EXPERIENCE OF SOME COUNTRIES IN AGRICULTURAL MECHANIZATION

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INTRODUCTION

It is indeed regrettable and grievous to find at the end of the 20th century some people in underdeveloped countries still using some primitive and manual means which were used by our forefathers about 5000 years ago. At the same time the people in developed countries use the mast recently invented agricultural tools and sets.

It is true that economic progress has undoubtedly become the responsibility of the whole international society to achieve the welfare for both the developed and underdeveloped countries. However, the main responsibility for the development in underdeveloped countries will always be the responsibility of these countries. We can affirm that every underdeveloped country will be more able to study and determine its national aims according to its special conditions. Through studying its aims, the country can ensure a minimum standard of living which does stand against man's dignity. This can be done through progress and development not only for the present generation, but for the future generations as well.

There is no doubt that hunger and malnutrition which previail over large area of the world need a great and comprehensive development which aims at increasing the

yield of agricultural sector. This sector which faces many problems and difficulties which obstruct the way for development in many parts of the world.

On the whol, the layman in our country and in other underdeveloped countries is looking forward to shedding the shackles of poverty and leading a dignified life like any other citizen in developed countries.

This study deals with the circumstances and problems concerning the development and improvment of agricultural mechanization in underdeveloped countries, especially in Africa, Asia and Latin America. It also deals with the experience of some countries like Romania and India in the field of applying agricultural mechization on the basis that this is one of the pillars of agricultural development, taking into consideration to select the bst means for increasing the agricultural productivity and achieving economic welfare for the country people and liberating the farmer from the hard labor and changing him into an active and competent person who can share in building and developing other economic national sectors insteed of being a burden on them.

CHAPTER I

BENEFITS AND COSTS OF AGRICULTURAL MECHANIZATION

1) What does agricultural mechanization mean ?

As carl W. Hall states, "A basic principle of agricultural mechanization is that change should be meaningful. Introduction of a mechanical aid should fulfill the cultural, employment, human, timeliness, and productive needs of the farmer and society as a whole, as well as the economic conditions. Meaning ful mechanization includes then anything from the improvement of the introduction of large power units and equipment on the time, place and the reated conditions".(1) Consequently, when we mention agricultural mechanization we do not mean only the process of ploughing as some people imagine but we mean succesive processes to get the crops, starting with the processes of seed bed preparation until the processes of gothering and harvesting the crops, vegetables and fruits. At last, we have also the process of transporting the crops and agricultural materials.

Through the above mentioned concept, agricultural mechanization means the achievement of many aims and results.

2) Yietd effects :

The high rate of germination and production of any crop depends to a great extent on serving the place of the seed and preparing it well. This process can be achieved effieiently through the use of suitable agricultural equipments which do the primary processes i.e., plaughing, harrowing, levelling .. .. .. etc. The use of some tools such as subsoiler,has enabled us to increase the efficiency of drainage and improving the soil, because animals are not used in such processes.

This thing has a positive and direct effect, because crops grow well, and the yield of the farm increases.

Mechanization can also increase p roduction and minimize losses through proper seed and fertilzation placement, adequate and timely cultivation and controlled harvesting, drying and storage. The mature crop should be removed from the field as quickly as possible to minimize losses that result from matural climatic causes.. rain, wind, hot or humid weather.. as well as from insects and diseases.

By using the seed drill in cultivating cotton we can save 50% of the seeds used through the traditional method. Also, by using this machine we can get 70000 to 90000 cotton plants in every feddan in Egypt, where as the number is 45 000 to 50 000 when we use the manual method. If we move to another process like irrigation, we shall find that by using the new equipments we can control the amount of wates needed for every crop, and of course this will affect the productivity of the soil. In this respect Carl W. Hall says; "Water control and multi-cropping are two major factors contributing to increase land productivity in developing countries". The importance of increasing the yield results from the fact that land is main source in most countries and agricultural is consequently the base for industrial production.

3) Timeliness of operation :

The factor of time is one of the most important factors which affect the processes of agriculture , starting from preparing the soil for cultivation to harvest time. It is well known that every crop has an ideal time for planting; ealled the most suitable time . This time is fixed as about 15 days. If the time for planting the crop was delayed, the resulf

will be a lack of production which may be estimated as 15% at least.

If we consider ploughing, as a one of the ways for preparing the land for cultivation in Egypt,we'll find the Egyptian farmer has to move with his animals about 21 kilometres in order to plough one feddan. At the same a 45 or 50 h.p. tractor can plaugh 8 feddans a day. The process of cultivation too, can take place in a very short time by using farm machines. By using the cotton planter for planting cotton, we find that through this machine we can plant 25 feddans every day, because about 20 minutes only need for cultivation of one feddan.

Agricultural mechanization is a major factor in maximizing land productivity through timeliness of operation. Paddy field preparation for transplanting or seeding rice must be done not only properly but in a minimum of time. As carl W. Hall says "every day that a paddy field is out of production can mean a loss of 50 kilograms of rice per hectar (based on production of 5000 k.g. per hectar in about 100 days)".

Specific operations, for example harvesting, must be done at a precise time or lagre losses occur. For

a givin crop the optimum period for harvest may be no more than 10 days, and fof course this time can not be done without the use of mechanical power for harvesting.

4) Labor use and cost :

The problem of agriculture concerning labor is still umsolved in underdeveloped countries. Agricultural operations suffer from the shortage of labor at the peak season in some countries, and all the year round in others. Egypt, for example, has suffered from labor shortage for the last five years. This is due to the poliey of reconstruction and economic development for all the national economic sectors. It is due also to the introduction of new tehnology in various productive branches. This led to the increase of opportunities for work in sectors other than that of agriculture. Another reason for the labor shortage is the spread of education and the emigration of some labors to Arab countries. In 1975 the population of Egypt was about 3% 4 million and the workforce about 12.5 million persons, giving a crude participation rate of 33.4%. The general participation of women (included in this estimate) in the rural economy raises the crude parficipation rate to quite a high level by regional

standards. In 1975 most Egyptian migrant workers were in Libya (58%), some 24% of them were in Saudia Arabia, and the remainder were distributed between other capital-rich and capital-poor Statses.(1) The above mentioned reasons led the agricultural labors to give up the manual agricultural work and to aspire for other economic activities such as industry, in order to get better wage and better standard of living. Statistics in Egypt shows that there is a labor shortage in the peak season especially in may and June, the time of harvesting of winter crops, threshing wheat, pest control in cotton and cultivating rice. The pressure of work increases but to a lesser degree in September and October, the time gathering cotton.

Consequemtly, the wages of laborers increase in such a way that can not keep up with the income of the Egyptian farmer or the increase of the price of crops. This way lead some farmers to escape from cultivating some importance crops such as cotton, because they need a great number of laborers.

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(1) "International Migration and development in the Arab Region". International labor office, Geneva. J.S. Birks and C.A.Sinelair.

The effect of the mechanization of agriculture is shown in the number of worker-hours required to grow and harvest on acre of wheat in the U.S.A. yielding 20 bushels. In 1830, when the grain was sown and harvested by hand with a cradle, 55.7 worder-hours were required. In 1896, with the use of a horse-drawn drill and binder, 8.8 worker-hours were required, while in 1930, with the tractor-drawn drill and combine for cultivation, harvesting and threshing, only 3.3 worker-hours were necessary. Newer machines and improved practices in producing spring wheat reduced the required worker-hours in 1950 to 1.4 in South Dakota, and to 1.8 in northeastern Montana and south western North Dakota.(1)

There has been also more progress in the reduction of workerhours required to grow and harvest one acre of cotton from 1940 to 1970 than in all the previous history of the crop. This resulted from farm mechanization practices and the use of chemicals. Thus the efficiency of agricultural productivity multiplied more than 40 or 50 times during the last

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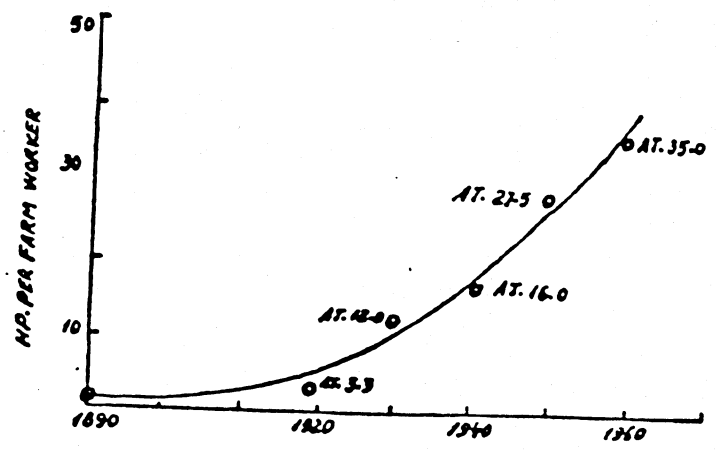
(1) Smith, and Wilkes, 1979."Farm Machinery and Equipment". Tata McGraw-Hill Puplishing Company Ltd. NewDelhi. Sixth Edition.

170 years, and farm equipment is being increased in size and efficiency so that farmers can produce more with less labor and cost.

5) Increasing the economic efficiency of inputs and outputs:

Mechanization means also include the efficient utilization of all available energy sources..human, animal, fossil fuels, wind, water and radiation. In 1960 each agricultural worker in the United States had a mechanical power equivalent of 35 h.p. available for his use, compared to 2 hp. in 1890. Figure (1-1) illustrates the increase in horsepower availability to agricultural workers over the 70 years of development. Today in the United States, each agricultural worker has at his disposel twice the mechanical horsepower of his industrial counterpart.

Increased labor productivity has parallelled the change to fuel consuming tractor power. Table (1-1) shows some average production figures for corn and other major crops. 1 bushel of corn



(Fig. 1-1) HP. AVAILABLE FOR FARM WORKER. (1)

was produced per manhour 50 years ago, 15 bushels in 1965, and it is estimateted that by 1980, 30 bushels per man-hour will be produced in the U.S.A

TABLE(1-1)

U.S.A PRODUCTION COMPARISON:50yrs.AGO AND TODAY

(PER MAN-HOUR)

	Corn, bu	Silag, ton	Hay, bales	Plow, acre	Eggs, dozen	Milk, Cwt.
50 Yrs. ago	1	0.10	29	0.25	4	39
1965 (ave)	15	1.30	160	1.10	15	102
1980 (est)	30	3	300	3	30	200

In 1855 practicolly 80% of the population of the United States lived on farms, while in 1973, more than 90% lived in towns, cities and Urdan areas. The period from 1945 to 1973 has had rapid progress in farm mechanization and sharp increases in yields of crops and livestock because of widespread adoption of improved farming practiees. These changes have made possible a great rise in total farm output, with fewer worker-hours spent of farm work.(2)

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(1) Ibid. Pag.6.

(2) Opcit. chapter 1.

6) Social development

The comprehensive meaning of agricultural mechanization means raising the farmeis hygienic and living standard. This can be done through liberating the human power from the hard manual labor in fields. It can be also achieved without employing children and women, thus giving them a chance to learn and to read a better life in the future. The farmers in underdeveloped countries became less able in doing their work because of the endemic diseases and ignoring both treatment and patection of disease. In Egypt, for example, the research studies estimated the number of siek cases in the country to be more than a million cases. The materialistic loss resulting from them amounted to 300 million pounds per year. It has been found that the Egyptian Citizen catches two diseases or more and this consequentely offects his age (The average age of man in Egypt is about 39 years). This average is considerably less than that in the hygienically developed countries. The number of cases catching parasites ranges from 25%, to 75%, those catching anaemia 70%, pellagra 8%, malaria 4%, gramular conjunctivits 90%.....etc.(1)

(1)Ahmed A.Imam.1979.,"Mechanization and the Social Development in the Egyptian Country".Paper 1979/10, in the scientific seminar about agricultural mechanization for food security. (in Arabic) Cairo.

On the other hand, the primitive means followed by the famers in Underdeveloped countries helped some bad social factors to spread, like the superficial economic and social culture. This factor does not enable the farmer to use the natural wealth. Another factor is mis-using the spare time, and acquiring bad habits in general.

As for social development, there have been various concepts to explain it . These concepts vary acc according to the continuous development of human life and the stages of the development of societies. However, there is a tendency to have an integrated concept for social development. This concept points out the trial to cause some changes in the constractive and social framework at the society, which willeventvally lead to raising the capability, the living standard and the welfare of all the members of the socity. Principally, agricultural machanization meams causing materialistic changes in the available productive tools in the country sector where more than half of the third world live.

7) Cost of Production

We can reduce the cost of agricultural yields when we minimize the cost of various agricultural

processes . This can be done by using the power of machines which is less costly than human or animal power. Some studies have found out that if the Egyptian laborer works for 10 hours in the field, the po power of his muscles will be equal to 1 hp./hour. That means, that the tractor whose power is 50 hp. will do the work of 50 workers per day. But, the average wage of labor in the year 1979 is £.1.06per-day,(1) while the cost of one mechanical horsepower per day is £.0.150.(2)

In 1969, many experiments were made on a relatively large scale by the Faculty of Agriculture of the University of Alexandria and the farms of the Ministry of Agriculture to show the contrast between mechanical agriculture and the traditional one which uses manual and animal power. The experiment whose results are pointed out in the table (1-2) is one of these experiments. This experiment was made in Kafr El-Sheikh Governorate, at "Mehalet Mousa farm", to compare the cultivation of cotton mechanically and

(1) Ministry of Agriculture,Department of Agricultural Economics and Statistics. Unpublic. Cairo.

(2) Ahmed Al-Beheiry,1979.,"The effects of agricultural mechanization on developing agricultural production. Paper 1979/8,in Arabic. Cairo.

TABLE (1-2)

TIME AND COSTS NEEDED FOR CULTIVATION FEDDAN MECHANICALLY, COMPARED WITH THOSE FOR A FEBBAN CULTIVATED TRADITIONALLY.

(MEHALET MOUSA 1970)(1)

The item to be compared	Machanic. cultive.	Tradition cultive.
The average of the production of feddan in quintar.(2)	7,02	4,60
Cost without the price of fertilizers or pesticides per pound.	18,68	32,53
Time needed for ploughing the feddan per hour.	10:1	25:
Time needed for harrowing or leveling per hour	- :40	8:-
Time needed for cultivation per hour.	- :30	8:-
Time needed for spraying the pesticides per hour	-: 30	1:20
Time needed for digging once only per hour.	-: 30	10:-
The total cost for producing a qu quintar of cotton per pound.	5.000	10.000

manually on area of 200 feddans for each. Two similar

(1) Ali Ali Al-Khishin, 1979., "Introducing the Agricultural Mechanization to the Egyptian Farmers". Paper 1979/10, in the scientific sominar about agricultural mechanization for food security (In Arabic) Cairo.
(2) 1 quintar= 157.5 Kilogram cotton (lint).

manually on area of 200 feddans for each. Two similar areas were chosen for the experiment. The same kind of cotton was cultivated mechanically in the first area and manually in the other. All the agricultural operations, except harvesting, wer made mechanically, in the first area. The table (1-2) shows us briefly the results of this experiment. From the results printed out on the table we have three important observations :

1- There is a great difference between the cost of performing the operations in both cases. The sum decreased from 32.53 pounds for traditional agriculture to 18.68 pounds for the mechanical one.

2- The time needed for performing the mechanical operations has considerably decreased. Harrowing and levelling need between 30 and 40 minutes to be finished mechanically wherease they need 8 hours to be finished traditionally. On the other hand, the feddan needs about 70 minutes to be ploughed mechanically by the tractor whereas it needs about 8 hours to be ploughed traditionally by the animals.

3- The production increased considerably. Mechanically cultivated gave us 7.02 quintars per feddan, whereds traditionally cultivated gave us 4.6

quintars. The increase in production is 52.6%.

This resulted in reducing the total eost of the produced unit (one quintar) to more than 50%; because the mechanical cultivation cost 5 pounds where as the traditional one cost 10.5 pounds.

TABLE (1-3)

THE TIME AND COST FOR A FEDDAN CULTIVATED MECHANICALLY COMPARED WITH THOSE FOR A FEDDAN CULTIVATED TRADITIONALLY.

Planting operations.	Time in hour		Cost in £E.		Notice.
	Tradition h. m.	Mechan. h. m.	Tradition	Mechan.	
Plowyhing	16: 00	1: 00	3.000	1.000	- Traditional ploughing needs to two animals (£. 1.000) a day (£. 0.500) per day 8 hours.
Harrowing	8: 00	-: 30	1.000	.000	
Mechanical leveling	- -	-: 30	- -	.500	
Ridge roller	8: 00	-: 30	2.000	.300	- A donkey and a boy for 4 days needs for organic fertilization.
Planting (Radication)	8: 00	-: 30	2.000	.500	
Manurig	50: 00	2: 00	4.000	2.000	
Cultivation	8. 00	-: 30	4.000	-.300	-
Chemical fertilization	8: 00	-: 30	2.000	-.500	
Chemical pest control	2: 00	1: 30	1.000	.250	
Harvesting	16: 00	-: 30	12: 000	2.000	

Other experiments were made on a larger scale in the Agration reform areas starting from 1972/1973. An area of 3500 feddans was mechanically cultivated by wheat under the supervision of the Agrariar Reform General organization and the cooperations of the users themselves. The table (1-3) shows the difference of

the time used and the cost needed for cultivating one feddan traditionally and mechamically. The total result of this table shows that the time decreased from 124 hours using traditional methods to 10:35 hours using the mechanical ones. The cost also decreased from 29:5 pounds to less thon one third by using the mechanical methods.

Increasing labor productivity, energy sources and the economic efficiency for caroying out the process, all of these means reducing the cost of agricultural yields. Also shortening the time for carying out of agricultural processes means the same.

In short, agricultural mechanization includes all mechanical means used for agricultural production, processing, transporting and storge. From the simplest hoe to the most complicated machine and powerful tractor, the purpose of mechanization is to make man a more efficient director of power, when a farmer is both a producer and director of mower his energies are mostly consumed for mower.

CHPTER II

TECHNOLOGY OF AGRICULTURAL TOOLS AND ITS RELATION WITH AGRICULTURAL PRODUCTION

I) Technology in agricultural sector

The history of economics in all developed countries has depended to a great extent on ogriculture. Any progressive step in Agricultural economics depends on using agricultural tools. And any development or improvement in designing the tools resulted to the immediate progress in agricultural production. This is turn to lead to progress in all other economic aspects. As a result of this, the number of agricultural labors in developed countries decreases gradually wherever the agricultural equipments spread and wherever the agricultural labors become clever craftsmen doing things other than agriculture. The remaining agricultural workers used modern agricultural machinges which increased their individual efficiency in agricultural yields. This gave agriculture a great prestige and enabled the agricultural laborers to have high incomes sometimes higher than those doing other things than agriculture.

Generally speaking, since the invention of the internal combustion engine, a great development has

occurred in using farm machinery during the previous fifty years. Consequently, great changes took place in means of agriculture in developed countries in Europe, Australia, Canada, U.S.A and all industrial countries. This is due to the use of agricultural mechonilation in great areas and to the decreasing mumbers of agricultural workers.

The table (2.1) point out the number of population, the number of working powers, the agricultural workers in some developed and underdeveloped countries. From this table we find that the percentage of those working for agriculture increase in under developed countries to reach 78.6% in Afghanistan, 77.9% in Sudan, 84.4% in Bangladish and 51.2% in Egypt. Generally spking this percentage is more than 50% in all underdeveloped countries. But, if we look at the same percentage in developed countries we shall find that it has decreased to 2.4% in USA, 4% in West Germany, 7.7% in Danmark ... ek.

2) <u>The evolution of the stages of agriculure in the world</u>

Agriculture in the world has passed through three stages:

Table (2-1)
Population and Labor: Total and Farm in some developed and underdeveloped countries. Year 1978

Country	Total Population	Farm Population	Total Labor	Farm Labor	
				Numpber	Percentage of Total Labor
Developed Countries:					
Danmark	5106	396	2435	189	7,7
France	53302	5089	22754	2173	9,5
W.Germany	61310	2821	28474	1310	4
Italy	56697	7076	21229	2649	17,5
U.S.A.	218340	5161	98466	2327	2,4
USSR	261200	47189	131771	23806	18,1
Australia	7508	760	3314	336	10,1
Hungary	10685	2060	5287	916	17,3
Hew-Zealand	3107	303	1246	121	9,7
Uhder Developed Count.:					
Egypt	37997	19451	110677	5466	51,2
Sudan	16693	13011	5209	4060	77,9
Afghanistan	20882	16420	7036	5533	78,6
Bangaladish	79900	67417	27335	23064	84,4
Burma	33550	17868	13560	7222	53,4
India	660976	427304	255546	163204	64,6
Ghana	10775	5685	4002	2092	52,3
Taneania	16886	13862	6975	5726	82,1
Eaire	26445	19917	11309	8518	75,3

Source: Production year book (1978) F.A.O. Vol. 32.

1. The primitive stage, or the stage of monual work.

During this stage agriculture was considered a main work depending on simple manual work, while the laborers were exploited and enslaved. This stage was characterised by the low agricultural production in comparison with the unit work and unit area. This stage lasted till the begining of 19 th century.

2. The semi primitive stage or the animal work stage.

Besides manual work, tame animals such as horses, mules and oxen were used for pulling fools designed for agricultural operations. In this stage the way of the farmer's life changed to some extent, their income increased and the average production raised in comparison with the worker and the unit area. This stage lasted fill the begining of the 20 th century.

3. The stage of mechanical agriculture, or mechanical work.

This last stage is the civiliyed one which represents the modern technology and its application in agricultural production in developed countries. This stage began at the begining of the present century by using steam engines which were followed by the internal combustion engines. At last electricity

was used and led to a rise in the stomdard of living of farmers and agricultural laborers. Agriculture became a respectable profession with no exploitation or slavery. At the same time the percentage of those working for agriculture decreased and the costs of agricultural production reduced.

The recent agricultural machines led to a considerable decrease of manual work. For example, in the USA in 1854 agriculture depended on primitive tools, and a single agricultural laborer produced what was enough for him and five ether persons. In 1974 using the modern agricultural equipment, the single agricultural worker produced what was enough for him and 55 other persons.(1)

3) Minimum power requirements

Minimum power requirments for the necessary cropping functions is a critical question. Giles (1967) developed a thesis that 0.5 hp. per hectar was a minimum power requirment for developing countries. Figure (2-1) helps to support the thesis with a grafical represemtation of the existing horsepower available for agricultural field production in various countries, regions and continents. Figure (2-2) relates the available horsepower to crop yields. The relationship does not necessary prove

(1) Smith, and Wilkes, 1979, "Farm Machinery and Equipment". Tata McGraw-Hill Publishing company Ltd. New Delhi. Sixth Edition.

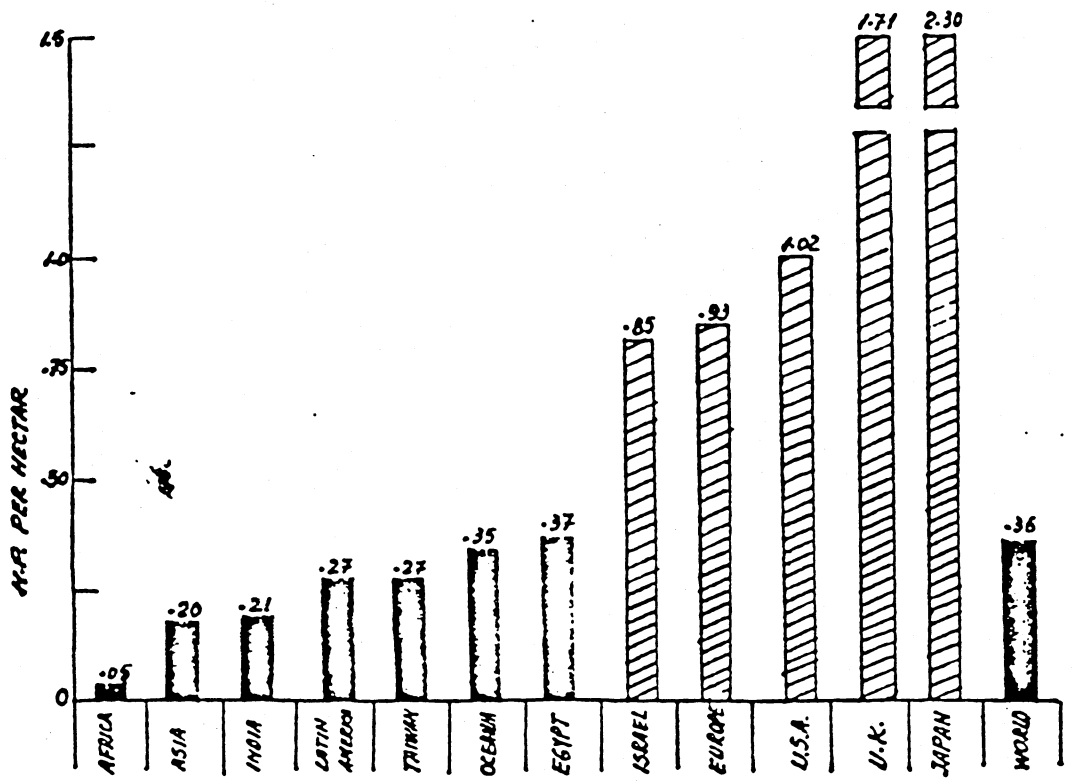

FIG.(2-1) POWER AVAILABLE FOR AGRICULTURAL FIELD PRODUCTION 1964-65 (ARABLE LAND AND UNDER PERMANENT CROPS)

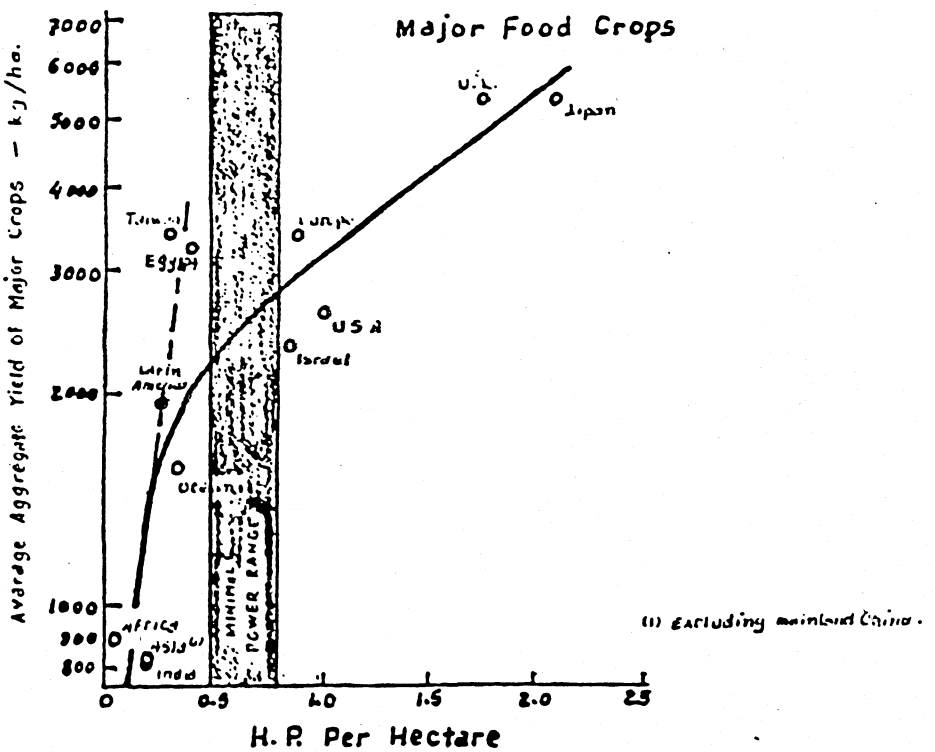

FIG.(2-2) RELATIONSHIP BETWEEN YIELDS IN KG./Ha. AND POWER IN HORSE POWER PER HECTARE.

that greater power applications to agricultural operations in the developing countries will bring about increased yields. The plot on the semi-log scale of Fig. (2-2) with an inflection point at 0.5 hp./ha does, however, confirm some infer-related cause and effect between power and yield.

There appears to have been a dramatic relationship between power and yield up to 0.5 hp./ha. The countries indicated with available power above 0.8 hp./ha. are all quite well developed and the high power application has been for the purpose of labor efficiency rather than just cropping intensification. The high yield-low conditions of Taiwan and Egypt would tend to belie to some extent the projected need of 0.5 hp./ha for high yields. These countries are however, atypical as compared broadly to the continents and large countries of Asia, Africa and Latin America. Taiwan and Egypt have a very high ratio of irrigated to total cultivated land, a greater portion of their land is related first class, the people are healthier and have a higher calorie intake.

CHAPTER III

Agricultural Mechanization in Equatorial African Countries

1) An overview of farming system in Equatorial African Agriculture:

The African Nations could become important suppliers of food and fiber for the world if the limited water, power and human resources were developed. Africa presently has the largest land area under shifting cultivation of any continent. And the key to economic development for nations in Equatorial Africa is productivity by agricultural population, as the countries are primarily agricultural. Mechanization along with other technological inputs can increase agricultural production, and productivity of agricultural population.

Small subsistance farming is a traditional pattern throughout much of Equatorial Africa. The farmers are mostly hand tools users. Locally made tools are used to till the soil, and more than 90% of farming in Equatorial Africa use in upland farming the short-handled hoe. A more efficient

source of farm power is an essential factor in increasing agricultural productivity. While there are many variations in method of attachment and style, shape and size of blade and handle, there is a remarkable similarity in indigenous small hand tools across Equatorial Africa. The evolutional changes in tools have been slow as many in present use bear striking resemblances ancient tools. Labour in the tropieal zone of Africa is generally under-employed except during peak seasonal demand period.

2) Hand powered Agriculture in Equatorial Africa:

Hand tillage is an arduous task, because of this, the African farmer follows a pattern that might be described as minimum tillage. A sistem of cultivation practices have evolved which assure a basic food supply with the least risk of failure. Compromises and short cuts are often reverted to as the farmers are conforted with wet and dry seasons, hard soils, intens rain falls and critical planting times. Hand tools are made genrally by local artisans, thus they are inexpensive and easy to repair. The development process for such tools is by evolution rather than design. They are often quite deficient in materials and ease of use.

The local supply and distribution of improved tools at the village level is critical. Isolated village and poor roads make distribution difficult. Suppliers and traders are relvctant to try different or improved tools as the margen of profit is small and they can't gamble on non-acceptance. Well distributed small local factories would improve the supply problem.

From 2 to 8 different crops growen together on the same plot of ground. Mixed cropping is practiced in both shifting cultivation and permanent agriculture. Crop mixing is a widely practiced schame for hedgine against risk. Merle L. Esmay and Carl W. Hall determined the following advantages of mixed cropping:(1)

1- Less risk of all crops being ruined by disease, draught or insects.
2- Total production from all crops is greater.
3- Land is prepared only once for the total mix of crops.
4- This intensified cropping can be done on the best land.
5- Weed control is effectively done by hand.

(1) Merle L. Esmay and Carl W. Hall, 1973, "Acricultural Mechanization in Developing countries". Shin-Norinsha Co., Ltd. Tokyo, Japan.

6- Labor utilization is quite uniform and extensive.

But also there are some disadvantages of mixed cropping like the following:

1- Cannot use tools for cultivating randomly-spaced plants.
2- Crops and weeds sometimes indistinguishable.
3- Cannot fertilize for individual plant needs.
4- Spraying for insects or disease is not enhanced.
5- Specialization or specific crop-improvement is not likely.

3) Animal Powered Agriculture in Equatorial Africa:

With the exception of Ethiopia, Oxen power is relatively new for most parts of Equatorial Africa. Most implements are drawn by two animals except in the sandy soil regions of West-Africa Where single animal provide adequate power. In the East-African high lands multiple oxen teams, of from 4 to 12 animals, are used to plow and break the heavy soils after a long fallow period. Tandem pairs of oxen are used on the western-type moldboard plows being used for deeper tillage in Kenya and Tanzania. The large ridging plow used in Ghana and Nigeria can be pulled by one pair of oxen in light soils after the rains.

In the traditional cattle herding areas of Equatorial Africa, there is a great opportunity to employ more animal power. Debilitating and fatal animal diseases are prevalent in an area of approximately 11.7 million square kilometeres of Equatorial Africa. Eradication of the tsetse fly would allow an additional 125 million cattle in the tropical zone of Africa. The African system for animal powered plowing and cultivating uses 2 or 3 men per team of oxen(1). Egypt, India and other countries have developed effective systems for animal control by only one man that also operates the implement.

Although the use of animal power has lost its merits in many underdeveloped countries such as Egypt, it is still the main source of power in Equatorial Africa especially for small farmers. Animal power can help in reducing the costs of agricultural operation. On the other hand animals help the farmer, get many things from organic fertilizers to milk and meat. Eventually it is easy to preform and control agricultural operation through the use of animals. All these factors contributing to the appropriateness of oxen in Africa specially for most of Tanzanian agriculture.

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(1) Ibid, Chapter 2.

This dosn't mean that the use of animal power in Equatorial Affica has many desmerits which can be found in other parts of the world. Such desmerits as:(1)

1- Low performance capability as compared to mechanical power, this, timeliness of operation is diminished.

2- Animals cannot always be controlled for rendering precise planting and cultivation operation.

3- Difficult to provide enough power for plowing new land, heavy soils and heavy sod or weeds.

4- Animal draft power depends on care and provision of adequate quality feed.

5- The tsetse fly and diseases make animal farming difficult if not impossible in some regions.

6- Some cultural attitudes and customs mitigate against animal farming.

4) Mechnical Powered Agriculture in Equatorial Africa:

Engine-powered mechanization can range from a single operation of plowing to a completely mechanized system.

(1) Ibid, Chapter 2.

The first problem area for engine. Power pertains to rational selection, operation and maintenance of machine systems to prevent costs from exceeding returns. The small farmer finds ownership impossible or difficult at best as the total value of his crops and size of land boldings limit potential income. African countries are using several approaches for the introduction of engine-powered agriculture. Tractor-hire services are provided for the small farmers by several governments. Some of the larger farmers that do buy tractors also do contractural custom work for other farmers. Several farmers might form a partnership in order to purchase a tractor and machinery. However, partial and gradual mechanization is likely to remain pragmatically, the approach in most of Equatorial Africa. With an abundance of labor, many operations such as harvesting can satisfactorily and economically be performed by hand. So, for the developing farmer as well as for the developing country, mechanization must be <u>selective</u> and for a long time to come, it is likely to be incamplete.

In addition to the main advantages previously mentioned in chapter I, about the use of mechanical power for agricultural operations, I should like to add what Merle L. Esmay

and Carl W. Hall" has stated concerning the positive and passive points of using mechanical power for agriculture in Equatorial Africa.

Some major advantages of engine powered agriculture are:- (1)

1- Land preparation can be done more thoroughly and in less time.
2- Heavy and otherwise difficult soils can be plowed satis facterily and quite independent of weather and season.
3- Operations can be done more timely in order to meet optimum planting dates.
4- Better weed control and inter-row cultivation is possible.
5- Engine power may be used efficiently for stationary operations of threshing and processing.
6- Multiple-cropping is more feasible by minimizing periods during which the land has no crops growing on it, thus maximizing land and water use.

In the same time, there are some difficulties that might be associated with engine powered agriculture like:

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(1) Ibid. (Abstract, from chapter 2).

1- The need to import, thus using foreign exchange and not enhancing the indigenous economy insofar as manufacturing and labor is concerned.
2- Tractors might undesirably displace labor that is already under or unemployed.
3- Repair and maintenance of complex engines and machinery is a problem.
4- Operational skills are often undeveloped.
5- Operational supplies and services for fuel and lubricant are expensive.

5) Mechanization in Equatorial Africa:

Mechanization is being introduced into a wide variety of ecologicelly different situations, and includes a broad range of tools and equipment. The number of traetors by country gives one index of the level of mechanization. Also the number of tractors operating in a country is a rough measure of the level of agricultural engine-power in use. The agricultural land under tractor cultivation in the African Equatorial countries amounts to only 3 to 5 percent of the entire agricultural area(1). Only 33927 tractors in use

(1) Ibid. Chapter 2.

for 50621000 ha in the thirteen countries included in the table (3.1), which represent an average 1492 tractor per hectare from the Arable land.(1)

In as much as all tractors are imports it perhaps is more demonstrative of a countries willingness to invest hard currency in mechanized agricultural technology.

Experiences of African governments in operating tractor-hire services and doing contract work for farmers, settlements, group farms, state farms and various special schemes have proved exceedingly costly. Much of the machinery obtained by developing nations under grants, loans, and technical assistance programs, has been subsequently found to be unsuitable for tropical conditions. Maintenance and utilization has often been less than expected because local capabilities of both operators and administrators have not been realistically assessed. Donor countries and machinery manufactures frequently have failed to select appropriate equipment or to provide adequate training for its use.

As the President's Science Advisory Committee (1967) stated that with one or two exceptions an analysis of yield in various countries indicated that a power level

(1) F.A.O. Production year book. vol. 32. 1978, And F.A.O. Trade year book. vol. 32 1978.

yield in various countries indicated that a power level approaching 0,5 horse power per hectare is needed for an efficient agriculture. And Africa average only 0,05 hp/ha. (look to Figure 2-1, chapter 2), then Equatorial Africa presently has only one tenth of the minimum requirement for efficient production.

6) An Economic Analysis of Farming Systems and Agricultural Mechanization:

Analysing the items of the table (3-1) we find that thirteen countries in Equatorial Africa have 50621 000 ha. of arable land. This area constitutes 6,23% of the whole land area. On this area work a number of 33927 traetors i.e. one tractor for every 1492 ha. This is a very l.0 w. rate. It shows how they are lagging behind in using the agricultural mechanization in the countries of Equatorial Africa. If we analysis this rate in every one of the countries on this table, we'll find that Burundi gives us the worst rate, because the number of tractors in use in the whole country is 8 tractors only i.e. one tractor for every 135625 hectare of arable land. In the Republic of Central Africa there are 135 tractors i.e one tractor

for every 43259 hectare. The best ratio is found in Gabon where there is one tractor for every 248 hectare, and in Kenya, where there is one tractor for every 297 ha., and in Ghana there is one tractor for every 320 ha.

As for harvesters and threshers, they are found in six countries only out of the 13 countries mentioned on the table. There six countries are Kenya, Ghana and Ethiopia where there are respectively 491, 230 and 140. As for Congo, it has 28. Both the Republic of Central Africa and Uganda have 9 tools each. The total number amounts to 907 harvesters and threshers with the average of one tool for every 55811 hectars.

This rate reflects the amount of animal and manual labor which is used for the agricultural operations in these countries. At the same time it explains the very high percentage of the economically active population in agricultural sector which reaches to 73.3% of the whole countries on the timetable according to the statistic of F.A.O. in 1978. Analysing this part of the table we find that Congo is the only country where the percentage of the economically active population in agriculture decreased to

(LV)

Table (3-1)

Land use, economically active population and total agricultural tractors in some Equatorial African Countries

Country	Land area (1977)	Arable land (1977)	Economically active Population (1978)			Total Agricultural Tractors (1977)					Harvester Thresher in use
			Total	In Agri.	Percent. in Agri.	Import	Value	Export	Value	in use	
	1000 ha	1000 ha	1000	1000	%	No.	1000 $	No.	1000 $	No.	No.
Burundi	2565	1085 F	1971	1653	83,9	16 F	100 F	- -	- -	8 F	- -
Cameron	46944	6790	3222	2627	81,5	1800 F	19218	20 F	327	350 F	- -
Central Af. R.	62298	5840 F	1040	917	88,2	35 F	400 F	- -	- -	135 F	9 F
Congo	34150	655 F	503	180	35,7	70 F	1000 F	- -	- -	658 F	28 F
Ethiopia	110100	13000 F	12635	10135	80,2	400 F	4000 F	- -	- -	3750 F	140 F
Gabon	25767	273 F	258	200	77,4	- -	- -	- -	- -	1100 F	- -
Guinea (1)	24586	4100 F	2152	1745	81,1	---	---	---	---	72 F	- -
Kenya	56925	1790	5613	4409	78,5	2801	28031	- -	- -	6028	491
Ghana	23002	1055 F	4002	2092	52,3	600 F	8500 F	- -	- -	3300 F	230 F
Nigeria	91077	23000 F	26301	14482	55,1	4450 F	80000 F	- -	- -	7900 F	- -
Tanzania	88604	4080	6975	5726	82,1	500 F	5000 F	10 F	100 F	7200 F	- -
Uganda	19971	4023	5160	4230	82	650 F	4300 F	- -	- -	2076	9 F
Zair	226670	5630 F	11309	8518	75,3	281	4854	- -	- -	1350 F	- -
Total/Average	812659	50621	81141	54214	73,3	11603	155403	30 F	427	33927	907

Source: FAO Production Year book, Vol. 32 (1978)
FAO Trade year book, Vol. 32 (1978)
(F) = FAO Estimate.

(1) As for Guinea, we have not yet any reports about its export or import of tractors.

35,7%. In the other countries this percentage amounted to more than 50%. It ranged from 52.3% in Ghana to 88.2% in the Republic of Central Africa.

As for the export and import of tractors in the countries we are studying, we find that the export activity is nearly nil. According the statistics of F.A.O. in 1977, only two countries had the export activity. Cameron, exported 20 tractors, whereas Tanzania exported 10 tractors. At the same time, all the countries except Gabon, import their needs (As for Guinea, we have not yet any reports about its export or import of tractors).

The matter which draws our attention is in a country like. Burundi, which imports 16 tractors and use only eight tractors for agriculture. As for Cameron, it imports 1800 tractors and exports 20 tractors, whereas it uses only 350 tractors for agriculture. This means that the tractors imported to these countries work for a sector other than that of agriculture, regardless of the great need of them for the sector of agriculture. It is an astonishing and questionable thing indeed.

According to the information and statistics pointed out in this chapter, we can say that in Equatorial African countries, the use of agricultural tractor is extremely limited. This is due for many reasons, such as the small number of the locally manufactored tractors and the small number of the imported ones in proportion to the actual number needed for agriculture. It is due also to the shortage of capital needed to cover the import of the sufficient number of tractors.

Eventually, the factors which constrain the introduction of the agricultural tractor in Equatorial African countries are the small farm size, the lack of training in using the tractors and the lack of knowledge concerning maintenance.

From the above mentioned points, we can say that it is very important to have an association between the mechanization inputs and all the other technological inputs in order to be able to get the most efficient use of agricultural mechanization in such a way as to realise the objective of introducing it, specially concerning the optimum utilization of economic resources, increase of productivity to achieve increase of return for all rural people.

CHAPTER IV

Agricultural Mechanization in Asia

1) An over view of Asian agricultural conditions:

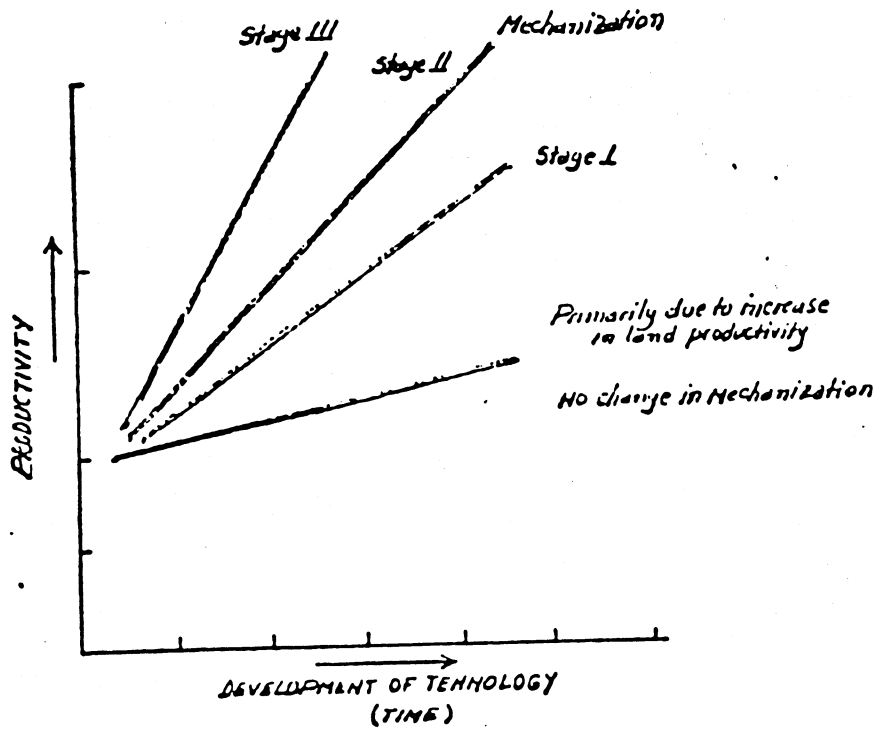
In many parts of Asia, in Est Asia in particular, farming is considered a hard job for millions of people. The area of land belonging to the individual there is too small. The farm areas in Asia are also small and consequently the products yielded by these farms are low. This is due to many reasons, some of which are the prevailing traditional, social and economic conditions. It is due also to the high percentage of rural population. Although the poor farmers in Asia constitute a high percentage, they don't own a great area of the land. This diverted them from caring for improving agricultural cultural methods or introducing good management practices or modern technology for cultivation. This led to an urgent and increasing demand for food in this countries.

In Asia, few countries such as Korea, Taiwan and Japan changed the traditional methods and economic condition for poor cultivation. In this way they realised

successful land reform. They followed a suitable price policy and used modern technology for carrying out agricultural operations. Thus they acquived a planned agricultural mechanization programme. In that way their agriculture leapt greatly towards realising an increase of labour productivity and improving their lands. On the whole they raised the standard of economic efficiency in the sector of agriculture.

2) Mechanization and its relation with Productivity in Asian Countries:

The stage I curve of figure (4.1), represents improved mechanical aids for humans, animals and some mechanical power, without displacing much labor. This degree of mechanization would be the most desirable program for labor surplus, capital short country such as Indonesia. A rural labor becomes scarce in developing countries, mechanization may be advanced to stage II (Taiwan and Korea are examples). In developed countries as Japan, mechanization of agriculture may move on to stage III in balance with other sectors of the economy.



(Fig. 4.1) Productivity with various degree of mechanization.(1)

Japan moved quite dramatically through the various stages of development shown in Fig. 4.1 subsequent to World War II (1946) there was no major industry, no capital and a surplus of labor. Cultural practices, even thoough by hand and animal, were improved.(2)

(1) Merle L. Esmay and Carl W. Hall, 1973, "Agricultural Mechanization in Developing Countries". Shin-Horinsha Co., Ltd. Tokyo, Japan,

(2) Ibid, pag. 8.

Japan moved into stage I mechanization when some new mechanical aids were made available along with some improved seeds and chemical fertilizers. The agricultural economy began increasing significantly with the resulting increased yields. Stage II mechanization was forced onto the agricultural sector when the industrial sector attracted many laborers from the farms. By 1960 Japan's industry was in full swing and agriculture was forced to maximize labor productivity along with land productivity. Two-wheeled tractors were manufactured and purchased by farmers to the extent that Japan acquired the highest mechanical horsepower per hectare of any country in the world. In the late 1960_s fourwheeled tractors began replacing the two-wheeld models.

However, with the use of favorable agricultural mechanization and available technological inputs, many of the Asian countries are now becoming self sufficient in rice and other cereal grains. Intensification and multicropping are emphasized in the new diversified crop rotations. Mechanization can increase the productivity of land and man but it too must be timed and planned with the introduction of other input factors. Mechanization plays an important part

in Asian agriculture through all its advantages mentioned in chapter I, specially deep plowing for mereased fertilires response, because nearly all Asian countries are short of adequate fertilizers. Also for timeliness of operation for maximizing yields and production per hectare per year.

It is normal that in Asia as in the other part, mechanization of field operation for crop production in small fractional hectare paddy fields is a difficult task from both physical and economic aspects. So the intensified utilization of the small land holdings throughout Asia has been done mainly by hand. Animals are however, common in many countries for plowing and paddy field preparation for transplating rice.

In labor short countries, mechanization development will depend on available capital, local manifacturing of machines and the training of people to build, operate and maintain the machines. In all cases there must be a close parallel between agricultural and industrial development.

3) Cropping intensity and power requirement in the Asian agriculture:

From the table (4.1) it will be noted that man-hours

required per hectare of rice is over 1000 hours per crop for most countries. The table shows also that the number of agricultural workers per hectare of land holding for the some countries, various generally between 0,37 and 2,49. Japan is the exception of these Asian countries. They had mechanized to an equivalent total of over 2 hp. per ha (2,664), even though the average land holding in Japan was only about one hectare (1,06 ha.), because Japan began a mechanization program soon of ter the year of 1955 desig- ned to replace the out-migration of rural people to the cities for jobs with industry.

The table shows also, that small intensivity farmed , land holdings are common throughout Asia. Of the countries includes in the table, the average amount of arable land per holding varies from a low of 0,90 ha. in South Korea, to a high of 6,17 ha. in Iran. But even these small land holdings are fragmented into scottered parcells. Japan and Taiwan have high labour inputs because of the intensive care given the growing rice, and the resulting high yields.

The Asian countries listed in table (4.1) have 105,6 million farm households for averages of 2,32 ha. per household

Table 4.1

Arable Land and Land Holding, Power Available, Agricultural Worker per Hectare and Man Hours per Hectare for Paddy Rice Production.

COUNTRY	Arable Land (1.000 Ha)	Land Holdings	Arable land per Holding, Ha.	Human Power, HP/Ha.	Animal Power, HP/Ha.	Mech'l. Power, HP/Ha.	Total HP Avail. Per Ha.	Agr'l. Workers Per Ha.	Rice Production Man Hrs/Ha
Ceylon.	1.876	1.174	1.59	0,120	0,148	0,110	0,378	1,20	
Taiwan.	890	808	1.11	0,195	0,164	0,146	0,505	2,00	1.300
India	161.940	61.780	2.62	0,090	0,204	0,008	0,302	0,90	1.000
Indonesia	22.852	12.148	1.89	0,110	0,062	0,001 ✱	0,173	1,10	1.400
Iran	11.593	1.877	6.17	0,037	0,048	0,154	0,239	0,37	
Japan.	6.004	5.665	1.06	0,216	0,120	2,664	3,000	2,16	1.400
Korea, Rep of	2.256	2.507	0.90	0,196	0,236	0,003	0,435	1,96	830
Nepal	1.831	1.496	1.22	0,249	0,480	0,004	0,733	2,49	1.000
Pakistan	26.021	11.000	2.37	0,109	0,288	0,013	0,410	1,09	900
Philippines	7.934	2.166	3.66	0,071	0,104	0,023	0,198	0,77	800
Thailand	11.267	3.087	3.64	0,110	0,184	0,054	0,348	1,10	
Vietnam, S.	2.935	1.893	1.57	0,210	0,244	0,023	0,477	2,10	
Total/Average	257.399	105.601	2.32	0,143	0,192	0,267	0,602	1,44	

✱ Estimated.
Source: Ozaki and McCally 1968. (Agricultural Mechanization in developing countries -) Chapter 3.

and 1,44 agricultural workers per ha. Average of human power 0,143 hp. per ha. Intensive agricultural operations by human power application as showen in the table, were in Hepal, Japan, South Vietnam, Korea R. and Taiwan. Animal power averaged 0,192 hp. per ha. for all the countries. Nepal recorded the highest application of 0,480; and Iran, the lowest at 0,048.

The use of mechanical power averaged 0,087 hp. per ha. and ranged from 2,664 in Japan down to 0,003 in Korea R. The total hp. per ha. in the Asian countries listed in the table (4.1) averaged 0,602 with Japan recording 3,000 the highest, and Indonesia, the lowest of 0,173.

4) Agricultural Mechanization through the Asian Surroundings:

The sixteen Asian countries mentioned on the table (4.2) include on, Arable land of 310829000 ha. The active population in agriculture on this area is about 503379000. This number forms 58,3% of the total active population of the countries studied on the table. This is undsubtedly a high rate. The only exception is Japan where the number of agricultural labourers is only 7752000. This number

forms 13,2% of the active population in Japan. From the same table we notice that another country such as Nepal includes an arable area of 2300000 hectars. The number of workers on this area is 5891000, more than 93% of the active population. This is the highest rate in the world up till now. In the other countries on the table, the number of agricultural workers ranges from the highest ratio in Nepal to the lowest one in Japan. On the whole the least ratio next to Japan was more than 40%, and reached 79% in Afghanistan.

The table (4-2) shows us the total number of agricultural tiactors in the countries on the table. It shows us also the distribution of these tractors between the importer and the exporter and the value of each in dollars. After studying the table we'll find that the ratio differs greatly. The highest number of imported tractors is found in Turkey where there are 50000 tractors estimated at 150 million dollars. At the same time Turkey does not export tractors. The number of agricultural tractors in use reaches 324669 tractors. That is to say there is a tractor for every 77,2 hectars of arable land.

If we move to Japan we'll find that this country gives us the highest figure in importing and exporting tractors. It imports 6746 tractors, the value of which is 49769000 dollars, the average price of each tractor is 7370 dollars. This is a relatively high price. It shows us that Japan imports a special type of tractors which cannot be produced by the local factories. The number of exported tractors from Japan reaches 139588000 which is considered the highest figure of export in Asia. This shows us the development and progress of Japan. As for the tractors in use in Japan, we'll find that they are 952000 tractors i.e. a tractor for every 4,6 hectars of arable land.

In the other country such as India we'll find that the area of arable land is 165300000 hecters. On these area there are 271836 tractors in use i.e. a tractor for every 608 hectars. This is of cours a very great area. It shows us the extent of backwardness in using the agricultural tools in India. The table shows us also that the number of tractors imported by India is 4000 tractors. This is a very small number especially for the ratio mentioned above namely 608 hgctars per hectar. Consequently we'll find that the number of tractors exported by India is only 65 tractors.

The same table shows us a very bad state concerning Afghanistan and Nepal where the arable land in the former country reades are 7910000 hectars, with a number of 730 tractors, i.e. a tractor for every 10835 hectars. This is the least ratio for using the tractor for agriculture in Asia. In Nepal the area of arable land is 2300000 hectars with 480 tractors i.e. a tractor for 4791 hectars. This is also a very low ratio in using tractors.

Consequently we can say that the ratio of using tractors in Asia ranges from the lighest ratio (4,6 ha. per tractor) in Japan and the lowest one (10835 ha. per tractor) in Afghanistan. This shows us the great difference among the countries of Asia in using the mechanical power.

As for the harvesters and threshers, we'll find that Japan has the highest figure 638000 whereas SriLanka has the lowest figure 3 (only three). Other countries on the table do not use tractors at all.

From all the items mentioned above we notice that shortage of power in many of the Asian countries limits

the farmers inability to prepare the soil in the optimum time available. Experience indicates that at least 0,5 hp. per ha. is desirable for soil preparation under the conditions of many countries (Look chapter II). The soil in many parts of Asia becomes dry and hard during the dry seasons and cannot be effectively plowed by the primitive plows and the plodding beasts. When the soil is tilled after the seasonal rains commence, the optimum growing season is shortened. Rains increase in amount and frequency in some areas until farming operations must cease. The shortage of power can delay crop planting in the optimum period and timeliness of operation is not achieved. Mechanical power in some areas, has doubled yields due to optimum seed bed preparation and timely crop planting operations. In a few days tractors may complete operations which required farmers a month using primitive implements with human and animal power. So, labour productivity in the Asian countries, ranged from a high amount per man-year in Japan to a low amount per man-year in other country like Nepal and Thailand. Also, farm wages ranged between the high and low for Japan and India. The ratio of the population of country engaged in agriculture is generally inversely related to productivity per man and wage rates.

Japan with lowest portion of agricultural population at 13,2% (table 4-2) has the highest productivity per man. Countries with the highest percentage of agricultural population, have generally low productivity per man.

Then, Mechanization, if planned and timed properly with other technological inputs can play an important role in increasing productivity of land and man, Specially that potentially productive land is a limited resource in many Asian countries.

CHAPTER V

Agricultural Mechanization in Latin American Countries

1) General Background about agriculture in Latin America:

It is extremely difficult to describe or analysis the agricultural economic conditions in Latin America. This is due to the great differences concerning many aspects. Latin America is considered have the countries of South America, Central America and Mexico. As we see it is a number of countries composing an entity with many points of contrast concerning the geographical features, the natural resources, the climatic, economic social and cultural conditions. The points of contrast are displayed by the nature of people. They are all of different nationalities. They make three groups concerning the origin of these nationalities. The first group forms the European origin. The second, the Indian origin, the third one forms the negros. Meanwhile the living standards of people are different, some are very poor, others very rich. Consequently, we must take into considerations these points of contrast when we want to make any study or analysis about Latin America.

On the other hand, any talk about Latin America should be tackled carefully as the countries of Latin America constitute a part of the third World. Nevertheless, the people in many places there lead a very developed life economically like other people in developed countries.

Generally speaking we can say that agriculture is common and important to the all in Latin America. Besides the land of every country in Latin America is suitable for agriculture, there are also some problems which hinder agricultural development. Some of these problems:

1- Shortage of water needed for agriculture.
2- The scarcity of the area of land which is extremely fertile.
3- Inability to have investment for developing agricultural productions and means of agriculture.
4- Farmers have lettle knowledge and experience. Their abilities in using modern scientific and technological means in agriculture, are limited.

Besides the above mentioned points we notice that in the area which is more than 1000 metres above sea level,

and in the mountains of Central America and Mexico, small farms and dens population are caractaristic. The land is fragmented, the people are poor and they lack the capital and technical knowledge to improve theire agricultural methods. Agriculture here is barely on a subsistance level, then there is not necessary any types of machin power. In the other part like Ecuador, Colombia, Horthern of Brazil and much of Central America are tropical area. Some specialized machines and methods are necessary for the production of bananas, sugar cane, peanuts and other crops. But in the northern central part of South America, equipment is needed for land clearing, earth moving, and possibly mechanized crop production.

The Coastal Zones of Chile and Peru are mostly of arid land which is formed with standard 4-hweel tractors and associated machinery. The land is generally level, capital is relatively plentiful, labor is limited and food for draft animals is expensive. Here, a high degree of mechanization and efficient use of machinery is potentially possible.

From all the above mentioned points we can perceive the great differences which cover many important aspects in

Latin America. These differences exert considerable influence upon the type of agriculture practiced and the need and the method by which mechanization can be applied.

2) An economic analysis of land, active population and from machinery:

Analysing the statistics economically of 19 Latin American countries on the table (5-1), we find that the area of the arable land is 114428000 ha i.e. it is only 5.83% of the total land area of these countries. According to the reports of FAO, 1978 about 38.55% of the economic active population work on these area. It is a low percentage in comparison with the group of underdeveloped countries in Asia and Africa. These percentage reached 12.5% in Uruguay, and 13.6% in Argentina. The high percentages were 68.2% in Haiti and 63.4% in Honduras. In the other countries the percentages ranged from 19,4% in Venezuela, Cile and 51.5% in El Selvador.

In the 19 countries mentioned an the table, the number of tractors in use is 844111 tractors with the average of one tractor in use for every 135.6 hictares of arable land. It is a low percentage of using tractors

(60)

Table (5-1)

Land use, economically active population and total agricultural tractors in some Latin American countries.

Country	Land area (1977) 1000 ha	Arable land (1977) 1000 ha	Economically active Population (1978) Total 1000	In Agri. 1000	Percent in Agri. %	Total agricultural tractors (1977) Import No.	Value 1000 $	Export No.	Value 1000 $	in use No.	Harvester Thresher in use No.
Argentina	273 669	25 000	10 130	1376	13,6	650 F	40 198 F	3 400	25 635	195 000 F	42 000
Bolivia	108 547	3220	1 606	820	51,1	350 F	3 500 F			665	192
Brazil	845 651	32 300	37 642	14 942	39,7	2400 F	59 876 F	4200 F	53052	280 000 F	33000
Chile	74 880	5 630	3 533	687	19,4	1800 F	12 454	60 F	415	29 000	10 800
Colombia	103 870	3 935 *	7727	2257	29,2	4700 F	32423	---		25000	1750
Costa Rica	5066	490 *	703	256	36,5	720 F	10 811	- -	- -	5750	950
Ecuador	27 684	3989 *	2473	1131	45,7	1000 F	11 500	-	- -	6 800	580
El Selvador	2072	507	1405	724	51,5	550 F	8392	- -	- -	3 050	280
Guatimala	10789	1450 F	1836	1030	51,1	1650 F	16 000	- -	-	3 800	2400
Haiti	2756	535 F	2415	1647	68,2	240 F	2501	— -	- —	460	- -
Honduras	11189	730 F	909	576	63,4	452	11379	-	-	1100	- -
Mexico	192304	21700 F	18879	7129	37,8	9 913	61 588		- -	150 000	13500
Nicaragua	11 875	1329	761	339	44,5	650 F	10878	- -	-	1636	- -
Panama	7505	450 F	614	221	36	470 F	9500	- -		3 850	490
Paraguay	39 730	950 F	927	460	49,6	500 F	3000 F			2900 F	- -
Peru	128 000	3103	4 913	1907	38,8	430	6 000 F	- - -	- -	13000	- -
Uruguay	17 362	1850 F	1 109	139	12,5	959	6 900	44	353	27700	5400
Venezuela	88 205	4780 F	4024	779	19,4	10000 F	158222		- -	30 000	2 050 F
Cuba.	11 452	2 480 F	3056	753	24,6	3300 F	15000		-	64400	2700
Total/Average	1962606	114 428	104 662	37 173	38,55	40732	480122	7704	79 455	844 111	116 092

Source: 1- FAO Production year book, vol. 32 (1978)
2- FAO Trade year book, vol. 32 (1978)
(F) = FAO Estimate.
(*) = unofficial figure.

in comparison with that in Equatorial Africa where the average rate did not exeed one tractor for 1492 hectares (the table "3-1). The best percentage of using the tracter in latin America is in Cuba, where the rate is one teactor for 38.5 hectares. In uruguay on tractor for 66.8 hectares, in Costa Rica one tracter for 85.2 hectares. The highest percentage was in Bolivia, one tractor for 4842 hectares, in Haih one tractor for 1163 ha. In the other countries the rates ranged from one 115 ha. In Brazil to one tracter for 812 hectars in Nicaragua.

If we analyse the export side of the latin American countries on the table, we find that this side is nil in 15 countries . The actual export of tractors is confined in Brazil which exports 4200 tractors whereas uruguay and chile export only 60 and 44 tractors respectively.

All the countries on the table import the tractors from abroad , the table number imported is 40732 tractors. It is indeed a small number and it shows the shortage of capital needed for eovering the cost of import.

Concerning the harvesters and threshers we can say generally that the number of these tools is very small in these countries although most of the countries use them. The

tools number is about 116092 for the whole arable land with the average of one tool for every 905 hectares.

Concequently, the analysis of the information obstr-actes and problems previously mentioned in this chapter. The solution of these problems will directly help in developing and improving the efficiency of agricultural meechanization.

This small percentage of the arable land in latin America (5,83%) utilized for crops, make it imperative to increase production per unit area, with utilize relective mechanization besid the other technological inputs, latin American countries, can intemsity the use of existing crop lands which lead directly to inrease their yields, atlthough, (eobert H. wilkinson) says in respect, that "extremely small land holding (1 to 3 hectares) may be economically or physically large enough for the application of improved technological inputs necessary for intensific-ation".

At the same time, latin American countries must increase the area of the land for cultivation, although this step in land development (horizontal expansion) is usually a more expensive prooedure than increasing productivity of land already in cultivation.

3) Efficient use of labour and machines:

The expression "mechanization" applies to improvment of all tools and equipment. It is remarkabley, that a great interest in mechanization of crop production is developing among operators of medium and larg sized farms, in latin America. Labor efficiency also improved with selected machines but also in many other ways such as the size and shape of fields. Field work efficiency improved too, by such methodes as shifting from hand methods to animals, and from animals to mechanical power.

Concerning the quality of labor, we know that the rural labor is aften not trained, educated or motivated to accomplish the sometimes drudgery tasks of agriculture. So,as agricultural technology increases there is a greeter need for better trained labor. Without trained labor, we cannot achieve the prope use of farm equipment and we cannot ensure the success of any program of mechanical cultivation or of introducing modern technology to agriculture. So, number agricultural programs involving modern technology have faild because labor was insufficiently trained.

Concerning the cest of various necessary tools, tractors and farm equipments in latin America, we find that the costs is high, often twice that in the USA or Europe.

Studies of farm equipment and costs have been made in several latin American countries. One study by "ECLA"(1) for Argentine and chile showed that a 30 to 40 hp. tractor that cost $ 3.400 in England was priced at $ 4.930 in chile. The price of a 8½ ft. Combine varied from $ 6986 in England to $ 15158 in Chile. The disc plow had a differential of $ 284 in Englans to $ 719 in Chile. Although mechanization is well advanced in ports of Argentina, the farmers are shill confronted with the high cost of equipment, fuel and supplies for farm operation, table(5-2).

The high costs coupled with the low market prices for agricultural products causes the latin American farmers profit margin to be very small. At that, in many areas in latin American labor is still cheep and horses and draft animals are low cost thus, the need for mechanization is not great.

From the table (5-1) we can observe the high prices of the imported tractors in most of the latin American countries. These prices reached to the sum of $ in the year 1977 in some countries like such prices would compel these countries to specialise large sums of hard currency to cover the price of the import of such tractors.

On account of the high cost of the prices of tractors and farm equipment, we find the subsistance farms and

small farms in Latin America do not use agricultural mechanization. They even do not try to adopt them to suit the size and shape of these farms. This is due to the high cost which surpasses the financial abilities of these farms. Conequently the excess of labor is necessary in such farms which are prevelant in many parts of Latin America. Besides the excessive high labor inputs these farms are characterised by many other qualities such as: capital is score, low yields, and much of land is poor and cropping methods are often inappropriate. All these qualities reflect directly the low level of technological development.

From all the above mentioned points we can say with certainly that it is surly true that agricultural mechanization should be an integral part of the total production system in order to have a positive effect on the yield increase and in order to be balanced with the other inputs. With the exception of what we have said, mechanization alone does not assure increased yields and productivity or share in reducing the cost of agricultural production. It does not also achieve the other various benefits which characterise the agricultural mechanization. Such benefits are saving the time, increase cropping intensity through the increase of the number of crops and causing cropping pattern changes to better ones under the local conditions.

CHAPTER VI

AGRICULTURAL MECHANIZATION IN THE SOCIALIST REPUBLIC OF ROMANIA

1) The role of agriculture as one of the materialist sources in the Socialist Republic of Romania:

Besids industry, construction, transportation and other economic branches, agriculture can be considered one of the main productive sources through which we get main materials necessary for the existence and development of human societies. The Romans assert that agriculture for them is a main source of production which supplies them with all their needs consumed by the people in addition to the other needs needed by the society. Agriculture takes up two thirds of total area of the country, and approximately half the number of the economically active population. It takes up also one fifth of the fixed productive funds of the Romanian economy. Meanwhile agriculture produces approximatly one sixth of the total production of the country and one fifth of the national income (see Fig. No. 6-1)[1]

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(1) Oprea Parpata. "Economy and Agricultural Policy". vol. 1. Bucharest 1974 (in the Romanian language).

The development of the total production of the society and the total agricultural production can be printed out through the information of the table (6-1).
We can observe from the table that regardless of the great increase in the total agricultural income and the total agricultural production during the twenty years of study, in spite of this fact we find that the development is slow when compared with the great of the total production of the society and the national income for the same period.

Table (6-1)

The development of Production and Income, Total and Agriculture, in the S.R. of Romania (1)

Specification	1950	1955	1960	1965	1970
Total production of the society	100	186	263	414	624
National income	100	192	268	413	594
Total production of agriculture	100	162	171	193	212
Total income of agriculture	100	170	168	170	166

(1) Ibid.

2) Introduction of modern techniques in agriculture, through agricultural mechanization:

The high ratio of investments specialised by the state of Rumania to ensure the modern technical means and the necessary mechanization and to introduce technology with the aim of increasing the agricultural production besides the circumstances of the continuous development and modernising the productive efficiency of industry in manufacturing different means of power for agriculture. These investments became responsible for developing the system of agricultural tools and achieving the demanded increase of tractors, of agricultural tools, combine planter, seed and fertilizer drill, combine harvester for wheat.... etc. Meanwhile the development of the efficiency of each of these equipments was taken into consideration.

Concequently during the period from 1976 to 1980 the introduction of remarkable means of modern technology to the field of vegetable and animal production. These means are of great horse power to have an excellent role in increasing the economic efficiency of agricultural production.

For example, in the year 1977 a number of 13071 tractors of different kind and power and another number of 4676 automatic combines were used for agriculture and they managed to do many operations with the help of other tools and other modern agricultural equipment.(1) Naturally this resulted in achieving the following advantages:

1- Taking part in getting higher amounts of production and less consumption of work power.

2- Encouraging the production in large areas of land under an economic conditions.

3- Encouraging the production specification, by a less number of products.

4- Insuring a great relationship between the area of the cultivated land and the amount of power needed, by reshaping the small agricultural units and gathering them in one large unit which allows the use of tractors with high power.

5- Using some powerful tractors which can do more than one operation at the same time. Such operations are: (-Seed bed preparation - fertilization - sowing the seeds - fighting the bad herbs - fighting the bests - and any agricultural operations which are performed

(1) Avramescu Pantelimon. "Agricultural Economy and how to make use of Agricultural Production". Bucharest 1978 (in the Romanian language).

for one time only if the agricultural conditions are favourable).'

6- The tractors with high power result in saving the work power e.g. a 180 hp. tractor driven by one mechanist can do the work of two or three mechanists working an a 65 hp. tractor.

7- It results in reducing the cost of maintenance, repair and the spare parts and for keeping and storing tractors.

8- Creating possibilities for distributing agricultural and productive territories according to the available natural and economic conditions.

9- Through the increase of the efficiency of agricultural mechanization, the shortage of labourers disappears, which in many cases fixes the placement of some crops e.g. it prevents the cultivation of vegetables in the areas which are not suitable and which are for from the populated areas.

10-All the above mentioned concequences lead to the increase of the economic efficiency for the activities of the agricultural production as a whole.

For all these economic consideration, agriculture in Romania has been supplied with 180 hp. tractors. The Romans have never thought of supplying their agriculture with tractors whose power is less than 65 or 45 hp. in order to mechanise the operation of cultivating vegetables, fruit, viticulture and animal products(1)

According to the permanent directives of the state for developing the policy of agriculture and for modernising agriculture, the number of the stations of tractors and agricultural equipments has increased. The number of operations done by mechanical tools has also increased in all branches of agriculture.

Concerning the establishment of a developed socialist society in Romania, the program of the party and the state has stated that the 1976-1980 five year plan should include the complet mechanisation for all the agricultural operations in the field, and also in the sector of animal products through providing this sector with the necessary mechanic means. In this way the area of arable land for the tractor will decrease. This will help the agricultural labourers to migrate to other economic branches, concequently their number will continuously decrease till it reaches to 12-15% of the economically

(1) Ibid.

active population as it has been planned in the year 1990.(1)

In order to make Romania have 12-15% of the active population working for agriculture in the year 1990 i.e. approximately 1,2-1,5 million agricultural labourers, about 15% to 20% of the youth should be directed every year to agriculture. Only in that way Romania can have in 1990 agricultural labourers ranging from 25 to 35 years old(2).

In order to achieve all the agricultural operations in an ideal time for all crops, agriculture will be provided in 1980 with 125-135 thousand tractors of different kinds. And in order to speed up the rate of mechanising animal product, this sector will be provided with various increased numbers of tooks and equipments. In the following years until the year 1990 the operation of speeding up the production intensification will be carried out through developing and modernising the technical and economic base in agriculture. The complex mechanization will be common

(1) The decision of the eleventh conference of the Communist Party in Romania. The Political Publishing House, Bucharest, 1974 pag. 91 in the Romanian language.

(2) V. Halmajan. "The Territorial Separation of agricultural production with the help of the Mathematic Economical ways". Bucharest, 1977 (in the Romanian language).

for cultiviting plants and vegetable and for also the animal product. A more idealistic system for agricultural tools and tractors with high power will be insured. This development will help in achieving a remarkable production of Cereals (28-30 million tons). It will double several times the production of sugar cane, vegetables and grapes which was produced in the year 1966-1970.

Table (6-2)

The denamic of the stations of tractors and farm equipment in Romania.

Specification	1950	1960	1965	1970	1972	1974/75
Tractors	12713	44194	81356	107290	115606	119533
Ploughes for tractors	13642	46130	86215	97249	97465	96633
Fertilizer distributer		3182	4363	14504	14492	12251
Traction combine		15995	36552	43916	34949	23165
Power duster and Power Sprayer		2864	5417	10713	13152	16705
Automatization combine	44	1582	292	1325	4628	17912

Source: In accordance with Statistical yearbook of S.R. Romania.

The table (6-2) points out how for the station of tractors and farm equipments in Romania are dynamic. The statistics of this table give us the proof that give great importance to develop and modernise agriculture as a main source of the national in come. From the imformation of the table we find that up till 1970 the average need of tractors for agricultural. was greater than that average in the years after 1970. The number of tractors used for agriculture in 1950, was 12713 tractors. In 1970 this number increased to 107290 tractors i-e. the average increase is 4729 tractors every year. From the year 1970 to the year 1974 the number increased to 119533 tractors i-e the yearly average is 3060 tractors. The same facts are true concerning the other kinds of tools mentioned on the teble an observation which shows us that agriculture in Romania began to have its full supplie of tractors in the last years.

There is another positive fact concerning the need of agriculture for tractors. This fact shows the various kinds of tractors for agriculture in Romania. Besides the Roman tractor Universal 650, there is a tractor specified for vegetables, another tractor specified for work in low and sloping lands.. and so on. The farm eqipments are also of various kinds.

Table (6-3)

Effect of the length of the parcels on the work of the tractor.

length of the parcelmetre	Differentiation factor
Less than 100	0,70
100-200	0,80
200-300	0,85
300-400	0,90
400-600	0,95
600-800	0,97
More than 800	

Source: Morad Khalil, Doctoral thesis Bucharest 1980.

Source: Morad Khalil;"Economic efficiency of the organization of big agroindustrial units". Doctoral thesis,Bucharest, 1980.

3- The effect of the collective land on the efficiency of mechanic use:-

From the table (6-3), we can observe that there is an obvious effect for the length of the parcel on the work of the tractor. The differentiation factor showed us a direct proportion to the length of the parcel. This factor rose from 0.70 in the parcel less than 100 metres long to 1.00 in the parcels more than 800 metres long. This result undoubtedly shows the importance of gathering the small fragmented parcels in great connected areas (without any necessity of changing the shape of ownership) in order to allow the tractors to work more efficiently and consequently achieve the highest rate of mechanical use.

The table (6-4), showd us the effect of the length and size of the parcels on the amount of mechanical operations, and on the cost of achieving these operations in one hectar of wheat. From the statistics

Table (6-4)

The effect of the length of the parcels on some techincal and economical indications.

Lenth of pacel -metre-	Tractor-trour	man-hour	Total production -lie-	Material cost -lei-	Total cost -lei-	Net income -lei-
Peste 800	24,0	59,2	6705	2942	3175	3530
600-800	23,3	63,9	5960	2923	3186	2774
400-600	22,8	80,2	52,5	2873	3193	2022
300-400	21,6	82,5	4470	2881	3211	1250
200-300	20,6	98,5	3725	2834	3229	496

Source: Idem.

of the table we can find that the length of the parcel if directly propartional to its production and its income, because the value of the total production rose from 7352 lei[1] to 6705 lei i.e. with a percentage of 80% whereease the income rose from 496 lei to 3530 lei i.e. more than seven times when the length of the parcel increased from 200 metres to more than 800 metres. The information of the total cost and the required number of man-hour, when the parcels became longer.

Generally speaking we can say that the shape and lenth of parcels effect to a very great extent the technical and economical indications.

4- The stations for agricultural mechanization in Romania:

The process of the concentration and specialization of the agricultural production had become in last ten years, one of the main targets of the agricultural development in Romania. Therefore Romania directed its effort to reorganize their agricultural production and modernize the technical-material basis of the agriculture, with the aim of creating a substantial increase in agricltural production, and achieving a new relations of production.

Romania, gave a great importance to the process of

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(1) lei, is the local currency in Romania.

horizontal and vertical integration of the agricultural production. This process have developed during this period from the very simple forms to the horizontal and vertical integration materialized in specialized agro-industrial units. Therefore, on February 1st, 1979 the government issued the decrees showing the form and functions of the Agroindustrial complex in Romania which was called "the State and cooperative Agroindustrial Unified counеel" as a higher form of management and supervision of agriculture in Romania. This Agroindustrial unified council, basid on the principle of the horizontal integation comprise all the units found in the territorial area of the councils. An essential unit of these units is represented by the Stations for agricultural mechanization, besides the State agriculture units, the agricultural cooperatives and the other agricultural units.(1)

The Stations for agricultural mechanization has the role of a unified organ for mechanization, chemization and mechanical repairs withen the agroindustrial unified couneil. The efficient use of tractors, farm machinery and other technical means is organized and supervised by the Station for agricultural mechanization. The unified use of all the mechanical and chemical means in agriculture is one of the principle measure which led to the rapid change of the

(1) Source: Morad Khalil.Economic efficiency of the organization of big agroindustrial units. Doctoral thesis. Bucharest, 1980.

romanian agriculture as the complex mechanization of all the agricultural works is of great importance for increasing agricultural production and reducing the labor force in agriculture.

The Stations for agricultural mechanization are responsible for proberly carrying out all the agricultural works in all the units of the council. They must assure the rational use of the tractors and farm machinary, strengheten the order and discipline and the sense of responsebility of the workers.

One Station for agricultural mechanization generally serves several cooperative forms of about 10.000 to 20.000 hectares. In the Station for agricultural mechanization are concentrated all the farm machinery and they have the best specialists, able to broberly perform all the agricultural work.

CHAPTER VII

Agricultural Mechanization in India

1)- A brief overview of the situation of Agricultural Mechanization:

The new agricultural strategy enunciated in 1965, marked a significant departure from previous agricultural production policies followed by the Government of India. The emphasis shifted from extensive to intensive cultivation. The development of the short duration high-yielding varieties of seeds was the critical new element. The fundamentaly policy change was to concentrate inputs in highest productivity areas.

The introduction of the high-yielding varieties along with the increased use of fertilizers, water, pesticide ... etc, considerably enhanced the scope for double and multiple cropping. The new varieties also made it profitable to irrigate and bring land, formerly used for pasture, under cereal cultivation.

The above facters, plus the increasing stress on time economy that is implicit in the new agricultural strategy, led to a substantial increase in the demand for energy on the farm.

Early in 1969, the Indian government also seemed to have been of the view that mechanization was essential to sustain the "Green Revolution". In that year, the government imported 15.000 tractors, 4.000 power tillers, 10.000

discs, 75 combines and a number of other items. Later on 10 ams were obtained from the International Bank for Reconstruction and Development for importing 35.000 fractors and additional capacity was licensed in the domestic tractor industry. The Planing Commission estinated the requireement of troctors at 60.000 and 70.000 additional units per year by the end of the forth Plan, while the Ministry of Food and Agriculture estimated it at 90.000 units per year in 1973/74.(1)

2)- Intensity of Land use, According to the size of operatinnal Holding:

Table (7-1) gives certain characteristices of sample farms in regard to land use according to the size of operational holding. The operational holding is defined as consisting of owned area self-cultivated plus land leased-in. There are no tractor farms among holding belew 10 acres and no bullock or mon-tractor farms among holding above 75 acres. The percentage of holding irrigated, cropping intensity with respect to operated area as well as irrigated area, and labor input per acre(total of family and hired) decline with the increase in the size of holding. Thus, small farms not owning tractors are still able to achieve higher irrigation and coopping intensities than the large tractor-

(1) Shyamal Roy and Melvin G.Blase.
"Farm Tractorization, Productivity and Labor Employment: A Case Study of Indian Punjab."

owning farms. However, large farms have taken a leas in the adoption of new technology. The percentage of cropped area under high-yielding varieties is highest among farms above 75 acres and the lowest manitudes in this regard relate to farms below 10 acres. The lowest figures of labor input as will as the highest figures of fertilizer input per acre relate to the two largest holding-

TABLE (7-1)

Intensity of land use according to the size of operational holdinc. Ferozepur (PUNJAB),1968 - 9[1]

(1) Size group of holding	(2) Average Size of holding	(3) Percentage of area frrigted	(4) Percentage of cropped area to operated area	(5) Percentage of gross irrigted area to net irrigated area	(6) Percetage of cropped area under high-yielding varieties	(7) Epeneses on labor per cropped area	(8) Expenses on fertilizers per cropped area
(acres)	(acres)	(%)	(%)	(%)	(%)	(Rs)	(Rs)
0-5	4-99	100-00	164.36	164.36	-	109.83	6.34
5-10	7-90	92-49	148.30	151.18	17.86	127.53	16.53
10-20	15-07	92-61	135.11	140.44	29.14	132.02	23.69
20-30	25-01	87-74	142.09	149.82	25.92	130.83	33.54
30-50	39-24	85-60	128.80	139.64	31.60	106.16	32.40
50-75	58-55	78-17	97.14	118.16	19.27	111.51	22.04
75-100	86-80	89-40	117.16	130.14	39.63	93.61	60.91
100 and above	129-22	67-29	73.38	109.07	64.06	91.87	35.39
Overall	3040	85.34	124.19	137.03	30.43	115.94	32.43

(1) Enployment Implications of the Green Revolution and Mechanization: A Cose Study of the Punjab. C.H. Hanumantha Rao. Institute of Economic Growth, Delhi.

size groups that own tractors. Since small non-tractor farms are able to achieve higher irrigation and cropping intensities, their poor performance in regard to the use of high-yielding varieties and fertilizers dispite the availability of labor may be attibutable to their inadequate access to Capital resources and to risk-aversion.

It is interesting to note that the tractor population in India doubled between 1956 and 1971, and the tractor use is not confined to large farms alone; the small and medium farmers also use tractors in large numbers.

3) Cropping Intensity:

In areas where few opportunities exist for area expansion, the effect of additional power an cropping intensity is often regarded as a major potential benefit, achievable mainly through fast cultivation between seasons. It should be noted, however, that agricultural system have existed in the past and at the present which achieved dauble and even triple cropping without any tractor use. (For example, bullock farms achieve 200% intensities).(1) High intensity levels have also been achieved in Taiwan lang before tractorization . But the irrigation of semi-arid lanks makes possible double cropping and produces

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(1) "The Economics of Tractors in the Indian Subcontinent: An Analytical Review."
Hans P. Binswanger. Hyderabod 500-016, India. October, 1977.

two critical periods in the annual cropping calendar. Proponents argue that only through greater power availability will the benefits of double cropping be realized. Proponents also of tractorization stress the importance of timeliness of seed bed preparation. Table (7-2) gives data on yields per acre (Value) and cropping intensities on tractor and non-tractor farms. The statistical tests showed that both the intensity of cropping and value of output per acre are higher on tractor farms.

4)- Yield Effects:

There is a complementarity between the use of tractors and area under gigh-yielding varieties (and use of modern inputs) in the sense that area planted to the high-yielding varieties cannot be expanded beyond a certain point without tractors because of the need for time economiy. Furtherm re, the seedbeds prepared with mechanical tillage equipment is superior to animal tillage and result in better germination. Generally speaking, there is some evidence to show that significant increases in crop yields can be effected by the mere substitution of mechanical power for animal power under circumstamces in which the timeliness or the quality of work is not changed.

Hans P. Binswanger Says "In Delhi territory and Hepal study the yield differences wary between 10 to 30% (significant in the case of Delhi territory), troctor farms have a yield

TABLE (7-2)

Productivity Differences Among tractor and Noh-Tractor Farms-Punjab 1971/72(1)

	Tractor Farms(TF)		Non-Tractor Farms (NTF)		Significance of Differences between TF and NTF	
Farm Groups 1	Intensity[a] of cropping index 2	Value of output per acre(Rs) 3	Intensity of cropping index 4	Value of output per acre (Rs) 5	Intensity[a] of cropping index 6	Value of output per acre(Rs) 7
Up to 15 acres	195	1.437	165	1.194	*	*
15 to 30 acres	167	1.207	150	1.031	*	* *
More than 30 acres	153	1.052	131	874	***	*****
All Farms	175	1.258	157	1.114	*	*

a) Intensity of cropping index is given as: Gross $\frac{\text{cropped area}}{\text{Net sown area}} \times 100$

b) * = Significant at 0.01 probability level.

** = Significant at 0.15 probability level.

*** = Not significant at 0.10 probability level.

differences vary between 10 to 30% (significant in the case of Delhi territory), tractor farms have a yield advantage

(1) Farm Tractorization, Productivity and labor Employment: A Case Study of Indian Punjab. Paper. by Shyamal Roy and Melvin G. blase.

in sugarcane and wheat ranging from 17.6 to 41 percent."[1]

5)- Tineliness:

One of the benefits of farm machinery most stressed by its advacats in the gain in timeliness achieved by farm machines. Umakesan, using the tractor and bullork Coeffi-cients of his survey, on average, for all 19 crops Consid-ered, tractor farms should be able to complete field prep-aration end sowing in exactly half the time of bullock farms (Umakesan, his table 10)[2]. It is also clear that farms owning both tractors and bullocks should be best placed with respect to timeliness. Furthermore, in each crop there seems to be a sowing period of at least a month or one and half months during which yields not decline substantially. In very arid tracts such as "Rajasthan" such a long sowing period may not be available, on these sandy to sandy loam soils with very scarce rainfall a safe sowing period is often only 5 to 6 days long which puts a much higher premium on timeliness than in the heavy soils or irrgated tracts. We thus can conclude that timeliness of operation should be most important in dry areas with scandy rainfall and shallow red and sandy soils.

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(1) "The Economics of Tractors in the Indian Subcontinent. An Analytical Review". Hans p. Binswanger. Hyderabad 500-016, India. October, 1977.

(2) Wayne Dyer, 1977. "Agricultural Mechanization and Agricultural Development in Egypt". USAID Contract No. NE - 147 - 77 - 8.

6)- Changes in the Cropping Pattern:

Binswanger (1977) finds obly a few instances where tractors are likely to be the causative factor in cropping pattern changes on the Indian subcontinent. Instead, his data illustrate the importance of the confaunding factors i in determining cropping pattern differences between bullock farms and tractor farms.(1) The determination of benefits tractorization through changes in the cropping pattern are even more elusive than the benefits from increases in cropping intensity and yields. Binswanger, says that there. exist at least 5 possible causes for cropping patern shifts between bullock and tractor farms.(2)

1. differences in irrigation
2. power availability, i.e. timeliness
3. Capital or credit availability enabling the planting of more high value- high input crops.
4. greater managerial ability enabling better perception of the optimal cropping pattern by the farmer.
5. less need to produce fodder (clear tractor effect).

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(1) Wayne Dyer, 1977. "Agricultural Mechanization and Agricultural Development in Egypt." USAID Contract No. NE - 147 - 77 - 8.

(2) Binswanger Hans P., 1977. "The Economics of Tractors in the Indian sub-Continent: An Anolytical Review". Hyderabad, India, ICRISAT.

7)- Tractor utilization:

Table (7-3) summarizes the evidence in the tractor surveys on the use pattern of tractors. Binswanger (1977) repesents the following main conclusions:

1. Tractor utilization is very much related to farm size. The larger farms have trigher utilization than smaller ones.
2. Small tractor farms rent out a higher proportion of their hours than larg ones.
3. Tractor rental markets appear weak in the Indian Punjab, Haryana and Delhi territory but fairly well developed in all other Indian areas, with Pakistan somewhere in between.
4. Tillage is by far the most important operation both ob farms of owners as well as on farms hiring the tractors (Gujarat).
5. Irrigation by tractors is important in the smaller Punjab farms, in Maharashtra and in chittoor district of Andhra Pradesh, Wherease tractors are used for threshing in most regions except Chittoor district (and by Owners in Gujarat).
6. Tractors are intensively used for transport both for agricultural as well as nonagricultural uses, which sometimes called social uses.

TABLE (7-3) UTILIZATION OF TRACTORS

Author / Area		Range or average size of farm in ha.	Total hours used (1)	USES BY OWNERS AS PERCENT OF (1) Tillage (2)	Irrigation (3)	Threshing (4)	Sowing (5)	Transport (6)	Total agri. uses (7)	Non-agri. uses (8)	Hired out (9)
Government of Punjab (India)		7-10	682	35.9	19.9	11.6	1.3	3.4	72.7	19.8	7.5
		10-20	792	43.6	18.7	9.2	3.3	5.8	80.6	17.7	1.7
		> 20	1008	49.7	8.3	11.8	3.6	5.1	79.5	18.8	1.8
Kahlon	I	10.6	655						70.4	26.9	0.0
Punjab (India)	II	9.5	707						90.9	9.0	0.1
	III	10.9	279						87.9	12.1	0.0
	IV	8.3	360						89.5	9.4	1.1
	V	15.5	550						63.4	33.5	3.1
Sharma		6-10	(278)	68.6	0.0	12.0	1.0	6.2	87.8		12.2
Haryana		10-14	(437)	70.1	1.0	11.3	0.7	10.1	93.1		6.9
		14-20	(575)	68.5	6.9	7.9	0.5	9.3	93.4		6.6
		>720	(870)	73.7	3.9	11.5	1.5	8.0	98.6		1.4
McInerny & Donaldson		0-24	1019								23.6
Punjab (Pakistan)		24-49	1279								24.7
		49-73	1325								8.9
		> 73	1523								0.4
Motilal		0-6	375								9.1
Delhi		6-10	672								5.2
		> 10	1243								0.7
Desai &	Daseroi	TO 9.6	655	28.6	0.0	2.7	0.0	18.6	49.8	5.8	44.3
Gopinath	Anand	TO 7.1	882	15.1	0.0	0.5	0.1	15.7	31.4	9.5	59.1
Gujarat	Dholka	TO 35.3	861	25.7	0.0	5.9	3.8	20.7	56.1	6.9	37.0
	Daseroi	TH 4.6	(35)	76.0		12.7		11.3	100		n.appl.
	Anand	TH 3.4	(57)	59.7	0.0	40.3	0.0	0.0	100		n.appl.
Sapre, Maharashtra		41.5	544	(51.6)	(23.2)	n.av.	n.av.	(17.1)	n.av.	n.av.	34.0
Narayana Chittoor, Andhra Pradesh		11.0	475	21.9	10.5	2.9	0.0	12.6	47.9	29.3	22.7

Source: Binswanger Hans P, 1978. The Economics of Tractors in the Indian Subcontinent: An Analytical Review. Hyderabad, India, ICRISAT. Table 12.

CHAPTER VIII

Possibities of using the other Countries experience in organizing and modernizing the agricultural mechanization in R.A. EGYPT.

1)- The objective circumstances of agricultural mechanization in Egypt.

Egypt's 43 million people[1] must make do with obly 6.5 million feddans of arable land, divided between approximately 5,667 million feddans of old lands and 0.9 million feddans of new lands which have been reclaimed since 1952. This area of arable land means that there is only 0.15 feddans per person (in comparison, 0?61 feddan arable land per person is available in Pokistan, 0.63 feddan per person in India and low 0.12 feddan per person in highly industrialized Japan).[2] Egypt's population is expected to grow to between 60 and 70 million in the year 2000 implying only 0.10 feddans. of arable land per person, if the current area of land remained as it is now. Consequently, the lack of cultivable land is one of the main obstracts in developing agriculture in Egypt. At the same time it is a strong motivation for the horizontal and vertical expansion.

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(1) After the last estimate of population in Egypt in 14. January 1981.

(2) Wayne Dyer: Agricultural Mechanization, and Agricultural Development in Egypt. Stanford University. April,1977. USAID contract No. NE - 147 - 77 - 8.

As for agricultural mechanization, the A.R. Egypt is considered one of the countries which used the modern agricultural equipments on a limited scale in spite of the great care given by the state during the last years. The use of mechanical tools in Egypt has been confined to some limited operations. the most important of which are ploughing, irrgation, threshing, threshing, transportation and plant protection. Morever, mechanization has not achieved the objectives planned by the state especially in the agricultural cooperatives. This is due to technical, economical and social considerations. Consequently mechanization became a burden for the agricultural cooperatives. Most of these cooperatives became indebted to the Agricultural Credit Bank.

The rise of wages and the scarcity of farm laborers especially in agricultural seasons are one of the main reasons which resulted in using agricultural mechanization recently in order to achieve the agricultural operation for suitable cost. However, the application of modern agricultural mechanization in Egypt was faced by some obstracts resulting from the characteristics which characterizes the agricultural poduction in Egypt

2- <u>Cropping pattern and cropping intensity in the Egyptian agriculture:</u>

The modernization of the Egyptian agriculture as a toll far meeting the increasing demand of agricultural

products, has become a "must" in the recent years. Farm machinery has to play on important role in the process of building up a modern agriculture, specially in the process of cropping intensity and the changes of crop rotation pattern, with the aim of increase in yield.

The basic crop rotation pattern is presented in (Figure 8-1). In addition to the major crops, there is also a wide varity of minor crops. The area devoted to each of these crops fragmented in small plats, but collectively they occupy a significant proportion of the total crop area. More specialization within zones, and larger areas an individual farms, would likely Contribute to increase output and improved marketing proctices.

Eypt's 5.667 million feddans of old land i.e., land in cultivation prior to the 1952 revolution produced two crops per year on most of Egypt's crop land. Cosequently the total cropped area in Egypt (average 1972-1974) is 10.722 million feddans as a result of cropping intensity, (table 8-1), but at the present time is over 11 million feddans. In the year 1985 the proposed cropped area will be 11.75 million feddans, as a result of increases the cropping ratio to 2.1. On the other hand, if the cropping ratio increases to 2.1 in 1985, and the new lands now in cultivation are brought under a more intemsive cropping pattern than that at present, water requirments would

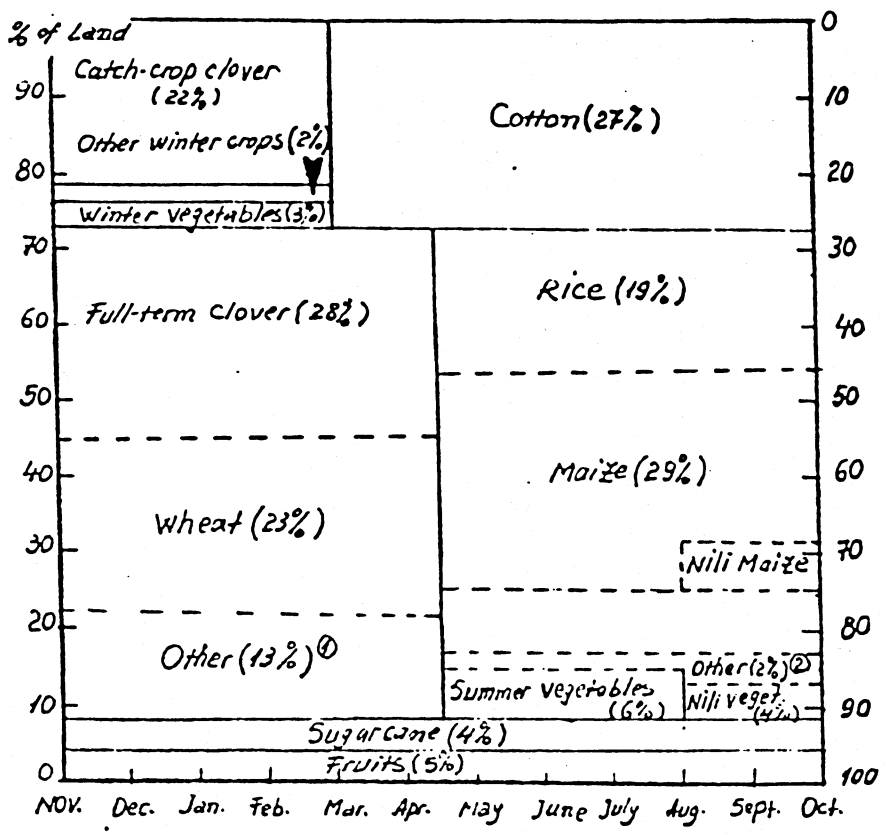
Table (8-1)

	Old land. Avg. 1972-1974	Proposed land 1985
Total Cropped area.	10 722 000	11 750 000
Total land area.	5 667 000	5 600 000
Cropping ratio (Average number of crops per year)	1.89	2.19

Source: ERA 2000 Inc. "Further Mechanization of Egyptian Agriculture," gaithersburg MD. April 1979.

PROPORTIONATE AREA DEVOTED TO SPECIFIED CROPS, 1972-74 AVERAGE.

Figure(8-1)



① Chiefly horsebeans, lentils and onions.
② Chiefly sesame, groundnuts.
③ Source : (1)

1-Source: USDA, 1976. Egypt: Major Constraintstto Increasing Agricultural Productivity, Foreign Agricultural Economic Report No.120, Washington, USDZ. pag., 4.

be only mofrtaely higher than they are now.

Improved cropping practices and irrigation facilities can not be done without using farm machinery at a high scale, specially various kinds of water pumpes. Possibilities for large quantities of ground water may exist in the Western Desert and in the Nile Valley and Delta. This would be available by pumping to supplement water from the

Table (8-2)

Percontage of increase in yield.

Crops	1972-74 yield metric tons per feddan.	1985 yield metric tons per feddan	Increase Persent %
Cotton (lint)	0.30	0.36	20
Wheet	1.40	1.75	25
Maize	1.50	2.00	33
Rice (paddy)	2.20	2.64	20
Sorghum	1.70	2.04	20
Sugarcane	36	45	25
Catch-crop clover	12	15	25
Full-term clover	24	30	25
Sweet Sorghum fodder	..	18	..
Maize green fodder	..	18	..
Barley	1.14	1.37	20
Lentils	0.80	0.96	20
Horsebeans	0.98	1.18	20
Fennugreek	0.74	0.89	20
Flax (seed)	0.49	0.59	20
Flax (straw)	2.50	3.00	20
Onions	8.86	10.63	20
Vegetables	7.20	10.80	50
Fruits	7.10	9.94	40

Source: (1)

(1) Source: USDA, 1976. Egypt: Major Constraints to Increasing Agricultural Productivity, foreign Agricultural Economic Report No. 120, Washington, USDA. Pag; 53.

the Nile if needed.

One from the things which characterize the agricultural production in Egypt is the rise of yield for most of the agricultural crops, regardless of using agricultural mechanization at a low scale. (see figure No. (2-1), Chapter 2.

Substantial increases in yields were assumed for 1985 which are belived to be technieally feasible by using farm machinery and modern equipments, besids all the other inputs. From the table (8-2) we notice that yield of maize was assumed to highest increase from 1.5 tons per fedden in 1972-1974 to 2.0 tons by 1985, an increase of 33%. The increase in wheat yields is somewhat less, about 25%, because substantial progress has already been made in the introduction of improved varieties. Yield increases for all the major crops are showen in the table, these percentage increases were applied to the yields by Zones during the 1972-74 base period to obtain projected total production for 1985.

Generally speaking, we can observe from the table, that the yield of all the major crops recorded an expected on expected increase in 1985. The percentage of this increase reached in vegetable crops to 50% and in fruit crops to 40%. These percentage didn't reach to less than 20% in any crop presented in the table.

3- Using the tractor for agriculture in Egypt.

According to the statistics of 1979, there are 29352 tractors in Egypt.(1) Out of this number there are 8400 tractors working on the state farms and agriculture cooperatives. The remaining 20942 tractors are owned by citizens and the private sector.

The number of tractors whose productive age is less than ten years amounts to 21000 tractors. The total number of tractors in a satisfactory state amounts to 19000 tractors. If this number is used serving the land and for agricultural aperations, the present rate of using tractors in Egypt will be one tractor for every 144 hectar of arable land. This ratio will be a reasonable one, showing a high rate of using tractors in Egypt. But in fact is a great difference. Many scientific studies proved that the number of tractors used for agriculture is about 30% only, in other wards only 30% of the time of tractor is used for agriculutre. The remaining 70% is used for transportation and other operations. Comseqently the real rate for using the tractor in Egypt is about one tractor for 479 hectars, (troctor /1140, 35 feddans).

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(1) Source: Ali M. Al.Hossary 1979 Agricultural Mechanization in Egypt, at present and in the future. Document No. 6./1979 Academy of Scientific Research and Technology. Cario .

In other words the ideal use of the same number of tractors can change the rate of area helped by one tractor. This shows us that the Egyption farmer is not aware of using aware of using tractor on the agricultural equpments in a good way. Transportation can be carried out by other means such as the light lorries givin to the farmers with great facilities.

Comsequently the current state's poliey aims at increasing the number of tractors waking for agriculture (See table 8-3) and introducing mechanization to the Egyptian farmer. Therefore the sums allotted by the Development and trustee Agricultural Bank for financing the purchase of tractors rose from 8 million pound in 1979 to 16 million pound in 1980.(1) The bank facilitated the steps and

Table (8-3)
The evolution of quantity , the copacity and the
The value of the tractors tell 1985.

Year	Number of	Average of horsepaner h.p.	Avg. of the price of tractor in
1961/1965	13607	45	1200
1969	16962	45	1546
1970	17500	48	1884
1974	18597	55	3255
1977	21000	58	4950
1980	28700	60	6500
1985	37000	65	7200

Source: Ibid.

(1) The reports of the Agricultural credit centre Bank (not published).

conditions of giving loams to the farmers. It allowed now the holders of five feddans only to borrow from the bank. The farmer is to pay one forth of the price wheraas the bank pays the rest. The farmer is to pay the rest through yearly instalments.

4- Possibilities of using the other countries experience:

The study of the experiments of applying agricultural mechanization in some countries can benefit Egypt while trying to apply the farm machinery on a large scale in order to cary out the various agricultural operations. But first of all I'd like to show that the possibility of the fareign experiments and experience does not mean that Egypt should follow the same footsteps followed by those foreign countries, because there are natural, economic and social differences between Egypt and the other countries, which make such a thing imposibile. But it is also tru that the solutions found by a country to extend and develop the agricultural mechanization in a short time like in Romania are worth being studied. The fact, that it was possible in Romania to change agricultural from a backward one to a modern efficient one in only three decades underlines the importance and the role played by a unitary clear conception materialized in well defined plans of measures, steadily reinforced by important investments.

We should not only benefit from the experiments and

experience of the developed countries which preceded us in using agricultural mechanization, but it would be beneficial as well to know the experiments and experience of the underdeveloped countries which suffer from social economic circumstance similar to ours. To know the aspects and causes of the defects in these countries help us avoid them in our Egyptian experiment. Hence, this study includes the experiments of the countries in Africa, Asia, Latin America and India.

As already mentioned, the agricultural development in each country is determined by specific natural, historical, political, economic and social conditions, and this makes imposible to identically transplace the experiemee of a country in this matter to another country with diffient conditions. However, some general traits tendenices and characteristics of the modern develqsment of the agriculture in some countries can be an example for other countries.

In the case of Rilania we find that the strategy of the development of the agriculture in Rimania has to determine the way in which the technical and material basis could be improved and modernized. The achievement of this task has called for huge efforts from the part of the romanian state. It was admitted that the tractors, the farm machines and all the other means of production be

manufactored in Romania and not imported. Consequently, an industry specialized in manufactruing tractors and farm machines has been created which was capable to meet all the demands in this respect and even to export of its production.

The stations for agricultural mechanization in Romania can be a good example for arganizing and adminstrating stations carrying out the same purpase for serving agriculture in Egypt. Mrznxhile we should take into consideration the characteristics of agricultural production in Egypt, the form of ownership ... etc.

As a matter of fact, the development of the Egyptian agriculture depends on a larg number of economic and social facters which on the whole, favor the establishment of any agricultural mechanization program.

The process of introducing and modernizing of the farm machines takes place under the specific conditions of the Egyptian agriculture which irrigated cropping is the principal one and the cropping ratio is high (average number of crops per year). Besides the multiplication of wages for the agricultural laborer from 0.55 pound in 1970 to 1.55 pounds in 1980. and the tack of laborers in the fields as about 2.4 million agricultural laborers migrated from the country to the towns in the years from 1961 to 1974. About one million farmers left Egypt forever in

the years from 1974 to 1980 in addition to the great number which turned to education, and the quality of the land which is disintegrated into small loits as it show in the table (8-4) which shows that the percentage of the

Table (8-4)

The total number of lond holders and the area of land land holding in Egypt 74/1975.
(The number includes the cooperative and agrarian reform land holdings)

	Land holding in Fedden	% of the total area	the number of holding	% of the total number
1 Fedd.or less	739.028	12,351	1.124286	39,410
Maretham 1-3	2023 456	33,816	1.160147	40,670
" 3-5	1.185 581	19,814	354841	12,440
" 5-10	944 411	15,783	148459	5,200
" 10-50	985 508	16,470	65059	2,280
" 50.	105 684	1,766	131	0,0004(1)

* Source: The Agricultural Economic Research Institut.
The Agricultural Economic Bulletin 1979.Cairo.

people holding five feddans or less is 92.52% of the total land holders in the year 1974/1975. The percentage of the people holding 1-3 feddans amounted to 80,8%,the percentage of the people holding one feddan or less reached

(1) The number includes the holdings of arganization, Companies and agricultural scools.

39.41% .

We can add the abundance of the various kinds of farm machinery and tractors. The number of kinds of tractors used in Egypt reached to about 45 kinds. At the same time we must note that there is no integrated technical staff who can maintain these machines and tractors.

These factors determin the tends of any program for developing and exlension agricultural mechanization in Egypt, taking into account that Egypt is trying hard to culitivate the greatest area at the lest time possible.

CONCLUSIONS AND SUGGESTIONS

Small farms are common in Egypt and in the underdeveloped countries in generally, thus any program for developing agriculture should be bosed on this fact. It should give more care to the small farms if we want to increase the agriculutral productivity. The Egyptian have to care for general eduction and training concerning production and technology, because, contrary to what some believe, our farmers wish to improve their agricultural operations, but they are unable to do so for many reasons, such as, lack of knowledge, lack of liquied currency and the lack of local abilities.

There is much evidence to show that seedbed preparation, general cultivation, plant protection, harvesting, threshing, waterpumping and land reclamation can be done more

efficiently and with greater productivity by using tractors and engine-powered machinery rather than traditional hand-operated or animal-drawn implements. Now, the question is not whether engine-powered machines are to be introduced into the agricultural in Egypt, degree and pace at which they can be introduced to maintain economic efficiency in the farming system.

The current circumstances in Egypt calls for giving priority to mechanizing some agricultural operation such as ploughing, irrigation, threshing, pest control and hoeing (cultivation). This can be done as a first which can be carried out through ten years.

1. Land preparation for seeding:

Carrying out this process through mechanization reduces labor required for land preparation and saves about 3 pounds in the cost of ploughing and preparing one feddan. It we take into account that the crop areas which can be ploughed mechanically form about 51% of the total crop areas i-e. about 6.4 million crop feddans, we find that the sums saved by using mechanization are about 18,3 million pounds.(1) Besides, time is saved. Meanwhile, the deeper plaughing

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(1) Ali M. Al-Hossary, 1979., "Agricultural Mechanization in Egypt: At present and in the future". The scientific seminar about agricultural mechanization for food security. Paper in Arabic. Cairo.

obtained by mechanical means has proved effective in obtaining higher crop yield.

2. Pumping of irrigation water:

Some studies estimated that the efficiency of irrigation through automatic pumping is equal to 75% or 85% in return for 25% by using the Archimedean screws (sakias) of which there are 190 000. This number of sakias should be changed for 1900 irrigation units every year. It is expected that the money saved as a result of this amount to mearly 40 million pounds every year.

3. Threshing of grains:

Mechanization of the threshing operation has a substantially increasing grain output per fedden by decreasing losses, cra cked Kernels and the chances for introduction of dirt and other foreign matter. Some Egyptian studies estimated the rate of loss of grains by using the traditional means as 7-10%. The table shows the amount of loss in harvesting and threshing the crops of grains by using the traditional methods (Nourag).

4. Pest control through mechanical means:

Insteed this process is carried out nowadays under the complete supervision of agriculture. This process save about 60 million pounds for the state. The value of the loss which any take place resulting from the damage caused by pests in cotton and in other crops.

Table

AMOUNT AND VALUE OF LOSS IN HARVESTING AND THRESHING THE CROPS OF GRAINS BY THE TRADITIONAL METHODS (NOURAG)(2).

Crop	Unit	Average of Total production	The quantity Thrshsa By Nourag.	% of loss.	The quantity of losses.	Average of Prices in LE.	The Value of Losses in Mullion Pounds.
Wheat	ton	2 190484	10 952340	7	766.664	5,100	3,91
Horsebee	ton	234205	234205	5	11 710	96,774	1,13
Rice	ton	2 505292	1 252598	8	100 170	37 037	3,71
Total Value of Losses.							8,75

5. Hoeing (cultivating):

Using the mechanical means for hoeing the orchards and the vegetable farms. This process should achieve their objectives which can be summed up as follows:

1. Cultivating equpments (or tillage equipments) should replace the animal power without effecting the operation efficiency.
2. They should aim at increasing the productivity besides saving labor.

(1) Ali H.Al-Hossary, 1979., "Agriculture Mechanization in A.R.E." Paper in Arabic, given to the Second Conference for Mechanical Engineering about the role of mechanical Engineering in rectifing the economic Course. 22-25 March 1979. Alexandria.

3. The equipments used should be standardized to the circumstance of agriculture in Egypt concerning the size, the simple way of operating, the low price and the efficiency in work.

Suggestions:

Of course, Besids the characteristics of Egyptian agriculture, there are still some other limitations, which must be considered when deciding upon the stablishment the program of introducing the agricultrual mechanization to the Egyptian farmer. Such as available financial means, but in the whole, some concrete suggestions can be made in this respect:

1. Making researches and applied experiments for knowing the kind of agricultural tools which suit the local conditions and the kinds of cultivated crops, the kinds of soil, means of irrigation ... etc.
2. Organizing the mechanical work through erecting mechanical service stations (service centres) which render services to the farmers for reasonable fares. Each station should contain a number of tractors, irrigation pumps, hoeing tools... etc. These equipments should be sufficient for covering the whole area. Every centre should be annexed by a maintenance and repair workshop, fuel stores, spare parts ... etc.
3. The centre should be in the middle of on area of

5-10 thouthand feddans. If should be run by a team of specialists in agricultural mechanization and the production of crops.

4. The required technical groups should be trained in especially equipped training centres. The number to be trained should be enough for expected expansion inuusing agricultural mechanization in the future.

5. The service station should be on integral technical and administrative entity. It should have its own identity, and its complete authorities in administrating the work. Its ownership is better to be cooperative, and it should be specialized in agricultural mechanization. Its capital should be contributed by the members themselves. The members should share in administrating the work in the stations.

6. The agricultural operations should be carried out according to the technical recommendations set by the results of scientific researches. This would make it easy for the farmers to follow the new trends of agricultural technology.

7. Concerning the new land and the newly reclaimed land:

   a. The cultivated land in the new reclaimed areas sgould not be disintegrated. The average land holding should not be less than 50 feddans. (the youth can be allowed to have a minimum holding of 10 feddans to encourage them provided

that they cooperative with each other for using agricultural mechanization).

b. The small land holdings should completely disappear. The old fashomed tools should be prohibited as agriculture should be carried out by using the recent agricultural equipments.

c. Eventually, the thought and mind of the Egyptian farmers should be changed. Generally speaking, it is the farmer who constitutes the essential and decisive factor in developing agriculture.