AGRICULTURAL MECHANIZATION IN IRAQ WITH REFERENCE TO DATES, WHEAT, AND BARLEY

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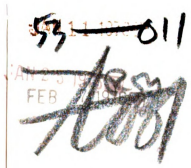
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ABSTRACT

AGRICULTURAL MECHANIZATION IN IRAQ WITH REFERENCE TO DATES, WHEAT, AND BARLEY

By

Kadhum Ibrahim Saied

Very little has been written on the topic of agricultural mechanization in Iraq. The intention of this thesis is to help fill this void, and to open up new vistas for study.

Agricultural production in Iraq is still traditional; primitive tools and a limited supply of power hamper agricultural production. Drudgery and hard physical work dominate the Iraqi farms. Millions of people engage in food production, but are unable to feed the eight million inhabitants of the country; and each year import of food increases. Agricultural mechanization is one of the assured means of increasing agricultural productivity. This thesis describes and evaluates present cultural and mechanization practices with respect to the production of the three main cash crops of Iraq: dates, barley, and wheat. Several stages of mechanization are studied--hand, animal, and engine-powered implements--and the importance of education, research, and extension programs are discussed. Finally a series of specific recommendations is presented.

Iraq is fortunate in her rich soils (particularly alluvial soils) and abundant water; but it suffers from the necessity for constant irrigation and the resulting salinization.

The Agrarian Reform Act of 1958 eliminated ancient inequalities, and made the peasants owners of small (30-60 acre) farms. These men are unaccustomed to their new responsibilities; they cannot yet afford new machines, and frequently cannot afford the risk of innovation. At present some can obtain the use of machinery through cooperatives and through government hire and rental services.

Iraq's thirty million date palms supply over 80 percent of the world's date exports, and account for the livelihood of many of the Iraqi people. The present yield per tree is the lowest in the world. The following suggestions are made to increase yield and make the industry more efficient: adopt the chisel and sledgehammer method of removing offshoots, which compete for nourishment with the parent tree; use the auger bit to dig the holes in which the offshoots are transplanted; use the Harvester Loadstar to reduce labor costs and make cultivation and harvest more efficient (the machines allow workers to reach the crown of the tree more safely and faster); use of mechanical hand sprayers for more rapid and thorough pollination.

It is physically and economically feasible to transplant mature palms now lost to urbanization and salinization. Research also shows that date pits contain many nutrients and

when crushed can be used for animal fodder. Further study is needed comparing the cost of crushing with possible profit.

Hand and animal powered tools will remain of great significance in Iraq for some time. Improvements are necessary in the raw materials and the techniques used in their manufacture and in their design. Improvements in native breeds of animals should be attempted.

Engine power, where feasible, provides the obvious advantages of deeper ploughing, increased areas of cultivation, less erosion, and more work per man hour. Guarantees should be obtained from every company importing machinery to Iraq that spare parts be easily available.

Extension workers provide vital instruction for the new land owners who were so recently peasants. Instructional materials should be illustrated, at least, and as much instruction as possible should be audio-visual. Sociologists and psychologists could fruitfully advise many extension program and cooperative society leaders.

Adaptive research should receive high priority; researchers must be freed of time-consuming duties and provided with adequate funds. A national committee to direct research and channel financial support would provide needed coordination. A Middle East regional center for research would give this direction on a larger scale, as well as conducting research of its own. Funds could be channeled through it on a matching basis.

Some specific topics needing research are: the physical, social, and economic characteristics of Iraq; the comparative costs of producing and importing specific equipment; a comparison of the state-owned hire-and-rental services with those that are privately owned; and tests of the adaptability of imported machines.

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CHAPTER I

INTRODUCTION

General Perspective

"Agricultural mechanization may be defined as the art of equipping agriculture with mechanical aids wherever possible for increasing the efficiency in the enterprise."[1] The aim of agricultural mechanization is to increase the physical and economic productivity of agriculture. The advanced countries have realized this for about two centuries, and have improved their productive capabilities accordingly. There is a striking contrast between their high productivity and the low productivity of the underdeveloped world. Unfortunately the gap between the two is increasing rather than decreasing with time. At the present time, for instance, the average American farmer produces enough food for himself and 31 other people; in the underdeveloped nations, (and Iraq is among them) farmers produce food sufficient for only himself and one other person. For this reason over half of the Iraqi population must live on the land and

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[1] H. F. McColly, "Agricultural Mechanization in South-East Asia," Agricultural Engineering, 46 (January, 1965), p. 26-7.

depend directly on agriculture for their livelihood. There is still not enough food to supply the country, and some food must be imported; and, ironically, the farmer performing the most necessary of all tasks, remains a man of little status, almost an object of scorn. What is the solution to this problem? Demographic pressures place these countries at a disadvantage; they must increase their productivity even more than the industrial countries do, just to maintain present (low) standards of nutrition. Although Iraq is not presently overpopulated, its rate of increase (3.3%) is among the highest in the world. Any improvement in present standards would demand an even higher rate of increase than the industrial countries achieve. The solution has two parts: to increase the yield per unit of land, and to increase the amount of land under cultivation.

Technology and greater input can bring about the first goal, an increased yield per unit of land; to bring about the second goal, increasing land under production, more capital and more labor are needed--primarily more labor. But if 70 percent of the population already lives on the land, supplying more labor would demand that almost the entire population be engaged in agriculture. This is of course not practical; there are other national tasks which must be done. And in fact the supply of agricultural labor is

constantly diminishing. Iraq, like many other countries, is experiencing the migration of many of the farm population to the cities.

The mechanization of agriculture can help achieve both goals. That is, mechanization can help increase yields per acre as well as make it possible to cultivate more land in Iraq. But it is not likely that mechanization will be easy or be accomplished without serious adjustment problems resulting for both people and government.

The Problem Setting

Iraq is the largest exporter of dates in the world according to the FAO.[2] Approximately 82 per cent of the world's export of dates come from Iraq. Dates are Iraq's most important cash crop. FAO figures, however, also reveal that the yield per tree of Iraq's date palms is the lowest in the world. Iraq's yield is about 12 kilos per tree as compared with a high of 30 kilos per tree in other areas. There are thirty million date palm trees in Iraq. It is obvious that increases in yield per tree could be extremely important nationally.

Wheat and barley are also commercially important in Iraq. These crops are cultivated today with tools and methods little changed in several thousand years--in fact, since the dawn of history. The wooden plow, the

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[2] FAO Trade Yearbook, 1969.

spade, and the sickle are the main tools. Methods of production are primitive, depending mostly on hand and animal power. The area under cultivation for these crops is steadily decreasing because of the problem of soil salinity which is occurring throughout most of the country. Furthermore, crop rotation is rarely practiced and nearly one-half of the cropland is left fallow each year.

Today in Iraq most farmers are landowners and decision-makers. This is a relatively new situation for them. Prior to the Land Reform Act of 1958, most farmers were neither landowners nor decision-makers. Thus, it is likely that many farmers, even after 13 years, do not yet have sufficient expertise in the acceptance of responsibility and in decision-making to provide the necessary foundation for a program of rapid mechanization of certain agricultural sectors.

Adequate agricultural planning which takes into account all factors is probably not yet in existence in Iraq. As is so painfully obvious in the developed countries, planning is absolutely necessary; yet mistakes and failure to consider relevant variables frequently plague even the most astute. As in many developing countries, a great gulf between those who plan the agricultural mechanization programs and those who carry them out probably exists in Iraq.

The Problem

It is assumed that all levels of the Iraqi society desire higher levels of efficiently produced agricultural output. It is further assumed that one of the suggested approaches to higher levels of output, agricultural mechanization, is a relevant alternative and indeed, the most appropriate alternative that can be studied.

Specifically, then, the problem to be addressed in this dissertation is: What are the obstacles to achieving a higher level of agricultural mechanization and how can these obstacles be reduced in magnitude or eliminated entirely? Perhaps this "problem" cannot be solved in the "classical" sense but the author feels that the investigation suggested by the problem as stated will yield valuable information to decision-makers in Iraq during the fateful years ahead.

Objectives of the Study

The first objective of this study is to describe some important factors which affect the success of agricultural mechanization in Iraq; these factors include physical, social, economic, and legal aspects. The term "agricultural mechanization" includes several different stages of mechanization: the use of hand-power implements, of animal powered implements, and of engine-powered implements.

The second objective of this study is to describe the present farming system, particularly cultural operations in date, barley, and wheat growing where tools and other mechanical equipment are used.

The third objective is to discuss the various stages of mechanization in Iraq, with a view to analyzing the principal problems involved in each.

The fourth objective of the study is to point out the important role played by education, research and extension work in the success of Iraq's agricultural mechanization program.

The fifth objective is to develop a series of recommendations for the improvement of agricultural productivity through mechanization.

Sources of Information

The information gathered together in this thesis is from many sources. Some of it is the result of personal experience; the author has taught at two universities in Baghdad, and before that was involved for many years with his family's date orchard. In addition, there are a number of estimates which he made in his capacity as agricultural engineer. The more recent information was obtained from friends who presently reside in Iraq; of particular value was the 1970 Quarterly Report of the Ministry of Agricultural Reform (Department of Statistics).

Other statistics are derived from United Nations publications, in particular, of course, those of the FAO.

Valuable information was also obtained from case studies of countries which face problems similar to Iraq's. Finally, although there is little written directly on the topic of agricultural mechanization for that country, use was made here of more general studies of Iraq; these often dealt with factors which affect the success of agricultural mechanization programs.

Limitations of the Study

Throughout this study the author encountered difficulty in obtaining adequate statistical data. Like other developing countries, Iraq is not yet able to gather complete and accurate statistics regularly and the lack poses a real problem for research. To take only one example: the time necessary for a laborer to climb a palm tree is a seemingly minor piece of information, and a point on which as yet no research has been done; and yet the information is important to this thesis. In this, as in other cases, estimates had to be made.

In addition, photographs of specific agricultural practices in Iraq would have provided valuable illustrations of points made here; unfortunately, however, these were not available. This is partially because of the fact, mentioned above, that there is little information on the specific topic of this thesis.

Many of the recommendations cited in the final chapter must eventually be verified experimentally, but to

do so is, of course, beyond the scope of this thesis. In fact, one of the main purposes of this study is to open up new avenues of research. For this reason, and because of the breadth of the topic, it was not always possible to give full details on methods of implementation; since so many factors are involved, it was thought preferable in many cases simply to describe the goal, and to leave the means for achieving the goal to further studies.

In general, then, since this is the first study of its kind, the emphasis has been on establishing guide lines for agricultural mechanization and given recommendations as suggested directives. Finally, it is beyond the scope of any one thesis to study in detail every crop grown in Iraq, and no attempt has been made to do so here. It is the three main cash crops: dates, wheat, and barley, which have been selected for close study.

CHAPTER II

REVIEW OF LITERATURE

Almost nothing has been written on the specific topic of agricultural mechanization in Iraq.* There is more information available on two related topics: 1) the mechanization of agriculture in the emerging nations; (this includes mechanization attempts in general as well as programs in specific countries other than Iraq;) and 2) the general agricultural situation in Iraq. This chapter will comment on Literature of the first type is review in this chapter; information gained from the second category is incorporated throughout the body of this thesis.

Iraq

One of the few articles with direct bearing on agricultural mechanization in Iraq deals with the country's most well known crop, dates. In his "Transplanting Mature Date Palms in Iraq," Nocton describes the techniques involved in, and the economic implications of, an experiment with successfully transplanted 87 mature date palms.[1] No special tree-

*It is worth noting here that statistical information on the country is equally difficulty to obtain.

[1]R. H. Nocton, "Transplanting Mature Date Palms in Iraq," World Crops, Vol. 17 (March, 1965), p. 72.

moving equipment was used; in fact, most of the machinery was available in Baghdad. He concludes that if the special equipment available in the U. S. or Britain were used, transplanting would be economically feasible. Since date trees may take 30 years to reach maturity Nocton sees the possibility of beginning ready-made orchards with trees which would otherwise be lost--destroyed by the expanding city or lost to saline soils.

Valuable comments on the general agriculture and some reference to mechanization situations in the country are contained in United Nations documents such as the "Development of Iraq" Middle Eastern Affairs, March, 1950. This article is an abstract of the final report of the United Nations Economic Survey Mission for the Middle East.

This document provides some historical insight into the agricultural situation in Iraq. It begins with the usual comments on Iraq's great potential for high agricultural production; it emphasizes the great amounts of unused land and the abundant water resources of the Tigris and the Euphrates, which carry enough water to irrigate millions of additional acres. Iraq exports then, as now, consisted mainly of foodstuffs and animal products. Since industry there is only beginning, the best means of increasing national wealth is by increasing agricultural production. This means cultivating more total land, and more land per worker; and this can only be accomplished by

mechanization. Of particular importance are irrigation and proper drainage.

Even twenty years ago the country was aware of its need for mechanization, and the government had created a five year plan for increasing the number of tractors and a ten year plan for greater mechanization. However, political events altered those plans, and the problems of today's Iraq remain substantially the same.

It was at that time, too, that the significant step of nationalizing the importing and distributing of all agricultural machinery was decided.

General Philosophy of Mechanization

A provocative introduction to the general problem of mechanizing agriculture is contained in Theodore Schultz's book, Transforming Traditional Agriculture. Although primarily dealing with economics, the author's essential point is relevant here: farmers in traditional societies, he contends, are not indifferent to price incentives. They may appear indifferent to western economists who fail to take adequate account of the realities of subsistence level agriculture; who do not recognize for instance, the unacceptability of risk when life itself depends on a successful crop or who fail to notice that markets may be lacking for any increased yield. Other points he makes are mentioned throughout this thesis; the two which are fundamental are

the responsiveness of these farmers to the possibility of real profit, and the basic importance of education. This has been mentioned in the Introduction of this thesis and will be a recurrent theme.

Schultz's contention was controversial at first but has been accepted at least in part by most contemporary theorists. The Science Advisory Committee to the President of the United States has noted some important factors which in peasant farming, can destroy the meaningfulness of price.[2] Often, for instance, landlords receive a large share of the harvest but do not help pay for improvements in method; or peasants may live in extended families and be forced by tradition to share any increased production with family members rather than make a profit by selling it. There may be no place to spend increased income--they might want to buy more consumer goods but find that they are no locally available; "This does not indicate that the price, considered by itself, is not a positive incentive even to a farmer in such a situation. It merely means that among the complex of influences on farmers' decision-making, the price incentive alone may be inadequate to overcome the combined effect of other influences."

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[2]President's Science Advisory Committee, The World Food Problem, Report of the Panel on the World Food Supply, Vol. II (Washington: U. S. Government Printing Office, 1967), p. 524.

The implication of all this is that mechanization is possible. Improved efficiency will result when improvement programs are realistic and take into careful account all these factors.

Publications Giving Specific Information

The remainder of the literature surveyed will be books and articles which are of special value in planning particular aspects of mechanization.

A good introduction to these, because of its detailed analysis of a particular situation, is "Agricultural Mechanization in South East Asia," by H. F. McColly.[3] Although this article does not deal directly with Iraq, it is a valuable study of agricultural mechanization in Southeast Asia, an area which shares some characteristics with Iraq. The most common problems impeding mechanization are high population density, low per capita income, and intensive crop production. In addition the cost of input is often high, particularly the price of fuel; there are inadequate transportation and service facilities. A frequent accompanying problem is the instability of related government policies.

The author lists other important factors in the advancement of agricultural mechanization which include: development of industrial production, development of machines for small farms, favorable prices of fossil fuels, shortage of labor, inefficient draft animals, and an encouraging

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[3] Agricultural Engineering, Vol. 146 (Jan. 1965), p. 26.

governmental policy. After surveying the Japanese situation in detail the article concludes that it is a model of agricultural development. A similar study of Taiwan reveals that the country is only on the threshold of mechanization. The efforts which have brought Taiwan to this stage have been her consolidation of fragmented land holdings, and the adoption of a new land reform program which made the tiller more secure in his land, as well as the adoption of a better land use policy. According to the article, if several deep-rooted practices could be changed, the efficiency of agriculture will be improved. The problem is sometimes that of a cultural resistance to change.

A valuable analysis of the sociological problems involved is "The Subsistence Farmer, Agrarian Culture, and Peasant Societies," by Everett M. Rogers.[4] Rogers states, "The nature of interpersonal relations among peasants serves as a powerful block to most community development programs, based on the notion that people, with the help of some professional technical advice, can cooperatively solve their social and economic problems. The basic community development assumption of peasant cooperation is seldom found and is one reason for the lack of success of many community development self-help programs in peasant settings."

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[4]Everett M. Rogers, "The Subsistence Farmer, Agrarian Culture, and Peasant Societies," in Subsistence Agriculture and Economic Development, Clifton Whorton, Jr., editor.

Rogers lists eight characteristics which he feels typified peasant society. These are: mutual distrust in interpersonal relationships, a lack of innovativeness, lack of differed gratification, fatalism, limited time perspective familialism, dependence on government authority, low aspiration level, and lack of mobility.

In the opinion of the author these are, in various degrees, quite descriptive of the fellaheen[5] of Iraq. Of particular importance is their marked dependence on the government. The government for them plays the role previously filled by the landowner, (the Shaikh), before the land reform of 1958.

A great deal of valuable work in the field of mechanization has been done by B. P. Pothecary.[6] He writes that almost no developing country has based its mechanization program on tractors of low horsepower (20 hp or less). Reasons for this include unfavorable circumstances of soil, climate, crops, production levels, and skills, as well as the fact that many of the fundamental tasks to be done require more than 20 horsepower. Then, too, there is a lower cost per unit for manufacturing large tractors.

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[5]Small farmers in Iraq, before Land Reform Act of 1958 these men were peasants.

[6]B. P. Pothecary, "The Small Tractor in Developing Countries," World Crops, XXI (July-August), 1969.

Nevertheless, in India the introduction of a 15-20 hp tractor with four wheels has been a great success; and a major reason for this is that farmers prefer riding a tractor to doing the manual labor which is necessary with two wheel tractors. Pothecary concludes that a 15 hp four wheel tractor would be eagerly used by farmers in developing countries.

Pothecary[7] writes that extension services play an important but often unrecognized role in the success of mechanization programs. The extension worker needs to acquaint farmers with economic facts such as depreciation, installment buying, the cost of repairs, and the cost of spare parts. He should also give basic instruction in the use and maintenance of the machines. Unfortunately men with the kind of practical orientation necessary for this kind of instruction in the field are hard to find. Finally, the extension worker should provide the following kinds of information to machine manufacturers: observations on maching performance, local farm requirements, and gaps in the technological tools available.

A thorough and interesting book is Farm Implements for Arid and Tropical Regions by H. J. Hopfen; it is FAO Agricultural Development Paper No. 91. The paper itself gives clear drawings of an immense variety of implements,

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[7]B. P. Pothecary, "Mechanization Needs Extension Work in Developing Countries," World Crops (March-April, 1969).

primarily those used for dry farming, in rice-growing, and for row-planting in tropical areas. The advantages and disadvantages of each of these tools is discussed, and suggestions are made either for its wider adoption or perhaps for some improvement in design.

The book's excellent introduction tells the reader that the continued use of non-motorized implements is to be expected and encouraged. Historically, advances in agriculture (such as the first attempts at field cultivation) have coexisted with the stage which preceded them (such as hunting and herding). As the author notes, "Agriculture is so diversified and so flexible by nature that abundant production can be secured from a variety of systems." (p.1) The important point to be drawn from this is that the use of hand and animal powered implements continues to be important even in the age of engine-powered tools.

The reason for this is that the use of power machinery cannot be justified unless there is a cash crop which can pay for the purchase, operation, maintenance, repair, and depreciation of the motorized implements. This cash can come from increased production, and/or from decreased cost--but in both cases good markets must exist. Naturally there are many situations where the use of motorized implements is not economical; the author lists these as small farms, irregularly laid out fields, widespread underemployment, insufficient mechanical skills among the farmers,

and insufficient repair facilities. For these reasons, Hopfen stresses, "in areas where agriculture will continue to depend for many years mainly on hand and animal power, significant improvements in production can often be obtained by the introduction of better small farm implements and machines" (p. 2). This increase in production can gradually lead to the accumulation of capital necessary for the adoption of larger engine-powered equipment.

In his discussion of the assets and limitations of a wide variety of tools, Hopfen often points out that the increased efficiency of the tool may lie not only in better design, but in improvements in such factors as the breed of draught animals used, the characteristics of the crops farmed, the abilities of the local craftsman, or a better source of raw materials for the equipment.

Certain points must be borne in mind when improvements in design are considered. Tools should be:

1) adapted to rapid, efficient, and non-fatiguing work;
2) safe;
3) designed simply enough for local construction;
4) lightweight and portable;
5) ready for immediate use (so no time will be lost in initial adjustments); and
6) made of available materials.

Man-powered tools should be shaped to obtain "working motions which follow man's most natural movements

in direction, speed, and frequency as closely as possible, the use of as many muscles as possible to diminish the loan on each single muscle, and a variety of working motions, engaging different muscles . . ."[8]

In his treatment of animal-powered machines he notes that animals are a cheap source of power, especially if they are raised by the farmer himself, and even more so if they provide byproducts such as milk, meat, manure, and hides. Horses are the most efficient of draught animals, and smaller animals are relatively harder working than larger ones. Improving the harness is one big step in gaining more power from animals already owned. Other steps are better feeding, so as to strengthen the animals the use of single animals instead of animals in pairs for light work, and the improvement of the implements pulled by the animals.

Finally, there is a work which deals with an area similar in many ways to Iraq: Agricultural Mechanization in Equatorial Africa, by B. A. Stout, et al.

This study, the result of several years' work including 18 months in the field, is a comprehensive compilation of information--published, unpublished, or learned

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[8]H. J. Hopfen, Farm Implements for Arid and Tropical Regions, pp. 3-5.

first hand by the authors--relevant to agricultural mechanization in equatorial Africa. The general aims of the team were to provide information on present techniques and equipment in use, to identify factors affecting the success of mechanization, to discuss the economic problems involved, to identify the specific mechanization problems which require research, and to develop a series of recommendations for the program as a whole. These objectives were accomplished; the work is highly detailed, highly professional, and invaluable for those doing further work in this area.

It is also of great value to those, like the author of this thesis, doing work of similar nature (although much more limited in scope) for a different geographical region. Much of the specific information on suitable tools and effective techniques is applicable to different regions (such as Iraq) which have similar problems. It must never be forgotten, however, as this study emphasizes, that local research into local problems must be done, and that transfer of techniques from one region to another must be done only after careful thought and experimentation.

A sampling of the specific information contained in the report and relevant to this thesis would include: the importance of adequate markets before increased productivity can be profitable, the need for simple but

effective methods of record-keeping for small farmers, and the fact that the cost of mechanization should be met out of resulting increases in production, and that tractors are ordinarily economically only if they can be used for a major portion of the year. The authors also discuss the economic advantages of animal power, the waste of energy and time caused by ineffective hand tools, which are often responsible for low levels of production and negative attitudes toward farming, the major limitation placed on cultivation by the necessity for weeding, the shortage of animal-powered equipment for harvesting and threshing, improvements which are possible in winnowing, and the unacceptable risks involved in experimentation on small holdings.

Of equal importance with this wealth of particular facts is the general philosophy of mechanization which forms the backbone of this report. The authors repeat a number of times that mechanization is not an end in itself; that it must serve the economic needs of the farmer and the country. They also emphasize that mechanization is not merely the use of sophisticated machinery, but of any mechanical means whatsoever. There are three stages of mechanization, the use of hand-powered tools, of animal-power, and of engine-power. What this report states of Africa is also true of Iraq: the first two levels of

mechanization will be of real importance for at least the remainder of the century. Selective changes in the tools and equipment used (selective changes rather than too general and too abrupt changes) have as their goal "to reduce human effort, improve the timeliness and quality of various farm operations, [and thereby to increase] yields, quality of product, and overall efficiency" (p. xvii). Finally, the philosophy of mechanization put forth by this report recognizes the impossibility of mechanizing without considering the many other interacting factors. The Preface summarizes the team's sane view of this important but difficult undertaking:

> There is no question that mechanization will be employed; the question is at what level and to what degree. These questions do not seem difficult to answer until one considers that agriculture is only one aspect to be considered, and that mechanization is but a small segment of agriculture. In other words, questions about mechanized agriculture must be considered in relation to much broader social, economic, and political issues. Thus,. . . there is no single or simple path to development. The role of mechanization in agricultural development will continue to be a matter of opinion and conjecture. (p. 2-iii).

CHAPTER III

SELECTED PHYSICAL, SOCIAL, AND ECONOMIC DIMENSIONS OF IRAQ

Physiographic Features

Iraq is the modern name for the old Mesopotamia, the land of the two rivers the Tigris and the Euphrates. It is situated in the southwest of Asia. It borders upon Turkey and Syria to the north and northwest, upon Iran to the east, Jordan to the west, and Saudi Arabia and Kuwait to the south. Iraq covers an area of 173,260 square miles, or 110,886,400 million acres; its population is 7,820,000 (1967 census). The country is about three times the size of Michigan, and has a population density of 42 per square mile.

Iraq possesses great physical variations for its size ranging from the mountains of the North to the alluvial plains of the West. Geographically, Iraq can be divided into three main regions: 1) the high land, 2) the plan, and 3) the desert regions. Through the plain flow the great rivers, the Tigris and the Euphrates, and it is here that the greatest part of the population is concentrated. Much of the economy is dependent upon

this alluvial region. The highland zone covers about 52 percent of the total area. The land rises gradually from the Tigris toward the northeast, until it reaches 12,000 feet above sea level in Iran. (In Iraq the highest crest reaches about 10,000 feet.) Agriculturally this part of the country depends almost entirely upon rainfall. The amount of precipitation may vary between 12 and 50 inches per year. The unpredictability of the precipitation makes this area somewhat risky for farming. For example, in 1962 this area did not receive sufficient rain to sustain the growth of winter wheat.

The Plain and the Rivers

The area between the Arabian deserts and the foothills of the Iranian mountains is the most important in Iraq. Upon this area the majority of the population depends for its livelihood. Rich alluvial soil, oil wells, the waters of the Tigris and the Euphrates--these constitute the main wealth of the country.

The Tigris rises in Turkey and continues to receive water from rainfall along its course in Iraq. Twenty miles south of Baghdad it is joined by its major tributary, the Diyala. The Tigris continues its course till it meets the Euphrates at Shatt al-Arab to make one wider river about 400 meters across.

The Euphrates, too, rises in Turkey, but passes through Syria before it enters Iraq. Though the Euphrates

is longer, it is smaller than the Tigris. At high flood levels the Tigris carries 250,000 cubic feet per second (in comparison with 12,000 cubic feet per second at its lowest stage). The Euphrates at flood stage carries 150,000 cubic feet per second, compared to its 3,000 cubic feet per second at its lowest. The rivers reach their lowest level in September and October; they flood in March, April, and May, when crops are already at least half grown.[1] At this time, because spring warmth is melting snow in the mountains, the rivers are carrying four times as much water as at their low mark in the summer months.

Climate[2]

Summer in Iraq lasts from May until October; during the season no rain falls, temperatures are hot (averaging about 95 degrees F, and sometimes reaching 120 degrees), and severe sandstorms occur. The heat is made even more difficult by high humidity in the river valleys. The winter (December-March) is cooler, more humid, and more variable. Frost is not common, but may occur. In the mountainous northeast summers are not as hot and winters are even cold; some places have up to three months of snow.

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[1] George Harris, et al., Iraq (New Haven: HRAF Press, 1958).

[2] W. B. Fisher, "Iraq," Encyclopedia Brittanica, Vol. 12 (1970), p. 536.

Soil Characteristics and Management

The soil of Iraq, in general, is rich in organic matter and other nutrients, and so highly productive. The deposited alluvial soils of the Tigris and the Euphrates Rivers, and their tributaries, have added fertility to the soil. The soils of the country fall into two groups:[3] 1) heavy alluvial deposits, which are found in the Tigris and Euphrates Valley; and are grayish brown in color; and 2) the very light, pinkish gray-brown soils found mainly in the deserts. The alluvial soil is rich and fertile as it contains a large amount of humus and other nutrients. It also contains a substantial amount of clay particles which, when dry, can be used for building. The majority of the peasant farmers have their houses built from this material.

The general texture of the Iraqi soils is silty clay loam or silty clay with somewhat low permeability. Soil reaction is generally basic with pH 7.7 to 8.6.[4]

The light soils are poor in humus and contain a low level of clay. However, for both groups of soils there is a serious problem of salinity. It is estimated that 1 percent of the total arable land goes saline every year. Today, it is estimated that 60 percent of all irrigated land in Iraq has become saline. This salinity is mainly caused by the lack of drainage facilities and

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[3]W. L. Power, "Soil and Land Use Capabilities in Iraq," Geographical Review, Vol. 44 (1954), p. 375.

[4]Ibid.

by the improper methods of irrigation. Irrigating the field without draining the water allows evaporation which gradually leaves salt to accumulate in the soil. Near the surface of the soil there are sufficient quantities of salt to inhibit cultivation. It is interesting to note that the Tigris and Euphrates contain about 30 parts per 100,000 of salt at the time they enter the country, while at their lower course the ratio usually has trebled.[5] Due to this problem of salinity, crop yields have suffered large losses. It is estimated that crop yields have fallen by 25 percent to 35 percent during the last 40 years, and this decline will continue until adequate measures are taken to rectify the situation.

The presence of a drainage system is indispensible to the agricultural development of the country. The benefits reaped from the introduction of mechanization into crop cultivation would be cancelled by the decrease in yield to higher salt level. At the present time the government is implementing a comprehensive drainage scheme to cover 400,000 hectares of the irrigated area of the country. Most of the land to be covered by this scheme is located about 100 miles south of Baghdad, namely the Hilla and Diwaniya districts. This area is subject to high levels of salination where most of the agricultural land has already become saline.

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[5] Ibid.

Irrigation

Irrigation[6] is vital to all agriculture in central and southern Iraq. The problem is complicated by the fact that the two main rivers, the Tigris and the Euphrates, flood each year when the crops have partially matured. Because of variations in the depth of the river, some places have free-flow irrigation while others need pumps. In addition, pumps must be used to get irrigation water back to the rivers soon enough to avoid salination of the soil. Two kinds of pumps are used: engine-powered pumps, and the Persian water wheels. No figures are available on the number of pumps, but estimates run into the thousands. On small holdings near Kufa, Hilla and Kut the water wheel is primarily used.

Flood Control

The Tigris is about 1270 miles in length, from its source to the Shatt-al-Arab; this is about two-thirds of the length of the Euphrates. A number of projects have been completed along the length of these two rivers in an attempt to control their flooding, which at times has caused heavy destruction of buildings, crops, and land.[7] These projects are also aimed at a more profitable use of the waters of the rivers. They include:

1. The storage of flood waters from the Tigris at Al-tharthar, an area of depressed land in northwest Iraq; this is regulated by a dam,

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[6] "Iraq," Encyclopedia Brittanica (1970), p. 536.

[7] Harris, op. cit., pp. 31-2.

which releases water stored during the spring for irrigation purposes during the dry summer months.

There is a 40 mile canal connecting the Wadi with the Tigris at Samarra. The basin holds 63 million cubic meters of water and is also used for the generation of electricity.

2. A similar storage of the flood waters of the Euphrates is accomplished at Al Habbaniyah utilizing a natural lake.

3. The erection of several barrages on each river at intervals along its course.

The dam at Kut, for instance, is three times the size of the one at Hindia, and aims at improving conditions southeast of Kut. Other irrigation works are planned or in construction around Lake Hammor, Sulaymaniyah, Mosul, Irbil, and at Shatt-al-Arab.

These barrages raise the water level upstream, so that all channels of the rivers continue to flow even during the dry season. This means that irrigation can be accomplished by gravity instead of by pumps. Like the other projects, these also generate electricity.

About $80 million has already been spent on drainage projects, but several times as much needs yet to be spent. About $400 million has been spent in projects to control floods, and it is planned to spend at least that much more.

Water is indispensible to agriculture; without effective irrigation, drainage, and flood control, no benefits will result from any kind of mechanization.

Increased production is impossible without a constant and well-regulated supply of water.

Social Environment

Iraq is now finishing its fourth decade of independence; this was won in 1932, and since then the country has played a significant role in world affairs. It is a member of the United Nations. Its geographic location gives it a strategic position in the world of politics and commerce and it serves as a link between the East and the West. The country has great natural wealth in its large oil deposits and in its date trees, which produce 80 percent of the world's supply of dates.

Iraq can be classified as an emerging developing country. It shares many economic and sociological characteristics with its neighboring countries. The Iraq society can be described as a traditional pre-industrial one, but it is going through a rapid change. The majority of the people, however, still follow definite norms which the society has established. The average Iraqi citizen acts in the prescribed manner and rarely questions the reasons for this pattern of behavior. What society has taught him he feels that he has sufficient justification to do.

This attitude has been responsible for preserving an older culture, and the differences in life-style are obvious to any visitor from a younger country. How-

ever, by the same token, the attitude has not allowed enough room for change.

Family and kinship ties are strong in Iraq; the individual is often more concerned about the welfare of his family and his tribe than about himself. He knows that his welfare is inextricably bound to the destiny of his people.

The average Iraqi values his honor, and that of his family, above all; he would not hesitate to give his life in order to protect his honor.

> Maintaining honor, contingent upon action in the traditional manner, or its converse, avoiding shame, is as important a motivating factor as the profit motive in Western society. Loss of honor, and the ostracism it entails, is the worst punishment that society can inflict upon the individual, and, because of the strength of kinship ties, shame is reflected upon all the members of his family. Society is hierarchical and requires the maintenance of one's status.[8]

Certain occupations even though highly profitable, are considered dishonorable and relegated to lower classes. Vegetable growing, for instance, is done only by certain lowly tribes; poultry are cared for only by lower-class women. In addition, a vegetable grower is unable to marry into the families of wheat or rice growers, for vegetable growing is an occupation of lower status than cereal growing.[9]

This attitude certainly inhibits growth and development. The introduction of new ideas or a new

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[8]Doris Adams, Iraq's People and Resources (Berkeley: University of California Press, 1958), p. 11.

[9]Ibid.

machine to mechanize vegetable crop production will be doomed to failure unless this attitude can be changed. Vegetable growing would have to become a respectable profession in the eyes of all the people.

In a traditional society, people tend to deal with each other on a personal basis. Written contracts have little meaning when the interest of one party is being threatened. A building contractor or a share cropper may refuse to live up to the terms of his contract if conditions change and the fulfillment of the contract is no longer profitable to him. Resorting to the law to settle conflicts is a lengthy, time-consuming process; in many cases the person may surrender his rights in order to avoid inconvenience and delay.

This fact may have prevented many great private projects in agriculture, industry, and commerce from even starting. The lack of mutual trust between the contractor and contractee must take its toll. Many economic opportunities have been lost that would have otherwise contributed a great deal to the welfare of the people and to the progress of the country at large.

In spite of all this, the Iraqi people, like the people of other developing countries, possess a real desire for progress, for changes that would bring a better life. This strong desire and the accompanying high expectations are more and more evident. The people are gradually becoming aware of their rights and

responsibilities. A higher standard of living is being achieved. More literate and more educated people are found in Iraq than in any time in the last several hundred years--perhaps even more than in any time in history. Unfortunately this progress has not taken place in every part of the country. The urban population is far ahead economically and socially. They are better fed, better cared for and better housed. The rural people, in contrast, and in spite of significant progress during recent years, are still traditional and follow the older mode of life.

Rural Organization and Values

The village is the typical form of agricultural settlement in Iraq. Typically, it is small, and forms a classic example of an "in-group." The fertility of the land surrounding the village determines its size. In addition, the fields must not be farther than a few hours' walk; otherwise they would be uneconomical to farm and impossible to protect against animals and thieves.

One of the economic characteristics of the traditional people is their attitudes toward the accumulation of wealth. The majority of them are content when they have accumulated sufficient economic means to provide for their livelihood in the immediate future--a span of weeks or even days. Once this has been attained they strive no more. This is a significant factor that may

retard progress and hinder the adoption of new technology and agricultural techniques. If the person is not concerned with gaining material goods beyond his short-term projected needs--or even his immediate needs--it can be assumed that he will not be interested in maximizing his output.

Time has little value, and is considered something to pass or "kill" rather than as an economic opportunity for improving one's lot. This traditional attitude toward time is reflected in everyday speech. In Arabic people say, for example, "al saa tasseer," which, translated literally, means "The clock is walking." In the English equivalent, a clock or watch "runs." This is only one simple manifestation of the Iraqi attitude toward time.

An increase in output would require either an investment in new tools or machines; or a change in methods of production. The villager is apt to do neither. He will not obtain a new tool or machine, nor will he alter his method of production. In the first place he cannot afford the new equipment, because he lives at a subsistence level. In the second place he is afraid of taking a chance; there is great risk in changing methods of production, and risk is unacceptable in subsistence level farming. From this it is clear that mechanization will not succeed unless it is preceded by a change in

attitude; any mechanization program must take into account the economic facts of subsistence farming.

In addition there is commonly a fatalistic attitude among the rural people, more than among the town and city dwellers. "God wills it" is a phrase often heard. Perhaps this fatalistic outlook is the result of a long history of domination by foreign powers on the lives and freedom of the people. Also to be taken into consideration are the severe climate, periodic floods, poor health conditions, a lack of economic opportunities, and many other things over which the individual has no control. However, the art of speech is very well developed. Several centuries of foreign control and the absence of decision making on the part of the citizens have made them versatile in the art of conversation--but less confident when decision and appropriate action are required. Therefore, talk becomes a substitute for action. The fatalism is gradually dwindling as more and more people come to have significant control over their destinies, and to participate in decision-making on matters pertaining to their lives and freedom.

The Iraqi population can be classified from the aspect of geographical distribution into three categories. (1) The urban sector--the cities and townspeople who make up about 35 percent of the total population; (2) The

villagers, who comprise about 57 percent of the total; (3) The remaining 8 percent are desert nomads and marsh dwellers.

The Urban Population

The urban population lives in large cities and towns. The biggest cities or the country are: Baghdad, the capital, whose population is about one and one half million, Basra, in the South, and Musel, in the North, are the next largest cities. These cities are characterized by modern buildings, paved roads, buses and cars, large schools, modern health facilities, airports, clean running water, and many other modern conveniences, including recreational facilities such as parks and theaters. At the same time these cities have the problems common to most large cities of the world; they have their slums, their deteriorating buildings, and poverty.

The people of the cities are primarily engaged in business, the professions, and trades. Still, a substantial number of people are engaged in craftsmanship, and some of these skills have not changed in over a thousand years. Of course a large percentage of the city dwellers are government officials and employees.

Besides these three large cities there are about a dozen towns scattered around the country whose population varies from 20,000 to 50,000 or more. They possess the same characteristics of the cities, but on a smaller

scale. These cities and towns constitute the main outlets for most of the agricultural produce of the countryside and the farms. They also provide the market places where most of the agricultural production can be sold. Seeds, fertilizer, tools, and machinery and equipment can also be bought in these towns.

The Villagers

In spite of the recent trend toward urbanization, two thirds of all Iraqis still live in rural areas. Agriculture is the main business of the Iraqi people and will remain so for many years to come. The villages, which may number in the thousands, range from 200 to 2000 or more in population. Life in the village is unlike life in the city or town. Long neglect and the persisting poverty of the people's life there has remained unchanged for the last two thousand years.

Any observer would notice a marked difference between village life and life in urban areas. Due to this difference there is hostility in the villages toward the town or city dwellers.

Almost every village has one or two coffeehouses where the villagers--farmers, merchants, and visitors--may meet. The coffeehouse serves as a place where contracts are signed and agreements are reached. Every coffeehouse has a radio and many of them now have television sets. There is a great potential opportunity for

the coffeehouses to serve the farmers, the villagers, in a more effective way. They could be utilized as places where the dissemination of knowledge can take place. Through the use of radio and television many educational programs can reach the farmer so that they may improve their methods of production. Or, the coffeehouse can be used as a place where extension workers can demonstrate and discuss with the farmers various problems pertaining to better methods of production, new tools, and marketing problems.

The Desert Nomads and Marsh Dwellers

There is a third group of people in the country; these are the Bedouins whose way of life makes them distinctive, different from both the urban and the rural population. They are mobile tribes. Political boundaries mean little to them. They come and go across borders just as they please, following the rain and green pastures. Their economy is based on raising animals such as sheep, goats, horses, donkeys, and above all camels. Their need for water makes them settle near wells or rivers, especially during the hot summer months.

There is no exact official count of these people but it is estimated that they number nearly half a million. Due to their continuous movement between Iraq and the neighboring countries it is difficult to take an

accurate census. "The life of the Bedouins is hard and simple. They subsist upon camel's milk and dates most of the year. Bread and rice are luxuries and meat is enjoyed only when an animal dies or is killed in honor of guests."[10]

Several government attempts have failed in past to get the Bedouins to settle permanently on agricultural land. The failure was partially due to the reluctance of the Bedouins themselves to accept and be part of a system where their freedom would be restricted. Another reason was that the government, in the past, did not take the matter too seriously for fear that the nomads would pose a threat to internal security as well as to the near-by agricultural development and irrigation schemes.[11]

More attention is urgently needed regarding a solution for the problem. The nomad's economy should be considered part of the national wealth. Their ability to turn the scanty resource of the desert into meat, milk, and wool is something which should be the subject of further consideration.

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[10] Ibid., p. 17.

[11] Often nomad tribes invade one another, for food and plunder; this is especially true after the dry season.

Again, there is no accurate figure for the number of people who live in Iraq's southern marshes. However, it is estimated that they represent about 3 to 5 percent of the total population. These people live in one of the most unfriendly environments of the world. The marshes are jungle-like areas, covered with wild trees and numerous islands. The people live in a very primitive manner; for their livelihood they depend on hunting, fishing, and matmaking. They also raise water buffalo whose milk is important in making cream. Some water buffalo are raised for sale to the local merchants. A good number of these marshes grow rice for their own immediate use and for the market in nearby towns.

Technology does not play a significant role in the life of these people. Their tools are simple and so are their needs and desires.

Economic Aspects

Market and Transportation

Mechanization and marketing are interrelated systems; the first cannot succeed without the second. Mechanization increases agricultural productivity, which in turn demands an outlet--a market for those products. Mechanization would be self-defeating without adequate channels for getting the crops to market. Many perishable commodities produced in northern Iraq

never reach markets because of inadequate transportation systems and marketing facilities.

In subsistence agriculture markets are not needed as strongly as they are for a commercial cash crop. In subsistence economies only a small portion of the food reaches the market; only perhaps the local market where farmers sell their surpluses for cash or barter them in kind.

In large scale cash cereal crops and date crops with which we are concerned, the size of the input demands marketing on a similar scale. The more mechanized and efficient the production is, the more sophisticated the marketing must be. Developing adequate marketing facilities in Iraq demands great effort on the part of the public and the private sectors. The government has the responsibility for providing roads and other essential transportation facilities, so the product may reach its destination. Most means of transportation in Iraq, highways, railroads, and ship, and so on, are government owned. The private sector must build storage facilities and provide adequate management of the marketing of the privately owned crops. United Nations figures estimate that 35 percent of all grain in the U. S. is lost before it reaches the consumer.[12] Marketing facilities, therefore, are of great importance.

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[12]President's Science Advisory Committee, op. cit., p. 526.

Some of the reasons for the loss are lack of storage facilities, lack of refrigeration, and rats. It is sad to see food meant for humans eaten by insects or rats, or to see it decompose for lack of adequate storage, the construction of which is well within human capabilities.

Although there are some storage facilities in Basra, they cannot contain all the barley which is exported. Storage is badly lacking for dates, which are often left in the sun and rain and so are ruined. Thus more adequate provisions must be made for these two main commercial crops.

Warriner and Schultz agree that the farmers are responsive to prices; but Miss Warriner describes the high cost of marketing in Iraq which tends to reduce the profit a farmer might make from higher prices. In effect the high cost of marketing destroys the incentive which might result fromresult from higher prices at least for farmers who are some distance from urban centers. She describes the rough roads which are the only link to town. ". . . small donkeys carrying farm produce teeter to the towns, occasionally killed by lorries loaded with imported canned goods, which roar up the good new main roads from the ports to the capital."[13] The result is that prices of imported foods are lower than prices of Iraqui produced food.

The two most urgent needs for improving the marketing situation in Iraq are storage and linking roads. The

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[13]Doreen Warriner, Land Reform in Principle and Practice, p. 98.

producing of more foods through technology and mechanization will result in no benefit to the farmer without these.

In Iraq there are several modes of transportation: railroads (at present there are about 1635 kilometers of track throughout the country); roads, suitable for motor vehicles, of which there are about 4,271 kilometers;[14] and dirt roads and paths, which are very common. These are often impassable during the rainy season. It may be more difficult to transport crops the ten miles to the nearest railroad track than it is to transport it--by rail--the remaining 500 miles to market. Many of these "roads" are in fact so narrow that only people and animals can use them; they are impassable to tractors, and trucks.

Several benefits would result from good roads. They would help lower the cost of the product, increase the mobility of the land-bound peasant, enable extension workers to reach distant farms and villages and support mechanization programs in these remote areas.

There are several examples of the essential role of transportation to mechanization programs and ultimately to crop production. A pump may fail at a crucial time during the summer in a distant village. If the farmer must spend days traveling to the city for spare parts or must wait for a repairman to make the journey to him, the crop may die for lack of water. Or,

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[14]Brittanica Book of the Year, 1970, p. 439.

heavy machinery may be shared among several villagers; if roads and bridges are unreliable, the machinery may not be available when it is needed.

Road-building should be accomplished by the government. The farmers are not capable of this job which properly belongs to the public sector. The government should make a survey of the needed roads which would link the farms to one another. These roads need not be expensive.

While Iraq does not need to be concerned about the effects of cold weather on their roads, the country does face severe problems from the summer sun. Perishable products will not survive long in the intense heat, and must reach their market quickly.

Another means of transportation is private trucking, which does most of the short-haul shipping. These trucks are owned by private owners, producers, and wholesale buyers. These haul produce from the farm to the countryside meeting-point for reshipment. Since the government imposes a 200 per cent tariff on trucks, this high expense is met by the private truckers but passed on to the farmer and the consumer. The high cost of shipping sometimes forced farmers to leave produce--for instance melons, which do not command a high price--to perish in the fields.

At the present time there are no refrigerated transportation facilities, either by truck or by railroad,

a fact which makes transportation of agricultural products susceptible to spoilage because of the intense heat. For instance, the cereal crops will spoil; and shipments of seed will not germinate if left too long in a truck or railroad car. Speed is an important factor in the Iraqi climate. Increasing production through mechanization would be futile if the outlet remains slow and expensive.

Agrarian Reform

To some people land reforms means only a redistribution of the land; in reality it is not so simple as that. True agrarian reform lies not in the revolutionary redistribution of land but in the evolutionary process by which people find security on the land. It involves not merely the cravings of land-hungry people, but the whole complex problem of rural insecurity.[15] We are concerned here mainly with agrarian reform as a social process where man-land relationships can be enhanced to advance the life of the rural people, the farmer and his family.

Inequality of ownership of the land has long been an acute problem in Iraq. The historical background[16]

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[15]Robert W. Hudgens, "Essentials of Land Reform," International Development Review, 1961-2.

[16]Fuad Baali, "Relationships of Man to the Land in Iraq," Rural Sociology, Vol. 31 (1966).

of the present problem begins in the time of Hammurabi (2124-2091 BC). At that time the monarchy, the upper class, and the merchants owned most of the land. Somewhat later, in the time of the Kassite kings (1760-1185) important chiefs received large gifts of land if they supported the rulers. In all those early period slaves were usually the actual cultivators of the soil. Slaves were in fact a large fraction of the population.

In the Islamic era there was also a great number of large land holdings. Caliphs gave feudal estates to civil and military officers as payment for their services. The result was not only a feudal system but the great poverty of the agricultural population, who were for all practical purposes forced laborers.

In the Turkish occupation (1534-1917) tribal ownership was common and the Turks often clashed bloodily with the Iraqi tribes over land use. Reforms attempted by the Ottoman government were usually too violent to succeed.

The British, during their occupation and later the Mandate (1917-1920; 1920-1932) took no real steps toward agrarian reform. When the new state of Iraq began in 1921 the officials discovered that many records of land ownership had been destroyed or lost. Land settlement laws were enacted entitling the government to keep records of all ownership and to settle disputes over property rights. However, for the following reasons,

Cooperatives

Cooperatives were tried in Iraq before the land reform, but were not successful; for one thing, the farmers had no interest or incentives, for they were only hired laborers. The shaikhs did not need cooperatives, since they were very large landholders with plenty of money and land.[28]

Since the land reforms there have been a few spontaneously organized cooperatives in the prairy provinces, including Mosul; but the concept is still alien to the irrigation zone. There seems to be little inducement for farmers there to join. During the early years of land reform the farmers were for the most part only temporary tenants (they had to prove their worth as farmers for 10 years before acquiring title to the land) and so they did not qualify as members of a cooperative. In addition there was no credit extended to them and no trained organizational help; there was not even equipment available.

Some of these problems have been solved; for instance, sufficient funds are available today; organizers and supervisors are receiving training from an FAO expert, and the 1964 amendment to the Land Reform Law allows temporary tenants to form cooperative societies.

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[17] Warriner, op. cit., pp. 97-99.

the heads of the tribes rather than the common people benefited from this law.

1. For a long time, the tribes exercised customary rights of collective ownership. The landholding entity was the tribe as a whole.

2. Law Number 50 of 1932 (amended by Law Number 29 of 1938) stipulated that all people must register the titles or deeds to the land they possessed.

3. The tribesmen were not fully informed with respect to this law, and their chieftains thus found an opportunity to register in their own names the tribal lands.

4. The government was aware of what was going on; but instead of compelling the shaikhs to register the lands in the names of the tribes, and in order to strengthen its own power, it encouraged them in their illegal procedures.

5. As a result of this, relationships between the shaikhs and the tribesmen became one between landlords and share tenants, and the power of the large landowners reached unprecedented heights.[18]

Size of Holdings

Aside from the desert area, the area of Iraq is 241,913 square kilometers, of which one third is arable. It remains true, as it has for thousands of years, that agricultural holdings are owned and controlled by a relatively small number of owners. In 1958-9 less than 2 percent of the total agricultural holdings included 68 percent of the land; and conversely 86 percent of the

[18]Baali, op. cit., p. 173.

holdings comprised less than 11 percent of the total area.[19] There are substantial differences, however, from one province to another and from one region to another. The largest holdings are found in Kut and Amarah,[20] perhaps because these provinces include much flat land, and because their population is of a single culture. In the Southern region[21] is found the most extreme example of this disproportion, for there 90 percent of the land is in the hands of less than 5 percent of the landowners. The North, more fragmented geographically and ethnically, has a more equal distribution, although even here almost 45 percent of the land is controlled by 3 percent of the people.

Land Tenure Prior to 1958

The laws of 1933 gave the landlords great authority over the peasants, even including the right to keep them on the land as long as they were indebted. In effect the fellahin were not tenants but laborers, receiving a small proportion of the crop production in place of a wage. The result of these oppressive conditions was a

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[19] Ibid., p. 174.

[20] Hashim Al-Dabbagh, Études Statistiques Sur Le Développement Économique de L'Rak, p. 121.

[21] Baali, loc. cit.

heavy emigration to the cities, as well as occasional violent outbursts in the countryside.[22]

The Dujailah settlement, initiated in 1945, was one relatively successful attempt to improve conditions. In spite of handicaps and some failures, the settlement overcame tribal differences among its members, salinity of soil, lack of adequate drainage facilities, and failure of the cooperative to become a "successful experiment in agrarian reform."[23] Nevertheless its successes and those of the few projects modeled after it were available only to a few of the agricultural population.

Land Tenure Since the 1958 Revolution

The Land Reform Act of 1958 had two principal aims; first, greater justice for the peasant; secondly, a means of improving the quality of agricultural production. The ignorance of the peasants and the lack of interest on the part of the landowners had previously resulted in agricultural production of poor quality. The Act reallocated any land holdings in excess of 1000 donums of irrigated land or 2000 donums of rain-fed land. However, "bureaucratic confusion, the uncertainties of the political climate, landlord indifference and poor weather combined to reduce agricultural

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[22] Ibid., p. 178.

[23] Ibid.

production by about 25 percent during the years 1959-1961."[24]

Production of grain fell 17 percent, rice declined 20 percent, and cotton over 16 percent.[25] The most important reason for this decline in production is uncertainty over ownership of land, for the people naturally hesitate to cultivate when they are not sure they are legally entitled to the crop. In addition, since the Iraqi soil becomes salty so soon when adequate drainage is not maintained, and the pumps have not been regularly operated because of uncertainty over ownership, some cultivable land has been lost. In spite of efforts at reallocating the land, the ownership of most of it has not yet been settled. It has been estimated that only about one fourth of the land which the government appropriated was actually redistributed to smaller owners.[26] In effect, it has remained under the control of the former land owners.[27] Other factors contributing to the failure are the ever-present village distrust of

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[24]Kathleen Langley, "Iraq: Some Aspects of the Economic Scene," Middle East Journal, Vol. 18 (1964), p. 186.

[25]Warriner, op. cit., p. 94.

[26]John Simmons, "Agricultural Development in Iraq," Middle East Journal, Vol. 19 (Spring, 1965), p. 131.

[27]Langley, op. cit.

the government, together with traditional resistance to innovation; but in spite of all this the government continues its efforts toward the goal. Work continues, for instance, on drainage systems, and efforts are being made to establish workable agricultural cooperatives.

The main provisions of the law are as follows:

1. The expropriation of privately owned land holdings in excess of 1000 donums (250 hectares or 625 acres) of irrigated land, or 2000 donums of rainfed land (Clause 1) Requisitioning was to begin with the largest properties.

2. The distribution of expropriated land to occupying and other cultivators in order of priority, in units ranging from 30 to 60 donums (7.5-15 hectares, 18-36 acres) of irrigated land and from 60 to 120 donums of rainfed land.

3. Payment of compensation based on assessed land values to expropriated landowners; and payment by the new owners to the full purchase price of the holding over 20 (in 1961 amended to 40) years.

4. Formation of co-operative societies, with compulsory membership for recipients of land, and wide functions, including marketing of produce, supply of farm equipment, and organization of agricultural production.

5. Regulation of tenancy relations between landowners and cultivators on land pending expropriation or not subject to expropriation. Eviction of cultivators was prohibited, and the proportions in which produce was to be divided between landowners and cultivators were prescribed, according to their respective shares in costs.

Before land reform, when holdings were large and labor plentiful, the land-owners mechanized only to a

limited extent. Now that Iraq is moving toward smaller holdings, the large supply of landless peasants willing to work for one landlord is disappearing, and the aid of mechanization is increasingly necessary. Holdings are limited to 30 acres of irrigated land and 60 acres of rain-fed land; holdings this size cannot be cultivated by one man unless he has some form of mechanization. Since the peasant is a new land-owner, this should provide incentive to improve the productivity of the holding and so increase the owner's lot in life. The machinery must somehow be made available at a reasonable expense to these poor farmers who are the new owners; perhaps the cooperative owning and sharing of machines would provide some answer.

The first stage of mechanization will be the full utilization of animal power, for this is quite readily available to small land owners; when this has been effectively used and productivity has increased, the farmers will be more capable of buying engine-powered equipment. The hire-and-rental service of the government will help the farmer through the initial stage of mechanization, since the equipment is made available at reasonable costs.

Cooperatives

Cooperatives were tried in Iraq before the land reform, but were not successful; for one thing, the farmers had no interest or incentives, for they were only hired laborers. The shaikhs did not need cooperatives

since they were very large landholders with plenty of money and land.[28]

Since the land reforms there have been a few spontaneously organized cooperatives in the prairy provinces, including Mosul; but the concept is still alien to the irrigation zone. There seems to be little inducement for farmers there to join. During the early years of land reform the farmers were for the most part only temporary tenants (they had to prove their worth as farmers for 10 years before acquiring title to the land) and so they did not qualify as members of a cooperative. In addition there was no credit extended to them and no trained organizational help; there was not even equipment available. Some of these problems have been solved. Sufficient funds are available today; organizers and supervisors are receiving training from an FAO expert, and the 1964 amendment to the Land Reform Law allows temporary tenants to form cooperative societies. In 1966 there were 339 cocieties in existence. However, few of these societies have undertaken marketing; most emphasize production aids, and are doing good work in this area. The government employees, and each society has about 2400 acres of land. The supervisors are in fact functioning as project manager, they invest new capital and supervise its use, operate demonstration plots introducing crop rotation, new crops, and implements and

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[28] Warriner, op. cit., pp. 97-99.

machinery. The supervisors live in the villages, and are supplied with a house, and a bicycle; they are paid about 30 ID ($84) each month.

This salary is too low to encourage men of high qualifications to undertake these rather lonely jobs. Their salary should be closer to a professional scale. Iraq, like much of the world, is suffering a high rate of inflation, and this makes it even more important to pay these men adequately.

Another shortcoming of the cooperatives as they exist today is that while they are encouraging the use of modern imported machinery and equipment, they make no mention of improvements in animal-powered machinery. The government should encourage the efficient use of animal-drawn implements; these are cheaper, more available, and more familiar to these new land owners.

Finally, "the societies are not cooperative societies in the ordinary sense of the word. They are agencies to induce peasants to cooperate on lines laid down from above."[29] This may be necessary as these cooperatives begin, but there is a definite danger involved. A cooperative society is ideally an independent unit which manages its own affairs, its heads and managers should be chosen from among the farmers. As time passes, the role of the government should diminish,

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[29] Ibid., p. 98.

and the local units encouraged to make more and more of their own decisions. The government should limit itself to extending credit and other facilities which the farmer might need. There is no point to agrarian reform if the skaikh's role as decision-maker is merely replaced by the government in the same role. In the final analysis, each farmer is capable of running his own affairs; he should not be merely the recipient of orders from above. "Crucial decisions which affect both the amount and efficiency of agricultural production can be made only by individual farm operators."[29]

A final recommendation: Simmons notes that in many places anthropologists and psychologists team up with organizers of cooperatives. This has not been done in Iraq, but would have obvious advantages.[31]

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[30] President's Science Advisory Committee, op. cit., p. 506, emphasis added.

[31] Simmons, op. cit., p. 66.

CHAPTER IV

DATE MECHANIZATION--DATE PALM CULTURE IN IRAQ

Introduction

Iraq is one of the oldest date-growing countries in the world; dates are considered an important food crop there, and upon it most of the people depend for their livelihood. The date palm (Phoenix dactylifera) probably grew in Babylon (now Iraq) as long ago as 6000 years before Christ; it is the leaves of this tree which figure in the Biblical account of Palm Sunday. According to the Koran, Mary the mother of Christ, had dates for her first meal after the birth of the Child.

The date industry plays a vital role in the economy of Iraq. According to the Food and Agriculture Organization of the United Nations (FAO) there are approximately 30 million palm trees in the country now, and Iraq is regarded as the number one exporter of dates in the world.

Table 1 compiled from FAO's trade yearbook, 1966, shows the average date export per country for the six years 1960 to 1965.

TABLE 1.--Date Exports 1960-65.

Exporting Country	1000 tons	%
Iraq	261	82
Iran	26	8
Algeria	21	7
Saudi Arabia	3	1
Tunisia	3	1
U.S.A.	3	1
Total	317	100

Trees are grown in the central and southern regions of the country; they reach a height of almost 100 feet, with a nearly straight trunk. The average height of the tree is 40 to 60 feet. There are no records establishing the average life span of the date tree, but it is believed that it may live as long as 150 years. The tree takes eight to twelve years to reach sufficient maturity to bear fruit, depending on

the amount of care it receives. The palm tree is made up of three main parts: the root system, the trunk, and the head (or crown) which contains branches and fruit. The diameter of the truck varies from one and one half feet to two and a half feet.

Iraq is endowed with a natural environment conducive to the growing of date palms. There is no country which can compete with Iraq in the world date market. A look at the most productive date-growing area in the world will explain why this is so. Along Shatt-Al Arab (the river formed by the union of the Tigris and the Euphrates) about half of the Iraqi date farms are found. There is a hundred mile stretch of date orchards on both banks of the rivers, and there is nearly a jungle of the trees. These gardens are watered twice daily by the actions of the tides of the Persian Gulf. The water backs from the river through channels dug for this purpose by the date growers themselves. The only expense involved in this assured irrigation system is the labor required to clear the channels at intervals. In addition this concentration of date palms is close to the port of Basra, and so ships can be reached at minimal cost. From this it is clear that no other country possesses such great natural advantages for commercial date production.

The other 50 percent of the trees are found in several other locations, including the following districts:

Baghdad, Hilla, Kerbala, Deywanih, Samaw, Baquba, and other places.

There are over 200 named varieties of dates in Iraq, but four of these varieties are the most popular and comprise about 95 percent of the dates produced in this country. These varieties are Zehdi, Kastawy, Halawy, and Khadray.

Uses of the Date Palm

The palm tree serves many purposes. Aside from the food crop it bears, its trunk is used in construction; in housing as support for the roof, and in the construction of overpasses over narrow channels, streams, and ditches. The green parts of the fronds are used in the making of household furniture in peasant dwellings; beds, chairs, doors, baskets, animal cages, and many other uses. The dry fronds and leaves are used as fuel. The leaves can also be plowed into the soil as a source of organic matter. The leaves are also wrapped around young trees when they have first been separated from the parent tree, to protect them from excessive heat and cold.

Fruit

The date consists of the edible part and the pit, or stone. The fresh fruit may be sold at a local market, but on a commercial basis the fruit must be cured (either on the tree or after picking). Some of the fruit

is boiled and its juice extracted to form a syrup about the consistency of honey. The remaining dry matter is used as feed for animals. The fruit contains many nutrients. The young tree, from 5 to 15 years old, develops from 3 to 8 offshoots which grow from the trunk of the parent just above the soil line. These offshoots are the main source of new trees. Date palms can also be grown from seed, but the process takes a much longer time.

Cultural Practices

Removal of the Shoots

The general practice is to remove the shoots from the parent stem as soon as they are ready for planting, that is, when they are 3 to 4 years old. In many cases the growers do not remove these shoots because of the extensive labor required. This is especially true when the growers has neither room enough on his own land for more trees, nor a buyer for extra shoots. If, on the contrary, there is a market, it is still possible that the market value does not match the cost of the labor required. However, most growers are in agreement that the early removal of the shoots is necessary for full production from the parent tree, for the shoots compete for nutrients which are needed by the parent.

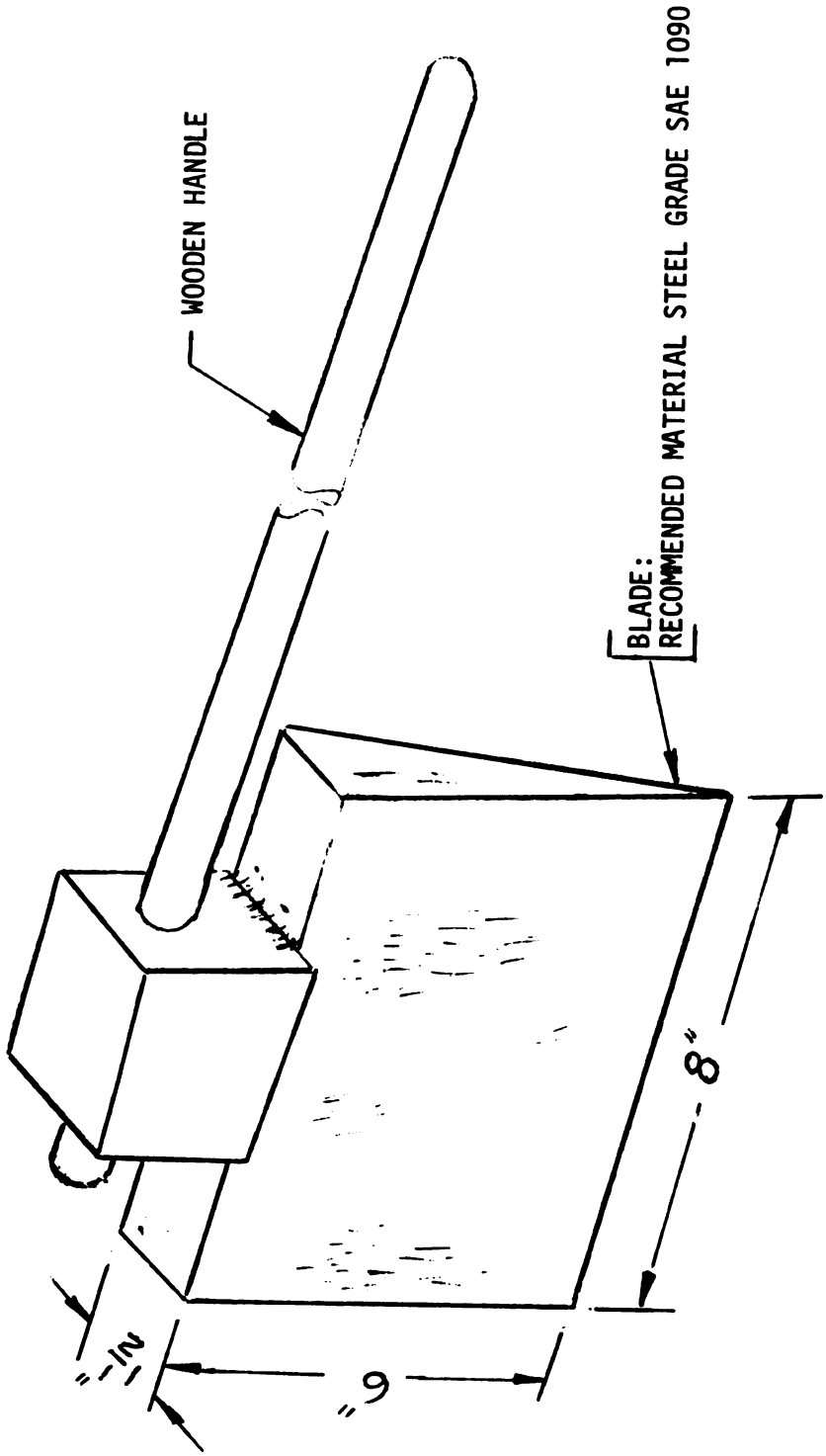

FIGURE 1.--A Proposed Offshoot Chisel.

The present procedure involves the use of a shovel and a sickle; it will be described in detail later. The sickle and shovel are both manufactured locally. The sickle is an expensive tool for these farmers; its price ranges from 600 fils ($1.50) to ID$1.500 ($4.20 US) depending on the quality. The farmer may ruin his sickle during a careless attempt to cut even a single shoot. In many cases the price for shoots is low (30--250 fils, or 8¢ to 65¢) depending on the variety of the shoot and the current price market. It is interesting to note the great difference between offshoots of the same tree and the even greater difference in price commanded by different varieties. For example, Khadrawi offshoots have small joints with the parent. They are easy to cut, both because of size and character of the joint. Zehdi offshoots have larger connections which are harder to cut. Since the usual price of the Kadrawi offshoots is several times that of the Zehdi offshoots (the Zehdi are exceedingly common), many date growers are naturally reluctant to remove the Zehdi offshoots.

Method of Cutting

First, the dirt and brush surrounding the offshoot is removed by shovel, exposing the spot where the offshoot joins the parent, but leaving a bole of dirt attached to the roots of the shoot from the exact cutting

spot. Repeated strokes from the sickle sever the offshoot from the main trunk. It takes from 10 to 30 minutes to remove one offshoot, depending on the variety of the tree. After the separation the shoot is pruned so that the top of the tree looks flat. This means that new growth in the transplanted tree will be obvious, growing as it will from the center of the squared-off clump of branches. The branches are then tied together with twine so they do not break off.

A more efficient method of off-shoot cutting has been used in the Coachella date gardens in Indio, California. This method involves the use of a special chisel, a shovel, and a sledge hammer. This chisel was originally developed by Bruce Drummond and Sterescu Blacksmith of Indio, California, and now is manufactured in various sizes for use in different-sized offshoots. The chisel has a rectangular cutting blade; one side is bevelled and the other is flat. They are made of high quality steel.[1] Grade 7 or 8 steel will suffice. This will give the tool a long lasting cutting edge. A hard wooden handle is attached to the blade. After clearing the brush, and dirt away from the site of the offshoot, the chisel is placed at the joint of the offshoot to the parent tree. The manual use of the

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[1] Leonhordt Swingle, "Tools for Cutting Off Shoots," Report of Date Growers' Institute, I (1924), p. 23.

heat of the sun and the frost of the winter for at least three years. Without this kind of protection the shoot will certainly die.

Spacing

The spacing of the offshoot in the field varies from one place to another in Iraq. In Baghdad the rate of spacing is 100-120 palms per acre. In Bosra the concentration is a little higher, from 120-130 trees per acre. There is no explanation for this difference although a possible reason may be the hot summer winds at Basra. The more closely spaced trees reduce the damage which could occur because of these winds.

There are two patterns of planting in Iraq. The older, more intensive pattern, has the trees fairly close together and citrus trees under each palm. The newer method has trees planted in rows, wide enough so that tractors can pass between them. The older method is found in small holdings where the farmer must use every inch of his land. Tractors and other machines of course cannot be used with the older method of planting.

Cultivation

Date gardens in Basra (at Shatt-al-Arab) are usually cultivated once every three to four years. This is usually done in May or early June, when the water

supply is cut off. The soil is cultivated to a depth of one and one half feet and left to dry for about a month. At the end of a month the land is again cultivated, leveled, and manured.

Tools used in cultivation are simple, consisting mainly of a spade with a foot rest, near the base. This spade is manufactured locally.

Cultivation is done most efficiently by a team who form a line and move together through the orchard. Since spading is hard manual labor, the men usually work about 50 minutes, resting for 10 minutes before resuming work. The average day's work is only six hours. These men are paid in cash, 600 to 700 fils a day, the equivalent $1.50 to $2.00. It takes, on the average, probably 90 to 100 man-hours of labor to cultivate an acre the first time. Plowing the second time is of course easier and takes less time. After the second cultivation manure is applied to the ground around each palm individually. A trench is dug around the palm, about 4 to 6 feet out from its trunk, and manure from a large basket is emptied into the trench. The trench is dug deep enough to reach the moist soil at the water level; this is usually 4 to 5 feet down. Putting manure in the dry topsoil would be futile, because there could be no chemical reaction without the presence of water. Transferring the manure from the pile to the tree is

manual; the basket is filled and carried whatever distance is necessary. When the trench is dug, some of the roots are inevitably cut. The year following the manuring there is a marked decrease in the yield of the tree; this is attributed to the damaged root system. However, the advantages of applying the fertilizer outweigh the disadvantages of the harm to the roots (the lower first-year yield) and so the farmers choose to continue the practice.

This method of fertilization must be adopted because the orchards at Bosra are not irrigated from the surface downward; in fact the surface is almost always dry to a depth of three feet. Instead tidal forces send water back through narrow channels, which fill from the base upward. This means that the land is irrigated from the subsurface, and the water gradually seeps upward, instead of the more usual irrigation in which water begins at the surface and works downward. There is one channel for every 6 to 8 palms. Irrigation is thus accomplished twice a day. The water is of course fresh water. As the tide in the Persian Gulf rises, the water of the Shatt-al-Arab is raised, and the fresh water flows out through the numerous tiny channels which form a network through the gardens.

In Baghdad and other palm areas of the country, date gardens are usually cultivated once each year.

Depending on the economic condition of the grower, and on circumstances of soil and water, cultivation may be done only every 2 to 3 years. In these regions the soil is plowed to a depth of one foot. Trenches are dug about 4 to 5 feet from the trunks of the trees, are about four feet wide, and are parallel with the rows. Manure is placed in the trench and then the area is irrigated. In time the manure decomposes and is absorbed by the roots. One year the trenches may be dug in north-south rows, the next year they will be dug in east-west rows, criss-crossing the trenches of the previous year. There are some exceptions to this practice and a few growers still prefer to dig circular trenches around each trunk, as is done in the Basra area. These trenches are only about one or one and one half feet deep, however.

Why are different methods used in Baghdad than in Basra? Possibly the three year cycle in Basra avoids the too-frequent cutting of roots which would be necessitated by the deeper trenches of that area.

Implements

Hand-cultivation is by far the most common practice. Less than 5 percent of the growers use tractors. Implements used throughout the country are the same except for slight variations. The spade which is rectangular in shape and has a straight wooden handle is

the only implement used in the cultivation of dates. The spade used at Baghdad is similar in shape to that used in Basra, but it has a longer handle, usually 4 to 5 feet, and a larger spade base. In Basra the spade is 3 to 4 feet long; in Baghdad 5 to 6. A possible explanation of the differences is the heavy clay soil of the Bosra area, which is best lifted in small amounts. In addition there are cereal fields around Baghdad, and spades made for the date growers may be longer so that the same product may be used in the grain fields. Spades there must be larger because they are used to clear the frequent siltage from the irrigation canals.

Mechanized cultivation is not the rule in Iraq. As indicated earlier, the fields are plowed manually. Cultivation would ideally be done every year, but the cost of the labor involved means this is not usually done. Cover cropping as a means of adding nutrients to the soil is also usually avoided because of the cost of the cultivation required. Even when cover cropping is done, the crop is often fed to the livestock rather than turned back into the soil. Animal power could be used, but this is not frequent in date cultivation. There are a sufficient number of horses, donkeys, and oxen, but they are not used on any large scale. Their use is infrequent, perhaps, because most of the date gardens are underplanted with vegetables and fruit

trees (mainly citrus). These undercrops make the use of animals undesirable because animals so easily damage or eat these crops.

Pruning

Only the dead leaves need to be pruned from the palm trees, and these are cut off once a year, preferably during or after the harvest season, so that the tree will be easily climbed during the next season. It is important to remove the dead fronds and their bases every year because the climber will otherwise have obstacles to his ascent. Pruning is done by the use of the hand tool, the sickle, or with a curved knife similar in shape to the sickle. This tool, which ends in a wooden hammer like that of the sickle, but has a heavier blade, will last longer and take heavier wear. It is called the chillab. In Iraq the sickle has small saw-teeth, but the chillab has none. The sickle and the chillab are the constant companion of date-growers throughout Iraq.

Not counting the climbing time, it takes about 30 minutes to prune one palm. The pruned wood has very little market value, but is often used as payment to the laborer. This presents a temptation to the cutter, however, who would like to cut even the green fronds and use them for furniture. This means the laborer must be supervised.

Pollination

Pollination is another required cultivation practice which is done manually, usually in March or April. To accomplish this a man climbs the male tree and cuts off the pollen. Each male tree produces enough pollen annually for the fertilization of 100 date palms. The procedure involves cutting off the strands of pollen with a sickle. The strand is shaken until white powder (the pollen) is collected in a basket; the climber then ascends the female tree and scatters the pollen on the cluster of newly developed dates. The worker takes handfuls of pollen and sprinkles them on the flower clusters, making sure that every flower is covered, if possible. The flower not receiving pollen will never mature to a date fruit.

Studies have been done in California in the use of helicopters to apply the pollen. The result was excellent, even including an increase in yield. This, however, is far from being practical at the present time in Iraq. Possibly the application of the pollen with a pressurized sprayer would be more efficient, however, than the present practice of sprinkling pollen by the handful. This might increase the yield by assuring more thorough pollination. Due to the constant decrease in labor, many date gardens have been abandoned. The shortage of labor has resulted in much neglect. In some areas instead of individual flower clusters being pollinated, as is

required, the climber of the tree places a male in florescence in the center of the crown and leaves the pollination of individual clusters to the wind.

Fruit Thinning

Fruit thinning is not practiced in Iraq. In certain cases where the yield seems very heavy (more than twelve bunches on a tree) the excess bunches are usually cut down by hand tools. Perhaps the difficulty in obtaining labor to climb the trees makes the thinning operation too expensive. If some means were available to reach the top of the tree without climbing it, fruit thinning might be more common.

Pulling Down and Supporting the Bunches

About a month after pollination, the bunches become heavier. Eventually this weight could break the stalk connecting them to the tree and so the weight must be supported. Usually the stalk is bent and the bunch propped against one of the fronds for support. If no frond is near by, the bunch must be tied by string to the trunk of the tree or other fronds.

Harvesting

The present date harvesting method is the same as it was several thousands of years ago. In spite of the advance in science and technology in agriculture, date harvesting procedure in Iraq is still primitive, laborious and uneconomical. The cost of harvesting

Figure 2.--Present Date-Harvesting Method: The laborer climbs the tree with the aid of a Tebalia, and carries a basket attached to a rope.

is the most expensive operation in date production. It is estimated that the total cost of harvest is equal to one-half of the total value of the crop. Almost the entire date harvest in Iraq is accomplished by simple hand tools: the sickle, the chillab, and the tebalia (a harnes to aid the climber climb tall palm trees). Short trees can be climbed without the aid of a tebalia (see Figure 2). Dates ripen in July, but are left on the tree to cure until September. However, a fresh fruit can be collected any time from June until September and sold for immediate consumption.

With the aid of the tebalia the climber ascends the tree, and with the sickle or chillab cuts off the stalks of the bunches. These are placed in a tray or basket and lowered to the ground. This is a very slow method and so frequently the branches are cut and simply thrown to the ground, where they land on mats. In spite of the mats, some of the dates scatter or land away from the mats and must be gathered. Women and children are employed to collect these scattered dates. The dates often pick up dirt from the bushes or streams in which they land. When the dates are piled on the ground, the moist dates are separated from the dry ones and only the dry ones are shipped to the storage area. Transportation is almost entirely by means of animals. The lack of good roads for trucks, and the presence of streams crossed only by narrow bridges makes the use of trucks impossible.

Date Harvest

Harvesting dates according to the old method described above is a costly, slow process. The shortage of palm tree climbers is worsening, and frequently dates remain longer on the trees than they should, because harvesting labor is not immediately available. The dates are damaged if they remain on the tree when the fall rains begin. The Iraqi date industry will probably cease to be profitable if it continues to depend on this old harvesting method. Therefore, mechanized harvesting offers great merit and could save one of the most important and certainly the largest agricultural industries in the country.

The date growers of Southern California's Coachella Valley faced a similar problem just a few years ago. The survival of their multi-million dollar industry was threatened by the ban on Mexican farm labor. The entire valley depended on the skills of these migrant workers in harvesting, pruning, pollination, and so on, of the 60 foot palms. The labor shortage induced one company (International Harvester), in cooperation with Cal-Dates, to develop what is called the Loadstar Harvesting Machine. In California the traditional method of harvesting had involved carrying a 30 or 40 foot extension ladder from tree to tree. Once at the top of the tree the bracero was supported by a harness somewhat similar to the one still used in Iraq; and, as in Iraq, dates were lowered by basket to the ground.

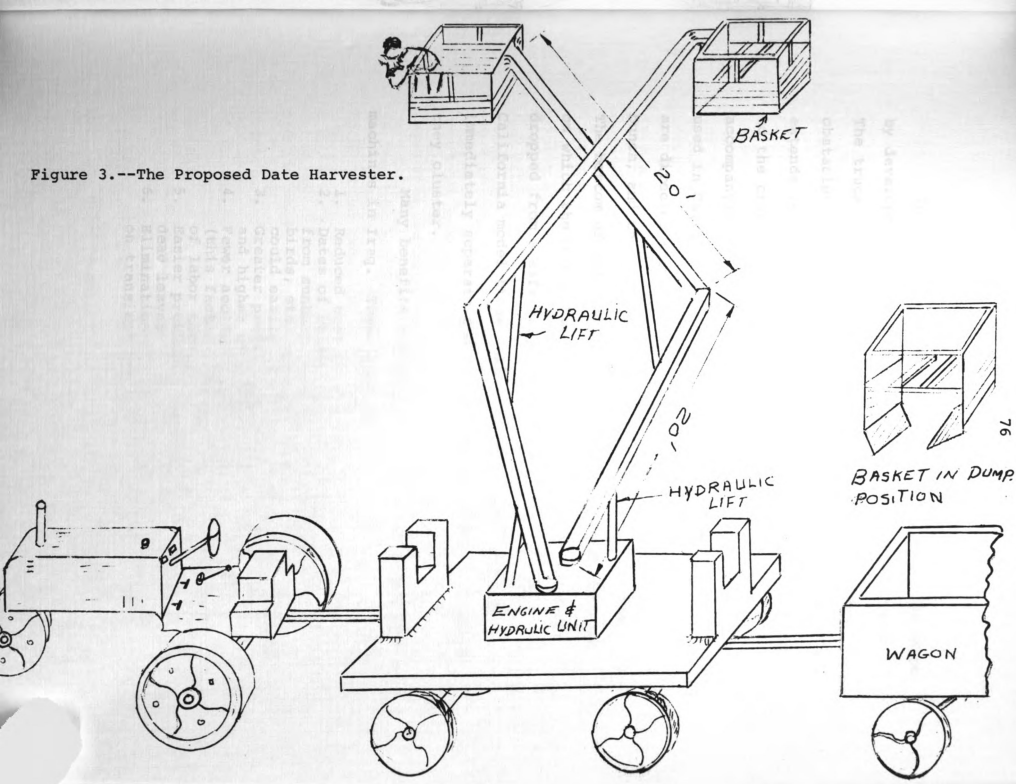

Figure 3.--The Proposed Date Harvester.

International Harvester solved the labor shortage by developing a platform carried by a four-wheel truck. The truck can cross the irrigation ditches and other obstacles with no problem. From the platform there extends telescopic booms which carry large wire baskets to the crown of the tree. As illustrated in the accompanying diagram (a modified version of the one used in California) the hydraulic-controlled baskets are directed from the truck. They go from bunch to bunch, and the ripe dates are collected in the basket. The bottom of the basket opens (there are small shelves on which the men can securely stand) and the dates are dropped from a safe height into the truck. In the California model these trucks contain shakers which immediately separate the dates from the strands on which they cluster.

Many benefits would accrue from the use of such machines in Iraq. These include:

1. Reduced cost of harvesting;
2. Dates of better quality, since damage from sunburn, bruises, mishandling, birds, etc. would be avoided (a man could easily cover the dates when necessary);
3. Greater profit through improved quality and higher efficiency;
4. Fewer accidents and deaths due to falls (this factor naturally causes a shortage of labor today);
5. Easier pruning, thinning, and removal of dead leaves;
6. Elimination of the uncertainty of relying on transient labor.

This approach requires less labor and resulted in a seven-fold increase in production per man in the California gardens.[2]

Transplanting Date Palms

An important piece of research was carried out by R. H. Nocton[3] some six years ago. In essence, it involved the transplantation, with 100 percent success, of 87 mature date palms. These trees were from 10 to 21 meters tall and weighted from 14 to 38 tons. The successful and economic accomplishment of this imposing task has important implications for Iraq. There are three areas where it has potential application, the first being the improvement of the climate in Baghdad. The city has doubled its size in the past years, and the great amounts of construction have meant the destruction of large numbers of trees. The difference in temperature and humidity--or rather aridity--in the city has been marked. Yet to grow trees to replace those which have been cut down takes at least 15 years, i.e., this is the growing period necessary before the trees provide shade and up to twice that length of time may be required for the tree to reach maturity. The reclamation of the trees now being destroyed would be a real asset to the city.

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[2]Harry Conner, "Long Reach for a Date," International Harvester World, I (1969), p. 7.

[3]Nocton, op. cit., p. 72.

The second potential area of application is to remove the trees which are now being lost because of saline soils. Large numbers of these are found in the tidal irrigated parts of Southern Iraq, particularly away from the river.[4] Effective drainage of the area is very expensive, and if an economical means of transplanting can be developed, considerable savings would be affected.

A third area of application is the reclamation of trees which have fallen during heavy windstorms. High winds are common in Iraq, and at present, trees which are uprooted during the storms are left to die. Keeping in mind the thirty years wait until a replacement reaches maturity, substantial savings would result from the replanting of these trees.

The most important potential benefit is the beginning of "instant orchards" with trees from any of these sources--city, saline areas, or victims of wind. When these orchards are underplanted with the citrus trees which flourish there, the value of the annual produce from an orchard of about 60 palms would within a year or two be about $1300 (500 x 2.4). According to Nocton, this easily makes the transplanting an economic undertaking. He does advise, however, government help. He adds that capital is available for shortterm projects

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[4] Ibid., p. 79.

such as this, where it is not readily available for projects--such as new orchards--which would take 20 or 25 years even to begin producing.

As he carried out the task, it involved mostly only machinery presently available in Baghdad. The steps were as follows: excavators were used to dig a trench around each tree; from this trench hand labor dug inward until a cone shaped bowl of earth had been formed, containing the entire root system. Steel plates were secured around the cone, hawsers passed under it, and the whole (weighing from 14 to 38 tons) was lifted by mobile crane (Le Tourneau) and placed on a Low Loader. At the transplanting site which had been chosen for its soil type, moisture content, the mobile crane lifted the tree from the Low Loader and placed it in its new position. Later tree alignment was accomplished with a mechanical winch. At various stages in the operation mechanical spraying of a water-dispersible plastic was done to control transpiration. During the first three months following transplanting, intensive irrigation was accomplished by overhead sprinkling equipment obtained from British Overhead Irrigation, Ltd.

He adds, however, that specialized equipment for the moving of large trees has been developed in America (Greenshade, Ltd.) and in Britain (Tree Movers, Ltd). He

apparently feels that though the trees can be moved using the general equipment described, on a long term basis investment in the special equipment would be wise.

Several observations follow: first the transplanted trees must be carefully and scientifically supervised during their first three months. The availability of this kind of technical labor must be checked before transplanting could be done on a large scale. Secondly, it is possible that the cost of labor involved in the manual digging could be saved if it proved feasible to remove the trees directly from water-drenched soil. This should be investigated.

It is apparent that these concluding words of the author have real potential significance for Iraq: "It is an economic proposition to transplant mature date palms and guarantee a 90 percent survival rate, providing special tree-moving equipment is used and that a scientific approach is made to the question of controlling transpiration and root growth."[5]

Potential Use of Date Seeds for Animal Feed

The date industry in Iraq suffers from lack of profit, because overhead costs are so high. A possible

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[5] Ibid., p. 721.

means of increasing profits would be the utilization of date stones, which are presently discarded. A good portion of the dates now exported are pitted, and these centrally collected pits have never been put to use. Another potential source of pits is the date oil industry, which extracts oil and discards the remaining dry matter, which of course, includes pits.

At the present time barley is heavily used as animal feed, but recent research has indicated that crushed date pits could be used as a component of feed and reduce the amount of barley needed. Harry[6] reported as far back as 1936 that they could be used in feeding cattle, El Shazley[7] has experimented with their use in feeding sheep, and Afifi[8] has successfully used date stones in chick rations. All three livestock are raised in large numbers, though chiefly for local consumption. Since barley could be exported as a cash crop, its partial replacement by date seeds would aid the economy of the country.

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[6]R. G. Harry, "Some Analytical Characteristics of Date Stone Oil," Analyst, 61 (London, 1936), 403.

[7]K. El-Shazly, E. A. Ibrahim, and H. A. Karam, "Nutritional Value of Date Seeds for Sheep," Journal of Animal Science, Vol. 22 (1963), p. 894.

[8]M. Afifi, F. Abdeu, and M. El-Sayed, "Date Stone Meal as a Substitute for Barley in Chick Rations," Tropical Agriculture, Vol. 43 (April, 1966), p. 167.

In Iraq there are thirty million date trees; if each of these bears about 100 pounds of dates annually, the annual date harvest approaches three billion pounds. One percent of this, or 30 million pounds[9] are pits; thus there is a potential for up to 15,000 tons of pits to be used each year for feed.

One of the reasons date pits are not now used for feed is the difficulty in crushing them, for they are extremely hard. They are hard to grind in ordinary hammer mills, and at present are usually crushed in a disc crusher, and then powdered with grain-grinding stone mills.[10] Studies should be made comparing the cost of crushing with potential profit from the sale of the crushed pits as feed.

Concluding Observations

Iraq is the largest date-producing country; it has a near monopoly on the fruit because of its unique natural advantages for their culture. These advantages should be fully exploited for the benefit of the country. Without improvements this multi-billion dollar industry will suffer. One of its main problems is the shortage of labor, which is required at every stage of date growing, from severing the offshoot from the parent, to

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[9] El-Shazly, op. cit., p. 894.

[10] El-Shazly, op. cit., p. 894.

pollination, to supporting too-heavy bunches, to pruning, to harvesting, and irrigation. Special trips up the height of the tree must also be made at times to protect the fruit from rain and insects. Date growers are finding it more and more difficult to make a profit from this important crop, because of the shortage of labor.

A second reason for mechanization is improved quality fruit, since bruises and other damage would be prevented. Mechanization would make it not only cheaper to reach the top of the tree, but safer.

Further profit might be made from using crushed date pits as animal feed. This and the feasibility of large-scale transplanting of mature palms presently lost to urbanization and salinization should be studied.

CHAPTER V

HAND AND ANIMAL POWER SYSTEM: BARLEY AND WHEAT

Wheat

Wheat is the most important small-grain crop in Iraq, being exceeded only by barley in acreage. Wheat is an important food crop in the country. It is consumed on a very large scale mainly for human consumption. Wheat is grown as indicated mainly in the north part of the country depending on the rainfall for its water.

The origin of wheat is not known. But the Bablonians and Summatic grew wheat in Mesopotamia 5000 years ago. It is believed that wheat was originated in Southeast Asia. According to De Condolle, wheat once grew wild in the Euphrates and Tigris Valleys and from there spread to the remainder of the world. The most common variety grown in Iraq is the Kurddia and Ajeba, which is similar to the hard red winter and the soft red winter that are grown in the United States. The Mexican improved wheat has been lately introduced and according to the latest report issued by the Agrarian it has met with success. Table 1 shows the production of wheat for 1950-1970.

TABLE 2.--Area, Production, and Yield Per Donum of Wheat in Iraq, 1950-1970.

Year	Area in Donums	Production in Metric Tons	Yield in Kg./donum
1950	380,000	520,000	137
1955	570,000	553,300	112
1960	5,084,625	591,519	116
1965	6,813,000	1,006,000	148
1966	6,947,000	826,000	119
1967	5,916,900	10,111,500	170
1968	6,650,700	1,512,200	227
1969	8,355,921	1,188,560	124
1970	6,980,558	1,228,477	175

Source: Quarterly Report, Ministry of Agrarian Reform, Iraq. General Directorate of Planning, Dept. of Statistics, March, 1971, p. 14. (Arabic language.)

Wheat is a winter crop and is usually seeded in late October or in the early part of November. When wheat is planted later than the normal date for locality 10% to 15% more seeds are advised to be sown.

The cultivation methods employed for wheat are similar to those applied for barley. In the central and southern region wheat is to be irrigated lighter and more frequently than barley. Wheat is less tolerant to salination than barley thus barley is usually given a favored place in the rotation system.

Barley

Barley has been known for a thousand years in Iraq, and was probably cultivated before recorded history. The Assyrians and the Babylonians grew barley on both banks of the Euphrates and the Tigris. It has continued to be an important crop through the centuries. Table 2 shows the production of barley for 1950-1970.

TABLE 3.--Area, Production, and Yield Per Donum of Barley in Iraq, 1950-1970.

Year	Area in Donums	Production in Metric Tons	Yield in Kg./donum
1950	4,000,000	801,000	200
1955	4,819,000	757,000	156
1960	4,151,284	803,807	194
1965	4,389,000	806,000	184
1966	4,677,000	832,000	178
1967	2,990,300	710,300	237
1968	3,502,400	973,700	278
1969	4,872,038	1,250,142	257
1970	2,646,618	675,999	255

Source: Quarterly Report, Ministry of Agrarian Reform, Iraq. General Directorate of Planning, Dept. of Statistics, March, 1971, p. 14. (Arabic language.)

Barley is mainly used as fodder and as a cash crop for export. Barley is also used for bread in rural areas, and for the making of beer in urban areas. As

shown in Fig. 1, the country has produced 931,000 metric tons in 1968; this represents a significant increase from the previous year when 860,000 metric tons were grown.

Barley is a winter crop, grown mainly in the central and southern regions of the country. Specifically, it is grown in the lower Tigris valley around the Kut district; in the central Euphrates zone from Nasiriyah to Samawah; and around Mosul, Irbil, and Kirkuk.

Although wheat sells for twice as much as barley, farmers still prefer barley because of its tolerance of aridity and soil salinity, and because of its relatively short growing season and its high resistance to pests and diseases. These reasons are especially persuasive in the central regions where salinity, for example, is high, sometimes reaching pH 8.3.

Hand Tools

Tools are an integral part of any cultivation system, even in the traditional farming of Iraq. Hand tools play an important part in the Iraqi agriculture. Every farmer has some kind of tool to aid him in cultivation, harvesting, or general management of the farm. Although these tools may vary from one area to another, their principles are the same, and in the final analysis serve one purpose: to aid in tilling the land. For example, the blade of the spade of the southern region of Iraq is smaller than that of the spade of the central region

Almost all hand tools are manufactured locally. The long history of agriculture in the land of Mesopotamia has fostered the development of the art of blacksmithing; tools made there truly withstand the test of time. Unfortunately these tools have not changed in design through the centuries; it is as if a resistance to change is built into them. Due to the scarcity and high cost of imported steel Iraqi tools are mainly made from scrap metal which has already lost its temper. It has become easy to break, quick to rust, and wears out quickly. Most of these tools, then, have a very short span of life. The farmer, therefore, has to take care not to place too great a load on his tools and at times he will do extra physical work himself rather than endanger his tools.

A major step in the development of hand-tool manufacturing in Iraq was the adoption of the tool-hardening system by many of the smiths. This has brought some relief to the farmer by making his simple tools last longer. The concept of steel grading or the scientific classification of metals is not fully understood by the local tool-makers. The majority of the tool blacksmiths own simple workshops with basic forges. It is interesting to note the total capital investment in the average shop in the opinion of the author very seldom exceeds $400. It cannot be expected that they will produce better quality tools with only cheap equipment available to them. In order to have better quality tools, major steps have to be

taken in the establishment of small factories preferably in the countryside where farmers could have ready access to the improved tools, which of course must be sold at a price they can afford. The improvement of hand tools will have a marked effect on agricultural productivity. Hand tool design is a complex process that may require a great deal of study and research to ensure products that are adapted to individual regions. It is indispensable that any change in the design of the present tools offer substantial improvement. Without this the farmers will certainly refuse to buy them.

Since at present the government is responsible for the import of all steel and other metals, the government must take measures to see that the proposed new hand-tool factories receive a steady flow of raw materials.

Lumber is another item which is important in the production of hand tools. Most hand tools are made partially of wood; wood makes the tool lighter and easier to handle. Good quality wood must be incorporated in the improved hand tools. As traditional agriculture develops into modern mechanized farming, a new demand for specialized tools will be created.

Stout gives a comprehensive list of the factors which must be considered in the designing of new tools and implements.[1] The list is as follows:

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[1]B. A. Stout, et al., Agricultural Mechanization in Equatorial Africa, Institute of International Agriculture, Research Report No. 6 (East Lansing: Michigan State University, 1969), p. 2-165.

1. Adopt tools for efficient performance and steady work;
2. Minimize fatigue by improved balance and working conditions;
3. Reduce injury or wear to man or animal;
4. Keep weight low for easy transport;
5. Construct from local readily available materials;
6. Choose the most simple design appropriate to the job;
7. Design for specific tasks, and with only simple adjustments;
8. Require the least maintenance and preparation for use;
9. Construct so that parts can fit together only one way;
10. Secure firm fastening between handle and blade;
11. Eliminate wherever possible the need for wrenches (spanners) or special tools for adjustment;
12. Make simple tool clamps with no nuts or pieces to lose;
13. Use self-locking pins, chained to frame for joining parts;
14. Design to accommodate high work loads caused by unusually dry or hard conditions (animal tool bars should be capable of pulls up to 454 kg);
15. Give careful attention to improving drawbar hitches.

Tools and Implements Used in Cereal Production

Traditional tools are used by most Iraqi farmers. Most of these traditional tools are even used on the most mechanized modern farms, since they are common, have been used for centuries, and represent a kind of security to the farmers. These traditional tools are:

1. Breaker plow. This is made up of three parts: a beam, a plow share, and a handle. There are two kinds of breaker plows; one is made entirely of wood, the other has a metal-plated tip. The plow merely breaks

and lifts the soil, leaving an open furrow without turning the soil.

2. Harness. Second in importance; it is single yoke.

3. Hoe. This is used for digging, cutting bushes, and chopping wood.

4. Spade. The spade is used for hand-cultivating, cleaning irrigation ditches, and making small dikes around irrigated field plots. It has two parts--the blade and the wooden handle--and has a foot rest.

5. Sickle. A curved steel blade ending in a point attached to a short handle, used primarily for reaping. It usually has small teeth along its blade.

6. Chillab. A larger sickle, but without teeth.

7. Fork. Made of a wooden head and tines. One type has two tines and is used for handling grain sheaves; another with five or six tines for grading.[2]

Tillage

In spite of controversies about tillage--depth of cultivation, or whether to cultivate at all-tilling is still practiced in all cereal farms in Iraq. Stirring the soil by tillage tools offers the following advantages:[3]

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[2]A. P. G. Poyck, Farm Studies in Iraq (Wageningen, Netherlands: H. Veenman N.V., 1962).

[3]Harold K. Wilson, Grain Crops (New York: McGraw-Hill, 1948), p. 72.

1. Improves the physical condition of the soil by increasing aeration and infiltration of water; this creates a more favorable environment for germination and growth.
2. Prepares a feeding zone for roots, often by incorporating organic matter, manures, or crop residue with the soil.
3. Reduces weed population by killing weed roots.
4. Controls certain diseases and reduces insect damage.
5. Reduces wind and water erosion.

The average Iraqi farmer may not be aware of all these advantages, but he does know that in order to have a crop, the soil must first be tilled. These farmers, as mentioned earlier, use only a few primitive tools; most of them do not have access to more modern equipment. Tillage operations are accomplished by hand-powered, animal-powered, or engine-powered operations.

Hand Operations

Many Iraqi farmers use this method. The most important hand tools are the hoe, the spade, and the shovel. The spade is the most commonly used.

The man who works his land by himself uses a great deal of the short growing season for this preliminary operation; a team of workers therefore is more efficient. The reason for the increased efficiency is that one of the men walks ahead clearing rocks, roots, and branches; this can even be done by a young boy. The plow then moves much faster than it could if the man who was driving it had to stop every few feet to remove obstacles.

The average depth of spade tilling is 8 to 12 inches. Hopfen writes that cultivating soil by hand to this depth requires about 500 man hours.[4]

The hoe is used to break up the hard soil or to dig out roots, rocks, etc. Women and children often use the hoe for clearing the fields of rocks and stones, preceding the tiller. The shovel is used for cleaning ditches or water channels. When a spade breaks, a shovel may be used instead until the farmer repairs or replaces his spade.

Hand tillage is slow and expensive. Hired workers are not always available and may charge high prices. The average worker charges 600 fils ($1.60) for a six hour work day. As mentioned elsewhere, the supply of labor is decreasing as men seek the less demanding jobs of the city. The shortage of labor is a problem not only during tillage, but all through the growing season and the harvest. The average hand-operator is mainly limited to the labor of his family and himself, which of course limits the amount of land he can till, no matter how large his holdings.

Time limitation is another factor which hinders the increase of land under cultivation. All tillage must be completed before the rains start in early

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[4]H. J. Hopfen, Farm Implements in Arid and Tropical Regions (Rome: Food and Ag. Org. of the U.S.), quoted in Stout, op. cit., p. 2-169.

October. If hand-operations are used not much land can be tilled at this time.

Animal Power Operation

The majority of farmers have some kind of animal power at their disposal--horses, mules, oxen, cows, and donkeys are the usual animals which are used as draft animals. Camels have never been used; perhaps this is because of the camel's difficult temperament, or perhaps because he is viewed by the Arabs as too noble for that kind of work. The camel is extensively used, however, for transportation and as pack animals. The author estimates that probably 80% of all cereal crops produced in Iraq at one time or another were transported by camel.

The use of draft animals and the introduction of the breaker plow have been of great importance in the cereal crop industry; the plow because it breaks the soil to a greater depth and saves both labor and time. Although it takes 500 hours to plow one hectare with a spade, it takes only a fraction of that by the use of draft animals. All in all, the use of animals in tillage should be exploited as much as possible. The draft animals are available almost everywhere in the country. The general practice is to use two cows or two oxen, but when horses are used, only one is hitched to the plow.

Horses are very important to farmers; possessing a horse will substantially increase his production. Unfortunately many farmers cannot afford to buy a horse,

so several farmers may share a single horse. A horse is usually thought of as consisting of four parts.[5] The farmer buys one or two parts, and uses the right to use the horse on the condition that he partly maintains and takes care of the animal. Foals belong to the original owner.

The breaker plow, which is hand and animal powered, has the advantage of being lightweight so that the farmer can easily bring it from his home to the field; another advantage is its low price. (Still, the farmer fears the theft of the plow, and this is why he carries it to his home at night. While the plow is usually pulled by animals, there are times when no animals are available, and then two men pull the plow.

No two plows are exactly the same. They are manufactured locally, and the local manufacturers have no quality control measures. The farmer chooses the plow which he likes best from those for sale, and pays a price set by a few minutes of bargaining. Prices vary from 600 fils to two dinars ($1.60 to $5.60) depending on the size of the plow and the quality of its wood.

The metal which sometimes plates the tip of the plow is forged by local blacksmiths. Sometimes the farmer himself attaches metal to the tip of the plow--he may use a horseshoe, scrap metal, or part of an old hoe. They reach a depth of 8 to 10 inches, and usually

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[5]Poyck, op. cit., p. 50.

cut a furrow four to ten inches depending on the size. The breaker plows last only about two working seasons, and then must be repaired or replaced. There has been no study of the average rate of work of this plow in Iraq. However, it is estimated in the United States that a man with two oxen on the average can plow one acre a day.[6] Some well-off farmers buy steel moldboard plows from the government, or rent one from a cooperative or hire-and-rental service set up by the government. These steel moldboard plows are more efficient. A horse, a cow, or an oxen can pull one of these plows.

The Government hire and rental service is located only in Baghdad; therefore, some farmers have to travel a hundred miles to rent a plow or other implement. Distance and the cost of transportation is often an inhibiting factor. Even when the farmer is willing to undergo the trouble and expense, there are not enough plows available at these stations for all who desire them. The farmers prefer the moldboard plows, and wish that credit would be extended to them so that they could buy them.

Planting

Hand Planting

Almost no farmers have special equipment for planting; seeds are either hand-broadcast or placed in

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[6] Ploughboy, 12 (1820-21); 133 (From Rhode Island America) quoted by Lee Rogin, Introduction of Farm Machinery (Berkeley: University of California Press, 1931), p. 16.

prepared holes in the soil. Seeds used for planting are seldom cleaned or treated by the farmers; clean seeds, however, reduce weeds and promote germination. So the government has occasionally distributed clean, treated seed of the better varieties, and at minimum cost.

The planting of wheat and barley is commonly done by hand broadcasting, after the field has been prepared. This simple method of hand broadcasting is as follows. The farmer wears a long garment, which blouses above the belt. In this fullness of the garment above the belt the farmer carries seed, and simply reaches in for a handful of it, which he then throws on the soil as he walks along. The amount of seed sown, of course, depends on the speed with which he walks and the size of the handfuls he takes. Through experience the farmer learns how much seed he needs per hectare. This method has a number of shortcomings; for one thing it distributes the seed unevenly. Only experienced farmers can distribute the seed at all evenly. After the crop grows, the very thick areas should be thinned, but the farmers usually avoid doing so because of extra expense.

A variation of the hand-broadcasting is the carrying of a basket woven from palm leaves to hold the seed. According to Stout's experience with similar methods used in Africa,[7] it takes about four hours to sow one hectare of land with this method. According to

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[7]Stout, op. cit., p. 2-199.

the U. S. Department of Labor,[8] it takes one hour and 18 minutes to sow one acre of small grain by the hand-broadcasting method. This places a limitation on the amount of land a farmer can sow. Those sho have larger holdings have to hire laborers to help with planting. Hand-broadcasting has the further disadvantage of consuming more grain per unit of land than would a grain drill.

Some farmers maintain that hand-broadcasting is satisfactory, and that the increase in yield brought about by a grain drill does not justify its cost. Another argument in favor of the hand method is the prevention of delayed planting; on rainy days, for instance, the machine cannot function, and must wait until the soil dries. The farmer is not so delayed by rain. For these reasons, the grain farmers of Iraq, whatever level of mechanization they may have reached, prefer to plant seed by the hand-broadcasting method.

The economic advantages of the two methods of planting should be studied. Such research has not yet been done.

Row drilling is not commonly practiced in Iraqi cereal crop fields, naturally, because the seed is hand-broadcast, but it is interesting to note that seed drilling was practiced in ancient Mesopotamia. According to Hopfen "the Sumerians were the first to seed their

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[8]Rogin, op. cit., p. 206.

grain in rows with a seeding-tube connected to a plow, a method still used in some Eastern countries."[9]

Covering Seed

Covering the seed is the operation which follows seed broadcasting. This must be done as soon as possible, as the farmers fear that the seed will be eaten by the birds. Seed covering is done in one of three ways. Animals may be led through the fields in groups, and their hooves trample the seeds into the ground; these animals may be sheep, goats, horses, donkeys, and cows. Trampling has the disadvantage that it cannot be measured, and so seeds are covered well in some fields, less well in others.

A second method is brushing the fields with branches. Both the first and second methods are carried out by women and children. When the field is very large, the farmer, rather than hire extra labor, invites his neighbors to a banquet perhaps of mutton and rice and in return they help cover his seed. This kind of "volunteer" work is called "sukra."

Hand broadcast seeders (either seed-box seeders or rotation seeders) that were used in the United States in the late nineteenth century may offer advantages over the present hand-broadcast method used by Iraqi farmers. The introduction of these seeders, or ones similar in

[9]Hopfen, op. cit., p. 78.

principle, would prove a step forward in Iraqi progress toward mechanized farming. They require little extra effort, and they would be inexpensive.

The third method of seed-covering is done by the plow, which is drawn over the field once more to bury the seeds. The method is not popular as it tends to bury some seeds too deep for germination. When the plow is used, the initial seeding must be heavier in order to compensate for the seed which is lost in this way. This method is the least used of the three.

Animal Planting Operations

Generally speaking, wheat and barley are not planted by animal drawn mechanical planters. Most farmers do not own seeders; although a few farmers use tube seeders attached to a plow, this is used mainly for maize and vegetable crops. A small grain drill implement which can be drawn by animals is available at the government hire and rental service, but, as indicated earlier, farmers are reluctant to use these services.

Mechanical Seeders

Mechanical-animal drawn planters are not popular in cereal crop production in Iraq. Only a very few farmers use them, mainly in planting vegetable seeds. In using these machines in cereal crops the farmer has to choose the right plate for the right seeds. Seeds intended for planting must be clean and free from weed

seeds. When in use the seeder must be regularly checked to be sure that it is dispensing seeds and that the dispenser has not been clogged. In the north part of the country where precipitation is high, the seed must be not only covered but firmly imbedded; otherwise rainstorms can wash away the seed, especially that which is planted on slopes. The use of a wheel or a board following the seed drill would accomplish this.

Weeding

Weeding is recognized as an important cultural practice in food crop production. Weeds cause big losses to farmers, since they reduce crop yield by competing for nutrients in the soil. They also increase the cost of cultivation and harvest, because a crop infested with weeds requires extra labor for threshing and cleaning, and so they reduce the market value of the crop. Crops to be used as seed are sold for less when they contain weed seed, because the weed seed must be cleaned from the crop seed before planting.

Weeding is not usually practiced in wheat, rice, and barley production. In Iraq farmers do not expend the extra energy to weed the fields because of the extra cost and labor involved. The farmer prefers to save the time and money involved rather than have a larger yield.

Weeding is practiced in fields where row cropping has been done. Most row cropping in Iraq is done for vegetable crops, little is done in cereal crop farms.

Weeds can be controlled by many methods. First, by tillage, which stirs the soil, second, destroying the weed by mechanical means such as spade and shovel; third, the use of clean seed; fourth, the use of chemical herbicides, fifth, mowing, and sixth, smothering the weed when crops become so dense that they prevent sunlight from reaching the weeds.

The above methods are all known to the farmers, but only a few are common. These are: crop rotation, the use of clean seeds, shallow cultivation before planting, and the use of the hoe in removing weeds. The use of the hoe is very expensive, and most farmers are reluctant, because of its requirement of extra labor, to use it. The use of certain chemicals (herbicides) such as 2,4D iron sulfate and copper sulfate is practiced by the government on its plantations and university experimental stations. Most smaller farmers do not use these chemicals. It is the opinion of the author that the use of chemical herbicides should not be practiced until the farmer has acquired sufficient knowledge about the potential danger of these chemicals.

To adopt other weeding practices aside from crop rotation and cleaner seeds, the farmers must first change their planting methods; that is, they must change from hand-broadcasting to a properly spaced planting method. Row planting will allow the adoption of animal drawn weeding implements and thus ultimately will make weed

control easier and less costly. Stout, in his book, Agricultural Mechanization in Equatorial Africa, has discussed several animal-drawn weeking implements. It is the opinion of the author that these implements should be tested in Iraq and, if they prove to be successful, should be made available to the farmers. These implements, as listed in the report, are as follows: (1) the single-row hoe, (2) the lever-expansion cultivator, (3) the steerage horse hoe, (4) the German Reno Cultivator, (5) the Indian-type single-handle cutlivator, and (6) the semi-flexible harrow. For further discussion and details see Stout, pp. 2-230 through 2-234.

No study has been conducted in Iraq to determine the effect of uncontrolled weed growth on yield, but there is no doubt that weeds are undesirable competition to the grain crops and should be removed. Research however is urgently needed to determine the extent of yield reduction due to lack of weed control on Iraqi cereal fields.

Harvesting

Hand Harvesting

The harvest season is the busiest time of the year on every farm in Iraq. Farmers and their families, and even their animals, are busy gathering the returns of their labor. Cereal crops such as wheat, barley, and rice need to be harvested as soon as the grains have matured sufficiently. Any delay may cause severe losses.

The main losses occur from the shattering of the grain and dropping of the grain from the stalk.

The common method of harvesting grain crops is to reap the stalks with a sickle. The sickle is believed to be the most important and the oldest tool in the world. Hopfen says,

> the sickle is still widely used all over the world to reap cereal, particularly paddy rice which has soft but tough straw and is easily shattered. Serrated sickles are more common in . . . southern and central Iraq.[10]

The sickle has been more fully described in the description of methods of harvesting dates. Since the sickle is a one-handed tool the other hand is free to hold the stalks while the sickle shears them. The cradle, although it has been used in Europe and the United States for a century, is not used in Iraq. Sickle harvesting is very slow. The cradle, if introduced into harvesting procedures in Iraq, would increase the efficiency of hand harvesting. According to Hopfen, grain can be reaped with a cradle three times faster than with a sickle on flat fields with uniformly standing crops.[11] The cradle, for all practical purposes, is a scythe, with a frame made of five tapering wooden fingers attached alongside the blade. This cradle can be used in harvesting each of the two crops with which we are concerned. However, in using the cradle, care must be

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[10] Ibid., p. 98.

[11] Ibid., p. 112.

exercised to prevent shattering, as this is apt to happen to very ripe grains. Most farmers do not bind their sheaves, but carry them loose and pile them on the threshing floor.

Threshing

Hand Threshing

Hand threshing is not commonly done in Iraq. Animal threshing is the method used in threshing wheat and barley.

Animal Threshing

Almost all threshing of wheat and barley, and most of the rice, is threshed by being trampled by animals. The stalks of grain are transported from the field, to the threshing floor (usually an open-air space), by the men themselves, their wives and children. Animals such as cows, donkeys, and horses are also used to carry the stalks. Animals are made to walk through the spread-out stalks.

Men, too, walk with their animals to help with the threshing. The animals are usually exhausted from the strenuous work required at harvest time; some of them even die from the exertion. To speed up the threshing process, many farmers tie a heavy piece of wood behind the animals; men or women may sit on the logs to make them extra heavy, and to herd the animals. Hopfen describes this device as:

> an animal-drawn implement consisting of two wooden boards, slightly raised in front, which are fitted with short pegs, serrated knives, or hard stone, inserted into holes on the underside of the boards. The operator stands on the implement to add weight and this is dragged over the crop, spread on the floor, the knives or pegs rubbing out the grain and brushing the straw.[12]

The disk roller for threshing seems to have a place in Iraq. A good example of this is the Olpad (Indian) Thresher. In Stout's words,

> The machine is pulled over the sheaves by an ox team and parallel sets of disks rub out the grain. The straw is turned by men with forks or it may be stirred by an attachment fixed to the rear of the device. The grain must be cleaned after it is separated.[13]

The introduction of this machine into Iraqi threshing practices could make threshing much more efficient.

Winnowing

Hand Winnowing

The next step after threshing is the separation of the grain from straw and other foreign materials. The most common method on Iraq's farms is wind separation. With the aid of a spade, a wooden fork, or a shovel, a man tosses the mixture into the air; the grain with the higher density falls in a nearby area, and the lighter chaff falls further away. Naturally this is done when the wind is strong. Luckily Iraq has frequent winds; no fan or artificial source of wind is used in

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[12] Ibid., p. 120.

[13] Stout, op. cit., p. 2-259.

winnowing. This is an area which needs further study. The present method is very slow and perhaps the use of a fan might be considered.

Transportation and Storage

After threshing, the grain and the straw are carried by animals, usually by the camel, which carries about 200 kg. and can travel a long distance without need of food and water--sometimes it can travel as long as seven days without these. The camel can travel on sand and desert, and cross dikes and ditches and unpaved roads where no trucks can go. Donkeys, mules, and horses are also used for shorter distances; however, in the north part of the country the grain is usually carried by horseback, because horses are more capable of traveling on hills and mountaneous areas. The grain is carried to the storage areas of the local merchants.

Because of lack of storage facilities, many farmers will store their grain in the open area, covered only by straw. Some of the grain which is kept for consumption by the subsistence farmer is stored in a cylinder made of dried mud, about 2-3 ft. in diameter and 5-6 ft. tall.

The straw is usually sold to the local building constructors who mix it with clay mud and then builds walls and houses from it; with the mixture he also builds roofs and fences.

Animals also draw carts which are used in transportation. The most common size is about 8 ft. long and 4 ft. wide; it is like a four wheeled wagon, and is usually pulled by two horses or oxen. This cart can carry up to 1000 kg. The back wheels are about 4 ft. in diameter, the front wheels about 2 1/2 ft. Some smaller carts have only two wheels. These carts have been hazardous to motorists; if the farmer is close to a blacktopped road he will drive the cart along it, but since his cart lacks lights and reflectors, many accidents can occur especially at night.

There is much room for improvement in cart manufacture in Iraq. The adoption of ball bearings and the wheel axle and tire wheels would offer great advantages over the traditional cart. The carts would then be more efficient and require less animal traction.

Animals can also be used for irrigation. In Iraq, many of the smaller holdings are irrigated by the Persian wheel (nauor). Its use is mainly confined to vegetable growing; although it is occasionally used for irrigating wheat and barley, it is never used in rice plantations. The nauor is powered by a horse, donkey, or cow.

> The Persian water wheel [nauor] is widely used for raising water from shallow wells. . . . It is powered by oxen [horses, and mules] and driven from a shaft by peg-gearing. An endless chain of buckets are mounted on a large diameter wheel at the top of the well. As the wheel rotates, the buckets dip into the water, at the

> bottom of the well, and lift it to the top into an irrigation canal.[14]

The disadvantage of this is that the horse or donkey, the prime mover, needs once in a while a whistle or a spank to make him move. He must be supervised. It is said that sometimes dogs are chained close by and trained to bark at the horse (mule, etc.) whenever it stops.

Advantages of Draft Animals

Although people tend to underrate the potential of animal traction, the expense and technical problem involved in the more appealing large machines means their use must be restricted. The unique advantages of draft animals should be seriously considered. These advantages include low cost, and the fact that since they are available locally and need not be imported, problems with foreign exchange are avoided. In addition, animal-drawn implements are well adapted to small holdings. In addition the compost manure is an effective fertilizer; some soils will not respond to any other fertilizer. Owning animals poses none of the technical and engineering problems which arise from the needs of machines; animals are simpler to manage.

Disadvantages of Draft Animals

Feeding these animals can be a problem during the dry season, although it is true that the animals presently used in Iraq are hardy and fairly resistent

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[14] Ibid., p. 2-282.

to the severe climate and their often inadequate diet.[15] In general the animals have to live on scraps, as very few Iraqis grow fodder, and pasturing is done only on a limited scale. In addition, animal teams must be directed by several people (one of the men leads the animals, another guides the implement, and the third prods the animals). A tractor can be driven by one. Another drawback is the limited traction power of these animals; and the quality of cultivation is not as high as that achieved mechanically. Animals, too, are inefficient with dry, heavy clay soils. Animals also are subject to disease and then need veterinary care. Since animals are only harnessed for work during the relatively brief plowing season, they do not develop the strength and work habits which they could have if used more often.

It is impossible to decide in this thesis what every individual farmer should do; his decision will depend upon all these various factors. However, the natural course is that the farmer gradually progresses from the use of hand power to the use of animal power, and eventually to the use of engine power.

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[15] Harris, op. cit., p. 205.

CHAPTER VI

ENGINE-POWERED MACHINERY AND IMPLEMENTS IN IRAQ

Introduction

Engine-powered machinery and implements are not new to Iraqi farms; in fact, they have been in use for many years. In the 1940s and 1950s a few land owners (Shaikhs) used almost every type of modern equipment. They owned tractors, combines, and various attachments, most of which was used for land preparation and harvesting. Before 1948 the import of machinery was done by private dealers, but at that time government decided to nationalize all importing of machinery. The argument for this was that the move would protect farmers from inferior machines which the private dealers might try to sell them. This obviously eliminated competition.

It is still true today that government is the only importer of farm machinery and farmers cannot buy imported machinery from any other source. Machinery now available in Iraq can handle every aspect of farming, from land tillage to harvest and transportation of the crops. (This is done on a very small scale mainly limited to government projects).

Some people fear that farming will be increasingly neglected as the people reach higher educational levels and refuse to accept the drudgery of hand and animal cultivation. If this is true, mechanization will become more and more necessary in the country. There are many other reasons for increasing use of engine-powered equipment. Mechanization offers many advantages. These include better land preparation through greater tractor power to work the heavy soils which hand plowing cannot handle adequately. Tractors also have greater power for turning green manure and breaking heavy grassland. It offers speed and efficiency in harvesting the crops and may prevent damage due to delayed harvest. Through the use tractors drawn plows, a deeper and more thorough soil preparation become possible thus help to control runoff by increasing the capacity of the soil to absorb and retain water. Most important of all it can facilitate expansion of the area under cultivation. The use of the tractor gives the farmer the power necessary for faster cultivation, and thus he can process more land in less time.

At the present time the supply of labor is constantly diminishing in Iraq, as more and more peasants move to the cities. The need for engine-powered machines becomes more acute every day, since the growing population means demand for increased food production. The cost of a tractor or similar implement is so high that the average farmer can seldom afford it. This may be one of the main

reasons that Iraq agriculture remains traditional, and why hand and animal-power still dominate the scene.

Economic Use of Tractors

Tractor-powered equipment should be used only when such use brings about significant improvements in quality of product or efficiency in labor. Labor freed by the use of this equipment should be effectively used throughout the agricultural season, rather than merely eliminated to reduce costs. The extension agent can most effectively instruct the farmers in the efficient use of this freed labor.

The cost of the machinery usually means that there must be a sizeable increase in production to make its use profitable. Too many farmers fail to appreciate the real cost of their machinery, and instead take any opportunity to mechanize and reduce the labor required, without taking into account the full economic implications of this change. Cost should be considered more important than saving labor in the decision to use mechanized implements.

Mechanization can extend the area under cultivation and improve the timeliness of such operations as weeding and sowing. It is not always possible to achieve both these goals, however, one may partially cancel the other.

The main problem of mechanization is to keep cost within manageable limits; often the market value of food crops is so low that mechanization cannot be profitable

Even when markets are good, however, machine use is usually not profitable unless it can be prolonged over a rather large amount of time each season. Although a tractor-drawn plow can cultivate an area several times as large as that cultivated by an ox-drawn plow, the size of the holding may impose other limitations on the total area cultivated. In addition, the larger area under cultivation may create other labor shortages; for instance, weeding the larger area may be difficult if the mechanized implements are used only for cultivation, rather than in facilitating early planting or releasing labor which could be devoted to weeding. This would be a major constraint to the expansion of land under cultivation if proper weeding were always done, but as yet this is not the case. The use of a tractor may contribute to weed growth unless plowing is done in advance of the planting; under this system many weeds will germinate and sprout before the regular crop is planted. One shallow cultivation will bury these weeds, and then the regular crop can be planted. Shallow cultivation requires less power and is just as effective as deep cultivation. Most of the

weed seed will have grown and been destroyed before the regular crop even starts. Inter-row cultivation is another effective way to facilitate weedings. Good land cultivation will certainly help reduce weeding problems.

The expansion of area under cultivation may create another labor problem at harvest time, depending on the method of harvesting and the availability of labor at that time. When harvest is fully mechanized then all the machinery and equipment should be ready for work when the crop reaches maturity. There are three factors which help overcome the labor bottleneck at harvest time: first, fuller mechanization of harvest; second, abundant supply of labor; third, the extent to which harvest-time can be stretched without damaging the crop.

The cost of the machine may induce the farmer to crop larger areas; he may have to increase yield in order to make his investment in machinery profitable. This can be achieved by the addition of more input such as fertilizer, pesticide, better quality seed, but the cost of the machinery will eventually necessitate increasing the area under cultivation and so reducing fallow land. At the present time 65%[1] of the

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[1]A. P. Poyck, Farm Studies in Iraq, p. 43.

land is cultivated; with the introduction of engine-powered equipment this may rise to 80 or 85%. Working the fallow land is more appealing and more profitable than clearing new land, since much effort is required to make new land suitable for cultivation. In addition the farmer does not care to risk damage to his expensive new machinery by using it in fields where there are large rocks and roots. Sometimes, however, there is new land which is quite smooth and free of major obstacles, and in this case the farmer may increase the land available for cultivation rather than reducing his fallow land. The fertility of the new land would be another factor affecting the farmer's decision.

From all this we can see that machines play a large role in the intensification of land use.

Plowing and Soil Erosion

Plowing hilly land may cause soil erosion unless this area is contoured. The use of grass strips will prevent some erosion, as will the use of cut-off drains or small dikes to check the intensity of water flows. In addition, the deeper cultivation which is possible with mechanized equipment will mean that more moisture is obsorbed in the loosened soil, and so less soil will wash away.

Use of Machinery and Fixed Cost

The[2] cost of machinery is largely determined by the extent to which equipment is utilized and the amount of time which is required for each unit of land. Some of the fixed cost is involved in pay for supervisory and operating personnel, as well as in the acquisition of repair facilities; but the most important fixed cost is depreciation. The rate of depreciation of course depends on the quality of maintenance. The life of the machine can be measured in terms of hours used, or in terms of years owned. Ordinarily it must be measured in terms of years; for one thing, the machine grows obsolete as time passes, and for another factors such as rust and corrosion make it less useful each year. For these reasons there is a minimum annual depreciation, and this cost must be related to the number of hours the machine was used that year. This hourly cost will decline as the number of hours the machine is used increases. "Experience indicates that it is very difficult to make mechanization pay unless a tractor can operate at least 500 hours per year." [3]

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[2] John C. deWilde, Experience with Agricultural Development in Tropical Africa, pp. 114-131.

[3] Ibid.

The average farmer in Iraq will never find the 500 hours of work for a tractor which would justify his buying it. He must either rent a tractor or use it cooperatively with his neighbors.

The length of time a tractor can be used will depend on both soil and climate conditions; the tractor will be more economically feasible if the farmer can find more than a single operation for it to perform. The tractor is also more justifiable if it is used in an area which grows two crops each year, for then it is used for twice as many hours. Tractors can also be made more economical if they are used for tasks other than cultivation, such as transportation, grinding, lifting water, and digging (with an auger bit). But the use of a tractor in these ways must be done only after careful consideration of the economics of other ways of doing the same tasks.

Operating costs per acre are more significant than cost per hour. Nevertheless, "the economics of mechanization will be determined by translating the cost of mechanical operation per unit of area into cost per unit of output."[4] The greater the market value of the crop, the more money--in terms of mechanization--can be invested in it.

For all these reasons the farmers can clearly use mechanization profitably in only one of two ways: either

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[4] Ibid., p. 119.

rent a tractor at a reasonable cost from a government or private agency, or use the tractor cooperatively. Cooperatives will be discussed in more detail later. Governmental hire-and-rental services are now available, and they too will be discussed at another point.

Although it is difficult to mechanize small farms economically, nevertheless the Land Reform in Iraq has made small farmers the majority of the agricultural population. They must be given careful consideration. The ultimate use of mechanization is to increase production. The farmer must always take into consideration the market for the product; only when demand is high enough to bring about good prices for the increased productivity can mechanization be justified.

To advise the farmer simply to mechanize is not just, since farmers vary widely in their socio-economic circumstances. For some farmers mechanization will mean changing from hand-power to animal power; to others it will mean changing from animal power to machine power. Some farmers tend to mechanize without basing their decision on sound reasons; in some cases it would actually be cheaper to use animal power than engine power. The stage of mechanization chosen should be the one that mobilizes the economic resources of the individual farmer and it is up to the farmer to choose the appropriate state of mechanization

for his particular environment and economic condition. The farmer, in the opinion of Schultz and of many others, including the author, will be responsive to the economic incentives actually available to him.

The Custom Use of Farm Machinery

Farmers in Iraq ordinarily have too little land to justify their buying large or expansive machines. Since they can nevertheless profit from the use of such machines, a sound alternative is to rent them. At the present time this can be done through two agencies: one is the government hire-and-rental service, and the second is private services of this nature. The government hire-and-rental service owns several hundred tractors, combines, and other implements. The government agencies are all in Baghdad, and so serve only those farmers fairly near the city; however there are plans to extend the service to other parts of the country. There are also private contractors who do custom work mainly land preparation for the farmer.

Even those farmers who could afford to buy this machinery should still carefully weigh advantages and disadvantages[5] of renting it instead. The extension agent can best instruct the farmer in these points; a more detailed discussion of his role is given in a later chapter. The most obvious advantage is that the farmer does not have to make a large capital investment in either purchase or maintenance. The money saved can be used for improving other facets of the

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[5]Harris Smith, Farm Machinery Equipment, p. 474.

farming enterprise. Another disadvantage is that a trained operator is furnished with the machinery. Finally, the farmers would gain the benefit of new machinery (without having to worry about obsolescence) and of machinery larger than he could profitably buy if his holding is small.

There is no doubt, however, that there are disadvantages in renting machinery. One is that machinery may not be available when the farmer most needs it, because of high demand. If the operator is careless or irresponsible, marked damage may be done to the crop. The cost of hiring machinery for large jobs may be as high as the cost of purchasing the equipment, and since the agencies prefer to do larger jobs, they may refuse to accept smaller ones.

Repair and Maintenance

Farmers in Iraq generally use hand- and animal-power, and very few use engine power. The hand and animal powered farmers generally obtain spare parts for their implements from local craftsman, probably the carpenters and blacksmiths of the nearest village. What they need in the way of spare parts and repair services is readily available, because the raw materials of their implements are wood and scrap metal. The farms using engine power have more difficulty satisfying their needs, and usually must go to the cities for parts and repairs. Even these services are not always satisfactory, because the artisans

there, although highly skilled, may lack necessary equipment and spare parts, since the importing of these items is controlled by the government. For this reason there is frequently some delay before the farmer can obtain the needed services.

Since the government has the responsibility of importing all needed machinery, it should be able to secure spare parts from the countries which supply the imports. However, a great variety of machines are imported, and there has frequently been difficulty in supplying spare parts for them.

In the final analysis the farmers are the victims of this inefficiency. What is needed is a guarantee from every exporting company or country whose products are imported that spare parts will be available whenever needed.

Table 4 on the following page tells the number of years, on the average, certain important farm machines are used, before they become obsolete; the hours of use they will give before wearing out; and the total repair cost for the machine, during its entire life, expressed as a percentage of the purchase price.

Selection of Implements

Some basic principles in selecting farm machinery deal with timeliness of operations, working days available, the ability to operate additional hours per day, and allowances for unplanned delays.

TABLE 4.--Depreciation and Cost of Farm Equipment.[1]

Machine	Years Until Obsolete	Hours to Wear Out	Total Repair Cost, % of New Cost
Tractor	15	12,000	120
Tractor Plow	15	2,000	80
Tractor Disk Harrow	15	2,000	30
Spring-tooth harrow	20	2,000	40
Spike-tooth harrow	20	2,500	30
Grain Drill	20	1,200	25
Field Sprayer	10	1,500	30
Tractor Cultivator	12	2,500	40
Tractor Mower	12	2,000	75
Combine[a]	10	2,000	40
Manure Loader	10	2,000	25
Manure Spreader	15	2,500	25
Tractor	15	12,000	120

[a]Operating costs such as fuel, oil, grease, wire, twine, etc., not included).

[1]Smith, op. cit., p. 468-9; Source: Ag. Engin. Yearbook, 1962.

TABLE 5.--Typical Ranges of Power Requirements, Operating Speeds, Field Efficiencies, and Field Capacities of Farm Machinery.

Machine or Operation	Power Requirements	Speed Km/hr	Field Efficiency %	Ha/Hr Per Meter Widty	Hrs/Ha Per Meter Width Average
Plow:					
indigenous	0.14-0.70kg/cm^2	1.6-3.5=	30-60	.05-.21	7.7
moldboard	.21-1/12kg/cm^2	2.4-5.0	30-80	.07-.40	4.3
disk	.21-1.00kg/cm^2	2.5-5.0	30-80	.08-.40	4.3
Disk harrow					
single action	.45-1.50kg/cm^2	1.6-4.2	65-85	.10-.36	4.4
Cultivating	6.00-20.0kg/shnk	1.6-4.0	60-85	.10-34	4.6
Grain Drill	6.00-22.0kg/row	1.6-5.0	60-75	.10-.38	4.2
Combining	2.0 -4.0kg/row	1.6-4.8	50-75	.08-.36	4.5

Source: APO Project SYP/III/67, Vol. 1 (1967).

Table 5 includes data for farm machinery applications, taking into account the wide range of values made necessary by such variables as soil, climate, power, and operator performance. Basic relationships relating to computing data such as included there are:

(1) $$dPs = \frac{\text{(draft, in kg) x (speed, in meters per sec.)}}{75}$$

where d = drawbar horsepower, and Ps = Pferdestarke
= 0.9859 hp

(2) $$\text{Ha per hr} = \frac{\text{(W, in m) x (S, in km per hr) x E}}{1000}$$

where W = rated width of machine action in meters
S = speed of travel of the operation
E = field efficiency in percent

The following formulas are helpful in estimating machinery annual costs.

(1) $$\text{Annual cost} = \frac{\text{Fixed Costs}}{\text{Annual Costs}}$$

(2) $$\text{Depreciation} = \frac{\text{First cost-Salvage value}}{\text{Years of Life}}$$

(3) $$\text{Interest} = \frac{\text{First cost+Salvage valuexRate of interest}}{2}$$

where Fixed costs include depreciation, interest, taxes, housing, and insurance. Variable costs include fuel, lubricants, repairs and maintenance. Taxes, insurance, and

housing charges may be known, but if not, they are often estimated at 4 percent annually. Repair costs are usually higher as the machine grows older. However, a uniform repair charge is usually levied each year. Fuel and lubricant charges can be estimated from experience or from information supplied with the machine. Fuel, oil and lubricants consumption of engines is obtainable, but they may be estimated on the basis of about 2.5 hp per liter of fuel (gasoline), and 3.0 or more hp per liter of diesel fuel.

The selection of the right implements for the job can mean the difference between success and failure. Implements should be tried out and tested before they are bought. For instance, a shallow disk plow may be preferable to a steel moldboard plow for soil that has low water retention qualities. Also, the disk plow is less susceptible to breakage. In the past, the extension of credit by the private dealers sometimes meant that the farmer chose equipment carelessly since he was not immediately asked to pay for it. Today the Iraqi government rents or sells all equipment to the farmer, and whether or not he receives credit, the farmer is limited in his choice of equipment available to him. He may have the choice as to what size or horsepower but he has little choice either as to whether it is English made or Swedish or any other make. The national policy as to what country these

machines are brought from always affects the suitability of the equipment available to the farmers.

Since the people do not fully understand and appreciate these machines, it is imperative that their use be supervised and directed by knowledgeable people. This is particularly true whenever new machines or equipment are introduced. Otherwise abuse of the machine takes place, breakage is common, and the early deterioration of the machine is inevitable. Farmers, tractor operators, and maintenance men should be fully instructed on the use and maintenance of the machine. The farmer should be told of the average life expectancy of the machines, so that he may intelligently calculate the benefits and expense of the machine. Many farmers think of the machine as a life-time companion, particularly since it costs so much, and do not think of the annual depreciation of the machine. The extension worker should play a big part in teaching farmers the economic and technical facts about their machines.

Ordinarily, an educated person will learn new facts faster than an uneducated one. Since most Iraq farmers are illiterate and uneducated the task of teaching these people new techniques or introducing them to new machines is a major undertaking. Educating the people is of highest priority in a program of mechanization; the reasons for this and specific means of accomplishing it will be discussed in a later chapter. For the present, it

is sufficient to refer to Theodore Schultz, who insists that governments invest in schools and education before they invest in factories and machines because unskilled labor cannot operate complex machines.

The introduction of farm machinery into a developing country such as Iraq requires a thorough study to determine the types and quality, of machinery needed, as well as a price range which is appropriate. In addition sutdies must be made to determine whether presently existing machines can survive the particular agricultural conditions in Iraq. Past experience has indicated that not all machinery is suited to the Iraqi soil and climate. Some of the machines that were imported from the temperate zone did not function adequately in the hot summer months of Iraq. They needed modifications, such as:

1. the addition of more blades to the air fan which cools the radiator;
2. reducing the water pump diameter so that the fan will turn at a faster rate thus drawing more air through the radiator for more effective cooling;
3. replacing the radiator with a larger unit.

This is only one example, but it illustrates the possible problems that result from operating machines produced in one country in another country of quite difference characteristics.

Obstacles to the Use of Engine Power

Mechanization is not an easy undertaking; there are many obstacles in its path. The following is a summary

of the major obstacles, which are treated in detail in various places in the thesis.

1. High initial cost of machinery and equipment, together with high costs of spare parts.
2. High depreciation rate.
3. High cost of repairs.
4. Inadequate maintenance system.
5. Lack of skilled labor.
6. Low per capita income among the farmers.
7. Inadequate transportation system.
8. Lack of research and extension facilities.
9. High illiteracy rate among farmers.
10. Shortage of credit facilities.
11. Inadequate food crop storage facilities.
12. Inadequate marketing system.

Another obstacle, one too subtle to express in a single short phrase, but just as important as those listed above, is ill-advised decisions which reflect a lack of understanding of the complexities of mechanization.

A Case Study

Since pumps are very important in irrigation, and irrigation is in turn essential to the agriculture and hence the economy of Iraq, a committee was formed at one time to study the various types of pumps available. In Iraq, as in many developing countries, local industries are beginning to produce a variety of products. For generations the pumps used in Iraq have been imported from abroad, particularly from England. The committee, which included several agricultural engineers (one of whom was the author) was asked to compare the pumps being newly produced by local industry with those which had previously been

imported, in order that the government might make recommendations concerning them.

Among the findings of the committee was that the local manufacturers were limited in their capacity to produce pumps, and could only manufacture a relatively small number each year. They also learned that these local manufacturers depended on scrap metal for their raw material.

However, an earlier committee had reported that the quality of the locally produced pumps exceeded that of the imported pumps (Rustens), and in particular had a higher discharge head. On the basis of that first report the Ministry of Agrarian Reform had been ordered to buy the machines from the local source. The local manufacturers were now seeking a further concession, the prohibition of any importing of pumps. During the preceding year the price of the locally produced pumps had nearly doubled, and still the manufacturers were unable to fill the needs of the department.

The committee asked the local manufacturers to what extent they could increase their output, and found that the companies (there were only two) had each less than $15,000 in capital and employed only a handful of workers. The committee concluded that these companies were not capable of supplying the needs of the entire country; their limitations in technical know-how, capital, and raw materials were too great. On the other hand, the manufacturers argued that if the government would eliminate the competition

from imported pumps, they could expand production and meet the demands of the agricultural industry. The committee concluded that the only feasible concession would be the imposition of a tariff of about 20 percent on imported pumps, thus giving the local manufacturers a possibility of making a profit on their product. They could not agree that cutting off of all imports was necessary; in fact, they felt that the great dependence of the country on pumps, especially during the intensely hot dry summers, would make this elimination of imports far too great a risk.

In other words the report of the original committee had been made hastily and without investigation in depth, and yet significant policy decisions had been based on it. If mechanization is to be a success, decisions must be carefully made and based on extensive research. Official decisions have far-reaching implications, and must be based on the best information and judgment available. The eventual success of mechanization may rest in large part on the selection of men for those committees who are knowledgable in their fields and willing to undertake all the research necessary.

The conclusion to be drawn from this case study is that a committee of men knowledgeable about agricultural machinery and aware of Iraq's needs be formed to secure an adequate and proper method for the selection of machinery and equipment based on the needs of the country.

CHAPTER VII

EDUCATION

Introduction

Although the value of education cannot be measured in purely financial terms, the economic results of a lack of education are undeniable. The tragic gap between the developed and the underdeveloped countries of the world is not so much due to a difference in natural resources as to a difference in educational levels. The greatest resource of any country is the ability of its people. Throughout his influential book Transforming Traditional Agriculture, Theodore Schultz insists that the capability of the farmers is the most important factor for explaining differences in agricultural production. More important than the distribution of seed, fertilizer--or machinery--isthe distribution of information. Post-war Europe recovered rapidly because of the knowledge and skills of the farm population; third-world countries lag, Schults insists, because their rural population is unskilled and uninformed. Simple

literacy is the farmer's mst important tool, because it is the key to self-education as well as to further formal education. More specialized knowledge, such as that of farm tools and machinery, opens the door to increased efficiency and higher productivity.

These emerging nations face severe problems in their efforts to improve education. Frequently demographic pressures are almost insurmountable; great efforts to educate more people are frustrated by even higher birth rates. In addition there are deep-seated traditional biases against the education of women. The worst problem facing Iraq, as this chapter will show, are: (1) an education system which has influenced young people to move to the cities; (2) an educational system which has concentrated on the social sciences and humanities, while neglecting the technical education which would be of most use on the land; (3) the emphasis on rote learning, and the resulting discouragement of a spirit of inquiry.

The Educational System in Iraq

Education in Iraq is recognized today as the most important factor in the country's economic development. Governments of the past and the present have given education a considerable amount of attention and support, because they realize that through education a nation can reach its highest social, economical, and political goals.

In the minds of the people, too, education plays an important role. There has always been a strong desire among the people of Iraq for education. Parents, whether they live in urban cities or in rural villages still strive hard to see that their children go to school. Although there is compulsory elementary education, the law hardly needs to be enforced. The attitude toward education in Iraq may spring from the desire for knowledge for its own sake; but deep in the hearts of these people education is viewed as an escape from a prison whose walls are poverty, disease, and ignorance. The farmer and the peasant believe that through education their children can enjoy a better life. The ultimate goal of these peasants is for their children to acquire a government post and live in the city rather than the poverty-ridden environment of the village.

Most government jobs are located in urban areas. Unfortunately, therefore, the school has been a contributing factor in encouraging migration to the cities, leaving the village and rural community with a shortage of educated people. It is obvious that rural schools should not only teach academic courses; they should also foster programs relevant to community life.

In addition the primary school should teach an elementary science course. It should be part of the elementary school curricula in order to prepare students for advanced science courses in the secondary school and ultimately in colleges and universities. Students would

then be better prepared to carry out the task of mechanization (in its broadest sense) and would be more familiar with scientific and technical phenomena. In advanced countries children are brought up in an environment where different scientific concepts and technical ideas become familiar to them at an early stage in life. The school in the underdeveloped countries therefore should see to it that this shortcoming is compensated for, by exposing pupils to more technical and scientific concepts. The school must be the most important factor in elevating the level of the environment in which the child lives.

In spite of all the efforts directed toward universal literacy in the country, many people still remain illiterate. However, a substantial and steady increase in the literacy level has been accomplished during the last twenty-five years. According to the census of 1947, the literacy level was 8 percent.[1] In 1957 the literacy rate went up to 15 percent.[2] According to the latest census of 1967,[3] a literacy level has been registered as 23 percent.

From the above it is evident that the literacy level has jumped at an accelerated rate, a further proof of the active campaign the government has waged to increase

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[1]Doris Adams, "Current Population Trends in Iraq," Middle East Journal, 10 (1956), 10pp.

[2]George Harris, Iraq (Harf Press, New Haven), 134p.

[3]Al Jamhuria, Newspaper, January, 1970, 5p.

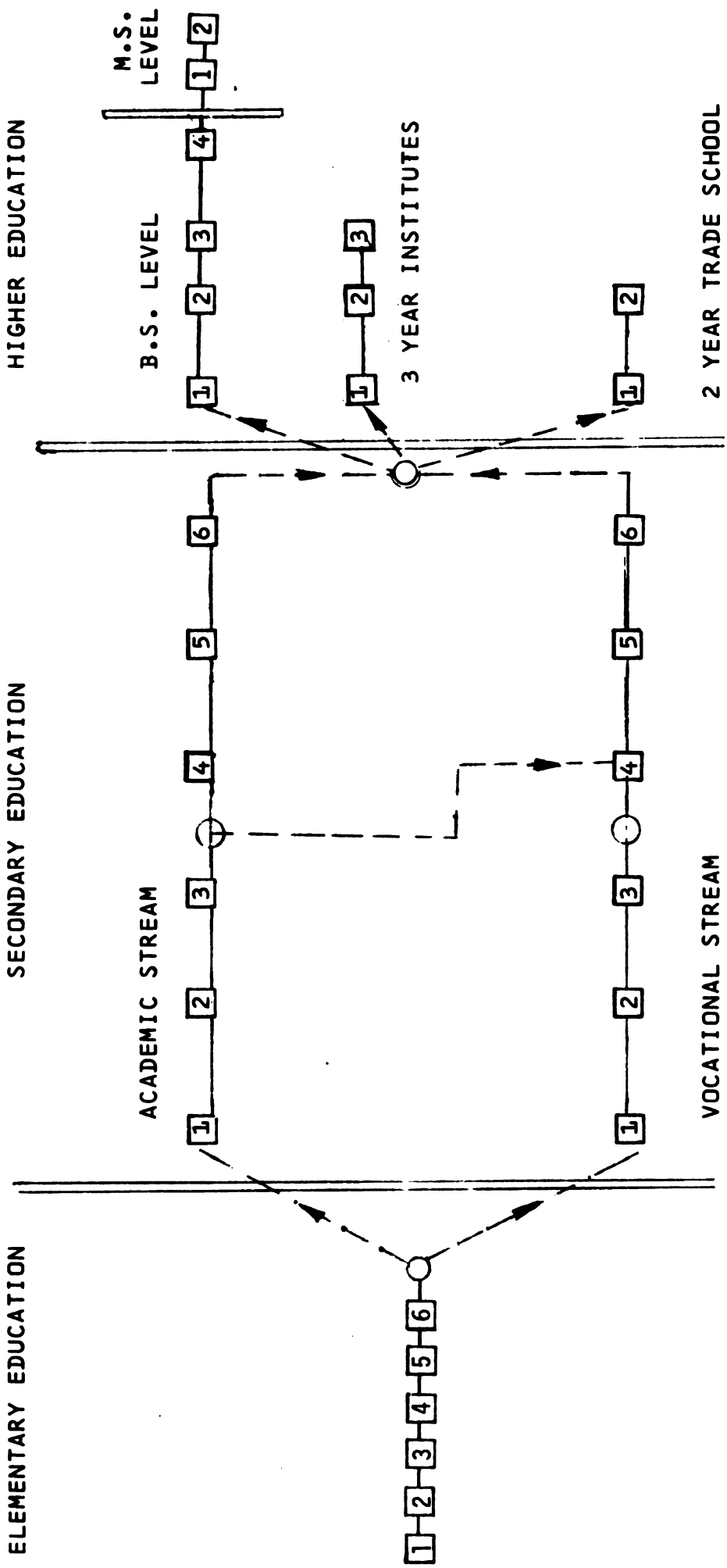

FIGURE 4.--Structure of Educational System.

literacy in the country. This accomplishment was obtained due to the sincere efforts on the part of many responsible persons in the government and outside it.

More people cannot receive higher education until more people receive elementary education. And, as was pointed out, simple literacy learned in grade school, is the foundation for all further learning, whether formal or informal.

Primary and Secondary Education

Public education is centralized under the Ministry of Education which is solely responsible for its organization; the Ministry designs curricula, sets examinations, appoints teachers, provides physical facilities, and so on. Education is free for both primary and secondary school pupils and is compulsory at the primary level. It is interesting to note that the latter provision is only enforced whenever and wherever the necessary facilities exist. To raise the literacy level the government has established night schools for adults.

School Attendance

Attendance at public school is quite often hindered by the lack of educational facilities and also by the extreme poverty of the peasants who make up the bulk of the population.

Poverty tends to limit school attendance beause of the attitude of families that children are economic assets;

the parents are very reluctant to dispose of the child's services readily. These people live off the land, and every pair of hands is of great importance. This is particularly true at harvest time, when it becomes a necessity for the children to stay at home and help. The parents, much as they may desire their children to have an education, are sometimes forced to keep their children home.

There may also be the feeling among the villagers that government schools are neither relevant nor suitable. This attitude, although it is dying slowly, is based on religious beliefs and the social norms of the village. Many people, especially among the older ones, look at the modern school as a threat to their traditional life. They believe it is introducing a set of values contrary to their own, and thus makes the children unfit for agricultural life. There is unfortunately some truth to this belief.

The element of truth is the nature and content of the school curriculum. The school curriculum, in the first place, was designed by members of the Ministry of Education, who themselves are city dwellers and urban-oriented in their attitudes; the curriculum is designed to meet the needs of urban life rather than those of rural and village life. Since the same curriculum is applied in both the city and the village, the village child is placed at a disadvantage, because the school will teach him and prepare him for a different life. Parents see very little relevance in what the child learns in school to what his actual needs

are as a villager. The result is that when the child becomes old enough he finds himself discontent with his life in the vallage, and no longer wishes to stay there and cultivate the land. Many youths leave their own village and migrate to the city, leaving the village to suffer from the shortage of educated manpower to raise food and other agricultural commodities. This of course has a marked effect on rural life and ultimately on the agricultural production, as it tends to shift a great number of people away from the rural sector into the city. In the cities this increase in population creates the many problems of urbanization. It is estimated that there are now close to two million people in the city of Baghdad alone, and this number represents about one fourth of the total population of the country.

The migration to the cities is due to the above-mentioned academic system as well as to the feudal system that existed before the adoption of the land reform program; the migration has preempted a large working agricultural force from the rural and farm areas to the city. The constantly decreasing supply of labor has made the need for the adoption of agricultural mechanization more urgent than ever before.

The school curriculum needs to be modified, especially for the rural people, and made more relevant to the life of the village. It should teach children love for agriculture and nature. It should sow in them the

desire and love for the land, and it should contribute to the stability and enhancement of rural life, rather than alienate the students from the village and make them unhappy with rural life.

The application of science and technology to the cultivation of land requires men not only knowledgeable in mathematics, physics, chemistry, botany, and so on; it also requires men of education who believe in their profession as agents of change. Above all it requires men who live nature and rural life.

Secondary Schools in Iraq

Let us examine the secondary school system and see if it is designed to facilitate faster growth and promote economic development. The emphasis here is to see if the schools are oriented toward scientific-technical education; if they are not, the problem is to discover why not.

Perhaps the most important stage in any educational system is the secondary school, as it assigns the individual a place in society. The secondary education of Iraq is as yet far from being adequate to the emerging needs of the country. As shown on the chart, the secondary educational system is divided into two streams, the academic stream and the vocational-technical stream. The academic stream has always been drowded with high enrollment, while the vocational technical stream did not receive much support from either students or government. Why has this happened?

One reason is that in the beginning there were only a very few secondary academic schools in the country, and only a very few individuals--mainly the elite--entered such schools. First of all, only the elite could afford it, secondly, they were confident that a high and rewarding position would be waiting for them in government civil service after graduating.

Later the government adopted a compulsory education law, and the number of students enrolled in these schools increased substantially and included both the elite and the masses. In 1967-68 the number of students enrolled in secondary schools was 254,000; this was an increase of 4 percent in a single year.[4] The masses of people, desiring to secure government posts, for the most part entered the academic track or stream, and ignored the technical and vocational stream. Besides leading to administrative white collar government jobs, the people recognized that the academic stream would also open further avenues of higher education for them. Until recently the academic stream terminated at the secondary level. A third factor in the people's choice of the academic stream has been the absence of genuine demand for technical and vocational graduates. The country has been underdeveloped, and has little industry and only primitive methods of cultivation.

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[4] Educational Development in 1967-1968, Report on Iraq International Conference on Public Education.

This problem became more acute when the government offices could no longer absorb the graduates of the academic stream. It would be ideal if the economic development and industrial growth of Iraq had progressed as fast as the needs of the government offices were met. In that case there would have been job opportunities with good pay and security to serve as incentives for students to enroll in secondary technical schools rather than crowding the academic schools.[5]

This phenomenon has continued for many years, until recently when the government launched a wide scale agricultural and industrial program aimed at improving the economic conditions in the country. The government found itself faced with a dilemma; that is, the shortage of skilled manpower to assume the burden of development. It may take three to five years to build a factory or construct a dam or to pave a highway; but it would take twelve to fifteen years to produce an engineer or a scientist or an administrator to man the different development projects in the country.

The 1970-74 Five Year Plan calls for the formation of ten district centers which would teach basic agricultural facts about crops, animal husbandry,

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[5]Afzal Manuchehr, "Problems of Secondary Education in Iran," Comparative Education Review (October, 1961), p. 86.

horticulture, soil science, and agricultural machinery. It is urged that these schools be set up in actual rural locations, where the sons of the farmers, or farmers themselves on special programs using the facilities of these schools.

It is hoped that these centers will be adequately financed, and will not fall heir to the same problems which beset the present vocational training facilities. At present the agricultural machinery workshops lack adequate maintenance; what equipment they have is sadly inadequate to teach the pupils the different phases of agricultural machinery. Most existing machinery needs to be repaired or replaced. In addition these presently existing facilities lack technical libraries. Most of these schools have few if any books, and what books they have are mostly in English. English is appropriate for college level instruction, but not for secondary schools, where very few of the students know the language. A real effort must be made to supply more books in Arabic.

Possibly the greatest need in the voational school system of Iraq is for trained supervisors and administrators, not only to improve the quality of the existing programs, but to develop further effective programs.

Higher Education

Although college education has been available in Iraq since before the First World War, the major institution

of higher learning, the University of Baghdad, was not opened until 1956. There are two other state universities, at Mosul and at Basra, and there are seven private colleges. A number of research institutions have been established at the University of Baghdad, including an Education Research Center, which studies the country's educational needs; the Planning Council for Education and Social Development; and the Council for Scientific Research. This last council is affiliated with the Institute of Applied Research on Natural Resources, at Abu-Ghraib. The council intends to set up, in the near future, an agricultural research center to study animal nutrition and breeding, management, dairy products, and production and marketing. The Council would also like to begin an agricultural research policy project, which would coordinate agricultural research from many different departments.

The University of Mosul is young, but includes among its six departments a faculty in agriculture. With the cooperation of UNESCO, the University is looking for technical assistance in the form of experts and in the form of money for scholarships in various scientific fields.

The University of Basra is growing rapidly; at present it has only four faculties; law, engineering, education, arts and sciences. The government, in its five-year plan, granted this University nearly ten million

dinars which was to be used for buildings, laboratories, and maintenance.

There are a number of fairly obvious improvements which are needed by the nation's colleges. Perhaps the most important is that students should be allowed to attend the college of their choice. At present the system effectively limits their freedom of choice. Students are assigned professional colleges according to their scores on a government examination. The result of this is that certain colleges are discriminated against, and in particular the agricultural colleges suffer. These colleges receive ordinarily the applicants with the lower scores; the college thus suffers a lack of status, as well as an inevitable inferiority in academic achievement.

While admission to colleges should be freer and more open than is presently the case, it would be advisable for the agricultural colleges to encourage applicants from rural backgrounds. At present most of their students come from the city, and, as mentioned above, most of them are students who were not accepted by other colleges and come to the agricultural institutions as the only way remaining for them to get an education.

There are a number of foreign experts teaching at educational institutions in Iraq. Some teach at the secondary level but most of them teach in universities. These teachers should, if at all possible, receive three year appointments rather than the more usual one or two

year terms. Under the present arrangement, teachers leave after just becoming acquainted with the Iraqi system and culture. In addition, the foreign teacher should be helped to find housing and other conveniences when he first arrives; this would help shorten the period of adjustment, as well as making teaching positions in Iraq more attractive to foreign experts. Most importantly, the foreign experts should be used to set up institutions of learning, not merely to teach at already existing colleges.

Summary

A sound educational system is vital to the success of any mechanization program. Unskilled farmers cannot operate complex machines. Illiterate farmers can only with great difficulty be instructed in the efficient use of agricultural improvements. A literate population has the one most powerful key for self-advancement. Iraq has made substantial gains in this area. However, Iraq's grade schools are inadequate in physical and financial terms. At present, their educational policies alienate the villagers and damage the future of the village by influencing their children to leave the land. It is imperative that rural-oriented curricula be devised; that the schools cease being instruments of the cities and become tools of the people they serve.

A similar problem exists in the secondary schools, which have not encouraged technical education.

facilities for vocational education must be improved; but most importantly, attitudes must change. Prestige must be attached to the learning of skills; and jobs must be found for graduates. The district agricultural schools which are planned are an excellent idea, and must be set up in the country, where they can reach the people most in need of their programs.

Finally, there is a similar problem in college. The agricultural college must receive the prestige it deserves. Not only should its facilities be improved, but the caliber of its students must improve. This can be partially achieved through open admissions, and partially through encouraging applicants actually from rural backgrounds. The skills of foreign experts must be used more efficiently. This can be accomplished through longer term appointments, more attractive working conditions, and the use of their skills in establishing centers of learning as well as in manning those which already exist.

CHAPTER VIII

EXTENSION AND RESEARCH

One of the most important aspects of successful agricultural planning is the role of the extension service which can upgrade agricultural production techniques and enhance the life of the farmers and the farming communities.

Nature of the Extension Service

An extension program is an out-of-school system of education in which adults and young people learn by doing. It is a partnership between the government and the people which provides the latter with many services, the most important of which is the dissemination of knowledge. The intention is that rural people become more capable of taking care of their problems in effective fashion.

The extension service in Iraq is not a new phenomenon. Responsible people in the past have recognized the need for educating the farmers in an effort to make them aware and able to apply the modern techniques of farming. (These include the use of improved seed varieties,

proper irrigation methods, the use of fertilizer and insecticides, proper use of tools and many other useful practices and innovations.) The government has created the Department of Cooperative Extension as an integral part of the Ministry of Agriculture. The fundamental objective of this department is the development of the rural people, namely the farmers (fellaheen).

The service which the department extends to these rural people has not accomplished this objective. There were many reasons for this failure. Perhaps the main one was the lack of competent personnel in the extension service. The educational background of most of the extension workers is high school. In addition many of them do not have any farming background, as a majority of them are city dwellers who have not had real contact with farming communities.

Limiting recruitment to graduates of the vocational agricultural school and the agricultural college would have been the ideal course of action, but regrettably that was not done. One reason for this failure was the lack of awareness on the part of some recruiting officials as to the relevance of the extension workers' knowledge and his capacity to disseminate this knowledge. Another reason is the pressure that is often exerted on the recruiting officials to appoint friends or friends of friends to positions for which they are not fully qualified. This has been common practice but it is gradually dying out; indications

are appearing that qualifications in terms of the common good are becoming the decisive factor in recruiting and appointing.

Another reason for the lack of success of the extension program is the lack of educational facilities such as printed materials, audiovisual aids, and means of transportation. These shortages have made the program less effective than was intended. Also, the philosophy of extension workers themselves. It is a new idea to the farmers and to the government workers as well that the government should be substantially helping the people.

In theory extension work extends agricultural information to the farmers, but in reality very little of this has been accomplished. Extension workers are for the most part stationed in the Ministry of Agriculture in Baghdad and are very seldom found even visiting the farming communities. Lack of funds, of transportation, and other factors keep them within the cities. Should the extension worker make the trip, it would usually be to the more prosperous farmers, where the host would demonstrate his high status by great ceremonial welcomes.

To remedy this situation there must be a new type of extension worker, one who is knowledgeable in science and technology, as well as in the sociology of the people with whom he must deal. The entire framework of extension must be overhauled.

At the present time farmers can either rent a machine from the government renting stations[1] individually or cooperatively, or he can buy his own. In any case, there is certainly an urgent need for extension services directed toward mechanization. This aspect is not fully recognized and often forgotten. The extension service directed toward mechanization should be encouraged and promoted. Neglect of this phase is costing the farmers a great sum of money because of their lack of understanding of the operating and maintaining of these machines.

In any plan to change subsistence agriculture into a cash industry, investment in machinery may represent the highest input in terms of capital goods. Therefore, the farmer should be able to select, operate and maintain his machinery otherwise failure would be inevitable. The role of the extension service in fostering this kind of educational program cannot be overemphasized.

It is rather beyond the scope of this paper to go into detail on every facet of a mechanization program which demands the presence of the extension worker. The newly emerging societies that are embarking on mechanization as a potential instrument for their development find it very difficult to assimilate all of the new technological innovations that the field of agricultural mechanization entails, without receiving systematic help in upgrading their educational capacity. The mere introduction of a

[1]Usually supplied with operator.

tractor to a traditional farming system, for example, may require on the part of the farmer a basic knowledge of how the tractor operates. To cite a technical example, the operator should understand in his effort to mechanize his farm that driving a tractor with little or no oil in the crankcase will ruin the engine in a very short time. Also the concept of depreciation of farm machinery and implements should be fully understood.

Recognizing a profit from the use of machinery in the first year is not an indication of the complete economic implications of mechanization. The farmer in the first year of using his machine has little or no repair bills; but as the machine gets older it may require more money for repair and maintenance. In addition the farmer often overlooks the necessity for saving against depreciation. A well-organized extension system will not only teach the farmer the many skills and knowledge, but will save him a great deal of money. It will also enhance the occupation of farming and promote desirable changes through the establishment of favorable attitudes toward machines and mechanization.

Another point at which the extension service can be of real help to the farmer is instruction in the potential danger of not being able to understand the man-machine relationship. If the machine is not properly understood, its function may cause severe accidents and even death. Risk can be minimized with the help of the

extension worker, who will show the farmer the proper use, maintenance, and operation of the machine.

The foregoing discussion mentions some of the technical, economical, and health problems that the farmer and his family may face from the introduction of machinery in to agricultural cultivation. The role of the extension service will not only be to help overcome barriers to change the technological gap, but also to instill understanding of the economic aspects of agricultural machinery operation and ownership.

The use of agricultural machinery requires a large initial investment; then it requires the development of technical skills and knowledge on the part of the farmer before they can be used at a profitable margin. As indicated, the role of the extension service in promoting agricultural mechanization cannot be overemphasized. The extension workers should accomplish most of these objectives: (the following is a modification of the excellent list given by B. P. Pothecary):

1. Basic instruction for tractor owners, including simple machinery management, cost, and the necessity for preventive maintenance;
2. Basic instruction, including equipment setting for tractor drivers/ machinery operators;
3. As above but for driver-mechanics (in remote areas);
4. The printing and distribution of literature in local languages;
5. The establishment of demonstration/training farms on which new techniques could first be evaluated and then demonstrated;

6. The establishment of formal training facilities for instructors and supervisors;
7. A two-way service for operational research units and machinery manufacturers or importers concerning machinery performance;
8. Liaison with machinery suppliers or government-operated workshops over service and spare parts supplied;
9. Safety instruction. Man/machine interaction is a new phenomenon to the fellahin;
10. Special efforts should be made to help the bedouin to improve their livestock;
11. Veterinary services are badly needed in many places; this is particularly true for the large flocks of sheep, which suffer from pests and diseases which could easily be controlled by modern measures.

Certain comments should be made about the instructional methods employed. For one thing, there should be much opportunity for demonstration and personal contact allowing individual instruction. This is for two reasons: first, many of the fellahin cannot read or write. Secondly, through the centuries these people have developed a conviction of their inferiority; thus personal attention from an agent of the government may help improve their self-concept and give them the confidence to tackle complex tasks.

Another point which should be made is that even the printed material which is used should contain many illustrations. And finally much instructional use can be made of radio and television. It is a common saying in Iraq that the fellah has always a transitor radio in his hand or his pocket; and when the day's work is over, many of them gather in coffeehouses to relax, where there is usually a television set.

> Through the instrumentality of radio and television, a transmitter room of a university radio or television station can become a classroom for literally millions of people who receive the teaching of a master teacher wherever a radio or television set is available. This actually has been demonstrated in Colombia and in many other countries of Latin America. The Colombia transmitter alone has educated over two million people scattered among the small mountainous countries where other educational opportunities have been lacking.[2]

Some Desirable Personal Characteristics

Recognizing the role of the extension service in agricultural mechanization, in fostering change, and in the education of the farmers, one would next ask what kind of person this agent of change should be. What kind of qualifications should he have to qualify him for this important task? What the extension worker must be and do depends on what he is. There are many important desirable qualities which it is necessary for the extension worker to possess. Here are some of these qualities. The order of listing does not reflect an order of importance.

1. He should be in good health, emotionally stable, and free from any serious disease; tactful and friendly.
2. He must be a man of good character with high moral standards; a man of integrity.
3. He must love people and possess the desire to help.
4. He should be old enough so that people can trust his judgment and yet young enough to be able to learn new things.

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[2]Lincoln David Kelsey and Cannon Chiles Hearne, Cooperative Extension Work (Ithaca, N. Y.: Comstock Publishing Associates, 1963).

5. He should have some appreciation for rural life and love for agricultural work. This is important as too often the college of agriculture graduates are appointed to this kind of position without any real desire on their part for work of this nature.
6. He should be able to work with others, and capable of displaying sound judgment in decision making.
7. He should have the ability to express himself with some administrative capacity.
8. He should have effective teaching ability.
9. He should be competent in the field of agriculture and agricultural mechanization, with some farm background.
10. He should have broad basic scientific and technological training as related to agriculture.

If these characteristics are to be required in the extension worker, it is necessary to pay an appropriate salary. Aside from the satisfaction which his work affords him, the extension worker deserves and will expect a reasonable monetary return. The situation in this regard is not encouraging. Little incentive is given for good work when the average salary is $120 per month; this is too little to be given when so much is asked from the employee. It is strongly urged that extension workers receive professional status and professional wages.

In summary, if it is true, as Schultz maintains, that the most important investment in the development of the emerging nations is investment in improving the capabilities of the farmers, a fundamental means of accomplishing this important goal is the improvement of the extension service. These pages have listed specific objectives of extension work, reasons for its past failure, and recommendations for its improvement. Perhaps the most

effective means of improvement is the careful selection and adequate remuneration of the staff of the extension service. Agricultural mechanization cannot be accomplished without a greatly improved extension service.

Role of Research

The future of the world, for better or worse, depends largely on how men utilize the resources available to them. Proper use of these resources depends on a thorough understanding of them.

Of all the problems facing an emerging nation, these three are paramount: first, the need to develop further knowledge through basic and applied research, second, the need to disseminate that knowledge to those who can make best use of it, and third, the need to apply this knowledge effectively through cooperation. We are concerned here with the development of a system of research such that the knowledge produced by it will have some guarantee of success when it is put into use. Iraq is a developing country and assuredly it will not develop far without high priorities being put on research. Population pressure is not yet a problem, although it may be soon. The deterioration of the soil due to increased salinity, social and sociological obstacles and other problems are becoming urgent. Each day's delay in solving these problems finds them more acute and more difficult to solve. Research holds the key to the solution to these problems.

Lack of research into the workability of a new technique may lead to disaster; its feasibility in the new environment must be studied.

> In the U.S. which owes its high standard of living to technology, research has become an inseparable part of the economy. Recently Raymond Ewell of the National Science Foundation tried to answer the question, 'How much does society get back in dollars and cents for investments in research?' His astonishing answer: A hundred to 200 % a year, over the last 25 years. In other words, society has got back $2500 to $5000 for every hundred dollars spent on research and development.[3]

One of the obstacles to developing an agricultural mechanization research program can be lack of trained personnel to carry out the task of research and investigation. Other obstacles include the lack of physical facilities and of an environment conducive to research.

Research Conditions Today

The following is a brief account of the research conditons existing today in Iraq. The research program is still in its infancy. In fact, the first research institutions in the country did not start until the early 1960's. There is a research institute which is an integral part of the University of Baghdad; the University is itself a recent development having been founded in 1956. Before that time there were only small and scattered institutions devoted solely to the education of undergraduates. No research was produced except on a very small and individual basis. It is interesting to note

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[3] The Mighty Force of Research, Editors of Fortune (New York: McGraw Hill, 1956), p. vi.

that no graduate studies existed in the country until about 1960, when a few colleges began instructional programs at the Masters' level. These were confined to the social sciences and did not include agriculture or engineering. However, since the early 1960's a great deal of progress has been accomplished. More schools and more facilities were made available for research and investigation. Significant in this respect was the creation of the Institute for Tropical Studies which shared the experimental stations of the College of Agriculture in the University of Baghdad. The College of Agriculture, in turn, had already started to give instruction at the Master's level. The college had expanded its research facilities to include a large range of problems. Recent developments have included research programs in veterinary science, soil science, and in another college, chemistry.

A closer look at the research programs indicates that all these efforts are far from being effective; there are numerous obstacles to the relevance and effectiveness of the research. Researchers are bogged down by excessive centralization in decision-making. When it comes to spending money, for example, the professor or the researcher has to go through many channels and obtain many signatures in order to fund his work. Often a research project is delayed or never reaches fruition because of lack of money or delay in receiving

money. The professor must be entrusted with sufficient funds to use according to his own awareness of his needs. Another obstacle is that the research professor often has little time to devote to his projects because he has been assigned too many classroom hours. The researcher should not be asked to teach classes beyond his normal load. Professors presently teach extra hours because of a shortage of faculty members, and although they are fairly paid for the excessive hours, the fact remains that this time is taken from their research.

Priorities in research should be established, with emphasis on adaptive research rather than on pure research. A researcher should be encouraged to publish the results of his research in a local Iraq publication rather than in a prestigious foreign journal. The researcher faces the temptation of choosing a research project, not according to its usefulness, but according to the recognition which could result from conducting it. In a sense the research itself becomes an end, rather than a means to an end.

Philosophy of Research

A spirit of research should be developed among the faculty. It is the impression of this author that the faculty of the University of Baghdad does far less research than is usual in an institution of its size. There could be many reasons for this lack, but possibly one is the attitudes which are learned in the elementary

schools. At this level the children are made to learn facts and recite them for examinations; a spirit of inquiry is not developed.

The government of Iraq each year sends a substantial number of graduate students and faculty members to different institutions throughout the world. These students should be encouraged to engage in research projects relative to the problems of Iraq. As Theodore Schultz points out, in 1959-60 there were 50,000 foreign students studying in the United States but only 1600 of these (3%) were studying agriculture. Of those studying agriculture, too few were studying problems relevant to their native country; most were studying problems of the country in which they were studying.

The author knows of at least one striking instance of this problem. An Iraqi studying in London was asked if his research project was applicable to Iraq; he replied that his research results couldn't be used in Iraq in at least twenty years. In addition, there's a good possibility that after twenty years the research will no longer be valid, and so this particular project would never be of any use to the student's native country. One possible solution to the problem would be the government's assigning topics to students before they go abroad, or offering them a choice of topics from those which are most pressing in the country.

Research in Farm Technology

It is estimated that a 4 to 5 percent annual increase in food production is needed to meet the demand of a growing population. The population of Iraq is growing at the rate of 3.3 percent. It is evident that even maintaining the present inadequate standard of nutrition demands an increase in production of over 3 percent each year; and to make progress against the prevalent malnutrition, the increase must be higher. Only a few countries in the world, however, have been able to achieve and sustain this rate of growth. What is really needed today to reach that goal is a full application of the known technology of farming. The transfer of technology from one nation to another has hidden difficulties; a long history of failures attest to the difficulty of the task.

> Time and again crop varieties, cultural practices, credit schemes, and organizational patterns have failed to produce the expected result when introduced into a new environment.[1]

A typical case is the attempt to introduce fertilizers to an area of India. Crop yield did not increase as they did in the United States. Studies eventually revealed possible reason; that the type of cultivation practiced in India is designed to conserve monsoon water, and accidently inhibited root growth.

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[4]Max F. Millikan and David Hopgood, No Easy Harvest (Boston: Little, Brown & Little, 1967), p. 68.

This in turn meant fertilizer must be placed differently in India than in the U. S. It may well be that the effective use of fertilizer will demand a new technique of handling the soil and even then the increase in yield may be limited. Another mistake in our attempts to transfer technology arises from our tendency to measure improvements in relative amounts; an improvement of 15 percent on an Iowa farm may be sizeable, amounting to hundreds of bushels a year. But the same 15 percent on a small subsistence-level farm may mean one extra bushel a year--not enough to justify the risks and effort involved. In fact, the possible improvements from the application of all presently existing technology is limited. "Almost everywhere it seems, yield based on such adaptations will reach a ceiling in the relatively near future.[5] The only answer to this dilemma is extensive basic research, and this takes years; the process must begin now if results are to be available when the potential applications of present knowledge have been exhausted. Under-developed countries should begin now to commit larger sums of money and trained manpower to this all-important task. This research is not prohibitively expensive, especially when its cost is compared to that of a steel mill or a major highway. "Though it is costly in manpower and many efforts will produce small returns, and useful results will be coming, a basic research program is a necessary investment

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[5] Ibid., p. 68.

in the future of agricultural nations."[6] According to Schultz, basic research cannot be profitable for private firms because the profit from new ideas diffuses rapidly and cannot really be captured. In addition, research cannot function without a fairly large investment in salary and equipment. This precludes there being many private firms able to invest enough to conduct research.

Unity of Research

Research should if possible be based on detailed knowledge about the country; about its soil, climate, people, economy--all of the factors influencing the acceptability and profitability of innovation--as well as of the institutions serving agriculture. Knowledge of these things is not automatically available to the government and some of it must be learned by intensive surveys of the area.

Agricultural mechanization is not an isolated study; it is necessarily related to the study of all these other factors. Mechanization is merely a link in a chain, and the chain is no stronger than its weakest link. Research confined only to mechanization will not take notice of the other essential factors which must be present if mechanization is to be effective. Mechanization is the study of the physical input into an agricultural system, and is by itself a relatively clearcut

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[6] Ibid.

science. However, the science of the study of social grounds for the effectiveness of mechanization is not highly developed. There is need here for intensive research.

To illustrate the interdependence of all agricultural factors, let us imagine that a combine was developed which substantially reduced the amount of wheat damaged during harvest. It is quite possible that the increase in yield here could be offset by the presence of a wheat blight, and so the introduction of mechanization would have been to no avail. Mechanization, to repeat, cannot be studied in isolation.

To mechanize a country we must first divide the country into several regions--each with a set of its own circumstances and conditions. What is needed in types of machinery for the northern mountain part of Iraq may be different from what is needed in the central flat region; there are still different needs in the southern marsh areas of the country. First a comprehensive study must be taken to determine the exact need for machinery in the region, in regard to soil, topography, climate, irrigation, cropping pattern, availability of labor, and so on. Secondly, decisions must be made as to the best way of satisfying this need.

Even today agricultural research does not receive enough attention in Iraq. The University of Baghdad recently closed its Department of Agricultural Machinery

because of a lack of faculty. This lack of faculty was felt in other fields, but in agricultural machinery it was acute. Dr. Chet Mackson (Professor of Agricultural Engineering at Michigan State University) observed after a tour of the Middle East (in 1968) that job opportunities for agricultural engineers in the private sector were excellent in the Middle East, and especially so in Iraq. We mentioned the closing of the Department at the University of Baghdad as a prime example of this.

In the meantime a multi-million dollar factory is being erected in Eskandria, 60 miles southwest of Baghdad. This factory is to produce agricultural machinery, implements, and equipment. One wonders if there are not enough experts to instruct a handful of students in the use of agricultural machinery and who will teach the agricultural workers of the country to use these new supplies? Who will oversee their construction? It is true that the agricultural machinery is important and badly needed; a large sum of money is spent abroad each year for this reason, and this does not help Iraq's balance of payments. Ideally the country should of course produce its own machinery so that it need not depend on a foreign source for such an important item. The question remains, is it really cheaper to produce these machines locally? The country must import not only the raw material for the machinery, but also know-how in the form of foreign nationals. Not only that, but the very machines

used for constructing the factory must be imported. The planner must have an excellent plan indeed, if he expects to outweigh all these disadvantages and still make his factory profitable.

It should be remembered that the cost of mechanization should eventually be met by the gains in increased production. Otherwise it is not economical; and mechanization should be considered as a means to an end rather than an end in itself. If locally manufactured machines cost more in the long run than imported machines, it would be better simply to buy the imported goods. The benefit accrued from expanding industry in terms of increased employment, greater accessibility and so on, must be weighed against the disadvantages which result.

Research in depth must examine these questions. It should precede any sizeable investment, to insure the feasibility and profitability of the plan. The author can illustrate this point with an instance from his own experience. Recognizing the need for practical experience, he sent his graduating seniors to various factories to observe their overall production plan. One student reported back that a certain factory which was apparently making a small profit was in actuality losing nearly $1000 a day, because the management had forgotten to calculate the depreciation of their machines. The factory would have to replace these after ten years, and the initial investment was huge but it had been made by the

government. It is sometimes forgotten that money spent by the government is real money, and must be included in studies of profitability. The point of this is of course that a realistic appraisal of all economic factors should be made before such factories are built. If plants producing agricultural machinery follow this kind of precedent the results will be equally bad. These, too, would begin with government investments, which however, must be accounted for in assessments of profitability.

At present Iraqi research institutions are understaffed, underequipped, and underfinanced. The Institute of Tropical Agriculture has only a handful on its staff and only a few researchers. The periodic shifting of personnel and responsibilities has its own effect on the progress of the institute. In spite of its short life, however, it has made significant progress. With the cooperation of the Agricultural Experimental Station of the College of Agriculture, and other institutions, as far as agricultural mechanization is concerned, however, little has been done. There is no research institution in this field.

Government assistance is indispensable to research; Schultz, in fact, believes research must be socialized. Basic research cannot be profitable for private firms because the profit from new ideas diffuses rapidly and cannot really be captured. In addition research cannot function without a fairly large team of workers and a

large amount of equipment. This precludes there being many private firms able to invest enough in research, and so there would not be much competition.

He feels, too, that non-profit agencies must often pave the way for introducing new factors such as fertilizer and feed. Private firms often find the cost of entry to new markets prohibitive. (Cost of entry includes advertising, education to the right use of theproduct, and distribution.)

Specific Suggestions for Research

Animal-powered implements are given no serious consideration in academic circles. Draft animals, nevertheless, can be efficient and useful, and the change of agriculture from hand-powered tools to animal-powered implement is a significant step in agriculture. Research in this area would be valuable. Another important area of research would be breeding draft animals, in an effort to develop sturdier and more efficient stock. The proposed Institute of Agriculture, mentioned in the previous chapter, could fruitfully consider these and other projects.

The government hire and rental service rents plows and other machinery. The cost of these machines, overhead, labor, service, cost of administration and wages of operators, are all met by the government. Studies should be conducted into the actual cost of these plows to the people--the cost to the country rather than to the individual renter--to determine if this is the most economical

way of making the equipment available. Significant in this respect is the fact that the government auctions off the old machines. Agents who buy the machines fix them up and then privately rent them to farmers. These private buyers are talented in re-shaping machines and making them usable. It has been said that these private agencies can rent the equipment at a cheaper rate than the government can charge. Research should be done into the efficiency of the private and public rental services; if the private sector is more efficient, the job should be done by them.

The great potential of the private sector should be considered at every stage of mechanization. Another point for study is the fact that these equipments are imported ordinarily from Britain, Russia, and the U. S. There is considerable confusion about obtaining the right spare parts for all the different makes of equipment available. It is not uncommon to see practically new tractors standing unused in the stations for lack of some small part.

Finally a research center should be established to study the entire mechanization of the country, from hand-power implements through engine-powered. A testing center should be established where recommendations can be given about types of equipment to be imported which will be compatible with the Iraqi environment. This Institute should coordinate the work of other research institutions. Results of this research should be made

available to the extension worker who could most effectively disseminate this knowledge.

Research must also be done into the sociology of the people, since traditional value systems may have much to do with the success of mechanization programs. Theodore Schultz argues that the resistance to change which we tend to explain sociologically can actually be explained economically. This argument too needs careful research.

The main goal of research should be to increase output and to improve the living conditions of the farmer. Additional areas which urgently need study are: the development of an adequate rotation system to improve soil and crop production, efforts to extend the area under cultivation, improving the timeliness of agricultural operations, the improvement and distribution of water, especially during the summer months, so that all fields have adequate irrigation, and developing new crop strains which are more salt resistent, to cope with the salinity problem common in Iraq.

Finally, these important needs of coordination and proper channeling of funds can best be accomplished by the establishment of a national committee. Actual research should be done in those already existing research facilities. The main function of this committee would be to direct research and provide financial support.

Beyond this national committee, it would be helpful to establish a regional Agricultural Mechanization research center, most likely an extension of some already existing facility. The purpose of this center would be to direct research among the various nations of the Middle East, eliminating duplication of effort, and providing channels for sharing results. Foreign aid could well be channeled through such a regional center, which would provide them to the countries involved as matching funds. The center would both conduct and direct research, and in particular would initiate projects on important but neglected phases of agricultural planning.

Conclusion

This chapter supplements the preceding chapter on education; research, formal education, and extension together comprise a system which both creates and disseminates knowledge. Iraq had made beginnings in all three areas, but faces serious problems also in each respect. The extension worker needs to be better chosen and better trained; he must learn to spend much more time actually in the field, and must learn how to communicate his knowledge effectively to the farmers.

The researcher also needs more time and more money. At present these are limited by over-centralization and by heavy teaching loads, respectively. A spirit of inquiry should be included in the grade

schools, and more professional research should be done in college. Iraqi journals should be strengthened.

The government should encourage those students who study abroad to work in fields directly relative to Iraq's problems.

Finally, this chapter listed a number of specific topics which need research. These topics involve machines, production, livestock, imports, and distribution services.

It must never be forgotten that just as education, extension, and research complement one another, so many various fields of research complement one another. Communication along these disciplines and coordinations of their efforts is an important part of any development plan, and especially vital to agricultural mechanization programs.

CHAPTER IX

SUMMARY AND RECOMMENDATIONS

Iraq was once part of the "bread basket" of the Mediterranean world; no longer does it enjoy that enviable position, for today it must import much of its food. Each year the gap between what the country produces and what it consumes becomes larger. As the nation realizes the gravity of this problem, it is at long last giving real emphasis to the improvement of its agriculture. These attempts at reform have led to the recognition that the country knows too little about itself--about its economy and about its communities. Iraq has serious need of research which is both imaginatively constructed and practically oriented.

This thesis has been an attempt in this direction. It has pointed out the basic importance of agriculture to the Iraqi economy, and the indispensibility of mechanization--at its various stages--to agriculture. It has pointed out the problems which hinder attempts to make agriculture, through improved mechanization, more efficient and profitable. Specific steps have been recommended to solve these problems, and more general suggestions made about the direction agricultural mechanization should take in the country.

It is the hope of the author that his native country, so rich in potential but suffering today from so many ills, will gain from the work done here.

As indicated, this thesis is necessarily limited, and can cover only some of the more important factors upon which the success and failure of Iraq's mechanization program depends. At the very least it will serve to provide guidelines for further research by pointing out the major problems and by calling attention to areas where little work has been done.

Recommendations for Improving Date Production

Since dates are one of Iraq's most important crops, and since the industry today faces major problems of labor shortages and primitive technology, the following recommendations are made. They are an attempt to upgrade this vital source of revenue through mechanization.

Adoption of the Harvester Loadstar

The high cost of labor is becoming prohibitive, and there is especially a shortage of men willing to climb the tall date palm in order to carry out vital cultural practices. To solve this problem there is available the Harvester Loadstar, which will make reaching the crown of the tree easier, safer, more efficient (seven times as efficient) and less costly. It is recommended that the owners of the large date gardens

should purchase these machines; smaller gardens should use the machines on a cooperative basis, or the public sector should make them available through the hire-and-rental services. These machines could be imported, or, they could be manufactured locally. The best location for local manufacture would be the agricultural machinery factory at Alexandria.

Use of Chisel and Sledgehammer

Present methods of removing offshoots through the use of the sickle and shovel are time-consuming and often damage valuable tools. For these reasons farmers often neglect this important cultural practice. The offshoots compete for nutrients with the parent tree and if removed can be used for transplanting. Since the procedure requires so much effort, it is recommended that the chisel and sledgehammer method outlined in detail in the earlier chapter be adopted. The chisel too can be manufactured locally. The important thing is to make the blade of a high grade of steel such as SAE 1090, or its equivalent.

Use of Auger Bit

The transplanting of the offshoots in a new grove requires the digging of holes. When this is done on a large scale it would be beneficial to the farmer to use a tractor with an auger bit. If he does not own a tractor, it would still be cheaper to rent a tractor with an auger bit rather than

doing all the digging with manual labor. These bits are presently imported; studies would be advisable concerning the advisability of manufacturing them locally.

Use of Mechanical Hand Sprayer for Pollination

The present method of pollination is primitive and inefficient; many flowers are not pollinated and the result is a decrease in yield. The adoption of a mechanical hand sprayer for applying the pollen to flower clusters would ensure a better distribution of pollen and so a larger yield. Hand sprayers are presently available in Iraq; some are imported, some are local products. These sprayers are not at present used for pollination, however, and such an innovation promises to be worthwhile.

Fruit Thinning and the Covering of Dates

Improvement of date quality through thinning is a desirable practice which has never been adopted in Iraq, the same is true of covering the fruit with plastic or moisture-proof cloth to protect them from rain damage in the case of delayed harvest. Although no studies have been conducted on the improved quality of yield when thinning and covering are practiced, there is no doubt that the practice is beneficial. However it is also true that thinning requires an extra trip to the crown of the tree, and so increases labor or machinery costs. Both these factors must be taken into consideration. Research should be done to determine cost-benefit relationship, especially in commercial date plantations.

The problem here is that the present national policy of a uniform price for dates regardless of quality gives growers little incentive for improving quality. It is recommended that a system of prices be established which would make better quality dates more profitable to the grower.

Transplanting Mature Date Palms

Date palms take about 15 years to mature and bear fruit; many of the mature trees are being destroyed today as cities expand. It has been proved physically and economically feasible to transplant these trees to a new location and thus save their productive capacity. Trees are also being lost to increasingly saline soils. It is cheaper to transplant these trees than to install adequate drainage systems. It is recommended that trees be transplanted whenever necessary and possible. It is further recommended that cities and towns consider passing ordinances requiring that any palm trees displaced by building be transplanted rather than destroyed.

Use of Pits as Animal Fodder

At the present time date pits are either discarded or burned. Research indicates that these pits contain many nutrients and a high level of protein; when mixed with barley or similar material they make good animal fodder. Studies should be made comparing the cost of crushing these extremely hard pits with their market value as feed.

Improvement of Access Roads to the Date Gardens

Most roads giving access to date gardens are narrow and unpaved; ditches are crossed by foot bridges made of palm branches, which trucks and tractors cannot pass. These roads should be widened and the bridges both widened and strengthened, so that tractors and equipment such as the recommended Harvest Loadstar can reach the gardens. Those roads which are within the gardens should be improved by the owners; others are the responsibility of the public sector.

Recommendations Concerning Improvement of Hand and Animal Tools and Implements

Farmers use tools for every activity they perform. Providing good quality hand tools is of great importance in improving the farmers' efficiency. Almost all hand tools are manufactured locally.

Local manufacturers are not highly skilled and usually use scrap metal. The tools dull easily and wear out quickly. Blacksmiths should be taught how to temper metal, and provided with a better grade of raw materials; carpenters also need instruction in better methods of production. Ideally the proposed district centers for instruction in agricultural machinery would provide night classes at which these craftsmen could advance in their trades. In this way the facilities would be more fully used and an improvement in tool manufacture would result. Credit at low interest should be extended to the artisans so they can buy better quality raw materials and improve the equipment in their workshops.

Artisans should follow the recommendations originally given by Stout in the manufacture of tools and implements.

Research is needed on the improvement of tool design. The Research Institute of the University of Baghdad should call upon scientists, engineers, and designers in the University to participate in this endeavor. Furthermore, the faculty in the College of Engineering should assign projects in tool design to their students, providing them with valuable experience and at the same time producing benefits for the country. Monetary returns should be awarded by the government to anyone--student, professor, farmer, craftsman--who produces worthwhile innovations regarding tools.

Recommendations Concerning the Use of Animal Power

Although tractor power is increasing in importance, draft animals will be important for many years to come in Iraq. The improvements of this source of power should be of national concern. At present many of these animals are weak, undernourished, and diseased. In addition, the equipment drawn by the animals is often inefficient. Recommendations already made concerning the manufacture of hand implements also apply here. In addition, the following recommendations are made.

1. Proper Care of the Animals

The farmers should be taught the proper care of these animals, it is the role of the extension service to provide this instruction.

2. Veterinary Care

At the present time most animal owners have no access to veterinary care. It is recommended that veterinary service be made available for each farm. This could be done by appointing veterinarians on the national level in sufficient numbers to visit all areas as they are needed.

3. Encouraging the Breeding of Indigenous Animals

The indigenous breeds of livestock in Iraq have developed the ability to survive under severe conditions such as extreme heat, disease, and malnutrition. Animals which have these qualities are strong and have proved their ability to survive in the area; their use and breeding is recommended rather than breeding of animals from the temperate zones.

4. Testing of Weeding Implements

The animal drawn implements for weeding discussed by Stout in Agricultural Mechanization in Equatorial Africa, should be tested for usefulness in Iraq, and if feasible, adopted.

5. Introduction of Olpad (Indian) Thresher

This is discussed in some detail in Chapter V. It should be tested and if the results are favorable, adopted.

6. Improvement of Cart Manufacture

Animal-drawn carts play an important role in transporting crops to storage or market areas, as well as in other aspects of agriculture. Most of the carts used in Iraq are clumsy and inefficient, and demand high animal traction. The use of ball bearings and wheels of larger diameter, and perhaps of tire wheels in place of wooden wheels, would require less animal traction. One animal could perhaps do the pulling now done by two animals, after these improvements are made. Light reflectors should be installed on carts in order to avoid accidents when these carts are used at night.

Recommendations Concerning Engine-Powered Implements

For the immediate future, draft animals will continue to be of great importance in agriculture in Iraq. But as population increases, men will become less and less willing to share his food with his animals and power-engines will become of prime importance. With the use of powered instruments better quality farming can be

cone. They can be used to improve the soil, reduce erosion, and accomplish more work per man-hour.

1 Availability of Spare Parts

A guarantee should be obtained from every manufacturer whose machines are imported that spare parts for these machines will be available when needed. If these guarantees are not fulfilled, the machines should no longer be imported.

2. Committee to Select Machinery

A committee of men versed in agricultural machinery and familiar with Iraq's needs should be formed to secure the proper choice of machinery and implements to be imported. These must be compatible with the conditions in Iraq. This committee would also review all animal-powered implements which are imported.

Recommendations Concerning Education

There is no denying that the schools are the basis of the success of any development program, especially in agricultural mechanization; for they provide the means for the developing of human resources, the most important of all resources. A problem common to all Iraq schools is the lack of trained personnel and adequate financial resources. The solution of these is beyond the scope of this paper. Certain concrete suggestions can be made however, about the school's

role in preparing the people for agricultural mechanization.

1. Recommendations Concerning Elementary Schools

These should place more emphasis on teaching of science. In addition the schools should attempt to instill a love of rural life and appreciation for farm work; they should make real efforts to avoid alienating the children from village life, as happens too frequently today.

2. Recommendations Concerning Adult Education

The country has planned district training centers for teaching basic agricultural facts. These should be set up in rural locations, where farmers and their children could easily attend them.

3. Recommendations Concerning Secondary Vocational Training

First of all, there are too few students in this educational stream, and they are generally the less talented students. Strong efforts should be made to attract more students, and more talented students, and especially students with a rural background. Presently existing workshops need money for better equipment and more educational aids. In addition, they need many more technical books in the Arabic language, for few students at this level read English.

In-service training is needed for teachers and supervisors so they can be acquainted with the latest developments in the field.

4. Recommendations Concerning Higher Education

There are almost no Iraqi teachers of agricultural mechanization. When the subject is taught it is taught by foreign teachers. It is indispensible that there be more people qualified to do research and teaching in this vital field, Depending on borrowed talent is not sufficient.

Students should be allowed to study at the college of their choice. Nothing is more frustrating than to study a field which one does not like; this is a waste of the nation's resources.

Foreign teachers should be appointed for at least three year terms, not on the year-to-year basis which is common. It takes at least one year to learn the new system and adjust to new ways. Significant contributions would come, for the most part, after this period of adjustment. Teaching in Iraq should be more attractive to foreign experts; the new teachers should be helped to find lodgings, for instance, and they should be allowed to transfer any or all of their salary to their home country without restriction.

5. University Agricultural Mechanization Programs

Every university in the country should have a program in agricultural mechanization. The graduates

of such curricula can man extension services, experimental stations, and the proposed Regional Middle Eastern Research Center.

Recommendations Concerning Extension

There is no point to research unless results can be disseminated to the people who can use them. The extension worker provides the essential link between researcher and the farmer. Because of the importance of this program, the following recommendations are made.

1. Improved Qualifications for Extension Workers

If possible extension workers should have a rural background; it goes without saying that they should be selected on the basis of objective qualifications, rather than on the basis of friendship. They should have training beyond high school, preferably college credits in agriculture. Since there is traditional mistrust between the village and the government, the extension worker's qualifications should include the personal traits which will win the villagers' trust and respect. In short, he must be both knowledgeable and personable.

2. Use of Instructional Materials which are Appropriate

The most effective method of instruction for the extension agent, is demonstration. He should be capable of demonstrating the innovations which he

suggests. In addition he should make extensive use of audio-visual aids, of illustrations in the literature used, and whenever possible of radio and television.

3. More Time Spent in the Villages

Today's extension worker spends most of his time in the city; his occasional visits to the country are more ceremonial than useful. The extension worker should be given sufficient funds to spend most of his time in the village where he can be of direct use to the farmer.

5. Method of Approach

Since there are many farmers and few extension workers, innovations should be suggested first to those farmers which are more successful. The new idea will be more effectively implemented by these competent men with their successful farms.

Recommendations Concerning Research

The success of any program depends on the development of a system for the creation of knowledge. In the case of agricultural mechanization programs, research creates new practices, gives basic information and evaluates existing practices.

1. Recommendations Concerning Present Centers of Research

A basic need of any research program is for adequate funds. Research in agricultural mechanization should receive adequate attention from those allocating

funds. A researcher should be freed of the burden of excess red tape. Money which is allocated should be forthcoming with a fairly short period of time.

Today most research is done by college professors. It is recommended that these people be freed of too-heavy teaching loads so they can devote more time to research projects.

Priorities should be established, giving more emphasis to adaptive research than to pure research.

The important goal of coordinating research and proper channeling of funds can best be accomplished by the establishment of a national committee, which would direct research and provide financial support.

2 Establishment of a Regional Middle East Center for Research on Agricultural Mechanization

The purpose of a regional Middle East Center would be to coordinate research activities among the various nations of the Middle East, eliminating duplication of effort and providing channels for sharing results. Foreign aid could easily be channeled through such a regional center, which would provide them to the countries involved as matching funds. The Center would both conduct its own research and initiate projects on important but neglected facets of agricultural mechanization.

3. Specific Research Projects to be Undertaken

A survey should be made to obtain data basic to any further research; this would be information about the soil, climate, topography, and cultural operations in agriculture.

Studies should be done evaluating and comparing the economies of home-produced machines versus imported machinery.

An evaluation should be done of the publicly owned hire-and-rental services, comparing their effectiveness and expense with those of similar private agencies.

Machinery which is new to the country should be tested before it is distributed to the farmers. Sociological studies need to be done of the factors which make the people resistent to change. A study is needed to determine the most effective times of harvest and planting. Studies should be undertaken to determine the best ratio of extension workers to farmers. Research is needed to determine the extent of yield reduction due to lack of weed control on Iraqi fields. Will it pay to weed, or not?

4. Publications in Iraqi Journals

Scientific articles should be submitted to Iraqi journals rather than to foreign publications, in order to strengthen the professional standing of the Iraqi scientific community.

General Recommendations

1. Credit Systems

Government should provide credit to individuals at a low rate of interest, from 3 to 4 per cent. This should be provided to promote mechanization, and extended to farmers, to buy hand tools, animal implements, and other machinery, as well as other input such as fertilizer, seeds, and so on. Credit should also be available to craftsmen to provide the necessary equipment and tools for these farmers.

2. Import Taxes

It is recommended that taxes on imports such as fertilizer, machinry, and equipment improved seed varities, and other agricultural input be removed.

3. Positive Price Policies

Positive price policies should be applied whenever needed. This will assure the farmer of adequate and just economic return on his product. This should be done, however, only in extreme cases. Mechanization often increases overhead costs for the farmer, and unless he receives fair prices, he will never be able to afford the more efficient means of production.

4. Coordination

Efforts should be made to bring agricultural mechanization plans into harmony with other development plans in the country. No facet of the economy operates in isolation, and the interrelatedness of many factors

must be constantly recognized. The establishment of a national committee responsible for this coordination, is recommended.

5. Personnel

Allow the person who starts mechanization projects to finish them. It is indispensible that the planner or the director who started a project be allowed to finish it; shifting responsibilities will have an adverse affect on the success of the project.

6. Evaluation

The periodic evaluation of all agricultural mechanization programs should be provided. Such appraisal can be used as a guide for the assessment of progress and provides the means for identifying bottlenecks and other problems hampering implementation. The national committee discussed above should handle this.

7. Storage Facilities

Agricultural products at the present time are lost or spoiled because of lack of adequate storage facilities. Dates may stay in railroad stations for days, exposed to sun and rain; this is also true of cereal crops. Storage facilities are important to protect these vital agricultural products. The benefit derived from increased yield due to mechanization will be cancelled out unless storage facilities can be improved. For cereal crops several elevators are available, some in Basra and others in Baghdad. Additional ones should be supplied by

the public sector, because the private sector is unable to do so. For dates storage facilities are also inadequate; the government, as the sole buyer of dates, has the responsibility for improving the storage facilities.

Participation in Cooperatives

The effect participation of the farmer in the cooperative societies should be encouraged; the role of the director should shrink as these farmers become more organized and take more initiative concerning their own affairs. Machines are too expensive for farmers to buy individually; their cooperative use is an effective solution to the problem of price.

Social Sciences in the Cooperatives

In many countries sociologists and anthropologists team up with cooperative societies and with extension workers to make their work more effective. This is an aspect of planning which has long been neglected in Iraq. The farmers were, as peasants, oppressed for centuries, and they became used to abuse. Their lingering sense of inferiority must be taken into account by the agents of change who work among them. Mechanization means change for the farmer. His life style must change, and personal adjustments to the new environment must be made. These social scientists can help direct the transition so that the people adjust more quickly.

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