash Rentals and Regionality

	Mean	Std err
Zone1	0.24	0.08
Zone2	0.20	0.10
Zone3	0.21	0.07
Zone4	0.23	0.11
Zone8	0.17	0.06
Zone9	0.07	0.07

Only zone 9, containing El Gamaleyia and El Sofia, is associated with less cash rents. This is also a region with significantly lower cotton and rice yields. Thus, it is not surprising that we would observe a positive relation between cash rentals and cotton and rice yields. However, this region also has lower corn yields, and yet we do not observe a positive relation between cash rents and corn yields. The story is not totally clear. On the other hand, Zone 1, containing Kanteer, Kafr El Nosiri, Monshat Radwan, El Samaana, and others, is associated with stronger cash rental relations, and is also a region of higher yields.

One last attempt to understand yield variations was made by looking at contrasts between the mean yields achieved by the 9 groups identified through the clustering above. Very little emerges that is new. In wheat, we find that group 7 achieves significantly higher yields than groups 5, 3, or 6. In cotton, groups 3, 5, and 7 achieve higher yields than group 2. Group 7 is that consisting of small peasants, with little marketed surplus, and little hired labor. Group 3 consists also of small farms, but uses more hired labor and markets a larger proportion of total output. Group 5 consists of small capitalists (having 8-12 feddans, but satisfying most of their labor power needs via hiring), while group 6 represents lands given out in share by large landlords. Group 2 is that of the largest capitalists found in the sample. Thus, we confirm earlier results about the importance of size and capitalist relations when regionality is not taken into account.

We conclude this section by summarizing our findings. Our first finding was that there is very little yield variation to be explained. This is not surprising, given the large amount of government-provided inputs, the uniformity of prices of the major commodities, and the existence of a good market for rental inputs. The most important variables in understanding the small amount of yield variation present in our sample are those that stand for the various zones. If one accounts for regional differences, the influence of farm size on yield becomes fairly small, though still noticeable in some crops. And when one accounts for the influence of physical (labor, nitrogen) and social (presence of sharecropping, intensity of capitalist social relations) factors, then farm size is swamped. However, this last result is reasonable given that the per-feddan intensity of input use on the larger farms is somewhat less than on the smaller ones. In a nutshell, the hypothesis that farm size affects yields negatively can not be totally rejected, but we have discovered that the relationship is quite weak statistically and perhaps unimportant economically.

4. Patterns of Input Use

In this section we will present data describing input use, both on a per feddan basis and as a proportions of total input expenditure, by farm size. The following set of tables shows per feddan input use for four major crops, by farm size. The units of measurement for all the variables are given in the appendix which describes the Farm Management Survey.

Per Feddan Input Use by Farm Size*

Crop: Wheat

Farm Size	1-3	3-5	5-10	GE 10	All
Hir Anim Power..	17.21	12.76	11.33	5.33	9.51
Seas Hir Lab....	10.88	13.07	16.45	14.61	14.01
Perm Hir Lab....	1.01	0.03	0.20	3.70	2.19
Mech Pw.........	12.90	10.54	12.25	6.15	8.87
Seeds Coop......	37.23	24.30	42.49	57.23	46.88
Seeds Mkt.......	19.36	19.12	8.55	11.76	13.94
Manure..........	2.55	10.94	6.38	1.33	3.73
Nitro Coop......	36.60	42.15	36.68	41.68	40.08
Nitro Mkt.......	4.63	5.22	4.45	0.89	2.66
Phosph Coop.....	5.99	4.09	6.06	6.17	5.81
Fam Lab.........	15.97	13.36	7.37	3.51	7.77
Owned Mach......	34.31	44.91	24.40	7.24	20.00
Owned Anim......	20.61	29.64	17.53	17.64	19.86
Owned Manure....	42.68	29.19	34.32	0.	17.45
Owned Seeds.....	15.59	33.55	26.90	5.64	14.20
No. of Farmers..	58	22	16	19	118

* If certain categories appear on other tables or in the list of inputs in the appendix, and not on this table, it is because the inputs in question are not used by farmers growing this crop. Furthermore, note that certain inputs are allocated by the government on a per feddan basis; however, they are obviously not applied at the same rate by all farmers, according to this table. This is not so much a measurement error, but probably due to re-allocation between crops within farms and sales from some farms to others.

Per Feddan Input Use by Farm Size*

Crop: Maize

Farm Size	1-3	3-5	5-10	GE 10	All
Hir Anim Power..	15.73	20.38	15.93	14.64	16.08
Seas Hir Lab....	10.96	10.03	24.29	21.25	17.38
Perm Hir Lab....	0.51	0.22	0.59	5.86	2.68
Mech Pw.........	8.10	6.43	7.22	7.85	7.60
Seeds Coop......	0.	3.56	0.	0.	0.49
Seeds Mkt.......	32.05	6.21	11.78	14.97	17.98
Manure..........	1.90	50.94	45.21	91.96	66.95
Nitro Coop......	41.16	34.19	28.68	55.27	43.79
Nitro Mkt.......	1.96	8.5	36.25	0.79	5.87
Fam Lab.........	23.69	25.55	14.28	4.87	14.60
Owned Mach......	57.30	44.20	38.69	13.96	34.40
Owned Anim......	28.34	21.29	20.42	14.98	20.52
Owned Manure....	237.32	219.05	162.39	67.67	151.48
Owned Seeds.....	2.09	13.63	5.77	12.02	11.15
No. of Farmers..	55	18	12	11	97

* If certain categories appear on other tables or in the list of inputs in the appendix, and not on this table, it is because the inputs in question are not used by farmers growing this crop. Furthermore, note that certain inputs are allocated by the government on a per feddan basis; however, they are obviously not applied at the same rate by all farmers, according to this table. This is not so much a measurement error, but probably due to re-allocation between crops within farms and sales from some farms to others.

Per Feddan Input Use by Farm Size*

Crop: Rice

Farm Size	1-3	3-5	5-10	GE 10	All
Hir Anim Power..	23.07	9.29	17.44	7.68	11.51
Seas Hir Lab....	20.86	16.72	26.52	31.49	27.85
Perm Hir Lab....	2.57	0.36	2.47	2.66	2.38
Mech Pw.........	12.43	6.54	7.33	10.53	10.04
Seeds Coop......	57.96	59.47	57.81	52.00	54.20
Seeds Mkt.......	20.09	0.	12.35	7.78	9.90
Manure..........	22.21	11.37	7.41	33.01	25.94
Nitro Coop......	28.99	28.20	25.19	30.41	29.30
Nitro Mkt.......	3.63	1.04	5.66	1.20	2.13
Phosph Coop.....	4.64	7.27	2.52	6.22	5.61
Fam Lab.........	30.19	19.48	13.13	3.16	10.16
Owned Mach......	81.24	62.15	22.06	13.16	29.76
Owned Anim......	63.54	61.39	32.42	30.24	39.05
Owned Manure....	63.64	83.20	40.28	50.54	55.09
Owned Seeds.....	10.78	24.19	6.88	8.05	9.76
No. of Farmers..	72	26	21	26	153

* If certain categories appear on other tables or in the list of input in the appendix, and not on this table, it is because the inputs in question are not used by farmers growing this crop. Furthermore, note that certain inputs are allocated by the government on a per feddan basis; however, they are obviously not applied at the same rate by all farmers, according to this table. This is not so much a measurement error, but probably due to re-allocation between crops within farms and sales from some farms to others.

Per Feddan Input Use by Farm Size*

Crop: Cotton

Farm Size	1-3	3-5	5-10	GE 10	All
Hir Anim Power..	16.55	10.16	8.38	5.11	7.92
Seas Hir Lab....	58.95	45.95	59.68	60.88	59.03
Perm Hir Lab....	0.79	1.03	0.73	2.92	2.05
Mech Pw.........	7.90	7.03	4.17	8.25	7.37
Seeds Coop......	64.02	68.31	59.53	54.16	57.93
Seeds Mkt.......	6.39	3.17	4.09	5.33	5.08
Manure..........	39.15	11.27	12.82	33.12	28.60
Nitro Coop......	46.39	43.02	29.91	47.15	43.67
Nitro Mkt.......	8.02	7.47	10.34	4.88	6.63
Phosph Coop.....	6.34	2.89	8.03	5.33	5.74
Pest Serv (LE)..	13.85	13.57	13.22	11.15	12.14
Fam Lab.........	29.91	28.12	8.94	5.43	11.73
Owned Mach......	48.17	63.69	31.87	19.35	29.91
Owned Anim......	29.35	27.76	19.75	11.00	16.94
Owned Manure....	141.59	199.96	97.59	92.55	109.91
No. of Farmers..	67	24	22	23	140

* If certain categories appear on other tables or in the list of inputs in the appendix, and not on this table, it is because the inputs in question are not used by farmers growing this crop. Furthermore, note that certain inputs are allocated by the government on a per feddan basis; however, they are obviously not applied at the same rate by all farmers, according to this table. This is not so much a measurement error, but probably due to re-allocation between crops within farms and sales from some farms to others.

A better way to explore the effect of size on intensity of factor use is to regress the per feddan factor use on size. This was done, including zonal dummies, and a dummy for farms smaller than 1 feddan, as it was felt some of these farms might have an artificially high input use intensity. The results are presented below in very schematic form. All that is shown is: 1 when t-value > 1.7, 2 when t-value > 2.0, 3 when t-value > 2.4; -1, -2, -3, when the respective t-values are < -1.7, -2.0, and -2.4; and 0 otherwise. S stands for size, D for the smaller than 1 feddan dummy, and the Zs for the zonal dummies.

Relations Between Per Feddan Input Use Intensity and Farm Size

Crop / Variable / Factor/Feddan	Corn S	D	Z2	Z3	Z4	Z8	Z9	Rice S	D	Z2	Z3	Z4	Z8	Z9
Labor	-1	0	-2	-3	-3	0	0	-3	0	0	0	0	0	0
Mech Pwer	0	0	0	0	0	3	0	-3	3	0	-2	0	-3	0
Nitro	0	0	0	0	3	0	0	0	0	0	-3	0	-3	-2
Manure	0	0	-3	-3	3	0	-3	0	3	0	-1	0	0	0
Anim Pwer	-3	0	0	0	-3	0	0	-3	0	0	-3	-3	-3	-3

Crop / Variable / Factor/Feddan	Cotton S	D	Z2	Z3	Z4	Z8	Z9	Wheat S	D	Z2	Z3	Z4	Z8	Z9
Labor	-3	0	0	0	-2	0	-2	-3	0	-1	0	3	0	0
Mech Pwer	-3	2	0	0	0	0	0	-1	3	0	0	3	0	0
Nitro	0	2	0	0	3	0	0	0	0	0	0	-2	2	2
Manure	0	0	0	0	3	0	-2	0	3	0	0	-1	0	0
Anim Pwer	-3	0	0	0	-3	0	-1	-3	0	0	0	0	0	0

Crop / Variable / Factor/Feddan	Aggregate S	D	Z2	Z3	Z4	Z8	Z9
Labor	-1	0	0	-3	-2	-3	-3
Mech Pwer	0	3	-2	-2	0	0	0
Nitro	0	0	0	0	-2	2	2
Manure	0	3	0	0	-1	0	0
Anim Pwer	-3	0	0	0	0	0	0

Several results emerge clearly. One: farm size certainly does influence factor use intensities. There is no doubt that larger farms use less of every input per feddan, except for chemical nitrogen fertilizer, and manure. In all crops larger farms use less human and animal labor per feddan, and in cotton, rice, and wheat they also use less mechanical power. This holds in spite of the fact that we have controlled for regional variability and the impact of possible bad measurement in the small farms by providing dummy variables. Of course, these results simply confirm our previous result that there is a definite but weak tendency for bigger farms to have smaller yields. (Note that the only input found to be definitely associated with higher yields was nitrogen, and this happens to be the one larger farms do not use less intensely.) Two: there are clear regional differences in intensity of factor use. In fact, in almost all cases, regionality seems to be just as important a variable as farm size in explaining variability in per feddan input use. However, it is not altogether clear that the zones using less inputs are the same as those achieving less yields. The zones using less inputs seem to be 3, comprising villages Shambret Manakala and Kafr Danohyia, and 4, comprising Manshat Elekhewa. Zones 8, comprising Manakhla, Bane Abaed, and Kafr El Wastane, and 1, comprising Kanteer, El Samaana, Kafr El Nosiri, etc., both have higher input use per feddan.

An interesting issue in this context is whether mechanical power is a substitute for human labor or for animal power. This issue is of policy relevance given the debate as to the possible effects of encouraging mechanization in Egypt. The following table of correlations between factor use intensities measured as proportions of total input costs throws some light on this issue.

Correlation Matrices for Input Cost Shares

Corn

	Labor	MechPow	Nitro	Manure	AnimPow
Labor	1.00				
Mech Pow	-.47	1.00			
Nitro	-.01	-.34	1.00		
Manure	-.44	-.15	0.10	1.00	
Anim Pow	-.03	-.23	-.36	-.46	1.00

Cotton

	Labor	MechPow	Nitro	Manure	AnimPow
Labor	1.00				
Mech Pow	-.45	1.00			
Nitro	-.34	-.29	1.00		
Manure	-.37	-.16	0.29	1.00	
Anim Pow	-.06	-.10	-.37	-.07	1.00

Rice

	Labor	MechPow	Nitro	Manure	AnimPow
Labor	1.00				
Mech Pow	-.54	1.00			
Nitro	-.24	-.34	1.00		
Manure	-.12	-.14	0.09	1.00	
Anim Pow	-.23	-.28	-.18	-.14	1.00

Wheat

	Labor	MechPow	Nitro	Manure	AnimPow
Labor	1.00				
Mech Pow	-.34	1.00			
Nitro	-.36	-.34	1.00		
Manure	-.12	-.17	-.01	1.00	
Anim Pow	-.05	-.40	-.40	-.23	1.00

Aggregate

	Labor	MechPow	Nitro	Manure	AnimPow
Labor	1.00				
Mech Pow	-.56	1.00			
Nitro	-.11	-.37	1.00		
Manure	-.24	-.12	0.31	1.00	
Anim Pow	-.07	-.36	-.10	-.03	1.00

From these tables it is clear that <u>mechanical power is a substitute for both human labor and animal power</u>, but the negative correlation is much stronger with human labor.

Because of the importance of this issue, we have attempted to study it further. We regressed the log of the ratio of human to animal labor used on two indicators of the intensity of mechanization: the log of the ratio of machinery use costs to total costs, and the log of the level of machinery use in hours per feddan. Below, the independent variable in the first equation is the cost ratio, and in the second equation it is the per feddan ratio.

Mechanization and Labor Use

	Equation 1		Equation 2	
	Coef.	t-ratio	Coef.	t-ratio
Corn	0.15	1.68	-.34	-3.11
Cotton	-0.09	-0.85	-.38	-3.69
Rice	0.17	1.59	-.31	-3.35
Wheat	0.34	2.49	-.15	-1.28

Evidently, except for the case of wheat, an increase in use of mechanical power, if measured on a per feddan basis, leads to a sharp reduction in the use of human labor relative to animal labor. This is further evidence that <u>mechanical power substitutes for human labor far more readily than it substitutes for animal labor</u>.

Time series studies may lead to rather different results, and it is reasonable that if the time series results are as strong as ours they should be a more adequate guide to policy, since responses over time are really what one is interested in. And we can not pretend that cross sectional results model results over time.

Of course, we still know nothing about the actual <u>rates</u> of substitution.

Some clues as to the rates of substitution between factors and the effects of farm size on this can be seen in the following tables, which report the results of regressing the ratio of each input's cost to total cost on farm size, including dummies to control for regional variability, and a dummy for farms smaller than 1 feddan. Below we report only data on the significance of the relation, where 1 symbolizes a t-value greater than 1.7, 2 a t-value greater than 2.0, and 3 for t-values greater than 2.4; and -1, -2, -3 for the negative t-values in the same ranges.

Relations Between Input Use Intensity (as a proportion of cost) and Size

Crop	Corn							Cotton						
Variable	S	D	Z2	Z3	Z4	Z8	Z9	S	D	Z2	Z3	Z4	Z8	Z9
Factor/Feddan														
Labor	0	0	0	-3	-3	-3	0	0	0	0	0	0	0	0
Mech Pwer	0	0	0	0	0	3	0	-3	0	0	0	0	0	0
Nitro	3	0	2	3	3	0	0	1	0	0	0	3	0	0
Manure	0	0	0	0	3	0	-1	0	0	0	0	3	0	0
Anim Pwer	-3	0	0	0	-3	-1	0	-2	0	0	0	-3	-1	-1

Crop	Rice							Wheat						
Variable	S	D	Z2	Z3	Z4	Z8	Z9	S	D	Z2	Z3	Z4	Z8	Z9
Factor/Feddan														
Labor	0	0	0	2	0	0	0	0	-3	-1	0	0	-2	-3
Mech Pwer	0	2	0	-1	0	3	2	0	3	0	0	3	1	0
Nitro	1	-1	2	0	0	-1	0	3	0	0	3	-2	0	0
Manure	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Anim Pwer	-2	0	0	-2	-3	-3	-3	-3	0	0	0	-3	0	0

Crop	Aggregate						
Variable	S	D	Z2	Z3	Z4	Z8	Z9
Factor/Feddan							
Labor	0	-3	0	0	0	0	0
Mech Pwer	0	3	-2	0	0	2	0
Nitro	3	-2	3	0	0	0	0
Manure	0	0	0	0	3	0	-3
Anim Pwer	-3	0	0	0	-3	-3	-3

Bigger farms certainly spend a smaller proportion of their cost on animal power than do the small ones. On the other hand, they spend a much greater proportion of cost on nitrogen fertilizer. It is interesting that <u>one of the responses to increasing size is not substitution between types of power</u>. Again, differences between regions seem much more important than differences between farm sizes. Region 2 (Elekhewa) spends less on mechanical power, while region 9 (El Gamaleyia, El Sophia) spends less on manure.

In order to gain some knowledge about rates of substitution we fitted equations of the form

$$\log(Xl/Xk)=a+b\log(Pl/Pk)+cD\log(Pl/Pk)+dZ\log(Pl/Pk)$$
$$\log(Xl/Xa)=a+b\log(Pl/Pa)+cD\log(Pl/Pa)+dZ\log(Pl/Pa)$$
$$\log(Xk/Xa)=a+b\log(Pk/Pa)+cD\log(Pk/Pa)+dZ\log(Pk/Pa)$$

where l refers to labor, k to mechanical power, and a to animal power, and X and P are quantities (measured in the units as described in the appendix to this document) and prices respectively. Multiplicative dummies D for small farms (those smaller than or equal to 1 feddan) and Z for a vector of regional dummies were included in the equations. In the tables below we give the results on the b,c ,and d coefficients and their t-values.

Substitution Relations for Corn

Equation #	1		2		3	
	Coef	t-value	Coef	t-value	Coef	t-value
b	-1.07	-2.32	-.84	-2.59	-.92	-5.06
c	0.28	0.12	-.78	-0.78	-.67	-1.23
d2	-1.41	-2.11	.22	0.76	-.35	-2.07
d3	-0.65	-1.21	-.20	-0.70	-.17	-1.02
d8	0.49	0.87	-.02	-0.08	.25	1.41
d9	0.02	0.02	.74	1.22	-.11	-0.38

Substitution Relations for Cotton

Equation #	1		2		3	
	Coef	t-value	Coef	t-value	Coef	t-value
b	-.83	-3.20	-1.02	-6.59	-.68	-4.04
c	-.19	-0.41	0.11	0.21	-.15	-0.50
d2	.19	0.64	0.01	0.03	-.06	-0.33
d3	.12	-0.43	0.16	0.85	.14	0.86
d8	-.03	-0.11	0.31	1.63	.36	2.09
d9	.14	0.45	0.68	3.00	.28	1.42

Substitution Relations for Rice

Equation #	1		2		3	
	Coef	t-value	Coef	t-value	Coef	t-value
b	-.85	-4.81	-0.47	-3.15	-.51	-4.41
c	.27	0.63	-0.31	-0.80	.01	0.05
d2	.82	3.63	0.37	1.86	-.38	-1.88
d3	-.08	-0.32	-0.37	-1.94	-.51	-3.25
d8	.45	1.42	0.20	1.05	.18	1.27
d9	.48	1.54	0.30	1.20	-.01	0.05

Substitution Relations for Wheat

Equation #	1		2		3	
	Coef	t-value	Coef	t-value	Coef	t-value
b	-.99	-4.04	-.73	-4.17	-.23	-1.37
c	.08	0.13	-.22	-0.39	-.27	-1.07
d2	.76	0.96	-.26	-1.23	-.49	-2.74
d3	.37	1.20	-.17	-1.01	-.47	-2.91
d8	-.61	-1.29	-.01	-0.03	-.34	-1.93
d9	.05	0.12	.34	0.83	-.36	-1.91

Several conclusions from these results are the following: First, this is one of the few cases where the importance of regionality is relatively small. In almost all cases the overall response to prices is statistically more significant than the regional response to prices. All the estimates have the correct sign, and point to a rather elastic substitution in response to input prices. Second, the small farms seem not to have different responses to factor price ratios than do larger farms, as we can see from the low t-values on the c coefficients. Third, the substitution of machinery for labor seems more elastic than that of machinery for animal power, but this result is not statistically significant.

5. Cropping Patterns

Another important issue in discussions relating to the Egyptian agricultural sector is that of cropping patterns. Relevant questions are, for example, to what extent do larger farms manage to avoid the government-controlled crops? To what extent do they specialize in high-return crops?

Initial evidence on cropping patterns is presented in the following table, which includes data on the percentage of total managed area devoted to each crop for various farm size groups:

Cropping Pattern: Area In Each Crop/Total Managed Area

Size	LT 1	1-3	3-5	5-10	GE 10	All
Wheat	0.20	0.22	0.24	0.18	0.17	0.21
SSBer	0.24	0.31	0.22	0.38	0.29	0.29
Maize	0.08	0.22	0.18	0.14	0.09	0.17
Rice	0.53	0.40	0.41	0.36	0.46	0.42
Cott	0.24	0.33	0.27	0.40	0.32	0.32
LSBer	0.41	0.37	0.31	0.31	0.23	0.33
Other*	0.15	0.11	0.28	0.14	0.26	0.17

*Other: includes potatoes, tomatoes, onions, and all fruits.

The data presented in the above table can be complemented by data on the number of farmers growing each crop, classified by farm size. This information is provided in the following table. In each category, numbers of farmers are given, and, in parentheses, the number of farmers in each category expressed as a percentage of the total for that column.

No. of Farmers by Crop and Size

Size	LT 1	1-3	3-5	5-10	GE 10	All
Wheat	3(23)	58(65)	22(70)	16(66)	19(63)	118(63)
SCBers	4(30)	60(67)	20(64)	21(87)	21(70)	126(67)
Maize	1(7)	54(60)	18(58)	12(91)	11(36)	96(51)
Rice	8(61)	72(80)	26(83)	21(87)	26(86)	153(82)
Cotton	4(30)	67(75)	24(77)	22(91)	23(76)	140(74)
LSBers	6(46)	72(80)	27(87)	21(87)	22(76)	148(79)
Other	1(3)	13(14)	14(45)	5(20)	13(73)	46(24)
All	13	89	31	24	30	187

Size apparently does not affect cropping pattern in any specific way, judging from the first of the two preceding tables. The proportion of total area devoted to each crop seems to jump around with no clear direction across farm sizes. Looking at the second table, though, one can discern an apparently very slight tendency for large farmers to plant more of the short season berseem-cotton rotation.

A more thorough check of the sensitivity of cropping pattern to size and to other factors is provided in the following regressions. The proportion of area in each crop to total cropped area was regressed against a set of zonal dummies, total managed area as an index of size, total revenue as another measure of size, hired labor as a proportion of total labor (an index of capitalist relations), the per feddan density of family members, and the per feddan density of cattle and buffalo stocks.

Cropping Pattern Response to Various Factors

Var.	Corn	Wheat	LSBers	SSBers	Rice	Cott	Veg	Fruits
Int.	.14*	.13*	.18*	.13*	.13*	.13*	.03	.07*
Z2	0	-.02	.12*	-.06	.12*	-.03	-.04	-.06*
Z3	.01	0	.02	.07*	.02	.06*	-.07*	-.05*
Z4	.02	.02	.02	.03	.03	.05	-.07*	-.05*
Z8	-.05*	-.06*	.07*	.01	.07*	.06*	.03	-.05*
Z9	-.10*	-.01	0	.09*	.10*	.10*	-.06*	-.06*
TMA	0	0	0	0	0	0	0	0
TotRev	0	0	0	0	0	0	0	0
HL/TL	-.06*	0	0	0	.05	-.02	.04	0
Famden	0	0	.01*	-.01*	0	-.01*	0	0
Anden	0	-.01	-.05*	.03*	0	.03*	0	0

* t ratio > 1.7

It is evident from this table that cropping pattern is influenced by the regional dummies and little else. Size, whether the farm is capitalist or not, and the presence of cattle or buffalo, all seem to be largely irrelevant. Thus, on the basis of these results, it can not be claimed that large or capitalist farmers avoid the government controlled crops and concentrate on the perhaps more profitable vegetables and fruits, which are less controlled by the government.

One more attempt to study the relationship between cropping pattern and "social" factors was made by attempting to draw contrasts between the cropping patterns of the groups identified in the cluster analysis performed in part 1 of this paper. Since these groups were created in such a way as to maximize the contrasts between them in terms of the social factors, it was felt that meaningful results could emerge. In the following table we note whether there were statistically significant differences between the shares of total area dedicated to the various crops by the various groups. Only the significant pair-wise comparisons are noted below. The members of the groups listed in the first column dedicated significantly larger proportions of their total managed area to the crop in each given row than did the members of the groups in the second column.

Comparisons Between Groups' Cropping Patterns.

	Group(s)	more than group(s)
Corn	7,8	5,3,2.
Wheat	4	2.
LSBers	7	5,3,2.
SSBers	3,5	7.
Cotton	3,5	7.
Veg	9	All but 2.
	2	3,7.

Certain clear patterns do emerge, evidently. There is an apparent tradeoff between the long season berseem-corn rotation and the short season berseem-cotton rotation. Groups 3 and 5 tend to plant more of the latter rotation and less of the former than groups 7 and 8. Group 7 is composed of small, traditional peasants: small plots, small marketed surplus, little hired labor. Group 8 consists entirely of small farmers whose total managed area is taken in share from others. Group 5 is composed of capitalists managing some 8-12 feddans (small scale capitalists), while group 3 consists of peasants who do not have significantly more land than those of group 2, but who market a much greater portion of their output and meet a much larger proportion of their total labor needs through the market than do those of group 7. This implies that the "modernized" farms, with larger marketed surplus and capitalist relations indices, and without sharecropping relations, tend to specialize relatively more in short season berseem-cotton, and less in long season berseem-corn, <u>regardless of farm size</u>. We can see that the very largest capitalist farms that compose group 2 tend to specialize more in vegetable production. Also, we see that the mysterious group 9 is characterized by a larger amount of vegetable production than all other farms except the largest capitalist farms of group 2. This still does not help explain why this group would hire such a large (95%) proportion of its required labor and sell only about 20% of its output. Finally, we note that the wheat contrast is not particularly meaningful, and that no contrasts at all emerged in rice or fruits.

We may conclude this exploration of cropping patterns by saying that the most important explanation of cropping pattern variations seems to be regionality. Farm size is totally unimportant, but the presence of capitalist relations seems to be of some importance in explaining a preference for the short season berseem-cotton cycle.

A related matter is the pattern of land use: do larger farms use smaller proportions of their land for cropping? Do they have, on average, as much of the land they manage under exploitation throughout the year? To answer this question we related total cropped area to total managed area, with the following results. In the first equation, the dependent variable was total cropped area, and the independent variable was total managed area. In the second equation the variables were the logs of the same. In general, we should expect the total cropped area to be about twice the total managed area.

Relations Between Total Cropped Area and Total Managed Area

	Linear		Log	
	Coef	Std. Error	Coef	Std. Error
Int	.348	.259	.6586	.0197
TMA	1.800	.026	.9819	.0125
R-sq	.96		.97	

Since in the linear equation the intercept is not significantly different from zero, it seems that the ratio of total cropped area to total managed area is quite constant across sizes. Similarly, looking at the exponent in the log relation, we can see that it is barely different from 1.0 (consider it in relation to its standard error) so that there is no curvature to this line from the origin, again indicating a practically constant relation between farm size and cropped area. Note that exp.(.6586)=1.93, so that the two estimated relations are about the same.

Finally, in this section, we turn to the relationship between cropping pattern and productivity of farms. Several specific crop rotations were identified. These were short season berseem-cotton, wheat-rice, wheat-maize, long season berseem-maize, long season berseem-rice, and a "fake" rotation fruits-vegetables. Dummy variables were set up for these rotations. That is, it was the presence itself of the rotation that was presumed to be important. As always, we included regional dummies to control for regional variability. Net revenue per feddan and per capita income were both regressed on the rotations and the regional dummies. There was no indication that the presence of any of the specific rotations is an important determinant of either per feddan or per capita income for each farm as a whole. Nevertheless, it should be clear from the section on yield and productivity that vegetables and fruits are indeed more profitable on a per feddan basis. It is likely that our survey does not have enough information on fruits and vegetables to allow us to come to any statistically significant conclusions about the contribution of these crops to farm-level per feddan profitability.

6. Marketing and Utilization Patterns

In this section we will describe the various marketing channels for the agricultural products. To begin with, the following tables describe the marketing channels by farm size, for various crops. The data on sales and animal or human consumption are expressed as proportions of total output, while all other data are expressed as proportions of total supply (that is, output plus purchases). Note that it is possible for some proportions to be greater than one because of the drawing down of stocks.

Utilization and Marketing Patterns for Various Crops*

Crop:Wheat

Farm Sizes	LT 1	1-3	3-5	5-10	GE 10	All
Market Purch....	0.65	0.24	0.11	0.07	0.04	0.12
Sold to Coop....	0.	0.18	0.07	0.11	0.22	0.17
Sold In Market..	0.	0.07	0.08	0.20	0.29	0.20
Temp Storage....	0.09	0.11	0.32	0.20	0.17	0.18
Cons On Farm....	0.51	0.43	0.41	0.40	0.29	0.37
Change in Stock.	-0.11	0.11	0.00	0.34	0.29	0.20
No. of Farmers..	13	87	28	22	28	178

*See note at the end of these tables.

Crop:LSBers

Farm Sizes	LT 1	1-3	3-5	5-10	GE 10	All
Market Purch....	0.34	0.15	0.12	0.13	0.12	0.13
Sold In Market..	0.30	0.31	0.32	0.51	0.56	0.46
An Cons of Prod.	0.60	0.51	0.52	0.98	0.35	0.53
An Cons of Purch	0.34	0.14	0.12	0.05	0.07	0.09
Total An Cons...	0.73	0.57	0.58	0.90	0.42	0.57
No. of Farmers..	10	81	28	20	26	165

Crop:SSBers

Farm Sizes	LT 1	1-3	3-5	5-10	GE 10	All
Market Purch....	0.38	0	0	0	0	0
Sold In Market..	0.40	0.28	0.36	0.38	0.45	0.40
Cons On Farm....	0.36	0.67	0.53	0.43	0.45	0.49
An Cons of Prod.	0.31	0.30	0.33	0.16	0.20	0.22
An Cons of Purch	0.38	0	0	0	0	0
Tot An Cons.....	0.57	0.28	0.33	0.16	0.19	0.21
No. of Farmers..	4	59	21	21	20	125

Crop:Maize

Farm Sizes	LT 1	1-3	3-5	5-10	GE 10	All
Market Purch.....	0.75	0.22	0.16	0.15	0.11	0.17
Sold In Market...	0	0.06	0.02	0.27	0.45	0.25
Temp Storage.....	0	0.32	0.46	0.32	0.08	0.24
Cons On Farm.....	0.24	0.37	0.36	0.30	0.34	0.34
Hum Cons Of Prod.	0.74	0.48	0.61	0.33	0.14	0.34
Hum Cons OF Purch	0.81	0.20	0.13	0.10	0.08	0.15
Total Human Con..	0.84	0.46	0.50	0.38	0.22	0.37
Change in Stock..	-0.27	0.26	0.03	0.31	0.21	0.21
No. of Farmers...	12	81	29	22	25	169

Crop:Maize

Farm Sizes	LT 1	1-3	3-5	5-10	GE 10	All
Market Purch.....	0.07	0.07	0.02	0.00	0.01	0.02
Sold To Quota....	0.32	0.26	0.41	0.41	0.50	0.44
Sold to Coop.....	0.22	0.19	0.10	0.15	0.09	0.12
Sold In Market...	0	0.02	0.03	0.02	0.07	0.05
Intmdte Frm Use..	0	0.01	0.02	0.08	0.06	0.05
Temp Storage.....	0.26	0.17	0.26	0.08	0.09	0.13
Cons On Farm.....	0.18	0.27	0.14	0.16	0.12	0.15
Hum Cons Of Prod.	0.34	0.23	0.16	0.05	0.02	0.08
Hum Cons OF Purch	0.13	0.06	0.02	0.01	0.01	0.02
Total Human Con..	0.33	0.21	0.10	0.06	0.03	0.08
Change in Stock..	0.10	0.26	0.26	0.22	0.23	0.23
No. of Farmers...	12	87	29	23	29	180

NOTE: While great efforts were made to assure that all errors and inconsistencies were weeded out from the data, some remain, so that if a result seems odd, it is probably due to thus far unresolved problems with the data.

One of the interesting aspects of these tables is the amount of berseem bought and sold on the market. Evidently, this is a function of the profitability of cattle production for meat.

As in previous sections, we can test the marketed surplus relations in a finer way by fitting simple functions. Below we test the dependence of marketed surplus on various factors. The factors were: animal density on the farm (defined as the number of cattle and buffalo divided by farm size), family density (family size divided by farm size), farm size, and zonal dummies. In the dependent variables, MS refers to the ratio of net sales to output (sales minus market purchases over total output), while Free/MS refers to the ratio of free market sales to total net sales. The functions were fitted for each of the marketing channels and for the total marketed surplus. In the case of crops marketed through only one channel, naturally, only one function is fitted. For certain crops some variables were not included in the equation (family density in the case of berseem, for example). Since <u>all</u> cotton is marketed, and only through one channel, no equation at all was fitted for cotton. In order to keep the presentation uncluttered and because the significance level, not the actual coefficient, seems important, in the tables below we report only the t-values.

Marketed Surplus Relations for Corn, LS Berseem, SS Berseem
(Total Marketed Surplus Only)

Factor	Corn	LSBers	SSBers
FamDens	-1.1	---	---
AnDens	0	-1.6	-0.8
Size	1.0	0.5	1.5
Z2	-2.0	0.4	-1.7
Z3	0.6	-0.6	-4.4
Z4	0.9	3.1	-4.0
Z8	-5.1	-2.7	-2.0
Z9	-4.6	-3.2	-0.8

Marketed Surplus Relations for Wheat and Rice

	Wheat		Rice	
Factor	Tot MS	Free/MS	Tot MS	Free/MS
FamDens	-2.5	-0.6	-1.4	-1.4
AnDens	0.3	0.5	---	---
Size	-1.2	0.4	1.4	-0.4
Z2	0.7	0.8	-2.4	0.5
Z3	-0.7	-2.0	0.1	1.4
Z4	-1.6	-3.1	-0.3	0.7
Z8	-2.2	-0.7	1.9	-0.3
Z9	-0.5	1.2	0.9	-2.2

Of the non-zonal variables, only family density in the case of wheat (with a negative influence, as would be expected), and animal density in the case of long season berseem (again with the expected negative sign) are of some significance. Regionality seems to be as significant as anything else in influencing patterns of marketing, as should by now be expected.

7. Family Income Analysis

In this section we analyze the sources and distribution of various measures of income.

Perhaps the most important measure of income is what we have called family income, which measures total cash plus imputed revenue minus cash costs except for land (due to incompatibility of land cost information for various farms). The table below lists the various sources of income.

Structure of Income by Farm Size

Farm Sizes	LT 1	1-3	3-5	5-10	GE 10	All
Total Net Family Income (LE)						
	220.5	277.8	895.5	746.3	2256.7	753.8
Per Capita Income						
	36.1	34.3	91.4	74.6	245.2	86.7
Crop Share of Net Family Income						
Wheat	-0.03	0.08	0.05	0.08	0.07	0.07
Maize	0.01	0.09	0.03	0.06	0.03	0.04
Rice	0.14	0.27	0.19	0.30	0.24	0.23
Cotton	0.07	0.27	0.15	0.39	0.40	0.32
LSBers	0.11	0.30	0.20	0.26	0.16	0.20
Potato	0.	0.03	0.02	0.	0.	0.01
Onion	0.02	0.02	0.00	-0.01	0.07	0.03
Tomato	0.	0.03	0.01	0.	0.05	0.03
Fruits	0.	0.	0.02	0.02	0.03	0.02
Share of Labor Sales To Other Farms						
	0.251	0.213	0.019	0.112	0.041	0.080
Share of Labor Sales To Non-Farms						
	0.651	0.158	0.421	0.053	0.092	0.175

Note: the various sources' shares do not add to 1 because livestock income and costs and general farm costs have been included in the total income numbers reported in the first line of this table.

From this table the evidence on sources of income seems to indicate that off-farm income sources are much more important for smaller farms than for larger ones. The share of various crops in total family income seems not to be affected by size, except possibly for the share of cotton and onions, whose share might increase slightly with size.

But more exact information on these issues is derived from several simple functions. If we allow for regional effects and regress the share of each crop in total income on size the results are significant only for vegetables (negative). It may appear that this last result is contradictory to what one would surmise from the table, but recall from the section on cropping patterns that the percentages recorded above for vegetables in the large size categories above are based on smaller numbers than those in the smaller categories, specially the 1-3 feddan category. On the other hand, regionality certainly has an influence on the share of each crop in total income. Even in the case of vegetables, regional influence is greater than that of size. We may conclude that size of farm has only a very minor influence on the various crops' shares in total income.

With respect to off-farm labor income as a share of total income, it seems that this share is not affected by farm size. We regressed each source of off-farm labor income (other farms and non-farms) as well as the total share on farm size and dummies various zones, and found no support for the idea that farm size affects the share of off-farm labor income in total income. However, the share of labor income derived from sale of labor to other farms, is certainly related to farm size, in an inverse way. Evidently the influence of labor sales to non-farms is important enough, and unrelated to farm size, so that the ratio of total labor sales to total income is unrelated to farm size. This could perhaps be due to larger farms having sizable off-farm incomes due to sale of more skilled labor. Again, regionality is more important in explaining variations in this ratio than farm size.

As for the dependence of family income on farm size, there is a very positive and clear relationship. A regression of per capita income on farm size, including dummies to control for regionality, yielded the following results (we report only the significant regions):

Per Capita Income
Related to Farm Size

	Coef	Std Error
Intcpt	137.6	44.7
Size	17.5	2.3
Zone8	-119.2	54.8
Zone9	-143.9	60.6

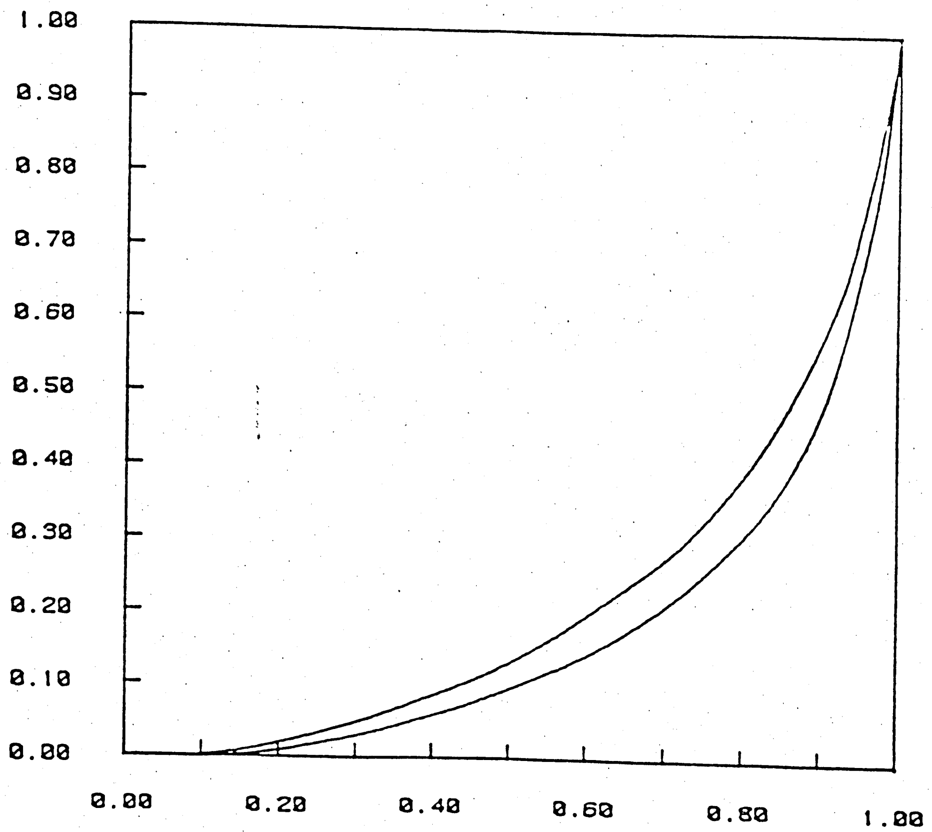
We can with great confidence say that a 1-feddan increase in farm size is associated with at least a 10 LE increase in per capita income. Of course, there is nothing surprising about this. Also note that Zone 8 and Zone 9 dummies are associated with at least as much of a decrease in income.

With respect to the distribution of income we have several results. First, we have calculated inequality measures for the distribution of several concepts of income and wealth. These are: total managed land as a measure of wealth or income potential, agricultural income net of cash costs (except for land costs - again, because of data problems), net agricultural income plus wage income, and the last two income measures but on a per capita basis. The Gini coefficients were the following:

Farm Size	.58
Net Ag Inc	.60
Net Ag Inc + Wages	.56
NAI Per Capita	.64
NAI+W Per Capita	.62

All these measures are very similar. It is especially surprising to find such a close correspondence between the distribution of land area and income. This clearly underscores the importance of land tenure as a distributional issue.

The Lorenz curve below allows us to get a more intuitive feeling for these distributions and allows us to make some international comparisons. Plotted below are the most equal curve (that for Net Ag Inc + Wages) and that for the least equal (that for NAI Per Capita), so we can have an idea of the range involved. Some international comparisons and also comparisons with other studies of Egypt are possible. Our results seem to match fairly well those results reached by other studies. Compared to World Bank data for Egypt (World Tables 1981), we find more inequality in income distribution. Using a measure as close to that reported by



the Bank, we find that the income received by the poorest 20% of the households was about 2%, while for the richest 5% it was about 28% The world bank reports 6.6% and 17.5% for 1960, 7.0% and 17.4% for 1965, and 5.1% and 22.0% for their most recent estimate (year not given). Lance Taylor ("Food Subsidies and Income Distribution in Egypt", mimeo., 1976, Table B-6) reports about 1% and 20% for 1974-75. So our results are in general agreement, though they imply greater inequality than the World Bank's results. It would seem that inequality has increased, as the Bank's results show increased inequality over time, and both Taylor's and our results, which seem to be subsequent to the Bank's, show even more inequality. Our estimates of the Gini coefficient show far greater inequality than Taylor's estimates do.

From Taylor's paper it is not clear exactly how he estimates the coefficients, but from his remark that they are "relevant" to certain Lorenz curves, we assume that he calculated it from the area under the Lorenz curve. Ours are some of the highest Gini coefficients we have observed for any country, indicating a large degree of inequality. Our measure of income might be criticized because it does not include land costs. On the other hand, the other estimates are based on expenditure surveys. Finally, we must note that our estimates are for <u>agricultural</u> households, not for rural ones.

Another possible problem with our data might be that, as we mentioned in the introduction, large farms are over-represented in our sample, and small ones are under-represented. This bias would certainly show up, if anywhere at all, when we look at distribution issues. In order to get at least some idea as to the effect of this bias on our gini coefficients, we reconstructed our sample in the following way. Since, in the category of farms less than or equal to 1 feddan in size our sample showed four times less farms than should have been the case according to the official data presented in the introduction, we simply duplicated the data for these farms four times. In all the other categories, we took a random sample of the farms present in each category so as to have a smaller number of farms than was present in the original sample. The size of the sample was in keeping with the proportions present in the official data. After all this was done, we had a "new" sample of the same size as the old one, but with the same as the "official" distribution of sizes. In effect, we simply mimicked a weighting mechanism, but we had to go through this tedious process because there was no clear way to use a set of simple multiplicative weights in calculating the areas under the lorenz curves. The results were as follows

Farm Size	.52
Net Ag Inc	.60
Net Ag Inc + Wages	.56
NAI Per Capita	.66
NAI+W Per Capita	.62

As we can see, the results hardly change. Only the Farm Size gini coefficient changes significantly, and it is closer to the range other studies have determined. But the other areas are unchanged and reflect much more inequality than other studies have discovered. One reasonable explanation, given the apparent way the sample was conducted, for why our data reflect so much more inequality is that our data's units of observation are businesses, rather than families, in a situation where the correspondence between the two is definitely not one to one. As we mentioned above, it is often the case that several families (say, several married brothers) operate several plots together as one business, in spite of having the plots registered as different farms in the official records. Since it is entirely reasonable that the distribution of business property should be more skewed than that of the income created by it, then our results might be reasonable, given that the actual surveying procedure seems to have used an operational rather than official definition of what a business unit is.

Looking at the distribution of income from a social class perspective, we get the following results.

Class distribution of income.

	Pop. Share	Income Share	IS/PS
Group 1	.0216	.0191	0.88
Group 2	.0486	.1703	3.50
Group 3	.3405	.1928	0.57
Group 4	.0270	.0262	0.97
Group 5	.1568	.2345	1.50
Group 6	.0378	.1269	3.36
Group 7	.3297	.1834	0.56
Group 8	.0162	.0413	2.55
Group 9	.0216	.0054	0.25

As we can see, this grouping produces a highly polarized breakdown of income shares. The groups earning above average incomes, in order of descending income, are 2, 6, 8, and 5. As we saw in part 1 (on typological analysis) group 2 consists of large capitalists, who meet most of their labor needs through the labor market, and market most of their output. Group 6 consists of rather large landlords, who rent out large portions of their land in share. Interestingly enough, group 8 consists of relatively small farmers who receive all of their land in share from other farmers. Finally, group 5 consists of medium scale capitalists. The poorest farmers, in order of decreasing poverty are those in groups 9; 7 and 3 in an approximate tie; 1; and 4. Group 9 is an odd group that markets very little of its output in spite of hiring large amounts of labor, and that concentrates on vegetable production. Groups 3 and 7 are middle peasants depending on family labor for most of their labor needs, selling less than half of their output, and depending on the sale of labor for significant parts of their total income. Group 1 consists of farmers who take in about 1/2 of their land in share, and who depend on the labor market for most of their income. Group 4 is a small group of small farmers who share out some of their land. To summarize, the large landlords and capitalists capture about 30% of the total income in spite of being only about 8% of the population. At the other end of the spectrum, sharecroppers, and semi-proletarians capture about 42% of the income, and comprise 72% of the population.

The absolute income levels by class can be studied in the following table, which gives the mean income per group and its standard error. The social groupings are as defined above.

Income Levels and Social Classes

	Mean	Std err
Group1	873	4703
Group2	3459	313
Group3	559	119
Group4	958	421
Group5	1478	175
Group6	3315	356
Group7	549	120
Group8	2518	543
Group9	247	470

From this, we can see that large capitalists' families receive incomes which are about the same as those of landlords, and usually not less than 3000 LE. Peasants and semiproletarians, on the other hand, receive incomes no higher than 700 LE. (At a 5% confidence level.) It is evident that the mean income levels for groups 1 and 9 are meaningless.

8. Land Tenure

In this section we will simply present two tables describing the amounts of land held under various forms of tenure by the farmers in the survey. There have already been references to land tenure above, as a possible factor in the determination of yields, in the section on yields and productivity. The table below presents data on total managed area, land rented in for cash, land rented in for crop-share, land rented out for cash, land rented out for crop-share, and land from the land reform. These categories are not mutually exclusive because of the way the survey was taken. Namely, in many cases when the farmer was renting land out for share it was assumed to be still under his management. Lacking better information, we preferred to leave the data as it was. In any case, this may refer reality better, as it is quite likely that management is in fact shared between owner and sharecropper.

First, the distribution of land tenure forms by size:

Land Tenure Data By Farm Size

Farm Size / Tenure Category	LT 1	1-3	3-5	5-10	GT 10	ALL
Tot. Area	0.57	1.92	3.65	6.76	22.21	5.99
Cash in	0.05	0.21	0.54	1.05	3.67	0.92
Cash Out	0.05	0.02	0.14	0.88	1.17	0.34
Tot. cash	0.10	0.23	0.69	1.93	4.84	1.26
Share In	0.03	0.08	0.12	0.35	0.	0.10
Share Out	0.	0.05	0.07	0.20	5.17	0.89
Tot. share	0.03	0.13	0.18	0.55	5.17	0.99
Land Ref.	0.	0.66	1.33	0.26	0.	0.57
No. farms	13	89	31	24	30	187

Next, the distribution of land tenure forms by zone:

Land Tenure Data By Zone

Zones / Tenure Category	1	2	3	4	8	9
Tot. Area	6.16	7.45	4.06	4.46	6.03	7.70
Cash in	0.34	0.72	1.37	1.05	1.11	0.81
Cash In	0.62	0.	0.13	0.	0.57	0.24
Tot. cash	0.95	0.72	1.50	1.05	1.68	1.05
Share Out	0.42	0.09	0.07	0.	0.02	0.
Share In	1.54	1.15	0.11	0.	0.	2.71
Tot. share	1.96	1.25	0.18	0.	0.02	2.71
Land ref.	0.21	0.37	0.48	1.32	0.90	0.27
No. farms	34	18	35	16	51	33

9. Summary and Conclusions

1. We found out that a clustering analysis of the Farm Management data based on size, proportion of hired labor, marketed surplus, and sharecropping relations as criterion variables provided a far richer typology of farms than the traditional typology based only on size. Furthermore, since the correlation between some of these variables and size is fairly low, the typology is by no means equivalent to one based on size. Nevertheless, the size variable plays a crucial rcle in the typology (in spite of the fact that all the

variables were standardized). This typology was later used as basis for some of the analysis.

2. After noting that in fact there seems to be little yield variability and that therefore an attempt to explain whatever there is might well turn out to be futile (because of diminishing returns to explanatory effort?), we nevertheless attempt to explain these small variations. By far the best "explanation" of yield variation is regionality. The dummy variables for the various zones always had much higher significance than any of the other factors we tried (farm size, labor use, nitrogen use, presence of capitalist labor relations, presence of sharecropping land relations). To the extent that this variability between regions is not due to natural factors (soil quality, etc.) an effort should be made to discover which institutional factors are responsible for higher yields in certain regions, so that, if possible, these positive factors might be duplicated in the regions with the lower yields. Unfortunately, our data do not allow us to go into this issue any further. In spite of the greater importance of regionality, size does indeed affect yields negatively, but only in a very weak and minor way, and only for individual crops - when one aggregates all crops, large farms get as much monetary output per feddan as the smaller ones. The effect of size on yields is so small, given the existing institutional framework in Egyptian agriculture (which dampens a possible effect of size on yield),

that it should be judged irrelevant to policy making, if the policy is mostly concerned with productivity. On the other hand, the near constancy of yields tends to imply a very tight correlation between control of land and control of income, so that almost the only justification for a concern with land distribution is a concern for equity. In general, we also found a positive (but, again, weak) association between cash rentals and capitalist relations (as opposed to sharecropping), and yields. Discouraging sharecropping relations, should this be judged convenient for reasons of distributional justice or for political reasons, would certainly not damage yields. Given all of the above, and from an efficiency point of view, changes in agrarian structure ought to be less concerned with the distribution of the land as such, than with the modernization of social relations and institutions. Moreover, from an equity point of view, there seems to be no loss of productivity associated with redistribution, though certainly no significant gain either.

3. In our study of input use we discovered that the main influence on variability of input use was regionality. Again, larger farms use inputs slightly less intensely than small farms, and, in fact, use the only input that seems to make a real difference to yield - nitrogen - just as intensely as small farms. Of course, this information is consistent with what we have observed above, namely, that bigger farms get only very slightly less output per feddan

than small farms.

We have found, at least on the basis of cross-sectional evidence, that mechanization replaces human labor more than it replaces animal labor. Thus, it can not be claimed that encouraging mechanization will not displace human labor. It is possible that time series studies might find different or even contrary evidence. For the purpose of policy making, more credence might be given to time series results, especially if they are statistically more meaningful than ours. It should not be surprising if time series results yield different, or stronger, results, as one would expect more variation in price ratios across time than cross sectionally. Even contradictory results should not be surprising, as individual farmers are responding to different forces over time than cross sectional results can model.

With respect to the intensity of land use in the Eastern Delta region, that is, the ratio of yearly land use to total land available, we found it to be constant across farm sizes: there is no evidence that large farms use smaller proportions of the land available to them throughout the year than do smaller farms.

4. We found that there is very little relation between cropping pattern and farm size. Large farms do not plant significantly larger proportions of their managed areas to any specific crops than do smaller farms. So it can not be claimed that larger farms tend to escape the government

restrictions implied by planting the government- controlled crops. On the other hand, the presence of capitalist relations does seem to be associated with the short season berseem-cotton cropping pattern, but it is not clear in which direction the causality runs. It can very well be the case that the labor intensity of this rotation makes farms who plant it appear strongly capitalist. It is interesting that these "capitalist" farms in fact favor cotton, a government controlled crop. The largest capitalist farms, however, do seem to favor vegetables, and here it is not likely that the causality runs from choice of crop to appearance of capitalist relations, as these farms would most likely appear as capitalist no matter what they plant. These same farms tended to avoid corn and wheat production. This is the only piece of evidence we found to support the claim that large, modernized farms avoid controlled crops. Even so, the only controlled crop they are avoiding is wheat, rather than cotton, which is subject to even more severe controls than wheat. But the most important determinant of cropping pattern we found was simply regionality.

We also found that cropping pattern choice seems to have little, if any, influence on either per feddan or per capita income. Since some crops are clearly more profitable than others on a per feddan basis, it is likely that this result is due to the lack of sufficient observed variation in the cropping pattern. The relevant point would therefore be that in the observed range of cropping pattern variation there was no relationship between this variation and variation in income per capita or per feddan.

5. In the analysis of marketing and utilization patterns we found little that would be unexpected. Farm size seems to have little influence on any of the utilization or marketing variables. The population and animal density on the farm land do seem to have some negative influence on the proportion of output that is marketed. But as should be expected by now, the by far most important influence on these patterns is simply regionality.

6. In the analysis of family income we first confirmed the overwhelming importance of rice and cotton to family income: they form about 50% of farm income net of cash costs, including income from labor sales. The share of income contributed by each crop to total family income is independent of farm size. Again, however, those results could be due to insufficient observed variability in the various crops' shares in family income.

We found a very close correspondence between farm size and per capita income, which is only natural. The regional influence was not as important as in many of the other issues we studied. We also found that the share of total labor sales in total income is unrelated to farm size. However, labor sales to other farms are negatively related to farm size.

APPENDIX

Description and list of variables in the 1976 Egypt farm management survey and in the 1982 follow-up.

There are 187 farms for 11 villages (see codes list for a list of the villages and their codes) in the 1976 survey. Each village has some 16 to 18 farms. All the farms are from the East Delta region. So far we have 34 farms in two villages for the 1982 follow-up. These two villages are El Sophia (# 5) and Kafr Danohyia (# 9).

For each farm there are 2100 variables, organized in various groups (general variables, physical input-output variables, monetary input-output variables, physical utilization pattern variables, and monetary utilization pattern variables). Within each group there are repeating sets of variables, each set applying to a different crop. A list and description follows.

Note: in the following lists, the second number applying to each variable is the monetary version of the variable. Only variables having only a physical or monetary aspect are listed with only one variable number.

Beware that the monetary aspect of a variable may be unknown even if the physical one is. That is the case, for example, with land used in the production of the various crops.

The physical units are indicated whenever I know them. The monetary units are implicit, but usually refer to LE, so I do not indicate them.

As to the quality of the data: whenever I have reason to be suspicious as to the quality of a certain variable, I make some sort of comment. The lack of a comment does not necessarily mean that there is reasonable certainty that the variable in question is "good": all it means is that we have not seen anything to make us particularly suspicious.

In the village code lists we indicate which farm numbers belong to which villages.

General Activities or Variables

Variable #		Variable Name
1		Farm Number.
2		Village Number (see codes list).
3		Farm number within village.
4		Age of farmer (sometimes unknown)
5		Years of schooling (when unknown=0).
6		Farm size ("Total Managed Area", in feddans).
7		Family size (sometimes unreliable).
8		So-called Total Man Equivalent (also unreliable).
9		Stock of cattle.
10		Stock of buffalo.
2050		Amount of land rented in for cash (in feddans).
2051		Amount of land rented in for share (feddans).
2052		Amount of land rented out for cash (feddans).
2053		Amount of land rented out for share (feddans).
2054		Amount of land from land reform (feddans).
2055		Value of owned land (LE/fed).
2056		Rent/fed of land rented in for cash (LE).
2057		Rent/fed of land rented out for cash (LE).
2058		Value of Land Reform held land (LE).
11	26	Sale of family labor to other farms(days).
12	27	Sale of fam. L. to non-ag. sector(days).
13	28	"Sale" of family labor to miscellaneous activities (includes army, school, in days).
14	29	Family labor used for household activities(days).
15	30	Anim. power hired for general farm activs. (hours).
16	31	Seasonal L. hired for general farm activs. (days).
17	32	Perman. L. hired for general farm activs. (days).
18	33	Fuel purchased for general farm activities (unreliable).
19	34	Oil purch. for gen. farm activs. (also unreliable).
20	35	Fam. l. used for gen. farm activs. (in days).
21	36	Own anim. power used for gen. farm activs. (hours).
22	37	Land taxes paid (unreliable).
23	38	Interests paid (unreliable).
24	39	Repairs and maintenance costs (unreliable).
25	40	"Participant Share" (unreliable).

NOTE: The following set of variables is repeated for each crop in the following manner:

c = 40, 68, 96, ..., 404
d = 432, 460, 488, ..., 796

Thus, for example (look at the list below), the 41st variable will contain the crop code for the physical accounts of the first crop listed for each farm; the 69th variable will be the crop code for physical accounts of the second listed crop, etc. The 43rd and 71st variables will contain the main output, expressed in physical units, of the 1st and 2nd crops, respectively, etc. The 433rd variable will contain the crop code for the monetary accounts on the first crop listed, etc. To better understand what is going on, note that, for example,

68 - 40 = 28
96 - 68 = 28,

and there are 28 variables for each crop.

Crop production and livestock maintenance activities.

Variable #		Description
c+1	d+1	Crop Code (see variable codes list).
c+2	d+2	Empty.
c+3	d+3	Main Product (in kg. for everything other than berseem. Kirats [=1/24 feddan] for the two types of berseem.)
c+4	d+4	By product (Donkey loads [=250 kgs.] for all crops).
c+5	d+5	Land area used for the crop (in feddans - no monetary version exists).
c+6	d+6	Hired anim. power (hours).
c+7	d+7	Hired seasonal L. (days).
c+8	d+8	Hired perm L. (days).
c+9	d+9	Hired mech. power (hours).
c+10	d+10	Seeds from coop (kg).
c+11	d+11	Seeds from market (kg).
c+12	d+12	Manure (donkey loads).
c+13	d+13	Nitrogen from coop (kg of pure N).
c+14	d+14	Nitrogen from mkt (kg pure N).
c+15	d+15	Phosph. from coop (kg pure P).
c+16	d+16	Phosph. from mkt (kg pure P).

c+17	d+17	Potassium from coop (kg pure K).
c+18	d+18	Potassium from mkt (kg pure K).
c+19	d+19	Pesticide from coop (kg).
c+20	d+20	Pesticide from mkt (kg).
c+21	d+21	Pesticide from coop (liters).
c+22	d+22	Pesticide from mkt (liters).
c+23	d+23	Pest services (LE).
c+24	d+24	Family labor (days).
c+25	d+25	Own anim. power (hours).
c+26	d+26	Own mech. power (hours).
c+27	d+27	Own manure (Donkey loads).
c+28	d+28	Own seeds (kg).

Note: for livestock (activity code # 25 - see variables code list) the first nine variables contain the same in-information as for the crops, but the rest of the varia-bles contain different information, as detailed below:

Variable #		Description
c+10	d+10	Green fodder (kirats).
c+11	d+11	Roughage (kgs).
c+12	d+12	Dry fodder (donkey loads).
c+13	d+13	Concentrated forage from mkt (kgs).
c+14	d+14	Concentrated forage from coop (kgs).
c+15	d+15	Other livestock inputs (LE).
c+16	d+16	Empty.
c+17	d+17	Empty.
c+18	d+18	Family labor (days).
c+19	d+19	Own anim. power (hours).
c+20	d+20	Own mech. power (hours).
c+21	d+21	Empty.
c+22	d+22	Empty.
c+23	d+23	Own green fodder (kirats).
c+24	d+24	Own roughage (kgs).
c+25	d+25	Own dry fodder (donkey loads).
c+26	d+26	Own concentrated feed (kgs).

Utilization pattern.

Note: the following variables cycle in the same way as the cropping activity variables, with the following structure:

e = 824, 841, ..., 1402
f = 1419, 1436, 1997

Variable #		Description
e+1	f+1	Product code (see code list).
e+2	f+2	Total output.
e+3	f+3	Market purchases.
e+4	f+4	Total supply.
e+5	f+5	Sold under quota.
e+6	f+7	Sold through coop.
e+7	f+7	Sold in market.
e+8	f+8	Intermediate farm uses.
e+9	f+9	Temporarily stored.
e+10	f+10	Consumed on the farm.
e+11	f+11	Animal cons. of on-farm prod.
e+12	f+12	Animal cons. of purch. prod.
e+13	f+13	Total animal cons.
e+14	f+14	Human cons. of on-farm prod.
e+15	f+15	Human cons. of purch. prod.
e+16	f+16	Total human consumption.
e+17	f+17	Change in stock.

List of Variable Codes.

Village Codes (needed to interpret variable 2).

Code	Village
1	"37-38" (farms 1-18),S-1
2	Shambret Mankala (farms 19-36),S-3
3	Manakhla (farms 37-51),Da-8
4	Bane Abaed (farms 52-69),Da-8
5	El Sophia (farms 70-84, and 1-16 for the 1982 follow-up),S-9
6	Elekhewa (farms 85-102),S-2
7	El Samaana (farms 103-118),S-1
8	Manshat Elekhewa (farms 119-134),Da-4
9	Kafr el Wastane (farms 135-152, and 17-34 for the 1982 follow-up),Do-8
10	Kafr Danohyia (farms 153-169),S-3
11	El Gamaleyia (farms 170-187),Da-9

Governorates and zones: S=Sharquiya, Da=Dakhlia, Do=Domiat. Thus, S-3 means Sharquiya, zone 3.

Activity Codes (needed to interpret variables 41, 69, ..., 405).

Code	Activity
1	Wheat (W)
2	Barley (W)
3	Long S Berseem (W)
4	Short S Berseem (W)
5	Beans (W)
6	Lentils (W)
7	Flax (W)
8	Maize (S)
9	Sorghum (S)
10	Rice (S)
11	Cotton (S)
12	Groundnuts (S)
13	Sesame (S)
14	Sugar (Perm)
15	Other field crops (Various)
16	Potatoes (S)
17	Onions (W)
18	Garlic (S)
19	Tomatoes (S)
20	Other vegetables (Various)
21	Citrus (Perm)
22	Grapes (Perm)
23	Mangos (Perm)
24	Other fruits (Perm)
25	Livestock

Utilization pattern product codes.

Code	Product
1	Wheat grain
2	Wheat straw
3	Barley grain
4	Barley straw
5	Long S Berseem
6	LSB Hay
7	LSB Straw
8	LSB Seeds
9	Short S Berseem
10	Broad beans green
11	Broad beans seed
12	Broad beans straw

13	Lentil seeds
14	Lentil straw
15	r
16	Flax stalks
17	Flax seeds
18	Maize grain
19	Maize stalks
20	Barley grain
21	Barley straw
22	Rice grain
23	Rice straw
24	Cotton fiber
25	Cotton stalks
26	Groundnuts fruit
27	Groundnuts residual
28	Groundnuts cuttings
29	Sesame seeds
30	Sesame stalks
31	Sugar cane main
32	Sugar cane by product
33	Other field main
34	Other field by product
35	Potatoes main
36	Potatoes by product
37	Onions main
38	Onions by product
39	Garlic main
40	Garlic by product
41	Tomatoes main
42	Tomatoes by product
43	Other veg main
44	Other veg by product
45	Citrus
46	Grapes
47	Mangoes
48	Other fruits
49	Milk
50	Fatless milk
51	Sour milk
52	Butter
53	Cream
54	Ghee
55	White cheese
56	Fatless cheese
57	Mish
58	Murta
59	Eggs
60	Skin and fur
61	Wool
62	Worm silk
63	Honey
64	Wax
65	Manure

66	All food
67	All non-food
68	Total