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"Labor Requirements and Supply for Cotton-Picking with a Special Reference to Tenant Family Labor in New Halfa Ag. Corporation - Sudan"

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Labor Requirements and Supply for Cotton Picking with Special Reference to Tenant Family Labor in New Halfa Agricultural Corporation - Sudan

by

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ABSTRACT

Contributing an average of 48% of the country's annual foreign exchange earnings and using 21% of the total irrigated land, cotton plays a major role in the Sudanese economy. Due to the expansion in cotton area which has been taking place during the last three decades, and the planned expansion in area and increase in yield during the 1977/78-1982/83 Plan for Social and Economic Development, the question of Labor Supply for cotton picking, which is estimated to require 14% of the country's labor force for a period of 2-3 months, assumes a special importance. This is particularly so in the face of a rapid rural-urban migration as well as immigration of labor of all calibers to the neighboring Arab oil countries at an increasing rate.

This study was intended to

(1) estimate the contribution of the tenant household in cotton picking and the labor supply functions for household labor in cotton picking in New Halfa Agricultural Corporation;

(2) estimate labor requirements for cotton picking;

(3) estimate the contribution of hired labor to cotton picking and their cost to the tenant;

(4) draw conclusions and implications for policy and future research.

The data were collected by means of a survey from a multi-stage random sample of 132 tenant households in New Halfa Agricultural Corporation for 1977/78 season. 84 of the households interviewed were from the Nomadic tribes and 48 from the Halfawi tribe.

This study showed that a typical Halfawi tenant household had 13 man-equivalent days available for cotton picking of which only half were actually utilized. The corresponding average figure for a typical household from the Nomadic tribes was 40 man-equivalent days of which 84% was utilized. Picking was performed only by men in the Halfawi sample. In the Nomadic households sample, however, cotton picking was undertaken by men, women and children.

Regression analysis was made to estimate labor supply functions for household members. The objective was to identify those variables which influenced the labor supply behavior of tenant household members in cotton picking and to predict the likely impact of certain policies on the tenant household labor supply. For comparison, Ordinary Least Squares (OLS) and Seemingly Unrelated Regressions (SUR) were used in estimating the household labor supply functions.

The results of the regression analysis showed that the labor supply of Halfawi tenant household men was positively associated with income from cotton, and income from groundnuts, and negatively associated with average age.

For the Nomadic households, labor supply of men for cotton picking increases with increase in implicit wage rate, income from cotton and the average number of men per household, and decreases with an increase in income from groundnuts, income from wheat, and number of children aged 6-9 years.

The labor supply of Nomadic household women was found to be positively associated with number of children aged 6-9 years, and 10-14 years, and average number of women per household. It was found to be negatively associated with family size, household income from groundnuts and average age of household women.

The labor supply of Nomadic household children (10-14 years) was found to be positively associated with implicit wage, household income from cotton, average number of years of schooling per child and number of children 10-14 years of age. It was found to be negatively associated with average child age (10-14 years).

Labor supply elasticities were estimated with respect to certain important policy variables. The labor supply elasticities with respect to net income from cotton were relatively higher compared with elasticities for wage rate, income from wheat and income from groundnuts. The labor supply elasticity with respect to income from cotton was highest for Halfawi men (around .9).

This study indicated that the labor requirements for cotton picking per feddan was not fixed. It varied with

level of yields. Matching labor requirements for cotton picking all over the country with potential labor supply revealed that labor shortfalls in the cotton production areas may be overcome if the necessary measures were made to mobilize laborers from those areas characterized by seasonal under-employment during the cotton picking season.

This study underscored the key role played by hired labor in cotton picking vis-a-vis family labor, especially among the Halfawis. To meet the increase in the demand for labor for cotton picking in the future, appropriate policies should be adopted to mobilize hired labor, including providing information on availability of employment opportunities, subsidizing the transportation of migrant laborers between their villages and the cotton producing schemes and raising real wages. However, this study does not underestimate the role of family labor which is important especially in recruiting labor and managing the process of cotton picking. As an effective way to increase family labor participation in cotton picking, appropriate measures should be made to ensure increasing tenant household income from cotton.

Future studies should deal with the total labor supply of the tenant household (including on- and off-farm labor allocations) all year round. Such an approach will improve our understanding of the decision-making process whereby the tenant household allocates its labor resources among

different activities. Another area where research is needed pertains to the determinants of labor supply of migrant hired labor. The determination of labor requirements of different crops and livestock in all major producing areas as well as the types and labor requirements of secondary occupations should also be pursued.

Dedication

Dedicated with gratitude and appreciation to my late father, my mother, my wife and our son, Muhammed.

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TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

CHAPTER I

INTRODUCTION

1. Importance of Agriculture to the Sudanese Economy

The total area of Sudan is 2.5 million square kilometers (596,621,000 feddans[1]). About one third of this area is desert or semi-desert. The remainder is suitable with varying capacities for crop production, livestock grazing, and forestry. Table I shows land utilization in the Sudan as of 1975. It could be seen from this Table that agricultural area comprises about 33.5% (200 million feddans). Pastures and forests occupy 46% of total land area. The rest consists of uncultivable land.

Of the total 200 million feddans of potentially cultivable agricultural area, only 18.7 million feddans (3.3% of total area, i.e. 9.3% of cultivable land) are actually cultivated.

The amount of land so far exploited is relatively small, mainly because intensive and continuous cultivation of much of the land area is hampered at present by limited water supplies, poor communications, inaccessibility

[1] A feddan is equivalent to 1.038 acres.

TABLE 1

Land Utilization in the Sudan, 1975

Land Category	Area in 1000 feddans Breakdown	Total
(A) Classification of Total Area		
Total Area		596,621
(1) Land Area	565,714	
(2) Land Under Water	30,907	
(B) Classification of Land Area		
(1) Agricultural Area		200,000
Cultivated Area	18,685	
Uncultivable Area	181,315	
(2) Pasture Land		57,143
(3) Forests		217,857
(4) Other Uncultivable		90,714

Source: The Statistics Division, Department of Agricultural Economics, Ministry of Agriculture, Food and Natural Resources, Democratic Republic of the Sudan, Sudan Yearbook of Statistics, 1977.

to markets, a relatively sparse population of 15 million (13), and lack of capital.

The cultivated area (18,685,000 feddans) can be subdivided further into cropped area which amounts to 89% of agricultural area, and fallow area comprising the remaining 11%. Of the total cropped area, 3,725,000 (22%) is irrigated artificially while the remaining 12,960,000 (78%) is rain-fed. However, irrigated agriculture plays a much more important role than is suggested by relative area. Most of the crops which earn or save foreign exchange are grown in the irrigated subsector. For instance, 100% of both wheat and sugar cane, 94% of cotton, and 51% of groundnuts are produced under irrigation (40).

Overall, agriculture is the mainstay of the Sudanese economy, contributing 49% of G.D.P. at factor cost in 1974/75 (12), employing more than 80% of the labor force (20), and providing more than 95% of the country's foreign exchange earnings.

2. The Significance of Cotton in the Sudanese Economy: Prospects and Problems

Contributing an average of 48% of the country's annual foreign exchange earnings, and using 992,890 feddans (which is 21% of the total irrigated land), cotton plays a major role in the Sudanese economy. Cotton also provides revenue for the two partners: the

government and the tenants. It also provides seasonal employment and income for agricultural laborers, and raw materials for the growing textile industry.

The 1977/78-1982/83 Plan for Social and Economic Development of the Sudan has projected the expansion in cotton production shown in Table 2.

According to this plan the annual increase in cotton production projected over the plan period is 2.5 percent, 18.9 percent and 24.3 percent for long, medium and short staple cotton, respectively. The overall annual increase in all types of cotton is 7.5 percent. Most of the increase will occur in the medium and short maturing varieties.

However, serious problems are now facing plans to increase cotton production, especially in irrigated cotton schemes where long and medium staple varieties are grown, undermining cotton's crucial role in the economy. These problems may be summarized as follows:

(1) Water shortage problems resulting from one or more of the following: (a) reduction in storage capacity of reservoirs behind dams, (a problem particularly important in Khashm Elgirba Dam[2]); (b) silting up of water canals and blockage by weeds; (c) defective farm and canal layouts and; (d) inefficient application of irrigation water by tenants.

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[2]Kashm El Girba Dam stores water for New Halfa Agricultural Corporation, the project where this study was conducted.

TABLE 2

Quantitative Targets for Cotton Production: 1977/78-1982/83

Type of Cotton	1974/75 (Actual)			1976/77 Base Year			1982/83 Quantitative Targets		
	Area[1]	Yield[2]	Production[3]	Area[1]	Yield[2]	Production[3]	Area[1]	Yield[2]	Production[3]
Long Staple Cotton	856	617	529	760	635	483	790	707	559
Medium Staple Cotton	222	459	102	210	500	105	350	849	297
Short Staple Cotton	141	116	16	155	122	19	350	200	70

Source: Ministry of Planning, the Democratic Republic of the Sudan, Six-Year Plan for Social and Economic Development of the Sudan 1982/83 (in Arabic), (Khartoum: Dina Modern Printing Press [1977]), p. 13.

Key

[1]Area in thousand feddans

[2]Yield in kilograms per feddan

[3]Production in thousand tons

(2) Aggravating cotton pests and disease situation.

(3) Energy related problems manifested by shortage of fuels and relatively high and increasing prices of fertilizer and insecticides.

(4) Heavy infestation by obnoxious weeds. (35).

(5) A possible labor shortage problem as indicated by:

(a) Expanding area and increase in productivity per feddan of cotton. The 1977/78-1982/83 Plan of Social and Economic Development envisages a 22% increase in the area under cotton and 43% increase in cotton production.

(b) A rapidly increasing urban population compared to a relatively slow growing rural population. According to the tentative findings of a 1973 census conducted by the Department of Statistics, the urban sector is growing at an annual rate of 7.5 percent compared to 1.5 percent for the rural sector and 2.2 percent for the whole population (13). Since the labor force (tenants and their families plus hired labor) involved in cotton picking belong to rural areas mainly from central and western Sudan, and to the extent that cotton picking will continue to be made by hand, shortage of labor for cotton picking is a possibility.

(c) Emigration to the neighboring oil-rich countries is increasing due to the wide and ever increasing income disparities between the Sudan and these countries.

Emigrants are not only professionals and skilled, but also increasing numbers of unskilled rural laborers are involved.

(d) Taking these factors into consideration, the Rahad Agricultural Corporation has already considered introducing mechanical picking as an alternative on a trial basis in the 1978/79 season. A technical committee has been formed the major objective of which is to evaluate studies on mechanical cotton picking worldwide and recommend the best machinery which will suit Sudanese conditions (9).

3. Emphasis on Cotton Picking Labor Problems

Without underestimating the importance of the other issues affecting cotton production, and due to the limited time and resources, this study will only concentrate on the labor aspects of cotton picking. The issue of cotton picking labor assumes increasing importance at this time when suggestions for introducing capital-intensive cotton pickers are already under consideration. Before committing the country's limited resources (foreign exchange and skilled labor) to any degree of mechanization of cotton picking, there is a need to explore the availability and better ways of utilizing existing labor potentials. The emphasis in this study will be from the tenant household perspective: labor availability and utilization, the role of men,

women, and children in cotton picking, the role of family versus hired labor and the possibilities of increasing family labor input in cotton picking as an alternative to make up for the possible decline in seasonal labor.

4. Problem Definition

The single most labor demanding cotton operation is picking. It has been estimated that 57% of the total cotton labor requirements are allocated to cotton picking (1). On the assumption of one picker per feddan (a rule of thumb followed by cotton scheme managers in the Sudan), cotton picking requires around one million pickers at the national level - namely farmers and seasonal agricultural laborers. This means that about 14 percent of the country's labor force is demanded at a critically short period of time of 2-3 months.[3] The time factor is especially more pressing for projects like New Halfa and Rahad Corporations which grow the middle staple cotton varieties with shorter picking seasons.

Part of the cotton picking labor is supplied by tenants and their families. The major source of labor supply, however, is hired labor - mainly migrant laborers coming from other areas in the same province or from different

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[3]This estimate is based on the broader definition of labor force which includes all persons producing goods and services for the market whether full time or part-time. On this basis the labor force is estimated at 7.32 million. (See ILO's Growth, Employment and Equity, Geneva, 1976).

provinces. An important segment of migrant labor are the nomadic tribes to whom cotton picking is a source of income and its debris provides grazing material for their livestock. Beside migrant hired labor, there are local hired landless laborers residing within these schemes who have originally migrated from other relatively more depressed regions.

Although the labor requirements and supply for cotton picking are of crucial importance for the cotton production corporations and tenants alike, very limited empirical studies, if any, have been made in this regard to furnish information for policy makers. For instance, in New Halfa Corporation (to which this study is confined) no studies have been made so far to:

(a) Estimate the labor requirements per feddan at different yield levels.

(b) Estimate tenant household labor force available during the picking season, the relative contribution of men, women and children and the factors affecting the supply of these categories of labor.

(c) Estimate the magnitude of the contribution of hired labor and the cost of picking by hired labor.

Such information is crucial in order for policy makers to be able to:

(i) predict the supply of and demand for picking labor in the face of government policy which aims at expanding the area under cotton and increasing yield per acre in

existing cotton area;

(ii) predict the impact on New Halfa Agricultural Corporation of existing and future projects which might absorb some of the existing migrant hired labor;

(iii) compare the cost of and the benefits from hand picking vis-a-vis mechanical picking which is considered as an alternative at least in the long run.

It is hoped that this study will provide insight into the nature and potential of the tenant household labor supply and its utilization and labor requirements for cotton picking.

5. The New Halfa Agricultural Project

(a) A Historical Background[4]

This study was conducted in New Halfa Agricultural Project, the largest project in Kassala Province and a major agricultural scheme in the Sudan, second in size only to the famous Gezira Scheme. The project was established between 1964 and 1969. Although the project idea was contemplated long before that, the final decision was prompted by the construction of Aswan High Dam in Egypt. The Aswan High Dam was a result of the 1959 Nile Waters Agreement between Egypt and the Sudan which superceded the 1929 Nile Waters Agreement. The construction of the Aswan High Dam meant that about 170 kilometers long of lands along the Nile inside the Sudan would be under water permanently. This includes Wadi Halfa area.

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[4]See map in Appendix 1.

About 50,000 Halfawis had to be relocated elsewhere and Khashm El Girba area was chosen as the appropriate site for the resettlement.

Other objectives which the project was designed to fulfill were:

(1) Settlement of the Nomadic tribes who used to enjoy grazing and cultivation rights prior to the project. Through increasing the incomes and provision of improved social services, the project was expected to transform their social and economic conditions from those of pastoral communities to settled and more advanced agricultural ones.

(2) Increasing national income and foreign exchange earnings by growing cotton and groundnuts.

(3) Promoting self-sufficiency in wheat and sugar cane. The latter is grown in a plantation separate from the New Halfa Agricultural Corporation.

(4) Utilizing Atbara River water which, until 1964, was more or less wasted.

(5) Proper utilization of the fertile project area which was part of the "Butana", a grazing land used by nomads for livestock grazing (23).

(b) Size of Project and Crops Grown

The total area which is supposed to be cultivated by the New Halfa Agricultural Corporation annually is 330,000 feddans equally divided between medium staple cotton (Accala 4/42), groundnuts and wheat. In addition, 25,000

feddans are designated as freehold land to Halfawi people as a compensation for their agricultural lands submerged by the Aswan High Dam water (35). In practice, however, not all potential area is utilized. For any one season the actual area under any of the three crops is usually below the potential area. This can be seen in Table 3 for 1977/78 season.

It can be seen from the table that the highest percentage area under crop is reached in the case of cotton. One important explanation for this is that cotton is a joint venture between the corporation and the tenants. For this reason, the corporation exerts great efforts to make sure that as much as possible of the cotton area is planted. This is in contrast to groundnuts and wheat which are the tenant's crop.

The 1977/78 New Halfa Agricultural Corporation annual report mentioned several reasons for failure to have all the area under crop. In the case of cotton, reasons mentioned included failure to carry out tillage operations and planting in time due to shortage in petroleum needed for operating tractors, and the incidence of heavy and continuous rains. Also mentioned was the fact that some farmers refrained from planting their fields because they did not get the rest of their share from the 1975/76 cotton proceeds.

The reasons behind the 44% fallow in groundnuts area were:

TABLE 3

Planned and Actual Area Under Crop in Feddans in New Halfa Agricultural Corporation in 1977/78 Season

Crop	(1) Alloted Area	(2) Area Under Production	(2) as percent of (1)
Cotton	110,000	98,000	90
Groundnuts	110,000	62,030	56
Wheat	110,000	71,720	65
TOTAL	330,000	232,550	70

Source: Public Agricultural Production Corporation, Annual Report for 1977/78 Season (in Arabic), (Khartoum [1978]).

(1) High cost of production and the weak financial position of most tenants. Since it is a private tenant crop, the corporation does not extend any credit services.

(2) Heavy infestation of weeds and shortage of hired labor.

(3) Some farmers from the Nomadic tribes were not available at the time of planting of groundnuts. They were in a state of seasonal migration in search of grazing for their livestock.

(4) Shortage of seeds.

(5) Shortage of agricultural machinery needed for tillage operations.

(6) Shortage of fuels.

(7) Low productivity plus marketing problems created a disincentive effect among farmers.

The most important problems behind failure to grow the entire wheat area were:

(1) Shortage in fuels and agricultural machinery.

(2) Heavy infestation of weeds which compete with the crop for nutrients and water and obstruct the flow of water in the canals.

(3) Farmers in the Halfawi tribe pay special attention to wheat since it is their staple crop. This is not the case for the Nomads who regard wheat as imposed upon them, their staple crop being sorghum.

(c) Tenants

There are 22,367 tenants with more or less a corresponding number of land holdings (tenancies). Not all the tenancy holders reside in the project area. At the beginning of the project in 1967, absentee percentage was 40%. By 1975, the percentage dropped to 25% due to off-farm employment opportunities created within the area (35). This is especially so in the case of Halfawi. As for the Nomadic tribes, both agriculture and pastoralism are maintained, each one reinforcing the other. For instance, the money received from selling animals is used in hiring labor in the fields, and the money received from the tenancy is reinvested in building up the herd (37).

(d) The Size of the Tenancy

The tenancy is 15 feddans in size. A tenancy of this size is considered adequate to provide income for and be managed by a typical tenant household. According to the laws governing the New Halfa Agricultural Corporation, a tenancy is the agricultural unit upon which the crop rotation is based. A tenant is the person to whom a part or a whole of a tenancy is allocated in accordance with the Agricultural Agreement prevailing at the time of allocation (33). The tenancy is divided between the three crops as follows: 5 feddans cotton, 5 feddans wheat, and 5 feddans groundnuts. Plots of the same crop belonging

to different tenants are grouped into larger units to facilitate irrigation and other agricultural operations such as the application of insecticides.

(e) Rotation, Crop Intensity and Competition Among Crops

On the same piece of land, the three crops are grown in the following succession: cotton-wheat-groundnuts at the rate of one crop per season. Unlike the Gezira system, no fallow was allowed and as such it was supposed to result in a more efficient land use. However, after fifteen years of experience, the absence of fallow proved to have serious negative effects by encouraging obnoxious weeds.

To reduce the conflict over labor, machinery, and irrigation requirements, and to satisfy the climatic requirements for each crop, ideally the three crops are supposed to be planted and harvested according to the schedule in Table 4.

Since wheat is largely mechanized, no serious competition exists with other crops over labor. Competition over labor exists between cotton and groundnuts. One important conflict occurs in October when both crops require labor for weeding. Another conflict may occur in January and February when delayed threshing of groundnuts coincide with cotton picking. This conflict is intensified the more groundnuts planting is delayed, increasing

its overlap with land preparation for cotton, and reducing the time between groundnuts planting and cotton planting.

TABLE 4

Planting and Harvesting Dates for Crops in New Halfa Corporation

Crop	Recommended Date of Planting	Recommended Date of Harvesting
Cotton	8/1 - 8/25	1/15 - 3/31
Wheat	10/15 - 11/1	5/10
Groundnuts	6/15 - 7/15	11/15 - 1/15

Source: The New Halfa Agricultural Corporation.

(f) Management-Tenants Relationships

The New Halfa project is a joint venture between the government and the tenants. The tenant is supposed to provide labor and supervision. The government provides the irrigation facilities, administration of the scheme, agricultural services, including mechanization of certain agricultural operations, ginning, transportation and marketing of cotton. The management of the project is undertaken by the New Halfa Agricultural Corporation which was established with the following purposes in mind.

(1) To initiate agricultural reform in the project and the development and improvement of the natural resource endowments within the project boundaries on commercial basis and following scientific methods to ensure such use of these resources as will maximize social and economic benefits. The scope of operation should not be confined to the production of raw materials alone but also include the industrialization of agricultural products.

(2) Besides carrying on the general obligations, the Corporation should undertake the following responsibilities:

(a) Planning and formulation of the policy on sound technical, and social grounds.

(b) Investigating the possibility of expansion of production by adding more land to the project if such expansion proves to be in the national interest.

(c) Undertaking any measures which will help accomplish the above mentioned responsibilities (33).

The management of the corporation exercises supervision over tenants to see to it that they fulfill their obligations. Those who repeatedly fail to do so can be evicted. In practice, however, this is not easy to do due to pressure from farmers' organizations. In the few cases where eviction was carried out, the tenancy was assigned to someone in the same family.

(g) The Distribution of Costs and Benefits Between the Tenants and the Corporation

According to the agreement between the tenant and the Corporation, share cropping applies only to cotton. Wheat and groundnuts belong to the tenant who is supposed to pay the Corporation the cost of services it renders for the production of wheat and groundnuts. In the past, this provision of the agreement was not enforced, i.e. tenants were subsidized on the grounds that they needed some time to establish themselves. The management of the Corporation believes that as a result of this, farmers pay more attention to groundnuts and wheat and less to cotton. The Corporation recently has decided to stop these subsidies in an attempt to correct price distortions. Such an action is believed to result in reallocation of labor and other resources in favor of cotton. The result, however, will not only depend on how much tenants are going to be paid for cotton relative to wheat and groundnuts, but also when paid. At present, due to marketing policy, tenants get paid for their cotton crop over a period of at least two years whereas for wheat and groundnuts, they are paid immediately.[5]

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[5]The marketing of cotton is undertaken by the Agricultural Production Corporation (the parent corporation of New Halfa Agricultural Corporation) through the Cotton Trading Corporation. The latter sells cotton in the

The proceeds from cotton are distributed between the tenants and the Corporation according to a certain formula. After deducting from the gross proceeds certain costs items which are agreed upon as "general joint cost" and "individual joint cost," 2% is to be deducted for the Tenants' Reserve Fund and 2% for financing Local People's Councils. The remainder would be divided equally between the Corporation and the tenants. The Corporation's share represents its returns to the services provided to the farmers and the administration of the Corporation. The tenants' share is divided between the tenants in accordance with the amount and quality of cotton produced by each tenant. Cost of operations particular to each tenant are then deducted from his share and the remainder represents income to his family labor and/or capital (in case the farmer uses hired labor) (33).

6. Objectives of the Study

In order to study labor requirements and supply for cotton picking in New Halfa Agricultural Corporation, the starting point should be to estimate the potential and actual tenant family labor supply for cotton picking and factors affecting it. Then an assessment of the

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international market. Groundnuts are sold by tenants to representation of companies in Wadi Halfa, wheat is sold by tenants to the flour mills in New Halfa.

contribution of hired labor is needed to find out to what extent hired labor supplements family labor in cotton picking and at what cost to the tenant. Due to the interdependence of cotton schemes in the Sudan with respect to cotton picking labor, an assessment of the supply of and the competition for labor for harvesting cotton and other major crops at the sectoral level is in order. Such plan of study will allow a better understanding of the problem and hence, more relevant policy recommendations can be made.

This study has been undertaken with the following objectives in mind:

1. Tenant Household Labor Supply:

(a) To determine the socio-economic characteristics of tenant households.

(b) To estimate the potential and actual utilization of tenant household labor in cotton picking in 1977/78 season.

(c) To estimate the labor supply functions for households labor in cotton picking disaggregated into men, women and children.

2. Labor Requirements and Supply:

(a) Estimating labor requirements for cotton picking at different yield levels.

(b) Estimating potential labor supply and requirements for harvesting cotton and major competing crops.

3. Hired Labor Supply and Cost:

(a) The contribution of hired labor to cotton picking.

(b) Cost of picking by hired labor.

4. Implications for policy and future research.

CHAPTER II

RESEARCH METHODOLOGY

This chapter reviews the analytical procedures, the sources of data and the survey design followed in exploring the objectives described in Chapter I (pp. 21-22). Throughout this analysis the population is divided into two subgroups: The Halfawis and the Nomads; and the analysis is made accordingly.

Analytical Procedures

In what follows, analytical procedures which will be used to pursue each objective, are described briefly.

Objective 1: Tenant Household Labor Supply

(a) Socio-economic characteristics of households.

(b) Estimating the potential family labor and actual utilization by tenant households in cotton picking in 1977/78 season.

Descriptive analysis (e.g. means, frequency, distributions, tables, etc.) will be used to analyze this objective. Features of that analysis are as follows:

(1) Age and sex structure of the sample population. Family size, sex ratio and dependency ratio.

(2) Participation of men, women, and children in the labor force.

(3) Occupational distribution of the labor force by age and sex with special reference to agriculture.

(4) Educational attainment of men, women and children.

(5) Number of hours of work spent on cotton picking by men, women, and children and quantity of cotton picked. Comparison of actual hours spent on cotton picking with potential hours available.

(6) Aggregation of labor input using a common denominator.

(c) Estimating labor supply functions of household men, women and children.

A regression analysis is used to show the factors influencing the labor supply of tenant household labor. Because the labor supply decisions of household members are interrelated, labor supply functions are estimated for the household as a decision unit. Labor supply functions are estimated separately for men, women, and children because the level of participation, intensity of work and roles assigned to these categories differ greatly. Hours worked in cotton picking are used as dependent variables. Independent variables, include opportunity wages for men, women and children separately estimated, net income from cotton, groundnuts and wheat respectively, education, number of younger children, number of older children, number of men, women and

children in the labor force category. The detailed description of the model and presentation and discussion of the results is the subject of Chapter IV.

Objective 2: Labor Requirements and Supply

(a) Labor requirements for cotton picking per feddan at different yield levels. A common denominator will be developed to be able to add different categories of labor (family and hired labor disaggregated by age and sex) used by the household.

(b) Estimating potential labor supply and requirements for harvesting of cotton and major competing crops.

(1) Using estimates of labor requirements for cotton picking estimated in objective 3, and labor requirements for harvesting other competing crops available from other studies, an estimate will be made of the amount of labor units required for picking cotton and other competing crops at the sectoral level assuming existing yield levels.

(2) These estimates will be based on the six-year plan's assumptions of areas and yields.

(3) Using the population census results of 1973, the agricultural labor force for each major agricultural region will be projected to estimate the potential agricultural labor supply.

(4) Potential labor supply will be compared with labor requirements for cotton picking and harvesting of

other crops overlapping with cotton picking. This will be done for each region to see which regions are likely to be deficit or surplus in labor.

Objective 3: Hired Labor Supply and Cost

(a) Contribution of hired labor to cotton picking.

(b) Cost of picking by hired labor.

(1) Number of hours of hired labor used per household by age and sex.

(2) Hiring arrangements and wages.

(3) Sources and ways of recruiting hired labor.

(4) Degree of dependence on hired labor.

(5) Hired labor used by households for activities competing with cotton picking.

(6) Tenants' opinions on the problem of shortage of hired labor.

(7) Cost of picking by hired labor.

Objective 4: Implications for Policy and Further Research

a. Implications for Policy

Knowing how much household labor is utilized in cotton picking compared to the potential will give an idea about the amount of under-utilized family labor which could be induced to participate in cotton picking, given the appropriate incentives. These appropriate incentives would be designed taking into consideration the factors which influence labor supply of household members. The elasticity of labor supply with respect to various policy

variables, as estimated from the labor supply functions of men, women, and children will be useful in this respect. For instance, it would be possible to predict the effect of an increase in income from cotton on labor supply of men, women, and children other factors being equal. The same could be made for groundnuts and wheat. As the analysis of the supply function in Chapter IV may show, income is an important policy variable. It is a function of quantity produced and prices received by farmers - both are very much influenced by government policy.

(2) This study would also show the extent of competition for labor between cotton picking and other competing activities related to wheat and groundnuts. It would also show how much labor could be made available for cotton picking by changing the timing of these operations or by performing these operations mechanically.

(3) The study would identify regions of deficit labor supply and regions of surplus labor supply as far as cotton picking is concerned. Policies concerning the mobilization of seasonal labor from surplus to deficit regions will be discussed and recommendations will be made.

b. Implications for Further Research

A discussion of some of the interesting aspects of labor supply for cotton picking not covered by this study will be made. A research agenda of the important topics which need follow-up will be proposed.

Sources of Data

(1) The Sample Survey

A sample survey was carried out to obtain primary data by direct interviewing of a sample of tenant household heads. The data collected in this survey included, among others, information on demographic characteristics of tenant households, family and hired labor input in cotton picking and other wheat and groundnut activities overlapping with cotton picking, estimate of net income from cotton, groundnuts and wheat.

(2) Annual reports of the New Halfa Agricultural Corporation.

(3) Interviews with officials of the New Halfa Agricultural Corporation and other relevant bodies and groups in the area.

(4) Some documents covering the development stage of the project, historical background and problems.

(5) Regulations governing the sharing arrangements between the government and the tenants.

(6) Sudan Second Population Census 1973.

(7) Miscellaneous reports and papers.

The Population

The population of study consists of the 23,367 tenant households which comprises the tenant population of New Halfa Agricultural Corporation. For all practical purposes, this population could be divided into two subgroups: The Halfawi group which consists of 6,553 households

(29%), and the Nomadic group which consists of 15,814 households (71%).[1] The Halfawi inhabit 25 planned villages. The Nomadic tribes inhabit 57 emergent villages, 15 traditional Nomadic villages and numerous seasonal Nomadic villages (1).

The choice of the tribal variable as a stratification factor is justified by the fact that major differences exist between the two subgroups in their ethnic and cultural backgrounds, their attitude towards farming and their dependence on hired labor.

Sampling Design

The choice of any sampling design is influenced by two major considerations:

(1) The desire to avoid bias in the selection procedure;

(2) to achieve maximum precision for a given outlay of resources (8).

Bearing these principles in mind, multi-stage sampling was chosen as the appropriate design for the following reasons:

(1) As mentioned earlier, the population was scattered over a large number of villages within and outside the project. The roads were rough and telephone communications

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[1]These households belong to the following subtribes: Shukria (7089), Beja (2201), Lahawyeen (2290), Ahamda (1089), Khawalda (443), Kawahla (1003), Northern Province tribes (1014) and Rashida (685).

were lacking.

(2) There was a severe gasoline shortage and strict gasoline rationing was in effect throughout the survey period which meant that movements had to be limited and therefore carefully planned.

(3) The picking period was a short one, 2-3 months, and for logistic reasons, we could not visit a tenant more than once, which meant we had to restrict our visits to the period around the end of picking.

Stratification of tenant villages was made after extensive discussion with the agricultural manager of the corporation and other informed officials. The stratification of villages, the villages chosen at random to represent each group of villages and the number of households interviewed in each representative village can be referred to in Appendix II.

The Halfawi villages were divided into two major categories. One category consisted of those villages where the management of the tenancy is undertaken by a cooperative on behalf of the tenants. The second major category consisted of villages where management of tenancies was undertaken by individual tenants. The second category was further stratified into two strata. One stratum consisted of those villages with high percentage of absenteeism among tenants and/or tenants having off-farm activities as main occupations. The second stratum consisted of villages with low percentage

of absentee tenants and/or low percentage of tenants with off-farm activities as main occupations. This stratum was further subdivided into two sub-strata. One sub-strata consisted of villages characterized by low levels of participation by households in cotton picking. The second sub-strata consisted of villages characterized by high levels of participation by households in cotton picking.

The Nomadic villages were divided into two major categories. One category consisted of those villages where main emphasis was on crop production even though livestock were raised. The second category consisted of villages where the main emphasis was on livestock, crop production being mainly a subsidiary occupation. The first category was further divided into two groups. One group of villages consisted of those where picking was undertaken mainly by the household. The second group of villages consisted of those where picking was undertaken mainly by hired labor.

Following stratification, 5 and 8 villages were chosen at random to represent the Halfawi and Nomadic populations, respectively. The number of tenants to be interviewed from each village was more or less proportional to the relative weight of the particular group of villages represented by the respective village. For each village a list of tenants was obtained from the agricultural inspector in charge of that village. Then

a systematic random sample of tenants was chosen for interviewing.

The Size of the Sample

As a trade-off between cost-minimization and precision, a sample of 150 tenant households was originally planned for 50 Halfawis and 100 Nomads.

The actual number interviewed was 132 households (48 Halfawis and 84 Nomads). One problem which had to be faced during the survey was the problem of non-response due to absence, which was more common, or reluctance to cooperate (only one case). To overcome this problem, the systematic random sample in each village was increased to begin with. The increase was 50% in Halfawi villages and 100% in Nomadic villages since the latter are more mobile. Well-informed members of households are also interviewed on behalf of absent household heads.

Interviewers and Method of Interviewing

The interviewing was made by the writer assisted by two recent graduates of the faculty of Agriculture, University of Khartoum. The interviewers were selected and prepared in advance for the interview. Each respondent was interviewed once. Nevertheless, the method was relatively effective because the data collected pertained to one activity only: cotton picking, which

happened to be the last activity undertaken or supervised by the tenant and therefore it was easy for the tenant to recall the events. A sample of the questionnaire can be referred to in Appendix III.

CHAPTER III

SOCIO-ECONOMIC CHARACTERISTICS AFFECTING TENANT HOUSEHOLD LABOR FORCE POTENTIAL AND UTILIZATION IN COTTON PICKING IN NEW HALFA CORPORATION

This chapter deals with the socio-economic characteristics of the tenant households in the two distinct settlements in as far as these characteristics affect the labor force size and participation rates. An attempt will be made to estimate how much of the tenant household labor force is available at the time of cotton picking and how much is actually used.

Socio-Economic Characteristics of Household Heads

Definition of Household and Household Head

For the purpose of this study, a tenant household applies to those members of a family who live and eat together and who are assigned a tenancy in New Halfa Agricultural Project. A household head is the decision-maker on all matters affecting the well-being of the family. Usually, the tenancy is registered under his name.

Age Distribution and Sex Composition of Household Heads

Table 5 presents the distribution of household heads interviewed by age and sex. The Table shows that there is only one household head below 15 years of age and no household head above 65 years of age. The majority of household heads (79 percent for Halfawis and 77 percent for Nomads) are between 25 and 54 years of age. Furthermore, the Table shows that males dominate females as heads of households and that the proportion of female to male household heads is greater for Halfawis than for Nomads. In either case, female household heads tend to be in or above middle age, which may suggest that they have assumed the responsibilities of taking care of their families after losing their husbands due to death or divorce.

Marital Status and Relationship of Household Heads to Other Household Members

Table 6 shows marital status of household heads. It can be seen that the overwhelming majority of heads of households are married, the highest percentage being among the Nomads (95 percent for Nomads compared to 82% for Halfawis). Another interesting point to be noticed is the low level of divorce among household heads which is one in the Halfawi sample and none in the Nomadic sample.

An important characteristic of the family is the

TABLE 5

Distribution of Household Heads* By Ethnic Group, Age and Sex

Age Category	Halfawis		Nomads	
	Males	Females	Males	Females
Less than 15	0	1	1	0
15 - 24	4	0	4	0
25 - 34	9	0	11	0
35 - 44	13	2	27	0
45 - 54	12	1	18	0
55 - 64	3	2	11	1
65 +	0	0	0	0
TOTAL	41	6	72	1

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Sample Survey on Labor Requirements and Supply for Cotton Picking.

*12 heads of households are excluded due to missing data.

TABLE 6

Distribution of Households Heads
in Halfawi and Nomadic Sub-Samples
According to Marital Status

Marital Status	Halfawis		Nomads	
	Number	Percent	Number	Percent
Married	39	81.6	78	95.1
Single	3	6.1	2	2.4
Divorced	1	2.0	--	----
Widowed	5	10.2	2	2.4
TOTAL	48	100.0	82	100.0

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Sample Survey on Labor Requirements and Supply for Cotton Picking.

type of relationship which existed between the household head and the members of the household. Table 7 depicts these relationships. It could be noticed from this Table that although the population of the sample households is dominated by sons, daughters, and wives, the list includes 15 other relationships, which explains the existence of the extended family system. This is especially the case for the Nomadic sample which is also characterized by a relatively higher average family size.

Distribution of Household Heads by Educational Attainment

Education, being an important form of investment in human capital, is an important characteristic of household heads. Education increases awareness of individuals with alternatives, facilitates learning and adoption of new ideas and increases productivity of human capital. As far as tenants were concerned, education is an important medium through which information can be obtained that will help the tenant improve his decision making process.

Table 8 shows the distribution of household heads according to the level of education. It can be seen that 81 percent of the Halfawis and 90 percent of the Nomadic household heads are illiterate. It can also be seen that all female household heads in both tribal groups are illiterate. Most of the Halfawi heads of households interviewed who were educated received

TABLE 7

Distribution of Family Members
in the Halfawi and Nomadic Sub-Samples
According to Relationship to Household Head

Relationship to Household Head	Halfawis	Nomads
Wives	41	85
Sons	54	174
Daughters	54	202
Fathers	3	11
Mothers	12	26
Grandmothers	0	4
Grandsons	1	7
Husbands	0	1
Wives of Sons	0	3
Nephews	0	3
Sons' Daughters	0	1
Uncles	0	3
Brothers' Wives	0	2
Brothers' Sons	0	3
Cousin	0	1

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Sample Survey on Labor Requirements and Supply for Cotton Picking.

TABLE 8

Distribution of Household Heads in the Halfawi and Nomadic Sub-Samples by Formal Educational Attainment

Years of Schooling Attained	Halfawis		Nomads	
	Males	Females	Males	Females
0	34	6	72	1
1	--	--	4	--
2	--	--	--	--
3	1	--	2	--
4	4	--	2	--
5	1	--	--	--
6 - 11	--	--	--	--
12	2	--	--	--
13 - 15	--	--	--	--
16+	1	--	--	--

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Sample Survey on Labor Requirements and Supply for Cotton Picking.

between three and eleven years of education, with one receiving more than 16 years of education. Of those Nomadic household heads who received education, the longest formal educational experience was four years. These facts more or less reflect the prevalence of illiteracy in the rural areas and point to the need to educate farmers so that they may improve their decision making pertaining to crop production as well as other matters affecting the well being of their households.

Socio-Economic Characteristics of Households

Age and Sex Distribution of Sample of Households

An attempt was made to estimate the size and characteristics of the population of the New Halfa Agricultural Corporation, using the data obtained from the sample survey.

Table 9 presents the age and sex distribution of the households in the two subsamples. The total population of the Halfawi sample is 237 persons. The sample from the Nomadic tribes consists of 647 persons. A common characteristic of the two subsamples is the fact that, overall, females are slightly in excess of males. This is particularly clear in the 20-29 age categories in the Halfawi group and 20-34 age categories in the Nomadic group. In case of Halfawis, this could be

TABLE 9

Distribution of Households in the Halfawi and Nomadic Sub-Samples by Age and Sex

	Halfawis				Nomads			
Age Group	Males	Females	Number	%	Males	Females	Number	%
0 - 4	5	11	16	7	40	67	107	17
5 - 9	19	20	39	16	70	71	141	22
10 - 14	14	14	28	12	57	50	107	17
15 - 19	17	14	31	13	30	25	55	8
20 - 24	5	8	13	5	12	26	38	6
25 - 29	4	10	14	6	11	16	27	4
30 - 34	7	6	13	5	9	19	28	4
35 - 39	9	7	16	7	14	15	29	4
40 - 44	4	7	11	5	12	12	24	4
45 - 49	7	8	15	6	8	3	11	2
50 - 54	7	3	10	4	12	7	19	3
55 - 59	4	2	6	3	6	5	11	2
60 - 64	0	5	5	2	8	9	17	3
65 - 69	3	3	6	3	6	2	8	1
70 - 74	2	5	7	3	7	3	10	1
75 +	4	3	7	3	6	9	15	2
Total	111	126	237	100	308	339	647	100

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Sample Survey on Labor Requirements and Supply for Cotton Picking.

attributed to the migration of young men to urban areas for education (since no schools above high school level are available in the area) or work. As for the Nomads, the raising of livestock requires that some members of the household stay with livestock off the scheme most of the time in search for grazing and water. As part of the division of labor in the household, looking after the herds is usually the responsibility of young men within the household.

Demographic Characteristics of the Samples

Table 10 shows some demographic characteristics of the two samples. The sex ratios for the two groups and the proportion of males in both is a further illustration of the excess of women over men. An interesting statistic is the high proportion of children (0-14) in the population which is a typical characteristic of populations in developing economies. However, the Nomadic population is characterized by a markedly higher proportion of children compared to the Halfawi population. The proportion was 55% for the Nomads and 35% for the Halfawis. According to the 1973 provisional population census figures, the proportion of children in the rural settled and rural Nomadic population of Northern Sudan is 47% (13).

Table 10 also shows a comparison between the proportion of the economically active members of the two groups.

TABLE 10

Demographic Characteristics of the Households in the Halfawi and Nomadic Sub-Samples

Characteristic	Halfawis	Nomads
(1) Sex Ratio: $\frac{\#\text{ of Males}}{\#\text{ of Females}} \times 100$	.88	.91
(2) Proportion of Males	47%	48%
(3) Dependent Children (0-14)	83	335
% of total population	35%	55%
(4) Active Population (15-64)	134	259
% of total population	56.5%	40%
(5) Dependent Aged (65+)	20	33
(6) Dependency Ratio: $\frac{(3) + (5)}{(4)} \times 100$	.77	1.5
(7) Average Family Size	4.9	7.7

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Sample Survey on Labor Requirements and Supply for Cotton Picking.

Economically active members are those in the 15-64 age categories (excluding disabled) who represent the potential labor force. It is clear from the Table that the Halfawi have a higher potentially economically active population than the Nomads mainly due to the relatively lower proportion of children compared to the Nomadic population. This fact is also reflected in the lower dependency ratio for Halfawis which is half that for the Nomads.

The average family size for the Halfawis is in line with the average household in the rural population of Kassala Province (the province to which the New Halfa Agricultural project belongs) as revealed by the 1973 Second Population Census. According to the census, the average rural household size in Kassala Province was 4.82 (compared to 4.9 for Halfawis obtained in the survey). The family size for the Nomads is relatively high compared to that for the Halfawis. But again, that is typical of populations with relatively high ratio of children.

Participation Rates by Age, Sex, and Tribal Group

An important measure of the degree of involvement by individuals or groups in economic activities is the participation rate. This is calculated as the percentage of people in a specific labor force category who are

involved in activities oriented towards the market.

There are problems concerning the definition of economically active persons. First, there is the question of the lower age limit. Although the age of 15 is universally considered to be the age of entry in the labor force, it is common for children in developing countries, in the absence of laws prohibiting child labor and lack of educational facilities, to enter the labor force well below 15. Secondly, whether (1) to include in the labor force only those with economic activity as their main occupation or also (2) to include, in addition, those who participate in economic activity as a subsidiary occupation. The first definition is more restrictive than the latter and will result in a lower participation rate. This definition was followed in both the 1955/56 Population Census of the Sudan and the 1973 Population Census. The danger from using that definition is that it excludes from the labor force such important categories as women and students whose main activities are not classified as economic ones but who nevertheless participate in economic activities part-time. The second definition seems to be more reasonable. However, unless a minimum level of participation in the labor market is specified, there is a danger of inflating the participation rates by including persons whose contribution to the labor force is marginal.

Table 11 presents participation rates estimated from

TABLE 11

Participation Rates in the Halfawi and Nomadic Sub-Samples by Age and Sex (Percentage)

Age Group	Male Participation Rates		Female Participation Rates	
	Halfawis	Nomads	Halfawis	Nomads
10-14	0	63.2	0	40.0
15-24	27.3	81.0	25.0	51.0
25-34	81.8	95.0	37.5	60.0
35-44	92.3	100.0	35.7	63.0
45-54	100.0	100.0	36.3	50.0
55-64	100.0	57.0	28.5	21.0
Average	79.7	80.0	32.8	50.3

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Sample Survey on Labor Requirements and Supply for Cotton Picking.

the survey of the sample of farmers in New Halfa Agricultural Corporation by age and sex. The definition of the labor force adopted here is the broader one, which includes all individuals engaged in economic activity whether as a main or subsidiary occupation.

It is clear from this table that men have much higher participation rates than women. It is also clear that while average participation rates for males in the two tribes are comparable, the participation rates for females differ substantially between the two ethnic groups, the Nomadic group being higher than the Halfawi group.

Comparing these figures with the participation rates for rural Kassala Province obtained from 1973 Population Census reveals marked differences. The 1973 Population Census figures reported a participation rate of 91.1 percent for males in rural areas of Kassala Provinces compared with averages of 79.7 and 80 percent for Halfawis and Nomads, respectively, as can be seen from Table 11. The difference is even greater in case of females, with the census reporting 8 percent for women in rural Kassala compared to 33 and 50 percent for Halfawis and Nomads, respectively.

However, apart from the general trends of participation rates, the two sets of data are hardly comparable. The census figures refer to all the rural population of Kassala while the tenant household sample survey, at best, represents the tenants of New Halfa Project which

is only a fraction of the rural population of Kassala Province. Moreover, the 1973 census adopted the restricted definition of participation rate while this study followed the broader definition of the labor force.

Distribution of the Labor Force by Occupation

To examine the occupational distribution of the labor force in the household sample survey, reference is made to Table 12. The table shows the number of persons engaged in economic activities either as primary or subsidiary occupation. Double counting should be expected since some people may have more than one economic activity.

The table shows that there are 21 economic activities represented in this sample either as primary, secondary or both. It could be seen that farming is the single most important activity. This is no surprise in this farming area. Another interesting observation is the fact that apart from crop production, 17 other occupations are reported in the Halfawi sample compared to only 4 in the Nomadic sample. In fact, 56% of those who reported primary economic activities had non-agricultural pursuits as their main occupations compared to only 10% in the Nomadic group. One important explanation for this difference in range of economic activities between the two groups is the level of educational attainment. The survey revealed that the number of Halfawi males who

TABLE 12

Occupational Distribution of the Labor Force in the Halfawi and Nomadic Samples by Sex

Occupation	Halfawis				Nomads			
	Males		Females		Males		Females	
	Primary	Subsidiary	Primary	Subsidiary	Primary	Subsidiary	Primary	Subsidiary
Farmer	19	16	2	19	93	13	3	67
Herdman	--	--	--	--	9	1	--	--
Teacher	3	--	--	--	--	--	--	--
Clerk	3	1	--	--	--	--	--	--
Guard	1	1	--	--	--	--	--	--
Flour Mill Worker	1	--	--	--	--	--	--	--
Contractor	1	--	--	--	--	--	--	--
Merchant	1	--	--	--	--	1	--	--
Mason	1	--	--	--	--	--	--	--
"Samad"[1]	--	1	--	--	--	--	--	--
Coffee Shop Owner	1	--	--	--	--	--	--	--
Water Supply Worker	--	--	--	--	1	--	--	--
Insurance Employee	1	--	--	--	--	--	--	--
Secretary	1	--	--	--	--	--	--	--
Professor	1	--	--	--	--	--	--	--
Administrator	1	--	--	--	--	--	--	--
Other non-agricultural white-collar workers	2	--	--	--	--	--	--	--
Other blue-collar workers	3	--	--	--	--	--	--	--
Agricultural Laborers	1	--	--	--	--	--	--	--
Drivers	2	--	--	--	--	--	--	--

Table 12 - Continued

Occupation	Halfawis				Nomads			
	Males		Females		Males		Females	
	Primary	Subsidiary	Primary	Subsidiary	Primary	Subsidiary	Primary	Subsidiary
Midwives	--	--	--	--	--	--	--	1
Total	43	19	2	19	103	15	3	68

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Sample Survey on Labor Requirements and Supply for Cotton Picking.

[1]Samad is a tenant appointed by the management on a part-time basis as a liaison between management and farmers. His main concern is to supervise the distribution of water among tenants.

attained any level of education is 48%. The corresponding figure for the Nomads is 16%. It is clear that education is a necessity for most of these occupations and therefore the Halfawis have more employment options than the Nomads. Many Halfawis engaged in off-farm activities still keep tenancies as a part-time business. Some are members in village agricultural cooperatives. These cooperatives are run by management hired by tenants to supervise on their behalf all the operations using hired labor and machinery.

The range and types of economic activities differ as between men and women. Men are involved in a wider range of economic activities than women. This can largely be attributed to the lack of education among women in both groups. The survey revealed that for those households included in the survey, the degree of illiteracy among Halfawi and Nomadic adult women is 100%. Another characteristic of female employment which is dissimilar to that of males is that the majority of women who participate in the labor force are engaged in economic activity as a subsidiary activity. In the absence of institutions for child care (which are present in some urban areas but on a limited basis) and the large proportion of dependents in the household, domestic activities represents the main occupation for the majority of women.

Participation of Household Members in Cotton Picking

One of the important objectives of this survey was to estimate the amount of family labor allocated by the tenant household to cotton picking in their own holdings. Table 13 summarizes household labor input in cotton picking.

Although ideally cotton should be picked three times, it could be seen from Table 13 that the amounts of labor inputs and cotton picked in the third picking are negligible. It could also be seen from the table that overall, a typical household in the Nomadic sample contributed much more labor and picked more cotton than a typical Halfawi household. The table also reveals that men contribute to cotton picking in both sub-groups, but the average contribution of men per household in the Nomadic sample is more than three times that of men in the Halfawi sample. The difference between the contribution of women in the two samples is even more striking with the Nomadic households' contribution exceeding the Halfawis twenty five times. As for children, no contribution was reported for Halfawi families, in contrast to the Nomadic families in which the average hours contributed by children exceeded even that of men. The lack of participation of children in cotton picking in the Halfawi sample could be explained in terms of the better educational opportunities in the Halfawi villages

TABLE 13

Labor Input (in Hours) of, and Quantity Picked (in Big Kantars* per Feddan) by Men, Women and Children in Cotton Picking per Household for Halfawi and Nomadic Sub-Samples

Activity	Halfawis				Nomads			
	Hours of Work by			Quantity Picked	Hours of Work by			Quantity Picked
	Men	Women	Children		Men	Women	Children	
First Picking	29	3.8	--	.35	104.3	95.7	114.1	6.6
Second Picking	16.6	.9	--	.35	58.3	50.8	51.7	3.8
Third Picking	.3	--	--	--	3.9	4.3	6.1	.3
Total	46	4.7	--	.7	166.5	150.8	171.9	10.7

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Sample Survey on Labor Requirements and Supply for Cotton Picking.

*A Big Kantar weighs 315 lbs. approximately.

compared to the Nomads. On the basis of crude estimates based on personal communications with some officials in the Department of Education office in New Halfa, there were around 16,600 Halfawi children attending schools in 1978 compared to 2,359 from the Nomads. Another factor which might be responsible in lowering the contribution of children in cotton picking in both settlements is the fact that during the time of cotton picking the schools are open. The only day school children can go to the field is Friday which is the weekend.

Common Denominator for Converting Labor Units

Since the nature of labor inputs differs between men, women, and children, the need arises for establishing a common denominator as a basis for comparison.

The problem of establishing a common denominator for expressing different labor units has been a subject of controversy in farm level studies in developing countries. Different approaches were suggested to deal with specific situations. Norman adopted a weighing procedure based on the assumptions that physical labor productivity is initially positively correlated with age and then negatively correlated with age, and that the physical productivity of women is lower than men. Accordingly, he assigned: small children (0.00), older

children (0.50), female adult (0.75), male adult (1.00), old male and female (.50). (30) Spencer argued that for those jobs in which women and children participate they are as equally efficient as men. For this reason women and children (less than 15 years) are converted to man-equivalents using weights of 1.0 and 0.50, respectively.(39)

The problem with both weighing procedures is that the validity of their assumptions is difficult to establish.

Spencer and Byerlee used relative wage rates to convert female and child labor to male equivalents. (38) Two assumptions were implicit in that conversion:

(1) That males, females and children were perfectly substitutable over the range of labor type combinations in the sample,

(2) That wage rates correctly reflect MVP of labor.

This approach may be a better approximation of the reality than the former ones except that in case of household labor, no explicit wage rates may be available, in which case implicit wages may have to be derived somehow.

For the purpose of this study, no explicit wage rates were reported in case of family labor. Moreover, there were hired labor involved beside family labor and there was good reason to believe that differences exist between the productivity of men, women and children as

well as between family and hired labor. The procedure followed was to ask each tenant to estimate the amount of cotton which could be picked per an 8-hour day by a man, a woman or a child for both family and hired labor. Then the family man day was used as the common denominator for the weighing of other types of labor. The result is summarized in Table 14. It could be seen from the Table that in each sex or age labor category, hired labor is more productive than family labor. This is especially so in the case of women and children. It could also be seen that for both family and hired labor there is a marked difference between the productivities of men, women and children.

Comparison of Potential with Actual Family Labor Inputs

Table 15 shows the number of household members who consider agriculture either as their main or subsidiary occupation. This represents the potential available for cotton picking. To translate this potential manpower into hours of work, the following assumptions were made:

(1) That there are three pickings, each requiring 10 days with a few days in between for irrigation of cotton and for waiting until the next bolls are ready for picking.

(2) That each person reported to have agriculture as his main occupation can allocate 8 hours of work a day

TABLE 14

Conversion of Labor Inputs by Men, Women and Children in Cotton Picking into a Common Denominator: Man-Equivalents

Labor Input Category	Household Labor	Hired Labor
Man	1.00	1.60
Woman	0.44	0.96
Child	0.20	0.43

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Sample Survey on Labor Requirements and Supply for Cotton Picking.

TABLE 15

Number of Household Members (Men, Women and Children) Who Reported Agriculture As Main or Subsidiary Occupation in the Halfawi and Nomadic Sub-Samples

Ethnic Group and Labor Input Category	Main Occupation	Subsidiary Occupation
Halfawis		
Men	19	16
Women	2	19
Children	0	7
Nomads		
Men	93	13
Women	3	67
Children	12	42

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Sample Survey on Labor Requirements and Supply for Cotton Picking.

during the period of cotton picking, six days a week. Those engaged in agriculture as a subsidiary occupation are assumed to be able to allocate a minimum of four hours per day during the same period.

(3) Hours of work were converted to man-equivalents using the conversion procedure of Table 14.

The results are shown in Table 16. It can be seen from this table that the potential man-equivalent hours per household for the nomads is more than three times that for the Halfawis. This is due to the fact that for most economically active Halfawis, agriculture is not a main occupation, while for Nomads, the majority reported agriculture as their main occupation. A more interesting point is that the Nomads achieved a higher percentage of utilization (84%) of their labor potential compared to that of the Halfawis (49%).

These statistics lead to the conclusion that, as far as the sample is concerned, the labor force engaged in agriculture in the nomadic tribes was highly utilized compared to the Halfawis where only 50 percent of the labor of those who were engaged in agriculture either as main or subsidiary occupation was used. Therefore, a very important policy objective in this regard would be to increase the labor input in cotton picking of those engaged in agriculture among the Halfawis. Another important objective should be to increase the participation

TABLE 16

Potential and Actual Family Labor Input in Hours in Cotton Picking per Household for Halfawi and Nomadic Sub-Samples

Labor Input Categories	Halfawis			Nomads		
	Main Occupation	Subsidiary Occupation	Total	Main Occupation	Subsidiary Occupation	Total
Men	32.5	40	72.5	279	19.5	298.5
Women	4.4	21	25.4	4	4.4	8.4
Children	-	3	3	5	12.6	17.6
Total	36.9	64	100.9	288	36.5	324.5
Average Potential Man-equivalent hours per household	101			320		
Average Actual Man-equivalent Hours per Household	49			268		
Actual as % of Potential	48.5			84		

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Sample Survey on Labor Requirements and Supply for Cotton Picking.

rates of those in the labor force age categories. This requires empirical knowledge of factors affecting the labor supply of men, women and children and whatever policy variables that can be introduced to increase labor supply in cotton picking. This will be the topic of Chapter IV.

CHAPTER IV

ESTIMATING LABOR SUPPLY FUNCTIONS OF TENANT HOUSEHOLD MEMBERS IN COTTON PICKING

Introduction

In this chapter an attempt will be made to estimate labor supply functions disaggregated by ethnic group, sex and age. The objective is to identify those variables which influence the supply of tenant household members to cotton picking, and to discuss the likely impact of wage and income policies on the tenant household labor supply. The emphasis will not only be on economic variables such as wages and income, but also on social and demographic factors such as family size, number of children, level of education, etc. This chapter is divided into four sections. Section I is a review of the literature on labor supply. Section II discusses the specification of the labor supply model used. Section III is a presentation of the results with the discussion. Section IV consists of concluding remarks.

I. Review of the Literature on Labor Supply

Current literature on labor supply is dominated by the new household economic theory which so far has been applied mainly to high income developed economies. This

approach can be traced back to Mincer's work on labor force behavior of married women. This approach rests on the proposition that the household is the relevant decision-making unit and that the household production and consumption decisions are interrelated (28).

Along these lines, Bowen and Finegan developed their model. The basic proposition underlying their model is that the decision by a household member concerning the allocation of his/her time is not undertaken independently of the circumstances of the rest of the household members; i.e. the household is the decision unit which determines the number of hours each member of the household is to devote to work in the market (including search for work) and to all other activities including working at home, schooling, leisure, etc. (6).

Bowen and Finegan's model was an attempt to explain how the household allocates the time of its members among different pursuits. These decisions are assumed to be affected by a large number of independent variables grouped under four major categories: (1) tastes, (2) expected market earnings rates, (3) expected non-market earnings rates, and (4) the households' total resource constraints.

In the following discussion some of the most important among these variables under these categories will be reviewed.

Expected Market Earnings Rate

Expected market earnings rate affects labor supply, as suggested by economic theory. Assuming that leisure is a normal good, an increase in wage rate will have a positive substitution effect (substituting more hours of work for leisure) and a negative income effect (substituting leisure for work since after increase in wage rate, the same income could be obtained by working less hours). Which effect is dominant is an empirical question. Generalizations about the effect of wages on labor supply is meaningless since wages affect the labor supply of different social groups differently both with regard to the magnitude of the impact and whether the impact is on labor participation or the number of hours worked or both. Boskin reported positive wage elasticities of labor supply in the U.S. for wives, female-teenagers and white husbands at or approaching retirement age (5). Lopes found a positive relationship between the total amount of work supplied by a husband or wife in low-income Brazilian households and the implicit wage facing him/her (26). A positive relationship between aggregate supply of farm wage labor for all adults per household and the weighted average village wage has also been reported by Bardhan in West Bengal (3).

While it is common to find a positive relationship between own wage and the amount of labor supplied by a worker, it is also not uncommon in cross section studies

to find a negative relationship between an individual's wage rate and the amount of work supplied by other members of his family. For instance, increase in the wage rate of the husband may result in a decrease in the amount of time supplied by the wife to the market since her marginal productivity in household activities may exceed her marginal productivity in the market. This phenomenon, plus the evidence from time series studies showing a historical decline (in the United States) of labor force participation rates of young and old men, and the decline of the working week, gave support to the notion of backward supply function (28).

The effect of an increase in the wage rate on the individual's labor supply in developing economies has been the subject of controversy in the literature. One school represented by Dalton advocates the notion of the backward bending labor supply function to explain the response of African labor to increase in money wage (10).

This school argues that once wage rates or incomes reach a certain subsistence level, increases in wages may cause some workers to prefer leisure rather than working time, because the income effect of higher wages dominates the substitution effect.

Contrary to this view, Berg believes that, in contemporary Africa, the aggregate labor supply function

for "target" labor is positively sloped. He identifies two contrary changes that follow a wage change: changes in the number of laborers in wage employment and changes in the average time each may spend at work. The first is positively related to change in wage and the second is negatively related to wage increase. The effect of the change in the number of laborers in wage employment more than off-sets the effect of change in the average time worked per person, resulting in a positively sloped aggregate supply curve (4).

Empirical evidence also supports the existence of a positively sloping supply function for commercial farmers in Africa. Dean, for instance, in a study of tobacco farmers in Malawi, found that increased amounts of labor were allocated to tobacco production when there was an increase in the returns to labor in that activity (11).

Total Household Income

Net household income has an effect on the total amount of work supplied by the household. As in the case of the wage rate facing an individual, income and substitution effects work in opposite directions. Mincer found that the income parameter in the labor supply of wives is negative, implying the dominance of the income effect over the substitution effect (28). Lopes found the same result for wives. However, for husbands the labor supply

elasticity with respect to income was found positive (implying the dominance of substitution effect over income effect) but the total earning elasticity was found to be low (26).

Education

Education is mentioned in various studies as a factor affecting the labor supply of individual family members as well as the total labor supply of the family. A study by Bowen has shown a positive relationship between the amount of time spent in the labor force and the level of education achieved (7). This could be explained in terms of the opportunity cost of staying out of the labor force being greater for a person with higher education compared to another with lower or no education (26). Education also increases productivity of time in the market activities and raises the opportunity cost of leisure (assuming leisure to be a normal good) resulting in more work and less leisure. However, education should have no relevance in many of the jobs held by the poor (26).

As far as the developing countries are concerned, the evidence is mixed. Lopes found a negative but non-significant relationship between a husband's labor supply and the level of education he attained (26). Evanson found that the relationship between the amount of labor supply and level of schooling is positive for husbands and negative for wives (15).

Age

Age is an important determinant of labor supply. Ando and Modigliani's "life-cycle" hypothesis constitutes a reasonable framework for explaining the labor supply behavior of time spent by an individual in the labor force is expected to be low at the time he/she enters the labor force (say 15 years of age) since at that age he/she may still have to spend a substantial amount of his time preparing himself for the job market through education or training. As the individual grows older and accumulates experience, his productivity in the labor market increases and the opportunity cost of time spent outside the labor market increases (2). explains the increasing amount of time spent at work as the individual passes through the middle age period. As the individual grows older, his physical and mental abilities decline, resulting in a decrease in the amount of labor allocated to work. Evidence from empirical studies is in the line of this hypothesis (26).

Children

The effect of children on the amount of labor supplied by the family, especially their parents, is dealt with extensively in the literature. Many studies distinguish between preschool and school children. Because of the intensive care they need, young children demand much of their mothers' time at the expense of work and leisure.

Gronau found that preschool children have a deterrent effect on their mother's participation in the labor force and cut into her leisure (17). The same evidence was reported by Kushman and Scheffler in a similar study (24). Moreover, Landsberger has shown that in the United States, young children decrease the probability of female holding a job on the market by about 13% (25).

Another important factor related to children which affects the labor supply of the household to the market is the number of children. The larger the number of children in the family, the greater the family's financial need and the greater the pressure on the family head and other earning members of the family to substitute work for leisure.

The Number of Potential Earners in the Household

The number of potential earners in the household serves as an indicator of the potential amount of time available to the household for participation in the labor market. Bowen and Finegan identified two forces which determine how much of its potential labor a household may utilize. On the one hand, the greater the household's time resources, the greater their potential income, ceteris paribus, the more leisure it can afford and the lower the level of labor force participation they are likely to commit themselves to. On the other hand, the larger the household,

the greater the need for money income to support its members. This exerts more pressure on earning members to substitute work for leisure. Predominance of the larger-potential-income aspect will lead to a negative relationship between number of household members and labor force participation. Predominance of the need-for-money aspect leads to a positive relation between number of potential earners and labor force participation (6).

At the empirical level, Bardhan found a positive and significant relation between aggregate supply of farm wage labor for all adults per household and the number of adults in the household in farm labor status in West Bengal (3).

Family Resources

Household labor supply is affected by the amount and quality of resources under the control of the household. An important resource in underdeveloped rural societies is land available to the household through ownership or rent. Bardhan found a positive association between the total supply of adult farm labor days for the household as a whole and the size of the household farm (3).

Hypotheses

Based on the preceding literature review, the following hypotheses are expected to hold regarding the relationship

between the labor supply of household men, women and children and the independent variables affecting them.

(1) It is assumed that a positive relationship exists between the total amount of work supplied by household men or women and the implicit wage facing each.

(2) There is a positive relationship between total household income and labor supply by household men and a negative relationship between total household income and labor supply by household women.

(3) It is expected that the labor supply of household men and children for cotton picking is negatively related to the average number of years of schooling.

(4) The labor supply of household men and women in cotton picking decreases with increases in their average age.

(5) The labor supply of household men in cotton picking increases with an increase in the number of younger children (0-9 years old) and decreases with an increase in the number of older children (10-14) per household. The labor supply of household women is expected to have a negative relationship with the number of younger children, and a positive relationship with the number of older children (10-14).

(6) It is expected that there would be a positive relationship between the number of men or women per household and their labor supply for cotton picking.

II. Analytical Procedures

Several alternative statistical models have been used to estimate labor supply functions. The following are some of the most common models used in the estimation of labor supply functions:

(1) Linear Ordinary Least Squares (OLS)

In order for the OLS model to yield best, linear, unbiased and efficient co-efficient estimators, the following conditions must be met:

a. The error term has zero expected value and constant variance for all observations; that is $E(\varepsilon_i) = 0$ and $E(\varepsilon_i^2) = \sigma^2$.

b. The random variables E_i are uncorrelated in a statistical sense, i.e., errors corresponding to different observations have zero correlation. Thus, $E(\varepsilon_i \varepsilon_j) = 0$ for $i \neq j$.

c. The error term is normally distributed.

d. The relationship between the dependent variable and the independent variables is linear.

e. The independent variables are nonstochastic variables whose values are fixed (19).

Because these conditions are seldom met, the relevance of OLS to the estimation of labor supply functions is often questioned. However, OLS can be used to get first approximations of labor supply functions. Moreover, OLS has the advantage of being less costly compared to other methods.

(2) Tobit Maximum Likelihood Method

Some researchers use the Tobit Maximum Likelihood Method to cater for the case where the lower limit of zero hours of work may be reached by some categories of labor such as women. This method involves estimating the conditional probability of an event occuring (e.g. hours of work spent by men on cotton picking per household (22)). It has the advantage over linear ordinary least squares method of yielding tighter confidence intervals about the point estimates, and more plausible values for predicted behavior away from the sample mean (36). One important disadvantage of this method is that it is relatively more costly compared to OLS and other relatively less complicated methods.

(3) Seemingly Unrelated Regressions (SUR)

Zellner's seemingly unrelated regression procedure treats the system of seemingly unrelated equations as a single large equation. In this procedure, coefficients in all equations are estimated simultaneously by applying generalized least-squares to the whole system of equations. The advantage of this method over linear ordinary least squares method is that coefficient estimators so obtained are asymptotically more efficient (have a smaller variance). The gain in efficiency could be quite large if independent variables in different equations are not highly correlated and if disturbance terms in different equations are highly correlated (43).

III. The Model Adopted for Analysis of Household Labor Supply

Characteristics and Assumptions of the Model

The model of labor supply adopted in this study has the following characteristics:

(1) This model deals exclusively with tenant household's labor supply for cotton picking. After all, of all the activities associated with cotton production, cotton picking is the most labor demanding activity.

(2) This model views the household as the appropriate decision unit which dictates the roles to be played by different family members and allocates their times between different activities in such a way as to maximize the total welfare of the household. For this reason, labor supply functions were specified and estimated for the household rather than for individuals within a household.

(3) Labor supply functions are disaggregated and estimated separately for men (15-64 years), women (15-64 years), and children (males and females, 10-14 years). Such sex and age distinction is suggested strongly by some studies on developing countries because: "the level of employment for these three categories and the functions they perform differ widely. Moreover, the social and developmental implications of men's, women's, and children's work are radically different" (18).

(4) The approach followed in this model follows comparative static microeconomic analysis, i.e., it depends

on ceteris paribus assumptions.

(5) To choose the appropriate functional form for the model, a comparison was made between the linear form and the log-log form, the two forms most commonly used. The linear functional form assumes a changing percentage relation between the dependent variable and the independent variables, and hence a changing elasticity. The log-log transformation assumes a constant percentage relation between the dependent and the independent variables and hence a constant elasticity (42).

The linear form was chosen over the log-log form because its statistical methods and properties are well understood. Secondly, many nonlinear functional forms look linear over small ranges, anyway. Thirdly, the log-log form can not be readily used in cases where the values of the dependent variable (number of hours spent by houshold men, women or children in cotton picking) are zero since the value of the logarithm of zero is undefined (31).

Specification of a Labor Supply Model in the Form of a Regression Equation

Three separate single-equation labor supply models are formulated for the three labor categories as follows:

$$(1)\ L_M = a_o + a_1M + a_2C_1 + a_3C_2 + a_4C_3 + a_5F + a_6A_1 + a_7E_1 + a_8w_1 + a_9X_1 + a_{10}X_2 + a_{11}X_3 + e_1$$

$$(2)\ Lw = b_o + b_1W + b_2C_1 + b_3C_2 + b_4C_3 + b_5F + b_6A_2 + b_7w_2 + b_8X_1 + b_9X_2 + b_{10}X_3 + b_{11}w_2 + e_2$$

$$(3)\ Lc = c_0 + c_1C_3 + c_2F + c_3A_3 + c_4V_3 + c_4E_4 + c_5X_1 + c_6X_2 + c_7X_3 + c_0W_3 + e_3.$$

Whereas LM, Lw and Lc on the left-hand side are the dependent variables such that:

Lm(measured by MENLAB) = Total number of hours per household spent by household men in cotton picking in 1977/78 season.

Lw(measured by WOMENLAB) = Total number of hours per household spent by household women in cotton picking in 1977/78 season.

Lc(measured by CHILDLAB) = Total number of hours per household spent by household children in cotton picking in 1977.78 season.

The remaining variables on the right sides of the three equations are the independent variables defined as follows:

M(measured by MEN) = number of adult males per household. These represent household men labor constraint.

W(measured by WOMEN) = number of adult females per household.

C_1(measured by CH0-5) = number of children 0-5 years per household.

C_2(measured by CH6-9) = number of children 6-9 years per household.

C_3(measured by CH10-14) = number of children 10-14 years per household.

F(measured by FAMSIZE) = family size.

A_1 (measured by MAGE) = average age of adult males per household.

A_2 (measured by WOMAGE) = average age of adult females per household.

A_3 (measured by CHAGE) = average age of children per household.

E_1 (measured by MEDUC) = average number of years of education attained by an adult male per household.

E_2 (measured by CHEDUC) = average number of years of education attained by a child per household.

W_1, W_2, W_3 (measured by IMPWM, IMPWW and IMPWCH, respectively) = wage rates in Sudanese pounds[1] per hour for household men, women and children. Since family members are not paid for their labor but they rather share family income (net of payment to hired labor and other expenses), it was not possible to obtain explicit wage rates. Implicit wage rates were therefore used as an alternative.

One way to impute implicit wages was to estimate the opportunity cost of labor, i.e., the highest alternative wage rates which could have been earned by household men, women and children had they not been engaged in cotton picking. However, for practical reasons, it was not possible to compute opportunity wages. Some family members would have been engaged in activities the returns from which could not be estimated in terms of money. Others were absent and no one knew what their earnings might have been.

For those reasons, implicit wages were imputed for household members in terms of income which they could have earned had they picked the same quantity of cotton for other households (rather than for their own) at

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[1]According to the official exchange rate, one Sudanese Pound (£SD) = $2.50.

the prevailing wage rate. To compute implicit wage rates, the amount of cotton picked per household by men, women and children was obtained separately, together with the number of hours spent by each labor category in picking. Using the prevailing wage rate received by hired labor (which was paid on weight basis), W_1, W_2 and W_3 were computed as the wage rates which household men, women and children would have obtained had they hired out their labor.

X_1 (measured by INCOMC) = a proxy for household income from cotton in 1977/78.

Since the total share of the tenant from cotton is received in installments over a period of up to two years after the tenant delivers the crop to the Corporation, it was not possible to calculate the actual income to the tenants for the 1977/78 season. As a proxy for this, figures from 1975/76 (the previous season) were borrowed. Since farmers do not have a precise idea about the prices they are going to get for their cotton at the time of picking, it would be reasonable to assume that the price they expected would be more or less close to the price of last year. The 1975/76 final joint account between the New Halfa Corporation and the tenants shows that the gross share per big kantar of seed cotton was LSD 7.58. However, there are still other expenses (such as advances for recruiting hired labor for cotton picking, green ridging, any additional advances) which should be deducted from tenants on individual basis. These items were not available from the accounts. This

payment also does not allow for the cost of family labor. Rather it is considered as a return to family labor. In spite of these qualifications, this payment could be useful as a proxy for what a tenant would expect from the crop he has delivered in 1977/78. X_1 was obtained by multiplying £SD 7.58 by the number of big kantars of seed cotton picked in 1977/78.

X_2(measured by INCOMGN) = Estimated net household income from groundnuts in 1977/78. This was arrived at by deducting total expenses from sales. Sales were arrived at by multiplying quantity produced by the market price (£SD 2.85 per sack of about 120 lbs. of unshelled groundnuts). Cost of production figures were borrowed from the New Halfa Corporation (see appendix IV).

X_3(measured by INCOMW) = Estimated net household income from wheat in 1977/78 arrived at by deducting total expenses from total sales. Sales were obtained by multiplying quantity produced by market price (which was £SD 67.15 per metric ton of wheat). The value of sales included the amount of wheat kept for household consumption which was also valued at the prevailing market price.

The assumption here is that if a household did not produce its own wheat, they would have purchased it from the market at the current price.

It is worth mentioning that this specification does not include land as a variable. The reason for leaving land out is that the size of land per household is fixed at 15 acres per household.

Application of the Model: Statistical Results

The model specified above was tested using the data collected from the tenants household survey. As far as the Halfawi sample is concerned, only the labor supply function for household men is estimated. The labor supply function for household women and children was not estimated because their contribution to cotton picking was negligible (Table 13, page 40). As for the Nomadic sample, the labor supply function of men, women and children were estimated. Each of the three household labor categories played a significant role in cotton picking.

The model was tested using both OLS and SUR for the sake of comparison. However, SUR was used only to estimate the set of three labor supply equations pertaining to the Nomadic group. The Halfawi group was excluded because there was only one equation to be estimated.

The idea behind applying seemingly unrelated regressions beside linear ordinary least squares is to see whether or not any efficiency could be gained in estimating the coefficients. The results are discussed below.

Means and Standard Deviations of Variables

The means and standard deviations of variables used in estimating the regression equations is shown in Table 17 (page 81). As far as the Halfawis are concerned,

TABLE 17

Means and Standard Deviations of Variables

	Hafawi Group		Nomadic Group	
Variable	Mean	St.Deviation	Mean	St. Deviation
MENLAB	78	104.55	175.35	134.22
WOMLAB	-	-	67.11	95.54
CHILDLAB	-	-	33.47	50.38
MEN	1.32	0.80	1.57	1.05
WOMEN	-	-	1.68	1.14
CHILD0-5	0.64	0.86	2.14	1.58
CHILD6-9	0.56	0.92	0.96	0.70
CHILD10-14	0.68	1.03	1.30	1.13
FAMSIZE	5.24	2.59	7.94	3.18
MAGE	33.96	15.93	35.04	15.28
WOMAGE	-	-	32.18	11.13
CHAGE	-	-	-	-
MEDUC	2.42	2.86	0.50	1.06
IMPWM	.41	-	3.27	7.54
IMPWW	-	-	0.79	2.00
IMPWCH	-	-	-	-
INCOMC	113.46	115.03	70.35	66.34
INCOMGN	76.14	77.04	40.99	67.64
INCOMW	19.88	52.10	-16.48	49.26
Number of Cases	25		72	

values of variables associated with women and children are not presented since women and children are excluded from the regression analysis because of their negligible contribution to cotton picking.

Significance Levels

The choice of a significance level is not an arbitrary one. It involves making a trade-off between two types of errors:

Type I: rejecting a hypothesis when it is true.

Type II: accepting a hypothesis when it is false.

Decreasing Type I error simultaneously results in increasing Type II error. In order to determine the appropriate level of significance he would be most comfortable with, a decision maker must evaluate:

(1) the costs associated with each type of error,

(2) the probabilities of the hypothesis and the alternative (27).

Since the probability of a Type II error associated with whatever level of significance is small (27), attention is usually focused on Type I error. In presenting the results of this analysis, a broad range of significance levels or probabilities of Type I error which are most commonly reported in the literature is given. No recommendation has been made regarding the appropriate significance level for any particular variable. Whether to choose 1% or 15% significance level depends on the particular situation of the individual who has to take

the decision and the costs of the Type I error with which he is faced, i.e., the higher the costs of Type I error, the more desirable it would be to choose a smaller significance level.

Estimating Labor Supply Functions for Household Men

Since only household men participated in cotton picking in the Halfawi sample, there was only one equation to estimate (i.e., supply function for men) as far as this sample is concerned. For this reason only OLS was used to estimate the labor supply function of men in this sample. The results are shown in Table 18.

Table 18 shows that the labor supply of household men per household increases with increases in IMPWM, INCOMC and INCOMGN. Decreases in income from wheat and number of children 0-5 all tend to increase labor supply of household men. Family size, number of children 6-9 and 10-14 and number of years of schooling attained per man per household are not statistically significant.

With the exception of INCOMGN, the direction of relationship between the dependent and the independent variables is in accordance with other findings. The expectation is that increase in either INCOMGN or INCOMW would reduce the supply of household men to cotton picking for two reasons:

(1) Since groundnuts and wheat compete with cotton for labor at harvest time, increase in income from each

may entail an increase in the demand for and hence more use of household men labor in the harvesting of those crops at the expense of labor used in cotton picking.

(2) Increase in income from wheat and/or groundnuts may increase the opportunity cost of leisure (assuming leisure to be a normal good) vis-a-vis cotton picking.

The direction of relationship between labor supply of household men and INCOMW was according to expectation. However, the relationship between labor supply of household men and INCOMGN was not. One possible explanation for this is that since the Halfawis depended mainly on hired labor for picking cotton while they did the supervision. An increase in household income from groundnuts, in the face of inadequate advance money paid by management for cotton picking (see pp 163-164 below) may induce Halfawi tenants to hire more labor. An increase in amount of hired labor calls for an increase in supervision time, which may explain the positive association between men labor supply and INCOMGN.

Table 18 also shows that only INCOMC, INCOMGN and MAGE are statistically significant at 10% level or lower. The R^2 is .540 which means that 54% of the variation between households in labor supply of household men is explained by the independent variables in the equation.

The coefficients of the labor supply equation for household men of the Nomadic group are estimated using both OLS and SUR. The results are shown in Table 19.

TABLE 18

Results of Ordinary Least Squares (OLS) Estimation of Labor Supply Functions of Household Men

(Halfawi)

Independent Variables	Regression Coefficients	Standard Errors of Coefficients
IMPWM	19.342*	19.700
FAMSIZE	16.464	22.240
INCOMC	.596*****	.200
INCOMGN	.534**	.366
INCOMW	-.554*	.578
CHILD0-5	-42.812*	33.764
CHILD6-9	-.388	37.737
CHILD10-14	-29.245	38.048
MAGE	-3.436****	1.641
MEN	9.703	49.829
MEDUC	6.246	10.710
Constant	22.819	81.719
R^2	.540	

Key:
* 15% level of significance
** 10% level of significance
*** 5% level of significance
**** 2.5 level of significance
***** 1% level of significance

TABLE 19

Results of Ordinary Least Square (OLS) and Seemingly Unrelated Regression (SUR) Estimation of Labor Supply Functions of Men

NOMADS

	OLS		SUR	
Independent Variable	Regression Coefficients	Standard Errors of Coefficients	Regression Coefficients	Standard Errors of Coefficients
IMPWM	1.306	1.967	2.645**	1.809
FAMSIZE	-2.638	12.838	3.323	12.192
INCOMC	.336**	.247	.379**	.245
INCOMGN	-5.34****	.233	-.478**	.231
INCOMW	-.441**	.322	-.434**	.319
CHILD0-5	-11.117	18.442	-17.892*	17.549
CHILD6-9	34.448**	25.336	-44.526***	24.413
CHILD10-14	-6.241	19.381	-11.751	18.822
MAGE	.492	.978	.226	.896
MEN	43.347****	20.364	27.342**	19.100
MEDUC	-2.031	13.732	1.642	12.549
CONSTANT	163.678*****	46.962	170.720*****	45.380
R^2	.379		.650	

Key:
- * 15% Level of Significance
- ** 10% Level of Significance
- *** 5% Level of Significance
- **** 2.5 Level of Significance
- ***** 1% Level of Significance

Comparing OLS estimates for the Nomadic group with OLS estimates of the Halfawi group, some similarities and difference can be noticed with respect to the direction of relationship between the dependent and the independent variables. An example of the difference in the labor supply of men to cotton picking for the Halfawis and the Nomads is the relationship between labor supply and income from groundnuts. As shown in Table 19 a negative relationship exists between labor supply of men for cotton picking in the Nomadic group and income from groundnuts, which, though contrary to the finding for Halfawis shown in Table 18, are more in line with expectations. The coefficients of MAGE and MEDUC are statistically non-significant.

In the case of OLS, five of the variables pertaining to the Nomadic group are significant at the 10% level or lower; namely INCOMC, INCOMGN and INCOMW, respectively, CHILD6-9 and MEN. In the case of SUR, the same variables were significant at the 10 percent level. In addition, IMPWM and the constant term, which were statistically non-significant in the OLS estimation turned out to be significant in the SUR estimation. For both estimation procedure, FAMSIZE, CHILD10-14, MAGE and MEDUC are statistically non-significant.

Comparing the estimation of regression coefficients and standard errors of Labor Supply obtained by OLS and

SUR in table 19, there was only one case where there was a difference in the sign of the coefficient of an independent variable, namely the coefficient of CHILD6-9, which changed from positive in case of OLS to negative, in case of SUR. The negative sign was in line with expectations. There were also differences between the two procedures in the magnitudes of the coefficient estimators. The main difference of SUR over OLS, however, is that more coefficients of independent variables became significant statistically.

This result was obtained in case of SUR due to a reduction in the sizes of the standard errors, i.e., a reduction in the estimated coefficient estimator variances as compared with those of single-equation OLS. However, the gain in efficiency (realized by comparing standard errors of coefficients estimated by OLS and SUR) is not very large in most of the cases. This could be attributed to the relatively high correlation between the variables in the equation. This can be seen in Table 20 especially with reference to FAMSIZE and CHILD0-5, CHILD6-9, CHILD10-14 and MEN.

Estimating Labor Supply Function of Household Women (with respect to cotton picking)

Results of OLS and SUR estimates of labor supply functions of Nomadic women are shown in Table 21. With the exception of the coefficient IMPWW, coefficients of

TABLE 20

Correlation Coefficients of a Labor Supply Equation for Nomadic Men

IMPWM	.14186											
INCOMC	.23381	.15143										
INCOMGN	-.08640	.25302	.27800									
INCOMW	-.40281	-.16946	-.28242	.03457								
MEDUC	-.00093	-.12317	.04008	.07701	.08171							
MAGE	-.04106	.08215	.20574	.02342	.16600	-.05637						
MEN	.35076	.12655	.27296	.15000	-.08519	.16478	.00007					
CHILD0-5	-.21899	-.04797	.19480	-.04746	.02989	.07030	.27010	-.04009				
CHILD6-9	-.28911	.08472	.15736	.19879	.19921	-.05376	.19135	.07126	.38757			
FAMSIZE	-.07101	.05797	.29729	-.01913	.01399	.00616	.25345	.39455	.69433	.50388		
CHILD10-14	-.12028	-.03876	.09600	.04222	.13998	.01091	.07872	.10063	.07832	.17576	.51975	
	MENLAB	IMPWM	INCOMC	INCOMGN	INCOMW	MEDUC	MAGE	MEN	CHILD 0-5	CHILD 6-9	FAMSIZE	

TABLE 21

Results of Ordinary Least Squares (OLS) and Seemingly Unrelated Regression (SUR) Estimation of Labor Supply Functions of Household Women

(Nomads Only)

	OLS		SUR	
Independent Variables	Regression Coefficients	Standard Errors of Coefficients	Regression Coefficients	Standard Errors of Coefficients
IMPWW	-1.788	5.819	1.848	5.331
FAMSIZE	-12.634**	9.499	-14.281**	8.902
INCOMC	.269**	.179	.220*	.178
INCOMGN	-.501*****	.168	-.505*****	.166
INCOMW	-.172	.226	-.162	.224
CHILD0-5	1.039	11.657	2.591	11.005
CHILD6-9	50.323****	20.769	45.176****	19.608
CHILD10-14	23.183***	13.642	25.683***	13.193
FEMAGE	-2.647*****	.929	-1.305**	.842
WOMEN	19.880**	14.511	22.625***	13.425
CONSTANT	138.239*****	41.141	103.182*****	38.790
R^2	.332		.434	

Key: * 15% Level of Significance
** 10% Level of Significance
*** 5% Level of Significance
**** 2.5% Level of Significance
***** 1% Level of Significance

all other independent variables have the same signs for both OLS and SUR estimations. Table 21 shows that the supply of women household labor per household is higher the higher the INCOMC. Increase in CHILD6-9 and CHILD10-14 tends to increase the labor supply of women to this particular activity. It can also be seen from Table 21 that the greater the number of women in the labor force per household the more hours of work supplied by household women to cotton picking. Furthermore, it is clear that the increase in income per household from groundnuts discourages participation of women in cotton picking. Increase in average women's age per household decreases amount of labor supplied by household women to cotton picking. Coefficients of IMPWW, INCOMW and CHILD0-5 were not statistically significant.

The most interesting finding in Table 21 is the fact that there is a positive association between the number of children and the labor supply of household women. Such a relationship is contrary to the expectation based on studies done elsewhere where the presence of a larger number of children was found to require more child care and domestic work vis-a-vis work on the farm. A possible explanation in this case is that in a very poor society, such as that of Nomadic tenants in New Halfa Corporation, the burden of a large number of children may force women in the household to increase their labor supply in the labor market. This might be true especially in the

case where there are enough children in the 6-9 years and 10-14 years categories to substitute women's work in child care and domestic work in general. The fact that the labor supply of household men would decrease with an increase in the number of children per household (Table 19) should not necessarily be interpreted as a reversal of role of men and women between field and home. A reduction in the labor supply of men to cotton picking could be accompanied by allocating more time to economic activities other than agriculture where the opportunity cost is higher.

Table 21 shows that limited gain has been achieved by using SUR instead of OLS. About 8 out of 10 variables have been found statistically significant at 10 percent level or lower using either statistical procedure. Using SUR vis-a-vis OLS resulted in a reduction in the standard errors of the regression coefficients. However, the reduction in the standard error of some variables was offset by a reduction in the regression coefficients.

This small gain in efficiency in the estimation of regression coefficients using SUR instead of single equation OLS may be attributed, at least partially, to the relatively high degree of correlation between the variables as shown in Table 22. It can be seen from Table 22 that a high degree of correlation exists between FAMSIZE and CHILD0-5, CHILD6-9, CHILD10-14 and the number of women per household (WOMEN).

TABLE 22

Correlation Coefficients of a Labor Supply Equation for Nomadic Women

IMPWW	.14113									
FAMSIZE	.08807	.20825								
INCOMC	.20095	.22998	.29729							
INCOMGN	-.04461	.03188	-.01913	.27800						
INCOMW	-.35778	-.19165	.01399	-.28242	.03457					
CHILD0-5	-.05803	.08456	.69433	.19480	-.04746	.02989				
CHILD6-9	.12934	.31294	.50388	.15736	.19879	.19921	.38757			
WOMEN	.13557	.27083	.56735	.14023	-.21961	-.12733	.21375	.01842		
FEMAGE	-.31182	.04430	.03984	.15954	.11550	.10363	.08521	.06545	-.01505	
CHILD10-14	.11451	-.03782	.51975	.09600	.04222	.13998	.07832	.17576	.15337	.03534
	WOMLAB	IMPWW	FAMSIZE	INCOMC	INCOMGN	INCOMW	CHILD0-5	CHILD 6-9	WOMEN	FEMAGE

Regarding the explanatory power of the model, Table 21 shows that SUR improves the explanatory power a little bit compared to OLS.

Estimating Labor Supply Functions of Household Children

Using both OLS and SUR procedures, coefficient estimators were obtained for labor supply of children in cotton picking. The results are presented in Table 23. It can be seen from Table 23 that the labor supply of household children increases with increases in implicit wage rate for children, expected household income from cotton, years of schooling of children and the number of children (10-14) per household. It could also be seen from the same table that the labor supply of household children decreases with increases in household incomes from groundnuts and wheat, respectively, and average age of child (10-14) per household.

As for the independent variables IMPWCH, INCOMC, INCOMGN and INCOMW, and CHILD in Table 23, the direction of their association with the dependent variable is in line with expectations. The justifications are similar to those applicable to the labor supply functions of household men in Tables 18 and 19, and labor supply functions of household women in Table 21. The direction of association between the independent variable and E_2 and average child age (CHAGE) deserves further discussion.

TABLE 23

Results of Ordinary Least Squares and Seemingly Unrelated Regressions Estimation of Labor Supply Functions of Household Children

(Nomads Only)

	OLS		SUR	
Independent Variables	Regression Coefficients	Standard Errors of Coefficients	Regression Coefficients	Standard Errors of Coefficients
IMPWCH	5.253***	3.150	6.840****	3.008
INCOMC	.202****	.093	.188****	.093
INCOMGN	-.096*	.085	-.093*	.085
INCOMW	-.146*	.114	-.142*	.114
CHEDUC	7.267**	4.415	5.619**	4.165
CHAGE	-2.646**	1.617	-2.088**	1.520
CH10-14	18.926*****	7.063	17.615*****	6.839
Constant	9.218	12.402	7.566	12.271
R^2	.284		.392	

Key:
- * 15% Level of Significance
- ** 10% Level of Significance
- *** 5% Level of Significance
- **** 2.5% Level of Significance
- ***** 1% Level of Significance

To say that the labor supply of household children is positively correlated with the average number of years of education may seem to be contrary to the usual expectation that the more education children get the less available they are for work. However, for this particular case it could be argued that as children go through the intermediate and high schools, the cost of their education increases. In a society characterized by low household income and a relatively large average family size as that of the Nomadic population of New Halfa, students may find it necessary to help their parents in cotton picking if only on part time basis, especially during weekends and holidays.

The negative coefficient of child age may be explained in terms of the marginal value product of labor for older children being higher in activities other than cotton picking. An obvious example of these activities is treking with livestock, a role usually undertaken by older children and young men in the household.

Table 23 shows that almost no gain in efficiency was obtained in measuring coefficient estimators by using SUR instead of OLS. For both procedures, all the variables are statistically significant at 5-10 percent levels. The reduction in the standard errors of some of the regression coefficients obtained by using SUR is offset by a decrease in the coefficient estimators.

Again, this limited gain in efficiency obtained as

a result of using SUR rather than OLS in estimating labor supply coefficients may be attributed, at least in part, to the relatively strong degree of correlation between some of the variables. Table 24 presents a matrix of correlation coefficients between different variables. Relatively higher correlation exists between the number of children and average child age per household, average years of schooling and average child age, family size and number of children, and family size and average child age.

Estimating Elasticities of Labor Supply for Cotton Picking With Respect to Implicit Wage Rates, Household Returns from Cotton, Groundnuts and Wheat

One important aspect of estimating labor supply functions is the measurement of the degree of responsiveness (or elasticity) of Labor Supply to changes in the level of a particular variable, other variables held constant. Elasticities of important policy variables (i.e. implicit wage rates, income from cotton, income from groundnuts, income from wheat) have been calculated from the estimated labor supply equations of men, women and children:

$$LM_H = \underset{}{22.819} + \underset{(19.7)}{19.342}IMPWM + \underset{(.20)}{.596}INCOMC + \underset{(.366)}{.534}INCOMGN$$

$$- \underset{(.578)}{.554}INCOMW + \ldots.$$

$$LM_N = \underset{}{170.72} + \underset{(1.809)}{2.645}IMPWM + \underset{(.245)}{.379}\ INCOMC - \underset{(.231)}{.478}INCOMGN$$

$$- \underset{(.319)}{.434}\ INCOMW + \ldots.$$

TABLE 24

Correlation Coefficients of the Labor Supply Equation for Nomadic Children

	CHILD LAB	IMPWCH	FAMSIZE	INCOMC	INCOMGN	INCOMW	CHEDUC	CH_{10-14}
IMPWCH	.27108							
FAMSIZE	.28338	.20998						
INCOMC	.31354	.24530	.29729					
INCOMGN	-.06065	.00626	-.01913	.27800				
INCOMW	-.15920	-.07904	.01399	-.28242	.03457			
CHEDUC	.20154	-.00325	-.02646	.09430	.04207	.06397		
CH_{10-14}	.26903	-.02354	.51975	.09600	.04222	.13998	.24847	
CHAGE	.13421	-.08002	.38868	.19349	.05431	.02600	.37914	.73165

TABLE 25

Labor Supply Elasticities For Cotton Picking With Respect to Implicit Wage Rate, Household Returns from Cotton, Groundnuts and Wheat by Sex and Tribal Group

Sex, Age and Tribe	Own Implicit Wage Rate		Income from Cotton		Income from Groundnuts		Income from Wheat	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Men								
Nomads	N.S.	.05	.13	.15	-.12	-.11	-.04	-.04
Halfawis	.10	N.A.	.87	N.A.	.52	N.A.	-.14	N.A.
Women								
Nomads	N.S.	N.S.	.28	.23	-.31	-.31	N.S.	N.S.
Children								
Nomads	.09	.12	.42	.40	-.12	-.11	.07	.07

Key:

(1) Estimation by OLS

(2) Estimation by SUR

N.S. Statistically non-significant

N.A. Not applicable

Table 25 shows that the labor supply for cotton picking with respect to own wage rate and income from wheat were extremely inelastic for men and children. As for women, the elasticities for these two variables were not calculated since their coefficients were statistically non-significant. Own wage elasticities range between .05 for men and .12 for children. A labor supply elasticity of .02 implies that if implicit wage rate was increased 100 percent, ceteris paribus, the number of hours spent by household men in cotton picking will increase by 2 percent., i.e. labor supply of household men with respect to cotton picking was extremely inelastic to changes in implicit wage rate. On the other hand, a decrease in implicit wage rate of the same magnitude has an equal and opposite effect on labor supply.

Labor supply elasticities with respect to income from wheat ranges from $\pm$.04 and -.14. The interpretation of the elasticities is the same as the case of own implicit wage. While a negative sign for elasticity of income from wheat is understandable (since some operations in wheat production are competitive with cotton picking) the positive elasticities in the case of women and children could not be justified. However, since these elasticities are very close to zero, the fact that they are positive or negative is of minor importance.

Table 25 shows that the elasticities of labor supply

$$LW_N = 103.182 + \underset{(5.331)}{1.848}IMPWW + \underset{(.178)}{.220}INCOMC - \underset{(.166)}{.505}INCOMGN$$

$$- \underset{(.224)}{.162}INCOMW + ...$$

$$LC_N = 7.566 + \underset{(3.008)}{6.84}IMPWCH + \underset{(.093)}{1.88}INCOMC - \underset{(.085)}{.093}INCOMGN$$

$$- \underset{(.114)}{.142}INCOMW + ...$$

In the above equation LM_H, LM_N, LW_N and LC_N stand for the Labor Supply of Halfawi Men, Nomadic Men, Nomadic women and Nomadic children, respectively. Figures in parenthesis represent standard errors of coefficients.

The elasticities of labor of Halfawi household men with respect to IMPWM, INCOMC, INCOMGN and INCOMW were calculated as follows:

$$\xi \overline{IMPWM} = \frac{\partial L_M}{\partial IMPWM} \cdot \frac{\overline{IMPWM}}{L_M}$$

$$\xi \overline{INCOMC} = \frac{\partial L_M}{\partial INCOMC} \cdot \frac{\overline{INCOMC}}{L_M}$$

$$\xi \overline{INCOMGN} = \frac{\partial L_M}{\partial INCOMGN} \cdot \frac{\overline{INCOMGN}}{L_M}$$

$$\xi \overline{INCOMW} = \frac{\partial L_M}{\partial INCOMW} \cdot \frac{\overline{INCOMW}}{L_M}$$

where:

L_M = amount of labor supplied by Halfawi household in cotton picking.

The elasticities of labor supply in cotton picking with respect to IMPWM, INCOMC, INCOMGN and INCOMW were calculated for Nomadic men, women and children in the same way. The results are presented in Table 25.

with respect to income from cotton are relatively high. The highest elasticity is that of Halfawi men (.87) - meaning that a 10 percent increase in household income from cotton picking will bring about a 9 percent increase in labor supply of Halfawi household men. On the other hand, Nomad household men have the lowest response (.13) with respect to change in household income from cotton, with children and women in between. The relatively high elasticity of supply of Halfawi household men labor with respect to income from cotton could be attributed to the fact that Halfawis, in general, have more employment opportunities open to them. Therefore it might be reasonable to expect them to be more responsive to changes in the marginal value product of their labor from alternative enterprises, including cotton. The Nomads, on the other hand, having limited alternative employment opportunities at the time of cotton picking, are expected to be less responsive to changes in the marginal value product of labor from cotton picking.

The elasticities of labor supply with respect to income from groundnuts are negative (with the exception of Halfawi men) and low, indicating that a change in income from groundnuts, other things being equal, will induce a smaller change in labor supply in the opposite direction.

IV. Concluding Remarks

The results of regression analysis of household men labor supply in cotton picking for the Halfawi group shows that for all the coefficients of the independent variables in the equation, only those of expected net income from cotton, net income from groundnuts, net income from wheat, and average male age were significantly different from zero at acceptable levels of significance. With the exception of the coefficient of net income from groundnuts all the other coefficients had the expected signs.

The statistical results of the regression analysis of household men labor supply in cotton picking for the Nomadic group, on the other hand, showed a larger number of coefficients of independent variables significantly different from zero at acceptable levels of significance than is the case for men in the Halfawi group.

All the coefficients had the expected signs, with one exception: the coefficient of the number of children (6-9) per household which came out positive. Again, no explanation could be found for the positive sign.

The statistical results of women household labor supply in the Nomadic group showed seven variables with coefficients significantly different from zero at the 10 percent level of significance or lower, namely: family

size, net income from cotton, net income from groundnuts, number of children (6-9), number of children (10-14), average woman age per household, and number of women per household. All the coefficients had the expected signs except the coefficients for the number of children which was positive. A possible explanation is that in such a poor community, the burden of a larger number of children may force women to allocate more labor to the market and less to the household, especially when some of the children are old enough to substitute women's work in taking care of younger children and other domestic work.

The equation of the Nomadic household children labor supply has seven variables with coefficients different from zero at 10 percent level of significance or lower. Those variables were: implicit child wage rate, net incomes from cotton, groundnuts and wheat, respectively, number of years of education attained, average child age and number of children per household. Signs of coefficients came out according to expectations with the exception of education, which was found to be positive. The positive sign of the coefficient of education may be attributed to a tendency among students to help their families meet the cost of their education (which tends to increase with increase in years of education) by participating in cotton picking on a part-time basis.

The use of SUR vis-a-vis OLS showed modest gains in

efficiency of coefficient estimators but improved the explanatory power of the model.

The labor supply elasticities with respect to wage rates and income from wheat derived from the estimated labor supply functions are generally very low (.02 to .12 for wage rates and -.14 for income from wheat), which implies that labor supply of household members is not sensitive to changes in implicit wage rates or net income from wheat.

The labor supply elasticities with respect to expected net income from cotton are relatively higher compared with elasticities for own wage and net income from wheat and net income from groundnuts. The labor supply elasticity with respect to income from cotton is highest for Halfawi men (.87) and lowest for Nomadic men (.13 or -.15), with Nomadic children and women in between.

The elasticities of labor supply in cotton picking with respect to change in income from groundnuts is low and negative for men, women and children in the Nomadic group (-.11 or -.12 for men and children alike and -.31 for women), implying that an increase in net income from groundnuts, eteris paribus, tends to induce a decline in the participation of Nomadic men and children in cotton picking, but the effect is very weak. As for Halfawi men, the elasticities of labor supply in cotton picking with respect to net income from groundnuts is .51.

The positive sign implies that an increase in net income from groundnuts, ceteris paribus, is associated with an increase in the participation of Halfawi men in cotton picking. A possible explanation for this is that an increase in income from groundnuts, other things being equal, may act as an incentive for tenants to allocate more time to cotton picking hoping thereby to increase their overall household income. This is not necessarily in conflict with their participation in the harvesting of groundnuts since the latter is managed almost exclusively by hired labor.

CHAPTER V

THE ROLE OF HIRED LABOR IN COTTON PICKING

Introduction

Hired labor is an important labor force component in cotton picking. A basic assumption behind alloting a tenant household a 15-feddans tenancy for all crops, which has been the practice followed in the Managil extension of the Gezira Scheme and in New Halfa Project, is that this size can more or less be handled by the tenant and his family, supplemented by hired labor in times of peak labor demand. However, over the years, the role of the tenant and his family in providing labor to the tenancy as a whole and to cotton picking in particular has diminished steadily. On the other hand, hired labor has become the dominant component of the labor force. For instance, in 1978/77 season, tenants and their families in the Gezira Scheme constituted only 26% of the total labor engaged in cotton picking (41). The situation in New Halfa Agricultural Corporation, which will be addressed in more detail below, is similar to that of the Gezira as far as the key role of hired labor is concerned.

This chapter will deal with some aspects of hired labor used in cotton picking in New Halfa Corporation.

Those aspects will include types and motivations of hired labor, estimation of hired labor requirements, cost of picking cotton by hired labor and tenants' opinions on and preferences towards hired labor. Since the main emphasis in the study has been on tenants and their families, and since hired laborers were not available for interviewing during the period of the field survey, data regarding hired labor could only be obtained indirectly from tenants interviewed supplemented by data obtained from the New Halfa Agricultural Corporation and other related sources.

Categories of Hired Labor

The ILO study identified four groups of rural migrant labor in the Sudan.

(1) There is a small minority of males who are at the stage of settling permanently either because they have obtained a plot of land in one of the agricultural schemes or have secured a permanent job in one of the smaller towns.

(2) A second group consisting of men and women are half-way between moving around and settling down. They may have established special links with some employers (e.g., tenants in Gezira or New Halfa Agricultural Corporation) with whom they seek employment every year.

(3) A third group consisting of males, who are maximizing their earnings over a short period of time by

moving around from one place to another in search of employment opportunities. After two or three years they would have saved enough money to go home and settle down permanently.

(4) A fourth group, consisting of men and women, are the traditional cotton pickers who migrate to cotton picking schemes every season and return home at the end of the picking season (20).

This study has not gone into detail to find out the relevance of all of the above categories to cotton picking in New Halfa Agricultural Corporation. However, a field observation shows that the first and fourth groups are the dominant ones in number in the New Halfa Agricultural Corporation. Those who conform to the fourth group consist of seasonal migrant labor who come mainly from Kassala Province. The pickers usually come as a family. Some of them (e.g., the Rashida tribesmen) bring their livestock with them at the time of picking since the New Halfa project represented the main source of grazing for livestock in the area.

Those who conform to the first group can be divided into two subgroups. One subgroup consists of laborers who migrated from Southern and Northern Darfur Provinces at the early stage of the project. Those laborers reside in separate villages or camps adjacent to Halfawi settlements. Those laborers provide seasonal hired labor throughout the year. Some engage into share cropping

arrangements with tenants with respect to groundnuts. The second subgroup of local hired labor consists of laborers from the Nomadic settlements. Those are usually families who have surplus of labor, relative to the tenancy and are in urgent need of cash.

Estimation of Hired Labor in Cotton Picking

An important objective of this study is to estimate the contribution of hired labor to cotton picking vis-a-vis family labor. Table 26 shows the amount of hours of hired labor used in cotton picking by those households interviewed. It is clear from this table that Halfawis use more hired labor per holding than the Nomads. It can also be seen that for both Halfawis and Nomads, migrant hired labor is more important quantitatively than local hired labor. Furthermore, Table 26 shows a relatively higher contribution of women relative to men in the local hired labor category compared to migrant hired labor category. In the case of the local hired labor category, the proportion of hours worked by men relative to women were3 to 2 in the Halfawi sample. For the Nomads, the ratio was nearly 1 to 4, reflecting the dominance of women labor over men in this category.

With respect to the migrant hired labor category, the contribution of men is obviously more important. The ratio of men hours to women hours were 6 to 1 and 67 to 1

TABLE 26

Contribution of Hired Labor in Cotton Picking

Ethnic Group	Local Hired Labor (Hours)			Migrant Hired Labor (Hours)		
	Men	Women	Children	Men	Women	Children
Halfawis						
Total	2530	1551	0	19212	3400	48
Average per Holding	52.7	32.3	0	400	70.8	1
Nomads						
Total	11262	3938	428	29461	441	0
Average per Holding	14	48.6	5.3	363.7	5.4	0

Source: The 1977/78 New Halfa Agricultural Corporation Tenants Sample Survey On Labor Requirements and Supply for Cotton Picking.

for the Halfawis and Nomads, respectively.

This low proportion of labor input of hired women in migrant hired labor compared with men of the same hired labor category could be due to the low proportion of women in migrant labor in the first place. This is especially true with respect to migrant labor from the sedentary population. For them the financial costs of moving all the family may exceed the returns from cotton picking. Moreover, there may be some household duties to be performed back home. Therefore, the tendency is for the migrating family to leave at home some of the women, young children and old men.

To compare the contribution of hired labor to cotton picking to that of family labor, hours worked by hired men, women and children per household are converted to man-equivalent hours, using the common denominator developed in Table 14 (page 58) and compared with average man-equivalent hours of family labor in Table 16 (page 60). The result is presented in Table 27.

Table 27 indicates that a typical Halfawi household from the sample interviewed contributes only 6 percent of the total labor input in cotton picking in their holding. Even if they utilized all the 101 man equivalent hours available to them (Table 16), and unless women can be persuaded to increase their participation in cotton picking substantially, the typical household share in labor

TABLE 27

Contribution of Family and Hired Labor to Cotton Picking (Measured in Man-equivalent Hours per Tenant Household)

Source of Labor	Halfawi Tenants Households		Nomad Tenants Households	
	Number of Hours	Percentage	Number of Hours	Percentage
Tenants and Family	49	6	268	24
Local Hired Labor	115	13	275	24
Migrant Hired Labor	709	81	594	52
TOTAL	873	100	1137	100

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Households Sample Survey on Labor Requirements and Supply for Cotton Picking.

input in cotton picking may not exceed 12%. The remainder of labor input has to come from hired labor.

A typical Nomadic household, on the other hand, contributes about 24% of labor input in their cotton compared to 76% by hired labor. Since the typical Nomadic Household more or less fully utilizes its potential labor in cotton picking, their share in labor input in cotton picking is not likely to change unless participation of women in cotton picking could be increased drastically.

Table 27 further reveals the dominance of migrant over local hired labor. The ratio of the former to the latter is 6 to 1 and 2 to 1 for the Halfawi households sample and the Nomadic households, respectively. The low contribution of local hired labor in the total hired labor input in the Halfawi sample compared with the Nomadic sample may be attributed to the observed tendency among local hired labor residing near Halfawi settlements to engage themselves in other activities competing with cotton picking, e.g., harvesting of groundnuts.

Estimation of Hired Labor Requirements for Cotton Picking in New Halfa Corporation

The Procedure Used by the Corporation

At the beginning of every picking season, the New Halfa Agricultural Corporation assesses the labor requirements for cotton picking and the potential sources of supply, including tenants and their families and potentially

available local and migrant hired labor.

On the basis of one laborer per feddan per season, it was estimated that 100,000 laborers were required for picking cotton in New Halfa Agricultural Corporation in 1977/78 season (32). Further, it was estimated that the tenants and their families can contribute about 35,000 labor-equivalents (at an average of 1.5 laborers per tenant family). The deficit of 65,000 laborers had to be secured from both local and migrant hired labor.

The actual number of hired laborers recruited by the Corporation was 16,000 (24% of estimated requirements). As a result of this shortage in labor some losses were reported in some parts of the project. The losses, however, were not as high as would have been suggested by the shortfall in required labor. The reasons for this discrepancy are:

(1) The assumption that a laborer (family or hired laborer) on the average, picks one feddan per season is an underestimation. This is particularly true for hired labor who are more efficient (Table 14, page 58) and usually work longer hours per day than family labor.

(2) This estimate also ignores those laborers who come on their own or are brought by tenants. These two sources are more important in recruiting labor than the New Halfa Agricultural Corporation. This fact is made very clear by Table 28 which shows that laborers recruited

TABLE 28

Sources of Recruitment of Hired Labor
for Cotton Picking for Halfawis and Nomads

Source of Recruitment	Halfawis		Nomads	
	Number	%	Number	%
(1) Recruitment by Tenants	76	29	332	72
(2) Recruitment by New Halfa Agricultural Corporation	66	25	27	6
(3) Laborers' Own Initiative	119	46	102	22
TOTAL	261	100	461	100

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Households' Sample Survey on Labor Requirements and Supply for Cotton Picking.

by the corporation represented 25% of labor recruited by the Halfawi tenants and 6% of laborers recruited by the Nomadic tenants.

(3) Since cotton is not planted in all the holding at the same time, and due to the differences among holdings in ecological conditions, e.g., incidence of diseases and pests, soil fertility, etc., and management practices, affecting growth and maturity of the crop, opening of cotton bolls in different holdings takes place at different intervals, allowing hired labor to switch from one holding to another.[1] This allows a more efficient utilization of hired labor during the picking season.

This apparent discrepancy between the estimates of the corporation management of cotton picking labor requirement and the actual requirements calls for a refinement of the methods by which these estimates are made.

An Alternative Approach for Predicting Labor Requirements for Cotton Picking

To develop a method for predicting labor requirements for cotton picking based on potential yield, tenant households in each of the two subsamples are classified according to cotton yield per feddan achieved. Then for each group of holdings with a certain average yield per feddan, an average of the number of man-equivalent days spent on

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[1]No significant mobility of tenants and their families was reported between tenant households.

cotton picking per holding is calculated. The number of man-equivalent days per holding is arrived at by converting the labor hours of picking of all categories of labor using the common denominator developed in Table 14. The number of man-equivalent hours is divided by 8 to get the number of man-equivalent days per feddan picked. The results are presented in Table 29.

The most important conclusion which may be drawn from Table 29 is that, contrary to the standard operating procedure followed by the New Halfa Corporation (and other cotton schemes) which assumes a fixed labor requirement of one person per feddan for cotton picking, the labor requirements per feddan vary substantially with the level of yield.

Although no definite trend could be seen in the relation between yield per feddan and labor requirements per feddan, it can be noticed (especially in the case of Nomads) that at yields above 6 big kantars per feddan, labor requirements increases less proportionately to increases in yield per feddan. An intuitive explanation of this observation is that at higher yields, productivity of a laborer per unit-time in cotton picking increases substantially compared to his productivity at low yield levels. This argument is supported by the findings of The Tambul Pilot Farm Study which suggested that at 5 kantars per feddan or more, the picking performance was about three times as high as when the yield was less than 1 kantar per

TABLE 29

Estimates of Labor Requirement
for Cotton Picking in Man-Equivalent Days
at Different Yield Levels

Range of Yield (in Big Kanter per feddan)	Average Number of Man-equivalent Days per Feddan Required for Picking	
	Halfawis	Nomads
Less than 3	19.8	17.8
3 - 3.9	17.2	33.6
4 - 4.9	36.0	31.8
5 - 5.9	19.8	28.5
6 - 6.9	25.6	20.7
7 - 7.9	16.0	25.9
8 - 8.9	-	25.7
9 - 9.9	23.4	-

Source: The 1977/78 New Halfa Agricultural Corporation Tenants Sample Survey on Labor Requirements and Supply for Cotton Picking.

feddan (21).

Therefore Table 29 presents a more realistic approach to the question of estimating the labor requirement for cotton picking ahead of season. For every level of yield anticipated, the corresponding amount of labor required to pick that yield could be estimated in man-equivalent days. Then using a common denominator, this could be broken down by sex, age and source of labor.

Cost of Picking by Hired Labor

One of the objectives of this study is to estimate the cost of picking by hired labor.

Labor cost items include wages in cash paid per unit weight picked, food, transportation, cost of providing temporary shelter plus other miscellaneous items.

Table 30 shows a breakdown of the cost of picking using hired labor. Wages in cash represent the major cost component followed by food. On a per feddan basis, the cost of picking for the Nomadic group is slightly lower than the cost for the Halfawi group. However, due to the higher average quantity picked by hired labor per Halfawi household compared to that picked for Nomads (21 big kantars for Halfawi compared to 16 big kantars for Nomads), the average cost per kantar for the Halfawi is lower compared to that of the Nomads.

An important aspect to consider in studying the cost of picking is whether or not there are any indications for

TABLE 30

Cost of Picking by Hired Labor per Household as Reported by Tenants (in ŁSD.)

Cost Item	Halfawi Group	Nomadic Group
Wages in Cash	30.75	22.50
Food	6.14	11.94
Transportation	.30	1.38
Shelter and Misc. Items	4.81	4.30
Total cost per 5-feddan holding	42.00	40.12
Cost per feddan picked	8.40	8.02
Cost per Big Kantar	1.98	2.51

Source: The 1977/78 New Halfa Agricultural Corporation Tenants Household Sample Survey on Labor Requirements and Supply for Cotton Picking.

efficiencies related to increased yields. Table 31 shows the variation of costs of picking per feddan with quantity picked per feddan. The figures in Table 31 indicate a trend for costs per big kantar to decrease with an increase in quantity picked per feddan. This could be attributed to cost of food, transportation and shelter which tend to be fixed irrespective of the quantity. Hence, their proportion to total cost tend to decline with an increase in yield. In contrast, cash wages are paid on the basis of per unit weight of cotton picked and therefore increase with the quantity picked.

The ordinance of New Halfa Agricultural Corporation stipulates that costs of picking should be shared equally between the corporation and the tenant. The corporation is responsible for paying the tenant an advance for hiring labor and paying the cost of their transportation from their places of origin to the project area. Many tenants complain that the advance payment is not adequate to pay the wages of the hired labor. Some have to pay out of their pockets at a time when they need money badly to meet their basic needs.

Cotton Picking Campaigns

At the beginning of every picking season, the New Halfa Agricultural Corporation forms cotton picking labor committees consisting of corporation officials and representatives of tenants. These committees visit potential

TABLE 31

Variation of Cost of Picking per Feddan with Quantity Picked per Feddan

Quantity picked per feddan	Cost of Picking per Big Kantar	
	Halfawis	Nomads
Less than 3	2.62	3.20
3 - 3.9	1.85	2.26
4 - 4.9	2.27	2.50
5 - 5.9	1.67	2.73
6 - 6.9	1.70	2.12
7 - 7.9	1.63	1.94
8 - 8.9	1.74	
9 +	1.49	

Source: The 1977/78 New Halfa Agricultural Corporation Tenants Household Sample Survey on Labor Requirements and Supply for Cotton Picking.

cotton pickers in their own villages outside the project area. These committees establish estimates of the number of cotton pickers expected to come to the project in that particular season and enlist the cooperation of village chiefs and religious leaders in these villages. Sometimes contracts between these committees and village chiefs are signed specifying the number of pickers a village chief will guarantee in return for an acceptable reward which could be in cash or kind.

In addition to the cotton picking labor committee, officials opened three offices in three towns during the 1977/78 picking season: One office in Kassala and another in Gedaref for recruiting laborers and transporting them to New Halfa. A third office was opened in New Halfa to receive pickers recruited in Kassala and Gedaref and allocate them among tenants according to tenant needs.

During 1977/78 season, New Halfa Corporation recruited about 16,000 laborers, which was 27 percent of the estimated hired labor requirements. This figure was also less than what they had planned to recruit. The Corporation was unable to recruit the target number of laborers for many reasons among which are the following:

(1) The preliminary estimates of the number of migrant hired laborers which would be available for picking were exaggerated by the village chiefs either to enhance

their prestige or their rewards.

(2) As mentioned above, not all of those who expressed their willingness to migrate to New Halfa and participate in cotton picking waited to be recruited by New Halfa Corporation. Some were recruited and transported to the project area by tenants. Others went at their own initiative to work with certain tenants with whom they had prior acquaintance.

(3) A third group migrated to the project area seeking employment in activities other than cotton picking. The significance of those activities in competing with cotton picking for hired labor may be judged from Table 32. It could be seen from Table 32 that threshing, washing, and bailing of groundnuts, in particular, use a substantial amount of hired labor during the time of picking, especially in the Halfawi sample.

(4) Another factor affecting the number of hired laborers which can be recruited by the New Halfa Agricultural Corporation is the competition from other cotton producing schemes such as the Gezira Scheme and the Rahad Agricultural Corporation. These two schemes have more funds at their disposal to spend in recruiting labor than the New Halfa Corporation has. For instance, in 1977/78 the Rahad Corporation paid the laborer ESD 2 at his village to prepare himself for the journey plus free transport from the village to the Rahard Project and back. The New Halfa Corporation paid only ESD.25 per Laborer plus free one-way

TABLE 32

Hired Labor Used by Households in Activities Competing with Cotton Picking (in Man-equivalent Days per Tenant Household)

Activity	Hired Labor Input	
	Halfawis	Nomads
Threshing, Washing and Bailing of Groundnuts	40	20.6
Watering and Weeding of Wheat	6.5	4.3
Bailing and Transportation of Cotton to Collection Centers	13	11.1
Total per Household	59.5	35

Source: 1977/78 New Halfa Tenant Households Sample Survey on Labor Requirements and Supply for Cotton Picking.

transportation.

Tenants Attitudes Towards Hired Labor

To get views on whether or not there was a shortage of labor, the following question was asked to each tenant interviewed: "Do you think there is a shortage of labor for cotton picking?" Table 33 shows the responses obtained. Around 87.5 percent of those interviewed in the Halfawi sample and 90% in the Nomadic sample thought that there was a shortage in hired labor for cotton picking. Interviewees were asked whether shortage of cotton pickers should be solved by increasing wage rates to attract more laborers or by introducing mechanical picking. Seventy percent of those interviewed in the Halfawi sample expressed the view that only mechanical picking can solve the problem. In the Nomadic sample on the other hand, 44% preferred raising wage rates.

The reasons given by those who preferred introducing mechanical picking over recruiting more laborers were varied, including timeliness in picking cotton which enhances quality of cotton and alleged reduction of costs. Reasons given by those who advocated solving the problem by increasing wage rates to attract more laborers included, among others, the belief that hand picked cotton is cleaner than mechanically picked cotton. To some, hand picking, which involves receiving advances from the corporation to help pay pickers, is a source of badly needed cash. Those

TABLE 33

Tenants' Opinions on Availability of Labor for Cotton Picking

Type of Response	Halfawis		Nomads	
	Number	%	Number	%
Shortage of Labor	48	87.5	72	90
No Shortage of Labor	6	12.5	8	10
Total	48	100	80	100

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Household, Sample Survey on Labor Requirements and Supply for Cotton Picking.

who manage to hire laborers for less than the advance keep the difference until the time when the account will be settled.[2] Others preferred hand labor over mechanical picking simply because they have no idea about mechanical picking.

Another aspect of tenants' opinions regarding hired labor pursued in the survey was the question of tenants' preferences for hired labor. Interviewees were asked to rank their preferences for laborers according to the tribes of the laborers. The results are presented in Table 34. The overwhelming majority of those interviewed said that laborers from Beni Amir tribe were the best because they did a good job and they were easier to get along with. Rashida came next in preference, especially for Halfawis because they stay on the holding until they pick all the crop. Of course, the main reason why the Rashida stay around for a longer period than other laborers is the fact that the Rashida are accompanied with their livestock. Perhaps they were more interested in securing the right to graze the holdings which they pick than the wages they get out of cotton picking.

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[2]Cotton picking belongs to the joint account. Its costs are divided between the corporation and the tenant each bearing 50%.

TABLE 34

Tenant Preferences Towards Hired Labor

Hired Laborer's Tribes	Halfawis	Nomads
Beni Amir	30	63
Rashida	10	1
Hadandawa	3	1
Darfur	2	1
Others	3	11
Total	48	77

Source: The 1977/78 New Halfa Agricultural Corporation Tenant Household Survey on Labor Requirements and Supply for Cotton Picking.

CHAPTER VI

LABOR REQUIREMENTS AND POTENTIAL LABOR SUPPLY FOR COTTON PICKING AND HARVESTING OF MAJOR COMPETING CROPS

Introduction

In the preceding five chapters, labor supply for cotton picking in New Halfa Agricultural Corporation was discussed. The discussion included both family and hired labor, with a special emphasis on family labor. The treatment of this subject, however, will not be adequate unless it is extended to include the rest of the agricultural sector. At least two arguments could be given to support the treatment of this issue at the sectoral level:

(1) With the exception of the Zeidab Scheme in the Northern Province, all irrigated cotton schemes in the Sudan are located either in the Blue Nile or Kassala Provinces. Those schemes demand substantial numbers of laborers for cotton picking and in many circumstances are engaged in keen competition for hired labor.

(2) There are other crops within each scheme and between schemes which demand labor during January-March period and therefore compete with cotton picking for labor.

The plan of this chapter is as follows:

(a) Estimate labor requirements for harvesting cotton and other major competing crops in Northern Sudan in 1977/78.

(b) Estimate potential labor supply in the provinces where cotton production takes place as well as in provinces with substantial agricultural labor potential.

(c) Potential labor supply will be compared with labor requirements for harvesting cotton and other major competing crops to see for each province whether there is a deficit or surplus agricultural labor during January-March, the critical period of cotton picking.

(d) Concluding remarks.

For practical purposes, only four provinces[1] are included in this analysis, namely: Blue Nile and Kassala, a major production region, and Darfur and Kordofan - traditional sources of hired labor for cotton picking. The three Southern Provinces of Equatoria, Bahr Elghazal and Upper Nile are excluded because the distance and cost of transport of labor from those provinces is prohibitive. In fact, not a single farmer from those interviewed in New Halfa Project reported recruiting labor from the

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[1]The 1973 Population Census was based on the nine provinces existing at that time. Since then, a reorganization of provinces took place and new provinces were created. However, because the labor force projections in this study are based on the 1973 Population Census, reference is made to the previous nine provinces.

southern provinces. The Northern Province is excluded because of the intensive cropping season where three crops are grown consecutively in the same season, which keeps the agricultural labor force occupied all the year round.

Kharfoum Province is excluded because the agricultural labor force is engaged mainly in the production of fruits, vegetables, and livestock products more or less all the year round to cater for the populated urban center.

Labor Requirements for Cotton Picking in Major Schemes

The varieties of cotton grown in the Sudan are classified into three types on the basis of the length of the staple: (1) Long staple cotton which is grown in the irrigated schemes of the Blue Nile Province: namely, the Gezira Scheme and Managil extension, and the Agricultural Reform Corporation Schemes on the Blue and White Niles. (2) Medium staple cotton: grown under irrigation mainly in the Gezira and Essuki Schemes in the Blue Nile Province and New Halfa, Tokar Gash and Rahad Corporations in Kassala Province. (3) Short staple cotton: grown under rain in southern Kassala and Nuba Mountains in Kordofan Province.

The labor requirements for cotton picking differ between these three types of cotton depending on their varietal characteristics which determine the pattern of vegetative growth, the number of bolls per plant and the timing of their maturity and opening. For instance, long

staple cotton which has a prolonged period of boll opening and much higher yields than short staple rainfed cotton (which opens all at once) requires about ten times as much labor.

The estimates of labor requirements for picking long staple cotton are based on findings of a study in 1966 on migrant hired labor and its implication for agricultural production in the Gezira Scheme (14). According to that study the average labor requirements for picking long staple cotton was around 55 man-equivalent days per feddan. Since the study provided an average figure only rather than different levels of labor requirements varying with yield levels, as is the case in this study (Table 29, page 119), this estimate is assumed to apply to the Gezira in 1977/78 season. This assumption seems reasonable since the difference in average yield in the Gezira Scheme between the season referred to by the 1966 study and the 1977/78 season is negligible (average yield in Gezira was 3.7 big kantars per feddan compared with 3.9 kantars per feddan in 1977/78), making it reasonable to assume that the same labor requirements that applied to 1964/65 season will apply to 1977/78 season.

To estimate labor requirements for picking medium staple cotton, an average yield per feddan is obtained for each cotton scheme. Then reference is made to Table 29 (page 119) to figure out the labor requirements corresponding to that particular yield level.

Estimates of labor requirements for picking short staple cotton are based on a study by the Public Mechanized Farming Corporation (34). According to that study a laborer picks around 6 feddans during a picking season of one month. This amounts to an average of 5 days per feddan.

On the basis of these estimates of labor requirements per feddan for the three types of cotton, Tables 35 and 36 are constructed showing cotton area, production, yield per feddan and labor requirements for cotton picking by province, type of cotton, and cotton scheme.

According to Table 35, around 40 million man-equivalent hours were required to pick cotton in the Blue Nile Province in 1977/78. Ninety-six percent of this labor was demanded by the Gezira Scheme alone (95% for picking long staple cotton and 1% for picking medium staple cotton).

Table 36 shows that labor requirements for picking cotton in Kassala Province is estimated around 5.3 million man-equivalent days. About 97% of this demand was required for medium staple cotton with New Halfa Agricultural Corporation requiring 63% of the total. The remaining 3% was required for picking short staple cotton in the Gadaref area. Table 36 further shows that total labor requirements for picking cotton in Kordofan was around .5 million man-equivalent days.

TABLE 35

Estimates of Cotton Area, Production, Yield per Feddan and Labor Requirements for Cotton Picking in the Blue Nile Province by Scheme and Type of Cotton

Type of Cotton	Cotton Scheme	Area[a] in Feddans	Production[a] in Metric Tons	Average[a] Yield in Big Kantar/ Feddan	Average Yield in Big Kantar/ Feddan for all Schemes	Labor Requirements in Man-days per feddan	Total
Long Staple							
	Gezira-Managil	489,080	280,000	4.01			
	Kosti-Renk	72,965	30,000	2.9			
	Duiem	33,330	16,000	3.43	3.89	55[b]	37,757,725
	Sennar-Singa	85,130	45,000	3.78			
	White Nile	6,000	3,000	3.57			
Medium Staple							
	Gezira	30,010	26,000	6.12		23[c]	690,230
	Damazin	15,200	3,000	1.4		18[c]	273,600
	Suki	38,585	36,000	6.67	5.2	23[c]	887,455
	Guneid	15,000	7,000	3.33		30[c]	450,000
Total Labor Requirements for Cotton Picking in Blue Nile Province							40,059,060

Sources: Computations based on...

(a) Sudan Yearbook of Statistics, Department of Agricultural Economics, Ministry of Agriculture, Food and Natural Resources (1977).

(b) El Khatim, S. I., "Casual Labor and Its Implications for Agricultural Production in the Gezira," Unpublished MSC Thesis, University of Khartoum, 1966.

(c) The 1977/78 New Halfa Corporation Tenant Households Survey.

TABLE 36

Estimates of Cotton Area, Production, Yield per Feddan and Labor Requirements for Cotton Picking in Kassala and Kordofan Provinces by Scheme and Type of Cotton 1977/78

Province	Type of Cotton	Cotton Scheme	Area[a] in Feddans	Production[a] in Metric Tons	Average[a] Yield in Big Kantar/ Feddan	Labor Requirements in Man-days Per Feddan	Total Labor Requirements in Man-days Number	%
Kassala	Medium Staple							
		New Halfa	98,795	56,844	4.11	34[b]	3,359,030	63
		Gash	22,900	7,000	2.55	18[b]	412,200	8
		Tokar	77,725	25,000	2.30	18[b]	1,399,050	26
	Short Staple							
		Gedaref	28,090	4,000	1.02	5[c]	140,450	3
	Total Labor Requirements for Cotton Picking in Kassala						5,310,730	100
Kordofan	Short Staple							
		Nuba Mountains	89,540	15,000	1.20	5[c]	447,700	97
		S. Kordofan	2,550	500	1.40	5[c]	12,750	3
	Total Labor Requirements for Cotton Picking in Kordofan						460,450	100

Source: Computations based on...

(a) Sudan Yearbook of Statistics, Department of Agricultural Economics, Ministry of Agriculture, Food and Natural Resources, 1977.

(b) The 1977/78 New Halfa Agricultural Corporation Tenant Household Survey.

(c) Mechanized Farming Corporation, "Estimates of Costs of Production of Sorghum, Sesame and Cotton," Tamadun Press (1975).

Labor Requirements for Harvesting Sorghum

Sorghum is the staple crop in the Sudan. It is grown under both rain and artificial irrigation. The labor requirements for harvesting differ between these two types of farming.

To estimate the amount of labor required for harvesting Sorghum in the critical period of January-March, only Sorghum grown under irrigated schemes and large dry farming mechanized schemes is included in these calculations. Sorghum produced under rain by peasant farmers is excluded because usually it is harvested by peasant family labor during November and December. Those peasant farmers themselves and their families constitute potential hired labor for cotton picking or Sorghum harvesting in large scale farms.

Estimates of labor requirements for harvesting irrigated Sorghum are based on ILO Study (20). According to that study, Sorghum grown under irrigation in the Gezira Scheme is usually harvested in November, December, and January. The amount of work needed in January, however, is negligible: about 0.1 man days per feddan.

As for the estimates of labor requirements for Sorghum produced under dry farming conditions, the same ILO report gives an estimate of 7.5 man-equivalent days per feddan. Table 37 is constructed on the basis of these assumptions.

TABLE 37

Estimates of Sorghum Area, and Labor Requirements for Harvesting Under Irrigation and Mechanized Dry Farming During January-March Period in 1977/78 Season

Province	Irrigated Sorghum			Mechanized Dry Farming Sorghum		
	Area[a]	Labor Requirements in Man-Equivalent Days		Area[a]	Labor Requirements in Man-Equivalent Days	
		Per Feddan[b]	Total		Per Feddan[c]	Total
Blue Nile	425,000	.1	42,500	625,000	7.5	4,687,000
Kassala	56,000	.1		1,900,000	7.5	14,250,000
Darfur	-	-	-	6,000	7.5	45,000
Kordofan	-	-	-	295,000	7.5	2,212,500
Total Labor Requirements			48,100			21,195,000

Sources: (a) Sudan Yearbook of Statistics, Department of Agricultural Economics, Ministry of Agriculture, Food and Natural Resources, 1977.

(b) Mohamed Shazali Osman: "Large Scale Agriculture and Employment Creation," paper submitted to the Preparatory Conference for the Comprehensive Employment Strategy Mission to the Sudan, 1975 and cited in ILO/UNDP Employment Mission's Report, op. cit.

(c) Farah Hasson Adam: "Development for Small-Scale Agriculture," paper submitted to the Preparatory Conference for the Comprehensive Employment Strategy Mission to the Sudan, 1975 and cited in ILO/UNDP Mission's Report, op. cit.

It can be seen from Table 37 that the total amount of labor required for harvesting Sorghum during the critical period of cotton picking is around 21 million man-equivalent days. About 67% of this labor is required in Kassala Province, 22% in the Blue Nile Province, 10% in Kordofan and 1% in Darfur.

Labor Requirements for Harvesting Wheat and Groundnuts Produced Under Irrigation

Groundnuts are grown under irrigation in Blue Nile and Kassala, and under rain in Kordofan and Darfur. Since groundnuts grown in Kordofan and Darfur are harvested by December, it does not compete with cotton harvesting. Therefore, only groundnuts produced under irrigation in Blue Nile and Kassala are considered here.

Wheat is grown exclusively under irrigation. Blue Nile and Kassala are the major producing areas. Wheat production is highly mechanized. However, labor is required to supplement machines in certain operations such as harvesting which starts towards the end of the cotton picking season.

Estimates of labor requirements for harvesting wheat and groundnuts during January-March period in the irrigated schemes of the Blue Nile and Kassala Provinces are presented in Table 38. According to the ILO's Study, estimates of labor requirements per feddan for wheat and groundnuts during this period is 4.5 man-equivalent days and 12 man-equivalent days, respectively. On the

TABLE 38

Estimates of Wheat and Irrigated Groundnuts Areas, Production and Labor Requirements for Harvesting During January-March by Province

Province	Wheat			Groundnuts		
	Area in Feddans[a]	Labor Requirements in Man-Equivalent Days		Area in Feddans[a]	Labor Requirements in Man-Equivalent Days	
		Per Feddan[b]	Total		Per Feddan[b]	Total
Blue Nile	469,000	4.5	2,232,000	387,200	12	4,646,400
Kassala	79,720	4.5	358,740	62,000	12	744,000
Kordofan	-	-	-	-	-	-
Darfur	-	-	-	-	-	-
Total Labor Requirements			2,590,740			5,390,400

Sources: (a) Sudan Yearbook of Statistics, Department of Agricultural Economics, Ministry of Agriculture, Food and Natural Resources, 1977.

(b) Mohamed Shazali Osman, op. cit.

basis of these estimates, the total requirements for harvesting wheat is around 2.6 million man-equivalent days, 86% of which was required in the Blue Nile and the remainder in Kassala.

The total labor required for harvesting groundnuts during this period of reference was around 5.4 million man-equivalent days. Eighty-six percent of that labor was required in the irrigated schemes of the Blue Nile. The remainder was required in Kassala: mainly in New Halfa Agricultural Corporation.

Estimates of Potential Labor Supply for Picking Cotton and Harvesting of Major Competing Crops

The 1973 Population Census classified the labor force into nine industries, namely: agriculture and animal husbandry, professional and technical, administrative and managerial, clerical and related workers, sales workers, production and related workers, services and workers not classified under any of the above categories. The Census defined the industry of an economically active person as "the sector of the economy in which he worked for production of goods or services for most of the time in the last twelve months before the census day."

For the purpose of this study, the source of potential labor for cotton picking and harvesting of major crops is the agriculture and animal husbandry industry.

To estimate the number of economically active popu-

lation in agriculture in the Blue Nile, Kassala, Kordofan and Darfur provinces, the 1973 Population Census figures were used as a bench mark. Then a projection of the potential labor supply in 1977/78 was made using the 1973 Population Census annual growth rates for each province. The results were summarized in Table 39.

Table 36 shows that in each of the four provinces, the number of males engaged in agriculture and animal husbandry exceeded the number of females. The Table also shows that Kordofan and Darfur constituted the main potential source of both male and female labor in agriculture. It is also clear that Kassala province had a very small number of females engaged in agriculture. It can be seen that Table 39 does not include estimates of the potential labor supply by children (10-14 years) because the 1973 Population Census excluded them from the labor force even though this study indicates that children play an important role in cotton picking as far as the Nomads in New Halfa Agricultural Corporation are concerned.

To translate potential male and female agricultural labor into man-equivalents, the following assumptions were made:

(1) Since the 1973 Population Census data did not differentiate between family and hired labor in agriculture, the assumption made here is that the two are more or less identical within sex and age categories. This

TABLE 39

Economically Active Population in Agriculture and Animal Husbandry in 1977/78 by Sex and Province

Province	Annual Growth Rate	Economically Active Males in Ag. and An.Husb.		Economically Active Females in Ag. and An.Husb.	
		Number	% of Economically Active Males	Number	% of Economically Active Females
Blue Nile	3.5	434,476	59	59,056	80
Kassala	3.0	178,963	53	12,008	44
Kordofan	2.85	504,555	81	190,145	94
Darfur	1.28	573,463	79	276,896	96

Source: Projections based on figures from Sudan Second Population Census 1973.

assumption seems reasonable considering that the input of hired labor is dominant in the production of all the crops under consideration.

(2) To use a common denominator to aggregate male and female labor, it is assumed that one woman is equal to 0.5 man. This assumption is in line with Table 14 (page 48) which shows that one family woman is equal to 0.44 household man, and one hired woman is equal to 0.60 hired man.

(3) It is assumed that an average man or woman is potentially available for cotton picking or harvesting of Sorghum, groundnuts, and wheat during the January-March period for 60 days. The remaining 30 days are allowed for rest, movement from one place to the other for work, or for sickness, etc.

On the basis of these assumptions, estimates of potential labor available for cotton picking and the harvesting of major crops during January-March period were made. These estimates were matched with estimates of labor requirements for harvesting cotton and other major crops (Tables 35 through 38) in each Province. These results are summarized in Table 40.

Table 40 reveals very clearly the fact that the Blue Nile and Kassala provinces had potential labor deficits. Their potential labor supplies meet 56% and 55% of their total labor requirements, respectively. On the other

TABLE 40

Potential Labor Supply and Requirements for Cotton Picking and Harvesting of Sorghum, Groundnuts and Wheat by Province

Province	Labor[a] Requirements (in mandays)	Potential[b] Labor Supply (in mandays)	Surplus(+) or Deficit(-) (in mandays)		Surplus or Deficit in No. of Laborers[1]
			Total	%	
Blue Nile	49,435,460	27,840,240	-21,595,220	56	-359,920
Kassala	20;310,330	11,098,020	-9,212,310	55	-153,539
Kordofan	2,672,950	35,977,650	+33,304,700	7	+555,078
Darfur	45,000	42,714,660	+42,669,660	0.1	+711,161
Total	72,463,740	117,630,570	45,166,830		752,780

Key: [1]Converted into laborers by dividing man/days by 60, the number of days assumed to be worked by a laborer per cotton picking season.

Sources: based on...

a. Tables 35, 36, 37, and 38

b. Table 39

hand, Darfur and Kordofan had great potential surplus labor. The local labor requirements absorbed only .1% of the labor potential in Darfur and 7% in Kordofan.

Concluding Remarks

The foregoing analysis indicates that matching labor requirements with potential labor supply by province reveals a substantial shortfall in Blue Nile and Kassala provinces, and substantial surpluses in Kordofan and Darfur. However, if the producingprovinces of Kassala and Blue Nile and the labor surplus provinces of Kordofan and Darfur are viewed as interdependent (which is the case), and if mobility of labor is not hindered by lack of information on alternative employment opportunities or high cost of transport, no shortage in labor would be experienced. In fact, there may be a substantial number of seasonally unemployed. As can be seen in Table 40, the estimate of surplus labor may be 752,780 laborers.

This analysis is meant to be indicative rather than to show the exact amount of labor required and available for cotton picking and harvesting of competing crops. Further research is needed on both the supply and demand sides to qualify and improve these crude estimates.

On the supply side, the next step should be to find out how much of this potential labor is actually available for cotton picking. This brings in the question

of mobility which depends, among other things, on:

(1) The opportunity cost of migrating to the Blue Nile and Kassala provinces for cotton picking and harvesting of other crops, or seeking temporary jobs in the urban centers versus staying home.

(2) The availability and cost of transportation to and from those places where seasonal employment is available.

(3) Availability of information on job opportunities in other areas.

On the demand side, further investigation is needed to identify and quantify labor requirements of other important activities which absorb labor during the January-March period. Two activities are particularly relevant in this regard.

(1) Secondary occupations taken up in the slack season to supplement income from agriculture. The importance of secondary occupations to the agricultural sector was underscored by a study in 1970 of patterns of labor utilization in the Rahad Project vicinity prior to the establishment of the project. That study identified twenty secondary occupations beside agriculture (29).

(2) Animal husbandry. It has been estimated that 40% of the population of the Sudan derive their living wholly or partially from animal husbandry. (20) Nomadism is the dominant system of animal husbandry in the Sudan

followed in adapting to seasonal incidences of diseases and scarcity of water and grazing. Due to the continuous movements of Nomads and/or their reluctance (for one reason or the other) to report the number of animals they own, the number of livestock in the Sudan and their labor requirements during the January-March period is yet to be determined.

CHAPTER VII

SUMMARY, POLICY IMPLICATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Summary

This study was intended to explore the labor requirements and supply for cotton picking in New Halfa Agricultural Corporation with special emphasis on tenant household labor. The survey data was collected from a multistage random sample of 132 tenant households. The sample was subdivided into two subsamples: 84 households from the Nomads and 48 households from the Halfawis, the numbers reflecting the proportion of the respective groups to the total tenant population. This subdivision was justified by the existence of differences between the two groups in their ethnic and cultural backgrounds, their attitudes towards farming and their degree of dependence on hired labor.

The sample was characterized by a slight excess of females over males indicated by a sex ratio of 47% in the Halfawi group and 48% in the Nomads. The proportion of dependent children (age 0-14) constituted 35% of the population of the Halfawi subsample and 55% of the Nomadic subsample. There was eight tenths of a dependent for every potentially economically active person in the

Halfawi group and 1.5 dependents for every potentially economically active person in the Nomadic group. The average family size in the Halfawi group was 4.9 persons, in contrast to a family size of 7.7 for the Nomads.

The study reveals that 80% of males in the potential labor force category in both subsamples participated in economic activity either as a main or subsidiary occupation. The average participation rate among women in the Halfawi subsample was 33% compared to 50% for women in the Nomadic subsample. The survey revealed that 48% of the economically active males in the Halfawi subsample have attained some level of education. The corresponding figure for Nomads was 16%. On the other hand, the degree of illiteracy among women in both subsamples was 100%.

Farming was the single most important activity in both subsamples. In addition to farming, 17 other main or subsidiary occupations were reported in the Halfawi subsample compared to only 4 in the Nomadic subsample.

Taking main and subsidiary occupations into consideration and aggregating input of household men, women, and children (using a common denominator), it has been estimated that an average household in the Halfawi subsample has an average potential man-equivalent hours of 101 per picking season (or 13 man-equivalent days on the assumption of 8 hours per man-equivalent days) of which only 49% was

actually utilized in cotton picking. The corresponding average figure for an average household in the Nomadic subsample was 320 man-equivalent hours (or 40 man-equivalent days) of which 84% was utilized. The justification for the lower labor input in cotton picking by Halfawi households (compared to Nomadic households) was that many Halfawis were engaged in other occupations where the opportunity cost of their labor was perceived to be higher. For instance, 50 percent of the Halfawi household heads interviewed had main occupations other than farming, compared to 1 percent for the Nomads.

Regression analysis was used to estimate labor supply functions for the household members. The objective was to identify those variables which influence the labor supply of tenant household members in cotton picking and to predict the likely impact of certain policies on the tenant household labor supply. The model adopted for the analysis of the household labor supply has the following characteristics:

(1) The model views the household as the appropriate decision unit which dictates the roles to be played by different family members and allocates their times between different activities in such a way as to maximize the total welfare of the household. For this reason, labor supply functions were specified and estimated for different labor categories (e.g., men, women and children) rather than for individuals within the household.

(2) Labor supply functions were disaggregated and estimated separately for men, women and children because the level of employment for these three categories, the functions they perform and, to some extent, the variables affecting their labor supply differ.

(3) The approach used in this model follows the comparative static micro-economic model, i.e. it depends on ceteris paribus assumptions.

For comparison, both Ordinary Least Squares method (OLS) and seemingly Unrelated Regressions (SUR) were used in the estimation of the household labor supply functions for the Nomadic subsample. It was hoped that by applying SUR which applies generalized least-squares to estimate coefficients in all equations simultaneously, coefficient estimators so obtained would be asymptotically more efficient (have a smaller variance) than is the case using OLS. For the Halfawi subsample, only OLS was used since only the labor supply equation for men was to be estimated (the labor supply of Halfawi household women in cotton picking was negligible and the labor supply of children was zero).

The results of OLS estimation of labor supply functions show that labor supply of Halfawi men to cotton picking increases with increases in expected net household income from cotton, and net income from groundnuts and implicit wage for men. It decreases with: increase in net income from wheat, increase in the number of young

children (0-5) and increase in the average age of men in the household.

Except for the coefficients of net income from groundnuts, the signs of all coefficients were in accordance with expectation. The positive coefficient of income from groundnut may be explained as follows: the advance paid by the Corporation is usually not adequate to pay all the wage bill for cotton picking. An increase in income from groundnuts will enable Halfawi tenants to hire more labor. This requires more supervision from family labor and may account for the increase in labor by family men associated with an increase in income from groundnuts.

It was also found that the labor supply of Nomadic household men in cotton picking increases with increase in: implicit wage rates, net income from cotton, the number of children (6-9), average age of men and the number of men per household.

The labor supply of Nomadic men was found to decrease with an increase in: family size, net income from groundnuts, net income from wheat, the number of children (0-5), and (10-14), and the number of years of education. Of those variables, the coefficients of implicit wage, net income from cotton, net income from groundnuts, net income from wheat, number of children (0-9) and (6-9), and number of men per household were statistically significant

at acceptable levels of significance. All the coefficients had the expected signs except that of the number of children (6-9) for which no justification could be found.

The labor supply of Nomadic women was found to increase with increase in net income from cotton, number of children (0-5), (6-9) and (10-14), and average number of women per household. On the other hand, implicit wage rate of women, family size, net income from wheat, net income from groundnuts and average women age, all tended to have a negative relationship with labor supply of Nomadic women. Of all the coefficients, only those associated with family size, net income from groundnuts, number of children (6-9) and (10-14) and average women age are statistically significant at acceptable levels.

All coefficients had the expected signs except the coefficients for the number of children. A possible explanation for the positive association between the labor supply of women and the number of children could be that in such a poor community the burden of a larger number of children may force women to allocate more labor to the market and less to the household, especially when some of the children are old enough to substitute women's work, e.g. help in taking care of younger children.

The labor supply of Nomadic children (10-14) was associated positively with implicit wage rate, net income from cotton, number of years of education and the number of children (age 10-14) per household. Net income from

groundnuts, net income from wheat and average child age were associated negatively with the labor supply of Nomadic children. All the coefficients are significant and all had the expected signs except for the coefficient of education. The positive sign of the coefficient of education may be attributed to a tendency among students to help their families meet the cost of their education (which tends to increase with increase in years of education) by participating in cotton picking on a part-time basis. Due to the high degree of illiteracy among tenants, students are needed to help their families in weighing cotton, paying pickers and keeping accounts.

The labor supply elasticities for men, women and children with respect to implicit wage rates and income from wheat derived from the estimated labor supply functions were generally very low (.02 to .12 for implicit wage rates and -.14 for income from wheat), which implies that the labor supply of household members for cotton picking was not sensitive to changes in implicit wage rates or net income from wheat.

The labor supply elasticities with respect to net income from cotton were relatively higher compared with elasticities for implicit own wage, net income from wheat and net income from groundnuts. The labor supply elasticity with respect to income from cotton picking was highest for Halfawi men (.87) and lowest for Nomadic men (.13 or -.15), with Nomadic children and women in between.

The elasticities of labor supply in cotton picking with respect to change in income from groundnuts is low and negative for men, women and children in the Nomadic group (-.11 or -.12 for men and children alike and -.31 for women), implying that an increase in net income from groundnuts, ceteris paribus, tends to induce a decline in the participation of Nomadic men and children in cotton picking, but the effect is very weak. As for Halfawi men, the elasticity of labor supply in cotton picking with respect to net income from groundnuts was .51.

The use of SUR vis-a-vis OLS showed modest gains in efficiency of coefficient estimators. This limited gain in efficiency may be attributed to the relatively strong degree of correlation between some of the variables. Another advantage of SUR over OLS was the improvement in the explanatory power.

Hired labor played a more important role in cotton picking than family labor. Ninety-four percent of the labor per household for cotton picking in an average Halfawi tenant household came from hired labor. The corresponding figure for an average Nomadic household was 76%.[1] Migrant labor was more important than local

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[1]This difference in labor supply behavior between Halfawis and Nomads can be attributed to economic and historical reasons. From the economic standpoint, the Halfawis were generally more educated than the Nomads. Consequently, many of them preferred to pursue off-farm employment because the opportunity cost of their labor in

hired labor constituting 81% of the total labor input in cotton picking in the Halfawi group and 52% of the total labor input in the Nomadic group.

Contrary to the assumption of fixed labor requirements per feddan widely accepted by planners and agricultural projects' managers, this study shows that the labor requirements for cotton picking vary substantially with the level of yield. For every yield level there is a corresponding level of labor requirements. By establishing a relation between yield levels and labor requirements, a more realistic approach is suggested for dealing with the question of estimating the labor requirements for cotton picking ahead of season.

Estimates of cost of picking showed that in 1977-78 season, the average cost of picking per big kantar was £SD1.98 for Halfawis compared to a £s 251 for the Nomadic group. The difference in cost was due to the fact that the Halfawis picked more big kantars per household using hired labor than the Nomads (21 big kantars for Halfawis compared to 16 big kantars for Nomads). This resulted in reduction of fixed cost for Halfawis vis-a-vis that of Nomads, e.g. since the cost of goods, shelter, and transportation are more or less fixed, their average cost per

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those activities was higher than in cotton picking. From a cultural standpoint, Halfawis, unlike Nomads, came from an area where tenant farming and cotton production were not practised.

per kantar decreased with quantity picked.

Both tenants and officials from the New Halfa Agricultural Corporation interviewed maintained that they have experienced shortages in hired labor in 1977/78 season. The main reasons given were: competition for hired labor from other agricultural schemes (e.g. Rahad Project and Gezira Scheme) which were in a position to offer more lucrative wages, and competition from wheat and groundnuts in New HalfaCorporation itself.

Matching estimates of labor requirements with potential supply for cotton and harvesting of major crops showed that the Blue Nile and Kassala provinces would have experienced substantial short-falls while Kordofan and Darfur would have experienced substantial surpluses. However, if the provinces with labor shortage and provinces experiencing labor surplus are viewed as interdependent, and if mobility of labor was not hindered by lack of information on alternative opportunities, or high cost of transport, and if the "right" wage was offered, no shortage would have been experienced. Due to lack of data, this analysis did not take into consideration labor requirements of live-stock and secondary occupations during the picking season which tend to reduce the amount of labor potentially available for cotton picking and harvesting of other crops.

Policy Implications Specific to New Halfa Agricultural Corporation

The survey reveals that the average Halfawi household in the sample had a potential of 13 man-equivalent days to allocate to cotton picking. This low potential labor supply is a consequence of the fact that a large number of household men are engaged in non-agricultural activities in the New Halfa area and in other parts of the country and yet they continue to hold tenancies. This group of tenants depends on hired labor to do all the work under the supervision of a local agent "Wakil" who could be a cooperative especially set up to handle these situations. Most of those farmers who are present and are pursuing farming as a main occupation view their role mainly as one of supervising hired labor. Another reason for the low potential family labor supply in the Halfawi group is the lack of participation of women and children in cotton picking. Not only was the potential tenant household labor very low, but also the actual utilization was only 50% of the potential.

In the Nomadic group the average household had a potential of 35 man-equivalent days which though almost fully utilized, constituted only 24% of the total labor requirements for cotton picking per household.

These findings should not be held as evidence of the futility of attempts to increase participation by family labor as one approach to alleviating the problem

of shortage of labor since there is still room for increasing the participation of men in the Halfawi group and increasing the participation of women, in both Nomadic and Halfawi groups. These findings only make it clear that under the existing tenancy size, hired labor will continue to be dominant.

Computed elasticities show that labor supply is extremely non-responsive to own wage rates for men, women and children. This means that the own wage rate is ineffective as a policy variable in inducing increased participation by household members.

Net income from cotton is the variable which seems to have the greatest impact on household labor participation in cotton picking. This variable is particularly effective with Halfawi men who have an elasticity of .87. This implies that an increase of 10% in net income from cotton, ceteris paribus, will increase labor supply of Halfawi household men by 9%. A decrease in income would have an opposite impact on labor supply of Halfawi men.

With an elasticity of .13, Nomadic household men showed the least response to change in income from cotton picking. On the other hand, Nomadic women and children, with elasticities of .4 and .3 are moderately responsive to change in income from cotton.

Increased income from cotton could be realized through

a policy of: (1) increasing yields by improved and timely land preparations, better control of weeds and pests, availability of irrigation and its efficient application by tenants, applications of appropriate amount of fertilizer, and educating tenants on the benefits of improved practices applied on time; (2) raising the grades of cotton lint by observing cleanliness in picking and by improving ginning; and (3) stopping the practice of deducting costs pertaining to groundnuts and wheat from tenants' revenue from cotton and (4) paying tenants in New Halfa an equitable price for their cotton crop.[2]

The elasticities of labor supply with respect to income from wheat are very low. This may be due to the fact that most husbandary practices in wheat (including harvesting) are mechanized anyway. The low elasticities imply that any plans for increasing wheat yields from their present low levels will not withdraw household labor from cotton picking.

Elasticities of labor supply with respect to income

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[2]The writer was told that it has been government policy to sell New Halfa cotton to the local industries at prices lower than what would have been obtained in international markets. At the same time, other corporations producing the same type of cotton are allowed to sell at higher international prices. This policy, the objective of which is to subsidize the consumer, is inequitable because it singles out New Halfa farmers alone for the sacrifice. It is also inefficient in achieving its objective, since it is believed that most of the cloth produced is sold by merchants to consumers at high prices in the black market.

from groundnuts show that this variable had the greatest impact on Halfawi men and Nomadic women (with elasticities of .52 and -.31, respectively). The positive sign of the elasticity with respect to Halfawi men implies that an increase in net income from groundnuts, ceteris paribus, would be associated with an increase in participation of Halfawi men in cotton picking. One possible explanation for this is that an increase in income from groundnuts, other things being equal, will enable them to hire more labor for cotton picking. Increasing hired labor calls for an increase in time spent by the tenant in supervision.

The negative elasticity associated with labor supply of Nomadic women implies that the labor supply of this group would decrease with an increase in income from groundnuts.

As far as the cost of picking per big kantar was concerned, it seems from cost figures from the two subsamples that the advances paid to tenants in 1977/78 season were not adequate to cover the cost of picking. Every tenant was paid ESD.01 per pound as an advance for cotton picking. Half of that amount was supposed to go to labor hired for picking. The remainder was supposed to go to other operations such as bailing, transportation of cotton to collection centers, etc. The part of the advance paid to pickers amounted to around ESD1.58 per

big kantar, which was far short of the Ls 1.98 and Ls 2.51 actually paid by a typical tenant in the Halfawi and Nomadic subsamples respectively. This implies that the tenant had to pay from his own pocket to supplement the advance, especially in such items as food. To the extent that some tenants may not have enough cash from their own resources to pay the extra expenses of picking (as was frequently expressed in the interviews held with tenants), there is a need to increase the advance adequately, so as to avoid situations where some tenants may have to leave a significant part of their cotton unpicked due to shortage of funds.

Current shortages of hired labor in Kassala and the Blue Nile provinces could be alleviated by allocating more funds by the agricultural schemes in these provinces for providing prospective laborers with subsidized information on employment opportunities in New Halfa project, subsidizing a two-way transportation of pickers and paying laborers the right wage rate.[3]

Another measure which could increase the availability of hired labor for cotton picking is the reduction of competition from other crops. For instance, Table 32 (page 126) shows that during the time of cotton picking

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[3]According to the ILO study (op. cit., p. 100) the wage rate seemed to have increased by only 3 percent per year over the last 20 years, which is far below the rise in prices over the same period.

a Halfawi tenant household uses 40 man-equivalent days in harvesting of groundnuts. A Nomadic household on the other hand uses 21 man-equivalent days for the same job. However, if land preparation and pre-watering could be completed by July 15 (the optimum date) so that harvesting could be finished by January 15, that much labor could be saved for cotton picking.

Overall Policy Recommendations

Some of the findings and recommendations from this study may well be extended to the other agricultural schemes. There are many features in common among these schemes (such as Government-tenant sharing relationship, types of crops, characteristics of farmers, etc.) which justify such a generalization.

One relevant finding from this study is the responsiveness of tenant labor supply in cotton picking to changes in income from cotton. Any measures which would increase the tenant's income from cotton tend to increase tenant household labor supply in cotton picking and vice versa.

Another important issue is the keen competition for cotton pickers among the different schemes. In the absence of coordination, this competition tends to be resolved in favor of projects which are able to pay higher wages because they have better access to public funds. However, those may not necessarily be the most efficient projects.

A national cotton picking committee should be formed to plan and supervise campaigns for recruiting cotton pickers. The functions of this committee should be to:

a) estimate the overall hired labor required for cotton picking in the country ahead of season;

b) identify the numbers and locations of prospective laborers,

c) disseminate information about employment opportunities and provide transportation for laborers between their villages and those schemes,

d) allocate those hired laborers among different schemes in accordance with national interest.

Suggestions for Further Research

Certain areas may be identified for future research to supplement this study.

The study focused mainly on labor supply of the tenant household with respect to cotton picking. There is an obvious need to study the total labor supply of the household (including on-and off-farm labor allocations) all year round. This approach will improve our understanding of the mechanism for the allocation of household labor among different activities, including cotton picking.

This study underscored the importance of hired labor in cotton picking. Further research is needed to estimate their labor supply functions in order to be able to see how their labor supply would change with changes in income

from cotton picking, income earned elsewhere, distance as well as socio-economic characteristics of the household. Such information is necessary for formulating policies regarding hired labor.

Since mechanical picking is considered a possible alternative in the future, studies should be made to examine the financial and economic feasibility of mechanical picking compared to hand picking. In case mechanical picking proved not feasible, under what conditions of yield, cotton prices, wage rates, prices of machinery, etc. will mechanization be the better alternative.

In estimating labor requirements for cotton picking in the country, estimates of labor requirements obtained from this study were assumed to be applicable to other projects growing the same cotton variety. Studies to determine labor requirements should be made at different projects taking into consideration variations in soils, climate, etc. Studies should also be made to estimate labor requirements of different crops and livestock in all major producing areas as well as the types and labor requirements of secondary occupations pursued by farmers during the slack period.

Labor supply estimates at the macro level used in this study need refining to identify more accurately the potential number of men, women and children available for work during the cotton picking period. A refinement

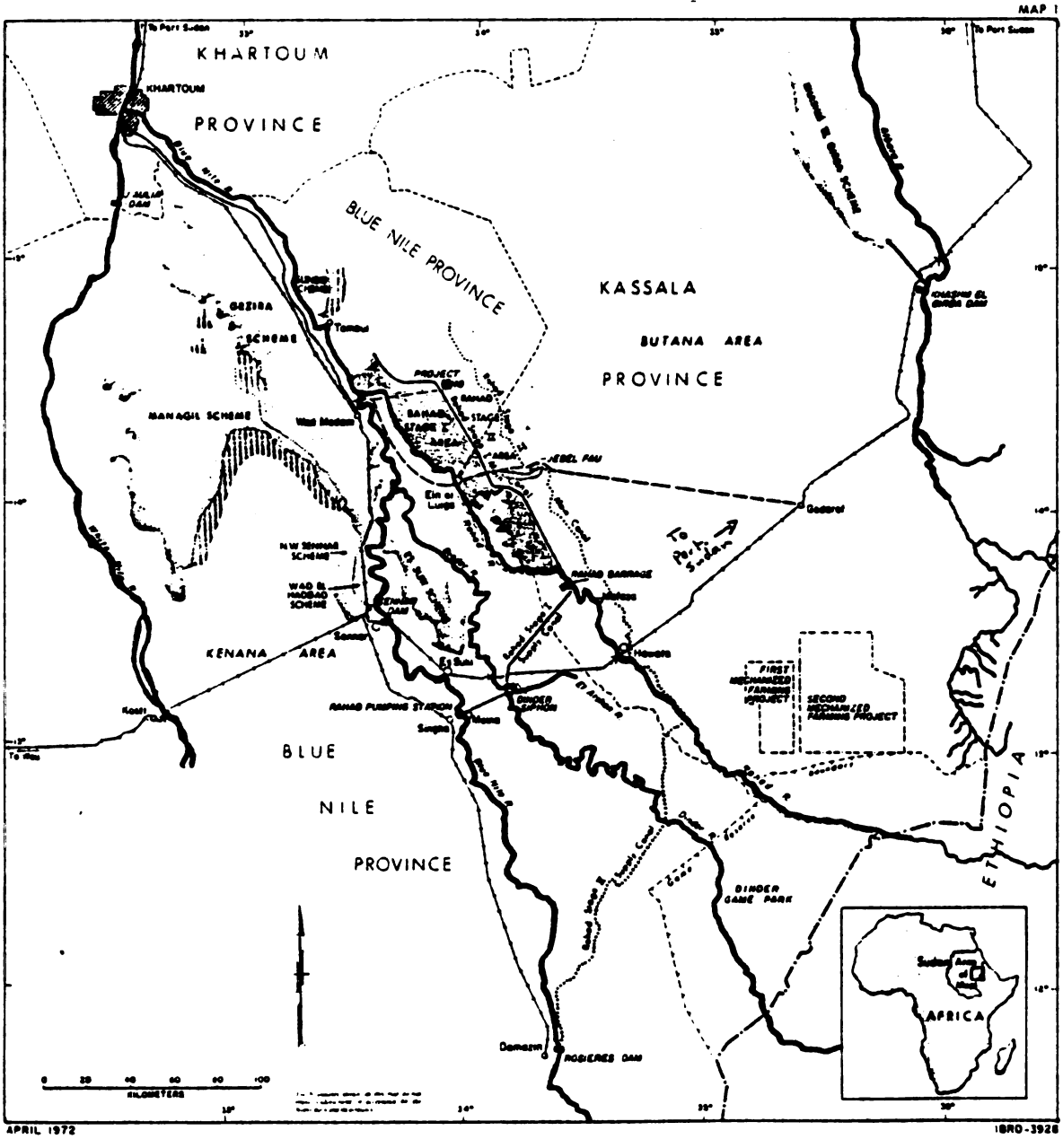
of the common denominator for aggregating different categories of labor is also called for.

One important variable which was excluded from this study due to lack of data but which may have proved important in explaining the difference in the labor supply behavior between Halfawis and Nomads was household net worth. It would be interesting for future studies of labor supply behavior to find out whether or not there is any association between household net worth and labor supply.

APPENDICES

Appendix I

New Halfa Corporation "Khashm El Girba Scheme" and Other Major Agricultural Projects in the Sudan



By courtesy of International Bank for Reconstruction and Development

Appendix IIA

Classification of Halfawi Villages for Multi-Stage Sampling

	Villages Where Management of Tenancies Undertaken by Individuals		
		Villages with Low Percentage of Absentee Tenants and/or Low Percentage of Tenants with Off-Farm Activities as Main Occupations	
Villages where Management of Tenancies Undertaken by Cooperatives (1)	Villages with High Percentage Absenteeism Among Tenants and/or Tenants Having Off-Farm Activities as Main Occupations (2)	Low Level of Participation by Household in Cotton Picking (3)	High Level of Participation by Household in Cotton Picking (4)
Village #18	Village #5	Village #1	Village #26
Village #19	Village #8	Village #2	Ard El Hagar
Village #22	Village #9	Village #3	
Village #23	Village #11	Village #4	
	Village #13	Village #6	
	Dabarosa	Village #7	
	El Basalwa	Village #10	
	Dewishab	Village #12	
		Village #14	
		Village #15	
Village selected to represent this stratum was #18	Village selected to represent this stratum was #5	Village selected to represent this group was #7	Village selected to represent this group was Ard El Hagar

Appendix IIB

Classification of Nomadic Villages for Multi-Stage Sampling

Villages Where Main Emphasis is on Crops			Villages Where Main Emphasis is on Livestock
Picking Undertaken Mainly by Household	Picking Undertaken Mainly by Hired Labor		
West Rataga	Um Rahaw	New Sophia	New Kurrag
East Rataga	Um Rukba	New Geih	Um Ararib
North Rashida	Um Gargur	Al Amlat	Warshalat
South Rashida	Rumat Gaed	New Reira	Al Shagrab
New Sobaga	Al Sheibik	Al Arid	Al Brais
Dabalwa	Village #7	Sabaat	Aridat Al Shukria
Dukhn	Village #8	Al Huda	Al Guneid
Al Aryal	Rataga Al Laoat	Salama Saroba	
Sabaat		Abu Harira	
Hayak Allah		Al Azaza	
Salim		Masak	
Mazar			

Appendix IIC

Villages Selected at Random (to represent their respective strata) and the Number of Households Interviewed in Each Village

Ethnic Group	Village Category	Village(s) Selected at Random	# of Households Interviewed
Halfawis	1	Village #18	8
	2	Village #5	12
	3	El Basawla	7
	4	Village #7	14
		Ard Al Hagar	7
Nomads	1	Dabalwa	8
		Sabaat	5
		Mazar	11
	2	Um Rahaw	11
		Masak	11
		Village #7	12
		Rataga-Al Laoat	7
	3	New Kurrag	11
		Warshalat	8
Total Number of Households Selected			132

Appendix III

The 1977/78 New Halfa Agricultural Corporation Tenant Sample Survey on Labor Requirements and Supply for Cotton Picking

Tenants' Questionnaire

A) Identification of Tenant

1. Name of tenant
2. Tribe
3. Section
4. Block
5. Village
6. Distance between Village and Hawahsa (kms)

B) Socio-Economic Characteristics of Tenant

1. Age
2. Sex
3. Marital status: _____

   Married: _____ No. of wives: _____

   Single: _____

   Divorced: _____

   Widow: _____
4. Occupations:

   a) Main: _____ b) Subsidiary:

   i) _____

   ii) _____

   iii) _____

5. Number of holdings held:

   a) In New Halfa Scheme: _____

   b) Elsewhere: _____

6. Management of crops in tenants' holding :

Arrangements by	Cotton	G. Nuts	Wheat
Tenant			
Village Coop			
Subletting			
Others			

7. Crops grown during 1977/78 season:

   a) Cotton _____

   b) Groundnuts _____

   c) Wheat _____

   d) Vegetables & Fruits _____

   e) Others _____

8. Livestock owned:

   a) Cattle _____

   b) Sheep _____

   c) Goats _____

   d) Camels _____

C) Socio-economic Characteristics of Tenant Household Members

S. No.	Relationship to tenant	Educational level	Occupations	
			Main	Subsidiary
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

D) Labor Input in Operations Competing with Cotton Picking

Operation	F.L.			H.L.					
				Local			Migrant		
	M	W	C	M	W	C	M	W	C
Putting Cotton in Sacks									
Transportation of Cotton to Collection Centers									
Collection of Groundnuts into Heaps									
Threshing of Groundnuts									
Washing of Groundnuts									
Transportation of Groundnuts from Field to Market									
Weeding of Wheat									
Harvesting of Wheat									
Transportation of Wheat									

Key: F.L. Family Labor

H.L. Hired Labor W. Women

M. Men C. Children

E) Sources of Labor for Cotton Picking

1) On what sources of labor did you depend to pick your cotton?

a) Family labor only _____

b) Hired labor only _____

c) Family plus hired labor _____

d) Others (mention, e.g. labor sharing with neighbors _____

2) Which of the economically active members of your family were engaged in cotton picking during this season (December 1977 through April 1978).

Member	Cotton picking	Other competing activities
1		
2		
3		
4		

F) Participation of Family Labor in Picking

Family Members	First Picking 1	2	3	4	5	6	Second Picking 7	8	9	10	11	Third Picking 12	13	14	15
Men															
1															
2															
3															
Women															
1															
2															
3															
Children															
1															
2															
3															

Key:

Nos.: 1, 6 & 11 = Date

2, 7 & 12 = No. of days

3, 8 & 13 = No. of hours

4, 9 & 14 = Total hours

5,10 & 15 = Quantity picked in lbs.

G) Participation of Hired Labor in Cotton Picking

1) Which category of hired labor did you hire.

a) Local _____

b) Migrant _____

c) Both _____

2) Estimation of Labor Input of Hired Labor in Picking

No. of pickings	Local Labor						Migrant Labor					
	1	2	3	4	5	6	7	8	9	10	11	12
First Picking												
Men												
Women												
Children												
Second Picking												
Men												
Women												
Children												
Third Picking												
Men												
Women												
Children												

Key:

1, 7 = No. of workers

2, 8 = No. of days

3, 9 = Hours worked per day

4, 10 = Total hours

5, 11 = Quantity picked in big kantar

6, 12 = Wage rate

3) How many laborers did you employ for cotton picking altogether this season? _____

4) Do you hire the same laborers every year?

Yes_____ No_____

5) From what tribe do you prefer to hire laborers for cotton picking?

Tenant's own tribe _____) Why:

Other tribes (mention) _____)

No preference _____

6) How did you get cotton pickers?

a) Tenant's own arrangements

b) Through New Halfa Agricultural Corporation _____

c) Through laborers' own initiative _____

d) Other means (specify) _____

7) What is the overall average yield of your holding (in big kantars per feddan)? _____

8) With this level of yield obtained in your holding this season, how much cotton (in lbs) do you expect a man to pick during what you consider to be a day or work?

Picking	Family labor	Hired labor
First Picking		
Second Picking		
Third Picking		

9) How do you rate the productivity of men, women and children in cotton picking?

	Family Labor	Hired Labor
Man	100*	
Women		
Child		

H) Estimate of Cotton Losses

1) Have you picked all the cotton you should?

Yes_____ No _____

2) If No

a) Why:

i) could not find enough laborers at the fixed wage rate _____

ii) Grazing of the cotton crop by livestock ____

iii) Others (specify) _____

b) What is your estimate of the losses (in Big Kantars per feddan) _____

I) Cost of Picking by Hired Labor

1) What system do you use in recruiting hired labor?

a) Recruit laborers individually _____

b) Recruit laborers as families _____

c) Both (a) and (b) _____

*The productivity of a man from the family is given an index of 100. The productivity of women and children from the tenant family as well as men, women and children from hired labor are measured in relation to this index.

2) Estimate of the Cost of Hand Picking by Hired Labor

Number of Pickings	System	No. of Individuals involved	No. of Big Kantars Picked	Wage Rate	Total Wage Paid	Transport* Cost	Food	Others e.g. Shelter
First Picking								
Second Picking								
Third Picking								

*Transport cost are usually paid one way from place of origin to New Halfa Scheme

J. Tenants' Opinion on Shortage of Labor for Cotton Picking

(1) Do you have problem getting hired labor:

(a) Yes

(b) No

(2) In case the answer is yes, what suggestions do you offer to solve the problem of shortage of cotton picking labor?

(a) Increase wage rate

(b) Introduce mechanical picking

(c) A combination of (a) and (b)

(d) Other suggestions (Specify)
(Give reasons for your suggestions)

Appendix IVA

Estimates of Average Cost of Production of Medium Staple Cotton (Acala 4/42) Per 5 Feddan Holding at an Average Yield of 5 Big Kantar Per Feddan

1977/78 Season

Sequence Number	Operation	Cost in L.S
1	Clearance of weeds and bushes	6.00
2	Deep plowing	12.50
3	Disc harrowing	5.00
4	Ridging	5.00
5	Maintenance of water channels	3.55
6	Pre-watering	1.00
7	Disc harrowing	5.00
8	Ridging	4.00
9	Fertilizer (Urea)	55.46
10	Fertilizer transport	.800
11	Fertilizer application	.800
12	Sowing	5.00
13	Dividing cotton area into 20 irrigation basins	2.25
14	Maintenance of water channels	1.00
15	First watering	1.00
16	Subsequent waterings (9)	4.50
17	First weeding	12.00
18	Green ridging	4.00
19	Redividing cotton area into 16 irrigation basins	1.50
20	Thinning	7.50
21	Second weeding	12.00
22	Third weeding	12.00
23	Fourth weeding	8.00
24	Cotton storage	10.00
25	Picking cotton and transportation to collection centers	50.00
26	Cost of 25 sacks	10.10
27	Cost of spraying (7 sprays)	100.00
28	Burning cotton stalks	13.00
29	Sweeping to remove small branches	5.00
30		
	Total	357.96

Appendix IVB

Estimates of Average Cost of Production of Wheat Per 5 Feddans at an Average Yield of .8 Ton Per Feddan

(1977/78 Season)

Sequence Number	Operation	Cost in L.E.
1	Clearance of weeds and bushes	5.00
2	Ridging	3.50
3	Maintenance of water channels	4.00
4	Pre-watering	1.00
5	Disc harrowing	2.50
6	Seeds (250 Kgs)	22.50
7	Transportation of seeds	.50
8	Sowing	4.50
9	Raising seed bed	3.00
10	Dividing wheat area into 16 basins	3.00
11	Fertilizer	55.47
12	Transportation of fertilizer	.80
13	Application of fertilizer	.80
14	Maintenance of water channels	1.00
15	First Watering	1.00
16	Subsequent waterings (7)	3.50
17	Weeding	9.00
18	Spraying insecticides	5.00
19	Harvesting	20.00
20	Cost of sacks	12.40
21	Transportation of crop	8.00
22	Taxes	16.20
23		
	Total	182.67

Appendix IVC

Estimates of Average Cost of Production of Groundnuts per 5 Feddans at an Average Yield of 1.5 Tons Per Feddan

Sequence Number	Operation	Cost in £S
1	Cleaning of weeds and bushes	5.00
2	Ridging	3.50
3	Maintenance of water channels	1.25
4	Pre-watering	1.00
5	Disc harrowing	5.00
6	Ridging	4.00
7	Dividing groundnut area into irrigation basins	2.25
8	Seeds	24.00
9	Sowing	5.00
10	First watering	1.00
11	Subsequent waterings (6)	6.00
12	First weeding	12.00
13	Green ridging	4.00
14	Redividing groundnut area into irrigation basins	1.50
15	Second weeding	15.00
16	Third weeding	8.00
17	Harvesting	85.00
18	Washing of crop	15.00
19	Sacks	32.10
20	Taxes	27.00
21		
	Total	257.6

Source: New Halfa Agricultural Corporation

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