MEANS FOR INCREASING WHEAT PRODUCTION AND IMPROVING EXTENSION'S EFFECTIVENESS IN MOROCCO

by

MEHDI ADLOUNI

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Approved by:

E. G. Heyne
Major Professor

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CONVERSION FACTORS

MEASUREMENTS

Metric		English
Length		
1 millimeter mm	=	0.0394 inches in
25.4 millimeter	=	1 inch
1 meter (1000 mm)	=	3.2808 feet ft
1 kilometer (1000 m)	=	0.6214 miles
Area		
1 square kilometer	=	0.3861 square miles
1 hectare ha	=	2.4710 acre a
Weight		
1 kilogram kg	=	2.2046 pound lb
1 quintal (100 kg) q	=	220.46 pounds
1 metric ton (10 qx)	=	2204.6 pounds
more than 1 quintal	=	qx
Yield		
1 kg/ha	=	0.8922 lb/a
1 q/ha	=	89.22 lb/a
1 q/ha	≠	1.5 bu/a wheat
Monetary		
1 Dirham DH	≠	$0.35
4.50 DH	=	$1.00

INTRODUCTION

Agriculture is the most important industry in Morocco. Seventy-five percent of the people depend on agriculture as their main livelihood. It also represents the country's most pressing developmental need. Historically, the country has been an exporter of wheat. This role was reversed in recent years. Wheat now must be imported to feed the expanding population.

In spite of good climate, soil, water resources, heavy investments and available research results, much of the agricultural population (using traditional farming methods) lives at or near the subsistence level. This situation is largely caused by the lack of a strong extension education program which is a great force contributing to progress in rural living and agricultural development in certain other countries. The Cooperative Extension Service of the United States is an outstanding example of an effective and successful farmer educational program. It has helped farmers achieve production records never attained before.

Purpose of the Study

The basic purpose of the study was to make suggestions for increasing wheat production and improving the effectiveness of extension work in Morocco.

Scope of the Study

The first part of the study surveyed extension work in the United States with special reference to the objectives, program

of work and teaching methods adopted. The objective of this review was to establish suitable guidelines and working principles for extension which would be adaptable to Moroccan conditions. It was proposed that if, under a particular set of circumstances or conditions, a country adopted a method or procedure of extension education, then in similar or near-similar sets of circumstances that type of extension service would also be successful. Similarity exists, to some extent, between the agricultural situation in the United States in 1914 when the Smith-Lever Act was signed and the Moroccan agricultural situation of the 1970's.

The second part of the study was concerned with delineating the agricultural situation in Morocco. This was followed by a third part that offers suggestions for wheat technical work followed by a revised organization for the conduct of an efficient extension program that will assist rural people in the improvement of their agriculture generally and to increase their wheat production particularly.

However, in planning the study, it was recognized that extension programs and procedures in agriculture could not be universally applicable and that at every level, the organization and operation of the extension service particularly, should be adapted to the situation. Consequently, the study was designed to provide a working basis for understanding and appreciating wheat production methods and the extension organization in the United States and Morocco in the context of their perspective

situations. Comparisons were not intended to be made, as it was felt that such comparisons between areas at different levels of economic and technological development, and which were socially and culturally distinct, would be irrational. The reason for analyzing the production technique and organization of these areas in an associative manner was to determine the factors responsible for the successful working of Extension in the United States and to assess its adaptability and applicability to Moroccan conditions.

Chapter II

SURVEY OF EXTENSION WORK IN THE UNITED STATES

Objectives

The extension service in the United States was established to educate farmers in the use of better farming methods and to acquaint them with the inventions and improved techniques that are constantly being discovered by research.

The extension service operates on the theory that farm people, both youth and adults, learn best by doing under the advice of county agents. Agents bring new methods to farmers and also pick up new ideas from farmers and pass them on to other farmers.

Extension workers recognize problems and pass them on to the research staff of the university or state department of agriculture for solution. Proven and applicable results are taken back to the farmers by extension agents.

The agricultural extension service in the United States is called the Cooperative Extension Service. It is so named because groups at the county, state (through the land grant universities) and the national level (United States Department of Agriculture) cooperate as sponsors of the organization. The work is carried out on the basis of plans agreed upon at all three levels.

The Cooperative Extension Service in the United States has grown gradually but its actual formation can be attributed to

the "Country Life Commission" and the subsequent "Smith-Lever Act."

The commission, which was appointed by President Theodore Roosevelt in August 1908, was impressed by the urgent need to make rural life as effective and satisfying as urban life. It proposed to remedy the disparity between the city and country by tackling fundamental problems. The most fundamental problem, according to the commission was: ". . . lack of the proper kind of education." The commission called for an immediate expansion of extension work.

In 1914, the Smith-Lever Act was passed creating a nation-wide "Extension Department" with a view ". . . to aid in diffusing among the people of the United States useful and practical information on the subjects relating to agriculture and home economics and to encourage the application of the same."

Actually, among the several countries where extension work is in progress, the Cooperative Extension Service of the United States of America is an outstanding example of success. The influence of extension work has been felt in nearly every sphere of agriculture and family life.

Organization

The organization which has been established for extension work in the United States is based on a cooperative, balanced relationship among the Federal, State and County governments. Administrative planning, financing, staffing, organizing,

operating and instructing constitute the major activities of the service.

Each state plans and executes its own extension program in collaboration with the federal extension program on one hand and the several county services in the state on the other.

Each county draws up long-range programs and establishes priorities of problems and objectives in subject-matter areas which are considered urgent and of wide concern. During the planning stage, as well as in implementing the program, representative local people and state specialists are actively involved.

National level. The Administrator of the Federal Extension Service represents the Secretary of Agriculture. The federal service includes many divisions. Its role is defined by the words of Lincoln D. Kelsey and Cannon C. Hearne (14):

> The extension service of the United States Department of Agriculture exists to do things which the state extension services cannot do readily or easily. It mobilizes, interprets, and prepares the resources of the United States Department of Agriculture for the use of state extension services. It interprets area, national, and international situations. It obtains the organized, active cooperation and support of regional and national groups. It approves appointments of each state director of extension. It approves cooperative projects that involve the use of federal and federal-offset funds. It informs the public about state extension programs and the progress made toward carrying them out.

State level. There is a State Extension Service in each state. The Cooperative Extension Service is established as a unit of the Land Grant College and is organized to conduct

extension work in all areas of relevant subject matter throughout a state.

The state director of extension is selected by the governing board of the state university and is responsible to the president of the university.

The state director is responsible for the administration and execution of all duties and obligations agreed upon by the Land Grant Colleges and the United States Department of Agriculture. He administers all funds, looks after projects and plans, approves all publications and is the link between the State and the United States Department of Agriculture.

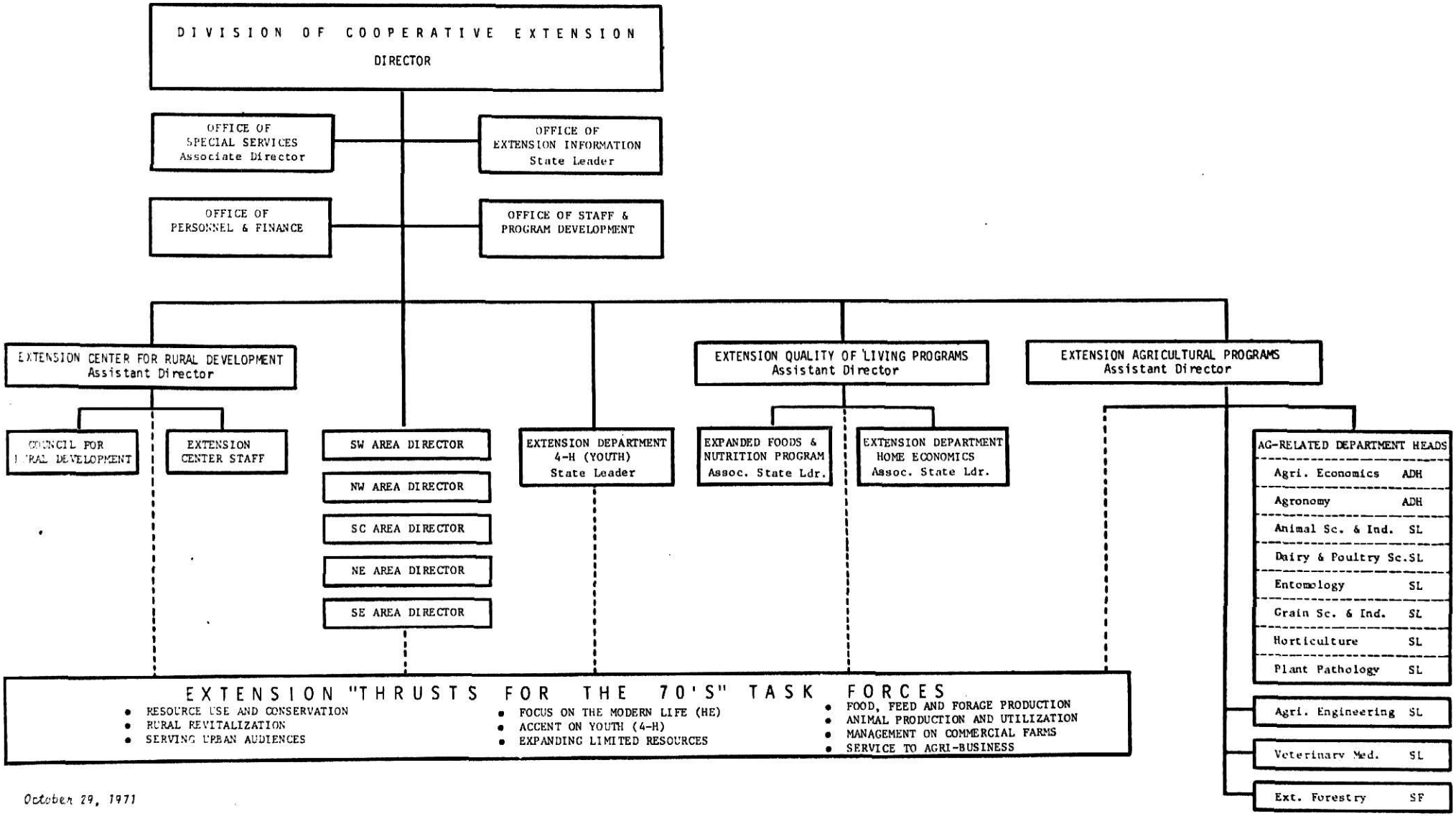
Authority flows from the director to department heads and area staff in each state. In Figure 1 we can see how the authority flows in Kansas.

Programs are not authored at national or state levels. Rather, they result from consultations between state administrators and specialists, area staff, county agents and local representatives. The resulting programs, therefore, reflect local concerns and priorities as well as state and national problems and policies.

State and area subject matter specialists. Subject matter specialists assist the county agents in planning and implementing their subject matter programs. These specialists may be located at the university or at area or district headquarters.

These specialists are necessary as they provide current technical advice upon request and thus assist county agents in

Fig. 1. ORGANIZATION CHART, COOPERATIVE EXTENSION SERVICE, KANSAS STATE UNIVERSITY



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their varied activitIes. They are the analysts and interpreters of scientific knowledge and factual information. They are the connecting link between research and practice. They enable county agents and farmers to more fully understand and apply scientific knowledge on specific subjects in the farms and homes.

While the nature and degree of specialization will vary among individual states, depending on the respective needs and arrangements, the more common areas of specialization are: agronomy (field crops and soils), horticulture, entomology, irrigation, dairying, animal industries, home economics, 4-H, rural development, engineering and economics.

With the help of extension editors and information staff subject matter specialists prepare simple bulletins, leaflets, slides, exhibits, motion pictures, etc. on various subjects from the complicated and detailed technical research bulletins. The specialist is an interpreter of scientific findings for practical application.

Regarding this role of the specialist, Edmond de S. Brunner and Yaug Hsin Poo (4) state:

> Unless the specialist is far more competent in his subject than the agent he is unqualified for the job. But in addition he must be an analyst, interpreter and popularizer of the subject matter he handles. If he is not an educator, he is not of maximum usefulness in extension. This calls for an additional type of competency not demanded of the research worker in the same field, yet the specialist must be qualified to meet the researcher on equal terms.

County level. County extension agents are representatives of the state university and the U.S. Department of Agriculture at the local (county) level. They are partially supported by county funds and reside in the county they serve.

County-wide agricultural activities are centered around the county agent who, in most cases, is assisted by a home demonstration agent, an assistant county agent and an agent especially recruited to work with 4-H members and clubs.

County agents are teachers of improved farming methods and better home living. They teach through field demonstrations, group meetings, personal visits, letters, bulletins, news articles, radio talks, etc. Agents take research findings directly to farm people and they carry back to the researcher the unsolved problems of the farmers.

In contrast to the characteristic of specialization, the county agents are basically generalists and cover the entire agricultural subject matter areas. The county agents, therefore, are required to work "across the board" with clientele in all areas of subject matter connected with agriculture, home economics and youth programs. Agents are very responsive to needs and problems of local people.

Local volunteer leaders play an important role as they cooperate and work with the county agent. They help in organizational, demonstration and promotional activities. Both men and women cooperate with the county agents in carrying out demonstrations of improved methods of farming, homemaking and community improvement.

County agents work with groups and organizations such as the Farm Bureau, the National Grange League Federation, the National Farmers' Union, Home Demonstration Clubs, 4-H clubs, civic clubs and so forth. Agents are more efficient when they work with groups some of the time rather than individuals.

4-H club work. The 4-H club organization is vitally important in extension work and has made significant contribution to the vocational education of boys and girls from 8 to 18 years of age. It is a part of the state and county extension system. Many successful farmers, for example, began their careers as 4-H club members.

4-H projects aid rural youth to learn to help themselves and to become acquainted with basic practices related to animal and plant production, home and community living.

The four H's stand for head, heart, hands and health. The 4-H clubs have as their guiding principle "To make the best better." The 4-H pledge is:

> I pledge:
> My head to clearer thinking,
> My heart to greater loyalty,
> My hands to larger service, and
> My health to better living, for
> My club, my community and my country.

As Harold Willman (25) stated in writing about 4-H club work:

> The purpose of club work is to place before boys and girls every possible opportunity for desirable, enriching experiences that should aid them in becoming more efficient farmers and businessmen and more useful citizens of their communities, 4-H work does not give boys and girls anything without effort on their part. In reality, it only opens opportunities to them. Club work gives

> nothing to members except the chance for experience and the rest depends upon them, their parents, and the influence of their other associations.

Various methods such as meetings, tours, entertainment, demonstrations and judging contests, fairs, and camps are used as aids for training 4-H club members.

Extension Teaching Methods

Extension education involves work with people who differ in age, sex, educational status, interests, levels of living, culture, values and other significant variables. Under these circumstances, the productivity of extension education is determined by the merits of the services offered, including effectiveness of the teaching methods used. It is clear, therefore, that there is no one extension teaching method which meets every situation. Thus a wide variety of methods are employed. The extension agent is constantly faced with the practical problem of selecting the teaching method or combination of methods best suited to meet a specific circumstance existing at a particular time. A few of the major methods utilized are considered briefly below.

Individual visit. The farm and home visit was one of the early and effective methods used by extension workers. In this kind of consultation where specific problems can be analyzed the educational result is quite evident. The same result can be obtained when farmers visit the extension worker's office. The farm or home visit can be one of the most effective teaching

methods used in extension work. This is one of the more expensive methods because of the great amount of time involved.

Demonstrations. The method demonstration is one which has been used effectively by extension throughout its history. This method is particularly suited to teaching home and farm practices involving skills. The result to be expected is the adoption of a new operational technique or practice.

Result demonstrations establish visual proof that the improved practice advocated is applicable locally. Under the direction of the extension agent the farmer, homemaker or boy or girl carry out the demonstration. Such demonstrations require a substantial period of time, such as a crop season. The success of the result demonstration depends upon evidence which shows that the new practice is definitely superior to the one it replaces. The result of the demonstration is not a matter of discovering new truths but of pointing out that the research findings of the state experiment stations or of the United States Department of Agriculture apply to conditions peculiar to the county or even a portion of county.

On demonstration purpose Ben D. Cook (6) stated:

> After over a half century of extension work, the result demonstration continues to be one of the important teaching methods. The need is past, in most areas, for result demonstrations to prove Cooperative Extension as a source of useful impartial and factual information. For the most part, result demonstrations are now used in situations that involve major changes in established enterprises, methods, habits or facilities; evaluation of new enterprises or services and better selection of certain similar practices, materials or services. In these areas, the successful demonstration of research

develops confidence in extension workers, demonstrators, program-building members and others afforded the opportunity of evaluation.

Meetings. Extension meetings are educational in nature. They are intended to bring about change: change in attitudes, change in knowledge or change in practices.

Meetings range from the small committee or commodity or project meeting with 6-20 people in attendance to Farm and Home Week gatherings attended by thousands. Geographically, the meeting may be held in a neighborhood, community, county or state. Such meetings lend themselves to a wide variety of educational purposes.

Printed matter. Printed matter, such as bulletins, leaflets, and circulars, is used extensively as an extension teaching method. Bulletins are usually mailed, distributed after meetings or picked up at the county extension offices. Many of these bulletins are distributed in the state each year. They are useful because of the high educational level of the farmers.

Discussion groups. Meetings of this sort are especially useful in dealing with some of the newer aspects of the extension program. These permit an exchange of views and a pooling of information. These discussion groups are important because of the fact that a farmer often discusses a practice with other farmers before he is ready to adopt it.

Other methods. Tours and field days are important methods used.

Traveling exhibits have been in extension for many years as a means of getting information to the people. Exhibit trains were used and were moved from place to place, to field days, county fairs or other assemblages of farm people.

Tape recorders are used individually by the county agent and by radio stations.

The telephone is another method used for interpersonal communication between the farmers and the county agent; this method is becoming more and more important.

Information mass media. In addition to bulletins, the extension service utilizes news stories and regular columns prepared by extension agents in local papers, exhibits, posters, circular letters, television and radio. County extension workers also utilize radio and television facilities in their counties to conduct educational work, usually on a definite schedule basis, e.g. 2 or 3 times a week.

The work of the extension agent is becoming more effective as he uses the facilities available in the state university. In state universities there is usually an extension editor or a department of communication that prepares publications, newspaper articles, radio and television programs, visual aids, films, slides and photographic exhibits. The department publishes materials that are useful to county agents and individual farmers and homemakers.

Teaching Agriculture in the United States

In the United States agriculture and education have long been of interest to rural people.

Agricultural education, like the other forms of American education, originated with private groups. Private schools and private organizations sponsored agricultural activities, even during colonization. Soon after the nation was established the state departments of agriculture began to aid various agricultural enterprises.

Public agricultural education originated in certain communities and state assistance followed later.

Actually, many organizations, associations and public schools are involved in teaching the future farmers as well as adult farmers. In-school and out-of-school activities, using different methods and techniques, were designed to make them better farmers and better producers.

Teaching young farmers. A young farmer program provides instruction on a part-time basis for young men approximately 16 to 25 years old who are establishing themselves in farming occupations after they graduate from high school or drop out of school. They may or may not have had previous instruction in vocational agriculture. These young men form a group between the high school student on the one hand and the adult farmer on the other. They are in between in age, farm experience, reading

and study habits. They are attempting to become established in farming but have not yet achieved this objective.

During the period before they begin farming on their own, many problems confront them which have a definite influence on their future. During this period systematic instruction is probably more fruitful than any other period in their lives.

In most communities class sessions are held in the evenings. Classes are usually held at the local high school.

Since many young men become established in farming by way of the home farm, the types of activities in the following list are considered in developing farming programs with young farmers. Most of these activities were suggested by Dr. George P. Deyoe in his book Supervised Farming in Vocational Agriculture.

1. Help improve the farm business by doing such things as:
   Carrying out improvement projects in crop and livestock enterprises.
   Reclaiming land by clearance, drainage, etc.
   Increasing the animal unit, buying some feed if necessary.
   Remodeling barn or other building to provide more or better facilities for livestock.
   Introducing a program of erosion control or soil management.
2. Rent and operate a farm or near-by piece of land as a part of the home-farm business or a separate unit.

Teachers visit the young men on the farm during crucial periods and make sure the young farmers are prepared to meet these situations.

Teaching adult farmers. Adult-farmer courses are given to those already established in farming, most of whom are farm operators. The teaching consists of giving courses of ten or

more meetings in length that deal with one subject and includes the necessary supervision of the activities related to the course.

Adult farmer work does not duplicate what is done by the agricultural extension service.

The two types of work carried on by different agencies are different. As we have seen, the agriculture extension work is carried on by the U.S. Department of Agriculture in cooperation with the Land-Grant Colleges in the states, and in the communities the work is done through county agents. But we can say that both agricultural extension for adults and adult-farmer courses by the school have their place. Each supplements and complements the other in educating farmers.

Teaching agriculture in public schools. Early in this century elementary agriculture was generally taught as a school subject. It was taught in nearly all of the southern states. Today only a few states require the teaching of agriculture in the seventh or eighth grades. As vocational agriculture under the federal acts developed in the high school the teaching of elementary agriculture declined and has been replaced by general science. Actually, young students may get experience practice through 4-H if they wish to join.

As agricultural education waned in the elemtnary schools it developed further in the high schools where it was first taught.

After 1917 (passage of Smith-Hughes Act) vocational agricultural instruction spread rapidly in the high school, and with its development general agriculture courses decreased.

General agriculture dealt with the areas of general instruction in agriculture that all rural people should have, regardless of vocation. The topics taught depended generally on how much time was devoted to agriculture. The length of the course varied from one semester to two years.

Vocational agriculture is designed to train prospective young farmers for proficiency in farming. Its objectives are vocational objectives, to make people proficient in farming as an occupation. This was included in the Smith-Hughes Act (1917) for the teaching of vocational agriculture in public schools below college level.

Future Farmers of America (FFA). FFA is the national organization of young people regularly enrolled in vocational agriculture in the public high schools. The average age of active FFA members is approximately 17 years, and 25 is the maximum age. FFA is an integral part of the program of vocational education in agriculture. It serves to motivate and vitalize the systematic instruction in agriculture.

Members learn, through active participation, the parlimentary procedure necessary to conduct and take part in a public meeting, to speak in public, to buy and sell, to work cooperatively and to provide organized recreation for themselves and others in the community.

Although the organization is a democratic organization led by young officers, it operates through adult guidance and counsel. FFA is a national organization with branches in every state. Each state association is composed of local chapters. The local chapters are formed by groups of boys and young men in secondary schools studying agriculture. The aim and purposes of FFA are attained through a program of activities which is set up annually by each chapter, each state association and the national organization. FFA is designed to supplement the training opportunities for boys and young men taking vocational agriculture.

The Morrill or Land-Grant College Act of 1862 resulted in the establishment of an agricultural college in each state. These colleges provided for the agricultural education of all the people who wanted it. Students could acquire more technical knowledge with the objective of becoming future agricultural researchers, teachers, extension workers, agri-business leaders, etc.

Coordination of Extension, Research and Teaching

In the United States there is close coordination between extension, research and teaching. Most of it occurs in Land-Grant Universities whose faculties engage in both research and teaching within a single administrative unit. Close and effective liaison between extension workers and research workers exists. This is essential to insure that important new

research findings can be relayed effectively and without loss of valuable time to those who can use these facts in their day to day activities.

Research and teaching are concerned with both the quality and nature of work done by extension. Extension services are maintained in each county and a special corps of specialists in different fields is maintained within the agricultural colleges to provide services and materials to the county level workers.

The extension agents and specialists are field representatives of the college. They are engaged in relaying the appropriate scientific information determined by research and taught in the college classroom to people of the state on their farms and in their homes.

They are also in a position to build good will for the college and for the experiment station and to relay to the experiment station practical problems facing farmers which would seem to call for additional research.

Hence, this liaison between researcher, teacher, extension worker and the farmer is mutually beneficial: the farmer profits by using the university's faculty and researcher as a resource of science and new techniques. Conversely, the university faculty and researcher become aware of the farmer's problem by using his field as a living laboratory. This continuing involvement gives the teachers direction to their teaching at the college.

That is why extension workers have a very important role in this situation. Their location between researchers and teachers on one hand and farmers on the other makes them fill a double communication role.

Extension, through this coordination, has enabled maximum benefits to be reaped by American farmers and scientists and to the economy of the country in general.

Chapter III

GENERAL CHARACTER AND AGRICULTURAL SITUATION OF MOROCCO

Geographical Characteristics

> Morocco is situated between latitude 28° and 36°N. and between longitude 2° and 11°W. in the northwestern corner of the African continent. It is separated from Europe by the Straits of Gibraltar and lies at the western edge of the Mediterranean region. The boundaries of the country are the Atlantic Ocean on the west, the Mediterranean Sea on the north, Algeria on the east and the Sahara Desert on the south (27) (Figure 2).

The country is 850 miles long along a northeast-southwest axis and a little over 300 miles wide at its greatest inland depth from the Atlantic Ocean. The area covers 174,000 square miles of mountains, plains and desert.

Topographically, it is sharply divided into an open agriculturally rich plain area in the northwest and economically poor mountains and plateaus in the eastern and southern portions. The coastal plains and plateaus, fronting for about 350 miles on the Atlantic Ocean, are completely cut off from the interior by encircling mountains of the High Atlas and Middle Atlas ranges and the rif Massif. The coastal plains are the most densely populated and economically advanced. Almost all the major cities are located in this area.

Climate

As a whole, except for the higher mountain areas, the climate of Morocco is of the Mediterranean type, with dry hot

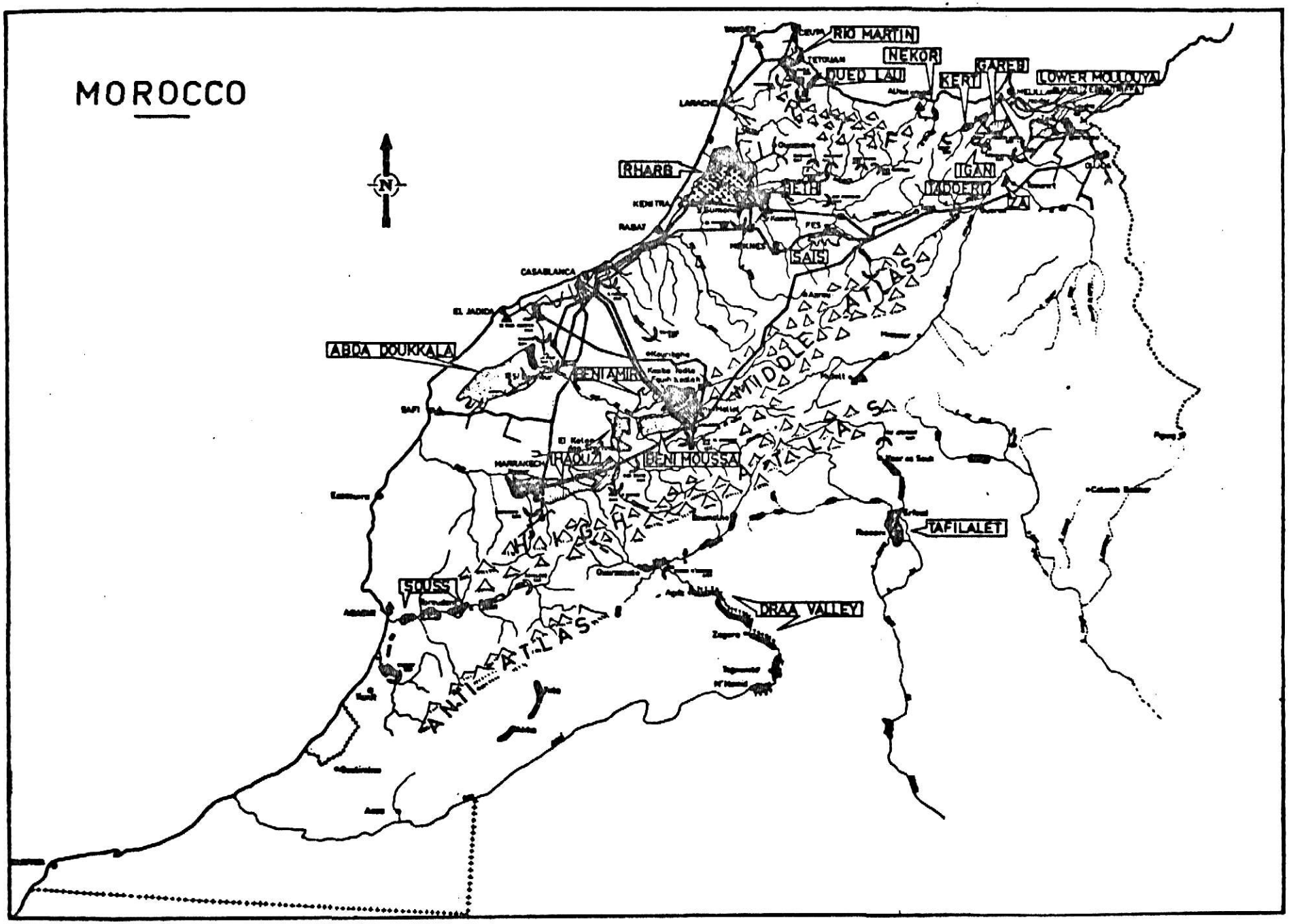


Figure 2. Main irrigation in Morocco.

summers and wet cool winters. In winter the westerly winds bring rain to the northwestern coastal region and still more to the mountain ranges facing the coast. Southeast of the mountain ranges the rainfall decreases rapidly. Precipitation, which is irregular in occurrence and amount from year to year, normally decreases from north to south and from west to east.

Over most of the country the rainy season extends from October to April or May, with the maximum precipitation occurring from January to April. Usually, except in the mountain areas, little if any rain occurs in the period from May to September. The average annual precipitation differs greatly for the various districts. On the Moroccan coasts precipitation decreases toward the east and south, from 900 millimeters (36 inches) at Tangier to 400 millimeters (16 inches) in the east and 300 millimeters (12 inches) at Marrakech in the south. In some of the cultivated areas along the coast the annual precipitation may be over 750 millimeters (30 inches). In some of the semi-arid grazing areas it may be 200 millimeters (8 inches) and in some of the desert areas there may be practically no rain at all (Figure 3).

As the high Atlas and particularly the Middle Atlas mountains have large snow collection areas the snow may lie to a depth of one meter or so. Thus a substantial reservoir of moisture for irrigation potential is built up every year. Water from 22 dams was available for irrigation purposes in 1972.

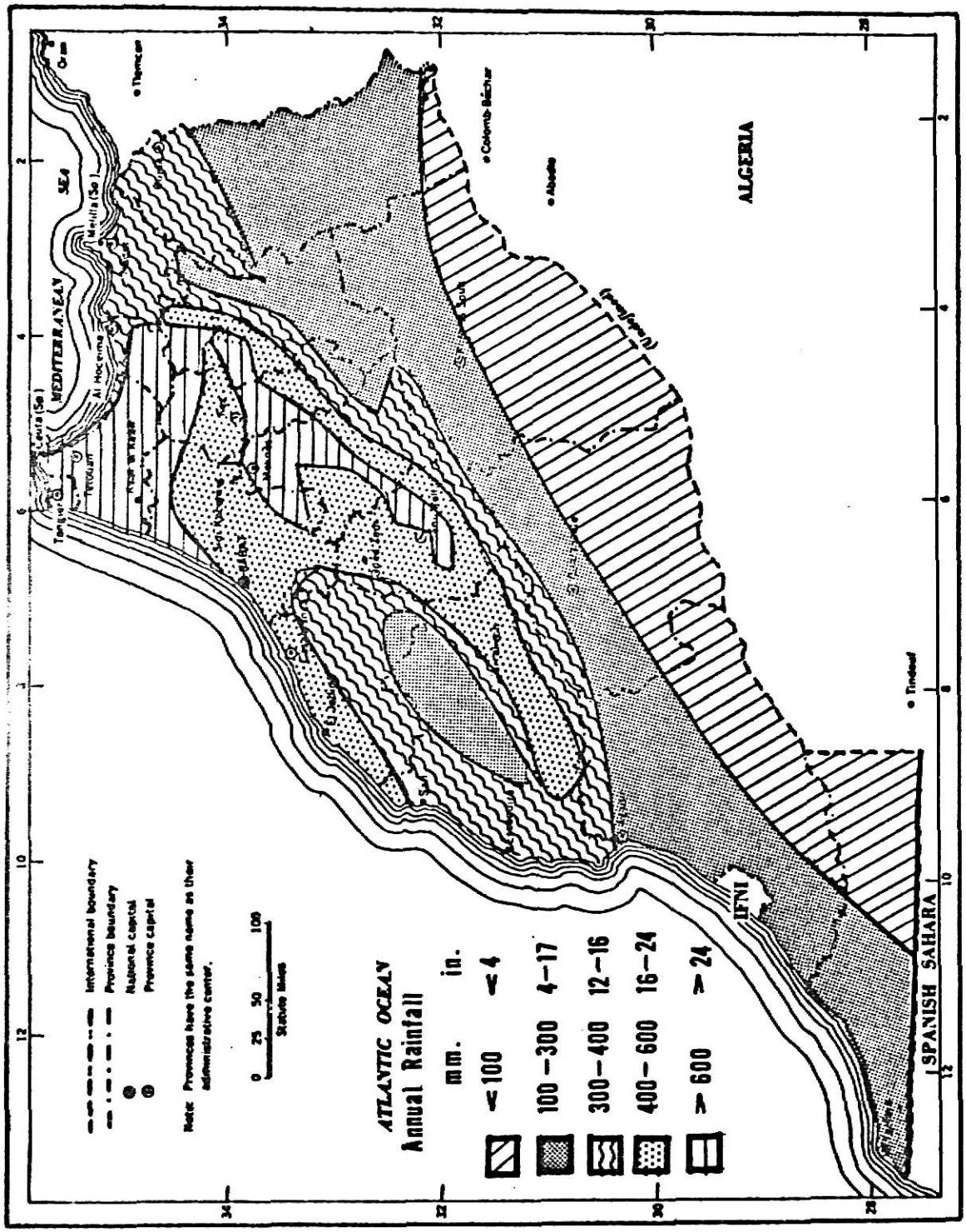


Figure 3. Rainfall of Morocco

Soil and Vegetation

Among the various soils of Morocco alluvial soils of the lowlands are deeper and more fertile than the soils of the uplands. The best soils of the country are considered to be those found in the coastal plain, the gharb and the lowland at the foot of the Atlas and Rif mountains.

On the basis of climatic differentiation the soils of Morocco can be divided into two broad groups: those of the humid or semi-humid Atlantic side (western Morocco) and those of the arid or semi-arid steppe (eastern Morocco). The soils of the Atlantic side include a wide variety of sandy, clayey and alluvial soils. The sandy soils are known in some parts as "sahel" soils.

The sandy red soils, which are known as "hamri" and owe their color to the presence of oxide of iron, occupy a large area in the country.

Clay soils are also common in Morocco. They are known as "tirs." They are stony and fine-grained, not very dark in color, fertile, somewhat deficient in potash and rich in iron and nitrogen. Sometimes, they are mixed with sand and are easily worked.

The vegetation of Morocco, in line with its climate, is largely Mediterranean in its nature. The most intensive stage of growth-development of natural vegetation, and also of cultivated crops, takes place in the spring when rising temperatures

occur before the cessation of the rains or at least before the soil moisture has been largely depleted. A second peak in the growth-development of plants takes place in Morocco in the fall with the beginning of the rainy season and before the temperature reaches its lower limits.

The principal vegetation of the country consists largely of evergreen forest and scrub.

Population and Living Conditions

According to demographers, the country's population is increasing at an annual rate of at least 3 percent.

> Assuming a growth rate of about 3.3 percent annually, experts estimated the population in mid-1970 at 15.7 million and in mid-1971 at 16.2 million. Actually it is more than 17 million and it is expected to reach almost 22 million by 1980 and to double by 1991 (28).

According to some statistics; "children under fifteen years of age accounted for nearly half of the total population in 1970. A population survey showed that 60 percent are less than 20 years old" (28). It is also important to note that more than 75 percent of the population is rural.

The rapid population growth, low agricultural production, urban crowding and widespread unemployment have kept the general living standard near or at the subsistence level.

A small urban and rural minority, constituting some 5 to 10 percent of the population derives its existence from the modern economic sector and receives more than half of the national income. "The average per-capita income increased

from the equivalent of U.S. $150 in 1964 to U.S. $190 in 1968" (28). The rural average per-capita income is generally much lower than the national average. Caloric intake varies from 800 calories per day among the poor rural population to more than 3,500 calories among wealthy groups. The diet is based on cereals: barley, wheat and to a lesser extent corn and oil. Literacy in 1970 was estimated to be between 15 and 20 percent.

The Agricultural Situation

> Of the country's land area of 174,000 square miles only 20 percent was estimated to be arable. Seventeen percent was permanent pasture, 20 percent was forest land and 45 percent was nonarable mountain, desert or urban areas.
>
> An estimated 15 million acres, or two-thirds of total croplands were under cultivation, the remainder lying fallow (7).

On the basis of farming methods, the agricultural area was divided into a traditional sector accounting for about 80 percent of the total and a modern sector accounting for the remainder (Table 1).

The traditional sector. As noted in Table 1 most traditional farms are small. These are characteristic subsistence farms in which land is worked by the farmer and his family with wooden plows drawn by animals and which produce low yields largely of cereal crops.

A lack of understanding of the use of fertilizers and insecticides and the absence of means to acquire them contribute

Table 1. Estimated distribution of agricultural land in Morocco, by ownership, 1965

Ownership	Area[1]	Percent of total
Makhazan, Jaysh and habus land	0.74	1.9
Traditional Sector		
Collective land		
Permanent pasture	13.09	34.0
Arable land	2.47	6.4
Total collective land	15.56	40.4
Privately owned land		
Greater than 25 acre parcels	7.41	19.2
Less than 25 acre parcels	11.11	28.8
Total privately owned	18.52	48.1
Total traditional sector	34.08	88.5
Modern Sector		
Ex-owned by foreigners	1.11	2.9
Reacquired from foreigners	0.62	1.6
Owned by Moroccans	1.98	5.1
Total modern sector	3.71	9.6
Grand TOTAL	38.53	100.0

From Area Handbook of Morocco.

[1]In millions of acres.

to low yields on the vast majority of farms. Continuous planting of one crop on the same land, despite a two-year plant-fallow cycle has lowered soil fertility. As a result, annual yields are low and may be expected to become even lower unless something is done to remedy the situation.

Fragmentation of land among heirs resulting from the provisions of Muslim inheritance laws has created large numbers of minute and irregularly shaped plots that are inefficient to cultivate.

The physical situation makes it difficult to use modern equipment in the traditional sector and, together with extreme poverty, continues to tie the traditional peasant to the hoes, wooden plows and sticks used by his ancestors. Harvesting on these small holdings is done by hand and threshing is done by animals. Expensive fertilizers are not usually used unless they are subsidized. Frequent droughts and insect plagues help make the life of the subsistence farmer even more precarious.

The modern sector. The modern system has been introduced by Europeans, primarily colons (French settlers) in the first half of the twentieth century on land they took over. The modern sector is mostly owned by foreigners and some Moroccans. After independence, the land was reacquired gradually by the State or the Government or by private owners. The last part of this land was recuperated during August 1973.

The farms are operated using modern farming practices including the rotation of crops, the use of chemical

fertilizers and modern machinery and equipment. Modern farmers in Morocco make extensive use of caterpillar tractors, subsoil plows and combine equipment. The yield is much higher on these modern farms. These modern farms are primarily organized to sell high-value cash crops both locally and for export.

Field crops and crop production. These crops are divided into two kinds: the early or autumn-sown and the late or spring-sown. The autumn-sown or "bekriya" crops include barley, wheat, oats, beans and flax. Barley is sown first, immediately after the rains, which usually come at the beginning of November. Wheat, oats, and the later barley are sown in December, or, if the rainfall is heavy, in January. Beans are gathered in April while still green. Barley is ready for harvesting early in May, wheat and oats by the end of that month. The threshing of these crops is done between June and August.

The spring-sown or "mazuzy" crops include corn, sorghum, chick-peas, lentils and beans. The ground is prepared in January and the seed is sown at the end of February or the beginning of March. Harvesting takes place in August and threshing in September.

The basic crops are barley, durum wheat and hard wheat, and maize. These cereals are planted on over 80 percent of the arable land.

After cereals, the important crops are pulses, citrus fruits, grapes, vegetables, sugarbeets, cotton, oil production

Table 2. Output of principal agricultural commodities in Morocco, average 1961-65, annual 1966-70 (in thousands of metric tons)

Commodity	Average 1961-65	1966	1967	1968	1969	1970*
Wheat	1,117	814	1,090	2,411	1,612	1,870
Barley	1,110	506	1,100	2,223	1,309	1,477
Sugarbeets	86	391	367	785	918	1,000
Oranges and tangerines	528	676	775	720	819	753
Milk	421	501	520	525	535	525
Grapes	396	448	450	470	400	420
Tomatoes	232	302	277	245	270	280
Corn	279	154	255	240	333	276
Meats	154	168	174	175	180	175
Potatoes	193	275	205	160	100	140
Dates	71	95	75	100	100	105
Chickpeas	42	33	67	70	57	94
Broad beans	77	50	52	113	75	93
Millet and sorghum	67	32	54	66	77	88
Figs (fresh)	76	59	65	65	60	60
Peas (dry)	34	30	32	47	41	60
Rice (paddy)	16	19	27	45	46	30
Olive oil	25	18	18	50	16	30
Canary seed	26	21	27	41	20	24
Oats	19	12	11	25	16	22
Lentils	15	9	15	18	20	20
Almonds (in shell)	18	20	24	20	20	20
Wool (greasy base)	15	14	14	12	14	14
Cottonseed	13	16	11	13	12	13
Sunflower seed	6	5	9	4	8	8
Cotton	6	8	5	6	6	7
Grapefruit	13	17	15	13	8	5
Flaxseed	6	3	3	5	4	4
Beans (dry)	4	3	5	7	4	3
Lemons	7	9	5	5	3	3
Tobacco	2	2	2	1	2	2

*Preliminary.

plants and nuts (see Table 2). The main cereal crops which provide the real diet of the people are barley, hard wheat and maize.

Agricultural Extension and Education

The Ministry of Agriculture is composed of several divisions: agricultural research, agricultural education, forests, livestock, economy and Mise en valeur (DMV).

Extension is included in the division as a service which works mainly in the dry-land areas. Each large irrigated area has an independent extension service.

The agents deal directly with the farmers and their work centers largely on the popularization of mechanized farming and of improved methods of cultivation and livestock practices. The extension service attempts to bring to the attention of the farmers the advantage of the use of seed of selected varieties, fertilizers, herbicides, etc.

The agricultural-education program of the country, therefore faces the task of helping those who come from the primitive environment of the traditional, small, subsistence-type cultivator. At the same time an appropriate agricultural education program must be provided for those of a higher economic level who have larger farms where modern farm techniques are followed. It was with this aim that two agricultural schools at the college level were created. The trained students, upon

graduation, are awarded a degree of agricultural engineer (equivalent to a Bachelor's degree).

In addition, twelve (12) specialized vocational agriculture schools, less than college level, are distributed around the country. Most students from these schools become extension agents.

There are regional centers where practical training in agriculture and the handling of farm machinery is offered for boys between the ages of 15 and 16 years, who have finished primary schools.

Agricultural Research

The principal objectives of agricultural research in Morocco are to increase, improve and diversify the production of plants and animals; to effect desirable changes in the physical environment; and to develop means and techniques for producing, storing, processing and marketing farm products.

The various agricultural research institutions may be subdivided into groups:

The Agronomy-Horticulture Research Group operates within the framework of the Agricultural Research Service. It is charged with the responsibility of conducting general research in soils, crops and food technology at Rabat as well as at four experimental farms, more than ten regional stations and a number of specialized institutions and laboratories in various parts of the country.

The Agricultural Engineering Research Group deals with the problem of irrigation and farm mechanization. It works also on the introduction of new techniques over the traditional.

As a whole, the agricultural research, education and extension programs work independently of each other. There is little coordination between them at any level. The extension agents teach the farmers what they learned years ago in school. They are not informed on the latest research findings. In research the researchers are not familiar with the extension agent's or the farmers' problems. Thus agricultural education ignores both areas. Extension agents are not designated as such by title. They are doing extension work without knowing what is really expected of them.

Chapter IV

WHEAT PRODUCTION IN MOROCCO

Production and Consumption

Wheat has been grown in North Africa for centuries.

In Morocco, bread is the staple food of the diet and is eaten at least three times a day and holds a place of high esteem and sanctity. If you drop a piece of bread, you will be asked to pick it up, brush it off and eat it or store it. The Moroccan consumes 130 kg of wheat a year.

After barley, wheat is the most widely grown cereal in the country; it occupies about 1.5 million hectares (3.75 million acres) or 20% of the arable land. Durum wheat is the most important occupying about 70 percent of all wheat areas. This area has been practically the same during the last 30 years. The average yield from 1938 to 1966 was 630 kg per hectare (9.4 bu/acre) and the average production was 1.4 million metric tons (Figure 3). During recent years, favorable weather conditions have resulted in higher levels of production (Table 3).

The country exported wheat more or less regularly from 1939 to 1962. The last large recorded export was 220,660 quintals in 1962. Because of population increases (3% increase per year), Morocco now imports wheat to feed its people. Imports of wheat since 1966 are shown in Table 4. Because of favorable weather conditions, the 1969 production was the

Table 3. Wheat area, production and yield in Morocco during various periods

	Species	Wheat cycles					Five-year average (1967-71)	25-year average (1938-62)
		1966-67	1967-68[1]	1968-69[2]	1969-70	Estimated 1970-71		
Area (Hectares)	T. durum	1,362,000	1,502,000	1,332,000	1,381,000	1,300,000	1,375,000	968,760
	T. vulgare	408,000	475,000	432,000	497,000	500,000	462,400	427,800
	Total	1,770,000	1,977,000	1,764,000	1,878,000	1,800,000	1,837,800	1,396,560
Production (Metric tons)	T. durum	850,000	1,775,000	1,192,000	1,400,000	1,595,000	1,362,400	585,836
	T. vulgare	240,000	636,000	421,000	639,000	612,000	509,600	293,900
	Total	1,090,000	2,411,000	1,613,000	2,039,000	2,207,000	1,872,000	879,736
Yield (kg/ha)	T. durum	624	1,182	895	1,014	1,227	988	605
	T. vulgare	588	1,339	974	1,286	1,224	1,082	687
	Average	616	1,219	914	1,086	1,226	1,012	630

[1]Highest production in history.

[2]Severe epiphytotic of Septoria.

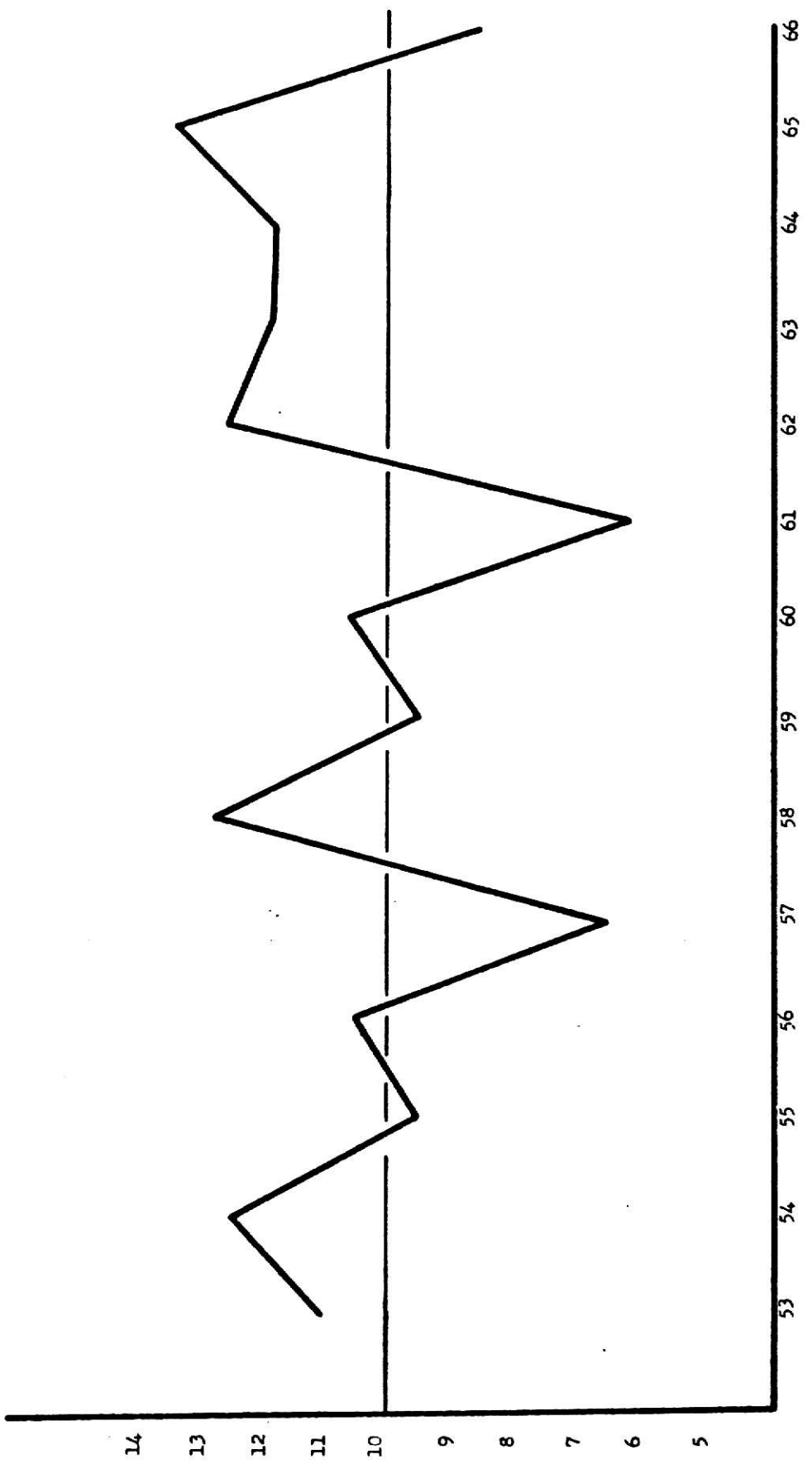


Figure 4. Wheat yield variation in Quintals, 1965.

Table 4. Bread wheat (T. vulgare) importation from 1966-70

Year	Metric tons
1966	537,893
1967	855,189
1968	591,478
1969	98,470
1970	650,000
Average	546,606

highest production in the history of the country and the importation was relatively low.

Recognizing the problem of insufficient wheat production the Moroccan government gives top priority to increasing wheat production.

An agricultural investment code which was announced July 1969 encourages farmers to improve cereal-production practices through a program of research, extension, credit and subsidies.

The wheat-improvement programs are joined by international agencies in their activities and research; U.S. Agency of International Development (AID), International Maize and Wheat Improvement Center (CIMMYT), the Near East Foundation and Food and Agriculture Organization (FAO) are the principal vehicles from outside sources used to increase national production. Many technicians and specialists of these agencies, with their Moroccan colleagues, are stationed in the major cereal-production areas.

Varieties of wheat in Morocco

Table 5. The selected varieties of wheat in Morocco

Variety No.	Variety Name	Degree of earliness	Length of growing period at Rabat (in days)
A. DURUM WHEAT (Triticum durum Desf)			
BD-250	Caid Eleize	Semi-late	175
BD-272	Selbera	Semi-early	170
BD-1658	Zemarek	Semi-late	175
BD-2777	Kyperounda	Early	150
BD-3225	Biskri x bouteille	Early	150
BD-0181	Ouled Youssef	Semi-late	175
BD-2909	Oued Zenata 386	Semi-late	175
B. COMMON WHEAT (Triticum vulgare Host)			
BT-284	Pusa 4		
BT-335	Cadet		
BT-386	Floreuie	Early	145-160
BT-982	Baroota Wonder		
BT-2511	Cailloux (Floreuie-Aurore)	Rather early	150-170
BT-1315	Florette	Rather early	150-170
BT-2306	Pinyte	Early	145-160
BT-2635	Scafoam	Very early	135-155
BT-2970	Indexa	Rather early	150-175
BT-2102	Vinkaflour		
BT-3268	Ble Auril		
BT-908		Rather early	150-170
BT-3597	Mara	Rather early	150-170

The Durum wheat variety considered to be the best is 2777. It occupied more than 50% of the area planted to durum in 1972. Its yield in non-irrigated cultivation often exceeds 30 quintals/hectare and under irrigation attains more than 40 quintals per hectare (60 bu/acre). The superiority of variety 2777 is shown both under irrigation in the southern half of Morocco and under dry-land cultivation in the moist, fertile and well-prepared soils of northern Morocco. It is a variety which tillers well, with a short straw and with little

tendency to lodge. It has shown good resistance to Septoria, rust, smut and brown rust.

The 3225 variety has the advantage of being a very early variety which is of excellent technological quality.

Among the common wheat varieties 2306 is well known although it is susceptible to yellow stripe rust (Puccinia glumarum).

The bread varieties that are more extensively grown are BT-908 and BT3597 (Mara) which were introduced from Italy ten years ago. They occupy most of the bread wheat area. They have good tolerance to Septoria and produce good yields.

There are around ten Moroccan commercial wheat varieties. Most of them originated in Morocco (see Table 6).

Table 6. Morocco's commercially grown wheat varieties

Species	Variety name	Origin	Septoria tolerance
T. durum	BD-2777 (Kyperounds)	Cyprus	--
	BD 3225	Morocco	--
	BD 2909	Morocco	--
	BD 1658	Morocco	
T. vulgare	BT-908	Italy	good
	BT-3597 (Mara)	Italy	good
	BT 2306	Morocco	--

Recent Introduction of New Wheat Varieties

With the assistance of U.S. AID, CIMMYT and Near East Foundation, the recent introduction of Mexican varieties has opened new horizons and has given high hope for the future. The variety Siete Cerros produces a high yield in the south of the country where its acreage is increasing. Tobari, another variety, produces a good yield in spite of heavy epiphytotics of Septoria. These two Mexican varieties have been retained by the Moroccan Seed Certification office. Other varieties (Penjamo and Iria 66) are grown on less acreage.

The most significant result was that, broadly speaking, the Mexican varieties performed very well in the drier regions of the country (south) while the Italian varieties were slightly better in the more humid areas. The high-yielding varieties, Mexican and Italian, out yielded local varieties by 6-10 quintals per hectare. This yield advantage is due not only to the varieties themselves but also to the use of more fertilizer and other improved-production practices. When local varieties are grown under the same conditions, they average nearly 15 qx/ha.

However, local varieties are seldom grown under optimum conditions, therefore the increased yield from the introduction of high-yielding varieties and accompanying improved practices represents a true increase in production.

Limited results indicated that the best date of seeding for the short-strawed Mexican varieties is around the middle of

Table 7. Results of the research service's varietal yield trials in Morocco

Variety	Non-irrigated (Av. of 7 locations)	Irrigated (Av. of 4 locations)	Av. (11 locations)
	qx/ha	qx/ha	qx/ha
Siete Cerros	32.7	43.5 (1)	36.6
BT 908	32.4	38.4 (4)	34.6
BT 3597	30.6	39.0 (3)	33.6
Penjamo	30.5	38.4 (4)	33.4
BD 346/68	28.1	38.4 (4)	31.8
Tobari	24.9	41.4 (2)	31.0
BD 342/68	28.1	34.4 (9)	30.0
BD 324/68	27.6	35.4 (8)	29.9
BT 2306	26.5	35.5 (7)	29.8
BT 554/68	28.5	32.8 (10)	29.3
BD 2777	23.8	27.6 (11)	25.2
BD 3225	20.8	23.9 (12)	22.0

December, nearly a month later than the recommended date for the later maturing local varieties. These varieties thus allow greater flexibility in crop rotation and alternate varieties in case unfavorable weather in November and December delay planting operations.

Recently, the CIMMYT Breeders planted 5586 entries of bread wheat, 521 entries of durum wheat and 48 entries of Triticale.

There were 18 pure lines of bread wheat which out-yielded Siete Cerros, the highest yielding Mexican variety, and the best Italian variety, variety BT 908. Some lines were found with promising insect resistance particularly to Hessian fly, which is a very serious problem in Morocco.

Several durum wheats under observation out-yielded the most popular local durum variety. This is of special interest since durum-wheat production accounts for nearly 3/4 of total Moroccan production. The Triticale lines tested also yielded well (up to 38% more than one of the best Italian varieties) and show promise for Morocco.

Wheat Culture in Morocco

The methods, tools and techniques used on a modern farm are different from those used on the traditional one. Even within one group, the farmers do not follow exactly all the recommendations; but in general, the following is practiced:

Tillage and seedbed preparation. In a modern farm, medium or deep tillage is usually done, depending on the nature of the soil and the period (summer or fall). After the first rains, a two crossing disc harrow is normally done in order to pulverize the soil.

The traditional farmer uses his wooden plow once after the first rains.

Stubble mulching is unknown and not practiced by either the traditional farmer or the modern farmer.

Date of seeding. For the main varieties actually seeded in Morocco, the dates of seeding are:

Varieties	Date of seeding
BD 2777	from 10 to 30 November
BT 2306	from 15 to 30 November
BT 2306	from 15 November to 1 December
Tobari	from 15 November to 15 December
Siete Cerros	from 1 to 15 December

For the traditional farmer, the decision depends on the weather conditions; but usually, he seeds immediately after plowing.

The rate of seeding. The modern farmer uses drills for seeding. He seeds about 100 kg per hectare but 120 kg are normally recommended. Seeds are seeded from 3 to 5 cm apart in rows. The traditional farmer broadcasts the seed by hand. After the seed is broadcast the field may be dragged to cover it lightly with soil.

Fertilization. The modern farmer applies fertilizer uniformly at the rate of 60 kg of nitrogen, 80 kg of P_2O_5 and 60 kg K_2O per hectare at time of seedbed preparation. An additional 60 kg of nitrogen is usually applied at the time the wheat is tillering. The traditional one uses little if any commercial fertilizer. When he does, he broadcasts it by hand without any specific rate.

Production Limitations of Wheat

In general, the characteristics of wheat yield in Morocco are:

- Overall low yields which are particularly accentuated in some regions.

- Extreme variability in yields. These characteristics probably reflect some of the adverse climatic conditions as well as some of the inefficient farm practices employed and unproductive varieties used in many parts of the country.

Climate. The word that describes the climate in Morocco is "irregular." The inadequacy of precipitation in the southern and eastern parts is one of the big limiting factors in those areas; the extreme variations from one year to another both in the amount of precipitation and in its distribution throughout each crop season may delay or hinder the timely planting of the crop. Some of the other adverse climatic limiting factors often involved and which can cause great damage or even destroy in a short time the most promising crop are: drought, hot winds, hail and frost.

Soils. Low fertility level, soil preparation and management in general, limit production. Insufficient working of the soil prevents adequate penetration of rainfall and is not conducive to conservation of soil moisture.

The sowing of seed on land which is either climatically or

topographically unsuitable for annual cultivation is another common limiting factor.

Weeds. Several species of weeds, particularly wild oats, are important factors.

Diseases. Climatic conditions favor development of Septoria and rusts. Septoria is the most important disease, especially on the newly introduced short varieties from Mexico and Italy.

Usually yellow rust is followed by leaf rust and then stem rust due to the gradual increase in temperatures as the season advances.

Insects. The important ones are:

The Hessian fly (Mayetiola destructor)

Sawfly (Ceplius cinctus) and

Wheat stem maggot (Meromyza americana).

Cultural methods. The limiting factors are:

The majority of the farmers still use the wooden plow.

The use of low yielding varieties.

The infrequent and insufficient use of fertilizers and supplements.

The absence of sound crop rotation systematically applied.

The excessive use of irrigation, which often brings about leaching and a progressive degradation of the fertility of the soil.

Sociological factors. The human element and its role in wheat production as far as resistance to accepting new varieties and techniques for obtaining better yield cannot be evaluated adequately.

This problem will disappear when the farmers realize the benefits of using good varieties and techniques for increasing yield. This realization will occur when the extension service, with aid of the wheat specialist, will be able to use efficient teaching methods.

Chapter V

SUGGESTIONS FOR WHEAT TECHNICAL WORK

At Morocco's present rate of population growth (3 percent plus, compounded annually), the population is expected to increase by 20 percent the next five years and maybe double before 1990.

Wheat production on the other hand has been relatively stable. During the good years in the 1950's almost as much wheat was produced as in the 1960's. During this time Morocco had gone from a major exporter of wheat to a major importer. Deficits are expected to increase if population growth rates continue at a faster pace than increased wheat production. Some suggestions to overcome this deficit are:

(1) Conduct extensive technical and research work.

(2) Undertake a major educational effort.

This section discusses how the improved technical work can increase production. In fact, experience in the United States and other countries shows that the proper use of fertilizer, improved varieties, seedbed preparation, use of pesticides and other improved practices brings about a rapid change. Total production could be economically increased by 50 percent without increasing acreage planted to wheat. Major acceptance is required, of these practices with respect to Moroccan conditions.

Use of Fertilizers

Due to rainfall variation, differences in soils and wheat varieties, the same fertilizer grade should not be used for all wheat production. Farmers should be taught the need for fertilization. They should be taught also that there are several kinds of fertilizers. They also should be taught the kinds and amounts of fertilizers to be used and time and methods of application.

There is little published research on rates, time and methods of fertilization. This information was obtained on experimental plots under good tillage and management conditions. No research information is available to show the nature of the response that could be expected under average field conditions by either traditional or modern farmers.

Nitrogen. The recommended rate of N in Morocco for wheat is 20 kg/ha (16 lbs/a) when rainfall is less than 400 mm (16 in) annually. For areas with higher rainfall, the recommendation is 40-50 kg/ha. Generally, when more than 20 kg/ha of N is recommended, the additional N should be applied by February 1. However, in Morocco, there are many areas with soils similar to those in the United States. Examples are eastern Colorado and western Texas, Oklahoma, Kansas, Nebraska, South and North Dakota. For nonirrigated wheat in these areas, recommended rates of N range from none to 100 kg/ha (3, 13, 29, 38).

At the Colby Branch, Kansas Agricultural Experimental Station, the 1972 fertility tests on wheat-fallow showed there was a slight yield increase for the 40 kg/ha (30 lb/a) nitrogen rate; on irrigated wheat, a four-year average indicated 100 kg/ha (80 lb/a) of nitrogen and 25 kg/ha P_2O_5 (20 lb/a) produced close to the highest yield.

Usually, there is little difference in yield for a given quantity of N regardless of whether it is applied in the fall, spring or split between the two seasons (13). Actually, it is recommended to apply all N during fall except on sandy soil.

Yield-limiting factors in these areas are moisture and ability of wheat varieties to respond without lodging. New varieties with short stiff straws are more resistant to lodging. However, these short varieties lodge in western Kansas and the reason is not known yet. As much as 150 kg/ha (120 lb/a) of N is recommended for these varieties.

For irrigated wheat, 50-150 kg/ha of N is recommended for long-strawed varieties and up to 220 kg/ha for short-strawed varieties (1, 11). The source of N used has little effect on yield responses (29). For top dressing, ammonium nitrate, ammonium sulfate and urea give comparable results.

For N applied at seeding time, USA farmers generally prefer N and P to be combined in the same fertilizer; it is more convenient to handle a single fertilizer. Also presence of N in close proximity to P stimulates plant uptake of P. Earlier growth and increased yield is the frequent result. Ammonium

phosphate and ammonium phosphate nitrate are common fertilizers in the USA wheat belt.

In future work for Morocco on nitrogen, results obtained in the United States may be taken as guides in setting up experments.

Phosphorus. The recommendations in Morocco for P range from 25 to 65 kg/ha of P_2O_5 depending mostly upon soil texture. An average of 40 kg/ha (32 lb/a) of P_2O_5 is chosen regardless of rainfall.

In the United States, soil tests are used extensively to determine best rates of phosphorus application; rates range from 10 to 60 kg/ha of P_2O_5 for nonirrigated wheat and up to 80 kg/ha (65 lb/a) for irrigated wheat (11, 13, 38). Greatest demand for P is by the seedling-wheat plants and there is little difference among varieties at this stage of growth.

For very high yields the rate of P application is increased to prevent depletion of soil P reserves. Source of P used is important for wheat, especially on alkaline soils. On these soils, phosphatic fertilizers should have a high content of water-soluble P. Superphosphate and ammonium phosphate are satisfactory but rock phosphate which is used by some Moroccan farmers is not.

Potassium. Nearly all soils in Morocco are calcarous. This indicates that little leaching of soluble minerals has occurred, especially on soils with a silt loam or finer texture.

Such soils should be high in available K. However, the antagonism between excess calcium and available K might be sufficient so wheat would respond to K fertilization. Also, centuries of cultivation, with virtually complete removal of straw and grain from the land could have depleted the available K in the soil. Research has shown the amount which will be necessary for different areas.

In the United States, the situation is quite comparable to Morocco. Many wheat belt soils are calcareous. But, few, if any, of these soils have been cropped more than 80 years. Generally, wheat does not respond to K fertilizers on these soils. As cropping continues, especially with higher and higher yields, K reserves will be depleted and K fertilization will be needed (13).

When K is used for wheat, the source is not important. The most economical source will be potassium chloride.

Methods of Application

Seventy-five percent of the wheat area in Morocco is planted by traditional farmers. They broadcast the seed and if they fertilize, broadcast the fertilizer and then scratch the soil with a stick plow. The research center (RDA) recommends, instead, plowing, broadcasting phosphate and harrowing, then broadcasting the seed and nitrogen and harrowing again.

The method of applying fertilizer to wheat in the United States is quoted from Growing Wheat in Kansas (13):

> Recommended phosphatic fertilizers and mixed fertilizers always should be applied for wheat with a combination grain and fertilizer drill. This method of application is at least twice as efficient for phosphorus as broadcasting it independently. There is no substitute for the combination grain and fertilizer drill when efficient use of phosphatic fertilizer is the major objective.
>
> Nitrogenous material may be applied ahead of planting, at planting or as a top dressing after planting. Top dressing may be made any convenient time during fall, winter or early spring.
>
> . . . Potash normally is applied to wheat land only in a mixed fertilizer, most efficiently at planting with a combination grain and fertilizer drill. Both phosphate and potash should be applied then. Top dressing after planting of either of those elements are ineffective.
>
> Wheat not only is the most consistent among Kansas crops in its response to fertilizer, but also is one of the safest and easiest crops to fertilize. Yield seldom is reduced by fertilizer application, either under extreme drought or from excessively large amount of fertilizer.
>
> Germinating wheat seeds are much less susceptible to injury from fertilizer applied in the row with the seed than are seeds of other important Kansas crops. However, there is some danger of wheat injury from excessive amounts of nitrogen and/or potash in dry years, especially on sandy soils. This danger virtually can be eliminated by using potash only where it is known to be required and by not applying excessively large amount of nitrogen at planting under drought conditions.

For Morocco, it is not recommended that all wheat be fertilized. The hazard of wheat production in the drier areas (less than 300 mm rainfall annually) is too great to justify fertilization on an economic basis.

Value of the increase in yield must exceed the cost of the fertilizer if fertilizers are to be used by farmers. That is

$$\frac{\text{value of increase per hectare}}{\text{cost of fertilizer per hectare}} > 1.00$$

When the ratio exceeds 1.00 only slightly, farmers will have a

high risk applying fertilizers. This, unfortunately, concerns more than 300,000 hectares of Moroccan dryland. In general, the higher the ratio, the more rapidly fertilization will be accepted by farmers.

Development of New Varieties

Morocco produces both durum and soft wheats. The yields are generally low, for which there is a little justification.

The newly introduced Italian and Mexican varieties, after a few years, showed good results. Total production and net gain per hectare are much higher than those obtained with local varieties. Illustrating this, in 1970, a research station, in cooperation with a USAID specialist, a demonstration of recommended wheat production under irrigation on four hectares of land on a farm just west of Marrakech (southern part of the country). A total of 60 kg/N/ha was applied and irrigation was made on a 2-3 weeks basis. One hectare was sown to each of three varieties, BT 2306, a local bread wheat, and Siete Cerros and Tobari, two Mexican varieties.

The yields obtained were 63 qx/ha for Siete Cerros, 60 qx/ha for Tobari and 30 qx/ha for BT 2306. Total production costs, including land rent, were equivalent to only 18 qx/ha leaving an extremely good profit for both Siete Cerros and Tobari. The net return on Seite Cerros can be compared not only to other cereals, but can be compared very favorably even with the best results obtained with irrigated citrus in the area.

Unfortunately, those varieties are susceptible to Hessian fly (Phytophagus destructor), sawfly (Cephus pugmaues and C. circtus), cereal leaf beetle (Oulema sp.) and stem maggot (Meromyza sp.). Several of these insects, especially Hessian fly and sawfly, reach levels of severe infestations. Septoria sp., mildew and all three rusts of wheat occur on those varieties. The local varieties are more resistant.

If a proper selection of nursery sites is made, it should be possible to develop varieties with a combined broad spectrum of resistance to both insects and diseases. Also, Moroccan varieties should be crossed with high yielding, stiff-strawed varieties to incorporate insect and disease resistance and Moroccan quality factors into new wheats. Such an accomplishment would be valuable to Morocco as well as neighboring African countries.

This work can be done only if there is a close collaboration between Moroccan breeders and international agencies (USAID, CIMMYT, Rockefeller Foundation, . . .).

As superior varieties are developed they should be multiplied and released to farmers.

At the same time, assistance to local seed-production agencies will provide adequate quantities of high quality seed. The farmer can take advantage of the high potential yield of those varieties. It is known that improved cultural practices and increased fertilizer rates are wasted if the seed used is of poor quality.

However, attention has to be directed to another serious problem: most of the newly introduced varieties are bread-wheat varieties. A problem may result when the high yielding bread-wheat varieties replace durum varieties, thereby upsetting the long-time balance between these wheat types. Because of the large demand of durum wheat for couscous (the staple dish of the Moroccan diet), it is essential to develop in the near future semi-dwarf durums capable of competing with the high-yielding bread-wheat varieties. Otherwise, in a few years Morocco could find itself with a surplus of bread-wheat and a shortage of durum wheat, just the opposite of the present situation.

Soil-Management Practices

All the crops, particularly wheat, have many requirements. They need moisture, plenty of air, proper temperature and adequate nutrients. Soil-management practices vary over the country and from season to season depending on soil moisture, structure and weed growth. Definite rules to follow are not possible. Rather, it is necessary to determine what is done in the United States and particularly Kansas. This information can be used later as a guide for further work under Moroccan conditions.

Mechanization of Traditional Farms

To build a modern and productive agriculture in Morocco requires the introduction of new materiel and machines,

especially for the traditional farm. There, the traditional farmer still uses the same type of implements used at the beginning of recorded civilization. Even the larger traditional farms have made little progress in adopting simple, animal-powered, steel land-preparation tools that are, however, available.

Experience several generations ago in Europe and the U.S.A., and more recently in Japan, demonstrated clearly the potential for mechanization of small farms. Small farms in Morocco can be mechanized with animal power. It is not necessary to have tractors and electric motors to benefit from mechanization. In fact, unusual care should be taken to guard against over mechanization. Locally manufactured, small animal-powered equipment, like a small combination grain-fertilizer drill are available; but too few farmers understand their potential and how to use them. The use of new materiel is basic because improvements such as deeper cultivation are necessary before optimum yields can be approached.

Seedbed Preparation

As Leonard and Martin (21) observed, the seedbed preparation in the United States differs from humid eastern states to semi-arid western states.

In eastern states: The important factor in wheat seedbed preparation is the depth of plowing and date of plowing or

initial tillage. For the depth, it has been indicated by Growing Wheat in Kansas that:

> tillage deeper than 7 inches does not increase wheat yields enough to pay for the added cost. Sometimes, lower yields followed deep plowing. On the other hand, plowing as shallow as 3 inches also lowered yields (13).

This explains the usefulness of the Moroccan traditional stick plow which goes no deeper than 1 or 2 inches in the soil.

The date of plowing is also very important:

> Plowing 7 inches deep on September 15, followed by disking on September 25, gave an average yield of 20 bushels per acre, whereas plowing 7 inches deep on July followed by disking August 15 and September 25 gave a yield of 33.9 bushels (13).
>
> Experiments in eastern Kansas indicated that one bushel of wheat per acre is lost for each week that plowing is delayed after July 15 (21).

Studies indicate also that

> cultivating a wheat seedbed after initial tillage is necessary only to control weeds and to prepare a friable, firm seedbed. More cultivation than that has no value and tends to destroy organic matter and to break down soil structure (17).

The implements that are commonly used are: the plow, the spiketooth harrow, and the tandem disks. The one-way disks have been effective also.

In western states: The lack of moisture in these states is tied closely with the methods of seedbed preparation for moisture conservation. The common tillage implements used are the one-way disk, sweeps and spring-toothed harrows, and rod weeders. The primary method used is summer fallow for moisture storage in dryland areas. In Kansas, summer fallowing stores 15 to 20 percent of the precipitation which is extremely

beneficial to wheat. Some results in Kansas showed that every inch of available moisture above the minimum will produce an additional 3.5 bushels of wheat per acre.

After harvest, the one-way plow often is the first tillage operation. Early tillage has many advantages: more moisture is stored and more nitrate made available.

Erosion Control

The primary purposes of tillage are to control weeds and to prepare a seedbed, but tillage procedures tend to destroy the structure of the soil. The degraded structure then lends itself to further destruction by making the soil susceptible to wind and water erosion. An inestimable quantity of good soil is lost every year by wind and water erosion. This loss of soil can reduce the yields of wheat and other crops.

Wind-erosion control: Principles of wind-erosion control can be applied by following a number of practices.

Practices successfully used to control wind erosion on dry-land cultivated soils include stubble mulching and minimum tillage, herbicides, cover crops, strip-cropping, crop rotation, wind barriers and shelterbelts.

Stubble mulching is one of the most effective ways to control wind erosion as well as water erosion and conserve soil moisture. The Soil Conservation Service of the U.S. Department of Agriculture defines stubble mulching as:

> the managing of plant residues on a year-round basis in which harvesting, tilling, planting and cultivation operations are performed in such a way as to keep protective amounts of vegetative material on the surface of the soil until the next crop can provide its own cover (36).

The main purpose of minimum tillage is to grow crops with fewer tillage operations and thus reduce costs of crop production. Minimum tillage also conserves residue, reduces soil pulverization and holds down soil losses by wind and water.

Water-erosion control: Practices that reduce the beating action of rain, slow the runoff of water, reduce the amount of soil carried away and make the soil more permeable to water are good ones to follow. The most important of these supporting practices for cropland are contour tillage, strip-cropping on the contour, a terrace system, and stabilized waterways.

None of these practices are used in Morocco and most of them could be applied.

Regardless of tillage procedures used in wheat culture, certain requirements must be met. These are:

> Weeds must be controlled during the fallow period.
> Any compacted surface condition must be corrected in order to insure infiltration of subsequent rainfall.
> A seedbed must be prepared so that the seed can be placed in firm moist soil.
> It is not necessary that the entire land surfaces be firm; in fact, the area between the rows should be loose in order to inhibit germination of weeds and to allow rapid movement of water and air.
> Sufficient residues must be left on the surface to retard wind and water erosion and prevent surface crusting (31).

Seeding Practices

Time of seeding. There is no specific best time to seed wheat. The best period varies from one year to another. Late-sown and early-sown wheat each have one advantage and inconvenience. The early seeding makes wheat more subject to Hessian fly injury. Late-sown wheat does not permit the roots to penetrate the ground deeply enough and the plant is more subject to winter injury than wheat sown at an optimum date.

In general, wheat seeding begins in all areas of Kansas by September 10. The peak rate of seeding is usually reached in the last 10 days of September. Wheat planting is usually completed by the end of October.

In the rainy regions of Morocco the sowing date is often decided by the amount of the autumn rains. It is recommended that when the rains are normal, the relatively late varieties should be sown in November. The earlier varieties can be sown at a later date. In dry regions, where there is no danger of too-prolonged rainy periods and where irrigation permits sowing whenever one wishes under good conditions, the optimum time for sowing should perhaps be studied for each variety. The later varieties would have priority as being the varieties which should be sown first.

Methods and depth of seeding. The broadcasting of wheat by hand is still used largely in many parts of Morocco and particularly by traditional farmers. After the seed is broadcast the field may be dragged to cover it lightly with soil.

As a result some seed is planted too deep to emerge and some so shallow that it sprouts and dies for lack of moisture or is eaten by birds.

Seeding has to be done by drills. Small combination grain-fertilizer drills with animal power can be used on traditional farms. In addition to improved uniformity of seeding drilling would save time and seed.

"Practically, all wheat in Kansas is sown with a grain drill and, in general, there appears to be no good reason to use other methods" (17).

Concerning the depth of seeding, experiments at Manhattan have shown that 5 cm (2 in.) seeding depth is the most advantageous. In western Kansas it is desirable to place the seed in moist soil and often deeper than in the eastern part.

Rate of seeding. Research showed that in western Kansas heavy seeding rates gave a large amount of leaf growth in the fall. This is not desirable because it uses too much soil moisture in the early life of the plant. Other experiments showed that early seeding from 20 of September to 10 of October in eastern Kansas requires 120 kg/ha. For later seeding 150 kg/ha (8 pecks) are better. In the drier area (western part) 60 kg/ha are judged to be enough. However, the irrigated areas require about 100 kg/ha or 120 kg/ha if the seeding is delayed.

Weed Control

Weeds are the primary limiting factor in many fields in Morocco. Poor land preparation often resulted in poor stands which, coupled with poor tillering and poor plant growth from inadequate fertilization, allowed usually heavy weed infestation. Weed competition for inadequate fertilization and limited available water, especially in the southern part of Morocco, further reduce the wheat-yield potential. Wild oats are particularly important and remain the major weed problem in Moroccan wheat production. Wild oats are not affected by most herbicides used in the country.

In Kansas, where the problem is not so serious, the annual weeds that are most common in fall-seeded wheat are: cheat, Russian thistle, Kochia, lambsquarter, pigweed and wild buckwheat.

Weeds in wheat fields are controlled by cultural practices, the use of chemicals or their combination.

Cultural practices. Tillage, fertilization, rotation and any practice which helps maintain a vigorous stand is usually beneficial. Rotations that include a cultivated row crop or a fallow season are effective controls. Spring tillage just prior to blooming of the weeds effectively controls winter-annual grasses during the fallow season. Also, a good quality seed may make a more vigorous seedling which will compete more strongly with weeds.

Chemical control (26). The various formulations of 2,4-dichlorophenoxyacetic acid (2,4-D) to control weeds in wheat fields have been used more widely than any other chemical. To control susceptible broadleaved weeds, generally this formula is applied: 0.3 to 0.4 kg/ha (1/4 to 1/3 pound of 2,4-D acid equivalent per acre) as an ester formulation or .25 to .35 kg/ha (1/2 to 2/3 pound acid equivalent per acre) as an amine formulation. Least injury can be expected on wheat if the product is applied from full-tiller to early-boot stages. Application of 2,4-D is most injurious when applied from early-boot stage to milk stage. The product cannot be applied in the fall.

After soft-dough stage the application of the ester formulation of 2,4-D at 2/3 to 1 pound acid equivalent per acre is suggested (.35 to .5 kg/ha).

Bromoxynil 0.2 to 0.25 kg/ha can be applied in the spring to seedling weeds until boot stage of wheat. The product may be used to control wild buckwheat.

Dicamba 0.06 to 0.12 kg/ha may be also used to control wild buckwheat after winter dormancy but before joint stage of wheat.

Dalapon has been used successfully as a preplant or fallow treatment in the control of wild oats.

Irrigation

Morocco is a dry country. Of all the factors that contribute to a solution of the problem of low wheat production in

Morocco, maximum use of available water is one of the most important. For centuries Moroccan farmers have irrigated their lands. Traditional irrigation now is giving way to modern projects in which concrete canals replace earthern canals. Huge dams and reservoirs replace dams of stakes and twigs. Because of the high yields expected on irrigated lands Morocco has placed great stress on irrigation development. One million hectares are planned to be irrigated by 1974. More than 500,000 hectares are already under irrigation.

The normal rotation in irrigated land includes wheat on more than one-fifth of the land. Generally little or no fertilization is used on that wheat. In the rotation wheat normally follows cotton or sugarbeets which are heavy fertilizer users. Yields are in the range of 15 to 20 qx/ha. With proper fertilizer management and adequate irrigation yields could easily be doubled. For example and comparison a look at work on irrigated wheat in Kansas is desirable.

It was recognized that wheat, with barley, has low total moisture requirements compared to other field crops. However, wheat responds well to irrigation water when a moisture deficiency occurs. Irrigated wheat at Garden City (12) used up to 24 acre-inches of water with unlimited moisture. Approximately half of it was used after wheat reached the boot stage as is shown in Table 8.

Table 8. Water use from emergence to various stages of plant development, irrigated wheat grown under unlimited soil moisture conditions, Garden City, Kansas (18)

Period	Water use inches
Emergence, October 5-10 to:	
Beginning spring growth, March 1-15	5
Jointing stage, April 28-May 3	10
Boot stage, May 13-18	12.5
Flowering stage, May 27-30	15.5
Milk stage of grain, June 5-8	19
Dough stage of grain, June 12-15	21
Complete maturity, June 25-30	24
Total	24

The daily use by physiological periods for irrigated wheat grown under optimum soil moisture at Garden City (25) is important and is reported in Table 9. The daily rate of use decreases during fall growth to a minimum during winter and then increases during early spring growth to a maximum during flower-to-milk stage of grain formation.

Now that the water use and the daily rate use are known irrigation requirements can be predicted. Whether or not irrigation will increase yields of wheat depends upon several factors, mainly the water-holding capacity of the soil. The amount of water a soil will hold and provide for plants must be known in order to predict how many times wheat must be irrigated (12) (Table 10).

Table 9. Daily use by physiological period for irrigated wheat grown under optimum soil moisture at Garden City (25)

Period	Water use inches/day
Fall (October)	0.07
Winter (November-February)	0.03
Beginning of spring growth of the jointing stage (March-April)	0.09
Jointing to boot stage (May 1-15)	0.16
Boot to flower stage (May 15-28)	0.25
Flower to milk stage (May 28-June 6)	0.35
Milk to dough stage (June 6-13)	0.30
Dough stage to maturity (June 13-28)	0.15

Table 10. Available water-holding capacity of soils in Kansas as affected by texture (25)

Texture	Inches of available water (6 foot profile depth)
Coarse sand	4.50
Fine sand	6.00
Fine sandy loam	9.00
Silt loam	12.00
Clay loam	13.20
Heavy clay	12.00

It is evident that coarse-textured sandy soils need to be irrigated more frequently than fine-textured clay soils.

The amount of water used by wheat plants at various stages is known as well as the quantity of water a given soil will hold. Now an irrigation schedule considering the seasonal rainfall can be developed.

Wheat is usually irrigated by one of four methods: border systems, basins, furrows or sprinklers. Sprinklers, however, have taken on more and more importance in Kansas irrigation.

Research Coordination

Morocco's research, in general, is unstructured, unmanaged, unevaluated and unrelated to goals.

If research is to be adaptable to Moroccan realities basic research has to be reduced and applied research given top priority. Research has to give more attention to provide answers to farmers' problems. Results of research already completed is largely unknown by the public. Research reports are technical writings. Most of them are classified and filed in administration offices while farmers, modern or traditional, still face their difficulties.

Research has to be "need-oriented" and coordinated. Such coordination will only be possible with a close relationship with an extension service that will transfer the information from the researcher to the farmer and the farmers' problems brought back to the researcher. Some coordination within the

research organization is necessary. While the RDA of the Ministry of Agriculture is doing some kind of research, the university (colleges of agriculture) and other private agencies do the same kind of work as well. All this research is done without coordination between these different organizations. This is not only a loss of capital and time, but a loss of precious researchers that are badly needed for other urgent work.

In the United States, the coordination and the program sections exist as the following statement summarizes:

> . . . The secretary of agriculture . . . establish an appropriate Research Review Committee comprised equally of representatives of the land-grant experiment stations, department research activities, affected producers organizations, and with appropriate industry representation to examine fully each and every line of agricultural research conducted by the department and by the state experiment stations . . . which would be directed toward the general objective of making recommendations on the respective roles, responsibilities and areas of cooperative effort that should be examined to arrive at an overall evaluation as the basis for future recommendations involving the realignment and reassignment of research responsibilities for existing programs, and also to be used as the basis for projecting agricultural research requirements for the next several years (U.S. Congress, 1965).

In July 1965, a subcommittee of the task force on the classification system reported:

> The Classification Subcommittee is charged with the task of developing a classification system which will permit a uniform classification of the totality of agricultural research in the U.S. Department of Agriculture, the state agricultural experiment stations, other public research agencies, private nonprofit agencies and industry . . . will form an information retrieval system which will facilitate more effective planning, development, evaluation, reporting, administration and

> coordination of the total agricultural research program, both within and among the several research agencies and organizations engaged in agricultural research (8).

In order to arrive at such coordination in the Moroccan research services, an establishment of national goals for agricultural research is necessary. A second activity which will play a major role in the estimation of future research needs is dividing totality of agricultural research into major research areas. One of the areas will be research of field crops and one division of field crops research will be a "division of wheat research." The next step will be the planning of future research on wheat. This planning has to take into consideration the urgent farmers' problems.

The division of wheat research has to be in close relation to the extension services which are as illustrated in the suggested organization (see page 78).

The planning of future research on wheat has to take into consideration the urgent farmers' problems and all the factors that will contribute to increased wheat production in the country. Some of these factors were discussed in the section on development of new and resistant varieties. The following variables might have priorities in the future research:

Depth of plowing and time of seeding.

Rate of fertilization as well as time of applying fall fertilizers such as preplant, planting time and post-plant.

Fertilization of sandy soils, especially with nitrogen in the spring.

Irrigation-fertilizer relationship.

Effect of previous crop on fertilizer requirements of wheat.

Rotations for different rainfall area: The modern farmers in areas with more than 300 mm (12 in.) of annual rainfall may go to continuous wheat rather than wheat-fallow. For traditional farmers wheat-fallow rotation may be suitable but the method of handling fallow land needs investigation. Such land is allowed to grow up in weeds which are usually grazed. This negates the purpose of fallow, which is to store moisture for the following crop and to accumulate nitrogen. A crop of weeds removes both nitrogen and moisture.

Studies are needed on causes, effects and control of soil erosion.

Nearly all research in Morocco is conducted on experiment-station fields under nearly ideal conditions. Research under practical farm conditions and especially under traditional farm conditions is needed.

In order to help the farmers select wheat varieties best for their areas and conditions, the research division has to compare annually both new and established varieties in the country's major production areas.

Booklets, bulletins, magazines have to be published and widely distributed to technicians and farmers (Table 11). Table 11 shows the comparison of wheat varieties grown in Kansas, and is revised annually. It gives an idea of what should be done under Moroccan conditions.

Table 11. Comparisons of winter wheat varieties grown in Kansas for important agronomic traits, disease and insect resistance, and quality characteristics[1]

Variety	Relative				Resistance or tolerance to							Relative quality in terms of		
	Maturity	Test weight	Straw strength	Winter hardiness	Bunt	Loose smut	Leaf rust	Stem rust	Hessian fly	Wheat-streak mosaic	Soil-borne mosaic	Milling	Mixing	Loaf volume
Pronto	0	1	4	7	7	-	7	7	7	7	1	2	2	2
Triumph 64	1	2	4	7	8	3	8	8	8	4	8	2	5	5
Danne	1	3	5	7	6	-	7	7	8	-	7	3	5	2
Parker	2	2	2	5	6	4	3	9	2	8	7	2	2	6
Satanta	2	2	5	5	2	0	7	7	8	7	1	2	2	2
Chanute	2	2	5	5	2	-	7	7	8	7	1	2	2	2
Kaw 61	3	1	6	6	2	4	6	6	6	7	8	2	1	5
Scout	3	4	5	3	6	3	5	2	7	7	9	2	3	3
Scoutland	3	3	3	3	6	-	5	2	8	7	9	2	1	3
Eagle	3	4	3	3	6	-	5	2	7	7	9	2	1	1
Shawnee	4	4	2	3	6	7	6	6	2	7	1	2	1	1
Gage	4	5	4	3	7	5	3	2	4	7	8	2	5	4
Tascosa	4	1	2	8	8	6	6	8	8	8	1	1	1	0
Centurk	4	4	5	2	7	-	4	2	6	-	7	2	1	3
Bison	5	4	3	3	2	8	8	9	8	4	9	2	3	1
Warrior	6	5	3	1	6	3	8	9	5	8	8	2	2	2
Lancer	7	3	3	1	7	9	8	2	8	8	8	2	3	1
Trader	8	5	5	1	7	-	8	1	8	7	7	2	1	2
Turkey	8	6	8	1	7	8	6	8	8	7	7	2	3	2

[1]Rated on a scale of 0 to 9; except for maturity (where 0 is earliest and 9 latest), 0 is best and 9 poorest. Zero means excellent or exceptional; 1 to 3, good or resistant; 4 to 6, average or moderately resistant; and 7 to 9, poor or susceptible. Ratings given are current averages for the state as a whole, and are subject to modification when applied to individual location or to future years.

Chapter VI

SUGGESTIONS FOR EXTENSION WORK

Objectives

As we indicated earlier, the overcoming of wheat-production deficit in Morocco can occur under an intensive technical and research program. But overcoming this deficit won't occur if the adapted and useful technical information doesn't reach the farmer. Agricultural production is primarily the result of the effort of millions of farmers. In most Moroccan rural areas there could be an immediate increase in wheat production if more of the knowledge already available for improving agricultural production were put into practice. But how to put knowledge to work seems to be the problem! Joseph Di Franco (9) noted that many people still think all we have to do is "tell" the farmer. This is not true for telling people does not get the work done. It takes more than telling, it means demonstrating, proving, discussing, convincing and helping people in order to put knowledge to work. This means educating people.

Education is the most permanent way through which to bring about change. Extension is a process of educating rural people. The main objective of agricultural extension then, is to help the farmer make the "right" decisions and to implement them in an effort to raise agricultural productivity by improving the technical and management side of farming.

Effective extension education must be based upon freedom of choice and voluntary participation. Participation in extension activities functions best when the democratic processes are applied. The objective in extension is to help people define the direction in which they want and need to go and then provide assistance to them in traveling in those directions.

As stated by M. C. Burritt "It is the function of the Extension Service to teach people to determine accurately their own problem, to help them to acquire knowledge and to inspire them to act, but it must be their own action out of their own knowledge and conviction" (5).

To improve any society you have to go beyond the school and educate people where they are. Extension has to do that; it has to extend out and "help people to help themselves." Extension must be a form of education that teaches people to do things, not a system of doing things for people. This would give a bad habit to some Moroccan farmers.

The objective of extension work goes beyond that of obtaining increased production which, of course, is the goal discussed herein. This is a way to increase agricultural production, particularly wheat production, and improve the economic conditions of the Moroccan farmer. It is also necessary that agricultural extension, in a second step, direct its efforts toward obtaining a general improvement in the level of living of the agricultural producers. This can be obtained through increasing the knowledge of the farmer, the understanding of his own

problems, the acquisition of improved practices and abilities and the development of new attitudes.

The success of such an effort depends on the winning of the confidence of those to be served, depends on how well extension services are organized and depends on the competence of the extension workers.

Reorganization

To make extension work more efficient the present extension organization, as it was described previously, should be modified.

Without full coordination of extension, education and research, extension cannot give maximum service. On the other hand, any reorganization that does not take into consideration the basic existent administrative structure cannot be successful.

The Extension Service has to be elevated to a division in the Ministry of Agriculture to the same level of other divisions: research, education, forestry, etc. The extension division would then have a director who would coordinate extension work throughout the country.

In order to respect the existing administrative structure within the Ministry of Agriculture, it is proposed that the seven OMVA (irrigated land areas) will be under one assistant extension director. Each OMVA is divided into a certain number of CMV (or counties); a total of 75 CMV handle agriculture programs in irrigated perimeters. The fourteen SP (dry land) areas would be under a second assistant director of extension.

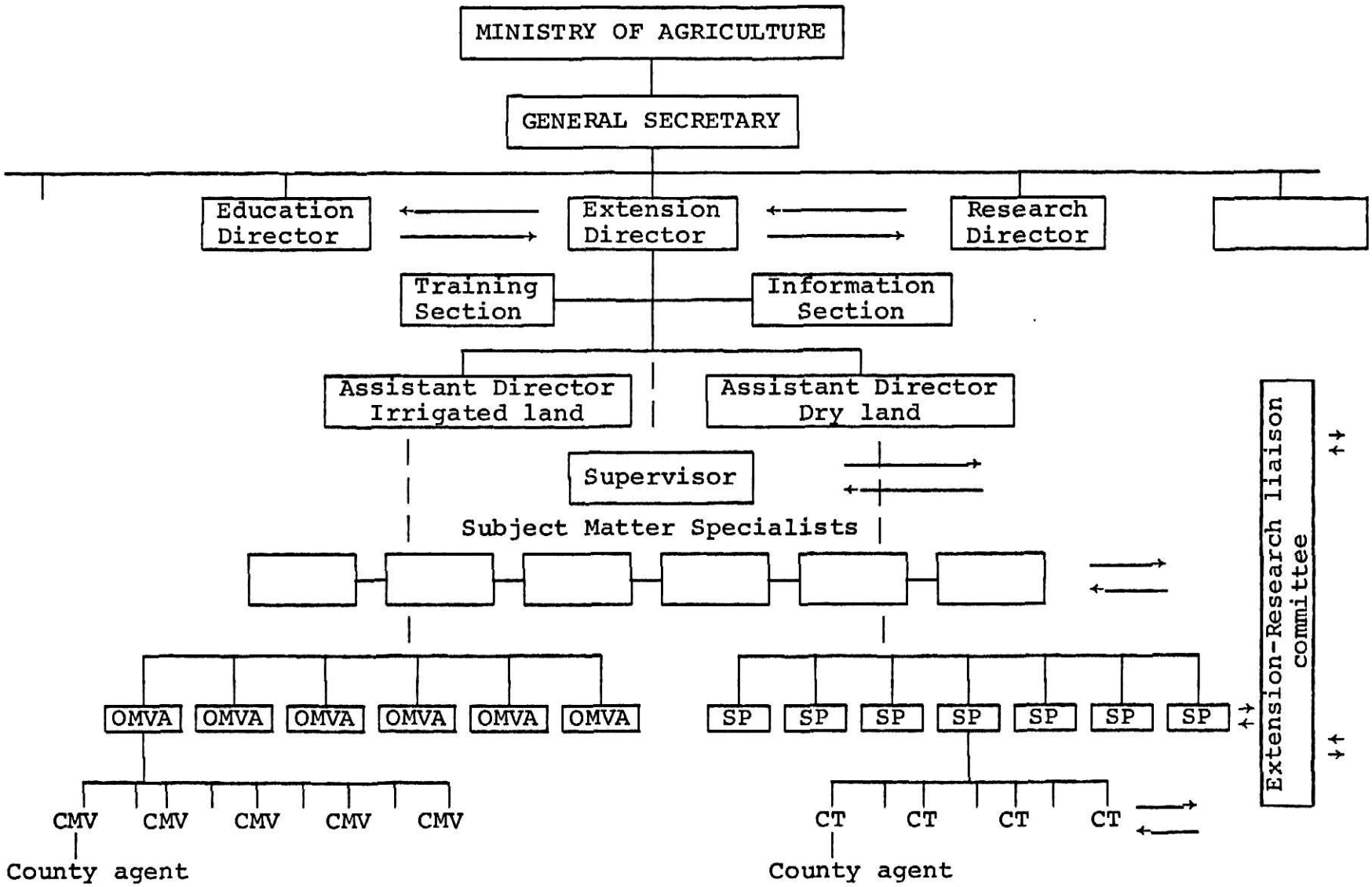


Fig. 5. A proposed administrative reorganization of extension service

These 14 SP are divided into 90 CT (or counties) which are responsible for agricultural programs in rain-fed areas.

Each CMV and CT is directed by an extension agent and his assistants. All CMV and CT extension agents could be assisted by a team of Subject Matter Specialists who will be given assistance in all agricultural subjects. This team will be coordinated by a Supervisor who would report directly to the extension director. When a greater number of subject matter specialists becomes available then as a second step, two teams could be utilized: one for the irrigated area and one for the dry land area. Later on, if their number increases, a team for each OMVA and SP would be even more desirable.

To orient all the extension workers in this new organization, directors must clarify the nature and purpose of the organization and explain the role attended from each.

To support development and improvement programs in rural areas, there are three main areas of responsibility: (1) administrative, (2) programming and (3) technical knowledge. Through a reorganization, the extension staffs will be sharing these responsibilities.

The Director: will have the major responsibility for administrative duties. He will administer all funds, look after projects and plans, examine and approve all publications. He will have to represent the organization at a higher level and coordinate the work with the other divisions within the Ministry

of Agriculture, especially with the divisions of education and research at the director level.

The Assistant Directors: will have to help the director carry out administrative duties. They will concentrate more than the director on specific problems in their field. They, also, will help in programming and coordination.

The Supervisor: will have certain administrative functions assigned to him by the director. He also will have the responsibility to help agents in program development. He will coordinate the visits of Subject Specialists around the country and will try to satisfy the demands of the two assistant directors in this matter. The Supervisor, with the two assistant directors, will determine needs of agents in training and skill development.

The "information" specialists are under direct supervision of the Director. The subject-matter specialists are under the control of the Supervisor.

Subject-Matter Specialists: Morocco has no Subject-Matter Specialists. The general belief is that they are not needed. Technical information is sought directly from research sources. An extension information unit to help in the preparation and dissemination of new information to field personnel and farmers does not exist. Contact between extension agents and specialists does not occur because there are no extension specialists.

In this reorganization one of the important areas of work falls on the shoulders of the Subject-Matter Specialists. They will not have any administrative responsibility but they will be the major resource of technical knowledge. Where new knowledge is created almost daily in agricultural research programs, eventually there arises a need for resource people who can keep up with the new knowledge to support the growing program.

In extension, the agent becomes more and more involved in organizing and planning outside his technical field. He may need to use more common language when passing on technical knowledge. Since extension education will be aimed at rural people, the use of technical knowledge depends upon the understanding the farmers have of the subject. The specialist must also be able to transfer rural people's problems related to his technical area to the researchers.

Some Subject-Matter Specialists will have to adapt to the role of "information specialists." These specialists will have to work in the information section and develop visual aids, bulletins and training material for agents' and farmers' use. They have to be responsible for reviewing the research in their fields of specialization and for writing technical notes and other information material in a form that can be used by extension field staff for teaching farmers. The materials will be produced as simple bulletins, guides and recommended practices on the major crops and for major areas.

A good Subject-Matter Specialist will be judged on his ability to keep informed in his technical field, get along with extension agents, help farmers put knowledge to work, promote national interests, and help develop educational efforts through the training of agents, developing demonstrations and bulletins and interpreting technical data for practical application.

CT and CMV Extension Agents: have the most important role and responsibility in the development and execution of programs. They are at the farmer's level and they determine the program, based on the needs of the people. These agents must determine problem areas, possible solutions, available resources, then plan, teach and assist people to improve their situation. Those agents are already working in CT and CMV areas. They need more skill and training. A later discussion in the "Introduction of Change" section will cover what CT and CMV extension agents, as well as all extension workers, should do, how they should behave and understand the farmer. Nevertheless, one important point should be discussed here: the CT and CMV extension agents are called "Director of CT" or "Director of CMV." We suggest that their name should be associated with extension work. By eliminating the title "Director" the farmer, as well as the agents themselves, will understand their role and what is expected of them, without confusion or misinterpretation. Instead of "Director of CT or CMV," "extension agent" or "extension responsible" (Vulgarisateur) will be more suitable.

Cooperation Between Extension, Research, and Education

By creating the proposed extension division, the research, education and extension divisions will be of equal importance. These three fundamental divisions will be administered by the Ministry of Agriculture and will afford a rigid and lasting foundation for the development of agriculture. Close coordination and relationship between these divisions will allow the available resources in personnel, equipment, facilities and finances to be utilized to the fullest extent.

Education-research coordination. The two schools: "Institut agronomique" and "Ecole 'Nationale d'Agriculture de Meknes" as well as the regional schools will coordinate their research projects with the research division. This way, they will avoid research duplication which is now happening. This will save funds and personnel. On the other hand the results will be transmitted immediately. The teacher can use them in his teaching and the research division will send them to the extension division. The lack of speciality teachers leaves some courses untaught at the university. The colleges can use some research specialists part time; also, the researchers can exchange knowledge and cooperate closely with the faculty members.

The research division will be able to express the need for specialists to the university; the university and especially the school "Institut agronomique" will then orient their education system toward the satisfaction of those needs.

Education-extension coordination. Extension personnel and specialists are now trained at the university and schools of agriculture. Education in the National School of Agriculture of Meknes should be more practically oriented to train future extension workers; Subject-Matter Specialists, extension supervisors and extension agents. The school programs should contain more educational courses. However, most Subject-Matter Specialists should graduate from "Institut agronomique." These specialists should have the same educational background as the research specialists. The faculty members have to participate in giving some training program to the extension agents. The extension workers may themselves be actively engaged in vocational teaching such as agricultural regional schools and can play an important part in covering the wide transitional field between more theoretical teaching on the one hand and more practical extension work on the other hand.

Research-extension coordination. This discussion on research and extension reaches the heart of the matter.

A close relationship between rural extension and applied research in agriculture is especially necessary. This liaison will ensure a steady flow of research finding applicable in practice to the rural population and in turn will assure that research workers are familiar with the most urgent problems facing the farmers in the field. In this respect, an efficient communication link would be provided by the team of Subject-Matter Specialists in the most important subjects. This will

lead to the establishment of an extension-research liaison committee; This committee would have as members some Subject-Matter Specialists, some extension agents of CT and CMV, some researchers in different subjects and some selected farmers. This committee would have the key role of assuring a two-way flow of communication between agricultural research and farmers who eventually make application of research findings. Coordination between extension and research will be, then, essential for effective extension.

If education, research and extension divisions are placed on an equal basis all three will benefit and complement each other. For that, the coordination between them has to be at all levels: from the directors to the field agents. In fact, in the United States this approach has been proven, and all three organizations are coordinated to each other. It is not a question of which organization is most important as all are important. Any one can do much to help people. Two of them can do more. All three working together could make the greatest impact on increasing agricultural production in the country.

Introduction of Change

Determination of the problem. The coordination between extension, research and education cited above will have a major role of ensuring a steady flow of research findings and technical information to farmers who have to apply them. The result expected will be improving wheat and crop production. But many

agricultural services and agents concerned with promoting agriculture in Morocco have found that their recommendations of improved farm practices are not followed by all cultivators where they are applicable. A low level of adoption prevails despite justification for practical practices and repeated recommendations over several years. Previously we said that more than 70 percent of the farmers still use traditional tools and methods. The question to ask is why some farmers adopt recommended practices while the majority do not. It should be recognized that it is one thing to offer a farmer a series of technical recommendations calling for change in his traditional agricultural practices and that it is quite another thing to offer him reasons, acceptable to him, for accepting new farming practices. According to Leagans (19) "To become widely adopted a recommended practice must be technically sound, economically feasible and educationally attainable. When a practice is recommended by scientists, it is assumed that the first two conditions are met. The task, then is to overcome problems in the third area--gaining educational acceptance."

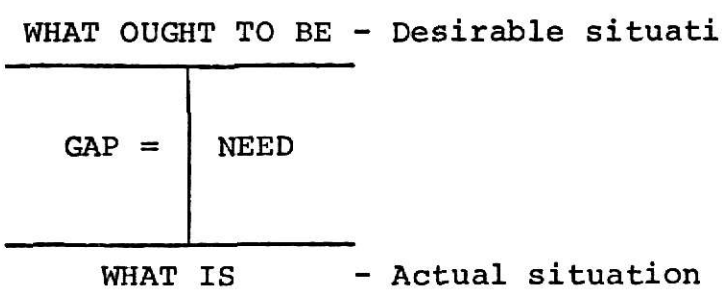
Leagans further stated that "diffusing knowledge is a relatively easy task. Getting people to understand, accept and apply it is the difficult one."

The intelligence, knowledge, interest, aptitudes and abilities of the Moroccan farmers, as well as the techniques and the methods that extension employs in the country, are factors which need to be taken into account because the majority of the farmers are illiterate. Urgent research on Moroccan

farmer incentives is needed if agricultural production is to keep pace with the rapid population increase in the country. Generalizations from United States and European studies may not be fully applicable to the Moroccan situation.

Determination of farmers' needs. The adoption of a new practice will not be successful if it does not respond to a need. The determination of farmers' needs has to be the first consideration of the extension worker.

A definition of need is relevant to an understanding of the concept of need in extension work. Webster (33) defines need as "a lack of something requisite, desirable and useful." A broader concept of the term is provided by Leagans (20) who provided the following definition: "Needs represent an imbalance, lack of adjustment or gap between the present situation or status quo and a new or changed set of conditions assumed to be more desirable." In other words it is a gap that exists between "what is" and "what ought to be." Leagans provides an illustration of the gap as follows:



Knowles (16) wrote that educational need ". . . is the discrepancy between what an individual (or society) wants himself

to be and what he is, the distance between an aspiration and a reality."

The common elements offered by these definitions are that needs may serve a motivational purpose and create an urge in an individual causing him to want to do something.

The successful extension worker has to start by determining the farmers' needs. He has to relate those needs to the desires of people, and then show farmers the needs of which they are unaware. A farmer can be motivated to a higher level of performance if the new practice satisfies his most important needs. "In Wisconsin, the use of grass silage increased only very slowly for eight years, but increased sharply during a two-year drought" (24). "Recommended practices for control of blue mold of tobacco went largely neglected in North Carolina until many farmers had experienced a high loss from the disease" (24). For any extension-program planning, or introduction of a new practice, the first consideration has to be the determination of people's needs.

Motivation. When the needs are known, they have to be used as motives. Such motivation is an essential condition for the adoption of a new practice. It is also vitally important when developing extension educational programs. Professionals are involved who are working directly with people. Motivation isn't always understood or used effectively with the farmer. R. B. Lewis (22) points out after extensive research that "if a man has little knowledge of what really makes men tick, less than a

precise sense of why men act as they do, and only a vague awareness of what motivates others, he will have little chance of getting excellent results" (31).

Klausmeier (15) defines motivation as ". . . An act or activity by one person designed to stimulate or arouse a state within a second person or group of persons that under appropriate circumstances initiates or regulates activity in relation to goals; or, is the aroused state of the individual that under appropriate circumstances initiates or regulates behavior in relation to goals."

Agricultural extension workers must have the taste of getting farmers motivated for adopting new ideas and practices. To sell ideas they have to keep in mind the fact that individuals differ greatly in their talents, needs and motivations. To bring about change, ideas that motivate should be included in the message.

The technical aspects of agriculture are usually easier to teach than ways to motivate the audience. The farmer in any Moroccan area must not only know what the fertilizer is for, but he has to see a successful demonstration, only then will he be asking for guidance instead of just listening. A very usable part of rural sociology is how to motivate rural people to help themselves make change that will benefit them as well as improve the agriculture of the country.

Adoption process. A new research finding is not of direct benefit unless it is practical and can be used by the farmer. A

new idea or practice is always faced with the problem of how and when it will be accepted by the user. Some new ideas and practices are accepted quickly and with little apparent effort, while the adoption of others takes time, and are accepted only after years of effort even when people appear to be motivated. This adoption process can be viewed as a series of stages or steps progressively advancing from awareness to adoption. For the purpose of this discussion, adoption may be regarded as "the point in time at which a farm operator decided to continue using a new practice; the time when the process would be completed for a specific practice" (2).

For many practices, people appear to go through a series of distinguishable stages:

1. Awareness: At this stage, the individual learns of the existence of an idea or practice but has little knowledge about it.

2. Interest: At this stage, a person seeks more factual information about the idea. He wants to know what it is and how it works.

3. Evaluation: The individual makes a mental application of the idea and sees if it is applicable to him. He obtains more information.

4. Trial: The individual is willing to try it on a small scale and acquire the information on how to do it.

5. Adoption: This is the stage of acceptance leading to continued use.

The adoption of farm practices is influenced by individual, social and psychological as well as economic factors. The average time between initial information and final adoption will vary considerably by person (literate or illiterate), place (different areas in the country) and practice (how technical it is). The adoption of the practice will depend also on whom is given the information, the source of the communication and the channel of communication.

Communication role. Communication may be defined as "the bridge that unites the producer of information with its user" (23). L. D. Kelsey (14) states "It is the process of transferring an idea, skill or aptitude from one person to another accurately and satisfactorily." In agricultural extension, the principal job is to deal with the human being. It is then of primary importance to be able to communicate and understand the conduct of the people with whom one is to work. In this case:

The communicator or sender: is usually the extension worker. He transmits messages related to improve methods of farming.

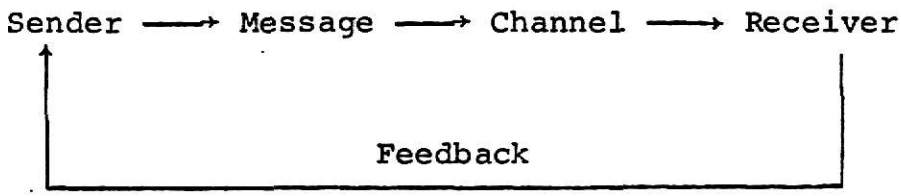
Message: is the information a communicator passes on to his audience. In extension messages consist of the whole range of scientific knowledge related to farming.

Channel: is the means by which the communicator and his audience are connected. It is viewed as any device in oral, written or visual form which transmits the message. A wide

variety of channels are associated with communication of farm information. Those channels will be described in the following section of "Extension Methods."

Audience: the receiver of the message or messages is known as the audience. In this situation, farmers and families constitute the audience.

The communication process usually follows the S-M-C-R model:



The basic purpose of this communication process in extension education is to include rural people to interpret messages related to change, and respond to them in a suitable manner.

If change is desired (all like to see most of the new practices adopted) one should know in what manner and at what level to communicate. An extension worker, therefore, must understand the function and relationship of the key elements of communication. As communicator, he is involved in the process of disseminating scientific knowledge about farming to rural people. The researcher, through the Subject-Matter Specialist, provides the extension worker with new knowledge pertaining to farming. The extension worker is called upon to treat these messages and transmit them in a manner that they are understood and meaningful to the rural audience. The success of the extension worker is judged by his ability to influence his

clientele to put the messages into practice. Hence, the extension educators must be concerned not only with useful information but also and especially with effective communication. The primary reason for any communication is to produce changes in attitude of the receivers and for this reason the extension agent, in addition to dominating the technical agronomic subject matter, should also be trained to be a good communicator. Leagans says (20) ". . . The success of rural-development programs directly depends on the transfer of useful ideas from a reliable source to people who need them. The transfer must be made in such a way that when received, the ideas result in action. This is the task of communication."

The extension agent's job is to communicate a series of ideas. For that he must know how to communicate, who the communication reaches and what results are obtained. When the extension worker is involved in the process of disseminating scientific knowledge about farming to rural people, he is serving as a link between knowledge and necessity. He must be prepared to receive communications in both directions: taking from science, the information to put at the disposal of the farmer and carrying to the researcher the problems of the farmer for solution.

For this reason, communication in extension is complex. Also, it is complex due to the heterogeneous nature of the rural audience. An extension agent has little choice in terms of his audience. He must work and communicate with his rural audience

as he finds it. The response of his audience will be judged from the standpoint of acceptance and use of improved methods of farming. Adoption or rejection will be the major determinant of success or failure of the communication and the whole extension.

The extension agent should make the best possible selection of the methods to employ. Various channels are not similar in their capacity to influence an audience and all audiences are not equally receptive to the same channel. Also, a single channel is not suited to communicate all types of information. A condition to effective communication therefore is a good knowledge of channels, their nature and role in the communication process. Those channels are used as extension methods.

Extension Methods

Teaching methods employed by an extension worker directly influence the effectiveness of his effort. Each method has advantages and limitations and is especially adapted to a particular condition. There are different conditions that exist between regions in the country and also between the farms within a region. The teaching methods will differ because farm people differ and their level of education differs. The level of education of the Moroccan farmers is generally low and it will be difficult to convince them that they should change their practices because they do not fully understand why change is necessary. Even if they do change their farming practices on

the advice of the extension workers they are likely to make mistakes if they do not understand why and if their basic knowledge of modern agriculture is deficient. The extension agent should take into consideration these factors before choosing a particular method. Regardless of the method, it is well to know that the associated use of two or more kinds of teaching methods often gives better results.

Individual contact methods. Nothing is more effective than personal contact. Visits are most useful for giving information and new practices so they will be understood and used. Individual contact has the great advantage in that the differences in conditions, under which the farm families are working, can be fully taken into account. General advice that is usually given through other methods is less detailed than this more effective one. There are several individual methods:

a. Personal visits of the extension worker to farm families.
b. Visits of farm people to the office of the extension worker.
c. Personal contact of the extension worker with farmer at market, meetings, field trip. . . .
d. Contact by telephone.
e. Contact by letter.

The last two will not be effective in Morocco for the majority of the farmers do not have a telephone and are illiterate. The first method is the most useful. The problems of the farmer can

best be discussed on the farm.

Individual contact is one of the more expensive extension methods; it requires a relatively large amount of an agent's time and, thus limits the number of contacts possible.

Group methods. These are ways of creating personal contact with a large number of people. Group methods are generally less expensive than individual contact and are usually more effective teaching devices than mass teaching methods. Group methods are demonstrations, meetings and discussion groups.

Demonstrations. When farmers are shown how to do work it is considered a demonstration. The method demonstration is not concerned with proving the worth of a practice but with how to carry out a farming method. The farmers watch the process, listen to the oral explanation and ask questions during the demonstration. On the other hand, a result demonstration is "a method of teaching, designed to show by example the practical application of an established fact or group of related facts. . . . With this method the extension worker can utilize the results secured from the adoption of a farm or a combination of practices to prove by comparison the value of the new method" (14).

How a demonstration is given is important. A good demonstration doesn't just happen; it is a result of knowledge, careful planning, preparation, practice and presentation. In order to give a successful demonstration, the extension agent or Subject-Matter Specialist must know every step in the job. He

must plan the demonstration and practice carefully so that he makes the proper impression on his audience and so that they will learn as quickly as possible. The demonstrator should ask questions, find out what the individual already knows about the practice, get them interested in learning the practice and place the farmer in the correct position to do the work. It is good to make members of the group repeat the demonstration in the presence of the others. This helps to fix the process in the minds of the audience and increase confidence in their ability to master the technique. The demonstration should be simple, because it must be distinguished from an experiment. A result demonstration proposes to show a known truth. The demonstration should be conducted according to a logical presentation of the fact. Differences in costs and returns should be clearly stated at every stage. After all, that usually is the first concern of the farmer. In order that the participants can remember their observations and profit from them, it is recommended that everyone be given leaflets or bulletins concerning the subject of the demonstration. It is important to advertise widely the results of a good demonstration by means of press, radio, news articles and pictures. The selection of the location of the demonstration as well as the farmer are very important.

Some specific recommendations for these demonstrations under Moroccan conditions are:

The farmer to be chosen should be as representative as possible of the average type of farmers to whom the demonstration is directed.

Selected farmers should cooperate in following instructions.

The farm chosen should be typical of the area served, according to the type of soil and farming system.

Selected farm should be along well-traveled roads and near the "Souks" (the every week market place).

Signs explaining the demonstration should be used. An agent should be appointed during the Souk day (the week market day).

Plots should be small and simple.

Tours to show the results to farmers and to give them a common ride should be arranged. Most farmers lack transportation to get to the demonstration place.

Meetings and discussion. Meetings include all kinds of group sessions held by extension agents other than demonstrations. They are planned by agents primarily for the purpose of getting a particular idea or a new practice across. General meetings make it possible for large numbers of people to acquire subject-matter information.

To make a meeting successful, many precautions should be taken:

The meeting should be well publicized.

The meeting should be held when people feel a need of information.

Farmers should feel that it is their meeting and not the agent's meeting.

It has to be known that the larger the audience the less individual members can be involved directly in the program.

The time and the number of topics should be limited.

Appropriate visual aids contribute much to the success of any meeting. The low education level of the Moroccan farmer has to be taken into consideration; the kinds of visual aids are: real objects and models, photographs, slides, movie illustrations are necessary when difficult facts are to be presented.

Audience participation should be encouraged through constructive and interesting discussions. Research has shown that when people listen passively they retain only about one-fifth of what they hear. By entering actively into the discussion, the amount retained may be increased three or four times (24).

The success of any meeting requires considerable time and skill of the adviser in advance planning, preparation and follow-up, as well as in the preparation of the subject matter.

Farm tours and field days. People in general and farmers particularly believe what they see. They are more curious if the work is done by a farmer. Farm tours expand experience of the farmer by providing an opportunity to see and hear what another has accomplished. Tours and field days are important. Even if the information can be presented by movies, pictures, oral or written description, it is never quite the same as a visit to the field. Spring field days, in Kansas, sponsored by research and extension personnel are important teaching days. Farmers see the difference between varieties, fertilizers, and practice. They ask questions and take pictures.

A farm tour needs advance preparation. The whole program

must be carefully timed. Transportation has to be arranged. In Colby Branch Station (Kansas) tractor-drawn trailers and trucks were used during spring field day (1973). During fall field days at the Manhattan Experimental Station (1973), new equipment and materials were brought to the farm and shown. Small farm groups were visiting demonstrations that were planned a year ahead.

During farm tours, opportunity should be given to the farmer-owner to talk freely about his work to specialists and agents.

Mass methods in extension. Mass media enable extension workers to greatly increase their teaching efficiency. It also makes possible the dissemination of information to a much larger and different clientele. Mass media uses newspapers, publications, news stories, circular letters, radio, television, posters, etc.

Printed matter. These are newspapers and publications (bulletins, pamphlets, circular letters).

Newspapers play an important role in Kansas Extension Services. Each county has a newspaper and the newsmen are in close contact with the extension agents who publish daily or weekly their articles. In Morocco there is little chance to reach the majority of the farmers through newspapers. Nevertheless these have to be used to diffuse information. Wall-newspapers have to be used more, especially in places where people gather and pass. Drawings and pictures should be used for

illustrating agricultural news. The main objective of newspapers is to diffuse it as it happens. Later on, information can be put into bulletins or other formal publications that require time for preparation and printing.

Use of bulletins, leaflets and pamphlets should be increased. They should be written as very simple ideas and in village language. Illustrations and pictures would be more important than words. The leaflet, for example, can be printed on one side and treat one job or one small problem. The best leaflet will give accurate and specific instructions on how to do a job. Bulletins and pamphlets on the other hand may contain many pages and treat a number of topics. Bulletins and leaflets should be used for follow-up work after meetings, visits or demonstrations. They should be available in places where people gather (Souk and Moussem). A verbal summary of the topic before distribution will be very useful.

Posters also can be widely used as a visual aid. They will serve first, to inspire the people and make them feel a part of the work. The poster should communicate the idea very simply and with pleasing colors.

Printed matter in general is a necessary supplement to other extension methods, but they are not sufficient in our condition for teaching people with limited education.

Radio and television. Radio and television are not used extensively in extension teaching in Morocco. The radio gives, once a week, an agricultural program of ten minutes.

Television is not used at all for any extension purpose. This is not normal in an agricultural country like Morocco where 70 percent of the population are farmers. The radio is very important as a mass media. It is very popular among Moroccan farmers and it is used for entertainment. Usually the farmer is busy; he can't attend meetings and demonstrations for lack of transportation; he doesn't read because in general he doesn't know how. Therefore, the information has to be brought to the farms cheaply, and at convenient hours. No medium fits these conditions better than radio. Also, the extension agent can reach thousands of farmers at the same time. The radio is a very successful medium to create the farmers' interest and to give recommendations. The radio is most useful for the diffusion of emergencies and timely information (crop diseases, broadcasting). The radio can be used to build interest in other extension media (announcement of meetings, demonstrations . . .). Radio broadcasts can be used for interviewing researchers, subject matter specialists or simply other farmers.

The radio has many advantages. The most important advantage, under Moroccan conditions, is that it allows to reach the majority of people who read little or not at all.

Television should also be used as an extension teaching method. It is more personal than the radio. The viewers meet the speaker in a simulated individual contact. Opportunity is afforded the members of the audience both to hear and see, which greatly contributes to the learning process. Over television

the extension agent can give a demonstration on how to do the work. Close-up pictures of key operations can make it more clear for a large audience. Television can also compare different operations and processes requiring much time that can be telescoped into a few minutes. Television is one of the finest media for teaching. The present limitation in Morocco is that it reaches mainly urban people, not the rural people. In the future this mass media method will be more useful for farmers.

Other methods. Among the various other methods that can be employed to inform the farmer, "visual aids" is considered a good method especially in the place where literacy is low. These include photographs, posters, flash cards, models and exhibits. Slides and films help to make all sorts of information easier for the viewer to understand. Wide use of those visual aids should be encouraged among Moroccan extension workers.

There are also two methods that can suit Moroccan conditions well:

Drama: When announced, the drama is well attended by Moroccan villagers and those in neighboring villages. The drama is a source of entertainment and education; the extension worker may get the artists by picking them from the village. The drama can be on some aspect of improved farming.

Songs: The Moroccan farmer has a great fascination for folk songs and dance. The extension worker should use this way for spreading information. In every village there will be

someone who is good in folk songs. The extension agent can get such person and write for him a song on subjects which he wants to popularize (a new wheat variety or a new practice). The songs are usually in form of a story with a moral. Such songs may prove popular with the village folk who will pick up the words and the message without the need for any printed literature.

Another way in which the extension worker can put the song to use is by a local competition for the best song on one subject. He can announce to the villagers the location and time of judging the best song. All will come and thus hear the messages he wishes to put across.

These are some methods that can be used by rural extension services. Much more could be written about them. The success of any method depends to a considerable extent on the personality of the extension worker as well as on his experience and training.

Training of Extension Agents

Most extension agents in Morocco graduate from regional agricultural schools where they study principles of agriculture for two years. Their educational level before enrolling in those schools is 6th or 8th grade of high school. Our extension agents are generally young and inexperienced. The program of training is adequate in some areas and inadequate in others. It is well known that a competent and well-trained staff is a

crucial factor in affecting the success or failure of extension work.

In a situation similar to Morocco Duncan (7) emphasized that:

> One of the high priority tasks in any state extension program is placing on the job and providing carefully planned and effective training for its extension workers. The significance of this problem is pointed up by the fact that approximately fifteen percent of the county workers of most states have been on the job less than one year. This is considered the critical period in an extensive training and close personal supervision in order to become productive and adjusted extension workers and to attain a high degree of job security in the shortest length of time.

The Moroccan extension workers not only have to know what they learned during two years school, but also they must have the chance to adapt themselves and adopt new approaches or methods in order to play their role effectively. They will have to adjust their skills, abilities and understanding through training which is related to the existing and future needs of their jobs. They should receive training of high standard with regard to general education, technical education and agricultural practices.

In addition to technical aspects of the practices, extension agents need to know how to use all appropriate extension methods in presenting the ideas and how to prove them conclusively. Farmers will find it difficult to believe any extension worker who, in trying to introduce a practice, is not familiar with the problem and the effects that the proposed change will have. The extension worker will need effective training to include a

complete familiarity with the practice before he can intelligently make recommendations and defend them.

How should extension staffs be trained? It is necessary to identify the areas in which extension educators need to be trained and which priorities should be established. It is suggested that a "National Section of In-service Training" be created. It is proposed that this section should be composed of extension workers from all levels, members of resident teaching and research staffs. The section will be under the control of the Director of Extension (Fig. 5) and will have for its purposes to:

1. prepare recommendations regarding in-service training that will overcome present inadequacies.

2. analyze and evaluate the training activities.

3. outline a comprehensive training policy.

4. assure and coordinate a continuing training for all extension staff of the country.

This will assure continuing education of extension workers by means of well-organized programs and prevent them from becoming "blind" in regard to the changing conditions and needs of agriculture and rural people. Those extension agents won't have the work with the farmer only, but with the whole family as a unit including the farm wife and the children.

Agriculture and Home-Economics Extension Coordination

Home economics or "social life" as it is called in Morocco is under a different ministry. No important role is given to

home economics. Agriculture extension has no relation at any level with "social-life" services. Moroccan extension is confined only to farming. Homemaking is not included.

In the United States the over-all purpose in home economics is to provide education for home and family living. The following statement is the principle: "A healthy, happy family is the best foundation for successful farming."

In fact, the Moroccan rural wife is responsible to a large extent for the well-being of the family. She participates in the field work, she takes care of the livestock, harvests, broadcasts seed, etc. She is a key person in determining the success or failure of the farm. In addition, her work as a homemaker includes the preparation of daily meals, care and training of children and keeping the house comfortable.

The extension service should approach the farm family as a functioning unit with adequate assistance to the farmer and children as well as the farm woman. The extension service can help increase the farm-woman's interest in improved farming methods as well as in more efficient organization of the work of the house.

This would be helpful to the farm family and its members, and make it easier to cooperate between agriculture and home-economics extension agents. The agricultural agent may help by giving lectures to the women's group on various agricultural subjects. Agriculture and home-economics agents at the community level could supplement the work of each other. They can be

called together with the family, or for joint meetings where problems are discussed while the extension agent is talking about new practices with farmers. The homemaker agent would be transmitting information on household management to the wives. When the agriculture agent visits a farm alone and finds some problems in home-economics aspect, he can inform the home-economics agent so that she can visit the farm as soon as possible. Sometimes the home economist is told of problems in crop production, disease or other agricultural aspects of farm life. She is able to pass on this information to the agriculture agent.

Since the success of farming depends on a healthy and happy home, the task of homemaking should be given a major consideration in Morocco. Close cooperation between agriculture and homemaker will be beneficial to each one of them and will be more useful to the rural family.

If, for a special reason, the two services cannot be joined under the same organization within the Ministry of Agriculture, special encouragement has to be given for a full coordination between the two services.

Extension Youth Work

Extension has an obligation to adults, but it also has a responsibility toward the preparation of future farmers.

In Morocco the place of youth programs in agricultural extension is not recognized. There is no youth organization or

club for rural boys and girls. One of the most serious problems is the drift of young people toward the towns. The reason is unproductive, traditional agriculture and absence of education, leisure and social services.

On the other hand, it was noted earlier in this report that rural youth organizations, particularly 4-H clubs in the United States, have been quite successful.

An extension program for youth should receive more attention. "The future of any society depends on how well it prepares its young people to make the decisions and carry the responsibilities of mature citizenship" (30).

It is suggested that extension services in different CT and CMV areas develop an extension program for youth. This will be possible by the formation of clubs for boys and/or girls in rural areas. These clubs should be helpful in reaching and supplementing an education experience of youth. These clubs will be formed and use the 4-H club experiences of the United States. It is not proposed to transfer all 4-H systems to Morocco without modifications that imply proper understanding of Moroccan rural conditions. H. P. Yang (37) said:

> In considering the problem facing a country while building an extension or advisory system, it seems worthwhile to bear in mind that no extension system or organization copied from a foreign pattern could be expected to work as satisfactorily in a peasant or agrarian society as in the modern industrially developed one. It would be folly to transplant without modification the extension system or organization from one area to another, where economic, social and cultural conditions may differ.

The formation of clubs for youth won't be a "Let-us-do-what-

they-did-in-the-other-place-approach" but it will be a "Look-at-the-situation-first-and-then-see-what-can-be-done-approach" (18).

It also prepares the way for influencing people toward the adoption of improved farm practices. In fact, research in the U.S. shows that individual attitudes are greatly affected at an early age and by discarding the old and embracing the new, are formed and modified in the 4-H club; a former 4-H member should be accepting and adopting improved farm practices at a faster rate than a non-member (10).

Extension youth programs can strengthen extension work with adults: while the rural boys and girls are "learning-by-doing" for preparing their future formation, they can bring new ideas to the home. Their influence can still be further extended by the fact that most of the parents are illiterate.

Wilkening's study of the adoption of improved farm practices in Wisconsin shows that farmers with children in 4-H or vocational agriculture adopted significantly more practices than farmers without children in 4-H (34).

The strengthening of adults can be done in the following ways: youth can teach adults. The first approach should be the one in which the whole rural youth situation in Morocco is carefully analyzed and programs prepared. The "survey approach" when applied to the rural youth situation should include the following steps:

1. Surveying of the rural youth situation.
2. Identification of high priority needs among rural youth.
3. Design of the program.
4. Implementation of the program.
5. Evaluation of programs.

Youth programs were a success in many countries and especially in the United States.

The development of extension youth programs in Morocco will be beneficial to the new rural generation. It will give them the opportunity to gain a better understanding and appreciation of their rural environment and to acquire the means to practice more efficiently their future occupations as farmers by communicating to them the basic elements of modern agriculture. Youth work can provide an avenue through which some parents become involved in adult extension programs. Youth programs can generate general support for extension activities, ensure continuity of, and upgrade extension programs. It can also help train future extension workers as well as adult extension group leaders (32).

For these reasons and others, extension youth programs should be formed and encouraged.

Chapter VII

SUMMARY AND RECOMMENDATIONS

If present trends in wheat production and consumption continue, Morocco will face large and increasing deficits in grains. Thus, the principal development problem in the country's agriculture is to increase production. For that reason, this study has described many factors and made many recommendations. These are given here in synopsis form with a reference to more complete expositions:

1. The same fertilizer mix should not be used for all wheat production. The farmer should be taught the kind and amount of fertilizers to use and the best time and methods of application (p. 51).

2. Wheat planted in areas receiving less than 300 millimeters (12 inches) of rainfall annually should not be fertilized. Yield increases would not pay for fertilizer in most years (p. 55).

3. All irrigated wheat should be fertilized as heavy as varieties permit.

4. Different rates of fertilization should be tried on different varieties. Under irrigation as much as 50-150 kg/ha of N for long-strawed varieties and up to 220 kg/ha N for short strawed varieties have been used in Arizona, New Mexico and Kansas.

5. For fertilization at seeding time, N and P would be preferably combined as such a combination is easier to handle and N in close proximity to P stimulates plant uptake of P (p. 52). Mixed fertilizers always should be applied for wheat with a combination grain and fertilizer drill.

6. Attention should be given to new varieties that yield higher and stiffer straw (p. 56). Production must overtake consumption.

7. Development of varieties with a combined broad spectrum of resistance to both insects and diseases should be encouraged (p. 57).

8. The mechanization of small farms with animal power seems to be basic because improvement of cultivation practices such as deeper cultivation are necessary before optimum yields can be approached (p. 58). Tillage as shallow as 3 inches or deeper than 7 inches does not increase yield.

9. Wind- and water-erosion controls are necessary, to prevent the loss of large quantities of good soil each year.

10. Methods, depth and rate of seeding should be studied. Small combination grain and fertilizer drills with animal power should be increased on traditional farms (pp. 63, 64).

11. Some various formulations of 2,4-D to control weeds in wheat fields has been used more widely than any other chemical.

12. The various practices of irrigation in Kansas are explained on pages 66-70.

13. Research must be adaptable to the Moroccan realities.

Basic research has to be reduced considerably and its place given to applied research. The research has to be "need oriented" and coordinated in the country.

14. Nearly all research in Morocco is conducted on experiment-station fields under nearly ideal conditions. Research under practical farm conditions and especially under traditional farm conditions is needed.

15. An effective extension-education system is needed for this conversion (p. 77). Teaching farmers to use fertilizer, new varieties and the steel plow and finally other improved practices is a proven approach.

16. The Extension Service must be elevated to a division with a director in the Ministry of Agriculture on the same level as the division of research and the division of education.

17. A reorganization of the extension services in Morocco is proposed (p. 78).

18. A corps of extension specialists and more field agents are needed. Specialists prepare and disseminate new information throughout the country, provide in-service training to field agents and translate research information into bulletins, radio programs and TV (pp. 90-92).

19. Coordinate the activities of research, teaching and extension to provide a freer exchange of information. Also, strengthen coordination between all other government organizations charged with responsibility for helping to develop agriculture (pp. 83-85).

20. The question then, is how to communicate most effectively. Besides the requirement of a good technical foundation, extension workers must have the task of getting farmers' needs and motivating them to adopt new ideas and practices.

21. The teaching methods employed by the extension worker directly influence the effectiveness of his effort. The value of using different extension methods is detailed on pages 94-104.

22. Establish and strengthen agricultural information, visual aids, demonstration materials, reference handbook and other tools of their trade. These are necessary in order that they may do an effective job in teaching farmers.

23. Provide in-service training for extension workers. They need to be trained well enough and have enough experience to make recommendations based on all factors involved. They need to learn of the interrelationship of practices so that a single practice is not recommended without also recommending others that are necessary to make it work.

24. Since the success of farming depends on a healthy and happy home, the task of homemaking extension should be given a major consideration in close coordination with agricultural extension.

25. Extension youth work should be helpful by supplementing an education of youth and by strengthening extension work with adults.

CONCLUSION

This study was exploratory and descriptive in nature. It did not attempt to answer all of the pertinent questions nor give conclusive answers to any one of them. It has, however, established the importance of studying certain factors that will contribute greatly to the improvement of agriculture in general and increased wheat production particularly in Morocco.

As was noted earlier in this report, it is not wise to attempt to transfer patterns of technical and extension work from one place to another without due regard to local conditions. However, the study has tried to demonstrate the importance of the organizational pattern in order to adapt some or all of them to the Moroccan condition. Each pattern could be a topic for new studies and research.

The value and usefulness of the report will depend upon the extent to which the factors identified are put to use in establishing a new extension system that hopefully will contribute to increased wheat production in Morocco.

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MEANS FOR INCREASING WHEAT PRODUCTION AND IMPROVING EXTENSION'S EFFECTIVENESS IN MOROCCO

by

MEHDI ADLOUNI

B. S., Ecole Nationale d'Agriculture, Morocco, 1970

AN ABSTRACT OF A MASTER'S REPORT

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Because of population increases of approximately three percent annually, Morocco where bread is the staple food, has become an importer of wheat since 1962 instead of an exporter.

The purpose of the study was to analyze the situation and determine the factors responsible for large increases in wheat production in the United States, to study the U.S. extension service and to review the agricultural situation in Morocco. From this analysis, suggestions to overcome the deficit of wheat production were developed.

Factors which appear to be critical to increasing wheat production in Morocco include:

1. Conducting extensive, need-oriented research work on wheat culture.

2. Introducing mechanization and improved practices into the traditional farm.

3. Coordinating research, extension and teaching activities.

4. Improving the understanding, acceptance and application of extension principles.

5. Reorganizing the extension service to facilitate the freer flow of information to the farmers, and

6. Selecting well-trained staff with the vision, initiative, knowledge and personality characteristics needed to work in a group effort, plus a good basic technical training in wheat production.

If efforts are concentrated on these factors, agricultural production will increase, and the wheat deficit will be overcome.