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LABOR SHORTAGES IN EGYPTIAN AGRICULTURE

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Egyptian farmers and government planners have complained increasingly of a "labor shortage" in agriculture. There are signs of increasing tightness in agricultural labor markets. Real wages have approximately doubled since 1974 and the hours worked per day of most families have declined.[1] In a country with a population growth rate of at least 2.5% and with less than .04 hectare of cultivated land per person, labor shortage complaints pose research puzzles and policy dilemmas. Is there really a labor shortage? How much scarce foreign exchange should Egypt allocate to purchase tractors? Should the policy of subsidized loans and fuel for agricultural machinery be continued?

Egyptians and foreign observers are divided on whether there is a labor shortage and the proper policy response. Some advocate rapid mechanization in response to what they perceive as irreverible changes in the agricultural labor market. Others caution that recent labor shortage conditions might be temporary and that mechanization itself was being induced by inefficient government pricing policies.

The vagueness of the labor shortage complaint contributed to the inconclusiveness of the policy response debate. What is a labor shortage? Rising real wages, an inelastic supply of hired farm workers, or an insufficient supply of

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[1]See, e.g., the discussion in Richards and Martin, "Rural Wages and Agricultural Planning: The Case of Egypt", ADS Working Paper No. .

family workers? Must farmers complain about labor shortages during both the May and October peak seasons? Are farm labor markets failing to clear at higher wages? Everyone agrees that important changes are occurring in Egyptian agricultural labor markets, but there is much uncertainty as to precisely what is changing and what should be the appropriate policy response.

Most previous analyses used macro level data to analyze the labor shortage issue, simply because sufficiently detailed micro data were not available.[2] Limited data on precisely what kind of worker performed which agricultural job and on the seasonal distribution of labor inputs existed, but detailed micro data on the distribution of wages by age, sex, and farm task were unavailable. The general labor utilization pattern of very small farmers was uncertain. Finally, no data set which would permit the estimation of labor supply functions existed, precluding any estimation of the elasticity of hired labor supply to wage rate changes.

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[2]See, e.g., Amr Mohi el Din, "The Development of the Share of Agricultural Wage Labor in the National Income of Egypt", in Gouda Abdel-Khalek and Robert Tignor, eds, The Political Economy of Income Distribution in Egypt. N.Y.: Holmes and Meier, 1982, 236-267. Alan Richards and Philip L. Martin, op. cit. Iliya Harik and Abdel-Basit Hassan, "Socio-economic Profile of Rural Egypt" mimeo, Cairo, 1979; James B. Fitch and Sonia Aly, "Agricultural Wages in Egypt", mimeo, Cairo, 1980.

The urgency of the labor shortage issue and the data lacunae justified a 1979 survey conducted in five villages in Sharqiyya governorate in the eastern Nile Delta. Villages were selected from the two principal crop zones of the Delta, and a census was made of each village. The population was then stratified into five primary occupational groups, and then a random sample was drawn and interviewed within each strata. A total of 182 household heads were interviewed, generating information of 1,293 persons.[3]

This paper presents the results of this survey. First, we examine the link between education and the probability that an individual will participate in the secondary labor market. Second, we describe the local farm structure, focusing on the farming activities of the very smallest farmers. We outline wage and employment patterns by sex, age, occupational stata, month, and crop operation in order to determine when women compete with adult male workers. Finally, we estimate the labor supply elasticities of hired male farm workers.

Several limitations of the survey data should be noted at the outset. Our sample is drawn from Sharqiyya province. While we believe that local conditions are reasonably representative of the Delta, the labor situation may be dif-

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[3] Details of the survey procedure are given in an Appendix.

ferent in Upper Egypt. Our sample is too small to test for regional segmentation of labor markets. The survey was of the "recall" variety, in which respondents were interviewed once about their activities during the entire past year.

Finally, our survey did not yield any direct evidence on migration. Egyptian peasants define a "household" (the sampling unit of observation) to be "those who eat together", thereby automatically excluding those relatives who may be working away from home.[4] Finally, since our survey was cross-sectional, we cannot study changes over time.[5]

Education and Farm Labor Supply

Many observers believe that spreading education is reducing the number of young people who are willing to do farmwork.[6] Our data finds that while spreading education may have reduced the number of young entrants into the pool of "full-time" agricultural laborers, there are still many farm workers.[7] Some 24.3% of those listing agricultural

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[4]However, some indirect information is available from the demographic profile of the villages. For example, the balanced sex ratio for the whole sample (50.2% men and 49.8% women) suggests that the usual pattern of overseas migration, in which adult males depart and women remain behind, is not an important feature of the survey area.

[5]We remain convinced that migration is crucial to any explanation of the discontinuous rise in real agricultural wages after 1974. See Richards and Martin, op.cit.

[6]See, e.g., Fitch and Aly, op.cit.; Harik and Bassam, op.cit.; Nicholas Hopkins, "The Social Impact of Mechanization", A.D.S. Working Paper No. 47.

[7]"Full time" workers are those who listed "agricultural labor" as their primary occupation. "Part time" or "secondary" workers are those who listed agricultural labor as

labor as their primary occupation were children. The median age of "primary agricultural workers was 21.5 years. By contrast, over 98% of all landholders were adult males. The age profiles of farm holders and of agricultural workers are given in Table 1. Further, a very large number of students list agricultural labor as their "secondary occupation."

Illiteracy remains widespread in rural Egypt: 38% of adult males and 77% of adult females were illiterate and only 24% of adult males and 7% of adult females had completed at least primary level education. Forty-seven percent of all landholders were illiterate, and an approximately equal share could read and write but had not completed primary school or higher. Eighty-one percent of primary agricultural workers were illiterate, while 63% of secondary agricultural laborers were illiterate.[8] Only 43% percent of the male children (under sixteen years old) and 25% of female children listed "student" as their primary occupation. Age specific literacy data show that although the percentage of illiterates is lower for the younger age groups, the absolute number of illiterates is larger, because of the greater number of young people in the popula-

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their "secondary" occupation.

[8]As shown below, this is probably the result of the large percentage of wives who are "secondary agricultural workers" and the very high female illiteracy rates.

tion.[9] For males, however, only 22% of males aged 7 through 20 were illiterate, and there were thus fewer illiterate males in this age group than in the next oldest group. (See Table 2).

The pattern seems to be one of spreading education for males, while women remain largely illiterate. Such a trend is probably eroding the pool of male agricultural hired workers. The impact of this development for wages would then depend on the substitutability of women for men in agricultural production. We shall see below that while women work in the fields, they tend to specialize in certain tasks, which are performed at certain times of the year.

However, the fact that education is spreading among young men does not mean that they withdraw from agricultural work altogether. We must distinguish between primary and secondary agricultural workers. Over 26% of all of the individuals in the survey listed agricultural work as their secondary occupation. Some 45.5% of "secondary" agricultural workers were children. Thirty-two percent of female children listed agricultural work as their secondary occupation. The vast majority (93.5%) of those listing agricultural work as their secondary occupation were either stu-

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[9]Approximately half of the villagers in the survey population were sixteen years old or younger. This is about the same as the age distribution of the national population and is, of course, typical of countries with rapid population growth.

dents or housewives. Over half (53.9%) of housewives listed agricultural labor as their secondary occupation; such women comprised 61% of all such secondary workers. Over 40% (42.1%) of students listed agricultural labor as a secondary occupation; they comprised some 32.5% of secondary agricultural workers.

Significantly, only 5% of farm holders listed agricultural labor as their secondary occupation. Such men were less than 1% of the total number of secondary agricultural workers. Since 44of the farms in our sample are very small (i.e., less than one feddan), it would appear that the old pattern of land-poor farmers entering the labor market to supplement their incomes is a thing of the past.[10] The remainder of the secondary agricultural workers had a variety of primary occupations.

We constructed a logit model to determine the probability that different types of persons would enter the secondary agricultural labor market. The estimated equation was:

$$Z = \ln(P [1-P]) = B1 + B2\ CHILD + B3\ ILLITERATE + B4\ HOLDER + B5\ OTHERJOB + B6\ WIFE + B7\ STUDENT + e ,$$

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[10]See, e.g., Mahmoud Abdel-Fadil, Development, Income Distribution, and Social Change in Rural Egypt: A Study in the Political Economy of the Agrarian Transition. Cambridge: Cambridge University Press, 1975.

where P = probability that an individual was a secondary agricultural worker (i.e. listed agricultural labor as a "second" or "third" job). The results are shown in Table 3. Land owners have a low probability of entering the hired agricultural labor market. Housewives and students show quite high probabilities of doing agricultural work for wages. The low probability for "illiterate children" is due to the fact that more than 250 under-school age children fall into this category. We may conclude that although the pool of as a result of spreading education, 1) the hired agricultural labor force remains quite young and 2) many students participate in agricultural work.

Farm Structure

Any discussion of agricultural labor markets must provide information on the size structure and distribution of farms and cropping patterns. The distribution of land itself constitutes an important element of the labor market, on both the demand and supply sides, because land ownership influences the need for hred workers and provides alternatives to participation in the hired agricultural labor market for small farmers. It has sometimes been argued that one of the alleged causes of the "labor shortage" has been farm fragmentation. Since smaller farms are allegedly more labor intensive than large farms, farm fragmentation should

increase the demand for labor.[11]

The total cultivated area of farms covered by the sample was just under three-hundred feddans, and was farmed by some seventy-three different families. The mean farm size was 4.1 feddans, but farm sizes ranged from a minimum of .42 feddans to a maximum of 59 feddans. Nearly three-fourths (73%) of farms are smaller than three feddans, but such farms contained slightly less than one-fourth of the cultivated area. Table 4 shows that the size distribution of farms is relatively unequal by national standards, with a Gini coefficient of .58.[12] Four large farms, all in one village, account for some 42% of the total cultivated area.

The fact that these large farms are concentrated in one village suggests that there may be considerable differences between villages. The remaining four villages are more egalitarian, with a Gini of .36, and have no large farms. For these villages, some 70% of the cultivated area is in farms of less than five feddans, which is closer to national level data. It is highly likely that labor markets and other features of socio-economic life vary considerably between such small farmer villages and those villages dom-

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[11]See Fitch, et.al., op. cit.
[12]In 1977/78 about 48% of the cultivated area of Egypt was in farms of under three feddans; the national Gini coefficient was roughly .49 (Ministry of Agriculture data). However, such data refer to *owned* rather than managed area. The latter are likely more concentrated than the former.

inated by a few large farms.[13]

It should be stressed that the information presented here is for the farmed area, not merely for owned areas.[14] Students of Egyptian agriculture have long been convinced that there were considerable differences between the two concepts. Our sample confirms this view. Only 60% of the gross cultivated area was listed as "owned and exploited by the farmer." Landless renters comprised some 29% of all farmers. A majority (59%) of landless renters farmed areas of less than one feddan and some two-thirds of farmers ("holders") with farms of less than one feddan were landless renters.

However, renting was hardly limited to these farmers. Even the four largest farmers rented an average of 30% of their farm area. Other farmers also entered the rental market: rented land constituted 28%, 5% and 10% of the cultivated area of farms between 1-3 feddans, 3-5 feddans, and 5-10 feddans, respectively. There is clearly an active rental market in land. Renting land appears to be an important alternative to agricultural wage labor participation for some landless rural residents.

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[13]cf. Nicholas Hopkins and Soheir Mehanna, "Egyptian Village Studies", ADS Working Paper No. 42. As noted above, since our sample contains only one "large farmer" village, and five very similar "small peasant" villages, such differences cannot be captured in regression analysis, because the number of observations is too small. Further research on this question would be useful.

[14]For the distribution of owned areas, see Tables 6 and 7.

We find few differences in cropping patterns between farms of different sizes. All farms cultivate the crops typical of the Delta: cotton, rice, maize, wheat, and clover.[15] Regressions that explored the percentage of area in various crops on farm size (Table 8) yielded no significant relationship. This finding is consistent with previous work.[16] Average cropping intensity was 1.72 for the sample as a whole, below the national average of almost two crops annually. This lesser cropping intensity is probably the result of 1) the surprisingly low amount of land in the sample which is devoted to the cultivation of vegetables, and 2) the high proportion of the total cultivated area of the sample which is in large farms. When the five largest farms are removed, the cropping intensity for the sample rises to 1.87.

Three further points are apposite here. 1) The very smallest farms have an extremely high cropping intensity (3.55); 2) cropping intensity varies inversely with farm size; and 3) small farmers devote a very large proportion (45%) of their cultivated area to fodder crops. (Tables 8 & 9) This suggests that livestock plays a crucial role in the

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[15]Such information may be taken as an indicator of the typicality of the survey area for the Delta as a whole, at least in this respect.

[16]Such as the Ford Foundation Farm Management Studies. See also Luis Crouch, Gamal Siam, and Osman Gad, "A Descriptive Analysis of Egyptian Agrarian Structure", ADS Working Paper No. 115.

survival strategies of such farmers.

Small farmers utilize labor and machinery more intensively than do large farmers. (Table 10) The higher labor input per feddan on small farms comes as no surprise, despite the relatively extensive mechanization of small farms in Sharqiyya.[17]

However, large farmers have mechanized more heavily than their smaller neighbors. In addition to plowing, threshing, and irrigating, large farms have already begun to mechanize planting, fertilizer application, harvesting, and transportation. While small farmers do use machinery, the level of farm mechanization clearly varies with farm size. (Table 11) It is especially significant for "labor shortage" debates that the peak season tasks of threshing and planting are already thoroughly mechanized.

Livestock: Distribution and Labor Use.

It has often been argued that livestock rearing constitutes an important alternative to wage labor for many small farmers. It has also been shown that small farms are more animal intensive than large farms.[18] Rising incomes and protectionist trade policies have created a booming market

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[17]Shawky Imam and Wayne Dyer, "Technological Trends in Egyptian Agriculture", ADS working paper # .
[18]James Fitch and Ibrahim Soliman, "The Role of Livestock Production on the Egyptian Farm" ADS Working Paper No. .

for red meat, milk, and poultry. Livestock products enjoy prices some 200% above border prices.[19] Small farmers take full advantage of these opportunities, devoting much of their time, energy, and resources to raising animals.

Our data confirm these observations. The smallest farmers, with less than 4% of the cultivated area in the sample, held 39% of the female cattle, 50% of the male cattle, 50% of the female buffaloes, 50% of the cattle calves, 40% of the buffalo calves, 40% of the sheep, 56% of the goats, and 58% of the chickens. (Table 12) Such small farms are truly "animal intensive" (See Table 13). This is consistent with the high percentage of the cultivated area which such farmers devote to forage crops, noted above.

Large farmers devote a substantial percentage of their area to forage crops despite their low "own-farm animal intensity". This strongly suggests that they sell fodder to small farmers. Small farmers' livestock operations thus appear highly commercialized, since they buy off-farm inputs like animal feed.

Livestock play a crucial role in providing small farmers with alternatives to entering the hired labor market.[20] Indeed, 54% of persons in the <u>entire</u> sample

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[19]See William Cuddihy, "Agricultural Price Management in Egypt", World Bank Staff Working Paper, No. 388. Washington, D.C., 1980.

[20]It may be worth noting that livestock may even affect hired agricultural laborers: some 28% of the chickens in the

devoted at least some of their labor time to livestock. The mean number of days devoted to livestock work was just under 169 days, or nearly half of the entire year! This is especially true for male farmers, who spend nearly two-thirds of the time which they have "available for work" in animal husbandry. The smallest farmers devote a larger amount of time to animals per feddan than do large farmers, as one would expect given the higher animal intensity of such farms. Interestingly, men do more animal work than women, and clearly do more such work than children. (Tables 14, 15) The seasonal distribution of men and women's livestock labor differs, with men doing relatively more in the winter months, and less during the summer. Our data strongly support the hypothesis that intensive animal husbandry provides an important alternative to wage labor for small farmers.

The Division of Labor in the Fields

We turn now to the division of labor in crop production. The survey contains two sources of information on labor utilization: 1) farmers reporting in detail on who did precisely what operation, how much they were paid, etc., and 2) hired agricultural laborers reporting their work days, wages, and tasks. Such information provides us with a rich descriptive picture of agricultural labor in the Delta. Since the welfare implications of mechanizing the jobs of

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sample were owned by such workers.

different kinds of workers (e.g., family vs. hired, adult vs. child) may differ considerably, such information is vital for the formulation of sound mechanization policies.[21]

Our data also permit us to specify the current pattern of substitution among different kinds of labor. An especially important question for the "labor shortage" debate is that of women's work and specialization. We hypothesize that as (increasingly literate) men withdraw from the hired agricultural labor market, the impact on wages will be smaller for those jobs which women and children perform. Our data allow us to pinpoint the jobs and seasons where such substitution now occurs.

The overall distribution of crop labor as reported by the farmers is given in Table 17. For the whole sample, an average of 794 hours of labor[22] per feddan per year was devoted to crops.[23] The same table also shows the proportion of labor which is done by the farm family, by hired

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[21]It has been suggested recently that farm mechanization may reduce the attractiveness of large families in rural Egypt because it will eliminate children's jobs. As we shall see, this is probably true only if certain operations are mechanized. Allen Kelley, Atef Khalifa, M. Nabil El-Khorazaty, Population and Development in Rural Egypt. (Durham, N.C.: Duke University Press, 1982).

[22]Throughout this report the hours of men, women, and children have been given the same weight.

[23]Assuming that a day in Egyptian agriculture is approximately equal to five hours, which is what farmers usually claim for hired labor, this comes to roughly 159 days per year per feddan.

workers, and by other workers -- "permanent workers", and "fellowship" workers, or in-kind labor exchange arrangements. It appears that crop labor is done mostly by hired workers. Even quite small farms show a very high percentage of work to be performed by hired workers (Table 18), and only the very smallest farmers do most of their own work. As expected, the percentage of total labor performed by hired workers rises with farm size. However, because small farms are so much more labor intensive than large farms, the total number of hired labor hours per feddan is larger for small farms (Table 19). Such data confirm the hypothesis of Fitch, et. al., that increasing farm fragmentation could lead to a steady increase in the demand for hired farm labor.[24]

Although men do most crop labor, women and girls do roughly one-third of such work. This confirms our earlier finding that official agricultural labor force data grossly undercount women. Children are also active agricultural workers, doing some 39% of the (unweighted) total work hours.

Table 20 gives the breakdown of family and hired labor for the different crop operations, which together constitute some 98% of total crop labor. It also shows the distribu-

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[24]Fitch and Sonia Aly, "Agricultural Wages in Egypt", Ford Foundation, Cairo, 1981.

tion of total labor time by operation. The most labor-intensive operations are (in order of total labor hours): 1)harvesting, 2) manual pest control, 3) irrigation, 4) "other", 5) fertilizer application, 6)planting, and 7) hoeing. Note that harvesting and manual pest control together amount to nearly 45% of all labor devoted to crops.

The same table also reveals that family members do most of the land preparation, irrigation work, fertilizer application, maize separating, transportation and marketing. Hired workers, on the other hand, do most of the planting, hoeing, harvesting, threshing and separating, and "other" jobs. Children do nearly all of the highly labor intensive manual pest control (Table 21), and Table 22 shows that such work constitutes just under one-half of all child labor hours in crops. Harvesting and manual pest control together constitute nearly three-fourths of all child labor hours.

Women's work also appears fairly specialized, although less so than children's labor. Table 23 shows that nearly one-half (43%) of women's total crop labor time is harvest work. The remainder of their labor seems fairly evenly distributed among different crop operations, with planting being their next most important work activity. Women do most of the maize separating, and perform significant amounts of the planting, fertilizing, transporting, harvesting, and "other labor" (Table 24), all in addition to their intensive work in livestock care. The heavy labor input of women and

children into certain crop operations helps to explain the observed variance in adult male wage rates by operation and season.

Table 25 gives a highly disaggregated picture of labor allocation. For hired workers, some 32% of (unweighted) hired labor hours is performed by adult males, 15% by women, and 53% by children, the latter a result of the extremely large number of hours devoted to manual pest control. Male adult agricultural workers seem to spend most of their time harvesting, hoeing, and irrigating (something of a surprise), and doing "other" types of jobs. Hired women spend most of their time as harvest laborers. Unsurprisingly, family labor time appears considerably less specialized than does that of hired workers.

Employment and Wage Variations

The labor shortage debate is confounded by the observation of both sharp increases in real wages and apparent under-employment in the rural areas. Such a puzzle is by no means limited to Egypt: An important impetus behind much recent research on LDC labor markets has been the observation that wages do not fall in the presence of unemployment. Our data on wage variations by seasons and by crop operations, and on employment patterns, helps to illuminate this paradox in the Egyptian case.

The employment data reported by agricultural workers (Tables 26 and 27) reveal considerable seasonal fluctuation in employment. There are two seasonal peaks, one in May-June and the other in October. It is worth noting, but hardly surprising, that employment fluctuates more for hired farmworkers than for other types of labor. Table 27 implies considerable underemployment at first glance, since even during the peak seasons only just over half of all workers are employed more than twenty days per month. However, the data on labor availability[25] reported in Table 28 show that on average most workers reported less than twenty days per month as "being available for work". By this reckoning, then, underemployment is less serious than that implied by Table 27. If one uses the common "300 days per year" as a measure of full-employment[26] then the seasonal pattern of unemployment for the sample (i.e., Days worked/25 days) will be as shown in Table 29. The same table shows, however, that if we use the mean of reported labor availability as the denominator, quite a different picture emerges. The revised picture emphasizes the well-known seasonal employment pattern, but it also shows that <u>if</u> if the absence of unemployment is the definition of a labor shortage, then there are <u>shortages</u> in the peak seasons of June and October,

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[25] "Labor availability" is the measure of labor <u>supply</u> used in this study. The data are the responses of interviewees to the question, "How many days did you have available for work during this month?"

[26] See, e.g. Amr Mohie el-Din, op.cit.

and <u>surpluses</u> in other months.

It should be noted from Table 28 that agricultural workers give a lower figure for labor availability than do workers with other types of occupations. Male agricultural workers give a lower figure for labor availability than any other group of workers except farm holders. Male agricultural workers' labor supply fluctuates seasonally, with a peak in May and June and a smaller peak in October. Women's labor supply is more stable, but also shows an October peak.

It has been argued[27] that wage rates are the most important indicator of "labor scarcity". Table 30 shows that wages for adult male laborers who are household heads[28] rise in the peak season of May and June; however, no such increase occurs during the other peak season, September-October. These results are not affected by the procedure used to remove the inflationary trend from the time series of wages.[29] Table 31 also shows that some operations pay considerably more than others: marketing, land preparation, threshing and separating appear to be the best paying jobs for adult male workers.

This operation-specific data and the labor utilization data suggest the following hypothesis on wage rates: Land

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[27]Richards and Martin, op.cit.
[28]The number of observations on other male laborers was too small to make any valid inferences.
[29]We thank Bent Hansen for pointing this out to us.

preparation, threshing and separating are commonly performed in May and June. The demand for labor rises, pushing up adult male wage rates <u>because no cheap alternative labor supply is available for these jobs</u>. These tasks are also fairly well-mechanized, so that labor productivity and wages are higher. By contrast, the very low adult male wage for harvest labor -- including the harvest of cotton in October -- indicates that there are very cheap alternative labor sources ready to do such work: women and children. Similarly, competition from the children of the farmers' families holds down wages for irrigation work. The sample data confirm the existence of operation and month specific "shortages" of adult male hired labor, in the sense that wages rise for some operations and for some months.

Our data provides evidence that labor markets do <u>not</u> clear during the off-season. The mean reservation wage (83.3 P.T. for males) is almost 20% below the monthly average for received wages. Clearly, there are workers who would be willing to work for less than the going wage, yet they cannot find jobs. The presence of such involuntary unemployment in Egyptian agriculture contradicts the common argument that agricultural labor markets in LDCs are competitive.[30]

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[30]See, e.g., Lynn Squire, <u>Employment Policy in Developing Countries</u>. London: Oxford Univerity Press, 1981. We would like to thank Bent Hansen for very helpful discussion of the issues raised here and in the following paragraph.

The market *may* clear at peak season. However, the "true" peaks of demand are shorter than one month. Farmers may not conduct certain operations at the optimal time, either because the additional output does not compensate for the very high wage at that time, or because an adequate number of workers is genuinely unavailable at any wage. Unfortunately, our monthly data cannot evaluate these possibilities. Since our data set does not match employers with employees, we cannot test theories which have been advanced to explain involuntary unemployment in the Indian context, such as interlocking factor markets. Clearly, further work here would be useful.[31]

Regressions of the reservation wage on dummy variables for the different sex and age groups are shown in Table 32. It can be seen that the only statistically significant coefficients were obtained for wives and girls. Unsurprisingly, females have a lower reservation wage than do adult male household heads. Regressions using village dummies yielded no significant impact on the mean reservation wage of a village. Although the reservation wage for non-household head males is higher (as theory would predict[32]), the coefficient is not significant at the usual level.

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[31]See Pranab Bardhan, "Interlocking Factor Markets and Agrarian Development: A Review of Issues". *Oxford Economic Papers*, 32,1 (March, 1980), 82-98.
[32]see Pranab Bardhan, "Employment and Wages in a Poor Agrarian Society", *American Economic Review*, 69,1 (March, 1979).

The survey contains information on the reservation wages of other occupations. These vary widely, and while the number of observations is too small for any inferences to be made, the reservation wage for manual non-farm labor (e.g., load haulage) is quite close to that of farm labor. The reservation wage of construction workers is well above that for agricultural laborers (e.g. "builder" 275 P.T., "painter's assistant" 100 P.T.). Jobs like mud tool maker and coffee maker have reservation wages well below the reservation wage of farm workers, 42 and 33 P.T. per day, respectively. This wage information is consistent with two hypotheses: 1) agricultural wage rates follow unskilled construction wages fairly closely, but lag behind them, and 2) workers in the tertiary sector may have replaced agricultural workers as the least well-paid village workers.[33]

Labor Supply Functions and Elasticities

The picture so far is one of relative wage flexibility within a village, in which an increased demand for farm labor leads to some combination of increased wage rates and increased labor supplies. Men's wages appear to rise and fall with demand conditions and the degree of competition from women and children. However, involuntary unemployment occurs during the slack season. At the same time, spreading

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[33]As suggested by Bent Hansen and Samir Radwan, Employment Opportunities and Equity in Egypt. Geneva: ILO, 1982.

education and considerable alternative opportunities -- renting land, animal husbandry and emigration -- for some landless families has reduced the pool of hired agricultural laborers.

This picture differs sharply from that of the models of W. Arthur Lewis, Fei and Ranis or indeed, any model which assumes a perfectly elastic supply of labor, as do linear programming or input-output models. These differences become sharper still when we turn to the impact of wages on labor supply. We have presented evidence that there is <u>some</u> responsiveness of labor supply to wages. We now seek to quantify this response.

The estimation of agricultural labor supply functions is relatively recent in economic studies of less developed countries. The most prominent studies[34] used very large data sets in India. Comparable data were unavailable in Egypt. The Egyptian was relatively small scale and our results are correspondingly less robust. Nevertheless, the Egypt survey results are consistent with Bardhan's findings that the farm labor supply is typically inelastic with respect to the wage rate.

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[34] i.e. Pranab Bardhan, op.cit., and "Wages and Unemployment in a Poor Agrarian Economy: A Theoretical and Empirical Analysis", <u>Journal of Political Economy</u> 87,31 (1979); M.R.Rosenzweig. "Rural Wages, Labor Supply, and Land Reform", <u>American Economic Review</u>, 68,5 (December, 1978).

We have constructed a simple, two equation system, which was estimated by two-stage least squares. Our model was:

1. WAGE = f(FEMALE, AGE, ILLITERATE, DEPENDENCY RATIO)
2. LABOR AVAILABILITY = g(WAGE) .

The variables are mostly self explanatory. In the first equation, the "dependency ratio" is the ratio of dependents to earners in the household of the agricultural worker. We hypothesize that an increased ratio of dependents to earners leads workers to demand a higher wage. The expected signs of the other coefficients in the first equation are:

FEMALE<0, AGE>0, ILLITERATE<0.

The dependent variable of the second equation, labor availability, is a measure of the labor supply of the workers, not merely the actual days worked.[35] We hypothesize that the coefficient in the second equation is positive.

The equations were estimated separately for each of the twelve months of the year, to reflect the seasonality of wages and of the demand and supply of labor. The regression results are shown in Table 33, and labor supply elasticities for the months, calculated at the means, are shown in

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[35]See the discussion in Bardhan, AER, op.cit.

Table 34. If "labor shortage" means "inelastic labor supply with respect to the wage rate", then there is indeed a shortage. The coefficients on age, sex, and illiteracy all have the expected signs, as does the coefficient on dependency ratio. It seems that education affects the wage rate directly, not just indirectly by reducing labor force participation.

Turning to the labor supply equation, seven coefficients have a seven-in-eight chance of being the product of something other than pure chance, while five are significant at the more conventional 10% level. None show the "perfect elasticity" assumed by the Lewis, L.P. and other models. ALL of the coefficients and elasticities are less than one. Such relative unresponsiveness of labor supply to wages probably underlies much of farmers' complaints of a "labor shortage".

Inelastic labor supply functions are not limited to agricultural workers. Estimates for non-agricultural workers, for example, yielded similar estimates (see Table 35). It appears that labor is supplied inelastically both to the fields and to the workshops of rural Egypt. As can be seen, the number of observations shrank considerably due to data lacunae. Since even with a very small number of observations, we are able to obtain some interesting and policy relevant results, it would appear that additional, larger scale surveys of this kind should be undertaken by the

Egyptian government.[36]

Conclusions and Policy Implications

There is considerable specialization of the farm work force by task in Egyptian agriculture. The highest paying work in May and June is performed by hired male workers. The absence of substitutes for male workers and the inelasticity of hired male labor supply in that peak season push up wages. By contrast, those jobs which women and children also perform show lower wage rates for adult males. Despite the inelasticity of the supply of hired male workers in October, for example, male adult harvest wages are reduced because farmers can obtain substitutes.

Women do a considerably greater amount of agricultural labor, including hired agricultural labor, than official government statistics report. Housewives are especially active in the part-time hired agricultural labor market, but women also work as full-time agricultural workers. The implications of this finding for the labor shortage debate depend upon the degree to which such labor can substitute for male labor. Such substitution is currently task-specific.

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[36]Cf. the recommendations of the ILO mission to Egypt, Hansen and Radwan, op.cit., pp.

Although the absolute number of rural illiterates continues to increase, the percentage of young men who are illiterate is markedly lower than the percentage for older men. Such a finding lends some credence to the argument that spreading education is effecting a long-run, gradual, and probably irreversible reduction in the supply of full-time agricultural laborers. However, students continue to participate in the hired labor market in large numbers as part time workers.

A substantial number of landless rural residents can avoid participation in the hired agricultural labor market by renting very small plots of land, cultivating them intensively, and practicing intensive animal husbandry. Livestock provide an important alternative to wage labor for small landowning peasants as well. Since the domestic price of livestock products is roughly double international prices, such a price policy has the unintended effect of reinforcing the independent livelihood of small peasants and of reducing their supply of labor time to the hired agricultural market.

Small farms seem to be labor <u>and capital</u> intensive, hiring most of their crop labor, renting tractor services, and purchasing fodder for their numerous animals. Such farms are sharply different from the usual "subsistence" picture of small Egyptian farmers.

The supply of full-time male workers to the hired farm labor market is inelastic with respect to the wage rate. Bent Hansen showed some fifteen years ago that the implications of a perfectly elastic labor suppply model, such as that of W. Arthur Lewis, were at variance with the evidence of fluctuations in wages in response to shifts in labor demand (marginal productivities). Our findings suggest that the assumptions of such models are equally suspect on the supply-side of the labor market.

The sample is too small to answer questions concerning the extent of labor market segmentation. The sample included four relatively egalitarian villages and only one village with concentrated landholdings.

Differences in wages by month and task can be explained using supply-and-demand assumptions. However, there is clear evidence that the agricultural labor market does not clear in the off-season. The existence of involuntary employment indicates that the labor market is not competitive.

Agricultural mechanization is spreading in these villages. Indeed, some operations are almost entirely mechanized. It is especially noteworthy that threshing and land preparation during the May-June peak are already fully mechanized. If the relatively high wage for male workers in May and June and/or the inelasticity of labor supply of such

workers in those months is the core of the problem called the "labor shortage", then it is unlikely that further mechanization will solve the problem, because the principal tasks in question are already mechanized.

Small farmers are apparently able to hire tractor and threshing services. However, larger farmers seem to be moving toward much more complete mechanization. This may have very important long run consequences.

Finally, because we have no information on migration and because this evidence comes from a cross-section survey, we cannot explain the discontinuous increase in rural real wages which occurred after 1974. It appears that emigration from rural areas has played an important but unexplored role in pushing up rural wages and that the subsidized mechanization response to the resulting labor shortages is devoting too much of Egypt's scarce resources to agricultural mechanization.

APPENDIX: THE SURVEY

The data were collected from five villages in Sharqiyya Governorate. Our collaborators from Zagazig Universty had considerable experience in and knowledge of the area. They were well-known to local government personnel, whose cooperation was essential to the success of the survey. The governorate is quite representative of the Delta.

Villages both near and far from the provincial capital of Zagazig were selected. The villages were: Kafr el-Jubran, El-Kenayat, Kafr el-Hadedy, Kafr el-Nossairy, and Sani el-Haggar. After a complete census of the five villages was completed by Mr. Yehia Badran, a M.Sc. candidate in the Department of Agricultural Economics at Zagazig University, the population was stratified into five occupational groups. The stata were: 1) farm holders, in turn stratified by farm size; 2) hired agricultural workers; 3) workers in agriculturally related activities; 4) workers in non-agriculturally related activities; and 5) service workers, largely government employees. The definitions of these categories are as follows: 1) farm holder: one who manages a farm; 2) hired agricultural worker: a landless (i.e., owns no crop land) worker who asserts that his primary occupation is working in agriculture, for wages; 3) and 4) agriculturally related and non-agriculturally related workers. Often we refer to these workers jointly as "non-agricultural workers", i.e. individuals whose self-defined principal

occupation is work outside of agriculture. There is a long list of such jobs and activities; these jobs were divided into those supplying inputs to or processing outputs from agriculture (called "agriculturally related" activities) and all others (called "non-agriculturally related activities").[37] 5)"Services" were defined as government employees.

The sampling was random within each strata. Mr. Badran and Mr. Ibrahim Youssef (also of Zagazig University) administered the questionnaire. Interviews were conducted from December, 1979 through February, 1980, usually either in the informant's house or at the gama'iyya (village cooperative society) headquarters. Mr. Badran and Mr. Youssef were aided by ten assitants from the Ministry of Agriculture. Each interview lasted at least one day, and required as many as three days in some cases for the farmers. It was a recall survey, covering the entire preceding year.

The survey covers 1223 individuals. There were 182 household heads and 176 wives of household heads. Approximately one-half of the villagers in families surveyed were children 16 years of age or younger. Over 90% of the individuals had been born in the village in which they were surveyed. The distribution of the surveyed population among

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[37]A complete list of these activities is available from the authors upon request.

the five strata, as well as of housewives, students, and others is shown in Appendix Table 1.

TABLE I

AGE PROFILES (PRINCIPAL OCCUPATION)

Age	N, Holders	N, Agr. Workers
0-7	0	0
8-10	0	7
11-15	1	11
16-20	0	23
21-25	2	16
26-30	3	5
31-35	5	12 (6 at 35)
36-40	4	3
41-45	10	4
46-50	12	7
51-55	7	3
56-60	5	1
61-65	7	0
66-70	6	1
70+	1	1

TABLE 2: LITERACY

Ages	All Persons		Males		Females	
	Per Cent Illiterate	Number of Illiterates	Per Cent Illiterate	Number of Illiterate	Per Cent Illiterate	Number of Illiterates
7-20	43	203	22	48	62	155
20-39	64	177	43	62	88	115
40-59	75	129	56	49	96	80
60+	87	69	74	29	100	40

TABLE 3

PARTICIPATION IN SECONDARY AGRICULTURAL LABOR MARKET

Individual Characteristics	Probability of Entering Secondary Agricultural Labor Market
Illiterate child*	.4%
Illiterate Holder	7.1%
Literate Holder	3.3%
Illiterate Other Employment**	12.8%
Literate Other Employment**	6.1%
Illiterate Housewife	50.7%
Literate Housewife	45.5%
Child Student	41.2%
Adult Student	25.8%
(N = 1124)	
(All coefficients significant at 5% level.)	

*Includes underage (<6 years old).

TABLE 4: DISTRIBUTION OF CULTIVATED AREA* IN THE TOTAL SAMPLE BY SIZE OF CULTIVATED AREA

SIZE RANGE OF CULTIVATED AREA	PER CENT OF TOTAL CULTIVATED AREA IN THE SAMPLE WHICH IS CULTIVATED BY THE FARMERS IN THE SIZE RANGE	PER CENT OF FARMERS IN SIZE CLASS
0-1 Feddans	3.734787	25
1-3 Feddans	20.94757	45
3-5 Feddans	13.91935	14
5-10 Feddans	15.5644	10
10+ Feddans	45.83389	6
(≥ 20 Feddans)	(42.0)	(5)
Gini Coefficient:	.58	

*Cultivated area is area owned and managed by the farmer and any land he rents from others.

TABLE 5 : DISTRIBUTION OF CULTIVATED AREA* IN THE TOTAL SAMPLE BY SIZE OF CULTIVATED AREA WITHOUT "LARGE FARMER" VILLAGE

SIZE RANGE OF CULTIVATED AREA	PER CENT OF TOTAL CULTIVATED AREA IN THE SAMPLE WHICH IS CULTIVATED BY THE FARMERS IN THE SIZE RANGE	PER CENT OF TOTAL FARMS IN CLASS
0-1 Feddans	7.928959	28.3
1-3 Feddans	39.17664	48.3
3-5 Feddans	24.61916	13.3
5-10 Feddans	28.27525	10
10+ Feddans	0	0

Gini Coefficient: .36

*Cultivated area is area owned and managed by the farmer and any land he rents from others.

TABLE 6: DISTRIBUTION OF OWNED AREA IN TOTAL SAMPLE, BY SIZE OF OWNED AREA

Size Range of Owned Area	Per Cent of Total Owned Area in the Sample Which Is Owned by the Farmers in the Size Range
0-1 Feddans	8.009872
1-3 Feddans	17.05744
3-5 Feddans	18.2578
5-10 Feddans	6.192506
10+ Feddans	50.48239

TABLE 7: DISTRIBUTION OF OWNED AREA IN TOTAL SAMPLE, BY SIZE OF OWNED AREA WITHOUT "LARGE FARMER" VILLAGE.

Size Range of Owned Area	Per Cent of Total Owned Area in the Sample Which Is Owned by the Farmers in the Size Range
0-1 Feddans	19.10403
1-3 Feddans	34.53159
3-5 Feddans	38.19444
5-10 Feddans	8.169935
10+ Feddans	0

TABLE 8: MEAN PERCENTAGE OF AREA CROPPED IN FIVE CROP CLASSIFICATIONS BY SIZE OF CROPED AREA

Size Range of Cultivated Area	Mean Percentage of Cultivated Area in Cotton for Farms in the Size Range	Mean Percentage of Cultivated Area in Grains and Beans for Farms in the Size Range	Mean Percentage of Cultivated Area in Fruits Vegetables Tubers for Farms in the Size Range*	Mean Percentage of Cultivated Area in Forage for Farms in the Size Range	Mean Percentage of Cultivated Area in Other Crops for Farms in the Size Range
0-1 Fed	8.421121	44.28847	0	45.09974	2.190676
1-3 Fed	21.29134	40.07064	0	38.63802	0
3-5 Fed	11.38893	49.30659	6	32.I0688	0
5-10 Fed	14.20984	53.14237	0	32.6478	0
10- Fed	23.01358	36.03159	0	40.95482	0

*Per cent fruit vegetables, tubers and per cent other crops had only one nonzero observation each.

TABLE 9

CROPPING INTENSITY BY FARM SIZE CLASS

Farm Size	Cultivated Area	Cropped Area	Intensity Index*
0-1 Feddans	11.17 Feddans	39.60 Feddans	3.55
1-3	62.65	115.64	1.85
3-5	41.63	76.30	1.83
5-10	46.55	70.72	1.52
10-20**	(10.08)		
>20	127.00	211.00	1.54
Total	299.08	513.26	1.72

*Cropped Area/Cultivated Area

**One farm only

TABLE 10: MACHINE, ANIMAL, AND LABOR HOURS PER FEDDAN, BY FARM SIZE GROUP

	Machine Hours per Feddan	Animal Hours per Feddan	Human Hours per Feddan	Total Area in Feddans
0-1 Feddans	155.2015	225.8762	1420.784	10.67
1-3 Feddans	89.63447	127.7989	1034.142	62.65
3-5 Feddans	124.8595	134.3742	811.3277	41.63
5-10 Feddans	77.29753	77.35983	640.1046	46.55
10+ Feddans	99.9037	29.06332	641.1203	137.08

TABLE 11: MECHANIZATION, BY OPERATION

Per cent of Farms in Size Class
Which Have Some* Mechanization

Operation	0-1 Feddans	1-3 Feddans	3-5 Feddans	5-10 Feddans	10+ Feddans
Ploughing	94	100	90	100	100
Planting	12	24	40	29	100
Irrigation	100	97	100	100	100
Fertilizing	0	9	0	14	40
Harvesting	0	6	20	0	60
Threshing	100	95	100	100	100
Transport	6	24	33	42	100

* "Some" means non-zero machine hours reported

TABLE 12: LIVESTOCK OWNERSHIP, BY FARM-SIZE CLASS

	Sum	Mean
	1959.0000	7.7126
Female Cow	74.0000	1.6818
0 through 1 Feddans	25.0000	1.3889
1 - 3 Feddans	30.0000	2.0000
3 - 5 Feddans	15.0000	1.8750
5 - 10 Feddans	1.0000	1.0000
10 - 20 Feddans	2.0000	2.0000
20+ Feddans	1.0000	1.0000
Male Cow	18.0000	3.0000
0 through 1 Feddans	10.0000	3.3333
1 - 3 Feddans	6.0000	6.0000
3 - 5 Feddans	1.0000	1.0000
20+ Feddans	1.0000	1.0000
Female Buffalo	62.0000	1.3778
0 through 1 Feddans	22.0000	1.2941
1 - 3 Feddans	18.0000	1.2000
3 - 5 Feddans	17.0000	1.7000
5 - 10 Feddans	4.0000	2,0000
20+ Feddans	1.0000	1.0000
Male Buffalo	1.0000	1.0000
20+ Feddans	1.0000	1.0000
Cow Calves	28.0000	2.8000
0 - 1 Feddans	14.0000	2.0000
1 - 3 Feddans	3.0000	3.0000
3 - 5 Feddans	10.0000	10.0000
10 - 20 Feddans	1.0000	1.0000
Buffalo Calves	5.0000	1.6667
0 through 1 Feddans	2.0000	2.0000
3 - 5 Feddans	2.0000	2.0000
5 - 10 Feddans	1.0000	1.0000
Sheep	15.0000	1.6667
0 through 1 Feddans	5.0000	1.6667
1 - 3 Feddans	3.0000	1.5000
3 - 5 Feddans	7.0000	1.7500

con't

Table 12 (con't)

Goats	25,0000	1.7857
0 through 1 Feddans	9.0000	1.8000
1-3 Feddans	8.0000	1.6000
3-5 Feddans	3.0000	1.5000
5-10 Feddans	5.0000	1.5000
Camels	1.0000	1.0000
1 - 3 Feddans	1.0000	1.0000
Donkeys	83.0000	1.4068
0 through 1 Feddans	37.0000	1.3214
1 - 3 Feddans	22.0000	1.2941
3 - 5 Feddans	19.0000	1.7273
5 - 10 Feddans	2.0000	2.0000
10 - 20 Feddans	1.0000	1.0000
20+ Feddans	2.0000	2.0000
Poultry	1647.0000	26.5645
0 through 1 Feddans	823.0000	29.3929
1 - 3 Feddans	499.0000	23.7619
3 - 5 Feddans	238.0000	26.4444
5 - 10 Feddans	50.0000	25.0000
10 - 20 Feddans	7.0000	7.0000
20+ Feddans	30.0000	30.0000

TABLE 13

ANIMALS PER CULTIVATED FEDDAN

Farm Size Class (Feddans)	Female Cow	Male Cattle	Female Buffalo	Cow Calf	Buffalo Calf	Sheep	Goats	Chickens
0-1	2.24	.90	1.97	1.25	.18	.45	.81	73.7
1-3	.48	.10	.29	.05	--	.07	.13	7.96
3-5	.36	.14	.41	.24	.05	.17	.07	5.72
5-10	.02	--	.09	--	.02	--	.11	1.07
10-20*	.20	--	--	.10	--	--	--	.70
20+	.01	.01	.01	--	--	--	--	.24

*Only one farm

TABLE 14

YEARLY LIVESTOCK LABOR, BY SEX AND AGE GROUP

Sex and Age Group	Sum	Mean Days of Livestock Labor
Household Head +	21765.0000	109.3719
Wife +	34016.0000	200.0941
Male >16 years +	20676.0000	156.6364
Female >16 +	19648.0000	251.8974
Male Pupils >16 +	526.0000	105.2000
Female Pupils >16 +	145.0000	145.0000
Male Children <16 +	1937.0000	161.4167
Female Children <16 +	5803.0000	241.7917
Male Pupils <16 +	352.0000	70.4000
Female Pupils <16 +	540.0000	270.0000
Adult Male >16 *	2953.0000	147.6500
Male Children <16 *	1155.0000	288.7500
Adult Male >16 **	2657.0000	221.4167
Male Child <16 **	676.0000	169.0000
Total	113109.0000	168.8

+ Members of Holders family

* Agricultural Workers

** "permanent" agricultural workers (i.e., "hired hands")

TABLE 15: CROP, LIVESTOCK LABOR FOR FARM FAMILY, BY FARM SIZE CLASS

	Crop Hours	Livestock Hours	Total	Per Cent Crop	Per Cent Livestock
All Farms	231,406	148,647	380,053	61	39
0-1 Feddan	15,160	31,794	46,954	32	68
1-3 Feddan	64,784	51,273	116,062	56	44
3-5 Feddan	33,776	24,393	58,169	58	42
5-10 Feddan	29,797	23,593	53,390	56	44
10+ Feddan	87,885	17,594	105,479	83	17

TABLE 16

SEASONAL DISTRIBUTION OF LIVESTOCK LABOR, BY FARM SIZE

SEASONAL DISTRIBUTION OF LIVESTOCK LABOR
BY FARM SIZE

Farm Size Class	Labor Hours per Feddan per Year
0-1	3,261
1-3	925
3-5	586
5-10	507
10+	128

TABLE 17

Total Labor Hours in Sample = 237576.9

Total Number of Reported Instances = 22396

Total Household Labor Hours = 96271.66

Household Labor as a Percentage of Total Labor = 40.52231

Total Hired Labor Hours = 138397.6

Hired Labor as a Percentage of Total Labor = 58.25379

Total Other Labor Hours = 2907.7

Other Labor as a Percentage of Total Labor = 1.223898

Total Male Labor Hours = 159276.1

Male Labor as a Percentage of Total Labor - 67.04189

Total Female Labor Hours = 78300.87

Female Labor as a Percentage of Total Labor = 32.95811

Total Adult Labor Hours = 144898.3

Adult Labor as a Percentage of Total Labor = 60.99004

Total Child Labor Hours = 92678.68

Child Labor as a Percentage of Total Labor = 39.00996

TABLE 18

Farm Size Ranges, in Feddans Cultivated	Distribution of Labor Inputs Percentages of Total Labor		
	Household Labor	Hired Labor	Other Labor
0-1 Feddans	62.55034	35.18717	2.262493
1-3 Feddans	48.25681	51.07447	0.6687129
3-5 Feddans	49.43672	48.16028	2.403002
5-10 Feddans	41.40504	58.5686	0.02635753
10+ Feddans	26.79531	71.75506	1.449625

TABLE 19

HIRED LABOR HOURS PER FEDDAN,
BY FARM SIZE CLASS

Farm Size Class (Feddans)	Hired Labor Hours per Feddan per Year
0-1	500
1-3	527
3-5	391
5-10	371
10+	460

TABLE 20

DISTRIBUTION OF CROP LABOR INPUT,*
BY OPERATION: PER CENT FAMILY VS HIRED

Operation	Operation as Per Cent of Total Labor Time	Per Cent Family Labor	Per Cent Hired Labor
Plowing	.9	94.3	5.7
Scrape, Ridge	.8	71.6	28.4
Scraping	.7	67.4	32.6
Planting	6.2	38.2	61.8
Irrigation	15.8	85.1	14.9
Fertilizer Application	7.9	60.8	39.2
Hoeing	5.9	27.1	72.9
Harvesting	23.6	23.2	76.8
Threshing	1.8	48.5	51.5
Separating	1.7	44.8	55.2
Maize Separating	1.1	57.9	42.1
Manual Pest Control	20.4	7.3	92.7
Transportation	4.6	59.9	40.1
"Other"	8.1	44.0	56.0
Marketing	--	71.7	28.3

*Hours, Unweighted

TABLE 21

DISTRIBUTION OF CROP LABOR TIME,
BY OPERATION: PER CENT ADULT VS CHILD

OPERATION	Adult	Child
Plowing	94	6
Scrape, Ridge	85	15
Scraping	92	8
Planting	76	24
Irrigation	84	16
Fertilizer Application	71	29
Hoeing	93	7
Harvesting	56	44
Threshing	88	12
Separating	95	5
Maize Separating	88	12
Manual Pest Control	10	90
Transport	87	13
"Other"	69	31
Marketing	77	23

TABLE 22

DISTRIBUTION OF ADULT, CHILD CROP LABOR TIME

Operation	Per Cent of Adult Time	Per Cent of Child Time
Plowing	1	1
Scrape Ridge	1	1
Scraping	1	1
Planting	8	4
Irrigation	22	7
Fertilizer Application	9	6
Hoeing	9	1
Harvesting	22	27
Threshing	3	1
Separating	3	1
Maize Separating	2	
Manual Pest Control	4	47
Transp.	7	1
"Other"	9	7
Marketing	--	--

TABLE 23

DISTRIBUTION OF MALE, FEMALE ADULT
CROP LABOR TIME

OPERATION	Per Cent of Male Time	Per Cent of Female Time
Plowing	2	1
Scrape, Ridge	2	
Scraping	1	
Planting	6	13
Irrigation	26	8
Fertilizer Application	9	9
Hoeing	12	1
Harvesting	15	43
Threshing	3	2
Separating	3	2
Maize Separating	1	5
Manual Pest Control	5	-
Transport	6	7
"Other"	9	10
Marketing	-	-

TABLE 24

DISTRIBUTION OF ADULT CROP LABOR TIME
BY OPERATION: PER CENT MALE, FEMALE

OPERATION	Male Time as % Total	Female Time as % Total
Plowing	97.6	2.4
Scrape, Ridge	96.7	3.4
Scraping	92.8	7.2
Planting	59.0	41.0
Irrigation	91.4	8.6
Fertilizer Application	75.6	24.4
Hoeing	98.2	1.8
Harvesting	52.6	47.4
Threshing	83.1	16.9
Separating	85.1	14.9
Maize Sep	26.4	74.6
Manual Pest Control	73.9	26.1
Transport	98.3	1.7
"Other"	73.7	26.2
Marketing	--	--

TABLE 25

DISTRIBUTION OF LABOR TIME

OPERATION	Hired Labor			Family Labor		
	Per Cent M-time	Per Cent F-time	Per Cent Chi-time	Per Cent M-time	Per Cent F-time	Per Cent Chi-time
Plowing	4.7	0	0	2.8	.3	.8
Scrape, Ridge	1.1	0	.1	1.8	.4	1.4
Scraping	1.0	.1	0	1.3	.6	.7
Planting	6.2	16.5	3.8	6.0	8.2	4.3
Irrigation	11.7	-	.3	37.3	19.2	33.4
Fertilizer Applica.	7.1	5.5	3.9	11.0	15.1	13.8
Hoeing	20.1	.1	1.1	5.5	1.5	.7
Harvesting	21.7	55.8	28.4	10.6	23.4	17.5
Threshing	4.0	1.1	.2	2.1	2.9	2.1
Separating	4.3	1.3	-	2.1	2.1	1.1
Maize Sep.	.2	4.9	-	.8	4.9	1.9
Manual Pest Control	5.9	-	56.0	3.6	6.1	7.0
Transport	5.7	5.3	.8	7.1	9.8	4.1
"Other"	10.4	9.3	5.4	7.9	11.0	11.4
Per cent of Total Time for Each Category	32.0 (of hired L-time)	15.0	53.0	63.0 (of family L-time)	15.0	19.0

TABLE 26

TOTAL WORK DAYS OF ADULT HIRED LABOR, BY MONTH

Month	Male Days (N = 58)	Female Days (N = 8)
1	400	30
2	523	25
3	652	57
4	745	39
5	960	74
6	1048	99
7	548	26
8	255	11
9	461	72
10	1166	171
11	832	52
12	281	9

TABLE 27

EMPLOYMENT OF HIRED AGRICULTURAL WORKERS,
AGR-RELATED WORKERS AND NON-AGR.-REL. WORKERS:
DAYS PER PERSON PER MONTH (MEANS)

MONTH	Agr. Workers (Ad.males)	Agr. Workers* (Ad.males)	Labor Availability Agr.Workers (All)	Agr-Rel. Workers (All)	Non-Agr. Rel. Workers (All)
1	6.9	11.76	13.62	14.3	16.4
2	9.0	13.41	13.4	13.5	15.9
3	11.24	15.16	14.1	14.2	16.1
4	12.8	15.2	13.8	12.3	16.4
5	16.55	18.82	17.3	13.6	15.8
6	18.07	20.55	20.25	14.6	16.4
7	9.45	12.45	19.5	13.2	17.0
8	4.4	12.14	18.2	13.8	17.8
9	7.95	13.56	17.42	13.4	17.3
10	20.1	22.42	15.1	14.7	16.1
11	14.34	16.31	14.13	14.4	16.3
12	4.84	10.81	13.63	13.3	17.4

*Days/N, for those working at least one day

TABLE 28

LABOR AVAILABILITY: ALL WORKERS

Occupation	Sum	Mean
Holder	17642.0000	238.4054
Ag Worker	80581.0000	190.4988
Ag Related	18975.0000	223.2353
Non Ag	19367.0000	236.1829
Service	9964.0000	284.6857
Other	1132.0000	161.7143
All Workers	147661.0000	209.1516

TABLE 29

UNEMPLOYMENT OF HIRED AGRICULTURAL WORKERS BY MONTH

Month	U_1^*	U_2^{**}
1	33%	53%
2	35%	57%
3	25%	42%
4	16%	39%
5	10%	25%
6	0%	18%
7	15%	36%
8	30%	57%
9	26%	46%
10	0%	10%
11	12%	35%
12	37%	57%

$*U_1$ = 1 - days worked/days available

$**U_2$ = 1 - days worked/25 days

Table 30

T-22

WAGE AND EMPLOYMENT PROFILE

KEY: MEAN DAILY WAGE FOR MONTH, FOR TYPE/EMPLOYMENT CATEGORY

NUMBER OF WORKERS FOR TYPE CATEGORY

TOTAL NUMBER OF DAYS WORKED IN BY CATEGORY

TOTAL INCOME IN P.T. FOR MONTH BY CATEGORY

NOTE: EMPLOYMENT CATEGORIES ARE,
20+ MORE THAN 20 DAYS IN MONTH,
20< LESS THAN 20 DAYS IN MONTH,
0 UNEMPLOYED IN MONTH.

WORKER TYPE M16+ IS A MALE GREATER THAN 16 YEARS,
WORKER TYPE F16< IS A FEMALE LESS THAN 16 YEARS.

TYPE /EMPLOYMENT CATEGORY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
HEAD 20+	100.3086	127.3622	126.3591	122.9852	141.9256	112.2536	132.1839	112.094	116.3889	117.0612	112.3497	115.11
	6	5	11	11	18	22	4	5	5	22	14	3
	162	127	298	270	457	631	87	117	162	621	366	86
	16250	16175	37655	33206	64860	70832	11500	13115	19179	72695	41120	5900
HEAD 20<	101.5436	107.2889	99.60417	122.663	128.5837	142.5393	119.3621	105.6306	102.0854	112.6721	120.524	122.52
	21	22	25	25	19	18	29	12	21	17	22	13
	149	225	240	276	233	191	290	111	199	247	229	59
	15130	24140	23905	33855	29960	27225	34615	11725	20315	27830	27600	12130

KEY: MEAN DAILY WAGE FOR MONTH, FOR TYPE/EMPLOYMENT CATEGORY

NUMBER OF WORKERS FOR TYPE CATEGORY

TOTAL NUMBER OF DAYS WORKED IN BY CATEGORY

TOTAL INCOME IN P.T. FOR MONTH BY CATEGORY

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0 UNEMPLOYED IN MONTH.

WORKER TYPE M16+ IS A MALE GREATER THAN 16 YEARS,
WORKER TYPE F16< IS A FEMALE LESS THAN 16 YEARS.

TYPE /EMPLOYMENT CATEGORY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
WIFE 20+	.	.	.	.	.	85	.	.	.	70	.	.
	0	0	0	0	0	1	0	0	0	3	0	0
	0	0	0	0	0	20	0	0	0	70	0	0
	0	0	0	0	0	1700	0	0	0	4900	0	0
WIFE 20<	.	70	86.84211	70	84.58333	71.37931	70	100	60	55.16129	69.54545	.
	0	2	3	1	4	3	1	1	4	2	4	0
	0	6	19	6	24	29	3	7	47	31	22	0
	0	420	1650	420	2030	2070	210	700	2820	1710	1530	0

WAGE AND EMPLOYMENT PROFILE

KEY: MEAN DAILY WAGE FOR MONTH, FOR TYPE/EMPLOYMENT CATEGORY

NUMBER OF WORKERS FOR TYPE CATEGORY

TOTAL NUMBER OF DAYS WORKED IN BY CATEGORY

TOTAL INCOME IN P.T. FOR MONTH BY CATEGORY

NOTE: EMPLOYMENT CATEGORIES ARE,
20+ MORE THAN 20 DAYS IN MONTH,
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0 UNEMPLOYED IN MONTH.

WORKER TYPE M16+ IS A MALE GREATER THAN 16 YEARS,
WORKER TYPE F16< IS A FEMALE LESS THAN 16 YEARS.

TYPE /EMPLOYMENT CATEGORY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
M16+ 20+	97.5	122.3529	133.9286	166.0101	140.5405	122.226	130.5682			119.5437	131	56.818
	1	2	2	4	6	4	2	0	0	10	5	1
	24	51	42	99	148	146	44	0	0	252	125	22
	2340	6240	5625	16435	20800	17845	5745	0	0	30125	16375	1250
M16+ 20<	112.6923	121.9167	120.2778	117.35	132.1311	120.75	131.063	121.2963	105.55	126.413	135.5804	139.86
	6	10	7	9	8	7	9	4	8	3	10	9
	65	120	72	100	122	80	127	27	100	46	112	74
	7325	14630	8660	11735	16120	5660	16645	3275	10555	5815	15185	10350

WAGE AND EMPLOYMENT PROFILE

KEY: MEAN DAILY WAGE FOR MONTH, FOR TYPE/EMPLOYMENT CATEGORY

NUMBER OF WORKERS FOR TYPE CATEGORY

TOTAL NUMBER OF DAYS WORKED IN BY CATEGORY

TOTAL INCOME IN P.T. FOR MONTH BY CATEGORY

NOTE: EMPLOYMENT CATEGORIES ARE,
20+ MORE THAN 20 DAYS IN MONTH,
20< LESS THAN 20 DAYS IN MONTH,
0 UNEMPLOYED IN MONTH.

WORKER TYPE M16+ IS A MALE GREATER THAN 16 YEARS,
WORKER TYPE F16< IS A FEMALE LESS THAN 16 YEARS.

TYPE /EMPLOYMENT CATEGORY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
F16+ 20+	55.15152	.	62.30769	.	61.42857	69.6	.	.	84	73.84615	.	.
	1	0	1	0	1	2	0	0	1	2	0	0
	33	0	26	0	21	50	0	0	25	52	0	0
	1820	0	1620	0	1290	3480	0	0	2100	3840	0	0
F16+ 20<	.	55.78947	60	58.78788	85.51724	.	64.34783	50	.	50	78	55.5555
	0	1	1	2	2	0	2	1	0	1	2	2
	0	19	12	33	29	0	23	4	0	18	30	9
	0	1060	720	1940	2480	0	1480	200	0	900	2340	500

WAGE AND EMPLOYMENT PROFILE

KEY: MEAN DAILY WAGE FOR MONTH FOR TYPE/EMPLOYMENT CATEGORY

NUMBER OF WORKERS FOR TYPE CATEGORY

TOTAL NUMBER OF DAYS WORKED IN BY CATEGORY

TOTAL INCOME IN P.T. FOR MONTH BY CATEGORY

NOTE: EMPLOYMENT CATEGORIES ARE:
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0 UNEMPLOYED IN MONTH.

WORKER TYPE M16+ IS A MALE GREATER THAN 16 YEARS.
WORKER TYPE F16< IS A FEMALE LESS THAN 16 YEARS.

TYPE /EMPLOYMENT CATEGORY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
M16< 20+	.	.	.	.	.	.	.	.	.	66	.	.
	0	0	0	0	0	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	25	0	0
	0	0	0	0	0	0	0	0	0	1650	0	0
M16< 20<	67.14286	.	60	70	70	60	.	60	.	.	.	60
	1	0	1	1	1	1	0	1	0	0	0	1
	14	0	14	16	6	14	0	10	0	0	0	7
	940	0	840	1120	420	840	0	600	0	0	0	420

WAGE AND EMPLOYMENT PROFILE

KEY: MEAN DAILY WAGE FOR MONTH, FOR TYPE/EMPLOYMENT CATEGORY

NUMBER OF WORKERS FOR TYPE CATEGORY

TOTAL NUMBER OF DAYS WORKED IN BY CATEGORY

TOTAL INCOME IN P.T. FOR MONTH BY CATEGORY

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0 UNEMPLOYED IN MONTH.

WORKER TYPE M16+ IS A MALE GREATER THAN 16 YEARS,
WORKER TYPE F16< IS A FEMALE LESS THAN 16 YEARS.

TYPE /EMPLOYMENT CATEGORY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
F16< 20+	.	.	.	40	.	17	17	.	.	60	.	.
	0	0	0	1	0	1	1	0	0	1	0	0
	0	0	0	30	0	25	25	0	0	20	0	0
	0	0	0	1200	0	425	425	0	0	1200	0	0
F16< 20<	40	.	.	.	17	.	40	40	.	.	.	40
	1	0	0	0	1	0	1	1	0	0	0	1
	10	0	0	0	10	0	15	8	0	0	0	4
	400	0	0	0	170	0	600	320	0	0	0	160

TABLE 31

AVERAGE HOURLY WAGES FOR MALE ADULT HIRED FARM WORKERS, BY OPERATION

Operation	Wage (P.T./hr.)
Plowing	25.0
Scrape, Ridge	20.8
Scraping	24.3
Planting	21.3
Irrigation	18.2
Fertilizer Application	20.4
Hoeing	20.3
Harvesting	17.3
Threshing	26.1
Separating	26.1
Maize-Separating	14.6
Manual Pest Control	10.7
Transport	23.4
"Other"	20.7
Marketing	28.8

TABLE 32

REGRESSION RESULTS FOR RESERVATION WAGES

Indep.Var.	DF	Parameter Estimate	Standard Error	T Ratio	Prob > |T|
Intercept	1	85.625000	5.999092	14.2730	0.0001
Wife	1	-38.958333	22.712197	- 1.7153	0.0919
Male 16	1	14.375000	12.113003	1.1867	0.2404
Female 16	1	-35.625000	22.712197	- 1.5685	0.1225
M Child	1	-35.625000	38.412934	- 0.9274	0.3578
F Child	1	-68.625000	38.412934	- 1.7865	0.0795

F Ratio 2.32
Prob F 0.0549
R-Square 0.1742

TABLE 33

REGRESSION RESULTS, HIRED MALE AGRICULTURAL LABOR SUPPLY

Equation/ Dep. Var.		I. Wage in Piasters/day					II. Labor Supply (Days/Mo.)	
Indep.Var.		Female	Age	Illit.	Dep. Ratio	Prob > F_I	Daily Wage	Prob > F_{II}
Mo.	N							
1	28	-70.13**	0.04	-16.70	1.38	.40	.06	.43
2	32	-68.70*	0.72**	-12.51	3.32*	.02	.10**	.11
3	38	-35.28**	.56	-34.08*	1.81	.03	.07	.25
4	39	-65.85*	0.88*	-38.25*	4.82*	.002	.03	.30
5	45	-60.89*	2.07*	-18.81	0.78	.03	.05*	.06
6	42	-64.62*	0.51	-76.89*	2.9	.003	.06*	.05
7	36	-75.74*	.16	-44.63*	2.45**	.004	.07*	.07
8	20	-39.52	.58	8.68	0.49	.37	-0.03	.67
9	28	-46.46*	0.3	-62.27*	1.50	.02	.06*	.09
10	44	-61.26*	0.3	-4.18	1.86**	.002	.06**	.11
11	42	-35.34*	-0.007	-34.02*	3.03*	.01	.10*	.06
12	25	-63.00	0.69	-38.58	3.9	.15	.08*	.10

*Significant at 10% level.
**Significant at 12.5% level.

TABLE 34

ELASTICITY[a] OF AGRICULTURAL LABOR SUPPLY WITH RESPECT TO THE WAGE RATE

Month	Elasticity
1. January	.31
2. February**	.67**
3. March	.41
4. April	.21
5. May*	.33*
6. June*	.35*
7. July*	.49*
8. August	-.19
9. September*	.36*
10. October**	.34**
11. November*	.63*
12. December	.54

*Significant at 10% level.
**Significant at 12.5% level.

[a]Elasticity calculated at mean

TABLE 35

REGRESSION RESULTS FOR "NON-AGRICULTURALLY RELATED WORKERS"

Independ.Var.: Labor supplied in days per month; for male adults

Month	N	Dependent Variable Daily wage in P.T.	Prob> |t| = Prob> |F|	R^2	η_{S_L}
1	23	.035*	.028	.21	.35
2	23	.034*	.021	.22	.35
3	23	.045*	.001	.39	.49
4	23	.045*	.001	.40	.50
5	23	.043*	.003	.46	.53
6	23	.046*	.0003	.46	.55
7	23	.030*	.007	.30	.44
8	23	.022*	.099	.12	.25
9	23	.034*	.011	.27	.32
10	23	.050*	.002	.37	.53
11	23	.037*	.003	.36	.40
12	23	.026**	.103	.12	.28

*Significant at 10% level.
**Significant at 12.5% level.

APPENDIX TABLE 1

OCCUPATIONAL COMPOSITION OF
THE SAMPLE POPULATION

Occupation	Number
Land Holder	59
Agr. Worker	99
Agr. Related Worker	49
Non-Agr. Related Worker	46
Service Worker	38
Housewife	371
Student	258
Under Age	222
Recruited for Army	22
Not in Labor Force	7
Old/Handicapped	38
Total	1209