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IMPLICATIONS FOR AGRICULTURAL POLICY

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LIVESTOCK AND CROP PRODUCTION LINKAGES: IMPLICATIONS FOR AGRICULTURAL POLICY

by James B. Fitch and Ibrahim Soliman

Recent studies by the authors and others have examined livestock production practices at the farm level (1,2,3,4). These studies not only verify that livestock production represents a large proportion of overall agricultural production--perhaps as much as 40 percent--but they also document the high degree to which crop and livestock production are integrated and interdependent under typical farm circumstances. Here it is estimated that 40 percent of the total value of farm livestock production, in the form of animal power and manure, is a direct input to crop production and that 22 percent of crop products is input directly to livestock production.

Because of the high degree of interdependence between crop and livestock production, the Egyptian farmer must always take livestock production considerations into account when making cropping decisions, and vice versa. Sound policy formulation requires the same approach. Failure to give due consideration to crop-livestock linkages may produce unexpected results. The purpose of this paper is to examine some of the recent survey results to see what has been learned about these linkages.

There are a number of obvious ways in which policy problems arise due to crop-livestock interrelatedness. Berseem clover production is a case in point. Ministers and urban consumers alike decry the fact that berseem clover has occupied increasing amounts of the limited cropping area in recent years. During the past two decades the proportion of winter crop area devoted to berseem has increased from 20 percent to 30 percent of the total, and cotton and wheat areas have declined correspondingly. Increases in berseem area have been associated with a livesock population which has grown by about 1.5 percent per year, according to official estimates (5).

The increases in livestock population and the rise in berseem area have undoubtedly been influenced by price

policy. The government has managed to control prices for such crops as cotton and wheat but has not controlled meat, dairy product, or berseem prices effectively. Whereas it has frequently been established that prices of major crops are well below their equivalent values in international trade (9), recent work by Soliman (10,11) indicates that meat and milk prices are above their international equivalents. The survey results verify that, at prevailing prices, livestock production is very profitable for most farmers. It is clear that attractive livestock prices have contributed to this profitaility and have thus served to stimulate growth in livestock production and berseem.

It could be a mistake, however, to conclude that livestock production trends have simply been a reflection of price incentives. The survey research data shows that important linakges other than price exist between livestock and crop production and that these have probably contributed to the intensification of livestock production. One purpose of the present paper is to examine these and to ponder some of thier implications for policy formulation.

An underlying theme of this paper is that land tenure and holding size dynamics must be taken into account in understanding the changing relationship between crop and livestock production. As will be demonstrated, there are important differences in crop and livestock production patterns, depending on farm size and family labor availability. Small farms with their abundant family labor tend to specialize in livestock production. The fact that the number of small farms has been increasing in Egypt and that average farm size has been declining thus appear to be contributing to the shift toward more livestock production.

One of the well-recognized linkages from livestock to crop production is the use of animal power for land tillage, irrigation, threshing, and transportation of crops. It is often stated that if these functions can be mechanized the livestock population can be reduced and berseem area will be reduced (6). This proposition merits further examination at this time. Farm size is seen to play a role here, too.

The findings presented here are based mainly on an analysis of data collected in the 1977 Farm Management Survey. The data are described and the analysis discussed in greater detail in another publication (2). Briefly, a sub-sample of 10 villages was chosen from the farm management survey to represent the various types of

livestock production situations which exist in Egypt. Six villages were taken from the Delta, two from Middle Egypt and two from Upper Egypt. In all, data from 164 randomly selected survey farmers, taken from five different farm size strata, were utilized. Since the number of observations in each strata was not proportional to the actual population, weights based on the MOA's national farm distribution survey for 1975 were utilized in order to derive estimates for a national average farm from the various strata averages .

In the following discussion, distribution and size of livestock holdings; composition of herd; composition of product; labor use patterns; animal use and mechanization in crop production; feed use patterns; and economic returns to livestock production are considered in turn.

SIZE AND DISTRIBUTION OF LIVESTOCK HOLDINGS

To account for the disparate sizes and characteristics of the various types of animals which make up the herds of Egyptian farmers, all holdings were converted to standard ANIMAL UNITS (AU's). The weights used for conversion are related to body weight and metabolic capacity. A camel equals 1 AU, a mature buffalo equals 0.8, a native cow 0.7, a donkey 0.5, and so forth.

As Table 1 shows, the holdings of animals per farm increase as farm size increases. Farms in the smallest size class (a feddan and less in size) had 1.26 AU, on average, compared to 3.80 AU for farms in the largest size category (more than 10 feddans). In density terms, however, the situation is reversed. Farms in the smallest size class average 1.52 AU per feddan, compared to only 0.18 AU per feddan for those in the largest size category. This demonstrates that smaller farms specialize more in livestock than larger farms. The pattern of holding distribution does not change when livestock are aggregated in monetary value rather than by the AU measure (Table 1).

The specialization of small farms in livestock production may be expressed in another way. Extrapolating from the per farm holdings found in the survey, and by using the MOA's 1975 survey estimates of farm numbers in each category for the nation as a whole, the percentage of the total national livestock herd held on farms in each size group was estimated. Allowance was made for the 9.7 percent of the naional herd which

TABLE 1. NUMBER AND VALUE OF ANIMALS PER FARM AND PER FEDDAN, BY FARM SIZE CLASS.

	FARM SIZE					WEIGHTED AVERAGE
	0 TO 1	1 TO 3	3 TO 5	5 TO 10	>10	
FARMS IN SAMPLE (N)	33	69	23	17	23	
AVERAGE SIZE (FEDDANS)	.83	1.97	4.06	6.56	21.63	2.13
TOTAL ANIMAL UNITS PER FARM	1.26	1.42	2.59	1.70	3.80	1.54
AVERAGE ANIMAL UNITS/FEDDAN	1.52	0.72	0.64	0.26	0.18	0.63
PERCENT OF ANIMAL UNITS IN:						
CATTLE	16	30	25	33	34	24
BUFFALOES	36	26	35	15	18	31
SHEEP AND GOATS	15	5	5	2	5	9
DONKEYS	19	23	17	20	16	20
CAMELS	12	9	8	10	5	10
OTHER WORK ANIMALS	2	6	10	19	20	6
PERCENT OF ALL ANIMALS HELD BY FARMS OF THIS SIZE:	29.7	34.4	19.8	5.3	1.1	0
VALUE OF LIVESTOCK:	EGYPTIAN POUNDS (L.E.)					
TOTAL ANIMAL VALUE PER FARM	433	450	846	509	1359	502
AVERAGE VALUE PER FEDDAN	522	228	208	78	63	236

Soliman (8) estimates was held in feedlots and large dairy herds rather than on tradtional farms. From these estimates (Table 1) it can be seen that farms of 3 feddans or less hold 64.1 percent of the total AU's which exist nationwide. According to the 1975 MOA study of farm size distribution, these farms have only 46.1 percent of the land area.

In terms of the types of livestock which are held, Table 1 shows that the bulk of all animal units are composed of cattle and buffaloes, which together account for an estimated 55 percent of all livestock. Smaller farms specialize in buffaloes (prized for their milk production) whereas larger farms specialize in native cattle (known more for meat production). Only 9 percent of all animal units are attributed to sheep and goats although farms of a feddan or less have an estimated 15 percent of their holdings in these small ruminants. Some 20 percent of all animal units are attributed to donkies and 10 percent to camels. The distribution of these animals does not change much with farm size. Other work animals (mainly oxen and other cattle or buffaloes reserved specifically for work) constitute only 9 percent of overall holdings, but these animals make up a larger proportion of the holdings of larger farms.

VALUE AND COMPOSTION OF PRODUCT

The concentration of small farms in livestock production is even more striking when measured in terms of product value. Table 2 shows that farms in the smallest size group produce an average of LE 429 per feddan per year in livestock products, compared to only LE 247 per feddan in crops. Livestock product value per feddan for the smallest farms averages about 15 times as much as for the largest farms. In contrast, the smallest farms only produce about 1.3 times the crop value that the largest farms do.

The distribution of livestock products parallels the pattern of herd composition. Table 2 shows that an estimated average 35 percent of farm level livestock production is attributable to dairy production whereas 18 percent is the estimated value of live animal sales at the farm gate. Animal work, manure, and poultry products account for the remainder. Dairy products are more important to smaller farms whereas live animal sales and animal work appear to be more important to larger farms.

Table 2 shows that an estimated 40 percent (27 % work plus 13 % manure) of all farm livestock products are

TABLE 2. VALUE AND COMPOSITION OF LIVESTOCK PRODUCTS, AND COMPARISON TO VALUE OF CROPS PRODUCED.

	FARM SIZE					WEIGHTED AVERAGE
	0 TO 1	1 TO 3	3 TO 5	5 TO 10	>10	
TOTAL VALUE OF ALL LIVESTOCK PRODUCTS PER FARM (LE)	356	505	563	445	630	451
VALUE PER FEDDAN (LE)	429	257	138	68	29	211
TOTAL VALUE OF CROPS PRODUCED PER FARM (LE)	205	619	1094	1862	3989	599
VALUE PER FEDDAN (LE)	247	314	269	284	184	281
PROPORTION OF LIVESTOCK PRODUCTS WHICH ARE:	PERCENT OF TOTAL LIVESTOCK PRODUCT VALUE					
DAIRY PRODUCTS	35	39	27	18	16	35
ANIMAL WORK	28	25	29	36	34	27
LIVE ANIMALS	17	15	21	26	29	18
MANURE	12	12	17	13	14	13
POULTRY PRODUCTS	9	8	5	8	7	8

devoted to crop production. In separate calculations it was determined that the work and manure used on the farm producing it represents 29 percen of total crop value.

DAIRY PRODUCTION PATTERNS

As indicated above, dairy production represents the largest single component of livestock product value. Table 3 shows that of the average LE 156 value of dairy products for all farms, only 21 percent is used as liquid milk whereas the remaining 79 percent is attributed to processed products, particularly cheese and ghee. Smaller farms had much higher proportions of the processed products, whereas larger farms tended to specialize more in liquid milk.

On average, 66 percent by value of all farm produced milk and dairy products are home consumed, but this figure reaches 77 percent for the smallest farms. In terms of the value of products sold, smaller farms nevertheless manage to do substantially better than larger farms. Farms of 3 feddans or less were found to sell an average of over LE 35 of dairy products per farm, which was well over twice as much as the sales reported by farms larger than three feddans. This level of marketing achieved by small farms is made possible because of the higher degree of processing as well as the higher productivity of their cows.

It is clear from Table 3 that, smaller farms attain part of their higher value of dairy output by adding more value through processing. As to increased productivity per cow, farms in the one to three feddan size class were found to average 1209 kg of liquid milk per cow per year, compared to much lower amounts for larger farms. Nevertheless, it is estimated that Egyptian farmers average only 977 kg of milk per cow per year, overall. This is quite low by international standards. In many countries with developed dairy industries, it is common to achieve 4000 KG or more of milk per lactation. This suggests that there may be substantial opportunities for raising dairy productivity on Egyptian farms.

LABOR USE

How do smaller farms manage to attain higher per animal productivity and add more value in livestock production? Labor use seems to provide the answer. Table 4 compares labor use in livestock and crop production for farms in the different size categories.

TABLE 3. VALUE AND COMPOSITION OF DAIRY PRODUCTION.

	FARM SIZE					WEIGHTED
	0 TO 1	1 TO 3	3 TO 5	5 TO 10	>10	AVERAGEE
TOTAL VALUE OF PRODUCTION PER FARM (LE)	124	199	154	78	102	156
PERCENT OF FINAL VALUE IN:	PERCENT OF TOTAL VALUE					
MILK	15	22	25	66	79	21
cheese	47	33	40	9	7	38
GHEE	34	40	23	20	5	35
BUTTER AND CREAM	4	5	11	5	9	5
TOTAL	100	100	100	101	100	100
PERCENT WHICH IS PROCESSED:	85	78	75	34	21	79
PERCENT OF TOTAL WHICH IS:						
HOME CONSUMED	77	64	58	39	23	66
SOLD	23	36	42	61	77	34
VALUE OF SALES PER FEDDAN (LE)	35	37	16	7	4	25
VALUE OF PRODUCT PER COW (LE)	199	245	141	89	46	199
TOTAL LIQUID MILK PRODUCTION PER COW (KG/YR)	997	1209	843	643	272	977

On a per farm basis, smaller farms use relatively more labor for livestock and less for crops, with farms in the smallest size category devoting 286 days per year to livestock compared to only 108 days for crops. This situation rapidly reverses itself as farm size increases. Farms in the largest size category average 2346 days for crops and only 422 days for livestock.

Again, it takes the per feddan calculations to bring out the relative degrees of intensification. Table 4 shows that the smallest farms average 130 days per feddan for crops and 344 for livestock. This compares to 108 days per feddan for crops and only 20 days for livestock for farms in the over ten feddan category. Note that the number of days per feddan for crops actually averages less (130 days) for the feddan or less size farms than it does for the one to three feddan farms (160 days). This corresponds with a similar relationship for value of crop shown in Table 2.

The most revealing point about livestock labor is that it is predominantly family labor. Whereas an estimated 65 percent of all crop production labor is supplied by farm family members, some 98 percent of the labor used in livestock production is supplied by the farm family. Virtually no hired labor is used for livestock. Farm family women provide 40 percent of all labor used in livestock production, including processing, whereas they were found to provide only two percent of crop labor (Table 4). The smaller the farm size, the higher the percentage contribution of women. Thus, the use of available family labor, particularly that of women, is obviously an important factor contributing to the specialization of smaller farms in livestock production.

LIVESTOCK AND MACHINERY USE IN CROP PRODUCTION

While human labor is used in both crop and livestock production, animal and mechanical power are both important inputs to crop production. Table 5 shows the relative importance of theses two inputs for the various farm size classes.

Calculations based on Table 5 reveal that almost all (95 %) animal power is used on farm rather than being hired out to others. Furthermore, less than 20 percent of the work hours are provided by cattle and buffaloes and more than 80 percent comes from "other work animals"--presumably camels and donkies. This implies that most of the animal work related to crop production is for transportation (carrying crops, crop residues,

TABLE 4. LABOR USE FOR LIVESTOCK AND CROP PRODUCTION.

	FARM SIZE					WEIGHTED
	0 TO 1	1 TO 3	3 TO 5	5 TO 10	>10	AVERAGE
	DAYS PER FARM PER YEAR.					
TOTAL LABOR USED PER FARM	394	524	840	1074	2768	554
FOR CROPS	108	315	570	915	2346	308
FOR LIVESTOCK	286	209	270	159	422	246
LABOR PER FEDDAN:	DAYS PER FEDDAN PER YEAR					
FAMILY LABOR	445	216	145	99	69	207
HIRED LABOR	30	50	62	65	59	53
TOTAL	474	266	207	164	128	260
(FOR CROPS)	130	160	140	139	108	144
(FOR LSTOCK)	344	106	67	24	20	115
SOURCE OF CROP LABOR:	PERCENT OF CROP LABOR					
HIRED	23	30	41	45	47	35
FAMILY:MEN	53	43	39	27	32	40
WOMEN	2	2	1	1	1	2
CHILDREN	4	5	5	7	6	5
ELDERS	17	21	14	20	14	18
SOURCE OF LIVESTOCK LABOR:	PERCENT OF LIVESTOCK LABOR					
HIRED	0	2	7	10	39	2
FAMILY:MEN	46	30	37	50	37	40
WOMEN	40	41	42	24	17	40
CHILDREN	0	1	1	1	0	0
ELDERS	13	27	13	16	7	18

fertilizers and manure), rather than for such activities as tillage and threshing. It must be granted that a small amount of the camel and donkey work is for water pumping rather than just transportation, but the proportion which this represents can not be significant.

When calculated on a per feddan basis, animal power inputs are found to be subtantially higher for small farms. At 867 hours per feddan per year, the smallest farms average more than 20 times the level of animal power inputs used on average farms in the largest size category.

Based on theoretical considerations as well as on the labor use and animal use patterns discussed above, it was anticipated that smaller farms would use proportionately less machine power than larger farms. The per feddan patterns shown in Table 5 do not bear out these expectations, however. While any pattern in the number of tractor hours per feddan is not clear, the pattern of other machinery use is: smaller farms appear to use substantially less other machinery per feddan than larger farms.

In an attempt to clarify the picture, alternative factor ratios were calculated and are shown at the bottom of Table 5. Surprisingly, these also come out contrary to expectations: the hours of machinery and animal inputs both tend to rise as farm size declines. This is especially surprising since the cost of labor probably declines, as farm size declines and the cost of machine use is expected to rise. Only the machine to animal use ratios appear to decline with farm size as expected. Some possible explanations of these phenomena will be entertained in the final discussion.

FEED INPUTS

The pattern of feed inputs shown in Table 6 helps to further clarify the relationship between crop and livestock production. Admittedly, dealing in terms of starch equivalent (an energy measure) and protein PER ANIMAL UNIT is rather imprecise. Needs vary somewhat depending upon the type of animal. Nevertheless, the averages shown in Table 6 are useful in gaining an idea of nutritional adequacy. At an overall average of 1911 kg of starch equivalent and 358 kg of digesitable protein per AU, overall average nutrient intakes appear to be adequate.

TABLE 5. LIVESTOCK AND MACHINERY USE IN CROP PRODUCTION.

	FARM SIZE					WEIGHTED AVERAGE
	0 TO 1	1 TO 3	3 TO 5	5 TO 10	>10	
ANIMAL WORK PER FARM:	HOURS PER FARM PER YEAR					
ON OWN FARM	695	865	1248	1188	1645	868
OFF FARM	25	66	47	49	47	46
TOTAL	720	931	1295	1237	1692	914
PROPORTION OF TOTAL ANIMAL WORK ON OWN FARM	97 %	93 %	96 %	96 %	97 %	95 %
PROPORTION DERIVED FROM:						
NATIVE COWS AND BUFFALOES	16 %	16 %	24 %	27 %	24 %	18 %
OTHER WORK ANIMALS	84 %	84 %	76 %	73 %	76 %	82 %
ANIMAL WORK PER FEDDAN	HOURS PER FEDDAN PER YEAR					
ON OWN FARM (HOURS/YEAR)	867	473	318	189	78	429
MACHINERY INPUTS PER FARM:	HOURS PER FARM PER YEAR					
TRACTORS	2	25	16	93	213	19
OTHER MACHINES	109	355	392	531	1141	503
TOTAL	111	380	408	624	1354	523
MACHINERY INPUTS PER FEDDAN:	HOURS PER FEDDAN PER YEAR					
TRACTORS	3	13	4	14	10	8
OTHER MACHINES	131	180	97	81	53	119
TOTAL	134	193	101	95	63	126
ALTERNATIVE FACTOR PROPORTIONS:						
MACHINE HOURS PER DAY OF HUMAN LABOR	1.03	1.21	.72	.68	.58	.88
ANIMAL WORK HOURS PER DAY OF HUMAN LABOR	6.67	2.96	2.27	1.36	.72	2.98
MACHINE HOURS PER HOUR OF ANIMAL WORK	.15	.41	.32	.50	.81	.29

Farms in the feddan and under size category reported feed input levels which were only 68 percent of average in the energy component and 61 percent for protein. These levels do not apear to be nutritionally adequate. Nevertheless, it was seen that animals held by these farms have relatively high productivity. It is suspected that not all feed inputs for animals on these farms were recorded. In the case of sheep and goats which normally are taken to graze on ditchbanks and roadsides, inputs obviously could not have been recorded. Since 15 percent of the AU's held by these farms are sheep and goats, that would reduce measured feed inputs by up to that amount, but this does not fully explain the differences in intake levels. It is likely that the extremely high family labor inputs reported for these farms reflects the time required to gather grass and weeds for larger animals from roadsides, ditchbanks and other common areas.

Table 6 serves to underscore the contribution of Berseem in the livestock diet. It accounts for an average of 37 percent of the energy and 54 percent of the protein which is utilized. Berseem is only available during the winter months, however, for less than half the year. Thus, there appears to be an imbalance in the distribution of protein between winter and summer months, as previous researchers have often pointed out (1).

One of the solutions which is sometimes suggested for the summer-winter feed imbalance is to have farmers put up hay. The Winrock study, which was limited to just two villages, found few if any farmers to be putting up hay, however. Their calculations indicated that it would probably not make economic sense to do so (1). Nevertheless, the Farm Management survey indicates that an appreciable amount of nutrients--10 percent of energy and 16 percent of protein--may be derived from hay. Since most of the hay which is put up is believed to come from berseem, this means that berseem may also be supplying a substantial proportion of summer as well as winter feed requirements. Thus, breaking the summer feed constraint could even have an effect on winter berseem area in those zones where hay is now being made.

Wheat straw and maize plants also provide substantial proprotions of total nutrient intakes, particularly energy. The straw provides an estimated 22 percent of all energy intake and is a more important source of feed for small farms than for larger farms. Maize fodder provides an estimated 18 percent of both energy and protein. Of this, almost two thirds was found to come from forage (darawa) maize and the remainder to come from the leaves and tops taken from plants being

TABLE 6. AVERAGE TOTAL FEED INPUTS, STARCH AND PROTEIN EQUIVALENTS, PER ANIMAL UNIT.

	FARM SIZE					WEIGHTED AVERAGE
	0 TO 1	1 TO 3	3 TO 5	5 TO 10	>10	
TOTAL STARCH EQUIVALENT (KG/AU)	1308	2190	2119	2792	1989	1911
PROPORTION DERIVED FROM:	PERCENT OF TOTAL					
BERSEEM	31	35	42	44	47	37
CONCENTRATE MIX	4	3	6	5	6	4
BRAN	2	3	3	1	0	2
GRAINS & LEGUMES	7	8	8	2	9	7
STRAW	30	22	19	12	19	22
HAY	11	8	8	20	9	10
MAIZE FODDER	14	21	14	16	11	18
TOTAL DIGESTABLE PROTEIN (KG/AU)	221	407	419	610	398	358
PROPORTION DERIVED FROM:	PERCENT OF TOTAL					
BERSEEM	50	52	58	56	65	54
CONCENTRATE MIX	6	4	7	5	7	5
BRAN	3	4	4	1	0	3
GRAINS & LEGUMES	6	6	6	1	6	5
STRAW	3	2	2	1	2	2
HAY	16	11	10	22	11	13
MAIZE FODDER	16	22	13	14	10	18

grown for grain. It is often suggested that a good way to increase maize yields would be for farmers to discontinue this so-called stripping and topping of maize. This study indicates that for them to do so would require the development of a substantial alternative summer forage crop.

Over the past two decades the government has developed a program of mixing and selling concentrate feed mix based largely on cottonseed cake, bran, molasses, and imported maize. This mix is officially sold at prices which are less than half the international cost equivalent. The concentrate often gets into the black market, however, and the survey data showed that traditional farmers typically pay prices which are well above the official subsidized prices (8). Soliman and Mousa have estimated that almost three quarters of the more than one million tons of the concentrate which is distributed each year goes to large feedlots and dairy herds. Table 6 verifies that the concentrates make up a relatively small proportion of the total feed intake of traditional farm animals covered by the survey.

Assurance of the availabiliity of outside feed supplies is very important in the case of dairy production. Eventhough the feed concentrate which is sold and distributed by the government does not make up a large proportion of feed inputs overall, it could play a very important role in keeping lactating cows on milk during the summer months when feed is most scarce. Even a brief interruption of key feedstuffs during lacation can cause a cow to dry up. Unfortunately, the supplies of both the concentrates and yellow maize provided through the government cooperatives are erratic. The summer feed problem and lack of assured, steady supply of feed during this period is a factor which may contribute significantly to the low levels of dairy productivity which were noted earlier.

In value terms, the feed inputs accounted for some 97 percent of the total value of livestock inputs, excluding any value assingned to family labor or capital. They represented just under half the total value of livestock output. Feed inputs from the farmer's own farm represented 22 percent of the total value of crop production. As with the case of livestock products used in crop production, this represents a high degree of interdependence between crop and livestock production at the farm level.

RETURNS TO LIVESTOCK PRODUCTION

By a rather painstaking process it was possible to develop a picture of the overall profitability of livestock production. The procedures used had some shortcomings, particularly where it was necessary to place values on commodities and services which were exchanged or consumed internally within the farm and did not go through a market. In the case of manure and livestock work, it has already been demonstrated that relatively low percentages are sold through markets. For such "thin" markets it is always risky to assume--as has been done here--that items which were not marketed could have been fully marketed at the existing market price. In some cases there were no market transactions at all reported by the sample farmers in a given village. In these cases, prices from the nearest survey village were utilized. These potential limitations should be kept in mind in interpreting Table 7.
To avoid the problem of non-traded goods, alternative calculations were made which involved only products and inputs which were actually marketed--the resutls are termed "net cash returns.

The average net return figures shown in Table 7 are positive for all farm size categories except the largest, as are the net cash returns. Either on a per farm basis or when converted to returns per feddan or per animal unit, smaller farms do better on average than do larger farms. The net returns represent returns to the farmer's own labor and to his capital investment in the livestock. The LE 240 average net return per farm was quite attractive by comparison to going rural income levels in 1977, the year of the survey. Even the LE 63 average cash return was substantial.

The final calculations on Table 7 show that returns to labor and capital were also attractive. The 18 percent average return to capital represents the adjusted net return, after family labor costs have been subtracted at the going market wage rate, expressed as a percentage of the value of the livestock holding. Eighteen percent compares to savings bank rates of 10 percent which might have been possible for farmers to attain in 1977. The return to labor, whcih averaged LE 1.25 overall, was derived by first subtracting the cost of capital investment in livestock (ten percent of the value of the animals) from the net return and then dividing by the number of days of family labor devoted to livestock. LE 1.25 per day compared quite favorably to the LE 0.75 per day agricultural wage rate which prevailed in 1977.

TABLE 7. RETURNS TO LIVESTOCK PRODUCTION.

	FARM SIZE					WEIGHTED AVERGE
	0 TO 1	1 TO 3	3 TO 5	5 TO 10	>10	
	EGYPTIAN POUNDS (L.E.) PER FARM					
TOTAL VALUE OF PRODUCTS SOLD	101	166	193	174	270	145
VALUE OF PRODUCTS HOME CONSUMED	255	339	389	271	360	308
GROSS RETURNS	356	505	582	445	630	453
NET RETURNS	238	272	232	59	-83	240
NET "CASH" RETURNS	59	77	50	31	-40	63
	EGYPTIAN POUNDS (L.E.).PER UNIT					
NET RETURNS PER FEDDAN	287	138	57	9	-4	113
NET "CASH" RETURNS PER FED.	72	39	12	5	-2	30
NET RETURNS PER ANIMAL UNIT	189	192	111	35	-22	162
NET "CASH" RETURNS PER A.U.	47	54	24	18	-11	43
PERCENT RATE OF RETURN ON INVESTMENT	13	31	12	-7	-18	18
RETURN TO FAMILY LABOR (LE PER DAY)	1.06	1.72	1.06	-0.09	-1.31	1.25

Consistently in the calculations discussed here, small farmers show higher returns than large farmers,. Farms over five feddans in size even appear to experience negative returns to their labor and capital inputs. This result follows directly from the fact that these larger farmers failed to achieve the rates of productivity demonstrated by small farmers and they did not add as much value to their dairy products through processing. Given this type of pattern of returns among farm size groups, it does not seem surprising that small farms specialize in livestock production.

FINAL DISCUSSION

The survey results discussed here are rather remarkable in their uniformity. When carefully interpreted, they tell an interesting story. Given the relative price position of crop and livestock products and given the levels of profitability in livestock production which were estimated for small farmers, it is not surprising that small farmers have been turning more and more to livestock and berseem production.

It would be a mistake to attribute the entire shift to prices alone, however. This study makes it clear that livestock production is successful in small units where there is abundant family labor. Much of the shift of Egypt's agricultural resources to livestock production may have been spurred by an incrase in the number of small farms. According to the 1975 MOA survey of land holdings and size distribution, there were many more small sized farms and the overall average farm size had decreased substantially since the time of the 1961 Census (Table 8). Even granting that the 1975 MOA survey is probably biased upward to some extent in terms of the number of holdings estimated, the direction of the change--that is, to a larger number of smaller sized farm units--seems undeniable.

In Table 9 it is assumed that the same per feddan labor use coeficients which were found in the 1977 Farm Mananagement Survey (Table 4) prevailed in both 1961 and 1975. These coeficients are used to estimate total labor use for crop and livestock production in the two years. The calculations show that whereas labor for crop production is estimated to have increased by 4 percent during the period, livestock production labor increased by 74 percent. In other words, LIVESTOCK PRODUCTION APPEARS TO HAVE ACCOUNTED FOR MOST OF THE INCREASE IN FARM LABOR USE BETWEEN 1961 and 1975.

As was demonstrated earlier, livestock production

TABLE 8. CHANGE IN NUMBER OF OPRATIONAL FARM HOLDINGS AND FARM AREA, 1961 TO 1975

	FARM SIZE					
	0 TO 1	1 TO 3	3 TO 5	5 TO 10	> 10	TOTAL
NUMBER OF FARMS:	THOUSANDS OF UNITS					
1961	434	673	274	170	91	1642
1975	1124	1160	355	149	65	2853
PERCENT CHANGE	+ 159%	+ 72%	+ 30%	- 12%	- 29%	+ 74%
AREA OF FARMS:	THOUSANDS OF FEDDANS					
1961	211	1153	990	1101	2768	6223
1975	739	2024	1186	944	1091	5984
PERCENT CHANGE	+ 250%	+ 76%	+ 20%	- 14%	- 61%	- 4%

OVERALL AVERAGE FARM SIZE:

1961	3.79 FEDDANS
1975	2.10 FEDDANS

SOURCE: 1961 DATA, 1961 CENSUS OF AGRICULTURE.
1975 DATA, MINISTRY OF AGRICULTURE, INSTITUTE OF AGRICULTURAL ECONOMIC RESEARCH, FROM CENSUS OF VILLAGE COOPERATIVE LISTS.

TABLE 9. ESTIMATED CHANGES IN LABOR USE, 1961 TO 1975

	MILLION PERSON-DAYS		PERCENT
	1961	1975	CHANGE
LABOR FROM:			
FAMILY	786	1107	+41
HIRED	360	322	-11
TOTAL	1146	1429	+25
LABOR USED FOR:			
CROPS	805	837	+4
LIVESTOCK	341	592	+74
TOTAL	1146	1429	+25

SOURCE: CALCULATED WITH LABOR USE COEFICIENTS FROM 1977 FARM MANAGEMENT SURVEY (TABLE 4) AND FARM SIZE/AREA DISTRIBUTION FOR 1961 AND 1975 AS SHOWN IN TABLE 8.

labor is almost entirely family labor. This, together with the fact that small farms hire less non-familylabor than larger farms, serves to explain why the estimates presented in Table 9 indicate that hired labor use may actually have decreased between 1961 and 1975.

If we can assume that the trend toward more and smaller farms continues--albeit not so fast as in the past, because there is currently no land reform activity--then it seems safe to assume that there will be continuing pressures in favor of livestock production. But could mechanization alter that trend?

Our findings on mechanization are somewhat unexpected and perplexing. Can we believe that small farms actually use more labor, more animal inputs AND more mechanical inputs PER FEDDAN than large farms? Assuming that the data shown in Table 5 were not erroneous, it may be necessary to distinguish between three phenomena to solve this mystery: factor substitution, land use intensification, and differences in technical efficiency. Factor substitution considerations would lead us to expect less machinery use, not more, as farm size declines, machinery costs per unit of area increase, and labor costs decline. However, we have seen how much small farms have intensified crop production through labor use. Are they doing the same thing through both mechanization and use of animals in crops production? And what about technical efficiency? Are the available machines so poorly suited for small, fragmented farms that it takes much more machine input per unit of land? These are questions which must be explored in future research. Until the answer is found, it may not be safe to predict a replacement of livestock by machines.

In a related vein, one thing is very clear about the animal work patterns observed here: a very high proportion of work animals are essentially transportation animals; a high proportion of the animal hours recorded was evidently related to transportation. Is this what is taking small farmers so much time? Current mechanization programs do not appear o meet this need.

As a livestock producer, Egypt's traditional farmer is largely outside the influence of government policy. Government policy has been largely oriented toward meat production, but the traditional farmer is mainly a dairy producer. The government has made repeated attempts--albeit without much success--to control meat prices, but there have been no similar attempts to intervene in the case of milk or dairy products. As

noted above, about three quarters of all the subsidised feed concentrate distributed by the government goes to large feedlot and dairy herd operations, and not to traditional farms. The main thrust of the government livestock credit program is aimed toward feeding operations, not traditional farmers.

In view of the large proportion of the national herd which is held on small farms--estimated to be at least two thirds of the total--and in view of the specialization of this herd in dairy production, it is believed that a shift in emphasis of policy may be in order. Indications are that poductivity of the traditional herd could be increased. Improvement of summer feed supplies would be a logicial place to start.

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