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ECON W/P # 95  
Rev. Sept. 1982

# AGRICULTURAL DEVELOPMENT SYSTEMS EGYPT PROJECT

UNIVERSITY OF CALIFORNIA, DAVIS

WAGES, PRICES, AND FARM MECHANIZATION IN RURAL EGYPT:  
THE NEED FOR AN INTEGRATED POLICY

by

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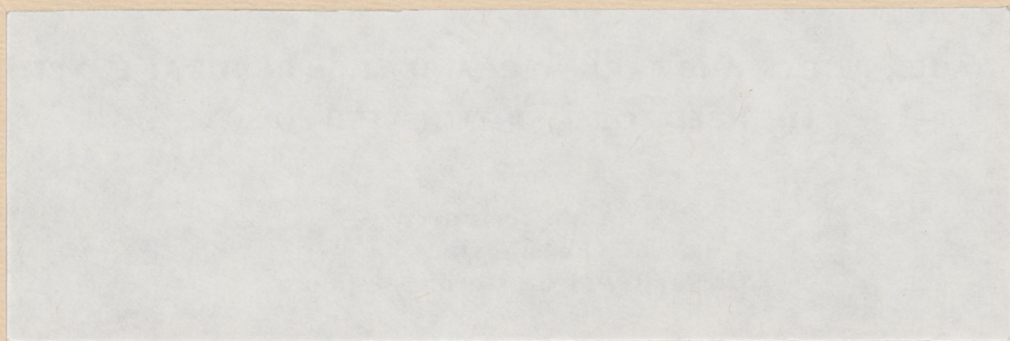
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WORKING PAPER







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Assistance from the Agricultural Development Systems Project of the University of California, Egyptian Ministry of Agriculture, and USAID, is gratefully acknowledged, but the author is solely responsible for the views expressed in this paper.

Economics  
Working Paper Series  
No. 95

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Revised September, 1982

Agricultural Development Systems:  
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WAGES, PRICES, AND FARM MECHANIZATION IN RURAL EGYPT:  
THE NEED FOR AN INTEGRATED POLICY\*

Introduction

Policymaking all too often results in consequences that are quite different from its most immediate intended purposes. This is due to three main causes. One is that much economic analysis, when it is indeed used as a basis for policymaking, is of an excessively partial equilibrium nature and, consequently, fails to account for the complex interactions and feedback mechanisms among variables that appear, at first sight, only distantly related. Another is that policies are often defined in response to the political pressures of specific constituencies with narrowly defined and myopic interests. The result is that the existing policy package is constructed on a piecemeal basis with little global consistency. Finally, policymaking is commonly formulated as short-run responses to urgent economic or political crises with little thought given to the long-term consequences of these policies and to their consistency with other active policies defined in the context of previous crises.

Not unlike many other countries, this partial and piecemeal nature of policy characterizes Egyptian agricultural and food policies. Unlike most other Third World economies, however, the consequences of these policies on economic growth and social welfare are far reaching due to the pervasiveness of government interventions in the price mechanism from farm prices to consumer prices and to the relation between domestic and international prices. An important element of policy analysis in Egypt is, consequently, to identify the cost effects among elements of the current package of price interventions and to create consistency among seemingly unrelated policies.

We show in this paper how policies toward (1) wages, employment, and migration; (2) the prices of staple foods, meat and dairy products, and animal feeds; and (3) mechanization have far-reaching interactive effects and consequently must be designed as an integrated policy package. We do this by studying the complex interactions in the effects of five sets of prices that have been manipulated to different degrees by policy interventions: rural wages, the price of food, the price of machinery, the price of meat and dairy products, and the price of animal feeds.

The main hypothesis we are advancing regarding the interrelations among these variables is that rapid mechanization in recent years has been largely induced by different degrees of price controls across commodities resulting, in particular, in the rise of meat and dairy product prices relative to staple food prices. This, in turn, has increased the price of feed relative to food and induced a shift in the use of animals from draft to the production of meat and milk products. The result is that mechanization has, to this stage, occurred principally in substitution of tractors for animal power and only marginally in substitution of tractors for labor power.

A secondary hypothesis is that the Ricardian theory of wage explains the evolution of rural wages until the beginning of massive international emigration in 1976. During that period, monetary wages were guided by the movement in food prices, and wages could consequently rise in spite of persistent unemployment. Since 1976, however, the tightening of the labor market due to migration explains the rapid increase in real wages of men. The level of women and children's wages remains, however, principally determined by Ricardian forces as these categories of labor are only secondarily affected by emigration and by labor substitution in the rural labor market.

## The Analytical Framework

The variables and relations singled out for analysis are presented in figure 1. We start by observing the direction of the price movements of three variables: staple foods (principally wheat, rice, and maize), meat and dairy products, and mechanical implements (principally tractors and fuel). The movement in two additional prices is partially derived from that of those former three: changes in the level of wages and in the price of animal feeds. From these five prices, the movements in four price ratios are derived: the price of machinery relative to that of labor, the price of animal feed relative to that of food, the price of meat and dairy products relative to that of food, and the price of machinery relative to that of feed. The changes in each of these four price ratios give us, in turn, the logic of four observed patterns of change: (1) the displacement of labor by machinery; (2) the shift in land-use patterns away from staple food production and toward the production of animal feed; (3) the shift in animal use from draft to the production of meat and dairy products; and (4) the displacement of animal power by tractors.

## Changes in the Prices of Food, Meat and Milk, Machinery, and Feed

The price of staple foods (wheat, rice, and maize) has been held down in Egypt through a system of price controls, forced deliveries at mandated prices, and subsidized imports. For wheat, prices are held down through massive imports (two-thirds of domestic consumption) and unrationed sales of bread and flour at fixed prices. These prices were not changed between 1965 and 1977 and were lowered by 15 percent in 1978 and 1979 relative to the previous period (Scobie, p. 72). In the meantime, world market prices doubled. Rice is distributed under quota at subsidized prices in public outlets and is procured

Migration

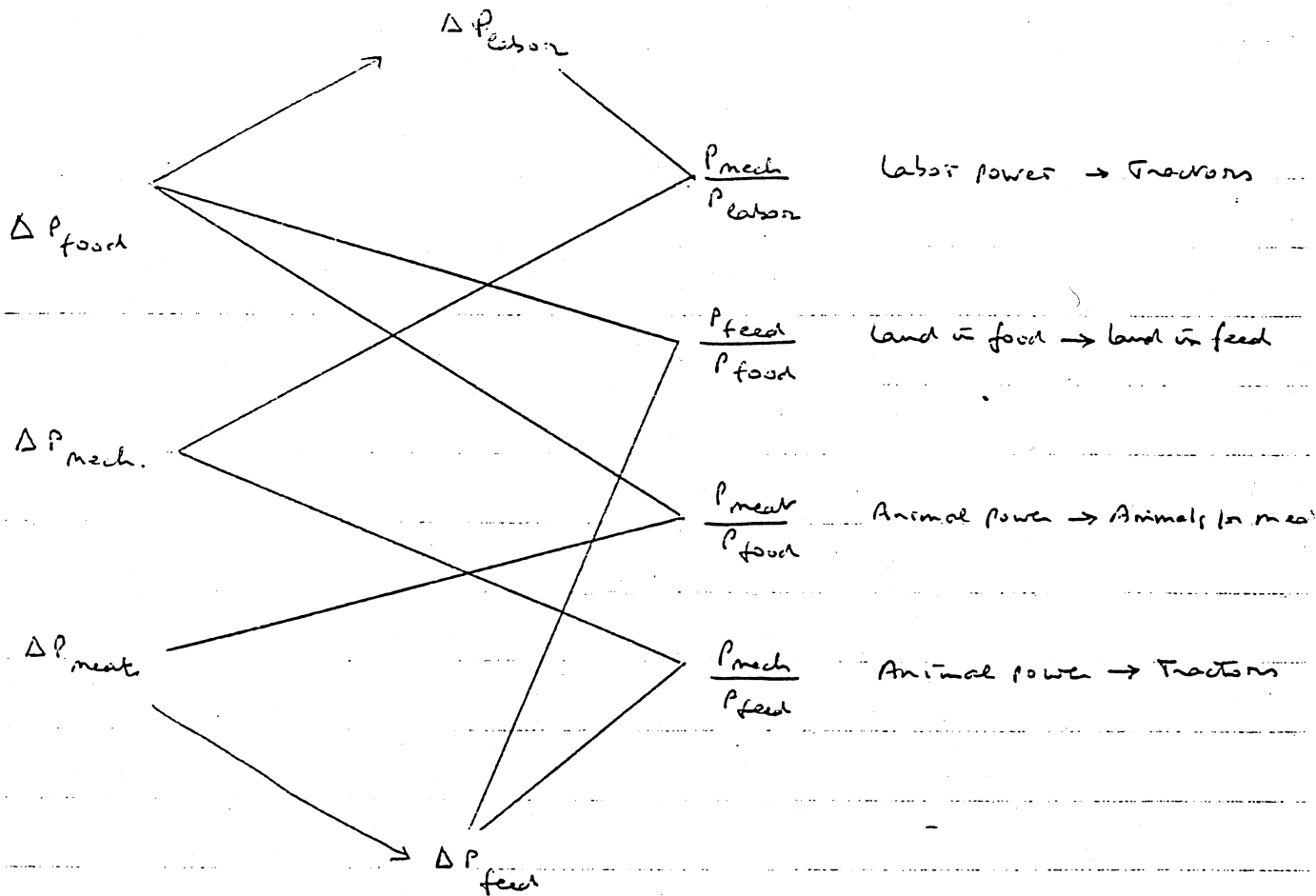


Figure 1 - Interrelations among Price Effects.



domestically through forced delivery of about 55 percent of production. Subsidized prices have not been raised for at least the last 10 years, while world market prices nearly tripled. Maize is priced freely, and its domestic price has been roughly in line with the world market price for the last decade. It is, however, a more important staple food for rural than for urban consumers.

Price controls at the consumer level have been more effective in the urban than the rural sector where the distribution of subsidized food through public outlets is less extensive. The result, as can be seen from table 1, is that the general consumer price index has risen faster in the rural than in the urban areas. The difference in price movements is particularly large for cereals: Over the period 1966-67 to 1980-81, the price of cereals rose 73 percent more in the rural than in the urban sector. This rapid price increase on residual free markets is due, in part, to the very mechanism of forced deliveries and subsidized sales since diversion of part of domestic supply outside the free market, combined with import constraints due to balance-of-payment limitations, puts upward pressure on prices in the residual free market (Hayami, Subbarao, and Otsuka).

The prices of meat and dairy products have risen sharply between 1966-67 and 1980-81 (table 1) and this in spite of rapidly rising imports and distribution of these quantities in ration shops at subsidized prices. This is due to the fact that rations still represent only a small fraction of domestic consumption and that domestic demand has risen rapidly, while production increases have been held down by feed shortages. As for cereals, access to subsidies is more widespread in the urban than in rural areas, resulting in more rapid price increases in the latter. Over the period 1966-67 to 1980-81, the price of meat products increased by 29 percent annually in the rural sector and by 27 percent in the urban areas.

TABLE 1  
Recent Changes in Rural and Urban Consumers Price Indices

Description	Base year, 1966-67	1974	1978	1980-81
<u>Rural</u>				
General consumers price index	100		234.6	331.8
Cereals	100		222.3	319.8
Meats, fish, eggs	100		313.7	502.9
Dairy products	100		344.0	480.2
<u>Urban</u>				
General consumers price index	100	141.0	212.6	288.9
Cereals	100	120.9	139.3	185.0
Meats, fish, eggs	100	190.3	331.8	483.6
Dairy products	100	173.3	315.4	441.8
<u>All Egypt</u>				
Wholesale price index	100 <sup>a/</sup>	152.7	214.1	

<sup>a/</sup> Base year, 1965-66.

Source: Central Agency for Public Mobilization and Statistics (CAPMAS).

The rapid rise in the price of animal products and the unavailability of rangeland to increase animal production led to a massive increase in the demand for feed. The main sources of feed in Egypt are berseem and wheat straw. Between 1965 and 1978, the price of berseem increased at the annual rate of 22 percent while that of wheat straw increased at the annual rate of 38 percent between 1969 and 1976 (Cuddihy, p. 148).

Finally, the price of machinery has been held down by a set of subsidies. Cuddihy calculates that diesel fuel had been sold in 1976 at prices 19 percent below production cost and 68 percent below international market price valued at the parallel exchange rate. Tractors are imported duty free and cheapened by the prevailing overvaluation of the exchange rate which was equal, in 1976, to no less than 72 percent (as measured by the gap between official and parallel exchange rates). Finally, special credit lines at interest rates as low as 5 percent are available for the purchase of tractors. With inflation rates on the order of 15 to 30 percent, these interest rates are clearly negative (Richards and Martin, p. 395). It can thus be concluded that the price of machinery has been held purposefully low in Egypt.

#### Determinants of Rural Wages

Tables 2 and 3 give the movements in money and real wages in rural Egypt from 1938 to 1978. An official rural consumer price index specific to rural areas is available only after 1966. For the period 1938-1965, real wages must consequently be obtained by using the cost-of-living index calculated by Radwan for the rural poor. As we saw before, both indexes underestimate the rise in rural prices since official data are used on subsidized prices and not

TABLE 2

Movement in Real Wages in Rural Egypt, Selected Years<sup>a/</sup>

Year	Average daily money wage piastras	Index	Cost-of-living index	Real wage index
1938	3.0	100	100	100
1939	3.5	117	101	116
1941	3.6	120	132	90
1942	5.0	167	198	83
1943	6.3	210	238	87
1944	9.3	310	262	117
1945	9.3	310	262	117
1946	9.5	317	297	107
1948	10.0	333	271	123
1949	10.0	333	259	130
1950	11.6	387	264	147
1951	12.6	420	263	160
1952	12.0	400	265	151
1953	12.0	400	269	150
1955	7.6	253	294	87
1956	10.0	333	342	97
1959	12.5	417	334	124
1960	12.5	417	337	123
1961	12.3	410	358	113
1962	14.0	450	367	122
1963	15.0	480	377	127
1964	19.0	609	438	138
1965	22.0	704	519	135
1966	25.0	801	468	170
1967	24.5	784	479	162
1968	24.5	784	499	156
1969	25.5	817	536	151
1970	25.0	801	576	138
1971	25.5	817	580	140
1972	27.5	880	613	143
1973	29.2	930	661	140
1974	32.2	1,001	792	125

<sup>a/</sup> 1938 = 100.

Source: Samir Radwan.



TABLE 3  
Nominal Wages and Indexes of Rural Consumer Prices and Real Wages  
1966-1978<sup>a/</sup>

Year	Man-day wage rate piastras	Index	Rural consumer price index	Real wage index
1966	25.5	100.0	100.0	100.0
1967	25.0	98.0	102.3	95.7
1968	24.0	94.1	106.7	88.2
1969	25.0	98.0	114.6	85.5
1970	25.5	100.0	123.0	81.3
1971	25.8	101.2	124.0	81.5
1972	26.5	104.0	131.0	79.3
1973	28.5	111.7	141.2	79.0
1974	35.1	137.7	161.0	85.5
1975	46.5	182.4	180.6	101.0
1976	61.6	242.0	202.3	119.6
1977	76.0	298.0	222.0	134.0
1978	88.0	346.0	256.2	139.0

<sup>a/</sup> 1966 = 100 for each index.

Sources: Egypt, Ministry of Agriculture; Central Agency for Public Mobilization and Statistics (CAPMAS).

free market prices for which published data do not exist. This underestimation tends to increase over time as the gap between subsidized and free market prices widens.

There was a sharp break in rural wages in 1976 when migration to the gulf countries became a massive population movement that tightened up domestic rural labor market. Before this, however, real wages fluctuated around a trend which is not significantly different from zero. Using Radwan's cost-of-living index, this trend is mildly positive both between 1938 and 1965 and between 1938 and 1974 as the following data indicate:

Trends in Real Wages

1938-1965 (CLI) <u>a/</u>	1.03 ( 2.01) <u>b/</u>
1966-1975 (CPI) <u>c/</u>	-0.77 (- .82)
1938-1974 (CLI)	1.22 ( 3.88)
1966-1978 (CPI)	3.32 ( 2.65)

a/ Radwan's cost-of-living index.

b/ Figures in parentheses denote t ratios.

c/ Rural consumer price index.

The scant data available for wheat and rice indicate the growing discrepancy between consumer subsidized prices and free market prices (table 4). Since availability of subsidized foods is limited in the rural areas, we conclude that the positive trend in real wages observed for the period 1938-1974 is probably largely the result of underestimating the rise in the cost-of-living index for the rural area during that period.

For this long period that preceded the outbreak of massive international emigration, rural wages were consequently fundamentally determined according to the Ricardian theory of wage (Ricardo). The rise in food prices implied

TABLE 4  
Subsidized and Free Market Prices of Wheat and Rice  
1967-1981

Year	Wheat <sup>a/</sup>		Rice	
	Price			
	Subsidized consumer	Free market	Subsidized consumer	Free market
L. E. per ton				
1967-68			50	60
1975-76	23	47	50	
1976-77	30	54	50	100
1977-78	25	62	50	105
1978-79	25	64	50	128
1979-80		88	50	147
1980-81		92	50	135

<sup>a/</sup> Forced deliveries of wheat were removed in 1976 with the result that producer prices approximate the free market price in rural areas since that date.

Sources:

For wheat: Egypt, Ministry of Agriculture.

For rice: M. Abdel Fadil for the years 1967-68; data for subsequent years are based on personal interviews with grain merchants.

increases in money wages, and the faster rate of increase in food prices in the rural than in the urban areas led to increases in rural real wages when measured relative to the national cost-of-living index. This may explain the "puzzle" observed by Richards and Martin of rising real wages in spite of continued open unemployment, including in peak seasons of labor demand.<sup>1</sup>

We thus argue that the basic impetus to the rise in rural wages throughout the 1950s and 1960s and until 1975 was the rise in food prices. Beyond that date, emigration constitutes the dominant factor in the explanation of men's wages while rising food prices become secondary. For the wages of women and children, lowering the price of food remains the dominant explanatory factor as migration is not as extensive as it is for men and substitution on the labor market is only partial.

To test the above argument for this latter period of important emigration, we made use of the available data on wages for men and nonmen (women and children) at the governorate level averaged over the years 1974-1978. The data on wages, along with other variables used in the study, are given in appendix table A-1.

For the analysis of intergovernorate variation in the wages of men, we used the following explanatory variables:

1. Index of the demand for labor of men, computed on the basis of crop-wise labor requirements, weighted by the prevailing cropping patterns in different governorates (computed).
2. Percentage of labor force born in the governorate, but residing elsewhere (Ikram), to quantify the impact of emigration.<sup>2</sup>
3. Wheat price (free market) to serve as a proxy for the price of food in the rural sector.



4. Percentage of wage labor force living on farms smaller than five feddans according to the 1961 Census (Mohie-Eldin).
5. Percentage increase in the peak-season wage rate compared to the trough rate (computed).

As far as the intergovernorate variation in the men's wage rate is concerned, emigration of labor emerges as the dominant variable followed by the price of food (table 5). As expected, the demand-side variable, viz., the index of labor demand weighted by cropping pattern, is unimportant. Other supply-side variables also do not emerge as significant such as the percentage of labor force permanently employed on small farms. One would expect that, the larger this percentage, the lower the availability of labor for capitalist farms and, consequently, the higher the wage rate. But this variable is not significant.

The peak rise in the wage rate, interestingly, is a function of the level of wage itself: the higher the level of the wage rate, the lower the percent rise in the peak wage rate and vice versa. This suggests that, even in the high-wage regions, there appears to be an upper bound for peak-season wage rate. It is significant that the cropping pattern weighted labor demand does not explain even the peak rise in the wage levels.

Emigration itself is positively associated with the price of food suggesting that the higher cost of food may have been at least one of the factors for the exodus of labor from villages. However, this relationship is understandably weaker because we have not been able to consider all the determinants of emigration.<sup>3</sup>

TABLE 5

Determinants of Intergovernorate Variation in Men's Wages, Rural Egypt, 1974-1978<sup>a/b/</sup>

Equation number	Dependent variable	Constant term	Explanatory variable					$\bar{R}^2$
			EMGO	WHPR	LAB <sub>M</sub>	LFPC	WR <sub>M</sub>	
1	WR <sub>M</sub>	45.40	0.98* (4.937) <sup>c/</sup>					.62
2	WR <sub>M</sub>	20.80	0.77* (3.84)	2.968** (2.12)				.70
3	WR <sub>M</sub>	19.28	0.79* (3.68)	3.19*** (1.97)	-.003 (-.32)			.68
4	WR <sub>M</sub>	20.33	0.76* (3.38)	2.83 (1.758)		.026 (.201)		.68
5	PEK <sub>M</sub>	83.75					-.845** (-2.427)	.26
6	EMGO	-16.48		3.354*** (1.99)				.17

<sup>a/</sup> n = 15.<sup>b/</sup> WR<sub>M</sub> = wage rate for men; PEK<sub>M</sub> = peak wage rate as a percent of trough wage rate; EMGO = emigration of labor from rural areas (percent of labor born in governorate, residing elsewhere); WHPR = wheat price; LAB<sub>M</sub> = cropping pattern-weighted labor demand for men; and LFPC = percent of labor force permanently attached to farms.<sup>c/</sup> Figures in parentheses denote t values.

\*Significant at the 1 percent level.

\*\*Significant at the 5 percent level.

\*\*\*Significant at the 10 percent level.

Source: Computed.

We now turn to an analysis of the wages of nonmen (table 6). In this case, food price emerges as the dominant variable followed by emigration. As in the case of men's wages, the demand factor does not contribute to an explanation of wage rate behavior.

It is well known that the rural areas in several governorates have poor access to publicly distributed cheap food. We tried the per capita availability of subsidized food as an explanatory variable, but the coefficient does not emerge as significant. This may be due to the fact that the ratio of rationed food per capita to total food consumed in the rural areas is quite low.

In the case of both men's and nonmen's wages, both the statistical significance of the hypothesized coefficients and the adjusted coefficient of determination ( $\bar{R}^2$ ) are impressive considering the fact that the number of observations is as low as 15.

It needs to be pointed out, however, that a limitation of this study is that, in the absence of governoratewise consumer price data for cereals, we have had to use producers' price for wheat averaged for the years 1978 and 1979 as a proxy for the price of food in general. During the study period, rural areas in many governorates had poor access to the government-subsidized bread and wheat products; thus, it appears reasonable to expect that the producer prices reflect the levels of prices of wheat products in the rural areas, especially in the upper Egypt region. However, we recognize that this is not a satisfactory proxy. A better indicator for the price of food is the cereal price index, but this is available only for six governorates in two regions. An examination of these data (table 7) shows that, within each of the two regions, the level of the wage rate is indeed higher in governorates

TABLE 6

Determinants of Intergovernorate Variation in the Wages of Nonmen (Women and Boys)  
Rural Egypt, 1974-1978<sup>a/</sup>

Equation number	Dependent variable	Constant term	Explanatory variable				$\bar{R}^2$
			WHPR	EMGO	RAIF	LAB <sub>NM</sub>	
1	WR <sub>NM</sub>	-16.48	4.82* (5.99) <sup>b/</sup>				.71
2	WR <sub>NM</sub>	-14.74	4.45* (4.19)		-0.09 (-.65)	.02 (1.16)	.70
3	WR <sub>NM</sub>	-11.57	3.82* (5.10)	.30** (2.76)			.81
4	WR <sub>NM</sub>	-19.18	4.90* (6.02)			.01 (1.01)	.71

<sup>a/</sup> WR<sub>NM</sub> = wage rate for nonmen (women and boys); WHPR = wheat price; EMGO = emigration of labor from rural areas (percent of labor born in a governorate, residing elsewhere); RAIF = rationed food per capita; and LAB<sub>NM</sub> = labor demand for nonmen (women and boys).

<sup>b/</sup> Figures in parentheses denote t values.

\* Significant at the 1 percent level.

\*\* Significant at the 5 percent level.

Source: Computed.



TABLE 7

1981 Cereal Price Index and 1978 Wage Rate in Rural Egypt

Region and governorate	1981 cereal price index <sup>a/</sup>	1978 average daily wage rate	
		Men	Nonmen
		1	2
piastres per day			
<u>Lower Egypt</u>			
Garbia	323.0	85.0	39.1
Sharkia	298.0	84.0	39.8
Baheria	247.0	79.6	35.6
<u>Upper Egypt</u>			
Aswan	324.5	104.7	59.5
Sohag	295.9	87.2	55.1
Beni-Suef	266.2	80.0	39.6

<sup>a/</sup> 1966-67 = 100.

Sources:

Col. 1: Central Agency for Public Mobilization and Statistics (CAPMAS).

Cols. 2 and 3: Egypt, Ministry of Agriculture.

with a higher cereal price index. A detailed examination of this issue will be possible only when cereal price indices for all governorates become available.

#### Changing Relative Prices and Their Consequences

Following the scheme in figure 1, we derive four price ratios from the five prices analyzed above.

#### *Shift in Land Use From Food to Feed*

The price ratio of feed crops to staple food crops has risen sharply as a result of price controls on food crops while feed crops have been free of controls and responded to a rapidly rising demand for meat and dairy products. Between 1965 and 1975, for instance, the price of berseem increased by 11 percent while that of rice increased by 5.4 percent, wheat by 6.8 percent, and maize by 6 percent (table 8). Because cost changes also favored berseem over cereals, the result is that the profitability of berseem increased by 6 percent over that period while that of rice, wheat, and maize changed by -1.7 percent, 1.6 percent, and -0.3 percent, respectively (table 8). In the average for 1975 to 1979, the value added per feddan and per month of land use was the highest for long berseem followed by rice and maize. The monthly value added for rice was only about half of that of long berseem.

The obvious consequence has been a tendency to shift land-use patterns away from cereals, especially wheat, and toward feed crops. This shift has been held in check by rotation requirements imposed on farmers by cooperatives. Yet, as table 9 shows, the index of the share in total cropped area (calculated as the product of the share in area use multiplied by the share in

TABLE 8  
Profitability of Food Crops versus Feed Crops

	1965-1975			1975-1979	
	Change in:			Value added	
	Output price 1	Input price 2	Net revenue 3	Per feddan 4	Per feddan and per month 5
	percent			L.E.	
<u>Feed crops</u>					
Long berseem				165.1	23.6
Short berseem				70.4	17.6
Berseem	11.0	5.0	6.0		
<u>Food crops</u>					
Wheat	6.8	5.2	1.6	88.3	12.6
Rice	5.4	7.1	-1.7	92.2	23.1
Summer maize				84.2	21.1
Nili maize				61.1	23.0
Maize	6.0	6.3	-0.3		

Sources:

Cols. 1, 2, and 3: Khalid Ikram.

Col. 4: A. H. Sarris, Hadi Esfahani, Mahmoud Mansour, and Fathia Moustafa.

Col. 5: Computed from N. Habashy and J. Fitsch data.

TABLE 9  
Index of Share of Crops in Total Cropped Area  
1952-1954 to 1980-1982<sup>a/</sup>

	Index of total cropped area				
	1952-1954	1962-1964	1972-1974	1977-1979	1980-1982
	percent				
<u>Feed crops</u>					
Long bersheem	11.1	12.3	16.3	17.5	17.5
Short bersheem	7.7	8.0	7.3	6.0	4.2
Total bersheem	18.8	20.0	23.6	23.5	21.7
<u>Food crops</u>					
Wheat	18.7	14.6	13.4	13.4	13.7
Maize	7.3	7.5	8.9	9.7	9.8
Rice	3.0	5.7	6.3	6.0	5.8
Sorghum	2.7	2.7	2.7	2.3	2.2
Total cereals	31.7	30.5	31.3	31.7	31.5

<sup>a/</sup> Index of share in total cropped area =  $\frac{\text{Share of total acreage} \times \text{number of months in use}}{12 \text{ months}}$

Source: N. Habashy and J. Fitsch.

calendar year of land use) increased by 15 percent for berseem between 1952-1954 and 1980-1982, while it declined by 27 percent for wheat, and remained about constant for all cereals. Today, Egypt thus faces the situation where half of the land in the months of November to February is planted in berseem to feed animals, while two-thirds of wheat consumption is imported and the exportable surplus of rice has been reduced to zero.

*Shift in Animal Use From Power to Meat and Dairy Products*

Due to both income effects and weaker price controls on meat and dairy products than on cereals, the price of the former increased much more rapidly than that of the latter. Thus, between 1966-67 and 1980-81, the price of meat products increased by 57 percent more than that of cereals and that of dairy products by 50 percent more than that of cereals (CAPMAS). The result of this high profitability in animal production relative to other activities is that it increased significantly the opportunity cost of using draft animals for draft power. This, in turn, induced a shift in the use of livestock away from animal power and toward the production of meat and milk.

There are few studies of the livestock economy in Egypt. The ERA 2000 study, however, estimated the opportunity cost of using draft animals as the value of milk and meat cost due to female cow/buffalo working in farm activities. The figure obtained for 1977 was L.E. 77 per animal per year, a significant amount when compared with the realized average net farm income per feddan of L.E. 112 in farms of the Northeast Delta region (de Janvry, Siam, and Gad).

An indirect measure of the shift in animal use from draft to meat and milk can be obtained from the evolution of the cost share of animal labor in total

production cost for the major crops between 1960 and 1979. The data in appendix tables B-1 to B-4 show that there has been a dramatic decline in the cost share of animal power in wheat, rice, maize, and cotton. This decline occurred in spite of an expansion in the herd of livestock (as indicated by the increasing area in feed crops) and a sharp increase in the price of feed (indicating that the declining cost share of livestock is not due to a price effect). The result is that the ratio of animal labor cost to human labor cost, which was close to unity in the 1960s in wheat production, declined to 28 percent in the late 1970s. The declines were, similarly, from 59 to 20 percent in rice production, from 57 to 18 percent in maize, and from 34 to 9 percent in cotton.

*Shift in Farm Energy From Animals to Tractors*

With both (1) rapidly rising feed prices and an increasing opportunity cost in using animals for draft instead of meat and dairy production and (2) extensive subsidies to the price of machinery and fuel, the price of machinery was lowered relative to that of feed. As a result, mechanical energy became cheaper than animal energy and tractors substituted rapidly for draft animals.

This process of substitution can be seen from the evolution of shares in total costs in appendix tables B-1 to B-4. The relative decline in the share of animal labor was marked by a sharp increase in the share of mechanical costs by the late 1970s; while, during the 1960s, the share of mechanical costs was close to zero in all crops except cotton where the share was less than .07 percent. In wheat production, mechanical costs reached 22 percent of total costs by the late 1970s.

The above-mentioned pattern of changes in the relative costs of energy use in farm production observed over time also appears to be true across

governorates at a point of time. As the regression results in table 10 show, intergovernorate variation in machine cost as a share of total cost bears a statistically significant inverse relationship with animal labor cost as a share of total cost.

*Shift From Labor Power to Mechanical Power*

Throughout the 1960s and most of the 1970s, the cost of human labor (wages) rose less than proportionately to the cost of animal labor (berseem prices). Simultaneously, the price of machinery was held down relative to the price of both animal and human labor. The result, as we have seen, has been a shift from animal to mechanical power and diversion of animal use from power to meat and milk. The next important question to answer is: How much did mechanical energy substitute for human labor energy in addition to displacing animal labor energy?

Evolution of the cost share for human labor (appendix tables B-1 to B-4) indicates a gradual rise throughout the 1960s and 1970s. This reflects the slow rise in real rural wages (relative to the national cost-of-living index) which, as we saw, resulted principally from the differential rise in food prices in the rural sector until the late 1970s. As mechanization was occurring and accelerating in the late 1970s, how much labor displacement did actually occur along with the sharp displacement of animal power?

To answer this question, the human labor inputs per feddan were calculated for wheat, rice, maize, and cotton for 1968-1970 and 1976-1978. As the data in table 11 indicate, changes in the human labor input per feddan are negligible for wheat and maize. For rice and cotton, they declined at the slow rate of about 1 percent per year.

TABLE 10  
 Determinants of Intergovernorate Variation in the Machine Costs  
 of Wheat, 1975-1978<sup>a/b/</sup>

Equation number	Dependent variable	Constant term	Independent variable			R <sup>2</sup>
			ANIC	ANTO	ANLA	
1	MACC	17.91	-0.77** (-2.30) <sup>c/</sup>			.23
2	MATO	.29		-.83* (-4.14)		.53
3	MACC	17.24			-14.97** (-2.24)	.22

<sup>a/</sup> n = 15.

<sup>b/</sup> ANIC = animal labor cost; ANTO = animal labor cost/total cost; ANLA = ratio of animal labor cost/human labor cost; MACC = machine cost (tractor hire, irrigation pump, etc.); and MATO = machine cost/total cost.

<sup>c/</sup> Figures in parentheses denote t values.

\* Significant at the 1 percent level.

\*\* Significant at the 5 percent level.

Source: Egypt, Ministry of Agriculture.



TABLE 11

Changes in Human Labor Input Per Feddan in Major Crops, 1968-1978

Crops	1968-1970	1976-1978	Annual
	man-day equivalent <sup>a/</sup>		change
			percent
Wheat	29.6	29.1	- .002
Rice	50.3	46.0	- .011
Maize	39.3	40.1	+ .003
Cotton	96.2	90.1	- .008

<sup>a/</sup> Average for men plus nonmen.

Source: Computed.

The above-mentioned changes in the pattern of energy use and human labor input in farm production are strongly suggestive of the proposition that farm mechanization, at least until the close of the 1970s, was largely of the animal-labor displacing variety, with very little actual adverse impact on the absorption of human labor in agriculture. In other words, machine use, including tractorization, appears to be selectively concentrated in operations where labor displacement is not the primary effect.

That farmers resorted to mechanical energy primarily to replace animal energy appears to be a perfect example of "induced" technical change. But the inducement, in this regard, stemmed essentially from a mixture of uncoordinated government policies which resulted in raising the costs of biological energy disproportionately to mechanical energy costs and, within biological energy, allowing animal labor costs to rise substantially faster than the price of food. It also needs to be stressed that such a change from animal to mechanical energy and diversion of animals to the production of milk and meat is probably the only alternative available to small and marginal farmers to augment their total incomes when the return from crop activity is held at bay through government price and area controls.

But this is not to suggest that mechanization, in general, and tractorization, in particular, would not have potential adverse effects on labor absorption in the near future. As Binswanger suggested, an existing stock of tractors does represent an enormous laborsaving potential which is likely to be realized if the price of food and urban migration continue to push upward the level of wages. Farmers may then prefer to use tractors to replace not only animals but also human labor. It is thus urgent for policymakers to consider an appropriate policy package to prevent such a situation from emerging, a problem to which we now turn.

## The Need for an Integrated Long-Run Agricultural Policy

We have argued in this paper that tractorization, resulting in the use of mechanical energy in farm production in Egypt, is essentially induced by an escalation of the price of fodder and of real wages. A complex set of factors were responsible for bringing about this situation. Of these, the more important, toward which government needs to adopt an integrated policy package, are briefly outlined below.

To the extent that substitution of mechanical energy for biological energy is not a natural consequence of factor scarcities but is due to artificially induced heavy capital subsidies, it seems imperative to allow for a rise in the relative price of machines and fuel. Continuous underpricing of capital relative to labor cannot but lead to continuous pressures for further mechanization with potentially serious long-term social costs.

To the extent that emigration of labor away from the agricultural sector induced wages to rise sharply, policies aimed at promoting interregional labor mobility appear to be crucial. Emigrated labor from the agricultural sector flowed in three directions: (a) to the urban bureaucracy where jobs were "guaranteed;" (b) to the gulf countries, mostly as construction workers; and (c) to industrial employment opportunities in the cities. Of these, quantitatively, international migration is the most significant (United Nations, International Labour Organization). It also constitutes the most "unpredictable" source of temporary emigration, with a considerable probability of further reverse flows taking place in the future. Emigration toward employment in the bureaucracy is entirely due to the existing "job guarantee" scheme which ensures that anyone with a basic degree can become absorbed in the government sector. This accounts for about 20 to 25 percent of total emigration.

The net result of the job guarantee scheme and temporary emigration, along with capital subsidies, has been the emergence of a highly capital-intensive agriculture and of a labor-intensive urban government bureaucracy which eventually might have to absorb more labor if the reverse international flows were to intensify. One wonders whether this development is in the interest of raising the overall total factor productivity of each of the three sectors involved--agriculture, industry, and services.

Egypt is at present passing through a phase where it is essential to strike a proper balance in the use of human versus livestock resources and of both of these relative to capital. The complex set of area and price controls, in general, reduced the profitability of crop activity and raised that of livestock enterprise. Whenever livestock is utilized for the production of milk and meat, female labor and child labor usually get tied to this activity. By contrast, livestock used as draft power in farm production serves as a complementary input to male labor (plowing, threshing, etc.), thus releasing female labor for other farm activities. Extensive diversion of livestock to milk and meat, along with a distortion of the price ratio between food and berseem, resulted in the spread of mechanical energy in an economy with a considerable amount of unemployment. This situation is the unexpected result of partial price controls; controlling food crops and cotton, while allowing meat and milk prices to escalate, is a contradiction because what is sought to be achieved by controls at one end is neutralized by the noncontrol of the other. It is for this reason that an integrated long-run policy package is imperative at this moment. For instance, an immediate short-run policy response would be to bring down the prices of meat and milk to the international levels. Such a short-run policy response, though tempting because of the pressure from the

urban population, may have disastrous consequences for farm welfare, especially for the landless and small farmers who own a significant share of the total animal herd. Bringing down meat and milk prices alone without raising crop prices will reduce farmers' total incomes by snatching the existing opportunity to augment incomes via switching livestock from draft power to meat and milk production without providing any additional source to augment incomes. An easing of controls all along the line, including capital subsidies, would go a long way in restoring a balance among cropland, human population, and livestock. This needs to be coupled with policies to promote internal migration--and a gradual removal of the urban job guarantee scheme--which undoubtedly raises jobs and employment artificially but reduces total factor productivity enormously. Such an integrated long-run policy approach toward controls, subsidies, and migration appears to be the urgent need for resolving the prevailing Egyptian contradictions.

APPENDIX TABLE A-1

## Wages, Prices, Emigration, and the Demand for Agricultural Labor, Egypt

Governorate	Average daily wage rate, 1974-1978		Peak increase in wage rate for men as a percent of trough	Average producer price for wheat, 1978-79	Index of demand for labor		Permanent labor on small farms	Labor force born in the governorate but residing elsewhere	Per capita availability of imported flour
	Men	Nonmen			Men	Nonmen			
	1	2	3	4	5	6	7	8	9
	piastres per day		percent	L.E.			percent		kilos
Baheria	54.6	25.0	31.8	8.6	263.8	268.0	65.1	8.8	20.5
Garbia	58.5	24.4	32.8	8.7	268.4	311.2	76.1	16.1	25.8
Dakhalia	54.4	25.2	47.1	8.5	209.8	255.1	70.9	13.2	28.8
Kapr-El-Shekh	54.4	25.0	21.7	8.4	144.3	163.6	49.6	6.3	25.9
Damitta	49.3	21.5	28.0	8.8	177.5	211.7	51.8	11.3	36.9
Sharkia	58.7	26.3	50.0	8.6	156.1	148.2	73.5	11.0	19.5
Manofia	70.7	32.8	26.7	8.8	235.9	234.3	85.5	30.6	20.9
Qalubia	69.9	28.6	28.6	9.4	150.5	141.6	83.5	14.7	12.8
Bani-Suef	53.3	30.6	50.0	9.2	152.0	130.7	83.9	11.6	15.6
Fayum	49.5	22.6	42.8	8.9	92.5	86.8	82.9	8.5	7.6
Minia	51.8	25.0	15.5	9.2	230.6	203.1	87.7	7.3	16.7
Assayut	63.4	27.0	6.7	10.8	92.8	92.6	84.9	18.5	4.5
Sohag	69.4	36.0	14.3	11.1	117.1	80.1	90.6	20.7	3.2
Qena	72.0	39.5	20.0	11.3	469.3	204.3	85.8	18.1	21.2
Aswan	68.8	37.1	37.0	11.0	626.6	205.4	87.0	24.7	6.6

## Sources:

Cols. 1, 2, 4, 7, 8: Khalid Ikram; A. Mohie-Eldin; and Egypt, Ministry of Agriculture.

Cols. 3, 5, and 6: Computed.

Col. 9: H. Alderman, J. von Braun, and S. A. Sakr.

APPENDIX TABLE B-1

Wheat: Relative Cost Shares of Human Labor, Animal Labor  
and Mechanical Energy, 1960-1979

Year	Cost				Ratio of ALC to HLC
	Human labor (HLC)	Animal labor (ALC)	Mechanical	Other	
1960	.23	.23		.54	
1961	.23	.24		.53	
1962	.23	.23		.54	
Average	.23	.23		.53	1.01
1970	.34	.17		.49	
1971	.31	.18		.51	
1972	.31	.19		.50	
Average	.32	.18		.50	.56
1977	.35	.09	.23	.33	
1978	.38	.09	.21	.32	
1979	.36	.11	.22	.31	
Average	.36	.10	.22	.32	.28

Source: Computed from Egypt, Ministry of Agriculture data.

APPENDIX TABLE B-2

Rice: Relative Cost Shares of Human Labor, Animal Labor  
and Mechanical Energy, 1965-1979

Year	Cost				Ratio of ALC and HLC
	Human labor (HLC)	Animal labor (ALC)	Mechanical	Other	
1965	.30	.18			
1966	.27	.16			
1967	.24	.13			
Average	.27	.16		.57	.59
1977	.26	.06	.10		
1978	.22	.05	.10		
1979	.28	.05	.10		
Average	.25	.05	.10	.60	.21

Source: Computed from Egypt, Ministry of Agriculture data.



APPENDIX TABLE B-3

Maize: Relative Cost Shares of Human Labor, Animal Labor  
and Mechanical Energy, 1962-1979

Year	Cost				Ratio of ALC and HLC
	Human labor (HLC)	Animal labor (ALC)	Mechanical	Other	
1962	.28	.16	.05		
1963	.28	.16	.04		
Average	.28	.16	.05	.52	.57
1971	.34	.13	.06		
1972	.33	.12	.08		
Average	.33	.12	.07	.47	.37
1978	.45	.07	.17		
1979	.45	.10	.12		
Average	.45	.08	.14	.32	.19

Source: Computed from Egypt, Ministry of Agriculture data.

APPENDIX TABLE B-4

Cotton: Relative Cost Shares of Human Labor, Animal Labor  
and Mechanical Energy, 1960-1979

Year	Cost			Ratio of ALC and HLC
	Human labor (HLC)	Animal labor (ALC)	Mechanical Other	
1960	.45	.14	.07	
1961	.39	.13	.07	
1962	.43	.13	.06	
Average	.38	.13	.07	.42
1970	.46	.06	.09	
1971	.45	.06	.08	
1972	.46	.07	.10	
Average	.45	.06	.09	.39
1978	.58	.04	.12	
1979	.58	.05	.09	
Average	.58	.05	.11	.27

Source: Computed from Egypt, Ministry of Agriculture data.

Footnotes

\*Giannini Foundation Paper No. (reprint identification only).

<sup>1</sup>Alan Richards and Philip Martin note the puzzle as follows: "One may wonder how to reconcile this evidence (unemployment and underemployment) with that we reviewed in our first working paper on the extent of increase in real wages. There does not appear to be a 'labor shortage,' if this is defined as the 'unavailability' or the full employment of hired laborers. Nor do the seasonal bottlenecks appear to be as severe as is sometimes thought of; even in the busiest of months, the landless male workers do not work for the whole month. At this stage of our research, we are unable to resolve this puzzle."

<sup>2</sup>An important limitation of this study is that the data on the percentage of labor force born in a governorate but residing elsewhere relates to the 1969-70 Labor Survey. One can only wish that more recent data on this phenomenon were available. The result would still hold true if the pattern of inter-governorate emigration remained the same with the passage of time even if the rate of growth may have accelerated in the recent period.

<sup>3</sup>We did not find it feasible to estimate a simultaneous equation model due to the nonavailability of data at the governorate level. However, the scope for simultaneity in the postulated relationships appears limited because a significant part of the agricultural economy of Egypt (prices, cropping patterns, input deliveries, etc.) was controlled by government during the period under investigation.

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