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THE NATIONAL INSTITUTE FOR AGRICULTURAL RESEARCH OF MOROCCO

Volume I - PRESENT SITUATION AND PROSPECTS

Volume II - ANNEXES

isnar

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The International Service for National Agricultural Research (ISNAR) began operating at its headquarters in The Hague, Netherlands on September 1, 1980. It was established by the Consultative Group on International Agricultural Research (CGIAR), on the basis of recommendations from an international task force, for the purpose of assisting governments of developing countries to strengthen their agricultural research. It is a non-profit autonomous agency, international in character, and non-political in management, staffing, and operations.

Of the 13 centers in the CGIAR network, ISNAR is the only one that focuses primarily on national agricultural research issues. It provides advice to governments, upon request, on organization, planning, manpower development, staff requirements, financial and infrastructure requirements, and related matters, thus complementing the activities of other assistance agencies. ISNAR also has active training and communications programs that cooperate with national agricultural research programs in developing countries.

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PRESENT SITUATION AND PROSPECTS

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SUMMARY

This report was compiled at the request of the Director-General of the National Institute for Agricultural Research (INRA), and with his support and that of other national institutions involved in the generation and dissemination of technical progress in agriculture. The study falls into three main parts: a description of agriculture in Morocco; an analysis of the Moroccan system of agricultural research; and proposals for improving its operation, structures, and results.

Vital need for controlled intensification of agriculture

After independence and until the beginning of the 1970s, Moroccan agriculture expanded at a relatively fast pace, and its net exports made a substantial contribution to the growth of the national economy as a whole. The rate of expansion has declined considerably in the last ten years, while the population has continued to increase rapidly. The country now faces a disquieting deficit situation in food and agricultural produce, for both of which it depends on imports.

To reverse this trend and redress the balance, Morocco must take full advantage of its large productive potential by exploiting all the resources of the country, most of which still have substantial untapped margins of productivity. The action necessary is not exclusively technical, but to a great extent involves political and institutional changes, some of which are absolutely essential if these margins are to be effectively used.

Within this framework, research would have a major role to play: it would need to adopt a diversified approach taking full account of the variability of physical and social conditions in the country, while offering solutions consistent with the country's limited resources, thereby limiting the risks as far as possible and optimizing the progressive steps necessary for the modernization of the agricultural sector. Can this be achieved by the research organization as at present constituted?

A modest national system of agricultural research lacking integration

In addition to INRA, which is the only institution specializing in agricultural research, many other institutions engage to some extent in research and experimentation, though these are not their principal activities. The Institut Agronomique et Vétérinaire Hassan II (IAV) [Hassan II Institute for Agriculture and Veterinary Medicine] is the most important; research at IAV is a natural complement essential to high-quality teaching. The conduct of research activities is essential for the other public development and production agencies, because of their highly practical or specific requirements and also because of the

weaknesses of institutional research, as discussed later. Although all these institutions maintain extensive communications among themselves, the resultant composite national research system is still modest and has little integration. Roughly speaking, total expenditure on agricultural research (disregarding INRA's activity in the field of seed production, which is not covered by this report) probably amounts to only about 0.40% of the gross agricultural product, a smaller figure than the typical proportion in Third World countries (which is about 0.50%) and well below the 1% usually recommended by the major international institutions.

INRA at a turning point in its history

Analysis of the structures, resources, operations, and activities of INRA has revealed three major characteristics.

The first of these is the weakness of its scientific capability relative to the programs formally undertaken and, in particular, with the diversity of the country's needs. The dearth of qualified staff (a total of 228 scientists) is especially pronounced in certain fields and disciplines, such as plant genetics/improvement, animal husbandry, agricultural engineering and, particularly, in the social and economic sciences (only one research officer). The deficiencies in quality are due to the inability of the institute in the past to attract and retain well-qualified staff. These deficiencies are reflected in the scientists' average level of training; 55% of the research workers are only at the B.Sc. level (ingénieurs d'application), and most of the staff have less than five years experience. This is inadequate for an overall level of high-quality research and results in which other national institutions could place their trust. However, it must be emphasized that there do exist a small number of top-quality senior staff who, for all the internal difficulties and problems of national integration, have been able to do more than merely safeguard the routine operation of the Institute and have also introduced innovative research programs and substantially improved their own level of expertise. Another important aspect is the project to raise staff status, to which further improvements are still possible.

The second principal characteristic is the extent of the Institute's physical facilities. INRA has an impressive network of experiment stations and farms which now covers the entire country. This network is an asset of which great advantage has been taken by a small number of decentralized research programs. However, it constitutes a considerable short-run burden in overall terms; it has resulted in excessive geographical and professional dispersion of the scientists (who must spend much time on management tasks), coupled with excessively high costs (large numbers of unskilled workers, expensive maintenance of fixed

assets and equipment).

The third important characteristic is the mixture of different types of programs. This is the result of a favorable trend in research involving a succession of decentralized experiments that have aims more consistent with immediate development problems, together with programs using more sophisticated scientific methods in the fields of citrus cultivation, vegetable growing, oases agriculture, and rainfed farming. However, INRA is still persisting with a large number of monodisciplinary production-oriented programs based predominantly on controlled-environment experimental work on stations, yielding partial and not always significant results that are usable to advantage only by the modernized agricultural sector, which is relatively small.

These three important factors have an inevitable impact on the internal functioning of INRA and on its national role. For instance, the extensive nature of the physical facilities and the wide range of programs have given rise to increasingly complex and rigid working procedures on both the administrative and scientific levels. It is becoming difficult, if not impossible, to imagine a fully homogeneous and coherent form of internal organization on either level. This is borne out by an examination of the present and various proposed organizational charts, in which the hierarchical classification of scientific units favors, alternatively, scientific disciplines and geographical locations (Rabat and the provinces). In both cases, scientific units in the provinces - especially the multidisciplinary commodity-based and production-system-oriented units - are penalized to a greater or lesser extent by being linked scientifically to a directorate of purely administrative character, and by the heavy weight of the financial and administrative procedures centered in Rabat.

The excessive compartmentalization of the research units and the isolation of many scientists are also a result of the three characteristics described. Only research workers who are sufficiently self-assured, experienced, and not too overwhelmed by administrative tasks, can cooperate and work together efficiently. However, such conditions are rather exceptional. Lack of self-confidence and the absence of communications within INRA also have repercussions on relations with the outside world, by reducing them to a minimum. Another factor militating against such relations is the quite justified behavior of the national institutions, which endeavor to solve their most urgent and vital problems from their own resources or by approaches to other scientific institutions (IAV or foreign cooperation).

None of these considerations is entirely new for INRA. They are certainly the main reason for the intensive work recently carried out for the purpose of drafting a Master Plan (Plan Directeur), involving an attempt to reformulate the research activities around large-scale,

hierarchical - and still formal - programs, and for the review to outline a long-term policy of regionalization and harmonious development of human and physical resources. This effort has, however, been overambitious and premature, and its main failing has unfortunately been that it has not faced up to the current problems upon whose solution the future of INRA depends.

Attention to the short and medium terms, with a view to better preparation of INRA's long-term future

The proposals put forward concern the various structural, functional, and relational aspects, which must be improved as soon as possible. These proposals can be grouped around two central themes.

The first theme comprises continuation of the action already undertaken to secure a better match between research and the requirements of development, in both the objectives and the conducting of research. The proposals on programming by objectives and on regionalization should contribute to this theme, in particular by establishing an organized and methodical tightening of INRA's relations with its "environment". However, this action must not distract INRA from its continuing scientific role in long-term prospective research and its collaboration with IAV, which is closer than the draft agreement suggests.

The second motivating theme is improved management of the total human and physical resources. Here again, programming by objectives should play an important part, arising from periodic evaluation of programs and their resources. Emphasis has been placed on well-qualified human resources, starting with those already at work at INRA, as they form the Institute's principal asset. This asset must be preserved and consolidated by improved working conditions to increase motivation (scientific and career) and responsibility, and to facilitate day-to-day operation activities. These points should be considered as essential preliminaries to subsequent rapid growth.

The proposals put forward will call for attentive and critical examination by the governing body of INRA and the relevant Moroccan authorities. Their time horizons are all limited to the short and medium terms, but in some cases the implications reach much further into the future.

In the short term (1 - 2 years), the following recommendations are the most urgent, in terms of both time and content:

- final "adjustments" to be made to considerations of staff status;

- introduction of programming by objectives, which would be reflected mainly in the clustering of applied research activities, hitherto carried out at the discipline-based "stations", around commodity-based and production-system-based research programs;

these "new programs" would mean a recentering of INRA's activities, and insofar as they would mean the new administrative units of INRA, they would entail appreciable changes in the total structure and functioning of the Institute;

- pruning the provincial network of research centers and experiment stations, including the demonstration farms (fermes d'application) and simplification of budgetary procedures;

- organizing seminars on research and development and production systems, directed principally towards the most senior staff of INRA, heads of discipline-based departments, heads of CRRAs (regional agricultural research centers), and staff in charge of the "new programs";

- establishing of an efficient documentation service;

- building up joint research laboratories at IAV in the disciplines in which INRA has the greatest deficiencies in staff (plant genetics/improvement, animal husbandry, agricultural engineering, social and economic sciences);

- finally, organizing a specific evaluation mission in relation to seed multiplication and gene bank problems.

All these short-term measures are within the financial possibility of INRA, especially if it can obtain some resources from foreign cooperation.

The following recommendations apply to the <u>medium term (2 - 4 years)</u>:

- completion of the introduction of program by objectives, involving in particular, first, the formation of the joint groups of research workers and users of research (sectoral "Program Commissions", Regional Agricultural Research Committees) responsible for evaluating and placing in order of priority the current and projected programs and, second, preparation of the annual budget in the form of a "program-budget";

- balanced decentralization of programs, to facilitate regionalization of research and resources;

- continuation of in-service further training of senior staff, and selection and training of young research workers;

- reconsideration of the long-term Master Plan: with the practice of programming by objectives, INRA will have a better perception of development needs, a greater capability to translate them into research topics and to formulate better-argued requests, supported by other institutions, as economically as possible.

On this medium-term time scale, costs would, of course, be higher: most of the costs would be accounted for by the growth, which is essential if research is to be able to make a significant contribution to solving the increasingly acute problems of development; a growth, however, that should be soundly based and fully justified by the regeneration of INRA and by its new accomplishments

PREFACE

The Institut National de la Recherche Agronomique du Maroc (INRA) (National Institute for Agricultural Research of Morocco) is the only Moroccan institution specializing entirely in this field. It was established in 1981 as the culmination of a long history which began in the country's colonial past. Over the years, there has been a succession of increasingly diversified research structures and activities resulting in considerable complexity. This bears witness to the rich endowment of the Institute, but also to the clear need for some reorganization.

This reorganization has been the main concern of the new governing body. In collaboration with the staff, it has introduced or proposed a number of measures, some of which are important (staff status, reduction in the size of the very large network of experimental facilities, new organizational chart, etc.) and others less so. In particular, however, it has endeavored to draw up a Master Plan conceived as the "optimum" profile for INRA in the long term (up to 1991) with the function of defining the programs and research structures most suited to solving the recognized problems of national agricultural development. INRA as at present constituted would adopt this Plan gradually, through a number of adjustments affecting all its components.

ISNAR was first invited by the governing body of INRA to undertake a "critical evaluation of the progress" of the Master Plan and to make methodological contributions to facilitate its completion. This objective was accepted at the time, and it was also felt necessary to perform a diagnosis of the present situation, which had to be properly understood for the purposes of formulating long-term policy.

However, after gathering a large volume of information in situ and subsequently examining it in depth, ISNAR came to see the value of drawing up a long-term plan in a different light. It was felt that this planning project could not be undertaken on a sufficiently precise and realistic basis unless it was preceded by a preliminary stage in which the emphasis was placed more modestly on the short and medium terms. This is the reason for the fresh approach proposed here, in which the starting point is the present situation as it is, with its weak and strong points. On the basis of preliminary considerations on the form that should be assumed by research with the aim of development, the implementation of an appropriate method of programming having the following principal objectives is proposed:

- gradual adjustment of the current objectives and methods of research to accord with requirements;

- determination of the resources - in particular research workers - necessary for this new emphasis.

It is therefore a matter of taking short- and medium-term actions to create the conditions for efficient working by INRA, thereby providing the Institute with a credible basis on which to prepare its own long-term policies and activities.

In proposing this approach, ISNAR has remained faithful to its status as a service to national research - an appropriate and practical service aiming at immediate improvements perceived as a necessary stage in the accomplishment of legitimate long-term aspirations. It is for INRA to consider whether this is appropriate to its needs and to decide whether ISNAR should or should not accompany it on the long path which would then lie ahead. This report aims to give the Institute a sound basis for its decision; while the length of the report may try the patience of its readers, it may also seem too short in that it does not go into sufficient detail in places.

The report falls into three parts:

- The first part is an analysis of the agricultural development of Morocco, intended as a reminder of the past role and potential of agricultural research.

- The second part is a critical description of the structures and internal operation of INRA, involving also an examination of its relations with its environment. Particular points dwelt on are the Institute's relations of complementarity and competition with other national institutions which carry out agricultural research as a secondary activity.

- The third part is devoted to the recommendations suggested by the preceding diagnosis, and justified by the country's need to endow itself with a new research system able to contribute to the essential intensification of its agriculture.

The Mission wishes to thank the Director of INRA, Mr. Hussein Faraj, for his attention and the trust he placed in it. It also wishes to thank all the members of INRA's staff who accompanied it on its visits and journeys in Rabat and to the interior of the country, and to those who welcomed it at the various centers and stations. Credit for the faultless organization of this tour is due to Mr. Cohen, Head of the Data Processing Service, designated by the Director of INRA to perform this function.

The Mission is very appreciative of its cordial welcome, and of the fruitful, frank, and open discussions it had with all persons with whom it met, not only at INRA but also at the other national institutions. Finally, it had very useful contacts with bilateral and international institutions - in particular, the World Bank - which were kind enough to receive it[1].

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(1) The terms of reference, and the timetable of the mission are presented in annexes 1 and 2.

PART ONE

AGRICULTURE IN MOROCCO

AGRICULTURE IN MOROCCO

1. THE NATURAL ENVIRONMENT

1.1 CLIMATOLOGY

The climate of the agricultural part of Morocco (north of the Anti-Atlas) is essentially mediterranean type - i.e., a temperate-zone climate with the rainfall concentrated in the coldest months of the year (from fall to spring), while the summer remains dry.

Mean annual rainfall varies over an extremely wide range: from about 2 meters in the Rif mountains to 20-30 mm at the edge of the Sahara. Generally, however, at a given altitude, rainfall diminishes sharply with latitude, from north to south; the general direction of the relief in fact results in a north-west/south-east rainfall gradient (see Map on next page). The Saharan climate is quickly encountered to the south of the Atlas and of the high eastern plateau. Here, rainfall is so low that agriculture is impossible except at the rare oases or where there are springs.

Over the country as a whole, precipitation is extremely irregular from year to year, the annual total sometimes varying by a factor of 4. However, this irregularity appears not to be completely random, as there are some sequences of years which are on average more unfavorable than others. At present, for example, there have been two very bad years (1981 and 1983), flanked by two others which can better be described as unfavorable (1980 and 1982). This situation has adverse consequences for agriculture: groundwater and dams are not replenished, farmers use up their reserves, and the poorest are forced to abandon the country for the town. The plant cover is under heavy stress from both man and animals; such stress may sometimes cause irreversible desertification in some areas[2].

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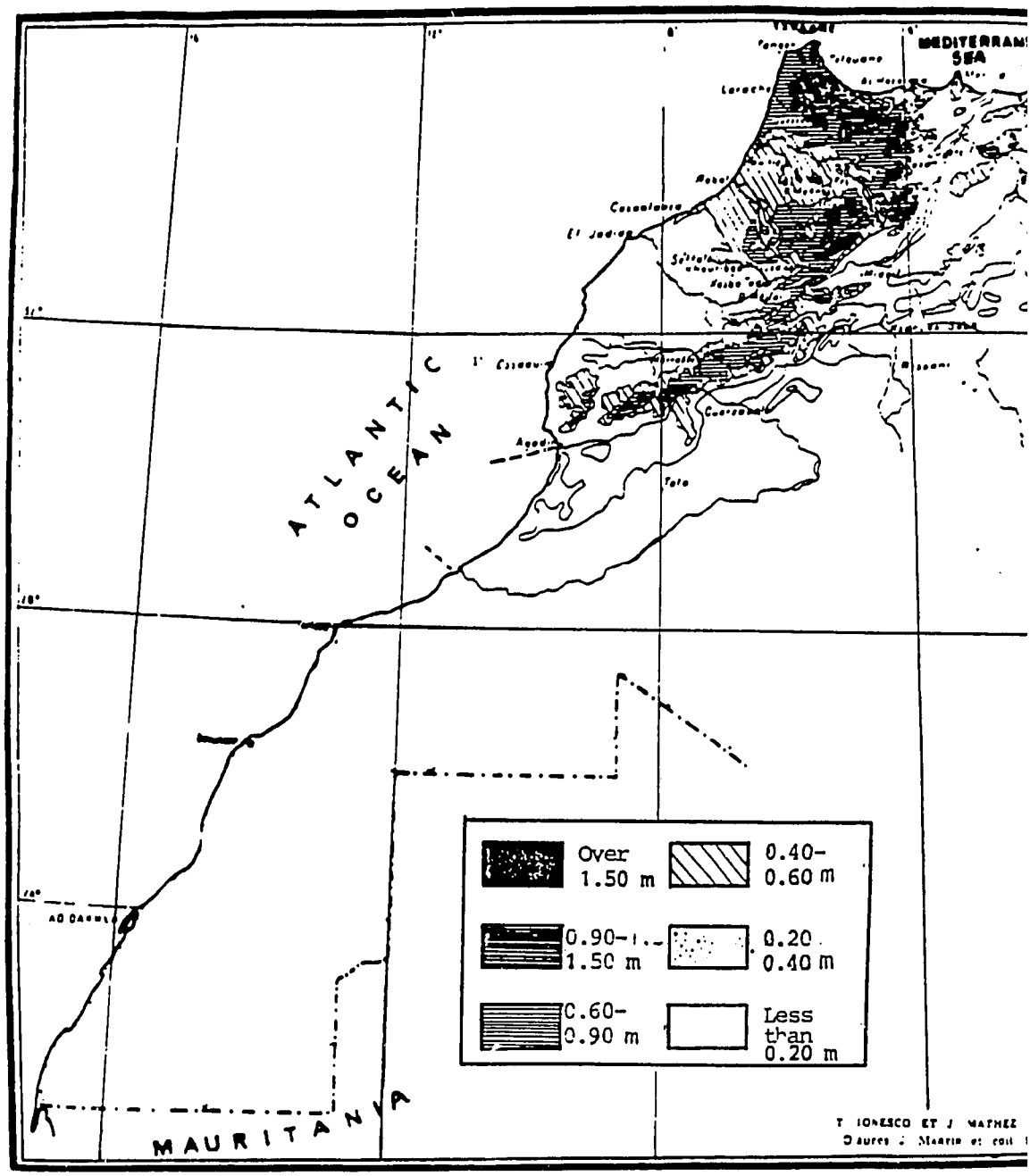
(2) Experience also shows that the return of substantial rainfall after a series of dry years may have serious adverse effects where the protective plant cover and the ability of soils to absorb precipitation have disappeared or been reduced; this situation resulted in the catastrophic floods in Tunisia in 1969. This is particularly serious because rainfall in the mediterranean may be violent (2-3 mm of water per minute) and have powerful mechanical effects.

ANNUAL PRECIPITATION IN THE NORTH OF MOROCCO

Annual Rainfall in Morocco



The consequences were less serious when the population density was much lower. Then used to be said that one or two good years were sufficient to wipe out the damage caused by even the most severe drought. Although in practice life still goes on substantially as if this idea held good, research is beginning to piece together a better picture of the ecological and social effects of such cycles[3]. This work should give rise to more research programs suited to the conditions prevailing in the country, and it already constitutes a precondition for the stipulation of specific agricultural policy measures intended to mitigate the effects of these cycles and to facilitate recovery from them.

These ecological regression phenomena form part of a long-term trend on a geological time-scale[4]. After a period of relative stability during the last few centuries, they seem to have gathered momentum again to an alarming extent in the last few decades, owing partly to a probably unprecedented increase in population and, in particular, to the crudeness of man's present-day tools: for example, many fragile soils were not harmed by the swing plow (which can today perfectly well accomodate tined implements), while the disk plow causes serious damage to them.

Another very important feature of this zone is the relative mildness of the winters in the low-lying plains of the Atlantic and Mediterranean slopes. Fall and perennial plants exhibit very little vegetative rest, growing almost continuously throughout the rainy season (October to May). This is why these areas are so well suited to winter cereals and fodder plants where rainfall is adequate. On the coastal strip, the very mild, almost frost-free microclimate gives Morocco an undeniable advantage for products of high economic significance, such as early vegetables and citrus fruits.

1.2 SOILS

The soils of Morocco are extremely varied owing to the diversity of the geological substrates and the undulating topography of the country, associated with a relief which is still young and whose evolution is continuing, as stated, as a result of the effects of climate and man

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(3) See, in particular, the work currently in hand at the Social Sciences Department of IAV.

(4) On this scale, of course, the Maghreb, like southern Europe, is engaged in a process of regression of the plant and soil capital built up during the Ice Ages; subsequent climatic change has destabilized the situation of this capital. In Roman times, when the formation of the Sahara was already well advanced, "it was still possible to go from Carthage to Tangier without leaving the shade of the trees". Throughout the course of history, man has been an essential agent in the progressive destruction of the balance.

(see Annex 5). Most of the soils are neutral to basic (limestone often being present in the profile), but acid soils are predominant in some areas (Rif, Mamora, Central Plateau, the coastal strip between Rabat and Tangier, etc.).

The soils are of variable texture, with fine constituents - clays and loams - predominating in the large irrigated alluvial plains (Tadla, Gharb, Loukkos, etc.), where there is frequently a danger of salinization. In areas where the annual rainfall is less than 500 mm, the useful soil depth is often limited by limestone crusts at a depth of 30 or 40 cm.

This diversity, often coupled with great local variability, is an asset insofar as it allows combinations and complementarities in agricultural utilization as well as in regional or even national terms. However, it is also a liability by virtue of the range and multiplicity of the problems it creates for research, agricultural extension, and development.

It is important to note that Moroccan agriculture and its future are dependent on the soil in three major respects: preservation of its existence (control of erosion); maintenance - or in some cases, improvement - of its production capacity (fertility); and finally, utilization of this capacity by appropriate practices.

With regard to soil conservation, it should be noted that extensive and varied areas are vulnerable. Their equilibrium was not in question as long as they remained protected by vegetation which, although not dense, was permanent, and as long as they were stressed only slightly and intermittently (e.g., by the swing plow). However, once a certain threshold of working is passed, the balance is disturbed, and if nothing is done, this leads within a few years to the establishment of new physical and cheminal equilibria with a much lower useful potential, or even to the disappearance of the soil itself.

Erosion (sheet, gully, or other) is thus favored on even gentle slopes by destruction of the permanent plant cover, which may be caused simply by overgrazing, but especially by the disturbance of the soil structure by implements, resulting in periodic exposure of the soil to the atmosphere. Earth masses slide down the marly hills (solifluction), covering the cultivated soil with much less fertile material. In extreme cases, this may give rise to the formation of badlands.

The violence and frequency of floods are increased owing to the reduced water retention capacity of the catchment areas, depositing heavy-structured sediments in the fertile plains which were not directly affected and thereby impairing their utilization. Dams fill quickly unless expensive protection work is carried out on their slopes. Wadi beds may widen considerably, causing these watercourses to become erratic and occupy entire valley bottoms.

The big change which has taken place within a few decades in the ratio of population numbers to the agricultural area in Morocco has thus become one of the principal problems facing both research workers and politicians in that country.

Second, the importance of preserving fertility is related both to the problems mentioned above and to the rapid deterioration of organic matter and low humus content of the soil in this relatively hot climate. Land clearance and reclamation are other factors which reduce the proportion of organic matter. The phosphorus which is present is not readily available in acid or calcareous soils; there is, usually sufficient potassium in most Moroccan soils, however.

Organic matter tends not to be returned to the soil for traditional reasons, while average fallow periods are declining; fertilizer application methods are thus assuming increasing importance.

Intensification of plant production thus presents particular difficulties, even in favorable areas, the land-fallow being in many respects a way to manage soil fertility.

In the irrigated areas, problems associated with the irrigation bed and salinization are always present. In the drier areas, compacting of the surface layers of the soil after disk-plowing also quickly gives rise to reduced fertility and encourages erosion.

The third major soil problem, which must be tackled in the short term, concerns expression of its productive capacity, which differs from year to year owing to climatic variability. This problem is bound up with water and its movements and storage in the soil, as well as soil-water-plant relations. It can be solved by specific techniques which are not all well known and are often difficult to master; they call for a good knowledge of the environment, considerable competence and agricultural experience, so that it will not be easy to gain general acceptance for them. However, these scientific techniques could be improved by an in-depth analysis of certain traditional practices.

1.3 THE MAIN AGRICULTURAL ZONES

This section does not give an exhaustive survey of the very diverse agricultural zones in Morocco but merely describes the most important characteristic of these zones. Readers unfamiliar with the Moroccan situation should remember that the small number of cases arbitrarily selected here represent an almost unlimited range of individual situations and intermediate forms, which could certainly also be classified differently. The aim is merely to give an overall view of the practical context of Moroccan agriculture.

An initial distinction may be made between "favorable" and "difficult" environments and among the former, between natural (rainfed) environment and controlled (irrigated) environments. The concept of a "favorable environment" relates to the level and reliability of yields feasible to obtain from socially accessible cropping techniques or the possible production diversification. This concept is thus historically relative.

1.3.1 The favorable environments

Rainfed agriculture

The most common type of rainfed agriculture is called the "favorable bour". Here, the average rainfall (400 mm/year or more) and the topography will at least allow cereal-based rotations including a field of soft wheat every year. These conditions prevail north of the line El Jadida - Fez - Taza - Oujda. The plains (Saïs, Gharb, etc.) are occupied principally by large mechanized farms with a large number of small farms or minifundios. Large-scale arboriculture is also practiced here (Meknès vines, olive groves, etc.).

Traditional social structures (fractions) have survived in the hills (Pre-Rif, etc.), where land occupying is better distributed with denser population, with smaller plots, and less widespread mechanical traction. Instead of specialized commercial agriculture, these areas feature mainly food crops, often diversified (legumes, etc.) and complex production systems whose development requires appropriate forms of support and extension activities.

There is an even more attractive potential in the areas which have both high rainfall (600 mm or more) and mild temperatures: a very wide range of crops, both summer and winter, would be possible here, such as potatoes, sunflowers, sugarbeet, etc. An example is the northwestern area between the Gharb and Tangier (the subhumid area of the Lower Loukkos, etc.). These areas, are unfortunately, small.

Irrigated agriculture

There are many different forms of irrigated agriculture, with varying degrees of control. They cover a total of nearly one million hectares out of 7.8 million ha which could in theory be cultivated.

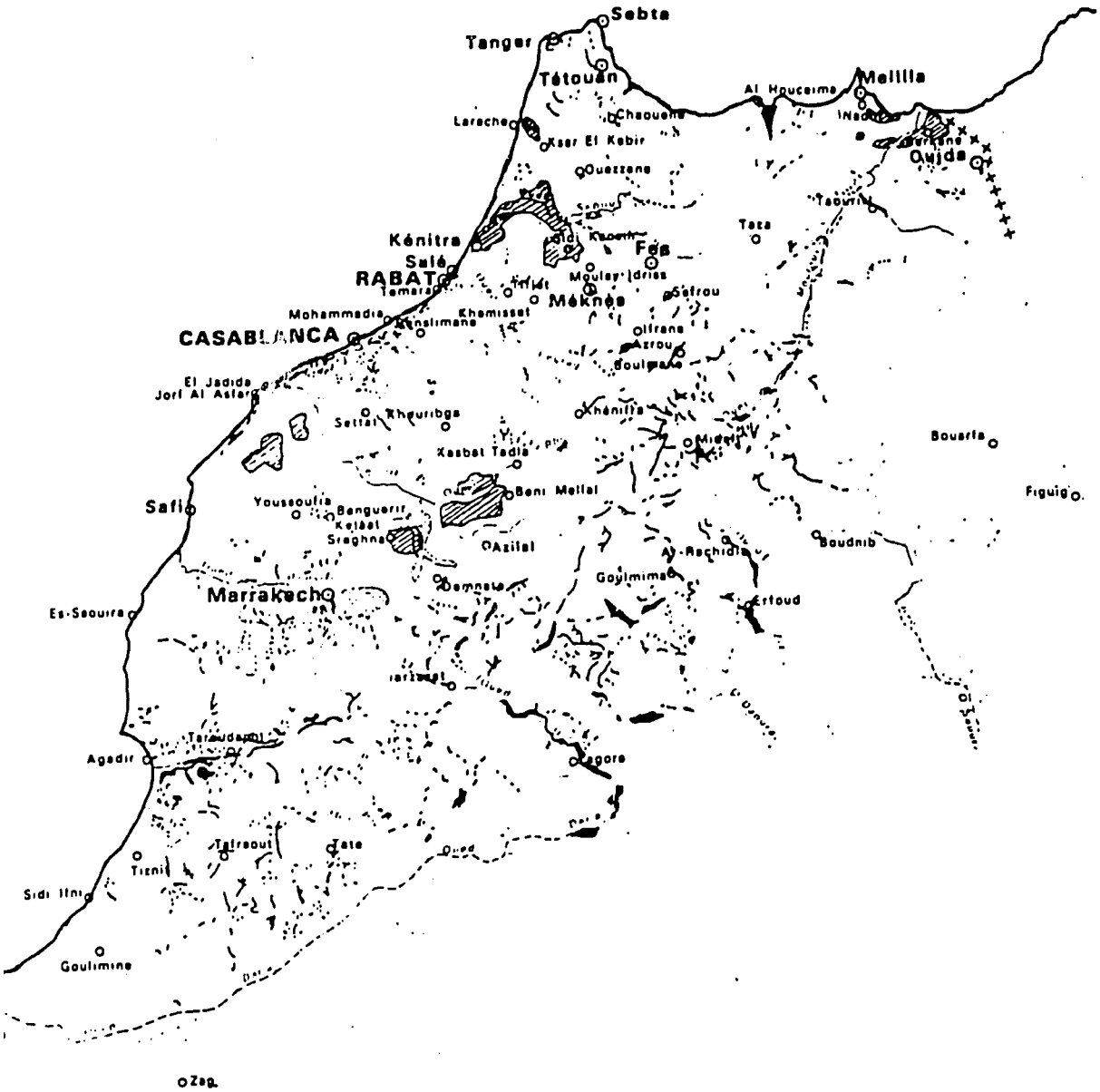
First of all, there is the so-called Saharan agriculture - in fact, oasis agriculture - which is important by virtue of its elaborate form of social and technical organization, its venerable age, its place in the culture and history of Morocco, its particular economic value to the country in the export of dates, and also its value as a form of occupation and utilization of vast expanses of land which would otherwise be empty.

The traditional forms of small- and medium-scale irrigation works are also very widespread in all regions: field-flooding systems, underground water supply tunnels (called rhetarras), wadi offtakes, surface wells, etc. These often form part of production systems combining dry cereal growing, arboriculture, and livestock farming. They may provide cash crops or simply facilitate the cereal harvest (supplementary irrigation).

Owning to the groundwater table of the coastal plain associated with the mild winter climate, the coastal strip between Casablanca and Safi is one of the two areas producing out-of-season vegetables for export.

Finally, there are the areas watered by large-scale irrigation schemes, which now amount to about 500,000 ha (see Map on next page). These are

IRRIGATED AREAS IN NORTHERN MOROCCO



Area irrigated by a large-scale irrigation works
Area with small- or medium-scale irrigation works
Crops irrigated by controlled flooding

SOURCE:

Ministry of Agriculture and Agrarian Reform
Directorate of Extension and Agrarian Reform
Division of Extension and Agricultural Cooperation
Hassan II Institute for Agriculture and Veterinary Medicine
Directorate of Land Conservation and Topographic Works
Cartography Division

closely supervised by the Regional Agricultural Development Agencies (ORMVA) and are the main object of the agricultural modernization program. Their principal function is to supply the country with some of the basic products which are in deficit (sugar, milk, oil, rice, etc.) and also for export (citrus, vegetable crops).

1.3.2 The Difficult Environments

These unfortunately account for the major part of the agricultural land area, as more than half the 7.8 million ha of cultivable land receives an average of less than 350 mm of rain per year. At least four main types of environments can be identified in this group.

First, there are the "contingent" cereal-growing areas, with less than about 400 mm rainfall, most of which are south of the line mentioned above joining El Jadida, Settat, Fez, etc., and extending to the Atlas. This is the "unfavorable bour". Soft wheat disappears and barley becomes the dominant crop (2 million ha in Morocco); fallow land becomes general (over 2 million ha). The main problem is the irregularity of climatic conditions and the conduct of an agricultural campaign on cropping season. Even the least important technical decisions must be considered not only in terms of the relevant cropping cycle but also of those following and preceding it.[5] Stock-raising - mainly sheep or draft animals - in addition to its other functions, acts as a bridge to help cope with unpredictable failures in the system. The population needs this large number of activities and sources of income as an essential guarantee.

In areas of even lower rainfall (less than 300 mm), cropping becomes occasional, itinerant; these are the areas of range management, with the characteristic big herds, transhumance, seminomadism, and particular social organization. This applies especially to the entire east of Morocco, on the plateaus beyond the Middle Atlas and the Moulouya. This zone is therefore important for meat production, but it also produces alfa grass and provides seasonal labor for the harvests (cereals, olives, etc.) in the western part of the country.

Another type of unfavorable ecosystem comprises the foothills areas extending along the Rif and Atlas ranges. Rainfall is often adequate here but the soil is shallower, the topography less accommodating, and the temperature also lower. Extensive fruit-tree culture (Rosaceae, olive trees) is therefore important here, but always in association with cereals and pastoral stock raising.

Finally, there is mountain agriculture, which supports a still considerable population in a traditional manner under difficult conditions, subsisting from all available resources; this also provides a source of temporary or permanent labor for other areas, the cities, and

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(5) See Benatya, Pascon, Zagdouni, 1983.

even foreign countries. Since it has no marketable produce to offer, except local forest products, it has hitherto been the most neglected part of the country in every respect.

1.4 CONCLUSION

On the whole, the Moroccan natural environment remains unfavorable. The land area which can be used for agriculture and stock-raising represents only 10% of the total area of the country (724,000 km^2); furthermore, half of it is semiarid. As a result, Morocco's potential for agriculture appears to be somewhat limited, even if the conditions are more favorable in Morocco than in the neighboring Maghrebian countries. The other half of the potentially useful land, suitable for normal farming (less than 4 million ha), features a large variety of ecological environments, which are seldom observed in other parts of the world, except in some other regions of the Mediterranean and in Australia. This greatly complicates the tasks of agricultural research and development.

2. AGRICULTURE AND ITS IMPORTANCE IN THE NATIONAL ECONOMY

2.1 THE PLACE OF AGRICULTURE IN THE NATIONAL ECOMONY

Agriculture accounts for a very important part, albeit decreasing, of the national economy. It directly provides 45% of all jobs, and more than 57% of the population is still rural.[6] Its contribution to gross domestic product - 18% in 1982, 22% in 1970[7] - may appear small, reflecting as it does both low productivity and under-remuneration of agriculture labor, but its true place in the economy is much more substantial in that nearly a third of industrial and commercial activities depend on it.

Agriculture also accounts for 31% of exports (1980), compared with over 50% in 1974 - mostly citrus fruits and early vegetables to the EEC. However, it accounted in 1980 for 17% of the value of Morocco's imports,[8] mainly in the form of basic products: soft wheat (over half of agricultural imports since 1975), dairy products, sugar, and vegetable oil. This trend partly reflects the increasing deterioration of the food situation to which the State is now endeavoring to respond.

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(6) However, the growth rate is only a third of that of the urban population: 1.5% compared with 4.5%.

(7) Source: MARA (Ministry of Agriculture and Agrarian Reform).

(8) Economic and Social Development Plan 1981-85.

2.2 DETERIORATION OF THE FOOD SITUATION

Deterioration takes the form of a reduction in the rate of demand satisfaction from national production, evident mainly through the evolving trends in the food trade balance: while exports were nine times as high as imports in 1969-72, they represented only 72% of the level of imports in 1981.[9] This is partly due to the growth of individual demand associated with some improvement in the average standard of living, but mainly to the substantial and persistent discrepancy between the population growth rate (nearly 21 million people) and the rate of growth of agricultural production.

While the population has increased at a high rate (2.7% per year, with an apparent small downward tendency), the growth of agricultural production has varied considerably, by up to 20% year-on-year.[10] According to FAO indices and on the basis of three-year moving averages, total food production increased by only 11% in the period 1971-81, while the population grew by over 31%. During the same period, per capita food production apparently fell by 16%. The most worrying figures concern cereals, which are the population's basic food source: according to FAO figures, per capita production fell by 40% between 1971-73 and 1980-82.[11]

However, trends in the 1960s were encouraging, but they may be partly due to a more favorable climatic cycle. A recent particularly difficult cycle has already been referred to: two years of catastrophic drought, 1981 and 1983, in a series of years of mediocre rainfall, imposing a heavy burden on foreign trade.

Overall, self-sufficiency rates for the major basic products have been declining for twenty years and, according to projections by the Planning Office (see Tables 1 and 2), are unlikely to improve in the medium term (1985).

The only product for which domestic supplies are improving - and indeed improving rapidly - is sugar. In the case of dairy products and oils, the self-sufficiency level is being held or is deteriorating despite the expansion of volume production. A serious situation is now arising in cereals, which currently account for half of food imports. Finally, the outlook is not good for the only product in which the country has until now been roughly self-sufficient - red meat - at least as regards demand satisfaction.

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(9) Qarouach (M.), 1983.

(10) The validity of statistical data is, of course, necessarily relative in an agrarian economy which is still largely traditional although in the process of rapid monetarization.

(11) FAO, Production Yearbooks 1981 and 1982.

Another indicator of the deterioration of the food situation is the steady decline in the cultivated area per head of population: 0.36 ha in 1970, 0.32 in 1975, 0.27 in 1980, and 0.26 in 1982.[12]

However, while the country is unable to increase the area of land under cultivation, the existing potential is far from saturated. The official estimates of the Ministry of Agriculture and Agrarian Reform (MARA) show that cereal production can be tripled, sugar production quintupled, oil production increased by a factor of ten, meat and milk production quadrupled, vegetable production tripled, etc.[13]

2.3 OBJECTIVES

According to the Plan, agriculture has a threefold part to play in the development of the country:

- improving the rate of self-sufficiency in food by increasing the production of basic food products which are in deficit or are liable to become so;[14]

- earning of foreign exchange from export products (citrus, early vegetables, etc.;

- facilitation of national integration by reduction of regional and social inequalities through improved incomes and living conditions among the rural population, which has hitherto been seriously disadvantaged.[15]

The importance attributed to these objectives is indicated first of all - as it has been in the last few Economic Plans - by the place given to agriculture in the country's development program. For instance, agriculture was to account for 17.7% of all public and private investment in the period 1981-85 - i.e., 28.5% of the level for the market sectors only. The public sector alone was to supply nearly 60% of the relevant capital, accounting for 92% of its contribution to the market sectors and over a third of all public funds invested during this period.[16] Capital investment in agriculture in 1981 amounted to nearly 15% of the value of the sector's production.

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(12) According to MARA's Directorate of Planning and Economic Affairs (DPAE).

(13) Economic and Social Development Plan 1981-85. Vol. I, p.112.

(14) Cereals, red meats, and oil plants have been declared priority products in this connection.

(15) According to the World Bank's 1980 Mission, 45% of the rural population was living below the poverty line, compared with 28% of the urban population, among whom the situation is also deteriorating.

(16) "Plan de développement économique et social 1981-85". Vol. I.

Table 1 - VARIATION OF THE SELF-SUFFICIENCY RATE FOR A NUMBER OF FOOD PRODUCTS IN MOROCCO IN THE PERIOD 1960-1980 AND FORECASTS FOR 1985

	Self-sufficiency rate (%)				Production/demand ratio	forescast
Products	1960-64	1965-69	1970-74	1975-80	1980	1985
Cereals	86	87	86	75	69	67
Red meats	100	100	100	98	93	88
Dairy products	61	54	60	58	61	61
Oils	27	38	31	19	36	33
Sugar	4	28	46	50	54	85

Source: "Plan de développement économique et social 1981-85". Volume I, p. 110.

Table 2 - VALUE OF THE MAIN IMPORTED AGRICULTURAL PRODUCTS (in current Dh).

Product	Value of imports in 1970	in 1980	Value of Moroccan production in 1980
Cereals	132	1,340	4,334
Sugar and confectionery	139	631	267
Milk and milk products	71	231	877
Vegetable oils	81	377	267
Total for the four basic products in deficit	423	2,579	5,745
Value of agricultural GDP	3,974		12,711

Source: Figures from MARA (DPEA).

However, investment is not the only foundation for the development of agriculture. It also benefits, for example, from the Plan's general emphasis on vocational training, training of qualified staff and the policy of regionalization, decentralization, and diversification.

It should be pointed out in this connection that for a long time priority of investment has been accorded by agricultural development strategy to dam construction equipment and development of irrigated areas:[17] the aim was to take advantage of Morocco's important potential in this field, to broaden the production base by establishing a sector comparatively sheltered from the vagaries of the climate and able to inject the dynamism of technology into the rural environment.

While these objectives have been only partially met, this relative success has been at the expense of substantial neglect of the rainfed sector of agriculture, on which nearly 85% of the rural population still depend for subsistence. The IBRD's feasibility studies, however, suggested that, in Morocco, many rainfed farming projects, even in the mountainous and pastoral areas, would be more profitable than the current large-scale irrigation projects.[18] Serious social problems are beginning to arise, reflected in particular in the uncontrollable migration of populations to the towns.

The current Plan therefore includes provisions aimed at restoration of the balance, reflected, for example, in a redirection of the public funds devoted to agriculture (see Table 3). The arid, semiarid, pastoral, mountain and Saharan zones are declared to be particularly important owing to their resources (in particular, they supply most of the meat) and the low level of incomes.

Table 3 - PERCENTAGE ALLOCATION OF PUBLIC FUNDS TO AGRICULTURE

	Plan 1978-80	Plan 1981-85
Irrigated agriculture	65	40
Rainfed agriculture	29	52

Source: Plans 1978-80 and 1981-86, taken from Qarouach (M.), 1983.

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(17) The long-nurtured objective has been to achieve an irrigated area of one million ha by the year 2000. The FAO estimated the irrigated area to be 460,000 ha in 1977 and 520,000 ha in 1981, but other figures are also quoted: MARA's publication "Agriculture marocaine: données essentielles" [Moroccan agriculture: essential data"] mentions 808,000 ha in 1982, made up of 427,000 ha of large-scale irrigation facilities and 381,000 ha of small- and medium-scale projects; however, it is not stated whether these areas are actually irrigated. Apparently, nearly 200,000 ha are also irrigated seasonally or are subject to flood waters.

(18) World Bank Report, 1980.

A new approach is being adopted in these areas, involving integrated projects with a place for research; several of these have commenced, and INRA is taking part in them.

However, there is little prospect of these targets being met, especially as regards the investment levels provided for in this Plan, owing to the considerable delays incurred in the first three years due to budgetary restrictions and to the vicissitudes of the climate. The measures ultimately decided on in this situation are apparently those with the prospect of having an immediate effect: they favor the farmers and sectors already capable of increasing their production (various incentives for the purchase of production factors, tax exemptions, etc.).

3. AGRICULTURAL PRODUCTION AND STRUCTURES

3.1 ANALYSIS OF CROPS AND PRODUCTS

Morocco has a cultivable area of approximately 7.8 million hectares, of which over 500,000 ha is irrigated, and about 20 million ha of rangeland. The following comments arise from the breakdown of cultivated land by major crop types (see Table 4).

Table 4 - BREAKDOWN OF CULTIVATED LAND DURING THREE AGRICULTURAL PERIODS ('000 ha)

Product	Period 1968-70	Period 1979-80	Period 1981-82
Cereals	4,469	4,418.3	4,280.5
Legumes	466	384	294.8
Oil plants	38	35.6	49.5
Industrial crops	63	87.7	88.9
Fodder crops	43	122.1	132.1
Vegetable crops	99	137	123.4
Miscellaneous crops	30	17.4	11.2
Fruit plantations (dense)	442	474.1	501.8
Total cultivated area[19]	5,533	5,470.4	5,307.6
Fallow	1,968	2,218.2	2,610.7
in % of total UAA	(26.2)	(28.8)	(33.0)
Total UAA	7,501	7,688.6	7,918.3

Source: Mara (DPAE). UAA: Useful Agricultural Area.

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[19] After deduction of casch crops and shrub crops: 117,000 ha (1969-70), 199,800 ha (1978-80) and 174,600 ha (1981-82).

Fallow areas are very large. This is largely due to climatic factors: half the cultivable land receives on average less than 350 mm of rain per year. The areas of fallow land vary widely with the variation of rainfall and seem to be increasing relatively.

The fallows are also important because of the lack of diversification of crop rotation, aside from cereals. In particular, fodder crops, although increasing, are still relatively insignificant. The growing of grain legumes is declining gradually apace. Again, fodder crops and grain legumes are mainly grown under dry conditions, while much of the increase in the other non-cereal crops (industrial plants, etc.) is associated with irrigated land; this suggests a trend for the rainfed farming rotations ("bour" agriculture) to become impoverished.

Owing to the development policy of the country's water resources, part of Morocco's agricultural production has been stabilized and increased by investment in large-scale hydraulic works - in particular for the export production sector (citrus, early vegetables) and basic products most in deficit (sugar, milk, vegetable oils). However, cereal production remains at the mercy of the vagaries of the climate and is still subject to considerable year-to-year variation: taking the production level of 1974-76 as 100, cereals production fell to 45 in 1981, rising again to 88 only in 1982[20] and falling again to about 60 in 1983.[21] As already shown, the dry areas, except for the "favorable bour", have long been neglected. This is an important sector, to which investment is only now beginning to be directed, particularly in the form of research.

Particular mention should be made of the export products sectors: citrus fruits and vegetable crops, mainly fresh and to a lesser extent for canning. Although limited in area - 20,000 ha and 8,000 jobs in market gardening; 68,000 ha and 300,000 jobs in citrus fruit growing -,[20] these sectors are of paramount importance by virtue of their foreign currency earnings: nearly 1,300 million Dh out of just over 2,000 million Dh for agricultural exports and 6,260 million Dh for total exports in 1978.[22]

Most of these exports are directed towards the EEC. They are extremely liable to external competition and also to some extent to Community protectionism.[23] The sector is extremely speculative and unpredictable, and this has compelled it to set up the controlling Office de Commercialisation et d'Exportation (OCE) [Marketing and Export Agency], which imposes necessary restrictions but also contributes a

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(20) FAO, Production Yearbook, Vol. 36, 1982.

(21) Based on provisional estimates published in "Afrique Agriculture", No. 98, 1 October 1983.

(22) Allaya (M.C. and M.), 1980.

(23) Qarouach (M.), 1983.

degree of dynamism. Finally, it is to be noted that the domestic market is increasing in significance.

Production from the livestock sector, which accounts for about a third of the value of total agricultural production (see Table 5), seems to have grown faster and more steadily than crop production. According to the FAO (base 100 = average for 1974-76), it rose to 127 in 1981 and 134 in 1982 (respective per capita indices 105 and 107). The disastrous years of 1981 and 1983 must, however, be allowed for, when the level of meat production was maintained only by the slaughter of breeding animals, involving serious capital losses. Production will therefore fall in the next few years, the decline being exacerbated by the necessary process of restocking. The level of consumption, which is already not very high (15 kilos/person/year) can probably therefore be maintained only by imports.

Policy in the livestock sector has been to take advantage of the irrigated potential to develop a dairy herd of imported breeds, while meat production was carried out in rainfed farming areas and, in particular, rangeland areas. Attempts are being made to improve the local populations and breeds, with good prospects, particularly for sheep. Research has played a part in these efforts. The animals receive good veterinary care. Feed supplies remain the most serious problem, as livestock farming is barely integrated with the cropping systems in the rainfed areas.

3.2 PRODUCTION STRUCTURES

Cultivable land in Morocco has a wide variety of forms of legal tenure status. According to the agricultural census of 1973-74, most (nearly three quarters) is held on a basis of strictly private tenure ("melk"). There is also "guich" land (nearly 5%); this is State land which has been allocated to former military personnel. Then, there is nearly 14% "collective land", the working of which is reallocated periodically, often annually, and 1% "habous", which are lands worked for the benefit of religious foundations. Finally, the State retains nearly 6% of the cultivable area, acquired mainly, but not exclusively, by recuperation of former colonial land. Most of this land is used in the form of farms [domaines] run by big specialized State corporations (SOGETA: 95,000 ha, a major producer of seed and animal products; SODEA: 65,000 ha, specializing in citrus and arboriculture; SNDE and COMAGRI, which concentrate on livestock; etc.). The State has also established an agrarian reform sector comprising about 325,000 ha distributed among some 23,000 households, themselves grouped into nearly 700 cooperatives (1982 figures), which have remained practically unchanged since 1978.

Aside from this diversity of forms of land tenure, there is a very large number of small farms. Some 80% of all farms are of less than 5 ha (including 23% production units without individual land) and account for only 24.5% of the cultivable area covered by the census. Conversely, 3.8% of farms, including the State farms (fermes d'Etat), account for a massive 33.6% of the cultivable area (see Table 6). Morocco thus emerges as a country of small farmers and of relatively large farms.

Table 5 - GROSS AGRICULTURAL DOMESTIC PRODUCT BY PRINCIPAL PRODUCTS IN 1980

Product	Volume (10^6 quintals)	Percentage of GADP
Cereals	45	34.1
Food Legumes	2.3	2.1
Vegetable crops	22.1	11
Sugar	3.4	2.1
Textiles (cotton)	0.2	0.4
Oils	0.4	2.1
Citrus	10.3	4.8
Date palms and other fruit trees	18.8	6.1
Fodder crops	4	1.8
Red meats	3.3	17.7
White meats	0.9	5.6
Milk and milk products	7.8	6.9
Miscellaneous animal products (honey, skins, wool)		2
Wood products and miscellaneous products (tea, etc.)		3.2
Total		100%

Source: Provisional estimates by MARA (DPAE).

Table 6 - BREAKDOWN OF LAND BY SIZE OF FARMS

	Existing farms	Cultivable area recorded in census
Total (absolute value)	1,930,000	7,250,000
Percentage by farm size classes	(100)	(100)
- farms without land	23.4	-
- less than 5 ha	56.6	24.5
- 5 - 20 ha	17.2	41.9
- 20 - 100 ha	2.7	23.9
- over 100 ha	0.1	9.7

Source: MARA - Agricultural census, 1973-74.

Overall, however, Morocco has two main types of agriculture with different forms of holdings and land tenure. First, there is the traditional sector made up of small holdings, mainly located in unfavorable areas, with poor-quality, limited resources, and with little market orientation. These farms provide - often inadequately - for the subsistence of the majority of the rural population and are unresponsive to conventional incentives to increase production. Second, there are a number of much better-endowed farms which, however, vary in their economic behavior: while a minority is on the lookout for advantageous innovations, or responsive to appropriate and competent promotional efforts, the majority satisfies itself with a form of working which, while profitable, mainly constitutes a lifestyle, and does not take full advantage - sometimes by a very wide margin - of the available potential.

4. SUPERVISION OF AGRICULTURAL PRODUCTION

The technical and administrative supervision of farming enterprises is provided for by two types of structures, one for irrigated and one for rainfed farming.

The areas with large-scale irrigation schemes have been entrusted to powerful bodies, the Regional Agricultural Development Agencies [Offices Régionaux de Mise en Valeur Agricole (ORMVA)], which are responsible for management, equipment, extension, and agricultural development problems in each of the relevant areas. They have legal-entity status and enjoy financial autonomy under the control of the Ministry of Agriculture (MARA), and their governing bodies include representatives of the various ministries, local authorities, and farmers. Their organization includes a dense network of 140 Development Centers [Centres de Mise en Valeur - (CMV)], which perform services (such as work with mechanical equipment), provide in-the-field agricultural extension services, and deal with relations of all kinds with farmers (advances, subsidies, loan portfolios, etc.). A CMV visited in the ORMVA of the Gharb had a staff of 31 for nearly 200 farms with irrigation facilities covering 3,300 ha and more than 2,000 other farms under rainfed conditions.

The rainfed farming areas - the bour - are covered by the Works Centers (Centres de Travaux - CT) and their subcenters, which are much looser and more extended structures; there are 118 of these throughout Morocco. They also have independent legal-entity status and financial autonomy under the control of MARA, with a governing body made up principally of local representatives and farmers. They operate under the supervision of and with the aid of the Provincial Directorates of Agriculture [Directions Provinciales de l'Agriculture (DPA)], which represent MARA and its services in each province.

Aside from the problem of supervisory staff density, the staff of the CTs in fact must perform a large number of administrative tasks (subsidy files, procurement of supplies, etc.) and do not possess the practical competence, communication skills, or other requirements necessary for effective extension work. This is, in any case, more difficult and less spectacular than in the irrigated areas, where the technical proposals

produce much more tangible practical results.

However, a number of successful experiments have been carried out: the CRAFAs (Centre Régionaux d'Animation et de Formation des Jeunes Agriculteurs [Regional Young Farmers' Motivation and Training Centers]), which hold intensive training courses for young people; the training centers for extension workers, who have to give evidence of their practical skills on a plot of land and with livestock allocated to them individually; and the more recent innovation of pilot work centers with increased resources and more appropriate working methods.

Aside from the State supervisory system, there are few forms of organization stemming from the agriculture professional sector itself. There are nearly 2,000 cooperatives, mostly for the joint utilization of agricultural equipment (CUMA) and service cooperatives, but these represent a largely State-sponsored movement, especially as regards preferential subsidization rates for the procurement of equipment, supplies, etc.

Each province has a Chamber of Agriculture to represent its farmers, but it seems that only the large farmers play an active part in most of these bodies.

Some sectors have, however, been forced to begin to organize: these are the market gardening and citrus-growing sectors, which have set up the Association Syndicale des Producteurs d'Agrumes du Maroc (ASPAM) [Moroccan Association of Citrus Fruit Producers], whose function is to defend their interests in a system dominated by the Office de Commercialisation et d'Exportation (OCE) [Marketing and Export Agency]. An intersectoral tax [taxe interprofessionnelle] is levied on the amounts produced and is used to finance a technical support body, the Société Agricole de Services du Maroc (SASMA) which, among other functions, is active in experimental work. Technical meetings and more active forms of agricultural extension are organized on this basis among various partners such as ASPAM, SASMA, OCE, the INRA Regional Stations, DPA, etc.

The only other sectors which have so far set up incipient organizations of their own are wine, rice, and sheep husbandry, but these are not very dynamic.

The technical and economic support environment in the agricultural sector, providing supplies of agricultural producer goods and marketing produce, is mainly left to private enterprises. The main exceptions are in the seed sector, particularly cereals, which is provided for by SONACOS, a State corporation, and the fertilizer sector, which is dominated by FERTIMA, an offshoot of OCP [Office Chérifien des Phosphates]. In the livestock sector, COMAGRI produces pedigree sires and distributes them to farmers.

Mention should also be made of the organization of agricultural credit, there being a national body [Caisse Nationale de Crédit Agricole (CNCA)], and regional and local institutions, on whose boards the farmers are represented. In practice, however, credit is restricted to farmers with farms above a certain size. Small producers, and often those who are most in need of funds, do not have access to them owing to the security terms demanded.

Although the standards have recently been relaxed, arrangements have not yet been introduced whereby credit would be placed within the reach of the majority.

Further down the chain, the Office National Interprofessionnel des Céréales et Légumineuses (ONICL) [National Intersectoral Agency for Cereals and Legumes] is responsible for monitoring and regularizing the cereals and seed legume market, but has no facilities of its own. This sector includes some 150 marketing cooperatives in addition to private operators.

The Compagnie Marocaine des Produits Agricoles (COMAPRA) closely controls the cotton and sunflower sectors, from seed multiplication and distribution to the buying and marketing of production. Finally, OCE, whose importance has already been referred to, has an export monopoly for citrus, early vegetables, wines, and cotton. The other sectors are open.

5. AGRICULTURAL POLICY: APPROACHES AND MEANS

The State's general strategy for the development of agriculture was described above, the emphasis being placed strongly on equipment and exploitation of the country's water resources for irrigation purposes at the expense of the long-neglected rainfed farming areas. An attempt to redress the balance is now under way, but is being held back by the present period of budgetary restrictions and drastic droughts.

Hence the modernization of Moroccan agriculture has followed the easiest and most impressive path, but also the most expensive one, so that it is inevitably incomplete, localized, and selective, having regard to the funding limitations of a country only moderately endowed with sources of foreign exchange. Much effort has been deployed to promote this modernization. A substantial budget has been devoted to encouraging the use of modern production facilities: the 1969 Investment Code provides for a detailed range of subsidies and aids for the purchase of inputs, machinery, and equipment. As described earlier, a dense supervisory network has been established in the areas under the control of the ORMVAs. Considerable funds have been devoted to the support of new products by research. Another aspect of this policy has been the training of a substantial number of technicians and engineers.

Nevertheless, this policy has evidently not been fully effective, on a number of counts. One of the main reasons is presumably that the difficulty presented by the wide range of farm sizes (see Table 6) has not been overcome by a sufficiently far-reaching reform of agrarian structures. It is difficult to solve the problems and satisfy the requirements of small, medium, and large farms at the same time: the large ones are usually the most likely to take advantage of the facilities and aid measures offered, thus absorbing a relatively high proportion of the State aid on offer.[24] This kind of resource

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(24) World Bank Report 1981.

allocation is not necessarily efficient, in that a high proportion of large farmers, who also engage in other activities, have other sources of income or are satisfied with their lifestyle, are not interested in taking the process of intensification to its limit and making the fullest use of the available resources.

Another aspect of the policy of encouraging production is the fixing or control of the prices of the principal basic products. A Compensation Fund [Caisse de Compensation] limits the effects of this system on consumer prices. However, in view of the rapid increase in the expenditure of this Fund,[25] the Government had to increase retail prices substantially in 1980, with further increases contemplated with the known consequences.

Imports of food products are controlled and subject to quota, but due allowance is not always made for the interests of producers, so that they have a depressing effect in some sectors.

Last but not least, among the instruments at the disposal of the State in the field of agricultural policy is the Plan. This represents a statement of that policy as envisaged at the time of preparation of each Plan, as well as the laying down of the program of public investment proposed for the relevant period. It is, of course, not binding, but exercises a homogenizing influence within the Administration and throughout the country's agricultural and para-agricultural sector.

6. PROSPECTS: VITAL NEED FOR CONTROLLED INTENSIFICATION OF AGRICULTURE

As stated above, the period of relatively fast expansion of production up to the beginning of the 1970s has been followed by a much slower and more chaotic phase of growth, from which Moroccan agriculture has not yet managed to emerge.

Indeed, the present stage is particularly acute and worrysome, with an almost continuous sequence of years of drought: the dams are not filling; the spontaneous plant cover, overstressed by man and his animals, is declining; and desertification is making rapid and irreversible inroads. The peasants in the unfavorable bour have used up their reserves, and the buffer of their livestock has diminished considerably. The favorable bour, it is said, has become unfavorable.

Again, in view of the difficult budgetary situation, in the midst of an ongoing international crisis, it seems unlikely that a solution to the agricultural sector's current problems can be found outside of the sector itself.

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(25) 578 million Dh in 1978; 1,360 million Dh in 1980.

Finally, having regard to the probable enlargement of the EEC, its growing protectionism,[26] and the increased agressiveness displayed by competitors in this market, there appears little scope for anything other than efforts to find new outlets in different markets.

Against this accumulation of adverse factors, however, must be set the large potential which is as yet untapped: the evaluations of the Ministry itself, referred to above (indicating the possibility of threefold to fivefold increases in the output of major products), even if disputed, offer such a considerable margin that any temptation to give up must be resisted.

The answer therefore lies in more systematic prosecution of the trend of intensification of the methods of exploitation of all the country's resources, most of which still have large untapped productivity margins. The relevant approaches are obviously not exclusively technical, but depend to a great extent on political and institutional changes - especially those which are most essential to the practical expression of these margins.

This radical change in future prospects calls into question the function of research. In the past, after Independence, it was, as we shall see, only a modest if not marginal instrument of development; indeed, as long as the relevant problems were still relatively simple and lacking in urgency, it was ultimately possible to dispense with research, especially in the most favorable regions, which had long been favored by agricultural policy. Here, especially in the irrigated areas, technology transfers (fertilizers, plant protection products, seeds, seed dressings, etc.) were sufficient, facilitated both by the public development agencies and by the many private undertakings upstream and downstream of production. In the future, the generalized intensification of agriculture will give research a function of paramount importance. Its function is obvious in the regions which have hitherto been untouched by development, where technology transfers are bound to be extremely limited, owing to the difficulty, specificity, and diversity of the relevant ecological, physical, and human environments; the object of research here will be to devise solutions consistent with the minimal resources of the traditional farmers - solutions which are inexpensive, involve little risk, and pave the way as carefully as possible towards modernization. In the already developed and modernized agricultural regions, research will have a no less important part to play for farmers who are technically more advanced and demanding. Here it will have to create technical innovations capable of raising the productivity of the scarcest factors and of improving the competitiveness of exported products. The more the technical innovations proposed are liable to modify farming practices (e.g., high fertilizer and pesticide consumption) in accordance with the

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(26) Moroccan exports of early vegetables to the EEC fell by 50% in volume between 1974 and 1981, while those of preserved fruit and vegetables fell by 40% (Qarouach, 1983).

interests of certain undertakings, the better their performance will have to be.

Finally, to satisfy the inescapable need for a new agriculture, the country requires new research, with a wider field of responsibility for development. The next two parts of the report, devoted to INRA, will concentrate on these considerations, which will be discussed in greater detail, together with their implications for the operation and structures of the Institute.

PART TWO

INRA: HISTORY AND PRESENT SITUATION

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INRA: HISTORY AND PRESENT SITUATION

INRA is the only Moroccan public institution specializing in agricultural research. This part of the Report presents a critical introduction to the Institute; it includes separate examinations of its origins, general organization, material, human and financial resources, activities and, finally, relations with its environment, and in particular with the other institutions of higher education, development, etc., institutions whose research and experimentation activities are not their primary vocation and which are complementary to or compete with those of INRA. This analysis will take account of the fact that all the aspects covered are interdependent and determine each other.

1. INRA'S HISTORY: THE KEY TO AN UNDERSTANDING OF THE PRESENT SITUATION

The body that is now INRA has a long history, which began in 1919 with the establishment by the colonial power of the "Service de l'Expérimentation Agricole" [Agricultural Experiment Service], based at the "Jardin d'essais" [Experimental Garden] in Rabat, which was to remain the location of the "Direction de la Recherche Agronomique [Directorate of Agricultural Research]. Notwithstanding the many changes in name and status (Service or Directorate of the Ministry of Agriculture; and autonomous institution except from 1962 to 1966 and after 1981), this history (see chronological table - Table 7) reflects a continuous extension of the successive institutions, with structures, general approaches, and methods of research substantially inflected by the colonial style.

On becoming independent in 1956, Morocco inherited a research structure centered in Rabat, supported by ten or so experiment stations, all situated in the most favorable areas, which had been monopolized by the French settlers. This research network was of high quality[27] and had, to its credit, an extensive and acknowledged scientific output, taking the form of many publications and resource inventories, while the experiment stations implemented technical innovations which had enabled colonial agriculture to modernize and progress rapidly.

After Independence and the first phase of nationalization of foreign land (1963), the research structure continued to grow rapidly, while its nature remained unchanged: from now on, research was national, but the relevant

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(27) Before 1956 the French agricultural research institutions (INRA, ORSTOM, IRCT, IFAC, etc.) sent some of their young research workers for training in Morocco.

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Table 7 - INSTITUTIONAL AND STRUCTURAL ANTECEDENTS OF INRA (1919-1981)

1919 - Establishment of the Jardin d'Essais [Experiment Garden] in Rabat (headquarters of the present INRA) and 2 experiment farms at Rabat and Fez.

1924 - Establishment of the Genetics and Seed Testing Station, Rabat (wheat, maize).

- Establishment of the Service de l'Expérimentation Agricole (SEA) [Agricultural Experimentation Service], based at the Jardin d'Essais, which incorporated the Genetics and Seed Testing Station and the two experiment farms, and later two new laboratories (at Rabat): wheat technology (1930) and chemistry (1934).

1934 - SEA becomes the Centre de Recherche Agronomique (CRA) [Agricultural Research Center].

1941 - CRA now has 6 stations and laboratories at Rabat: genetics and plant improvement; botany, fodder plants and seed tests; agronomy and agricultural experimentation; soil research (established in 1939); agricultural chemistry; technology (seeds and flours).

1946 - CRA becomes the Service de la Recherche Agronomique et de l'Expérimentation Agricole (SRAE) [Agricultural Research and Experimentation Service], with:

. 5 main departments: general services; soils, botany and plant genetics; agricultural experimentation; agricultural chemistry; and technology.

. 4 experiment stations and farms: Debagh (Rabat), Sidi Slimane, Xavier Bernard (Ellouizia), and Fez.

1948 - Publication of the first "Cahier de la Recherche Agronomique".

1956 - SRAE has 10 experiment stations: the 4 already mentioned, and those of the Guich (Rabat, rainfed farming), Afourer (cotton, with irrigation), Boulaouane (with irrigation), in the Gharb, etc. It also carries out tests outside in modernized sectors (Gharb: rice) and traditional peasant sectors (El Hajeb, Sidi-Aïssa: sheep).

1957 - After Independence (1956), a Moroccan (Mr. El Ghorfi) was appointed as the Head of SRAE, which in 1957 absorbed the Horticulture Service (arboriculture and market garden crops), the Plant Protection Service and the official analytical and chemical research laboratories at Casablanca and Rabat. SRAE then had:

. central Research stations: soils, botany and plant genetics, horticulture, plant pathology, entomology, agricultural chemistry, technology, etc.;

. the Tadla cotton research station;

. the horticulture bureau;

. the seed testing and seed production monitoring station;

. the plant protection bureau, responsible, for example, for the Aït-Melloul locust control squad (Agadir);

. the experiment stations inspection bureau;

. the cropping trials bureau, responsible for agricultural pre-extension work (set up in 1958);

. the administrative service, with a documentation section.

1959 - Establishment of the Service de la Recherche Agronomique et de l'Enseignement [Agricultural Research and Education Service], research now being complemented by education (Meknès National Agricultural School (ENA) established in 1942, Ellouizia and Souihla technical assistants' schools established in 1952 and 1954).

1961 - The above Service becomes a Sous-Direction [Subdirectorate] and then (1962) Direction de la Recherche Agronomique et de l'Enseignement Agricole [Directorate of Agricultural Research and Education].

- Establishment of two new central stations (phytoecology and animal husbandry) and the Documentation, Studies, and Dissemination Service (which absorbed the former documentation section and cropping trials bureau).

1962 - Franco-Moroccan Convention on Cooperation in Agricultural Research.

- Establishment on 30 June of INRA, "a public establishment having the status of a legal entity and with financial autonomy", with the Ministry of Agriculture and Agrarian Reform (MARA) as its supervisory authority. The Directorate-General is assisted by a General Secretariat and a General Inspectorate, and is responsible for four Directorates: research; external services; general affairs; documentation, studies and dissemination. In 1966, INRA is running 22 experiment stations, the new ones established being Deroua (Beni-Mellal) and El-Menzeh (Kénitra). Increased efforts to forge links with outside organizations: the Technical Consultative Committee (with 20 specialized commissions) meets regularly and includes research workers, extension workers, and representatives of the Ministry and the sector; a liaison committee with the Offices de Mise en Valeur Agricole OMVA [Agricultural Development Agencies] also includes both representatives of INRA and of the Offices de Mise en Valeur, OMV [Development Agencies]; the new INRA Experiment and Socio-economic Trials Service works closely with these Agencies. Education is separate from INRA, but the Director-General of INRA is also Director of Education, and good relations are maintained between research and education.

1966 - Establishment of the Institut Agronomique at Rabat, which in 1971 became the Institut Agronomique et Vétérinaire Hassan II.

- Reorganization of MARA: the three main types of decentralized national institutions (Offices Nationaux de l'Irrigation [Development Agencies] and INRA) are wound up and become MARA Directorates. INRA thus becomes the Direction de la Recherche Agronomique (DRA) [Directorate of Agricultural Research]. DRA is first reorganized into two main divisions: research (including the documentation service) and external services (including general affairs); in 1974, after a further reorganization of MARA in which Provincial Directorates of Agriculture were set up, DRA has an Administrative Service, a new Studies and Data Processing Service and two divisions:

. the Research and Experimentation Division, with ecology and crop husbandry "services" and the central animal husbandry station;

. the Technical and Plant Protection Monitoring Division, which, in addition to the regional centers, has four external service units: the plant protection monitoring and locust control service; the technical monitoring and seed and plant multiplication service; and the two official analytical and monitoring laboratories.

The total number of experiment stations increases to 43 (7300 ha).

1977 - Aside from El Koudia (animal husbandry), the newly established stations are situated mainly in the outlying regions of the country: Oujda, Marrakech, Zagora, Riad Rissani, and then Goulimine and Talsint.

1980 - 21-22 January: national seminar on "agricultural research in the service of development", organized in Rabat by the Moroccan Agricultural Research Scientists' Association.

- 20 February: appointment of the Director of the Institut National de la Recherche Agronomique (INRA) [National Institute for Agricultural Research].

1981 - 8 April: official date of formation of INRA.

Source: Information supplied by INRA.

scientific staff, still largely made up of expatriates, although their number was rapidly decreasing (117 out of 127 research workers in 1963; 58 out of 86 in 1966), remained concentrated in Rabat and was based on an increasingly extensive network of experiment stations (22 in 1966), almost all of them in the most favorable regions.[28]

After 1966, the autonomous Institute for Agricultural Research once again became a mere Directorate of MARA. The number of Moroccan scientists increased steadily until 1973, but the rate of increase was held back substantially by many resignations, usually because the persons concerned moved to other organizations which were more rewarding in terms of pay or responsibilities. Since the number of foreign cooperation staff fell at the same time, the total number of research workers declined by 1975 to the same level as in 1967 (see Table 9, page 43). The remaining qualified staff was still heavily concentrated in Rabat. At the same time, more and more regional stations were set up in accordance with circumstances (e.g., after the second wave of land nationalization in 1973) and the request of MARA; these were now located in less favorable areas. The network of stations now covered the entire country and became more and more of a burden on the scientific staff.

This unbalanced situation did not improve after 1976. The total number of research workers increased rapidly, from 137 (including 82 Moroccans) in 1972 to 212 (including 198 Moroccans) in 1982 and 228 in 1984. However, the number of stations continued to increase (41 experiment stations in 1980; 48 in 1982), most of them being managed from Rabat. Except for a few decentralized innovatory experiments (in citrus growing, Saharan agriculture, vegetable production, and rainfed farming), the research methods have remained essentially unchanged, involving the development, under controlled conditions (stations, laboratories), of technical innovations intended to be disseminated by agricultural extension and aimed principally at the modernized agricultural sector, with increasing difficulties due to the deterioration of the country's economic situation (limitations on transport facilities and operating budgets).

The position of research has thus deteriorated over the years, especially since 1966. In spite of steady increases in overall resources, the productivity and credibility of research have declined steadily.[29] As will be shown, there are many reasons for this. Some of them are exogenous, but others are inherent to research itself insofar as the successive institutions have been unable to control their growth, and

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(28) For example, the El-Menzeh (Kénitra) and Agadir regional stations, specializing principally in citrus growing and horticulture, were set up between 1962 and 1966.

(29) The Moroccan research workers themselves emphasize the considerable reduction in publications, which fell from 1,500 pages per year, on average, in 1962-65, to less than 200 pages after 1975 (although this criterion is only partially significant).

especially the growth of infrastructures, or to call into question a pattern of research which was fledged before 1956 in a completely different social context and which has proved ill-suited not only to the new constraints and requirements of Moroccan agriculture as a whole, but also to the possibilities and resources of Moroccan research itself.

It was not until 1980-82 that significant changes were observed. The body responsible for agricultural research again became an autonomous institution. Now, however, its responsibilities lay principally in the field of research, since the activities of plant protection, seed monitoring, and analysis/fraud control, which were formerly within the competence of the old Directorate of Agricultural Research, were now entrusted to other Directorates of MARA. The change in status was accompanied by a large number of innovations or proposed innovations concerning structures, operations, staff regulations, etc. These innovations will be discussed later.

This historical review, being concise, is necessarily simplified. However, more information will be given in the detailed discussion of the present situation of research. This will reveal incipient changes which are encouraging for the future, such as the formation of INRA in 1981, the initiation of new types of research, and a first attempt to introduce decentralization.

2. GENERAL ORGANIZATION OF INRA

This section discusses the assigned task of INRA, the Institute's supervisory structure, and its administrative bodies and internal organization.

2.1 ASSIGNED TASK OF INRA

INRA was established by Law No. 40-80 of 8 April 1981 (with detailed provisions set out in an Application Decree dated 22 March 1982)[30] as a public establishment having the status of legal entity and with financial autonomy. It replaced the Direction de la Recherche Agronomique, most of whose staff, resources, and functions it took over.

Under the Law by which it was set up, INRA is required (see Law, Article 2):

"1 to carry out scientific, technical, and economic research on the subject of the development of agriculture and stock-raising;

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(30) The complete text of this Law and its Application Decree are reproduced in Annex 4.

2 to conduct prospective studies, especially concerning the natural environment or relating to the improvement of plant or animal production;
3 to undertake, either on its own initiative or at the request of individuals, tests of new crops and crops to be improved and on animal production, and in general to conduct all forms of agricultural experimentation or experimentation relating to the development of techniques for the processing and utilization of plant and animal products;
4 within its field of competence, to monitor research, studies, or other work conducted on behalf of public agencies;
5 to disseminate documentation on its own research and research carried out abroad;
6 to examine and determine scientifically the practical procedures for application of the results of its research and, in this context, to advise the bodies responsible for agricultural extension and farmers;
7 to market the results of its research, studies, and other work".

2.2 SUPERVISORY STRUCTURE AND ADMINISTRATIVE BODIES

State supervision is "exercised by the Minister of Agriculture and Agrarian Reform subject to the powers and functions vested in the Ministry of Finance by the laws and regulations applicable to public establishments [établissements publics]" (Decree, Article 2).

INRA is administered by an Executive Board [Conseil d'Administration] which has full powers, in particular, to stipulate the research programs, budget and accounts and to draw up the staff regulations (Decree, Article 5). The Board includes the Ministers (or their representatives) of Agriculture, Finance, the Plan, Higher Education and Scientific Research, the Interior, and Health, the Chairman of the Federation of Chambers of Agriculture, two representatives of the producer's associations, and finally, the Prime Minister or Government authority delegated by him, who is its Chairman (Decree, Article 4).

The Board meets at least twice a year. For routine matters, it delegates its powers to a smaller committee - the Technical Committee - which meets at least four times a year under the chairmanship of the Director of Agricultural Education and Research of MARA.

The Director of INRA attends meetings of the Executive Board and the Technical Committee, with consultative status; he is responsible for implementing their decisions. He has all powers and functions necessary for management, and may delegate some of these to the managing staff of the Institute - in particular, the Secretary-General (Article 6 of the Law; Article 9 of the Decree).

2.3 CURRENT AND PROPOSED ORGANIZATIONAL STRUCTURES

Since its foundation in 1980, INRA has operated on the basis of a provisional organizational structure which, aside from a few significant

changes, is the same as that of the former Direction de la Recherche Agronomique, without the service and other units responsible for plant protection, seed control, and the two national analytical laboratories. This organizational structure (reproduced in broad outline in the organizational chart shown in fig. 1), has in practice already undergone a number of amendments associated with the continuing process of change within INRA. It has four main parts.

The first, which is by far the largest in terms of the number of scientists attached to it (about three quarters), is the Research and Experimentation Division [DRE]. It includes the Crop Husbandry Service, the Ecology Service, and the Animal Husbandry Service, which are of very different sizes:

- the Crop Husbandry Service is made up of 13 "centralized stations" located in Rabat, ten of which are commodity-based and the other three organized by fields of operation (crop protection, crop improvement, and technology); they are so named because they are responsible for drawing up the programs of activity in their scientific fields at national level and for implementing them, either by themselves or with the help of the regional stations working in the same fields which perform some of the specialized work; these regional stations, which have little autonomy, are not shown in the organizational chart;

- the Ecology Service groups only the 10 stations in Rabat, all of them very small (this is why they are not called "central") or "dormant", and has a total of 17 research workers;

- the Animal Husbandry Service, based in El-Koudia, near the capital, with its five research scientists, has remained embryonic; its six stations were set up about a dozen years ago (with foreign cooperation) and subsequently abandoned.

The second part comprises the "Regional Services". It is made up of 10 regional units, which have recently become known as "Regional Centers". These are coordinating and management units for "stations" of a number of different kinds - scientific, experiment, and seed production stations.

- The scientific stations are few in number. They are as follows:

  . five discipline-based regional stations,[31] which it was considered inappropriate to place under the administrative control of the relevant services of the DRE because they are generally at least as large (in terms of the number of scientists) as most of the stations of similar status located in Rabat;

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(31) Including the Radioisotope Laboratory of Tangier and the "Field Laboratory" [Laboratoire de campagne] at Meknès.

- commodity-based stations: aside from the small sericiculture station, these comprise the two central vegetable crop stations at Agadir and the central citrus station in the Gharb; the form of activity of these stations is identical to that of the central stations of the DRE: they too are multidisciplinary and have an experiment network in other regions;

- finally, there are two units which conduct multidisciplinary and "multiproduct" research on production systems: the Central Saharan Agriculture Station at Marrakech and the "Dryland Farming Project", recently instituted at Settat (not shown in the organizational chart);

- The 42 "experiment stations" shown in the organizational chart are usually run by Technical Assistants [adjoints techniques]. They are of three types:

  - "general": most of the experiment stations empowered to carry out tests ordered by any scientific station are of this kind;

  - stations specializing in a single commodity or group of commodities: tea at Larache-Tangier; cotton at Afourer - Beni-Mellal; animal husbandry at El-Koudia;

  - stations engaged in seed production, sometimes in conjunction with other activities: this group comprises a number of experiment stations involved in seed production and nursery plan multiplication, but only five of them (Douyet-Fez, Jmaa Shaim-Marrakech, Marchouch-Rabat, Deroua, and Afourer in the Tadla) are highly specialized in these activities.

In addition to these 42 experiment stations, there are 22 "demonstration farms",[32] which are not shown in the organizational chart. These are small experiment stations entrusted to one or two agricultural workers, where INRA tests the validity of technical innovations under "conditions as similar as possible to those of small farms".

The other two complexes call for little comment. The first is the Administrative Service, which deals in Rabat with most administrative, financial, legal, personnel, etc., problems, and the second is the small Studies and Data Processing Service, which is important by virtue of the nature and diversity of its activities on behalf of the Administrative Service and the scientific units.

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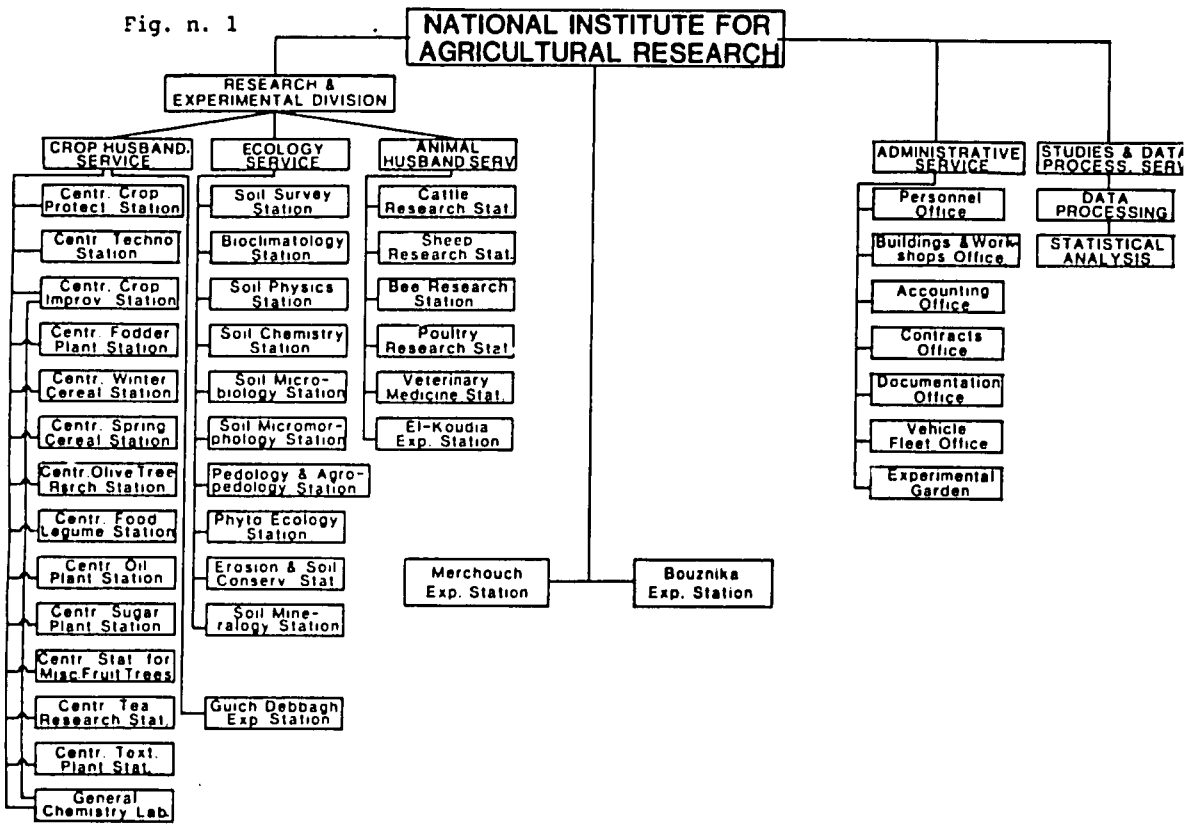
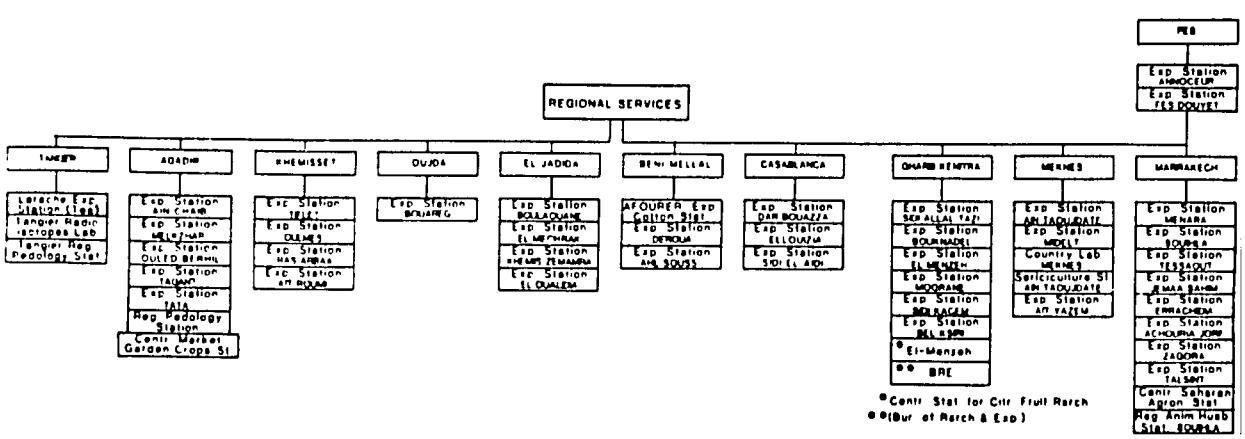
(32) This number has varied slightly because some of the experiment stations shown in the organizational chart were subsequently to be turned into demonstration farms.

PRESENT ORGANIZATIONAL STRUCTURE OF INRA

Fig. n. 1





A final point to be made is that this organizational structure has some flaws, which have been well analyzed by INRA. It is "structurally unbalanced", by virtue of the disproportionate importance of the DRE. It is complex, both by virtue of its unclear terminology ("stations" meaning several different things), and because of the vague criteria whereby the provincial scientific units are attached to the DRE or to the Regional Services. Some hierarchical uncertainties are also unresolved: first, the Regional Services do not constitute a Division, so that each Service or Regional Center is directly attached to the senior managing body [Direction] of INRA; and second, the provincial scientific units sometimes form part of a dual (administrative and scientific) hierarchy which does not simplify their operation and gives rise to a "risk, which is not always avoided, of inconsistencies between their activity programs (substantially determined by the DRE) and the logistic resources required for their implementation" (assigned by the Regional Services).

In view of the foregoing, INRA has considered possible ways of improving this organizational structure and the form of operation to which it gives rise, and has produced a succession of three draft structures to replace it. The last of these, Organizational Chart III, (see Fig. 2), is considered to be "capable of amendment in due course - for example, after completion of the Master Plan" [Plan Directeur] and was still being discussed by the various Ministries concerned in January 1984. It certainly represents a step forward compared with the current organizational structure, featuring a better balance between a larger number of Directorates, attempts to achieve decentralization of the Regional Centers, which are represented at the senior managing body [Direction] of INRA by a Director who is also responsible for seed production (which is thus individualized), simplified terminology, etc. The justification for this new organizational structure and also its limits will emerge more clearly from the description given in the following sections of the network of INRA units scattered throughout the country (Section 3) and of the activities and working of INRA's scientific units (Section 6).

3. MATERIAL RESOURCES

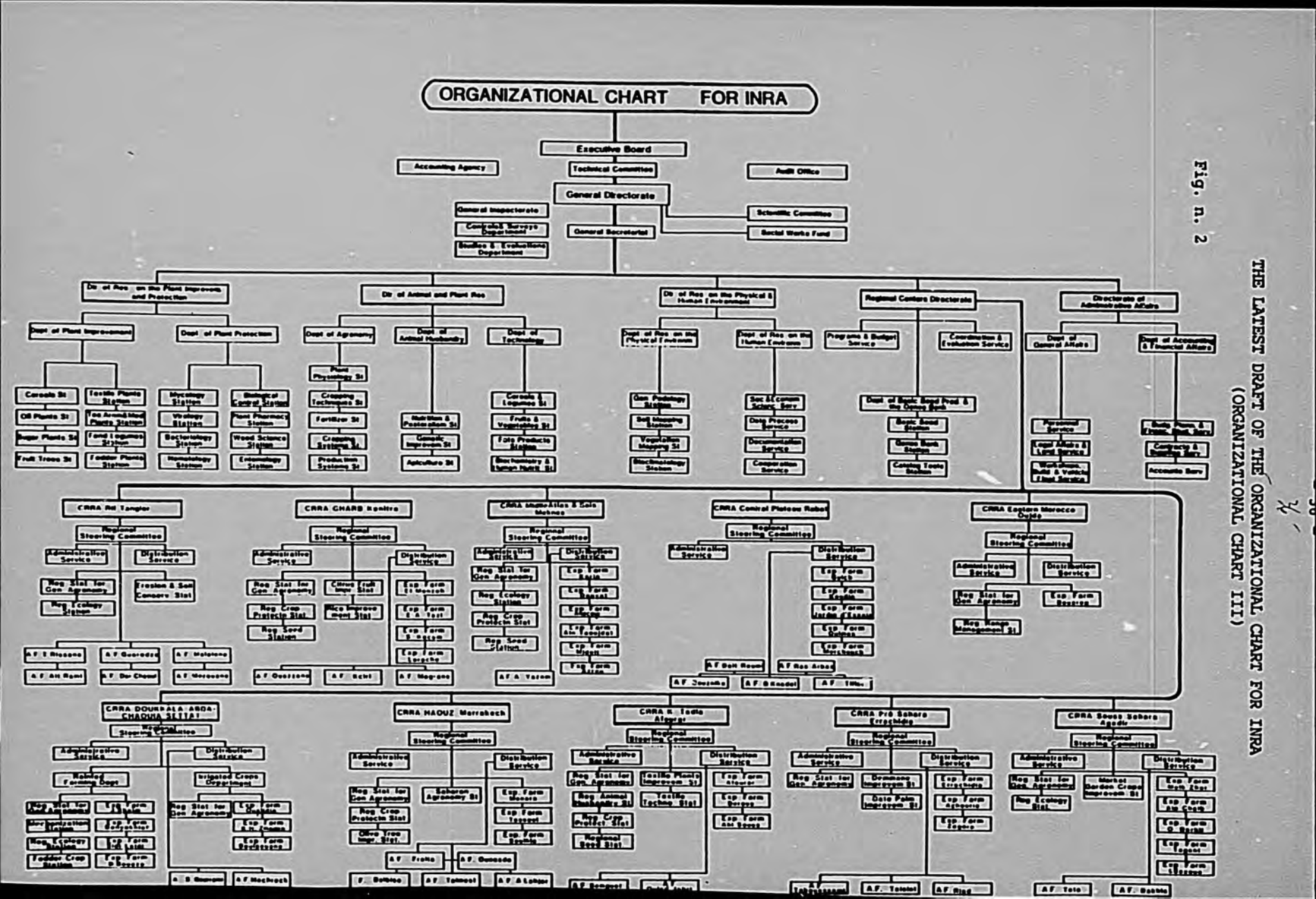
This critical description of INRA's network of facilities will be followed by brief comments on the buildings and equipment and on documentation.

3.1 UNWIELDINESS OF INRA's NETWORK OF FIELD STATIONS AND OTHER FACILITIES

As we have seen, INRA has over the years set up more and more research stations and experimental farms, culminating in the formation of a large and complex network of units attached to 13 "potential" Regional Centers. The geographical areas for which these Centers are responsible and the latest Center locations were recently specified so as to give a balanced distribution based on the natural and administrative regions of the country, the zoning in the latest National Development Plan, and the

Fig. n. 2

THE LATEST DRAFT OF THE ORGANIZATIONAL CHART FOR INRA
(ORGANIZATIONAL CHART III)



present research structures.[33] Table 8 shows the overall structure of this network, confirming the diversity of its components mentioned in the previous part of the Report and revealing its relatively large scale and dispersion, which INRA is endeavoring to reduce.

3.1.1 Relative scale and dispersion of the network

INRA s network of units throughout Morocco is considerable: there are 78 stations and 64 experimental farms and demonstration farms attached to 14 Centers (including Rabat). A network of this kind is not inherently excessive in view of the size and diversity of the country and the scale of its agriculture, and also having regard to the requirements of research which is called upon to carry out observations and tests in a wide range of natural and human environments. However, this network is certainly out of proportion to INRA's present situation - i.e., its scientific and supervisory staff and financial resources.

In view of the concentration of scientists in Rabat, which is excessive, primarily in relative terms, there is inevitably a dearth of research workers in the Provinces, where they are distributed extremely thinly. Only five CRRAs [Regional Centers for Agricultural Research] have more than 10 research workers (and not all of them at a single geographical location), while five others have only between one and four. Each provincial station has, on average, less than four research workers. Such a situation, which compounds the difficulties of transport and communication,[34] has serious consequences.

First, most of the scientists are both scientifically isolated, sometimes very seriously, and overloaded with administrative tasks.

Second, this inadequate density of supervisory staff does not allow the Institute's land resources to be used efficiently. According to a partial survey by INRA,[35] 75% of the useful agricultural area in 1981-82 was in use, 10% for tests (440 ha), 45% for seed multiplication and 20% for "production". In other words, at the present time, only a small part of these land resources is necessary for the Institute's scientific activities. Moreover, according to INRA, the present farms are "sometimes in unfavorable locations".

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(33) See the document "Organigramme de l'INRA" submitted to the Executive Board in July 1983, pages 7 and 8.

(34) These difficulties will be discussed in more detail later. It may be pointed out here that some of the experiment stations visited have neither a telephone nor a permanently assigned automobile.

(35) Only three-quarters of the relevant units (5,558 ha out of 8,134 replied to this "experimental station identification" survey.

Table 8 - NETWORK OF CENTERS, STATIONS, AND EXPERIMENT FARMS

	Number N		N scientific stations based on				Experiment farms	
	Engineers	Technical	Disciplines	Products	Systems	Total	N	Area (ha)
I Rabat H.Q. (Direction)	6	10						
II Rabat (including Rabat CRRA)	118	108	14	14		28	3	1040
III Provincial CRRAs								
Tangier	9	11	2(+1)			2(+1)	8	79
Kénitra	16	26	2	2(+2)		4(+2)	6	991
Saïs	4	11	1			1	3	548
Meknès	12	21	3	(+1)		3(+1)	3	236
Khémisset	4	14	1			1	5	1527
Oujda	3	5	1			1	1	50
El Jadida	7	19	1	(+2)		1(+2)	4	468
Settat	11	28	2		1	3	4	271
Tadla	9	32	2	1(+1)		3(+1)	5	736
Marrakesh	14	47	2	1	1	4	10	722
Errachidia	3	12	1	2		3	6	1216
Sousse	11	21	2(+1)	1(+1)		3(+2)	5	251
Laayoune	1	2	1			1	1	
Total III	104	249	21(+2)	7(+7)	2	30(+9)	61	7094
IV Total I+II+III	228	367	48(+9)	21(+7)	2	35(+2)	64	8134

Sources: Table drawn up from computer analyses for staff and the documents "Organigrammes" ("Organization Charts") and "Patrimoine foncier" ("Land Resources") submitted to the Executive Board of INRA in July 1983.

( ) : Proposed stations

' : Combinations of CRRAs proposed by INRA

A third consequence of the relative size and dispersion of this network is its direct financial cost in terms of both the labor and the maintenance of a considerable volume of assets in the form of buildings and agricultural equipment. This will be discussed in more detail later.

3.1.2 Acknowledged need for a reduction in the size of the regional network

The managing body [Direction] of INRA is aware of these disadvantages and has made concrete proposals for reduction and simplification. In July 1983, it asked its Executive Board for permission to abolish 14 of the 64 experimental farms and to merge several of the remaining 50[36]. In Organizational Chart III, it proposes a reduction in the number of CRRAs from 14 to 10 by appropriate mergers, which would, however, still leave two excessively small Centers, at Oujda and Errachidia.

INRA also proposes to continue its decentralization program in parallel with this physical reduction: it intends to set up in the medium term nine new regional scientific stations (two of them discipline-based and seven commodity-based).

3.2 GROWING OBSOLESCENCE OF BUILDINGS AND EQUIPMENT

The capital represented by the buildings and equipment is considerable. While the situation is at first sight relatively satisfactory,[37] it is in fact disquieting. For instance, according to the budget documents for the 1984 financial year:

- "the present condition of all buildings (22,000 m^2 of offices and laboratories, plus the specifically agricultural buildings) is deplorable, so that it is urgently necessary for all the work required to be put in hand";

- "with the vehicle fleet in its present condition, it is impossible to fulfill the complete mission program as fixed annually,[38] owing to the obsolescence of over 250 vehicles out of the existing fleet of 343 (72 private cars, 203 commercial vehicles, and 62 trucks);

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(36) See document "Patrimoine foncier de l'INRA" ["Land Resources of INRA"] submitted to the Executive Board in July 1983.

(37) The mission was not particularly aware of deficiencies in the maintenance of buildings and equipment during its visits (which were admittedly often too short).

(38) The budget documents stipulate for 1984 an average number of travel days per scientist of 77 (120 for the "Ingénieurs d'Etat" of the Ecology Department); this is appropriate, but apparently not readily feasible.

involving heavy expenditure, particularly on lubricants, and resulting in insufficient budget allocations for vehicle operation".[39]

The agricultural equipment pool comprises 213 tractors, 20 combine harvesters, and about a hundred items of fixed equipment. A number of units are stated to be laid up because of their age and delays in spare parts procurement.

Some of the scientific equipment is also in need of renewal, modernization, and supplementation.

3.3 DOCUMENTATION AND PUBLICATIONS: DORMANT FUNCTIONS

The Documentation Service is located in the Rabat Central Library; it is virtually nonexistent in the CRRAs. According to INRA, "despite its relative wealth, it has serious problems which fall into two main groups: lack of qualified staff and lack of awareness of the available documentation by research workers. A huge task remains to be performed in this field to facilitate the utilization, indexing, and dissemination of documents, to obtain documentation required within a reasonable time and to further national and international exchanges, which are currently declining".

This Service is also responsible for INRA's publications: administrative publications (annual reports, budget documents, etc.) - these represent the largest number - and scientific and technical publications, which are also in serious decline, as the "Cahiers de la Recherche Agronomique - El Awamia", which used to be very well known, no longer appear regularly, owing to lack of material and also because of the long delays in the publication of articles submitted.

4. FINANCIAL RESOURCES AND THEIR MOBILIZATION

4.1 RESOURCES: INADEQUATE OR EXCESSIVE?

INRA's funds originate from three sources: its own resources, "ex-budget" resources obtainable through relations with national foreign institutions and, mainly, State subsidies.

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(39) Another factor which limits the use of vehicles for research purposes, which is just as serious as obsolescence, is apparently their monopolization by the Administrative Services and their allocation to individuals according to hierarchical criteria.

Own resources: INRA sells products and services, and may perform contract work for a number of bodies. These services feature in the accounts under own resources. However, the product of seed sales, which would provide the major part of these resources, in fact accrues to the national exchequer, since it is deducted from the State budget subsidy. The total of these resources is slight: they represent 2.5% of the estimated operating budget in 1984.

The ex-budget resources, which are ipso facto difficult to estimate, are resources in kind accruing from cooperation with certain national institutions and, in particular, international cooperation. The contribution of the former has been very limited, although decisive for the implementation of some research activities (for example, the D'Man sheep flock was established solely from donations in the 1970s). The dearth of funds from these sources, as well as from INRA's own resources, seems to be a reflection of INRA's relative isolation and lack of credibility in its national environment (see section 7). The contribution of international cooperation, which has been significant for the last three years, after a period of stagnation, includes equipment, working capital, training (studies, training programs abroad) and information (missions abroad, documentation), as well as the temporary provision of scientific and technical staff.

State subsidies account for almost the whole of the officially budgeted resources of INRA (130 million Dh out of 134 million in 1984 for the staff[40] and operating budget and the whole of the equipment budget). These resources have increased substantially since 1981.

In all, INRA's resources apparently account for only about 0.32% of the gross agricultural product (GAP), and are stated to have fallen slightly, compared with the 1960s (0.34%). This proportion will be considered again later in the report, after discussion of the research and experimentation activities conducted outside of INRA, to allow international comparison of Morocco's agricultural research program.

It may be noted for the time being that INRA's resources per scientist are relatively high and certainly higher than the level observed in most developing countries. This no doubt reflects the present mismatch between qualified human resources and all other resources (material and unskilled human resources) within INRA.

4.2 INFLEXIBLE WORKING PROCEDURES

The budget procedures governing the deployment of the available financial resources seem to represent a serious obstacle to their efficient use. These problems will not be analyzed in detail in this document because

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(40) Staff have not yet been fully integrated in INRA and are still managed directly by MARA.

they depend on decisions substantially beyond the control of INRA and even of MARA. We shall merely try to assess their harmful effects.

The operating budget is in fact subject to the procedures of a capital equipment budget. For expenditures of this type, the Managers of stations, farms, or Regional Centers have no funds of their own and cannot make any payments. They have a budget, but may only incur expenditure; all the relevant expenditure incurred has to be passed by the Financial Controller in Rabat. There is sometimes a considerable delay before he finally authorizes the Administrative and Financial Service to issue the payment orders to INRA's suppliers. A system of this kind, with prior control of all operating expenditure, has serious disadvantages:

- "it has the practical effect that budget resources decided upon at the beginning of a season reach the implementing unit only after long periods: up to six months in some cases;[41] hence the paradox of an operating budget which is both insufficient and not fully used;

- the suppliers react predictably: where possible, they apply price increases, said to be typically 10%; some of them refuse to supply INRA, or else they deliver or render their services only after payment. In these last two cases, activities may be paralyzed. For example, field tests or cultivation operations for seed production may not be carried out in the event of a tractor breakdown calling for the purchase of spare parts: the economic damage (waste of research worker's time, loss of crops) may then be considerable;

- because he has to check everything, the Financial Controller wastes much of his energy and efficiency, particularly for major supplies obtained at fixed prices (fuels, fertilizers, seasonal labor); he would certainly be able to work more effectively if he could concentrate on capital equipment expenditure and certain types of operating expenses;

- station, farm, and Center Managers have to perform much more tedious administrative work.

These are various reasons why the results of the change in the legal status of research - from DRA to INRA - have apparently not matched the expectations, especially those of the Institute's staff.

5. HUMAN RESOURCES

In January 1984, INRA had a permanent staff of 2,225, including 228 research staff with research and service duties, 366 technical assistants [adjoints techniques], 95 technical staff, and 1,535 clerical and agricultural workers. Each of these staff groups will be discussed below, although the discussion will primarily focus on the professionnal staff.

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(41) Report by the Director-General to the Executive Board of INRA, July 1983, p. 4.

5.1 THE SCIENTISTS: INRA's PRINCIPAL LIMITATION

The senior scientific and technical staff of INRA comprises, in addition to what is now a very small number of foreign experts, Moroccans who, until the implementation of the new staff regulations discussed later on, have been and still are "Ingénieurs d'application", "Ingénieurs d'Etat", or "Ingénieurs en chef", according to the level of their degrees and experience.[42] The following review of this staff group will discuss the variation in their numbers, with its significance and consequences, their geographical distribution, and, finally, the problems of staff regulations.

5.1.1 Serious consequences of past instability

Historical figures for numbers of research workers at INRA can be found in a variety of statistical sources. The figures for the number of Moroccan and foreign research workers (see Table 9) reveal two important points which have already been referred to in section 1: first, the almost complete substitution of Moroccans for foreign senior staff over a 20-year period; and second the lack of growth in the total number of research workers between 1963 and 1976, followed by a rapid increase in the following six years.

The figures for annual recruitment and resignations of research workers (complete only for the 1963-1975 period) highlight the high turnover of scientific and technical staff in the past.

This applies first to the foreign staff: 193 expatriates were engaged

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(42) The "Ingénieurs d'application" (126 in January 1974) are holders of the diplôme d'application, obtained after four years' study at the Ecole Nationale d'Agriculture (ENA), Meknès, or the "Institut Agronomique et Vétérinaire (IAV)" Hassan II, Rabat. The "Ingénieurs d'Etat" (98 in 1984) possess a degree obtained after at least six years' study; this degree may be:

- the "diplôme d'ingénieur d'Etat" awarded the IAV first to "long-cycle" students (4 years + 2 years of graduate studies) recruited from those with the best grades at the end of the first year (a "preparatory" year of basic sciences, prior to the beginning of higher agricultural education); secondly awared to some "Ingénieurs d'application" selected after a minimum of three years of professional experience, who have completed two additional years of graduate studies; or
- a foreign graduate degree for "Ingénieurs d'application" selected by INRA after less than 3 years of professional experience.

The four "ingénieurs en chef" are former "Ingénieurs d'Etat" promoted after at least ten years' professional experience at that level on the grounds of their competence, services rendered, or the responsibilities entrusted to them.

during the 1963-75 period, but stayed for an average of less than three years. This instability is common, almost a "rule", for foreigners and is indeed "institutionalized". However, it was excessive, for a number of reasons: recruitment of young cooperative staff on a short-term basis from the outset, exceptional difficulties associated with budget restrictions or changes in the status of research (involving nonrenewal of contracts after 1966), or diplomatic tensions (for instance, with France in 1964).

Table 9 - VARIATION IN THE NUMBER OF RESEARCH SCIENTISTS AT DRA AND INRA (1963-82)

Year	Moroccans	Expatriates	Total
1963	10	117	127
1964	18	109	127
1965	24	72	96
1966	28	58	86
1967	27	76	103
1968	28	82	110
1969	29	90	119
1970	42	82	124
1971	48	82	130
1972	52	71	123
1973	48	53	101
1974	58	40	98
1975	68	35	103
1976	84	53	137
1977	103	49	152
1982	198	14	212

Source: Zouttane, E.M., 1982, P. 14.

However, the high turnover of Moroccan scientific and technical staff is more serious: during the 1963-75 period, there were 112 recruitments and 53 resignations, with individual staff members seldom staying for more than five years. This situation, due mainly to the lack of specific staff regulations and to the attraction of other sectors (see below), explains why the number of research workers did not increase. During this period, DRA was rarely able to utilize the full national recruitment potential allowed by MARA's budget. This fast turnover rate of staff had serious consequences:

- it was an obstacle to the continuity of scientific activities and stood in the way of full control and utilization of international cooperation (which is generally very expensive), preventing the accumulation of experience, much of which has been partially or wholly lost;

- it resulted in a highly unbalanced age pyramid, with a relative excess of young research workers (about half the present research workers were recruited in the last five years) and a dearth of experienced scientists. Since the latter are often called upon to perform technical and administrative functions within INRA, they are not available sufficiently to conduct their own in-depth, original scientific activity, which, however, is the only way to supervise young graduates and help them in their scientific training. Finally, to provide work for and supervise their young colleagues, experienced scientists are sometimes compelled to insist that they continue working on projects and research activities undertaken in the past, while neither group has the capacity and time to analyze satisfactorily the significance, value, limitations, and results of this work.

5.1.2 Unbalanced geographical distribution of scientists

The concentration of research staff in the scientific stations and in the technical and administrative services in Rabat is not new. As stated earlier, it is partly a result of the colonial heritage, which the present research structure has been able to correct only partially, for a variety of reasons.

Some of these reasons are beyond the control of the research organization. For example, the attraction of the capital, which has the best economic, social (health and education), and cultural facilities in the country, and also offers the best opportunities for training programs and scientific contacts, owing to the presence of IAV and the University.

Other reasons lie in the weaknesses and demands of the past policy of regionalization, which led to excessively fast growth of the network of regional centers and stations, insufficient attention often being paid to the requirements for an effective operation (adequate working and living facilities, administrative flexibility) and to professional and material incentives to encourage research workers to be more willing to decentralize (responsibilities, opportunities for teamwork, promotions, etc.).

However, it is evident that the managing body [Direction] of INRA has been endeavoring since 1982 to somewhat speed up the decentralization of scientific staff. During the last two years, the percentage of research workers (all groups combined) working in the capital has fallen from 57.7% to 51.7%, with a very slight increase in the numbers in the capital and a comparatively much larger increase in the provinces, resulting from the assignment of a number of young newly hired staff to outlying centers and also from some negotiated redeployment of more experienced staff away from Rabat. This decentralization has resulted in the strengthening of certain CRRAs to whose development the INRA Management wishes to give priority. For example, the Center at Kénitra increased from 13 to 16 research workers, the Center at Settat from 5 to 11, under the rainfed farming project, and the Center at Meknès from 7 to 12 (transfer of the bacteriological laboratory). Despite these recent efforts, the geographical distribution of the research workers is still too unbalanced

(see Table 10), with the disadvantages already discussed in section 3.1.1: not only geographical but also professional dispersion (a relatively high proportion of administrative work in comparison to research), and the scientific isolation of the majority of scientists in the provinces, who are thus condemned to low scientific productivity.

5.1.3 The new staff regulations: a considerable but still insufficient improvement

The general regulations for the Civil Service, which have hitherto applied to the scientific and technical staff of the "Direction de la Recherche Agronomique" and its successor, INRA, have many disadvantages which have been widely criticized - for example, the lower material status, in career terms, of research workers compared with staff in other MARA decentralized institutions; the lack of criteria for admission and promotion other than higher education qualifications and seniority; the lack of access to research for persons who are not graduates of higher or mid-level agricultural educational institutions, etc. These disadvantages have been strongly criticized since 1966; some of them have certainly had a decisive effect on the level and quality of the research workers recruited and have caused many of them to move to the decentralized public institutions or the private sector.

The drafting of new staff regulations thus met one of INRA's most urgent requirements. The draft text dating from 1 January 1983 is evidently a considerable step forward insofar as it endeavors to overcome the main drawbacks of the general staff regulations for the Civil Service, with the introduction of pay and bonus scales which place INRA on an equal footing with the other decentralized institutions, the proposal of specific rules for admission and promotion, the recognition of non-agricultural degrees, etc.

However, the new regulations do have some defects. For example, of the scientific career structure:

- there are too many grades: although this large number of grades may facilitate rapid career differentiation between the many graduates of the same generation recruited in the last few years, it may also encourage a hierarchical - rather than functional - conception of relations between research staff and an excessively individualistic behavior; these two flaws are already prevalent at INRA;[43]

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(43) A hierarchy as similar as possible to that of IAV (with four grades: "Assistant", "Maître-Assistant", "Maître" and "Directeur de Recherche") would have two advantages: first, hierarchical simplification (with the resulting saving in time for the scientists and their evaluators in competitive examinations) and, second, the possible attraction of the grade of "Maître de Recherche" at INRA for some IAV "Maîtres-Assistants" who have only the unattractive possibility of attaining the grade of "Chargé" under the present regulations.

Table 10 - INRA STAFF IN JANUARY 1984: ANALYSIS BY PROFESSIONAL CATEGORIES AND LOCATIONS

	Engineers			Technical Assistants (Adjoints Techniques)	Technical Officers	Other	TOTAL
	State or	Application	Total				
1. Total 2+3+4	102	126	228	367	95	1535	2225
2. Headquarters Rabat [A]	6	0	6	10	4	257	277
3. Central Stations, Rabat	57	55	112	95	27	170	404
4. Regional Centers	39	71	110	262	64	1108	1544
4. Including: Tangier	3	6	9	11	3	38	61
Kénitra	5	11	16	26	6	157	205
Saïs	1	3	4	11	2	51	68
Meknès	5	7	12	21	8	63	104
Khémisset	2	2	4	14	4	118	140
Oujda	1	2	3	5	1	5	14
Rabat	2	4	6	13	6	127	152
El Jadida	2	5	7	19	5	94	125
Tadla	3	6	9	32	14	187	242
Settat	7	4	11	28	7	38	84
Marrakech	4	10	14	47	5	133	199
Errachadia	1	2	3	12	1	51	67
Sousse	3	8	11	21	1	46	79
Laayoune	0	1	1	2	1	0	4

Source: INRA (Studies and Data Processing Service).

[A]: General Directorate, Directorate of Administrative and Financial Affairs, Studies and Data Processing Service.

- the research staff would have to take an excessive number of examinations during the course of their career. For each competition for admission to the grades of "Assistant Principal", "Chargé" and "Maître", research staff would first have to have their research work approved by a Scientific Committee and then face an ad hoc scientific jury; finally, appointment to the grades of "Assistant" and "Assistant Principal" would be subject to completion of a research project submitted to a jury approved by the Scientific Committee; and so on. An "Ingénieur d'Application" could only attain the grade of "Maître de Recherche" after he has appeared at least nine times before various juries and the Scientific Committee for assessment - aside from evaluations carried out with a view to "slow or fast" promotion in each grade.(44) Again, this excessive density of tests and evaluations would be bound to have adverse repercussions on the practice of research (constant tension; emphasis on career instead of on scientific work; risk of discouragement of research staff), and on the working of INRA, which would waste too much effort merely in the organization of these tests and evaluations;

- it is impossible for holders of "doctorate of third cycle" degrees to enter for the competitive examination for "Assistant Principal de Recherche".(45) This provision applies in particular to INRA's

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(44) The differentiation in the rates of promotion after the fourth step, at the grades of "Assistant" and "Assistant Principal" (3 or 4 years and 4 or 5 years, respectively), seems insufficient to justify the waste of time and energy involved in assessing research staff who have an opportunity of achieving a higher pay level much faster by taking the competitive examination for the next higher grade.

(45) Note that at IAV and the Moroccan universities, holders of the "Ingénieurs d'Etat" or doctorates degrees have direct access to the grade of Maître Assistant without a competitive examination, according to the available posts. With a "doctorat d'Etat", they can in theory reach the highest grade, that of Professor [professeur] in as little as 10 years. Since these possibilities of promotion without competition are based principally on the quality or subject matter of theses, and on the scientists' actual abilities in the field of pedology, research, team work, etc., Moroccan higher education has been or is able to satisfy its quantitative senior staff requirements very quickly, but the lack of stringency as regards quality benefits the first comers, freezes the existing hierarchies and obstructs the advancement of more brilliant young scientists for long periods. This digression from the terms of reference of the Mission is made for the purpose of expressing approval of the more selective and slower system of promotion at INRA (at least 16 years being required to reach the highest grade - Director of Research [directeur de recherche] and to signify disagreement with the demand by the "Association des Ingénieurs de la Recherche" for career opportunities as "easy" and fast as in higher education.

future Assistants (usually "Ingénieurs d'Application" recruited by competitive examination); the Director wants to prevent these from aiming for promotion to the higher grade by way of such a "doctorate of third cycle", because of the risks thereby entailed: biasing of research; wastage of time in university "formalization"; high probability of temporary out-of-country status while there are insufficient Moroccan senior scientific staff, etc. These arguments may be applicable to the senior staff of the Institute, but are irrelevant to "doctors of the third cycle" from abroad, who are thus refused access to INRA. It seems essential to maintain access to INRA, pending successful competitive examination, to remain possible to young university biologists, technologists, biometricians, sociologists, and economists, so as to avoid onesidedness in recruitment (too many agricultural specialists) and to facilitate the relations already existing (e.g., at Marrakech) or to be forged with the Moroccan universities.

In the technical career structure, which is also open to INRA research staff, the rules of promotion seem unclear. For instance, admission to the grade of "Ingénieur d'Etat" (Article 25) is open to holders of this qualification "by open selective examination" and to "Ingénieurs d'application" with four years' service "by competitive examination". However, it is not stated whether this is a common selection process (or what the criteria are), and no quotas for each of the two possible channels are stipulated. Appointment to the grade of "Ingénieur en chef" is "by decision of the Director of INRA and subject to the opinion of the Ministry of Agriculture"; once again, no precise criteria are laid down.

These examples show that the new staff regulations are still capable of improvement and that some of the disagreements expressed by the research staff deserve to be taken into account so that appropriate amendments can be made before the regulations finally take effect at the end of 1984. It is also important to ensure that changes can be incorporated in the new regulations if INRA introduces a new Programming System with all the implications it might have on program assessment, teamwork, etc. (see part 3, section 4.1).

5.1.4 The first conclusion that may be drawn from the foregoing is that the current scientific and technical potential of INRA is insufficient as regards both quantity and quality for the satisfactory implementation of the research and service activities already undertaken in an excessive number of geographical locations. The situation is even more serious, of course, for activities which are presently in the planning stage. This is, of course, an overall assessment, and it is important to praise some scientists who, notwithstanding the difficulties, have been able to carry on valuable research programs (see section 6.3) or resume their studies after several years' professional experience at the Institute: this is true of at least 20 "Ingénieurs d'Application who have become "Ingénieurs d'Etat", and of about 10 "Technical Assistants" who have become "Ingénieurs d'Application".

5.2 OTHER STAFF GROUPS

These are the technicians, administrative staff, and unskilled workers. The technicians include the Technical Officers [agents techniques] (with the qualification of the brevet technique spécialisé) and the Technical Assistants [adjoints techniques] (qualification: baccalauréat). On the whole, their total numbers and distribution appear satisfactory compared with the situation of the "ingénieurs". The requirements of certain activities (e.g., critical analyses, data processing, and documentation) and of some centers should, however, be better met. In general, the technicians seem to be appreciated for their good knowledge of agricultural problems and their sense of responsibility, as evidenced by the relatively satisfactory operation of the experiment stations and major services. The new staff regulations offer them theoretically attractive opportunities for internal promotion (even up to the "ingénieurs" grades), but these will only be effective in practice if the competitive examination criteria are adapted to their skills and abilities, and if a specified proportion of the posts filled by these competitive examinations (to which non-INRA candidates are admitted) is reserved for them.

Among the administrative staff, there is a very serious shortage of qualified senior executives: INRA has only four graduate-level administrators, all based at Rabat. As we have seen, this deficiency compels many experienced research workers to undertake financial and administrative managerial tasks. This situation might improve because the new staff regulations will allow the recruitment of highly trained and relatively highly paid, administrators.

The unskilled labor force appears very large compared with the numbers of graduates and technicians. This makes it difficult to exercise proper control and secure adequate productivity.

6. ACTIVITIES AND OPERATION OF THE SCIENTIFIC UNITS[46]

6.1 PRELIMINARY NOTES

It is not easy to give an outline of the research activities of INRA, for

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(46) Seed production and service activities will not be examined in the body of this Report. Production of cereal seeds and, to a lesser extent, other plant material, accounts for a high proportion of the resources of the Institute. This problem has considerable effect on INRA's operation and is considered in detail in annex 6. INRA's infrastructures and skills also enable the Institute to render miscellaneous services (soil survey, analyses, etc.) which do not call for detailed comment. INRA apparently plays a small part in various forms of training for an institution of its kind. A few research staff lectures are given in various higher-level institutions, and aside from those of the research staff, few formal theses are submitted on the basis of the information at its disposal.

several reasons.

The first reason is the limited space which can be devoted to these activities in this document: rather than examining the various units and activities exhaustively, it is a matter of bringing out the main characteristics they have in common, and of highlighting those whose objectives and methods reflect the research renewal efforts in hand.

The second reason is connected with the available information. The published programs constitute the first reference source, but do not always faithfully reflect the true situation. For example:

- Document no. 7 of the file prepared for the meeting of INRA's Executive Board in July 1983[47] and the booklet "Programme de recherche pour la campagne 1983-84: classement par secteurs" [Research Program for the Year 1983-84: Analysis by sectors"] suggest that all research activities are organized around a limited number of major multidisciplinary programs based on specific commodities or groups of commodities: cereals, edible oils, etc. In practice, however, the prevailing approach is on the basis of individual disciplines or small groups of disciplines. This obviously applies to the "central stations" or "single stations" at Rabat and to the regional stations specializing in ecology, crop improvement, and plant protection. It is also true of some commodity-based central stations - e.g., winter cereals, oil plants, sugar plants, etc. - most of which focus on the improvement of the plants which constitute the relevant products. Each of these stations has its own manager, program, and resources, and organized, broadly based collaboration and coordination between stations have hitherto been the exception.

- Similarly, while the "card index of research workers", consisting of forms completed by those concerned, gives useful information on their training and history, it must be viewed with some reservations in its presentation of their "current programs and research topics". In most cases the programs mentioned are too numerous to be reasonably undertaken by a single worker, or over-ambitious in the light of the level of training and experience of the individuals concerned or actual working conditions. Again, the information in the card index is not always consistent with the featuring in the booklet [fascicule] mentioned above, published a year later.[48]

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(47) "Réalisations scientifiques" ["Scientific Achievements"]. This is basically an inventory of the main technical problems of production and the results obtained by INRA over an unspecified but apparently quite long period (10 years or more).

(48) The booklet mentions more operations and research projects than the research workers' card index, thus reflecting a much wider range of topics. The activities described in the two sources differ considerably: for example, according to the card index, most of the research workers at the central Sugar Plants Station were working mainly on sugar beet, with only one specializing in sugarcane, but according to the booklet, the latter crop received slightly more attention. However, this inconsistency may be specific to this sector.

- Finally, publications, which are a major source of information in countries where science has more varied and complex functions than solving urgent problems of production, are a limited indicator of research activities. As stated earlier, publications, papers, and scientific articles tend to be rare. The volume of crude documentation (activity reports) seems to be large, but it is probably used insufficiently. Again, dissemination of information in a country like Morocco is more direct, unorganized, and individual. Lastly, an institution of this kind, where knowledge is concentrated, certainly performs a range of services which are useful although inconspicuous, relatively unacknowledged and not easily expressed in concrete terms. By applying the criteria and methods appropriate to a country in which science is well developed, it would therefore be easy to miss important contributions and to fail to appreciate the exact nature of the local situation and its connections with its environment. Ultimately, hasty and dangerous judgments can be avoided only by long familiarity with this complex situation. The mission clearly did not have the benefit of this familiarity, and although it received a great deal of information and had the advantage of direct contact with many individuals, caution is essential. However, abstention from comment would be unsatisfactory and inconsistent with the aim of the mission; the comments which are made should not be taken as final and irrevocable judgements but as invitations to discuss the situation. The proposals set out later in the report, and the logic of these proposals, are also based on these comments.

In returning to the research activities and units, we are faced with the problem of choosing the appropriate form of presentation. Two criteria could be applied: the importance of the units of research or research topics, measured by the number of scientists mobilized in them; or the nature of these topics - commodities, disciplines or groups of disciplines, or production systems. A third criterion might be the form of research organization. It was ultimately considered preferable to concentrate on this last criterion, which gives a better idea of how the units work and of their results, and also takes better account of the evolution of the programs. Two major types of research are therefore distinguished - research organized by Rabat and research organized by provincial units. A few research activities which do not fit in this simplified typology will then be dealt with.

6.2 RESEARCH "ORGANIZED BY RABAT": THE LIMITS OF CENTRALISM

This class comprises all research included in the "national programs" devised by the Central Stations at Rabat and implemented by them through experiment stations. The research concerned is as follows:

- commodity-based research on annual plants; in decreasing order of importance: winter cereals, sugar plants, fodder plants, food legumes, oil plants, spring cereals, and textile plants;

- research based on individual disciplines and groups of disciplines: crop improvement and ecology.

Descriptions of the common features of these types of research are followed by brief comments specific to each of the fields mentioned above.

6.2.1 Common features of these types of research

These relate to the research conception and implementation, scientific content, and results.

Conception and implementation: the research forms part of "national programs" drawn up by each of the relevant Central Stations at Rabat, which implement it separately through experiment stations, whose main functions are to execute the trial protocole according to a stratified, hierarchical, excessively systematic and mechanical conceptual framework of the activity of research.

To operate satisfactorily, this system would require intensive exchanges between the central and experiment stations, and in particular a substantial mobility on the part of the research scientists for the organization, follow-up, and monitoring of their trials. It would have the advantage of a high concentration of scientists in Rabat, where national and international exchanges are easiest, and hence, in particular, of making it possible to go beyond the mere solution of immediate local or regional problems by placing them in a truly scientific context, which is essential if progress is to be achieved in the long term.

Unfortunately, the conditions for such a system to work satisfactorily have apparently not be meet. First, the scientists are insufficiently present in the field, partly owing to lack of transportation means and loose arrangements governing their allocation, so that they do not generally take part in the planting, cropping, or even the harvesting of the test crops. This means that the reliability[49] and value of the experimental results are limited. Also, the central teams have suffered from high staff turnover and are for the most part too small, so that their autonomous scientific life is necessarily limited. As a result,

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(49) To say that the reliability is limited is not to call into question the professional honesty of the managers of the experiment stations. It is merely to underline that each year they have to manage a number of experimental trials; since they are not associated with part of these trials but have only implementation responsibilities, they become, therefore, ill-motivated - especially when the trials concerned are unrelated to immediate and explicit regional expectations. Again, where these experiment stations also produce seeds, there is a substantial de facto competition for resources from this activity, whose success seems to be universally considered worth striving for.

they cannot be sufficiently critical of their own activities, utilize their results with a maximum efficiency, or collaborate efficiently among themselves.

All of this accounts for the inconsistency observed between the apparently intense activity at the experiment stations - reflected particularly in the bulky reports of regional activities - and the ultimately very limited results in terms of scientific publications, proposed innovations and, in general, integration into development structures. This situation also explains the isolation of the experiment stations, not only from the research workers in Rabat, but also from their local agricultural environment, which therefore is not a priority in their activities.

Scientific content of this research: the emphasis here is placed on genetic yield improvement and improvement in disease resistance, while other aspects related to plant protection and fertilizer techniques are studied elsewhere. This means that the results obtained are partial and cannot readily be utilized other than by the groups of farmers who are able to use them as such. It is to be noted that most of the trials are concentrated at the most "experienced", best-endowed experiment stations - i.e., the oldest ones, which are located in the most favorable regions and are consequently most favored.

6.2.2 Specialized research on annual crops

Winter cereals

These commodities (mainly soft wheat, durum wheat, and barley) are of first priority for both the country and INRA.

The Central Station for these commodities passed through a long period of decline after the departure of many research scientists, especially foreign cooperation staff. It is now in the process of recovering its productivity owing, first, to the establishment of a young Moroccan team (eight Moroccan M.Sc., including five "Ingénieurs d'Etat", with an average of four years' experience) and, second, to various international cooperation projects (ACSAD, USAID, FAO). Its main concern is the improvement of the plant material available in the country, with many new varieties once again included in the catolog:

- for durum wheat (1.5 million ha cultivated), the catalog included only seven varieties in 1982; four new ones will be registered shortly (three Moroccan varieties and one ACSAD variety);

- for soft wheat (0.55 million ha), the catalog of varieties is larger; to replace the most widespread variety, Nasma, which has recently become susceptible to a number of diseases, INRA has undertaken a large-scale program of introduction, hybridization and evaluation, with valuable results both for the "favorable bour" and irrigated areas (variety 5/70-32), and for the "unfavorable bour" (ACSAD 67);

- for barley (2.4 million ha), newly registered varieties have contributed to reducing malt imports, while others are offered in the catalog.

However, efficiency is not always as high as it could be[50] and the results remain far below the country's requirements. Practical workers have made many comments about the deficiencies of the available varieties, their inability to withstand the diversity of ecological conditions, the consequent necessity in such cases of calling upon neighboring countries (Tunisia), etc.

Up to now, the conception and operation of this Station have hitherto probably been consistent with the expectations of efficient cereal growers and cereal specialists in favorable areas. As and when it is felt essential to respond to more varied and more complex demands, changes will become necessary, entailing not only involvement in forms of collaboration extending as far as projects like the Dryland Farming Project (see below) but also more substantial and diversified means, other working methods, etc. In particular, the Stations will have to work together more closely with the cropping practice improvement, agropedology, plant protection and agrotechnology stations, where more than twenty Moroccan researchers are working, often on a part-time basis, on these products.[51] Action has been taken in this field, but remains conceptually inadequate; this will be discussed in more detail later (see section 6.5).

Sugar plants

In view of Morocco's efforts to achieve self-sufficiency in sugar, research has an essential function to perform in this non-traditional and highly intensive sector. This requirement seems to have been partially satisfied with the aid of German cooperation (Federal Republic of Germany) and now of a young national team (seven Moroccan research workers, including three "Ingénieurs d'Etat", with an average of five years' experience, at the Rabat Central Station), which includes more than plant breeders.

The producers have at their disposal plant material suitable for the conditions prevailing in the country, selected from varieties created abroad, in the case of both beet and cane. Plant health problems, which are very serious for beet, seem to have been largely solved. The cultivation techniques and technological problems have been substantially mastered. However, much remains to be done in these two fields; for example, as regards water requirements. Again, Morocco does not produce its own seed or take part in the creation of varieties.

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(50) A 1982 mission by ICARDA (Schaller Ch., Rasmusson D., Srivastava J.) made a number of valuable comments and recommendations, which INRA has subsequently endeavored to take into account.

(51) According to the scientists' card index, the numbers of research scientists working on a full- or part-time basis on "cereals" (usually winter cereals, although this is not always specified) are as follows: 11 research scientists specializing in agronomy and agropedology, six in plant protection, four in technology, and one in plant improvement (Saharan agriculture).

The support institutions of the sugar sector are now being diversified by the establishment of the Technical Sugar Cane Center (at the ORMVA of the Gharb), but the apportionment of tasks and responsibilities between this and other bodies is not entirely clear to us.

Fodder crops

Although increasing, production of fodder crops still satisfies only a minute proportion of the requirements of Moroccan livestock. Nevertheless, this is one of the strategic sectors of agriculture in a country like Morocco, not only because it constitutes the basis for intensification of animal production but also because it is the interface between the problems of cropping systems and those of livestock-raising systems. Pasture improvement is also closely bound up with the problems of environmental protection.

In the past, research on fodder crops was relatively active and there were some highly reputed comprehensive reviews (four between 1934 and 1964). After a long period of stagnation, this research sector, which has only five Moroccan research staff (four of them at the Rabat Central Station), has received a substantial boost[52] from German cooperation. However, it is legitimate to wonder whether the true scale of the research problems has currently been realized. For example, they do not appear to have been investigated sufficiently in relation to livestock-raising systems or even the types of user animals (admittedly INRA has very few animal husbandry specialists). Surely this field of research, more than any other, calls for multidisciplinary approaches covering specific types of livestock-raising, including socioeconomic, animal husbandry, and agropedological aspects, possibly involving the structures responsible for supervision of production. Great importance attached to the survey program for fodder and pasture plants (over 400 ecotypes have been taken from the regions with rainfall of 100-600 mm alone), intends to safeguard the national genetic stock and to provide material for the selection program in hand, with the introduction of foreign varieties and species.

Food legumes

In Morocco, food legumes are traditional crops which are well integrated in the cropping and production systems of small- and medium-size farms. For this reason they cover large areas (the second largest after cereals), but have declined appreciably. They are ample to satisfy national demand and could provide considerable surpluses.

The small team at Rabat (three research scientists, two of whom are currently undergoing training abroad) are working on genetic improvement of the various species existing in Morocco, particular attention being

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(52) Surprisingly, however, this sector has been placed third in the classification of research priorities, red meats being put in first place.

paid to winter chickpeas and broad beans (concentrating on resistance to anthracnose and broomrape respectively); promising results have been obtained.

Oil plants, spring cereals, and textile plants

The three Central Stations for these crops have two research workers each.[53] The first station concentrates on the introduction and evaluation of foreign varieties of sunflower, safflower, and rape, with some creation of new varieties. Work on the other products (castor oil plant, poppy, sesame, and madia oil plant) is limited to conservative selection of varieties. The second station works on maize, sorghum (production of hybrid varieties for these two species), and rice. These two groups of commodities, and cotton, are very limited geographically and do not occupy large areas. In all three cases, what is involved is fundamentally scientific and technical support, which, although very useful to sectors which cannot be neglected, is not important enough to warrant at present the allocation of research resources sufficient to boost production substantially through significant innovation.

6.2.3 Research organized on the basis of disciplines and groups of disciplines

General agronomy

This research is concerned mainly with cultivation practices (field work, fertilization, rotations, etc.) applied to a variety of crops, dynamics of soil mineral nutrients, etc.

The work is carried out by several units: the Central Crop Improvement Station (eight scientists, including two "Ingénieurs d'Etat", averaging just over four years' experience); the Agropedology Station and the Soil Chemistry Laboratory of the Pedology Service at Rabat (seven research staff, including four "Ingénieurs d'Etat", with more than five years' experience),[54] and the various regional stations engaged in these disciplines, in particular the Central Radioisotopes Station at Tangier (four research staff) and the recently established Agricultural Machinery Station at Settat.

On the whole, the activities concerned appear to be conventional, based on trial programs kept ongoing for an excessively long period, although interest has recently begun to focus on the semiarid and arid zones. Turnover of scientific staff is high in these fields, with young

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(53) There is a regional station specializing in cotton at Afourer (Tadla), with two plant protection specialists.

(54) According to the scientists' card index, the research activities of these two central units are very similar, and the reasons for their separation are not at all clear.

research workers joining the State corporations or taking up other posts as soon as opportunities arise.

Other "ecological" research

This is conducted by the Ecology Service in Rabat and a few small regional stations (often limited to a single researcher), which have long been engaged in the surveying of the country's agricultural resources and investigation of their development potential in the fields of bioclimatology (two researchers), pedology (nine researchers, including soil conservation and survey) and soil microflora (three researchers).

A large volume of information has been built up in these different fields. Through soil surveys, some 10 million ha has been mapped over the years at different scales, erosion being studied over an area of more than 6 million ha. In the arid and semiarid zones, recent studies have confirmed results obtained elsewhere: for example, the fact that water is conserved better in fallow land which has not been plowed but has been chemically cleared of weeds, as in the case of vertisols, or in plowed fallow land as in loamy soils; the superiority of the chisel or cultivator over the disk and moldboard plows. In microbiology, the favorable effect of manganese on the growth of certain strains of Rhizobium has been demonstrated. Active research in plant ecology was pursued during the 1960s and 1970s (survey, production of a herbarium of 20,000 specimens of cultivated and spontaneous species), but this work has now ceased.

However, various fields remain to be covered or to be investigated in greater detail for their agricultural development potential - in particular, soil surveys, impact of irrigation techniques, water resource management, etc.

Plant protection

Crop protection plays an important part in the emergence of modernized agriculture in Morocco, especially with the development of irrigation. Agricultural research has contributed greatly to this through its many long-standing activities and by virtue of the long period (up to 1980) during which INRA was directly responsible for the warning services. These are now the responsibility of a Directorate of the Ministry, the DPVCTRF.[55]

This sector of INRA research was in the past strongly supported by French and German cooperation, and has become the largest in terms of numbers of research staff, most of whom are concentrated at the Rabat Central Station (22 scientists, including one Chief Scientist and four "Ingénieurs d'Etat", averaging six years' experience). However, there

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(55) Directorate of Plant Protection, Technical Supervision and Fraud Control.

are a number of staff in the Provinces (seven at Kénitra, Meknès, and Tadla).[56]

The research carried out in the fields of entomology, biological control, mycology, virology, bacteriology, nematology, and weed science (and control) have so far given rise to a large number of publications and scientific and technical results, much of which has been utilized for plant protection. Research is at present concentrating on cereals, vegetable crops, fruit trees, and food legumes.[57] Other crops, however, are not currently covered - in particular, oil plants and fodder crops.

6.3 DIVERSITY OF DECENTRALIZED RESEARCH

Decentralization was opted for at the beginning of the 1970s and has increased since the reestablishment of INRA. It is reflected in the establishment of two central commodity-based stations (citrus and vegetable crops) and two production-system-based research units (Saharan agronomy and dryland farming).

These experiences, which stem from the initiative of those in charge of research or the persistent interest of some research staff, are interesting for their diversity. They have all brought the research staff closer to the practical situation in the field, made them take more account of agricultural realities, and caused them, where possible, to work in multidisciplinary teams. But owing to their regional location, these innovative units have suffered more than those in Rabat from staff turnover as well as administrative and financial difficulties.

6.3.1 Decentralized commodity-based research

Citriculture

The Central Citrus Fruit Station based at El-Menzeh in the Regional Center of the Gharb, the main area of citrus plantations in the country, is responsible for the national program for this commodity. It was set up in 1972 with a single young Moroccan scientist who has ever since ensured its continuity and who has gradually established a well-equipped unit, a well-organized structure, a relatively large team (ten research

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(56) This excludes the large number of plant protection specialists working in the commodity-based specialized units (citrus, vegetable crops, cotton) and the production-system-based units (Saharan agronomy and rainfed farming).

(57) These crops are listed among the principal ones investigated by six, five, four, and three researchers respectively in the 1981 scientists' card index.

staff, including three "Ingénieurs d'Etat", averaging four years' experience),[58] a pool of accumulated experience, a network of relations with the production or professional sector and foreign teams, collaboration with other national bodies and, finally, a good reputation.

The Station's research program is directed mainly towards the improvement of plant material and protection of orchards. Matters of cultivation techniques and, in particular, the use of fertilizers, are left to SASMA, a body responsible for experimentation established by the professional sector.[59] Eighty percent of this program is carried out on the spot, the internal and environmental working conditions apparently being good. The rest is conducted in conjunction with other INRA stations with a citrus component in other producing regions (Tadla, Marrakech, Agadir, etc.), along traditional lines (mailing of details of experiment procedures, occasional visits, or even the mere maintenance and safeguarding of collections or plantations). This may be unsatisfactory, but the disadvantages are limited in this case.

Finally, this Station has one important specific feature: the sector in which it operates is exposed and at the same time important to the national economy, since most of the relevant products are exported on an extremely competitive market. It is therefore gratifying and promising to note that INRA at present has one of its best research units in a sector of this kind.

Vegetable crops and the example of regional integration of the Agadir Center

Agadir has long been the location of the Central Vegetable Crops Station, and here the situation is of a different type. Although work on these crops accounts for most (40%) of the resources of the Souss-Massa Regional Center because of their regional importance, it is regional agriculture in all its aspects - irrigated, rainfed, and mountain farming - which remains the chief concern, and the Stations's national function in the field of vegetable crops is only one aspect of its work.

This is indicated first by the fact that the same person fills the two posts of Central Station Manager and Regional Center Manager. The aim is to tackle as far as possible the immediate problems of the commodity of the region from the five existing stations (at present manned by ten

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(58) The youthfulness of the researchers (and also the technicians) is due in this case to the rapid turnover of qualified staff. After learning their trade at the Station, many skilled employees were able to turn their skills to account in professional bodies in the same sector offering higher pay.

(59) A number of operations are governed by an agreement between INRA and SASMA. For example, INRA produces healthy plant material (in collaboration with IAV, which is competent in micrografting techniques) and verifies its health quality, while SASMA distributes it.

research staff and twenty Technical Assistants), particularly as the Souss is located far away from the country's active research and assistance centers and depends mainly on local skills.

In these circumstances, the relative autonomy of planning in the field of vegetable crops, offered by the unit's status as a Central Station, is utilized to enable it to tackle the growers' problems as directly as possible: testing of new varieties offered by foreign seed breeders, disease control, tests of types of shelters and glasshouses.

These activities are conducted on a basis of coordination and collaboration with the relevant sector organizations and the structures established by them: SASMA, OCE, the Souss-Massa ORMVA, the outstation of IAV Hassan II, etc. This coordination takes place through a Regional Technical Committee for Early Vegetables which meets once a month and examines and tackles all present and future concerns.

This basis for the research work is well suited to the immediate requirements of a type of produce subject to the constraints of a very speculative and fickle export market. It has the advantage of closely integrating the Regional Research Center in the realities of agriculture and enabling it to obtain support and stimulation from that source. This is therefore a highly positive initial step. However, this approach does not seem to have progressed beyond the stage of individual responses to uncoordinated and very specific problems, and has not led to the tackling of increasing numbers of truly scientific types of problems. This is at least a consequence of the remoteness and isolation from the country's main intellectual centers. Of course, staff turnover is again a problem, especially with the already small staff numbers.

One particular consequence is that the station has not so far been acting as a Central Station for the other vegetable crops stations in the country (Casablanca and El Jadida regions, on the way to Rabat), although this function could help to prevent the undue concentration on the Souss region.

However, a new factor may facilitate the tackling of this second stage: the establishment, three years ago, of the outstation of IAV Hassan II, which decentralized its vegetable crops department (and other departments) and adopted a decidedly scientific approach to research, concentrating on topics such as water resource management, salinity problems, drought resistance, genetic improvement, etc. The breaking down of intellectual isolation by close contacts between these two complementary structures is vital to both, and also to the future of vegetable production in the area and in Morocco as a whole. However, the difficulties probably outweigh the goodwill of both stations, and should be considered in detail and at length at higher levels.

The Agadir Regional Center is also in the process of setting up an interesting experiment in the field of organization and internal motivation: Sectoral Committees are being established gradually for all Center activities: vegetable growing under glass and in the field, cereals, industrial plants, fodder crops, and even administration. Their members are the relevant staff of each experiment station, sometimes with outside guests, who, however, are from the region. They meet - at least

once a year at present - to discuss the results of the year's activities in their fields, future programs, etc.

Again, exchanges have recently been instituted with the Marrakech Regional Central Station on Saharan produce (date palms, D'Man sheep). This simple measure highlights the potential for initiative and invigoration of decentralized, locally integrated structures.

6.3.2 Decentralized research on production-systems

Saharan agriculture

Work in this field began some 20 years ago with research based in Marrakech on the bayoud disease of date palms. Research on further aspects of this species was gradually initiated, as well as on the other main products of the oases: fruit trees, cereals, vegetable crops, fodder and raising of D'Man sheep, and finally range management. This extension and diversification of the range of activities led in 1974 to the establishment of the Central Saharan Agriculture Station (SCAS), which now has a relatively large staff (twelve research staff, including four "Ingénieurs d'Etat", averaging just under four years' experience),[60] supported by a network of five experiment stations, south of the Atlas.

Much know-how has been acquired in twenty years of research with the help of French cooperation, and covers the entire oasis production system - e.g.:

- date palm: survey of palm groves and identification of 223 varieties, investigation of the bayoud disease (distribution, propagation, etc.), selection, hybridization program with the creation of bayoud-resistant individuals whose date quality is currently under study, in-vitro multiplication, etc.;

- other tree species: selection and collection of local material from almond, apricot, fig, and pomegranate trees: introduction of the pistachio tree and the jojoba;

- cereals: selection, evaluation, and propagation of local varieties of wheat and barley;

- livestock raising: demonstration of the characteristics of the D'Man sheep breed and establishment of foundation flocks; floristic inventory of the pre-Saharan ranges;

- support for other Arab countries with similar ecosystems, etc.

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(60) Including the research workers of the Errachidia station initially set up by SCAS, which apparently tends to become an autonomous station (or even regional center) concentrating on problems of range management.

The multidisciplinary scientific approach to problems is perhaps more intended than fully practiced. Socioeconomic research is also lacking. This would allow more objective and comprehensive analyses of the relevant environment. The well-known difficulties in the practical implementation of research results are an indication of this deficiency. The station also has close and very positive relations with other scientific bodies, both in Morocco (the faculty of Marrakech) and abroad (FAO, France).

Dryland farming

This subject falls within the province of the "Dryland Farming Project" initiated in 1980 with American cooperation, which aims "to implement an applied research program with the objective of increasing production of cereals, legumes, and fodder plants, and of contributing, together with the Directorates of Agricultural Development, to dissemination of the techniques developed". The Project, which is based at Settat, aspires to be not a research station alongside those already existing, having its own resources, but a program partially mobilizing the interests and facilities of the existing stations.

A detailed, critical review of this project is given in Annex 8. Its broad outlines are as follows: it was organized as a formal Project around 1981, and has two components involving two separate institutions, IAV and a consortium of American universities. A detailed socioeconomic survey of the production systems and technical itineraries prevailing in a semiarid region of central Morocco was carried out first, the results being processed from a primarily comprehensive viewpoint.[61] A little later and separately, a team of agronomists (together with other INRA stations) began detailed investigation of the characteristics of the area, technical tests (research on soil management and weed control, together with the crop improvement and ecology stations, as mentioned above) crop tests (research, also mentioned above, on cereals, winter chickpeas, and the fodder crops vetch and oats), implicitly assuming a form of modern farming accessible to sufficiently well-endowed farmers. These two conceptions so far have not converged.

6.4 OTHER RESEARCH

The above two major categories exclude research on fruit tree production, which is partly decentralized, animal husbandry research organized and conducted mainly at El Koudia, near Rabat, and food technology research, which is confined to Rabat.

Miscellaneous Fruit Tree Production

This sector covers fruit production other than citrus and dates. INRA is interested mainly in traditional species: first, almond,

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(61) See Menatya, Pascon, Zagdouni, 1983.

pistachio, and pecan trees, which are little cultivated elsewhere and yield easily exportable products and, second, olive trees, which are important in light of the country's massive and growing oil deficit.

This research is covered by the central station in Rabat (four "Ingénieurs d'Etat", averaging nearly six years' experience), the Arboriculture station at Aïn Taoujdate-Meknès (also with four research staff) and a small outstation for olive trees at Marrakech, concentrating on propagation techniques, rootstock selection, prospection of local genetic material and, to a lesser extent, the use of fertilizers and plant nutrition. The problems of plant protection and conservation are relatively well covered by the Central Plant Protection and Technology stations, which employ five and four researchers, respectively, on the relevant species, on a full- or part-time basis.

On the whole, for this relatively small sector, INRA has a scientific potential which could come to full fruition in the projected establishment of a "National Arboriculture Research Center" at Meknès.

Animal products

Animal husbandry research began some fifteen years ago with the establishment of the El Koudia farm, with the assistance of German cooperation. This research later suffered many obstacles to its continuity and development, so that its only significant achievement is in apiculture, where the attention devoted to training (in addition to the work on bees and the effect of pollination on increasing agricultural production) gave rise to the establishment of a modern apiculture sector which has enabled Morocco to become an exporter instead of an importer within 10 years.

The animal sector is at present covered by a very small staff (seven research staff, including one "Ingénieur d'Etat": four at El-Koudia, two in the Tadla, one in the Middle Atlas Project, and also the Saharan agriculture animal husbandry specialist), much of whose time is taken up by administrative tasks and whose work is divided among the various fields concerned (cattle, sheep, poultry, and bees). The staff is manifestly insufficient for the very large animal products sector (more than a third of gross agricultural domestic product), which is growing, intensifying and therefore experiencing many problems.

Research in the field of animal husbandry is normally lengthy and expensive, so that the choice of relevant programs must involve a very thorough procedure based on in-depth studies taking full account of conditions in the country and the present and future needs of those active in the field. This stage does not yet appear to have been fully reached. This is indicated, in particular, by the importance formerly attached to research on local cattle populations whose future was extremely problematical, while the problems of the introduction and adaptation of foreign breeds, which are good performers but are inevitably delicate in the local environment, have not yet even been identified.

Food technology

The Central Food Technology station at Rabat accounts for all the human resources (twelve research staff, including two "Ingénieurs d'Etat", averaging six years' experience) and material resources allocated by INRA to this field of research. Its activities (technological analyses, development of processing techniques, preservation techniques, etc.) are directed towards cereals, fruit, vegetables, and olives, in approximately equal proportions.

This research unit is in a difficult situation. It works in a sector in which Morocco has large-scale public and private undertakings, many of which have the resources to gain access to technical innovation by the purchase of foreign licenses or by funding their own research. Again, in the past, these firms had no difficulty in assuring for themselves the services of INRA's most highly qualified researchers, and there is little prospect of this situation changing quickly.

6.5 INITIAL CONCLUSIONS

The above brief description of INRA's research activities gives an impression of the apparent large scope and the great diversity of thematical, methodology, and organizational research activities of INRA. This is the result of past evolution, which included a number of very favorable factors.

The first of these factors is the relative balance between the research activities described, with a fairly large number of moderately or even well-endowed sectors, but also some very badly endowed ones, such as animal husbandry and range management. This spread of resources admittedly reflects the concern of successive managing bodies to cover all the main problems of agriculture and satisfy national demands, but it also means that the scientific staff have to work in a wide variety of fields. This is particularly evident in the booklet "Program de recherche par secteur 1983-84" ("Research Program by Sectors 1983-84"), in which many research staff quite often feature in nine or ten research projects or activities.

The second favorable factor is the increasingly synthetic approach adopted for the problems, on the basis of commodities and production systems. However, it does not yet seem possible on the basis of the action taken to specify the country's problems in a fully satisfactory way. For example, it is significant that in Document no. 7 addressed to the INRA Executive Board in July 1983, the proposed inventory of "problems raised by the (vitally important) winter cereals sector for agricultural research" (p. 6) should still be based on a conventional, general-purpose, abstract classification which is valid everywhere and nowhere and is ultimately inefficient in any given country: analysis of the components of yield, resulting in the conventional breakdown into choice of varieties, use of fertilizers, cultivation techniques, etc. Conversely, the real problems of cereal growing in Morocco, the diversity of production zones and conditions, the random variations and constraints of the climate, and the need to associate cereals with other farming activities, such as livestock-raising, are not taken into account in the compilation of this inventory.

Other positive factors are: the trust placed in a number of research scientists who have been able to perform the innovative experiments mentioned, and the diversity of international cooperative relations.

However, the scientific activities appear to suffer badly from the qualitive and quantitative weaknesses of the scientific potential. First, the inexperience and barely adequate level of most of the research staff seem, with the present dearth of skilled scientific staff, to present serious obstacles to the satisfactory implementation of the intended programs. This weakness applies to all the research in hand, including the projects which are numerically well enough endowed; it is evident particularly in some important disciplines such as plant breeding and genetics, where only one research worker apparently has a doctorate.[62]

Second, some fields of research and disciplines are virtually nonexistent - in particular, agricultural engineering (water resources management, small-scale water engineering works, small-scale mechanization, etc.) and the social and economic sciences (in which there is only one specialist for the entire INRA).

The absence of a social and economic sciences department is certainly one of the main reasons for INRA's present difficulties. This situation is bound to deteriorate as the Institute comes to be confronted with the demands of an agriculture in the process of intensifying and becoming more complex, so that it has to make more careful use of limited resources and facilities, and so on. There is no point in repeating here the well-developed arguments set out in document no. 7 (Réalisations scientifiques de l'INRA [Scientific Achievements of INRA], July 1983) on the need to base the choice of research topics and strategies, and agricultural policy measures on a thorough knowkedge of the conditions and processes of production of the different groups of farmers.

However, other, analogous arguments must be mentioned. A knowledge of microeconomic processes must be supplemented by familiarity with macroeconomic phenomena - e.g., the problems of the commodity-based systems and the operation of the markets for factors (supplies of goods, credit, labor) and commodities, or the impact of institutional structures and agricultural, economic, and social measures. A clear view of the basic elements of agricultural production, competition, and complementarities between regions, trends, productivity levels and how they are expressed, is essential for determination of the research policy and its gradual adaptation. Detailed and ongoing familiarity with the international markets on which Moroccan products must compete, and the conditions of production from competiting countries would be a valuable asset for all involved, including OCE and the other exporters, whose research and information services inevitably have a very uncoordinated, fragmentary, and short-term view of these problems.

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(62) A doctorate is not always a representative criterion of the scientific value of a research scientist, but in the present scientific structure circumstances, it may be a sign of greater autonomy and initiative.

The fact that IAV has an experienced unit in this field does not militate against such activities but is a favorable and stimulating factor having regard to the width of the field to be covered.

Finally, the present scientific potential is substantially reduced by the compartmentalization of scientific units, especially at Rabat, which has hitherto hindered the establishment of major research programs wished by INRA. In addition, the dispersion of scarce human resources has also reduced the effectiveness of research and accounts for the half-way achievement of the research results and, to some extent, their numerical paucity.

7. INRA AND ITS NATIONAL AND INTERNATIONAL ENVIRONMENT

This section will review INRA's relations with its national environment and with foreign institutions.

7.1 INRA'S DIFFICULT POSITION WITHIN MOROCCO

To understand the relations, or the inadequacy of the relations, of INRA with other national institutions, it must first be realized that the Institute does not have a monopoly on agricultural research in Morocco: although it is the only MARA institution whose principal activity is research, other institutions are also active in this field alongside their main functions.

7.1.1 The other institutions: a research potential at least equivalent to INRA's

There are at least four types of institutions which conduct agricultural research as a secondary activity: the higher education institutions, certain government agencies, the bodies directly concerned with production - both those responsible for supervising agriculture in the areas with large-scale water engineering projects (ORMVA) and the corporations which manage State land - and professional and private organizations.

The university higher education institutions (science faculties), and in particular the institutes of agriculture, now have concentrations of large numbers of high-level staff who take part, or are capable of taking part, in the national agricultural research effort. The oldest of these institutions is the Ecole Nationale d'Agriculture at Meknès. The largest is the "Institut Agronomique et Vétérinaire Hassan II (IAV)" in Rabat, which has an outstation at Agadir (vegetable crops). It has some 300 "teaching/research staff" whose level is at least equal to the grade of "Ingénieur d'Etat" (three times as many as INRA); half of these are stated to be involved part-time in research activities, usually in preparation for doctoral theses.

Some of the work consists of essentially fundamental research, but

applied research is not neglected, this being associated with this institution's concern for highly concrete and practical training. Much of this work is carried out at the request of the agencies responsible for development, which also fund it. In some fields - in particular, animal husbandry and the social sciences - IAV is the only body in Morocco with a real research potential.[63]

Regarding governement agencies, some central directorates of ministries - in particular MARA - and external services carry on research or experimental activities associated with their principal function, either direct or through their subordinate agencies. For example, the Directorate of Livestock Production has a few experiment stations, the Directorate of Plant Production entrusts research and experimentation programs, which it funds, to other institutions (INRA, IAV), and the Directorate of Agricultural Extension and Agrarian Reform is responsible for a major project recently started up, the CNERV (National Agricultural Extension Studies and Research Center) at Meknès. The Provincial Directorates of Agriculture are in charge of integrated development projects, some of which have a research component.[64]

As for the public production structures (State corporations) and production supervisory structures (ORMVAs, Centre de travaux [Works Centers]), these engage in research and experimentation in the capacity of users with direct operational needs.

Finally, while the limited research and experimentation activities of professional organizations such as SASMA are familiar, activity in this field by the public and private agro-industrial undertakings (both Moroccan and foreign) is much less well known.

Overall, it was not easy in the limited time available to the ISNAR mission to identify precisely all research activities, whether or not

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(63) For more information on Moroccan higher agricultural education, especially at IAV, see Casas, Baeza, FAO, 1980.

(64) One of these projects, visited by the Mission - the Haut-Loukkos Project in the Rif - is being run by the Directorate of Water, Forests and Soil Conservation. Among the problems of management of the catchment areas above a large dam built on this river, it is involved with all aspects of the agricultural development of the mountain population (choice of crops, cultivation methods, introduction of improved cattle, etc.). These aspects were being dealt with by a team of young scientists from the Directorate, without proper agricultural training or experience of socio-economic analysis and development. This suggests that the institutional basis of this project might perhaps be too narrow: agriculture in this area would be worthwhile only if the problem of soil conservation were tackled, while the main priority in these mountain regions is the entire complex of the production and subsistence systems.

declared as such,[65] carried on outside INRA. Very roughly speaking, this research activity as a whole probably accounts at present for a total number of qualified workers (on a full-time equivalent basis) comparable to that of INRA.

7.1.2 Reasons for the expansion of research outside INRA

The growth of research outside of INRA reflects the ability of many Moroccan institutions to engage in relatively elaborate activities. To understand the consequences of this situation, it is important to understand the reasons for it.

For the higher education institutions, research is a normal activity, essential to the quality of education and the formation of dynamic, diversified, and large enough teams.

In the case of the government agencies and public bodies visited, two types of reasons were put forward, or observed, to justify their conduct of research. The main reason seems to have been the deficiencies of DRA or INRA itself: they had to tackle problems which were not covered by these institutions. These included important problems such as most of those concerned with irrigation. It was appropriate in these circumstances for the ORMVAs, densely structured bodies responsible for all matters concerning the areas irrigated with large-scale water engineering works, to tackle these problems themselves. More often, however, the problems involved were more individual in nature, where the person confronting them could not find a research unit prepared to help him and was compelled to undertake a minimum of experimentation, resulting, if this situation recurred frequently, in the setting up of a permanent capability. The problems are usually simple and very specialized, but of vital importance to the relevant practical workers - e.g., the choice of fertilizers, varieties, seed densities, etc., for each region. The methodologies are well known and the solving of these problems is not necessarily a matter for a research institution which, in view of resource limitations, must be selective in the work it undertakes and must decline to satisfy some demands.

The second reason is apparently lack of confidence in the quality, time-scale of work, or type of response expected from INRA or any other body which might be approached. This lack of confidence, which might be justified in some cases, is sometimes due to lack of contact, or the wish, for the sake of convenience or security, to be in control of the experiments needed by the person commissioning them where the resources are available, as they are in some of the relevant bodies.

Generally, the government agencies with whom discussions were held complained of the inadequate volume of research conducted in Morocco to

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(65) The last three types of bodies often assert that they are not engaging in research but merely carrying out experiments, fitness trials or even demonstration tests, to fend off accusations of performing activities outside their mandate.

their particular interest. Some acknowledged that they sometimes tried to mitigate this situation from their own resources, but that this was not a satisfactory approach. Others, like the Directorate of Livestock Products, declared their willingness to second resources - in particular, research staff - to INRA, provided that the priority research topics were decided on jointly and that the available facilities ensured effective working. All declared to be in favor of increasing the resources allocated to research. These findings show that major needs still exist in the field of agricultural research in Morocco and that these are acutely felt in some production sectors.

7.1.3 Relative isolation of INRA

The great expansion of research initiatives was certainly in response to demand. This led to the gradual establishment of a national system of agricultural research made up of a number of disparate institutions operating separately from each other, whose fields of activity appear to be basically different and complementary, and to overlap seldom.

In its sphere of action, INRA is relatively handicapped and isolated as it cannot meet, other than formally, with the large number of government agencies and public bodies which should be its partners but which have their own research and experimentation facilities which make them somewhat independent from INRA.

The overlaps between the fields of activity of INRA and the other organizations are still limited, owing to the overall slenderness of national research resources when compared with the range of problems to be tackled. These overlaps ultimately occur in the exceptional situations of collaboration or competition. Collaborative relations organized systematically with other national institutions are virtually nonexistent. On the other hand, a relatively large number of decentralized, uncoordinated relations exist, reflecting deliberate attempts to forge contacts at the regional level. These were mentioned in the description of INRA's activities: they exist in the field of citriculture (relations with SASMA), vegetable crops (Regional Committees), Saharan agriculture (Office du DRA), apiculture (with the professional sector), etc. Other examples could be mentioned: the establishment of an association of tree-growers at Aïn-Taoujdate, the small livestock raising program with the "Office du Tadla", pedology research agreement with the "Safi DPA" and with the Integrated Middle Atlas Project, etc. On the whole, these relations remain on a small scale and were forged as and when they appeared appropriate and possible in the context of the actual work of INRA. They probably foreshadow wider and better-institutionalized forms of collaboration in the future, along the lines of the cooperation with IAV (which is quite active in animal husbandry and the social sciences), for which a draft outline agreement has recently been drawn up.

Unfortunately, however, there are also some evident situations of competition and duplication of effort. A recent illustration is the formation in 1982 of the Technical Sugarcane Center under the auspices of the ORMVA of the Gharb, which currently has six research staff and involves important bilateral cooperation. This seems to be a project

organized quite separately from INRA, since INRA has a "Central Sugar Plants Station" with eight research staff, and responsibilities do not appear to have been apportioned between the two bodies in advance.

7.1.4 A national agricultural research system lacking integration

The existence of such a national system of agricultural research gives rise to three fundamental problems which are liable to be exacerbated by the probable growth of resources allocated to this activity.

The first problem is inadequate circulation of information. If this were more effective, much of the duplication could probably be avoided: the information sought by some bodies may already be the subject of investigation elsewhere, without the knowledge of the former. Similarly, the relevant information may have been acquired in the past (examples have been given) but is inacessible to senior staff who are often freshly recruited or still turning over at a high rate. In this connection, the research stations, and in particular the departments, have an important recording function to play, but, for this purpose, require stability of scientific staff. In general, INRA does not appear to have been organized in such a way that its current and past work is readily available for reference.

The second problem is coordination of the various institutions which have a research function or are prepared to undertake research. In theory, this function should be organized through MARA's Directorate of Agricultural Education and Research. In fact, this Directorate, which has existed as such only since the DRA was transformed into INRA, has not yet organized itself to assume responsibilities in the field of research.

There is also a National Center for the Coordination and Planning of Scientific and Technical Research (CNCPRST), connected with the Ministry of Planning and responsible for promoting and coordinating all research conducted in Morocco in all fields. This Center is apparently now in operation, but it is not yet able to initiate action in the sphere of agricultural research.

Hence the coordination of research remains a problem which is as yet entirely unsolved. It is an important and many-faceted problem whose significance will increase steadily.

The final problem is the evaluation of the quality of such a diverse range of agricultural research activities, particularly those of the non-scientific institutions which do not have the facilities to set up their own ad hoc internal units. On this point, INRA's function is partly explicit: the Institute is responsible "for overseeing, within the context of its competence, research, studies and other work carried out on behalf of public legal entities (article 2, point 4 of the Law establishing INRA). However, it is not clear whether this mandate applies to activities of the same kind carried out by public legal entities. At any rate, INRA does not at present seem to have the capacity to assume such functions. It will first have to grow steadily

in both size and quality, until it secures the full respect of its partners.

7.2 INRA's REACTIVATED INTERNATIONAL RELATIONS

7.2.1 Bilateral cooperation relations

INRA maintains bilateral cooperation with four main countries: France, Germany, Spain, and the United States.[66]

Cooperation with France has the longest history. After Independence, many French scientists remained in the country and kept its agricultural research structure alive. Their number was to fall rapidly after 1964. Relations were reactivated by a cooperative agreement between INRA and France, particularly in the fields of plant protection, Saharan agriculture, and the training of research staff in France. These relations are now at a relatively low ebb, involving assistance with training and research in cereal and fruit tree production, Saharan agriculture, animal husbandry, and research techniques.

Cooperation with the Federal Republic of Germany began later, but has been kept up at a fairly constant level although the relevant fields have changed, from plant protection, animal husbandry, and sugar crops in the past, to fodder crops only today.

Cooperation with the United States is relatively recent and has expanded greatly in the field of dryland farming (aridoculture), with the training of qualified scientific staff as an important aspect.

7.2.2 Relations with international organizations

INRA is directly involved in wide-ranging cooperative projects with a number of international organizations; for example:

- ACSAD, in cereal variety trials, arid zone development, and introduction of the pistachio tree;
- FAO, in research on the date palm and improvement of olive oil production through FAO's Regional Project to strengthen basic seed production stations;
- FAO and UNDP in the training of apicultural research scientists and technicians;

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(66) The scientific staff was reinforced temporarily and at low cost by the cooperative programs undertaken in the 1970s with some eastern European countries (Bulgaria, Romania, and Poland); these programs have now been suspended.

- EEC, to strengthen research on cereal technology;

- UNDP, in investigation of horizontal resistance to pests and plant diseases;

- the World Bank, in a number of research components at experiment stations (Karia, Khemis-Zemamra, Melk-Zhar, Oualidia, and Dar Bouazza), and the first draft of the INRA Master Plan;

- IAEA, IOBC, IFAD, IOC, etc., in other research and service activities.

There are also contacts with international agricultural research centers such as CIMMYT, ICARDA, IBPGR, CIAT, ICRISAT, and IRRI for exchanges of genetic materials, visits by research workers, and attendance by Moroccan scientists and technicians at training courses.

8. TENTATIVE OVERALL ASSESSMENT: INRA AT A TURNING POINT IN ITS HISTORY

The foregoing sections have demonstrated the interdependence of the main aspects of INRA - its structure, resources, programs, operation, and external relations. It is now time to attempt to summarize these items in order of priority. This will inevitably entail some repetition of comments already made.

The first major characteristic of INRA seems to be the weakness of its scientific potential relative to the programs formally undertaken and the diversity and, to an even greater extent, the needs of the country. The numerical weakness (228 research staff in all) is particularly acute in some fields and disciplines such as genetics, animal husbandry, agricultural engineering and, above all, the social and economic sciences. The qualitative weakness results from the Institute's past inability to attract and retain qualified staff; it is reflected in the relatively low average levels of training and experience of the research staff, who are unable to conduct research and obtain results of sufficient quality to warrant the trust of other national institutions. It must, however, be emphasized that INRA does have a small number of qualified staff of the highest caliber who, despite all the internal difficulties and problems of national integration of INRA, have been able to do more than keep up the routine operation of the Institute, by establishing innovating research programs and substantially improving their training. The proposed new staff regulations are also very important, although improvements to these are still possible.

The second major characteristic is the large scale of the Institute's material facilities. INRA has an impressive network of stations and experimental farms which now covers the entire country. This network is an asset which a small number of decentralized research programs have been able to utilize. In the short term, and considered as a whole, however, it is a substantial burden: it has resulted in excessive geographical and professional dispersion of the research staff (who must perform too many administrative tasks) and excessively high costs (overabundance of unskilled staff, expensive maintenance of fixed assets and equipment).

The third major characteristic is the superimposition of different types of programs. This is the result of the growth of research, which has ultimately been favorable, involving more and more decentralized experiments with better-defined objectives to tackle the problems of development, with more sophisticated scientific approaches, in the fields of citrus, vegetable crops, Saharan agriculture, and rainfed farming. However, INRA is still persisting with too many unidisciplinary commodity-based programs based excessively on controlled-environment experimental work, ultimately yielding partial results which are not always significant and of which full advantage can be taken only by a relatively small modernized agricultural sector.

These three major factors have an inevitable impact on the internal operation of INRA and on its national integration. The scale of the material facilities and the diversity of programs have given rise to increasing complexity and rigidity in both the administrative and the scientific fields. It is becoming difficult if not impossible to imagine a fully homogeneous and coherent form of internal organization in both of these spheres. This view is borne out by examination of the current and proposed organizational structures: the hierarchical classification of the scientific units favors the scientific disciplines and also the geographical location of Rabat, as opposed to the Provinces, so that in both cases, the scientific units based in the Provinces - especially the multidisciplinary ones based on commodity and production systems - are penalized to a greater or lesser extent by being attached primarily to a controlling organization of an administrative nature and by the unwieldy financial and administrative procedures centered in Rabat.

Similarly, the compartmentalization of the research units and the isolation of many research staff are a result of the three characteristics described. Only research staff who are sufficiently stable, experienced, numerous, and not overwhelmed by administrative tasks are capable of consulting each other and working together effectively. But these conditions are far from being satisfied. Lack of self-confidence and of openings within INRA also affect relations with the outside world, thereby minimizing them. This situation is exacerbated by the behavior of the national institutions, which are justified in endeavoring to solve their most urgent and essential problems from their own resources or by resorting to other scientific institutions (IAV or foreign cooperation).

None of these considerations is entirely new for INRA. They certainly form the basis of the recent intensive efforts which have resulted in the intention to draft a Master Plan and, in connection with this, to endeavor to reformulate the research activities around major hierarchical programs which are still formal, and to devise a long-term policy of regionalization and harmonious development of human and material sources. However, as will be shown later, this effort was overambitious and premature, and unfortunately made no attempt to solve the practical problems of the present, which may determine the future of INRA.

Finally, it should be noted that total expenditure on agricultural research in Morocco, including the research resources of INRA - other than seed production - and those of the other national institutions, probably represents only some 0.40% of the value of the gross agricultural product. This represents a relatively low level of funding,

lower than the typical value observed in Third World countries (about 50%) and far below the 1% rate usually recommended by the major international institutions. In other words, appreciably increased efforts are necessary, involving, in particular, faster recruitment and training of young research workers and technicians, which INRA requires as a matter of priority. This brings us to the area of recommendations, which is the subject of part three.

PART THREE

PROPOSALS: ATTENTION TO THE SHORT TERM, WITH A VIEW TO BETTER PREPARATION OF INRA's LONG-TERM FUTURE

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PROPOSOSALS: ATTENTION TO THE SHORT TERM, WITH A VIEW TO BETTER PREPARATION OF INRA's LONG-TERM FUTURE

Part two has shown the complexity of INRA, its strengths and weaknesses, which reflect the advantages and disadvantages of some of its characteristic features. As suggested on a number of occasions by the analysis, INRA can be improved by specific or comprehensive decisions which must ultimately be aimed at increasing its scientific potential and enhancing its integration into the renewed process of rural development.

If they are to be realistic, these decisions must take account of the present situation, preserve what is satisfactory in it, improve what can be improved at least cost, and endeavor to solve the most serious problems by measures likely to secure the adherence or understanding of those most affected: the qualified staff of INRA and the national institutions which form the Institute's environment. In any case, this is the spirit in which the proposals and recommendations set out below have been drawn up; they are offered on the basis of prior consideration of the "new research" to be implemented for optimum servicing of the essential "new agricultural development" prescribed at the end of the description of Moroccan agriculture (part one). These proposals and recommendations are based on the introduction of objectives-based programming (section 2), conceived as a multi-purpose instrument of short and long-term management. This will justify or foreshadow the proposals on regionalization (section 3), human and other resources (section 4) and relations with IAV and other bodies (section 5). These recommendations are followed by a brief consideration of the long-term future (section 6) and a final section in which the recommendations are summarized and their chronological priorities spelled out.

1. NEW RESEARCH CAPABLE OF DIRECT AND RAPID APPLICATION BUT BASED ON A FIRM SCIENTIFIC FOUNDATION

1.1 TWO HAZARDS TO BE AVOIDED: NEGLECT OF PRACTICAL RELEVANCE AND READY-MADE SOLUTIONS

Two main dangers threaten the research institutions of a country confronted by urgent development needs.

The first is to find quick solutions, but without concern for how they are to be applied under practical field conditions - i.e., in areas and situations subject to many specific constraints, which are also of many different kinds if, as in Morocco, there are several different types of farmers. The function of research is then regarded as having been completed when satisfactory results have been obtained in the laboratory or at the experiment station. The result is an uncoordinated and fragmentary form of scientific production and an inability to supply

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genuinely effective results, which can be reflected in a loss of credibility by the institution and in frustration of the research workers, some of whom might be tempted by the idea that they could work more effectively and rewardingly elsewhere.

The second danger stems from the urgency and number of problems to be solved with necessarily limited resources. The stresses and pressures are so intense that the institution cannot easily refuse to take action on a large number of fronts at a time, but it does so at the cost of a dispersal of effort and, in particular, by seeking immediate, uncoordinated, one-off solutions while remaining unable to set its work within the larger scientific context. The result is a form of research which is extremely applied, lacking in imagination and detachment, unable to give a diversified response, to adapt rapidly to new demands, to produce significant and worthwhile results, and ultimately to progress and to enable its environment to progress. The research then tends to produce ready-made solutions transposed more or less satisfactorily from foreign situations, which cannot be exchanged with external cooperation agencies, and is not able to train qualified staff in the country. Highly applied research is necessary, but its vigor and effectiveness depend on its resting on a solid scientific foundation. It is not therefore necessarily the exclusive prerogative of an institution such as INRA, although INRA's function is to provide the essential support required.

1.2 NEED FOR RESEARCH OPEN TO AGRICULTURAL REALITY

It is certainly not easy to avoid these two hazards, which are extremely liable to occur in a situation like that of Morocco. To avoid the first, the most important step appears to be to abandon the exclusive idea of research projects in a single discipline, which are in most cases additive [illegible] never meet, and to reorganize a high proportion of these projects [illegible] the form of multidisciplinary programs based on an in-depth analysis of the technical, economic and social conditions in which the types of farmers it is intended to help work.

INRA has already embarked on this path by setting up commodity-based programs (citrus, vegetable crops) and production-system-based programs (Saharan agriculture, dryland farming), but a much higher proportion of its activity needs to be reorganized in accordance with this new approach, which would involve three major phases.

The first phase would be multidisciplinary diagnosis of the problems of the relevant commodity or production system. This is not feasible without a good knowledge of the agricultural realities - i.e., without close relations, with the representative farms confronted by the problem being analyzed and with the main agencies, institutions, and firms constituting their environment. This diagnosis will be more complex and important the more the situation involves "nonspecialized" and "traditional" forms of agriculture, where the complementarities and competition between products are particularly significant because of the low level or total absence of external inputs (fertilizers, plant

protection and other products, paid labor, etc.),[67] risk problems, interactions between form of production and lifestyle, etc. This diagnosis should finally reveal the single-discipline research topics which are necessary in order to maximize the prospects of achieving results which will be not only significant in terms of the possible margin of progress but also likely to be adopted by the largest number of farmers.

The second phase would be identification of the technical and other solutions (credit, qualified/supervisory manpower, etc.) to the problems diagnosed in the first phase. These may be techniques already available or known in Morocco, foreign techniques which can be transposed after adaptation, or new techniques to be developed. This phase would include controlled-environment work - stations, experimental farms, etc. - like that carried out by INRA, and also work under actual farm production conditions, which is new to INRA.

The final phase would be the devising of technical innovations consistent with the needs, constraints, and potential of the target groups of farms, and also with the characteristics of the firms and agencies which might help to disseminate these innovations (sale of recommended production inputs, allocation of credit, technical advisory services, etc.). Development and agricultural extension experts should be involved in this final phase.

Annex 10 examines in more detail the conceptions, conditions, and limits of this type of research. It needs only to be said here that apart from its efficacy, it is a prerequisite for the essential integration of the institution into the agricultural reality of the country. This integration cannot be achieved through intermediaries, such as extension workers, commodity-based agencies, well-known farmers, or pilot farms. This type of research also provides some of the information necessary for the implementation of the Programming by Objectives method described later.

Of course, this new approach is accessible only to truly multidisciplinary teams with sufficient staff, who can not only, in particular, cover the first and third phases which have so far been neglected by INRA - sometimes totally - but also increase the prospects of achieving relatively prompt significant technical innovations accessible to farmers.

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(67) Less account needs to be taken of these complementarities and relations of productivity in the case of modern and/or large farms, where these inputs are used. For example, the use of fertilizers, herbicides, pesticides, and cattle feeds offers a greater or lesser degree of freedom from the agricultural constraints of crop rotations and makes each product relatively less dependent on the others.

1.3 VITAL NEED FOR "BASIC RESEARCH"

The second danger - that the research might be too lacking in imagination, too fastidious, and too amateurish, without a "reserve of productivity" - may be even more difficult to avoid. It is a matter of persuading the politicians, administrators, and funding agencies responsible for INRA that it is essential to devote part of the resources demanded by the Institute in so-called "basic" research, undertaken for purely scientific reasons, and possibly without any immediate benefit to the agricultural economy of the country.

However, this is essential if the research workers are to be able to diversify their methods and approaches, acquire greater mastery of their fields of research, engage in effective dialogue on equal terms with scientific circles outside the country, evaluate promptly the advantages and possibilities of introducing innovations from outside, etc. It is an essential condition if the Institute is to be able to improve its ability to respond to existing and future demands and to translate the questions received from practical workers into scientific problems and strategies.

This basic, or sometimes called "thematic" research, may be of different types - viz:

- inventory of physical environments (soil survey and soil characterization, bioclimatology, etc.), biological environments (survey of flora and fauna, biological cycles and their determinants) and human environments (survey on forms of organization and functioning of social groups, population surveys, etc.); some such inventories were carried out in the past, others are the subject of work being conducted at present, and more will be required in the future;

- exploratory research, for example, to test the value of new approaches, such as biological control and genetic resistance in combatting certain diseases or predators (INRA has accumulated some extremely valuable results in these fields in the past), use of cytogenetics in plant improvement, etc.;

- prospective research, to pave the way and establish the basic information for the program intended for the future, or preventive research, where a disease already present in a neighboring country treatens to spread to Morocco;

- research on the fundamental characteristics of Moroccan agriculture - in particular, the complementarities and competitive relationsships between different commodities and regions, both directly and in terms of use of inputs (land, capital, labor) and of use of the products concerned (domestic consumption/market; foods crops/industrial crops; exports/imports). Clearly, these problems are mainly, but not exclusively, socioeconomic: assessment of the production potential of individual commodities and regions, which is essential in this kind of research, also calls for the involvement of experts in other fields, such as pedology, agronomy, agricultural engineering, geography, etc. These fields have so far been almost entirely neglected by INRA and are covered only with insufficient

resources, and hence superficially, by other institutions (MARA's Directorate of Programming and Economic Affairs, OCE, etc.). But a relatively detailed knowledge of Moroccan agriculture is essential:

- to INRA, for a better understanding of the place of each commodity and region in the context of the country as a whole, for the setting of priorities and the relative importance to be given to programs finally decided upon;
- to the decision-makers in the field of national agricultural policy, who require more reliable and precise information.

It is evident that there are many possible topics for basic research. Some of them are definitely applied in nature, while others are not directly concerned with development problems at all, but all have specific aims: the advancement of scientific knowledge which will eventually serve the process of development, although it is inevitable that some research projects will fail or won't achieve the desired results. Choosing the appropriate topics from the wide range of possibilities remains a critical and difficult matter, since it involves the Institute's development strategy and substantially determines its future. This choice constitutes the foundation for the decisions determining its future capacity.

Insofar as the basic research uses up budgetary resources, it is essential for these not to go to waste. Whatever the results, the resulting store of experience may be lost if the scientists responsible leave the institution or the world of science.

This is another important factor in the process of choice, which lead to placing such choice in the hands of established research scientists, or preferably teams, where the loss of a single member does not involve the loss of the entire accumulated experience. Again, it is easier for a team than for an individual to evolve and defend a balance between research directed towards particular practical objectives and a more detached form of research. This is another argument, militating in the Institute's policy, in favor of systematically backing groups and team workers rather than isolated individuals, which is what many of the laboratories ultimately are obliged to do.

1.4 GRADUAL IMPLEMENTATION OF NEW RESEARCH PROGRAMS: ADVANTAGE OF PLANNING - PROGRAMMING

It is evident from the foregoing that INRA's overall program should be a compromise between development concerns and scientific concerns, the following being conducted simultaneously:

- a majority of applied multidisciplinary programs on a commodity or production-system basis, with the aim of "producing" useful innovations which can be used outside INRA, through a renewed approach to research;

- a minority of single-discipline or multidisciplinary "basic" programs relating to more fundamental scientific objectives; these are essential to feed down to the applied programs and to guarantee their quality; their "results" are useful mainly to the research workers themselves, and without being directly relevant to development.

As stated earlier, these two types of programs should be conducted by sufficiently large teams and should represent a certain volume of scientific activities deployed over a period of time and at a limited number of privileged geographical locations.

These essential principles - for a renewed and critical mass of scientific approach - could not be applied fully to all INRA's research activities in the immediate future, owing to the quantitative and qualitative weaknesses of its current scientific potential, the limited short-term possibilities of cooperation with other Moroccan and foreign institutions, and also the necessary adaptation of the research workers to the new proposed approach. In other words, INRA will have to make choices and set priorities for the programs it intends to implement on this basis. This will therefore entail the allocation of fresh resources (particularly research scientists) or the transfer of available resources withdrawn from research programs or activities which are to be curtailed or abolished.

This entire complex of progressive, controlled, and coordinated action could be implemented satisfactorily only in the context of an internal programming process and on the basis of specific government policy expressed through annual budget decisions and the Plan.

Research programming remains primarily a <u>scientific and administrative</u> act which is a matter of the responsibility of each institution concerned. This involves the making of a simultaneous choice from the various possible activities, both current and contemplated, and the allocation of resources - both available and possibly upcoming - with a view to increasing the "value" of the activities chosen in this way, evaluated by a variety of criteria, chief among which remains consistency with the objectives of national development. If this choice is to be operational and realistic, it must apply principally to the <u>short and medium terms</u>, but it cannot disregard the long term because:

- much of the research often forms part of long-term programs (e.g., those relating to major national agricultural products);

- new research operations may have to be conducted by young scientists still to be recruited, who will not have acquired the relevant experience for several years;

- the choice will in general be based on guidelines featuring in the Plan.

In the field of research, the <u>Plan</u> in theory sets the broad <u>medium- and long-term</u> outlines of <u>policy</u> - the priorities assigned to individual products, regions, and groups of farmers, technological options, etc., and the orders of magnitude of the resources to be allocated to these

(manpower, principal investment headings) and their apportionment to the various institutions concerned. In reality, in Morocco (and indeed in many other countries too), prospective planning especially on such a long-term basis, is not always successful, except if based on appropriate efforts deployed by the relevant institutions. In any case, the results would only be illustrative in value and subject to considerable variation in accordance with national economic trends.

In practice, therefore, an institution such as INRA can predict its long-term future only by consideration based on two possible approaches. The first involves specific consideration of the long term, with an attempt to determine precisely the "ideal" long-term situation of INRA. This is the approach of the Master Plan [Plan Directeur] (see Preface).

The other possibility is to adopt a programming approach, devoting particular attention to the long term, and especially the evaluation and forecasting of demand for researchers, at present INRA's most limiting factor. This approach is more pragmatic and realistic, because it aims to create as quickly as possible the conditions for better scientific and administrative operation of INRA and for more rational and effective use of available resources. If it succeeded, the Institute would substantially improve its "brand image" with:

- young graduates: INRA could be more selective in recruitment of its future researchers, who would be assured of integration and good working conditions;

- other national institutions and government authorities, thereby enhancing its prospects of gaining national acceptance and a more sustained and regular growth of its resources.

What is ultimately necessary is to take action in the short term with a view to better preparation of the long-term future.

This second approach thus constitutes the cornerstone of the proposals set out below. This is why the most important of these proposals is the so-called method of "Programming by Objectives".

2. PROGRAMMING BY OBJECTIVES: A MULTI-PURPOSE INSTRUMENT WITH WIDE IMPLICATIONS

In the majority of the world's research institutions, the process of choice of activities and allocation of resources is empirical, based on a subjective but usually rationally founded assessment of expected results from these decisions in terms of development, scientific knowledge, or even public relations. In the developing countries, this process is rendered more difficult by the very conditions under which agricultural research is conducted (these also apply to other public institutions): budgets may vary unpredictably, and there may be unforeseeable changes in agricultural policy.

However, this form of management is also due to the nature and limits of the programming methods which have been established,[68] whose dissemination has been prevented by their complexity and limitations. Nevertheless, while not having proved perfect, these methods have contributed to the establishment of approximate techniques which aim no longer at "the best" program (which cannot be defined) for a research institution but for a program resulting from well-thought-out choices based on methodical examination of foreseable consequences and likely costs of the various activities.

Among these approximate techniques, the method of "Programming by Objectives (PBO)", already practiced in some countries, is a relatively simple and rigorous instrument of organization, internal management and planning of research activities and resources, and ultimately of internal and external means of communication. This versatility - which will be clearer after the technique has been described - would justify the use of PBO by INRA. The following sections describe its principles, the possible phasing of its introduction at INRA, and finally its advantages and limitations.

2.1 PRINCIPLES OF PROGRAMMING BY OBJECTIVES (PBO)

Programming by Objectives (PBO) applied to a scientific institution such as INRA has two main features:

- it is based on identification of the research activities of the institutions in the form of programs and recognition of these programs as organizational units of the institution for scientific, functional, and financial purposes; in contrast, these organizational units at present consist of "stations" organized on the basis of disciplines, commodities, or production systems; the preliminary stage therefore consists fundamentally of the establishment of "new programs"[69] - with specific practical objectives, for most of them would be more "prospective" - around which the institution would be largely reorganized;

- it comprises the periodic evaluation of the research programs from both the scientific and financial points of view (the programs themselves being subdivided into research "operations") through a "cyclic procedure" involving the researchers themselves, the persons in charge of research, and the users of the research.

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(68) Examples are benefit-cost analysis, the Planning Programming Budgeting System (PPBS), the Scientific and Technical Potential method (PST), the graph method, etc. Bibliography (see Annex 3) for an illustrative list of references on research planning and programming.

(69) These "new programs" would at first not be at all novel in their scientific content, as they would simply result from combination of the research activities at present undertaken by the various stations.

2.1.1 Short-term conversion of research activities into "new programs": a decisive act

This conversion is a decisive act in the life of an institution which adopts PBO because it involves the setting up of new internal management units, with transfers of scientific and administrative responsibilities, changes in hierarchical relations and operations. The description of its principles and implications, elucidated by constant references to the situation of INRA, will be preceded by a brief definition of the concepts of "program" and "operation".

A. Research programs and operations: definition and characterization

The proposed convention is as follows:

- a program[70] (or project) is defined as a coherent complex of complementary and mutually supported research operations intended to yield "products" which can be used for development (applied research programs) or "research results" useful to the researchers themselves (basic research programs);

- a research operation[71] is the implementation unit within the program (or project). It is closely connected with the discipline, its object and its methods, and also with the resources involved in its accomplishment - both human resources (researchers, techniques, etc.) and logistic resources (equipment and infrastructure). Normally, an operation constitutes the activity of one scientist, who assumes responsibility for it.

Since a program must constitute a unit of internal management of the Institute, it must not consist of a disproportionately large and unmanageable complex, for example, involving several dozen workers (for the cohesion of the team) or located at a large number of Regional Centers (CRRAs) (for geographical recentering). At the other extreme, the program must not be conceived too restrictively, owing to the two limitations mentioned earlier: development significance and critical volume of activities and resources.

The length of a research program depends on the nature of the relevant problems. Most programs are medium- or long-term. Conversely, operations are usually of shorter duration; they are undertaken within a

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(70) Program has been used in its generic meaning, including any level of program aggregation (Major program, Program, Sub-program, Project, etc.).

(71) An Operation is the smallest implementation unit of a Program (or Project) performed by one scientist, further divided into Actions, the lower identifiable working units of a scientist's Operation.

coherent timetable with a precise schedule. Programs are thus dynamic in time: they begin simultaneously with their first, constitutive operation, develop with other successive or simultaneous operations, and end with their final operation which, if all goes well, will have yielded the product. This mobility of the program in time contrasts with the relative stability of the structures and infrastructures which are the setting for its implementation (directorates, departments, stations, laboratories, etc.).

B. Principles of establishment of the "new programs"

The conversion of the current research activities into "new programs" would be reflected mainly in the aggregation of the applied activities hitherto conducted by the discipline-based "stations" around commodity-based and production-system-based research programs. Each applied "new program" would thus be the responsibility of a multidisciplinary team comprising:

- the research scientist already assigned full-time at the relevant current commodity-based or production-system-based "station";

- research scientists on secondment on a full- or part-time basis from the discipline-based "stations" where they are currently working on the commodity to which the "new program" relates. These detachments mean that the researchers concerned would be placed under the direct scientific and administrative responsibility of their "new program chief" without having to be relocated for the present (see next section).

The only difficulty concerns the assignment of researchers from discipline-based "stations" who work on a number of commodities at a time. This involves two situations which at present arise too frequently at INRA and should be eliminated:

- situations where a discipline-based research scientist is responsible for several different operations, resulting in excessive dispersion of effort, and also in research which is insufficiently concentrated, excessively prolonged in time and hence less effective;

- situations where a number of scientists work part-time on the same operation; which is indicative of a dispersal of efforts and inefficient organization of these operations.

Hence these research workers whose activity is dispersed should be assigned to a limited number of programs (not more than two), allowance being made for the scientific needs and priorities and the skills and tastes of the individuals concerned. The formal assignment of each research worker to one or two programs should be accompanied by a clear definition of his activities and a precise apportionment of his working time between the individual programs concerned.

This form of assignment would inevitably involve a "re-adjustment" of research objectives and activities: in the absence of "Jack-of-all-trades" researchers, some minor commodities would have to be abandoned

(for example, some of the ten different species of fruit trees stated to be studied), as well as some small regions which are less relevant in terms of the commodities or the systems under investigation. This does not mean the exclusive implementation of "large-scale programs". Alongside these, there would remain "autonomous operations": these might be either one-off operations subsequently becoming more important (or even becoming programs: triticale is a possible example), or what might be called "scientific watch" operations[72].

C. Far-reaching implications for structures

The conversion of current research activities into "new programs" would have a powerful bearing on the structures of INRA and their operation. First, the commodity and production-system-based "stations" would be abolished in their present form and replaced by programs (or possibly autonomous operations in the case of some of the smaller stations), run by larger teams put together by scientific and administrative aggregation of researchers from relevant disciplines.

Second, the discipline-based "stations" would be largely deprived of their substance. They would no longer have direct and exclusive control over a high proportion of their scientists assigned to the applied programs. They would retain control only over the small number of researchers who would continue their single-disciplinary work, which would also have the status of "new programs" or, more often, of "autonomous operations". The question would ultimately arise whether these stations should be retained; this also calls into question the appropriateness of establishing discipline-based departments as contemplated by INRA (see Organizational Chart III).

The value of retaining or establishing discipline-based units at INRA cannot be doubted, for a number of scientific and organizational reasons:

- their existence is a guarantee of the essential continuation of "prospective research" (see Section 1.3 above) and of the quality of the applied programs;

- their existence encourages exchanges between research workers in a given specialty, whether within INRA or with the national higher education institutions and the international scientific community;

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(72) The latter group of operations could be withdrawn from commodity programs (e.g., maintenance of genetic collections of minor crop species, these being turned into simple operations for the time being without more specific objectives) or even turned over to development (e.g., repetitive observations or tests of no great scientific relevance).

- their abolishment would raise the problem of responsibility for basic research; it would also involve excessive upsets in the internal organization and structures of the Institute, which might destabilize it, impair its internal and external credibility and thereby even detract from the effectiveness of its entire range of programs;

- finally, in terms of the implementation of research programs and operations to be established, which will envolve in time, as already stated, discipline-based departments would constitute the permanent units of reference for the researchers to be assigned to the applied programs for specific periods.

During these periods of specific assignments, the research scientist would be responsible not only to the person in charge of his program but also to his department head. The responsibilities of the former would concern mainly operational matters (working conditions and facilities, multidisciplinary work, utilization of results, etc.), while the latter would be more responsible for keeping track of the research scientists' careers (scientific and administrative aspects).

Ultimately, therefore, discipline-based "stations" (and/or departments) would be retained and would have wider, shared scientific responsibilities and reduced administrative responsibilities. In this context, the new heads of departments would finally have the following main functions:

- in the definition and planning of programs, they would represent their departments and disciplines and would take part in the decisions on the general orientation and content of the programs, and the appointment of the persons in charge of them;

- they would be responsible for the scientific management of the scientific and technical staff of their departments: assignment of topics and geographical locations among the various programs, evaluation of their research activities, and monitoring of staff careers, with periodic assessments (made together with the heads of programs);

- they would undertake the scientific and administrative management of all the services and laboratories associated with their department and the supervision of all the department's monodisciplinary programs (see Annex 12).

Hence, when the "new programs" are established, the persons responsible for them should be appointed at the same time, and should be chosen from the members of the newly established teams on the basis of their scientific skills and experience, the importance of their discipline for the relevant commodity or production system, their leadership capability, and their popularity with the other members. These persons need not necessarily be the present heads of commodity-based or production-system-based research "stations"; for psychological reasons, it would be better for some of the "new programs" to be entrusted to research workers from the discipline-based "stations".

2.1.2 Procedure for evaluation and setting of priorities for current and projected research programs and operations

INRA's programs and operations could be evaluated and placed in order of priority at any time, but it seems preferable to do so in the context of the decision-making process by which the Institute's resources and general pattern of operations are determined - the process of preparation of its annual budget.

In this context, the programming procedure could follow a "circuit" similar to the one shown in the accompanying diagram 1 (explained in more detail in Annex 15), which involves two new agents: the Program Commissions and the Directorate of Programming.

The Program Commissions would play a central part in programming. Each would be in charge of a "sector" (as defined by INRA), consisting sometimes of a number of programs grouped together by virtue of the nature of the relevant commodities, because a single government agency is responsible for follow-up action, etc. (e.g., the cereals sector with the wheat, barley, and maize/sorghum programs). Their members would be senior INRA staff,[73] or representatives of Government agencies (MARA, the Plan, and local administrations for research programs on production systems) and representatives of the research users (all in the relevant sector).[74]

Each Program Commission would have the following objectives:

- evaluation of priorities to be assigned to the development problems in its sector and translation of these priorities into research topics;

- evaluation of current and planned research programs and operations;

- classification of these research activities in order of priority: current activities, those to be maintained at current funding levels or strengthened; new operations to be initiated; operations completed or to be terminated.

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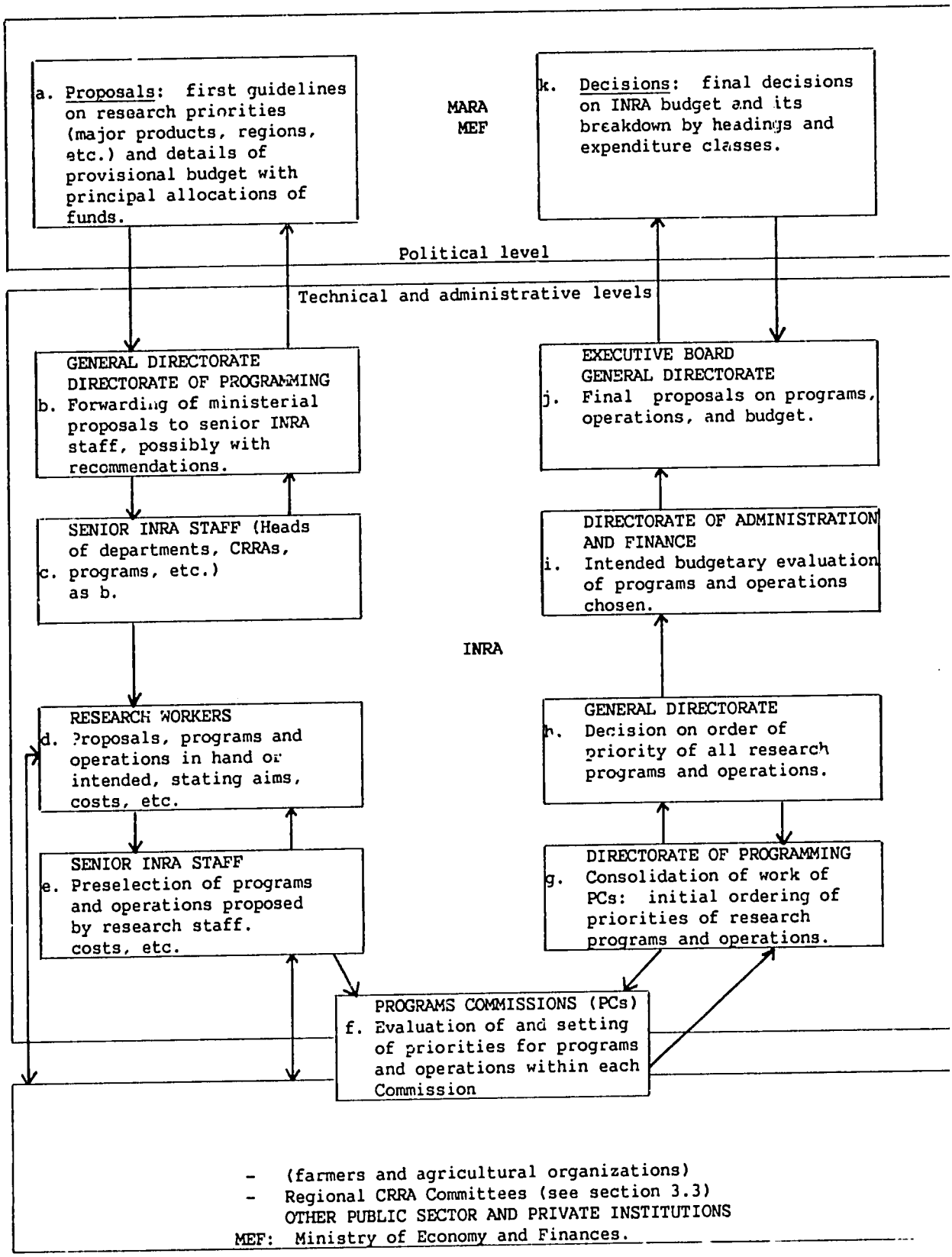
(73) These would be the head of the relevant program assisted by the researchers responsible for the main operations, and those in charge of the INRA Directorates, and in particular, of the discipline-based departments concerned.

(74) The Program Commissions for more basic or prospective research topics would include only representatives of INRA and of other national scientific institutions.

PRINCIPLES OF THE ANNUAL PROGRAMMING CYCLE AT INRA



This work would be considerable throughout the initial phase of the programming exercise. It could be reduced later on if it were decided that a program or operation could be approved for a period of two or even three years. Once the system is operating normally, each Commission could then undertake a more profound examination of a small number of programs and operations: half or a third of those in hand and the proposed activities.

The Directorate of Programming would be responsible for operating the "circuit" described:

- one of its priority tasks would be to organize the standardized transcription of information on the current and proposed programs and operations by means of program data sheets and operation data sheets[75] which would provide precise frameworks for analysis and communication support throughout the programming work;

- it would also be responsible for the joint secretariat of the Commissions and the consolidation of their work, making an initial inter-program classification of the priorities to be observed.[76]

This programming procedure should take account, at all levels, of the different types of resources mobilized by the programs and operations and their cost. In the final phase, INRA's Directorate for Administration and Finance should check the forecasts or estimates of expenditures made for the programs and operations which have been selected; the Directorate should also draw up the budget estimates. Complete budgeting by program, with as precise as possible an allowance for all actual expenditures, including staff costs, is part of the logic of programming and has been recommended or practiced. However, this approach would be too perfectionist and complicated for practical purposes. Aside from the traditional budget based on major cost headings (staff, operation, equipment, with their relevant headings) which are always calculated precisely, it would ultimately be better to have a "constructed" program-budget based on an approximate evaluation of the cost of each

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(75) Models of such data sheets (to be adapted to suit INRA's requirements) are presented and discussed in Annex 15. The data for all current activities would form the "central research file", which would provide better knowledge of and information about the scientific activity of the Institute; for this purpose it should be computerized from the outset.

(76) The Directorate of Programming has other important functions such as the organization and guidance of the work of the Program Commissions considered later (see Section 2.2.2); improvement of programming, coordination and evaluation procedures, and mechanisms; maintenance of close links between INRA and the planning agencies of the Ministries (Ministry for Planning, Ministry of Finance, MARA, Ministry for Higher Education and Research, etc.) and other research institutions; etc.

program, made up of the sum of the following:

- the actual direct operating and equipment costs; these would be the only ones to be managed by the heads of programs;

- staff costs calculated conventionally on the basis of working time and the average cost of the various classes of staff involved;

- overhead calculated on a pro rata basis (for instance, by the ratio of the number of researchers engaged on each program to the total number of researchers).[77]

The slight loss of accuracy would be substantially offset by the saving of administrative work: the operating and equipment funds currently allocated to the commodity and discipline-based stations should be allocated to the programs by the same procedures or, if possible, by improved procedures (see Section 3.3). The overall "constructed" program-budget would be just as representative of scientific policy as an exact program-budget.

2.2 GRADUAL INTRODUCTION OF PROGRAMMING BY OBJECTIVES AT INRA

2.2.1 Establishment of "new programs" in the short term: an Institute responsibility which cannot be shared

Conversion of the current research activities into "new programs" would be the first stage in the establishment of PBO. This presupposes an accurate knowledge of INRA's present research activities and the actual work and skills of each research scientist. In view of the high internal importance of this phase, it should be carried out mainly by INRA.

For this purpose, the Institute would organize internal sectoral working groups, and later, intersectoral ones, responsible in particular for examining the activities of the research workers of the discipline-based stations; decisions would have to be taken to assign these research scientists on a full- or part-time basis to the applied or prospective research programs (without changing their station or workplace).

These working groups could initially refer to the booklet "Programme de recherche pour la campagne 1983-84 - classement par secteur" ["Research program for the year 1983-84 - classification by sector"], but with some

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(77) These last two expenditure categories - staff costs and overhead - may be regarded as fixed costs of the Institute.

Table 11 - ILLUSTRATIVE IDENTIFICATION OF CURRENT INRA RESEARCH ACTIVITIES IN "NEW PROGRAMS"[a]

TYPE OF RESEARCH	"SECTORS"	RESEARCH PROGRAMS[b]	AUTONOMOUS OPERATIONS[c]
BY DISCIPLINE	SOIL SCIENCE	. Soil fertility . Survey and Mapping	+ water balance + erosion
BY COMMODITY	CEREALS	. Wheat . Barley . Maize and sorghum	+ oats + triticale + rice
	LEGUMES	. Legumes	
	VEGETABLE CROPS	. Field crops (industry) . Greenhouse (export)	
	SUGAR CROPS	. Cane . Beet	
	OIL PLANTS	. Olive trees	+ rape, soya, safflower
	MISCELLANEOUS FRUIT TREES	. Miscellaneous fruit trees	
	CITRUS FRUITS	. Citrus fruits	
	FODDER PLANTS	. Fodder plants	
	ANIMAL PRODUCTS	. Cattle . Sheep	
	DIVERSIFICATION PRODUCTS	. Cotton . Tea . Apiculture	+ ornamental plants
BY PRODUCTION SYSTEM (OR BY REGION)	DRYLAND FARMING	. Winter cereals . Spring cereals . Legumes	
	SAHARAN	. Date palms . Fruit trees . Sheep . Cereals	

Notes: [a] List taken from booklet "Programmes de recherche pour la campagne 1983-84, classement par secteurs ["Research programs for the year 1983-84, classification by sectors"].

[b] Size of programs by "staff" numbers (scientists and technical assistants, full- or part-time): wheat: over 10; sheep: 5-10; cotton: less than 5.

[c] Minor operations involving not more than two staff (see Section 2.1.1).

reservations. As shown in section 6 of part two, this document features a much larger and more diversified number of research operations and activities (totalling 1887), than those indicated in the scientists' card index, which suggests a quite excessive (if not indeed physically impossible) degree of dispersion of the researchers. This document is thus more a catalog of actual and possible research operations and activities which claims to cover the virtually exhaustive field of research envisioned by the INRA researchers. For this reason, when it is used, it is important to refer to the actual activities of the researchers, mentioning the proportions of their time actually devoted to these activities.

Because of INRA's responsibility, and owing to information's "uncertainties", it is virtually impossible to go any further here. However, purely for the sake of illustration, the accompanying Table 11, based on the document mentioned above, gives a list of INRA programs and autonomous operations, classified by types and "sectors" of research. The details given of program sizes are of limited significance: in the absence of detailed information on the level of the relevant staff (researchers only, or scientists and technical assistants, in accordance with the "sectors" of the document) and their degree of involvement (full- or part-time), only small additions could be made, so that, for example, the table does not reflect the true relative sizes of the programs.

The first phase of programming by objectives (PBO) would be a matter for the immediate future. It would lead to the establishment of "new programs" and new teams, with appointment of team leaders and modification of financial arrangements so that their direct operating and equipment funds can be allocated to them.

2.2.2 Priority tasks and gradual introduction of the programming system at INRA

The decision to set up the Directorate of Programming would be taken at the same time as the decision to adopt programming by objectives. The Director would be assisted by a small technical unit with methodological capability, responsible for the establishment and updating of the general programs and operations files. The first activity of this Directorate would be to organize and to motivate the sectoral groups mentioned above to establish "new programs" up to the stage of proposals made by their heads, appointed by the Director General of INRA.

The second phase would be the preparatory work for the establishment and the conduct of the work of the Program Commissions; this must be particularly thorough because the quality of the early work performed by these Commissions will substantially determine the image of the "new" INRA to the outside world.

This preparation would involve the following for the major "new programs":

- an initial critical internal evaluation intended to identify

weaknesses of these programs in terms of both conception and qualified scientific staff, taking into account the desirable features of "new research" as set out in Section 1 above; it is to be noted that "new programs", consisting merely of the juxtaposition of seemingly complementary activities, are not genuinely multidisciplinary programs, when specific attention must be paid to interfaces between disciplines and inter-relations between commodities, so that agricultural realities are better tackled;

- consideration on the optimum composition of each Program Commission.

In the case of commodities and disciplines poorly represented or not covered at all (animal husbandry, agricultural engineering, and the social and economic sciences), specialists - wherever possible Moroccan - would have to be appointed to the sectoral working groups (by discipline, by commodity, or by production system).

On the basis of thorough preparation, the third phase, the establishment of the Program Commissions and their actual work, should concern, by priority, the "sectors" in which INRA already has a significant scientific potential and is able to maintain a high-quality dialogue with scientists outside the institution.

The second and third phases would be implemented over a period of one to three years, after the preliminary phase of establishment of the"new programs". One of their main outputs would be a forecasting of qualified manpower requirements (recruitment of new researchers and further training of existing staff), for which priorities would need to be set for all programs.

2.3 ADVANTAGES AND LIMITATIONS OF PROGRAMMING BY OBJECTIVES

2.3.1 The many advantages of PBO

As described, PBO proves to be a multiple end-use instrument.

It is an instrument for organization and internal management of research activities and resources. The choice of programs and operations, based on current activities, or to be undertaken later during the programming cycle, determines the team composition of researchers and their respective responsibilities. This choice also determines the resources allocated to them, work methods, schedules, and locations. It cannot be a technocratic, authoritarian choice, as the programs are put forward initially by the research scientists, though, of course, amendments may be proposed by the programming bodies.

PBO is also a medium-term planning tool, particularly with the assessment of requirements of qualified staff who will contribute to the establishment of new medium- and long-term research activities.

Finally, PBO is an instrument of communication: it is based on the organized and systematic exchange of information within the Institute and between the Institute and the outside world. Apart from its purely functional purpose, this exchange of information may be an effective means of motivating researchers, since it gives them a better perception of the objectives and usefulness of their work. Advantages with regard to work performance and dynamism of the institution are many.

Not only is every staff member better able to understand his own position in the organization and the importance of his work; he also has a chance of making a more effective contribution because he is better informed. The transparency in the operational activities of the institute is also an obstacle to the establishment and running of small "empires", where individual power is exercised without control and without limitation, leading to demotivation, inertia, and even silent hostility on the part of subordinated staff. Social control takes place, limiting not only "group" infighting and vying for influence but also all forms of negative behavior. This results in the development of favorable conditions for collective decision-making on a mature, informed and fully shared basis. Conversely, the acknowledged competence and authority remain unimpaired.[78]

In view of these characteristics, it seems that the use of PBO by INRA would be fully justified. It would ultimately enable the Institute to initiate, organize, and conduct its debate on a collective basis with a view to more thorough analysis and better control of its activities, to have a more operational perception of the needs to be covered, and finally, to make a simultaneous choice of its pattern of activity and the means necessary for its implementation, while at the same time involving all the appropriate persons or those concerned, and those only.

2.3.2 Limitations and risks of PBO

The main limitation of PBO is that it is merely an instrument.

It admittedly allows more thorough consideration of the aims of research, their priority in development terms, and the appropriateness of changes in scientific policy, orientations, and approaches. However, it does not in itself constitute a means of implementing these changes. In

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(78) It is to be noted that the exchange of information can also be improved by means other than PBO - for example, through the establishment of commissions with well-defined mandates, the holding of staff meetings, or the selection of representatives of different staff groups, regular circulation of internal information newsletters, etc. (see Annex 11).

fact, the mobility of the programs in time will largely depend on available resources. This mobility can be relatively large or easy only if resources are expanding: new programs deemed to have priority status cannot be undertaken without calling existing programs into question and without the addition of new researchers (who must be trained), new equipment, etc. Where available resources are stagnant, program mobility will be inhibited by the inertia of people and infrastructures. After all, while the researchers of the discipline-based stations, specializing in particular commodities, may fit readily into programs with specific objectives relating to these commodities, their assignment to other programs would entail prior retraining and therefore time. Current research which is deemed not to have priority status always has some value, and its curtailment or elimination may give rise to opposition even from those senior staff members who are in favor of a "re-orientation" of INRA's activities. Finally, the reduction or elimination of infrastructures may give rise to similar opposition and, even when a decision has been taken, it cannot be implemented immediately.

This is not to advocate a status quo but a process of reasoned and gradual change, taking account of internal and external social realities, which might be overlooked by PBO if it is operated in too abstract a manner.

Second, the PBO emphasizes the concept of a "critical mass" of activities and resources and, in particular, the establishment of research teams. If, for the sake of organizational principles alone, these teams are formed without adequate consultation with the persons directly concerned, the result may be poor-quality human resources management. As far as possible, therefore, team formation must create incentive and leave room for personal affinities: this is in general a condition for the satisfactory performance of teams. However, if some scientists work better with more autonomy, it is preferable, in that case, to grant them that autonomy. Should this spirit exist at the time of the establishment of "new programs", it may be a great incentive to researchers who are presently too often subject to hierarchical relations of authority (this is seen, for example, in meetings).

Finally, programming presupposes an allocation of tasks involving the reduction or elimination of duplication. However, although such an allocation may be appropriate in a small or medium-sized institution, it may be less so for a large institute or at the national level (between different institutions), in that it precludes competition, which induces emulation and imagination. This risk is very small in the short term, owing to the inadequate scientific potential both at INRA and in the country as a whole, but will increase with the growth of INRA's qualified human resources.

Last, the most serious danger is that programming may be used or perceived as an authoritarian instrument for personnel management in the name of the "public good". It would then ultimately work against its apparent objective by impairment of the creative potential of the institute. This last comment refers back to the idea that an overall research program, however good it may be in theory, is on the whole no

better than the people who implement it. Hence the paramount importance to be given to the management and planning of human resources, at the same time as the programming of activities.

3. THE IMPERATIVE OF REGIONALIZATION: LONG-TERM PRINCIPLES AND SHORT-TERM MEASURES

3.1 AN IMPERATIVE: WHY?

The Center in Rabat and the network of Regional Centers (CRRAs), together with their subordinate units (stations and experimental farms), form the operational structures of INRA which, as shown earlier, is unbalanced in its resources and operational means in favor of Rabat.

Restoring the balance of this system and developing harmoniously the CRRAs are essential conditions to enable INRA to conduct research more in line with development needs as regards both assessment of objectives and the operational conduct of research. The ultimate aim is to produce results consistent with practical agricultural problems of the regions and hence of the country (see Part one, section 1 and 2).

It is therefore essential to regionalize research; but excessive regionalization would be a mistake. In particular for commodities largely represented throughout the country, research conducted in the CRRAs must be mutually supportive, and their interrelations within a national scientific framework would enable them to strengthen their regional concern. Therefore, CRRAs must constitute polyvalent and multidisciplinary interdependent bases, through which INRA's programs should be conceived and implemented to an increasing extent.

Regionalization of research also implies a reasonable level of decentralization, both as regards resources, for which easier mobilization is necessary, and in terms of the relations between the CRRAs and their environment.

After these preliminary remarks, we can now review some principles leading to good operation of CRRAs.[79] However, such principles could only be fully implemented in the long term, although some short- and medium-term measures might already give a partial answer.

3.2 TWO ESSENTIAL PRINCIPLES: MINIMUM SIZE AND MORE RESPONSIBILITY FOR THE CRRAs[77]

3.2.1 Minimum size required without weakening Rabat

A Regional Center (CRRA) can only work satisfactorily if it has

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(77) No mention will be made here of principles regarding size, geographical location, and area boundaries of the Regional Centers, as they have already been worked out in great detail by INRA (see Part two, section 3.1).

sufficient human and material resources (infrastructures, vehicles, analytical facilities, documentation, accommodations in some cases, etc.) to give it a minimum of scientific autonomy, required:

- to avoid professional and psychological isolation of research scientists and other qualified staff;

- to ensure credibility from and to maintain effective relations with its environment;

- to perform a minimum of well-balanced research activities and service facilities enabling it to satisfy the priority needs of agriculture in its region and to contribute to diagnosing and solving the major national problems.

The main criterion of this minimum size is the number of researchers. This could range from at least twenty to up to fifty, depending on INRA's total human resources and each individual Center: the relative importance of the agricultural problems in the relevant region, and the availability of support from other scientific institutions, especially the most active regional institutions of higher education.

It would be appropriate for the centers close to such institutions, such as Meknès, Marrakech, and Agadir, to grow faster in the short and medium terms, provided that this growth is accompanied by cooperative relations whereby, in particular, students can be observed and selected for recruitment as future researchers, mostly for other, more isolated centers. However, the growth of these first centers could subsequently reach a ceiling at a lower level than that of the more isolated centers, precisely because of the presence of these other institutions and the total regional scientific potential which, if properly used, would satisfy local development needs. (INRA can perform a motivating function here).

This selective growth of the CRRAs may be viewed in different ways. The one most frequently advocated would involve a weakening of the Center in Rabat. There is no doubt that this would be a serious mistake. This Center is oversized only in relative terms, but an institution such as INRA needs a major unit in the capital to conduct in due time prospective research at the highest level. This calls for a closely knit national scientific environment, highly expensive equipment purchased and used jointly by several institutions, and international exchange facilities. Again, the Center in Rabat, being close to the most important institutions of higher learning in the country, can greatly facilitate the selection of future researchers and perform much of their initial training. Of course, these considerations do not preclude gradual, carefully thought-out and motivating transfers to Regional Centers, as was done recently. However, they do mean that restoration of the balance between Centers could be carried out satisfactorily only if INRA's resources - in particular, qualified human resources - were to be appreciably expanded.

3.2.2 Attribution of scientific and administrative responsibility

The CRRAs should be much more responsible than they are at present for their scientific activities, their administration and financial management, and the development of relations with their regional environment.

Each CRRA should be able to perform its regional and national scientific functions through its responsibility for both of the following:

- at least one of the INRA programs (referred to here as a "national program" for convenience), entrusted to one of its research scientists and consisting of coordinated operations performed by the Center and other CRRAs. This national program should, of course, relate to a commodity or a "topic" of great importance to the region. Research programs on production systems would be warranted only in specific circumstances, such as the particular character of the agriculture of the region (e.g., the mountain agriculture program contemplated at Meknès or in the Rif) or its socioeconomic or political importance;

- a number of elementary operations of the national programs, performed by researchers at the Center, but under the supervision of program leaders based elsewhere.

All the programs and operations should be apportioned between the different Centers in such a way that each CRRA, through the national-level activities entrusted to it, can cover the majority of the most significant development problems of its region without having to undertake other, less important, regional research and thereby spread the limited resources of the Institute too thinly.

The responsibility for management and for integration within the region is an essential condition for Regional Centers effectivly to perform the scientific activities entrusted to them. This responsibility is less a matter of principles than of concrete measures, which are discussed in the next section.

3.3 SHORT-TERM CONCRETE MEASURES

The balanced development of the CRRAs is a long-term undertaking which is already included among the concerns of INRA. Together with the forecasting of the demand for researchers, it must be one of the major concerns involved in the work of the PBO. From this point of view, the Director of the Regional Centers included in Organizational Chart III should be the person responsible for regionalization in the Program Commissions, with the following two functions:

- first, to make sure that needs expressed by the CRRAs in consultation with their respective Regional Committees (see below) are well-taken into account through an appropriate allocation of national programs;

- second, to ensure the availability of operational and material aspects to perform the activities assigned to each Center (availability of all physical means and facilities, whether existing, new, or obtained by exchange between Centers).[80]

This balanced development would also include a number of concrete measures, most of which could be adopted in the short term. The first of these would be pursuing reduction and concentration of the regional experiment network, with a view to limiting the dispersion of INRA's effort and facilitating the management of the Regional Centers. INRA's proposals for reducing the number of Regional Centers [CRRAs] (from 14 to 10) and the number of experiment farms, could be supplemented by the following measures:

- the provisional reduction of the number of CRRAs to eight (compared with the 10 shown in Organizational Chart III and the 14 existing before), by grouping the Centers in the Pre-Sahara and the Haouz, which have many activities in common, while attaching the small center of Oujda to the Middle Atlas and Saïs Center (see accompanying map);

- the abolition of approximately twenty demonstration farms, whose usefulness is questionable because they are never representative of the complexity of the actual conditions of extensions of the results nor of the risk associated with the adoption of new technologies (so important in traditional agriculture). These demonstration farms

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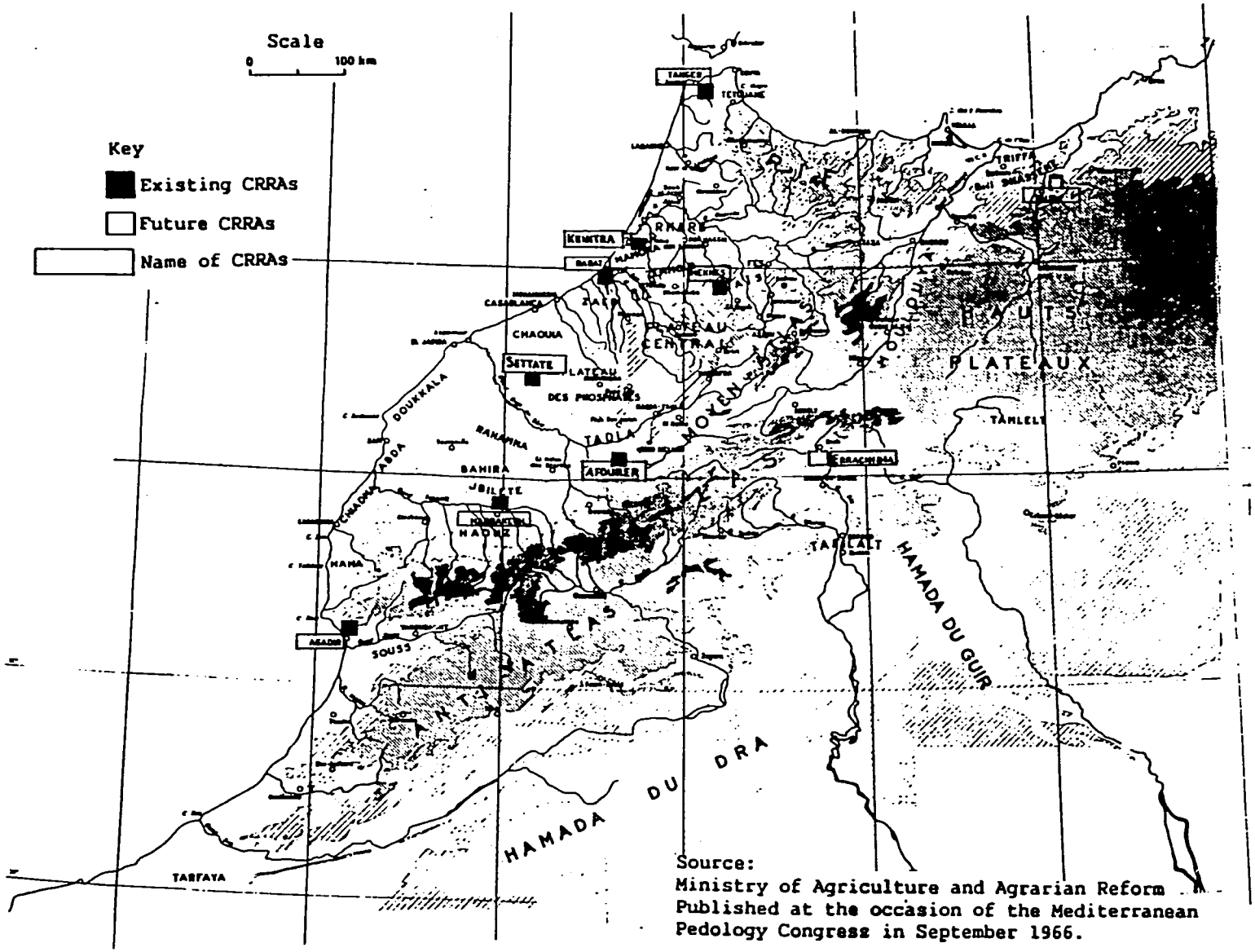
(78) The Directorate of Regional Centers would be responsible for liaison between the CRRAs; the holding of periodic meetings of all Heads of CRRAs; supervision of the Heads of CRRAs and coordination of all logistic resources, supporting, and operational management services of the CRRAs; submission of a consolidated report on the management and operation of the CRRAs; participation in the contractual arrangements of the CRRAs with the development agencies; conduct of an annual in-depth examination of one or more CRRAs; etc. The Director of the CRRAs would also be responsible for management and organization of all programs and activities relating to plant and seed production - in particular, production of basic or breeder seeds, for which he currently has complete responsibility within INRA at the national level (see Organization Chart III). Note the proposal in Annex 7 that INRA shoud continue to produce only breeder seeds for distribution (see Organizational Chart P2).

RELIEF MAP OF NORTHERN MOROCCO
AND
DISTRIBUTION OF INRA'S REGIONAL AGRICULTURAL RESEARCH CENTERS (CRRAs)



Source:
Ministry of Agriculture and Agrarian Reform
Published at the occasion of the Mediterranean
Pedology Congress in September 1966.

would be replaced by "experiment sites" selected in the rural environment (farms or rural communities) or located on land belonging to other bodies (Works Centers [Centres de travaux] of the Directorate of Agricultural Extension, farms of the Regional Development Agencies (ORMVs), the Directorates of Plant and Animal Production, etc.) representative of the most diverse experimental variables possible. The CRRAs would benefit on several levels: increased flexibility (because the experiment sites could be changed in accordance with the requirements of research); direct, compulsory contact with agricultural realities; and a better adjustment of results to needs.

The reduction of the experiment network in these two ways would appreciably reduce capital overhead costs (administration and maintenance of infrastructures), so that if the total budget remained the same, there would be scope for a concomitant increase in operating costs, especially for travel, which is expected to expand. Infrastructures finally abandoned should be returned to MARA and allowance should be made for the interests of the unskilled workers affected.

The second complex of measures would relate to the administrative and financial management of the CRRAs, which must be facilitated by genuine delegation of authority from the central administration to those in charge of the relevant programs, through the heads of the CRRAs and under their control and that of the Director of Regional Centers, with ex-post control of current expenditure by the Financial Controller in Rabat.

The head of each CRRA would thus be directly responsible for the administrative and financial management of his Center. He would have the assistance of a Service named accordingly and run by an administrator, which would be responsible for dealing with all the relevant problems, together with the Direcotrate of Administrative and Financial Affairs. In the financial sphere, this Service would manage all the budget resources allocated at the beginning of the year for the performance of the planned research activities and for capital investment and joint services.[81] It would keep strictly separate accounts for each activity. The head of the Center would incur expenditure through existing procedures, but with the two following amendments:

- the upper limit of authorizations for local expenditures (at present 30,000 dirhams, soon to be increased to 50,000) would be raised in certain specified cases (e.g., major repairs to agricultural machinery in the middle of the season); prior consent of the Financial Controller would then not be necessary and might perhaps be replaced by that of the Direcor of Regional Centers;

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(81) It would also be desirable for each CRRA to have a small reserve amounting to about 5% of its operating budget, for unplanned activities.

- the joint signatures of the research program and operation heads would be required for all expenses relating to these activities.

These proposals could be implemented in the short term, at least at the largest CRRAs.

The last group of measures would be those intended to secure better integration of the CRRAs in their environment and to ensure that better account is taken of the problems of the relevant areas in the programming process. To improve relations between the CRRAs and the authorities responsible for agricultural development in their regions, for which the CRRA managers have hitherto been formally responsible on an uncoordinated basis, INRA has rightly suggested the creation of "Regional CRRA Committees", intended to be consultative bodies to assess research programs of regional interest. The functions of each of these Committees should be strenghtened to include the following:

- critical examination of the current programs and operations of the Center in terms of the agricultural problems of the region;

- drawing up of specific proposals for new research activities, both short-term (urgent problems) and medium-term;

- consideration of all possible forms of practical collaboration between INRA and its partners.

For this purpose, the composition of the Regional Committees would be modified. In addition to the outside participants,[82] their membership would not be limited to the senior staff of the relevant center (head of CRRA, heads of research programs and operations), but would also include the Director of the Regional Centers and the Director of Programming or their representatives. These Committees would meet annually at the beginning of the INRA programming cycle and would set up working groups of specialists to assist them, whenever necessary. Particularly closer consultations should take place at least every five

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(82) These external participants would be:
- the Provincial Director(s) of Agriculture of the relevant Provinces; one of them (either chosen by rotation or, preferably, the senior Director) would chair the Regional Committee;
- the heads of the Services of the Provincial Directorates of Agriculture (DPA), in particular, the head of the Agricultural Extension Service;
- the directors of the decentralized public bodies located in the region of the CRRA concerned (Regional offices, development corporations, integrated projects, agro-industry).

years; for example, when the five-year economic and social development plans are drawn up, or whenever any other important event in the agricultural life of the region occurs (e.g., the establishment of a development project).

These proposals would also be applicable in the short term, but only at the largest Centers, where INRA is significantly present to conduct an efficient dialogue as required.

4. HUMAN RESOURCES: PARAMOUNT IMPORTANCE OF RESEARCH SCIENTISTS

As shown earlier, qualified human resources are the main limiting factor of INRA. In tackling this vital problem, the conditions for the scientific promotion of the existing research workers should be considered first. Improvement of these conditions would be the best way of attracting a larger number of young graduates and hence of making the best possible selection of young researchers, which are badly needed by INRA for the medium and long terms.

4.1 PRIORITY FOR EXISTING RESEARCH SCIENTISTS

The proposals in the preceding sections concerning the establishment of a programming system and the extension of regionalization of research will probably create the conditions for enhanced scientific (and general) promotion of the researchers, coupled with more effective ways of working on their part, by virtue of the following:

- reduction of professional dispersion (reduction of administrative tasks) and scientific dispersion (concentration on more limited, priority research objectives);
- reduction in geographical isolation (reduction of the number of CRRAs and controlled growth of these Centers) and scientific isolation (increase internal and external exchanges);
- greater responsibility and increased motivation in program implementation;
- stimulating and non-authoritarian geographical and scientific mobility, etc.

These are necessary preliminaries if full advantage is to be taken of the ongoing training effort which remains essential for improvement of the scientific level of the researchers and the quality and results of the research (see Annex 11, Training and Fellowship Service). The relevant action could take a number of forms, all of which are so well-known that

they need not to be be described in detail:

- organization of national scientific seminars by INRA, preferably in association with other national institutions,[83] with some foreign researchers taking part. The aim of these seminars should be not only the mutual enrichment of the participants but also an improved perception of research requirements so as to better prepare the Program Commission meetings. Priority topics for these seminars would be:

  . the most important commodities,

  . the key disciplines, such as crop improvement, water problems, social sciences,[84] etc.,

  . the more general and perhaps most urgent topics of research - development relationships and production systems, likely to be of interest to all INRA research workers;

- short- and medium-length missions or courses abroad, to be organized during periods which will not interfere with research operations in progress; these activities would focus on scientific and technical problems and be offered to individual researchers (including courses for Technical Assistants); they could also include research management topics addressed to research leaders (including administrators) in charge of present and future programs;

- longer periods of training, at IAV for the B.Sc. graduates and abroad for the "Ingénieurs d'Etat" (M.Sc equivalent) graduates; these courses should be reserved for individuals who have demonstrated initiative and capability;

- support missions by foreign experts on specific scientific topics or organizational problems - in particular on the introduction of PBO, etc.

Most of these activities are not new for INRA. It is merely a matter of developing them out of the Institute's own resources and resources to be mobilized through foreign cooperation. In the short term, in addition to the activities mentioned above, priority could be given to seminars on support missions concerning the introduction of PBO, research and development linkages, and production systems.

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(83) The draft agreement between INRA and IAV provides for the "joint organization of seminars, colloquia, or conferences, which may be bilateral, national, or international" (Title one, Art. 2[4]).

(84) These seminars should be coordinated with those organized by the Association of Former Students of IAV (which includes a high proportion of INRA's "Ingénieurs d'Etat").

Some final improvements would still have to be made to the staff regulations - in particular, to reducing the number of examinations which researchers have to take to secure promotion and also with the view to changing the promotion system (and annual staff evaluation) so that it is not exclusively based on personal work but also on assessments and evaluations done by the Program Commissions. Also, the contribution to team work and appreciation from Program Leaders could also be taken into account.

4.2 FUTURE RESEARCH STAFF: REQUIREMENTS, SELECTION, AND INTEGRATION

4.2.1 Evaluation of the substantial demand for research workers

INRA has a considerable demand for researchers. This demand still has to be precisely evaluated in accordance with the requirements of development and the existence of other institutions.

For INRA itself, it has been proposed that this evaluation be carried out in detail for the medium term only, through programming by objectives (PBO) (see Section 2.2.2 above). This evaluation should yield a demand inventory specifying the relevant job profiles on the basis of current and future programs, with precise indications on the nature, the orientation and the location of the research to be carried out, as well as the relevant order of priorities.

Without anticipating the results of this evaluation, an initial rough estimate of the staff requirement for the research activities described in part two, and the minimum requirements of the Regional Centers, indicate that at least 150 additional research staff will be needed in the medium term to satisfy the most urgent requirements.[85] These will include at least thirty animal husbandry specialists, an equal number of rural economists and sociologists, and some fifteen specialists in agricultural engineering and plant breeding. This enumeration covers only the disciplines with the most obvious deficiencies.

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(85) In 1965 the managing body [Direction] of the first INRA estimated "conservatively" that the minimum number of researchers required by the Institute to tackle the main problems identified was 297. The country's agricultural and food situation has since deteriorated seriously; the relevant problems have become more severe, so that the demand for research has increased. However, other institutions (IAV, Offices, etc.) have also conducted research and experimentation activities since then.

A precise evaluation of long-term requirements would be unrealistic because the level of funding available on this time scale is too uncertain. However, training of small teams consisting of INRA staff or pluri-institutional teams should be started as soon as possible - this requires a very long time - in areas of basic research such as biotechnology (genetics, molecular biology, microbiology, etc.). This should be a matter of concern for the country's top scientists in their capacity as members of the Scientific and Technical Council, whose establishment is proposed below.

4.2.2 Selection of young research staff: need for close links with higher education

An adequate number of young researchers can be properly selected only if there are close links with higher education. Only professors with research experience, who are also well-acquainted with INRA, will be truly capable of identifying and directing to INRA good students who may not necessarily be the best when measured by traditional educational criteria.[86]

The closer the links between INRA and Education, the better this essential service for INRA will be performed: this is the aim of the highly relevant draft agreement between INRA and IAV, which will be discussed in more detail later. It would, however, be appropriate for similar agreements to be concluded with other higher education institutions, including, of course, the National Agricultural School (ENA) at Meknès and also the faculties of economics and biology at Rabat.[87] In this way, INRA would increase the pressure of selection in the disciplines where this is possible, at the same time securing a minimum level of diversification in the training of its research staff - which can only be favorable to research.

4.2.3 Integration of young research workers at INRA

Young researchers would not immediately be capable of full integration into the research team, and it would be bad strategy to assign them immediately upon recruitment to the posts for which they are intended if, as would usually be the case in the provinces, they cannot enjoy good-quality scientific supervision and general working conditions.

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(86) The qualities required include not only intellectual ability but also, for example, imagination, patience, perhaps a degree of modesty, etc.

(87) Similar links with faculties in other cities would no doubt also be appropriate, but unfortunately the mission was not able to determine their relevant scientific potential.

For this reason, it would normally be desirable for young research scientists to begin by spending at least two years in already well-manned teams, where they should undergo thorough training in the relevant disciplines with the emphasis on acquiring methodologies. Only then would they take up their assigned posts and be capable of effectively taking part in multidisciplinary research; it is also essential to ensure that the good reception conditions mentioned above actually exist.

5. OTHER REMARKS AND SHORT- AND MEDIUM-TERM PROPOSALS

These relate to collaboration with IAV and to certain aspects of the structures and internal operation of INRA.

5.1 IMPORTANCE OF THE DRAFT AGREEMENT BETWEEN IAV AND INRA

This agreement appears essential because it would lay the foundations for close collaboration in the future between the two largest national scientific institutions specializing in agricultural research, whose human and material resources complement each other, with a view to the following:

- "strengthening the national scientific potential in order to facilitate the development of agriculture and of the rural community;
- "pooling the resources of the two institutions to enhance the stock of scientific and technical knowledge to be placed at the disposal of farmers;
- collaboration in the training of future qualified agricultural staff, research scientists, and teaching/researchers by means of research;
- acting jointly to secure an international reputation for Moroccan agricultural science".

To achieve these objectives, the two institutions propose to increase opportunities for mutual consultation and to establish common research programs and other joint activities in the field of research and experimentation.

One of the main proposals is the intended establishment of "sectoral scientific committees responsible for determining, conducting, and evaluating the research programs of each sector". In terms of the preceding proposals, this could mean that the Program Commissions involved in the programming cycle would not only be automatically open to IAV's teaching/researchers but that they could be common to INRA and IAV - i.e., they could examine at the same time existing and proposed

programs and operations, whether specific to each institution or undertaken cooperatively. Such Commissions would be "ideal" for a number of reasons:

- they would avoid the need to call in twice (once for each institution) the small number of relevant outside persons;

- they would provide an opportunity for more meaningful and thorough debate because they would be likely to have a wider scientific membership, with more substantial consequences;

- they would allow optimum coordination of the research activities and resources of the two institutions.

Still, in the field of research and experimentation, the draft provides for the possibility of "assigning research or teaching staff to either institution for the purpose of integration in an existing team working on a specific joint program ..." In view of the serious deficiencies of INRA in the fields of plant breeding and genetics, animal husbandry, agricultural engineering, and the social and economic sciences, this proposal could be implemented by the establishment at IAV of "associated INRA laboratories". Under such an arrangement, which has worked satisfactorily elsewhere, INRA would strengthen the relevant departments of IAV by the provision of additional resources (young research scientists, facilities, etc.) with two intentions:

- to make a direct contribution to the implementation of the INRA (or INRA-IAV) research programs;

- to train young INRA research scientists, a small number of whom could remain at IAV (working on INRA programs), while the majority would be subsequently assigned to INRA's Research Centers.

This approach would have the advantage of optimum utilization of scarce national skills, motivating those concerned and giving them full responsibility (the heads of department would be responsible for the INRA-associated laboratories) for the future development of the disciplines which are under-represented, or completely non-existent, at INRA.

The associated laboratories in the fields of agricultural engineering, and social and economic sciences would be INRA's first research units in these subjects. They could eventually develop into new departments with equal status to those proposed in Organizational Chart III.

5.2 FINAL PROPOSALS ON THE STRUCTURES OF INRA: A NEW DYNAMIC ORGANIZATIONAL STRUCTURE

5.2.1 The departments by discipline: a structural pattern adaptable to the new mode of operation of INRA

The departments of INRA (and of its predecessor, DRA) were for a long time under the control of a single authority: the Director of the

Research and Experimentation Division. A new organizational structure has been put forward more recently (Organizational Chart III), in which the existing seven departments are placed under the control of three Directorates.[88] Detailed analysis of the advantages and disadvantages of these two hierarchical structures, within the general context of the PBO and the broadening of the multidisciplinary programs, shows that a another structural pattern (see below) could better facilitate the introduction of the new (PBO) system and ultimately lead to a form of organization more consistent with the new programs.

In this form of organization, the heads of departments would not be subject to the authority of one or three Scientific Directors, but would be made responsible directly to the Secretary General, so that they would be at the same administrative level as the Director of Regional Centers and the Director of Administrative and Financial Affairs (see Organizational Chart P1). This approach would have two considerable advantages:

- first, it would allow the heads of departments to be involved more directly and on a basis of equality, in implementing the PBO; this way, they could better ensure the success of PBO by acting as more faithful and better-motivated advocates of the possibilities, limits, and needs of their respective departments, and by endeavoring to interest their researchers more actively in program preparation;

- second, it would allow careful preparation of the introduction of a new hierarchical structure more consistent with the nature of the new programs and establishing the discipline-based departments, three Scientific Directorates by commodities, production systems and disciplines, which would supervise and coordinate the relevant research programs. The choice of these new Directors by INRA's managing bodies would be of utmost importance and would be facilitated by the identification of the best-qualified scientists (heads of departments, Directors of Regional Centers, program leaders), who have shown the most competence and ability during the early stages of the reorganization of INRA.

5.2.2 Establishment of Directorate for Information and Training

The activities related to documentation, publication, communication, national and international external relations, and training programs have some common features: they are all means of information, exchange, and training. For this reason, a single entity ought to be responsible for all of them, and in view of their obvious importance for the improvement

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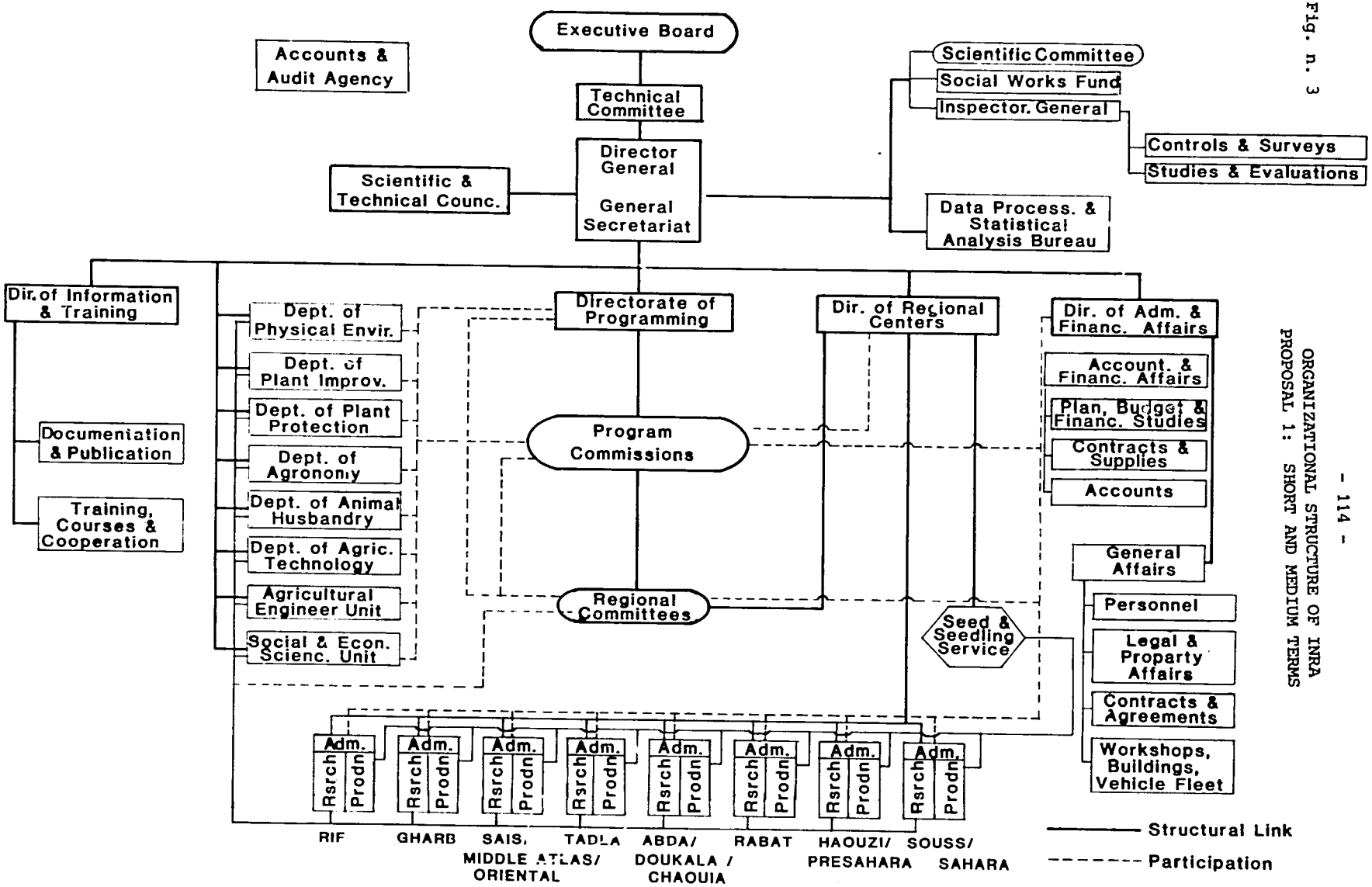
(88) Directorate of Research for Plant Improvement and Protection; Directorate for Animal and Plant Research; Directorate of Research for the Physical and Human Environment.

Fig. n. 3

ORGANIZATIONAL STRUCTURE OF INRA
PROPOSAL 1: SHORT AND MEDIUM TERMS



of INRA's scientific potential in terms of both quality and quantity, it would be appropriate for a new "Directorate of Information and Training" to be set up.

This Directorate could, in a first stage, combine the documentation (and publication) service and the cooperation service (which is also responsible for training courses abroad), both presently attached to the Department of Research on the Human Environment in Organizational Chart III. Later, increasing resources and activities could eventually justify the formation of a larger number of more specialized services, such as information and documentation, publication, communications and external relations. A detailed description of the activities and functions of these respective services (including those for education and training) is given in Annex 11. For our present purposes, attention is drawn to two points.

The first point is of vital importance for the research scientists, especially those at the Regional Centers, to have ready access to comprehensive and up-to-date documentation and information. For this purpose, INRA should as soon as possible set up a central documentation unit considerably larger and more efficient than the existing one, capable of providing prompt and flexible services such as the holding or loan of publications, photocopying, bibliographic selections, etc. This central unit should quickly be supplemented by satellite units at the largest Regional Centers, and later at all centers which have reached the "critical" size mentioned earlier. Furthermore, the prior existence of such units could help to encourage the voluntary decentralization of some researchers. When a genuine documentation service is established in the immediate future, account should be taken of the existence of similar service facilities in Morocco, and the availability of national (as in Colombia) and international experiences (the AGRIS and CARIS documentary systems of the FAO).

The second point is the importance of "public relations". The allocation of increasing resources to science in a country passing through a difficult period is a decision that necessitates courage and clarity of vision. For this reason it is essential that research maintains an open relationship with the public and official authorities, through organized events, miscellaneous forms of communication and mass-media (press, radio, and television). The objective of these activities will be to convey, in a readily assimilable form, the present role and the potential of agricultural research for development and training. It is particularly important to underline the value of research, not only in the long term, but also its advisory and diagnostic functions, in the short and medium terms in the regional and national agricultural policy. It is also important to recognize the limitations of research, inherent to the complex nature of its work, requiring patience and accuracy; the need to make priority choices and the fact that research, to be really fruitful, must be shared with partners, as regards program orientation and evaluation and dissemination of its results. The establishment of a small "Press and Public Relations Service" would therefore be desirable, but only in the medium term, when INRA has substantially completed its reorganization and improved its effectivess.

5.2.3 The Directorate for Administrative and Financial Affairs: an organizational alternative

This Directorate at present consists of two departments: the "Department" of General Affairs and the "Department" of Accounting and Financial Affairs.[89] A subdivision into three more specialized subdirectorates, more consistent with the requirements of INRA's reorganization, might be appropriate at a later stage.

A Subdirectorate for the Budget and Finances would combine the activities of two existing services: the Service for Plan-Budget-Financial Studies and the Accounting Service;[90] it would be responsible for the "program-budget" system and for analytical accounting by individual programs and operations.

A Subdirectorate for Technical and Internal Administrative Services would combine the present Workshops-Buildings-Vehicle Fleet Services and Contracts-Supplies Service. This amalgamation could help to make these logistic support activities more effective; this would be essential in a less centralized system with greater mobility for the researchers.

Finally, a Subdirectorate for Personnel and Legal Affairs would combine the existing Personnel Service and the Legal and Land Affairs Service; this would be useful in the next few years, when there could be more and more links between these two orientations resulting from the change in status of the staff, the urgent need to increase the number of researchers, and the intended reduction in the number of experiment and demonstration farms. The Personnel Service would have more duties than at present: it would be responsible for career monitoring (periodic reports on staff; promotion) and would share responsibility for training activities[91] with the Service for Education and Training of the Directorate for Information and Training (see Annex 11).

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(89) The terms "Division" or preferably "Subdirectorate" would be more appropriate to avoid any confusion with the discipline-based Departments.

(90) The establishment of an Agreements and Contracts Service could be contemplated when warranted by the growth of research programs partially funded by other bodies.

(91) Planning of human resources; links with national and foreign institutions concerning short- and long-term training arrangements for researchers; scholarships, training courses, and short-term missions: the Personnel Service would be particularly responsible for assessing the implications of these activities for INRA's budget and the careers of those concerned.

5.2.4 Data Processing and Statistical Analysis Bureau

Presently the Data Processing Service could be attached to the Directorate of Scientific and Technical Research Support Services.

However, in view of its present and future functions in administration, financial management and in planning-programming, as well as the increasing importance of statistical analysis (biometry) as a scientific discipline in itself, it seems appropriate to combine all these activities in a "Data Processing and Statistical Analysis Bureau" attached directly to the General Secretariat (see Annex 14).

5.2.5 Top-level management structures

Only a small number of comments need to be made about the existing structures. The term "Director" of INRA should be replaced by "Director General", to distinguish this position from the INRA Directors of lower rank. The functions of the General Secretariat, which would cover the scientific, administrative, and financial fields, ought to be defined precisely.[92]

A more important recommendation is the establishment of a Scientific Technical Council (CST) made up of a number of national experts of high standing selected for their scientific competence (from the universities, IAV, and other scientific institutions) or technical ability (e.g., some of the well-known research scientists who have "moved into the production sector").[93] The CST would be responsible for advising the Director General and the Executive Board of INRA on the following matters:

- guidelines for long-term research activities;
- recruitment and training policy for scientific staff;

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(92) This comment applies to all posts at Director level (including the Director General) and Heads of Services, whose functions, powers, and responsibilities should be defined or redefined by detailed terms of reference.

(93) The CST must not be confused with the "Scientific Committee", which is responsible for approving the research work of scientists before their formal appointment to the grades of Research Assistant or Principal Research Assistant or prior to their candidacy for higher grades. The Scientific Committee's composition, functions, and powers, mentioned in the Staff Regulations (Articles 126 and 127), have yet to be "specified by order of MARA on a proposal from the Director of INRA" (Article 13 of the Regulations).

- scientific cooperation with national and foreign scientific institutions.

It would also be useful for the CST to be consulted during the final phase of the programming exercise (when INRA's Director General finalizes its choices) and during the elaboration of the long-term Master Plan (see Section 6).

5.2.6 Proposed new dynamic organizational structure

The foregoing comments and proposals and those set out in earlier sections of this Report would be illustrated from two new organizational charts dissociated from INRA's draft Organizational Chart III: the first, P1 (P for Proposal), would apply to the short and medium terms, while the second, P2 (long term), would follow from the first, with the differences mentioned earlier, such as:

- the establishment of three directorates for the discipline-based departments (by commodities, production systems, and thematic topics);

- the transformation of the socio-economic sciences "unit" and the agricultural engineering "unit" into departments, and the creation of new departments if required[94];

- a possible slight increase in the number of regional centers (CRRAs);

- consideration of proposals concerning the directorate of Research Support Services and the Directorate for Administrative and Financial Affairs.

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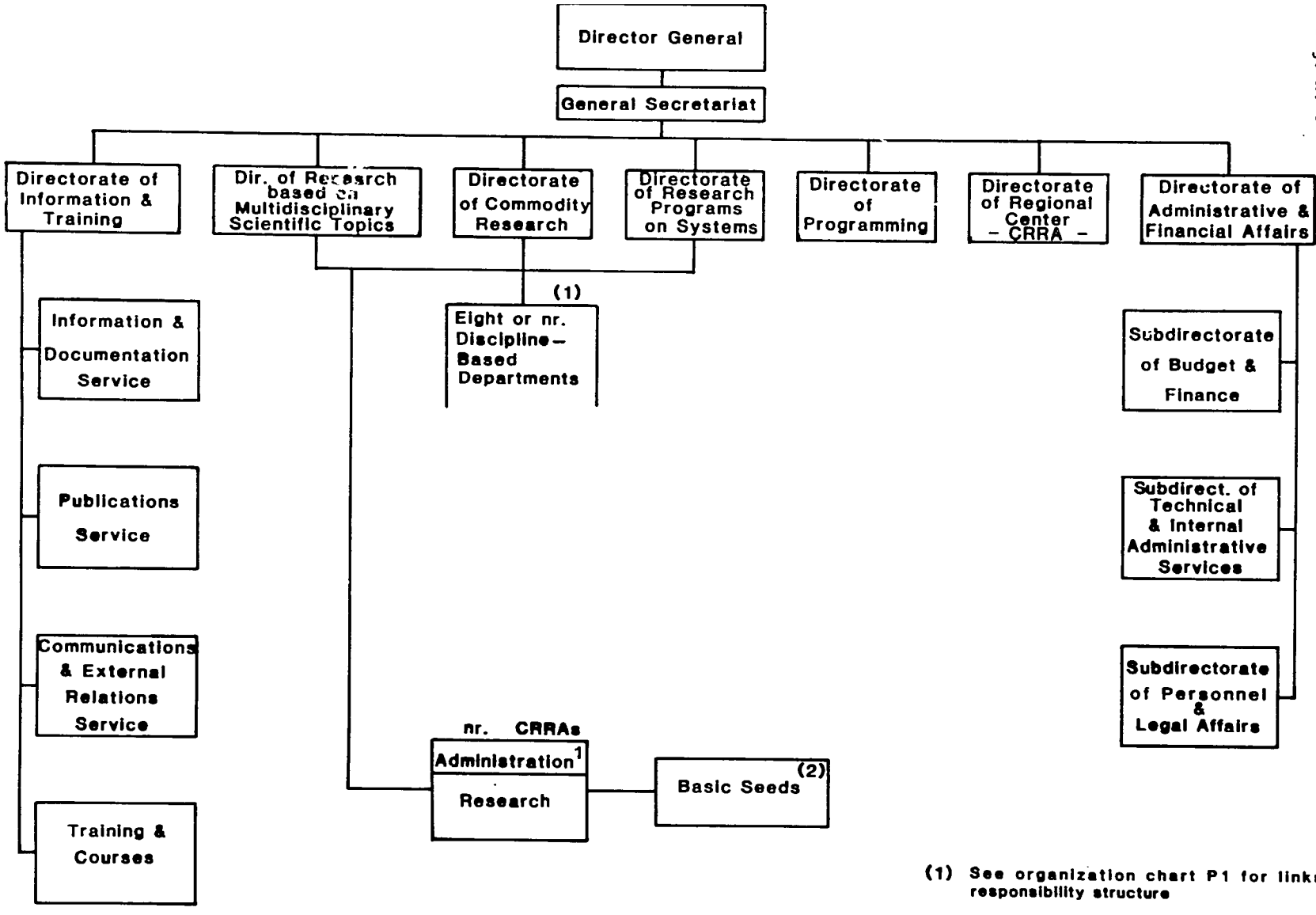
(94) The number of Departments, their scientific focus and their names might change in the long term, depending on the scale and nature of the problems encountered and the resources allocated to them. For instance, some of the present divisions, such as plant pathology, pedology, etc., might become departments. Additional departments could eventually be set up, for example, in the fields of statistical analysis (biometrics), animal genetics, and animal health. However, in view of the priority given to the multidisciplinary programs, it seems inappropriate to set up too many new departments, as this would have the disadvantage of reducing relations between connected scientific specializations.
Annex 13 gives a detailed illustrative list of the main research subjects already covered or possible, and the relevant "laboratories" and "services" for each of the eight existing and proposed INRA departments.

Fig. n. 4

ORGANIZATIONAL STRUCTURE OF INRA
PROPOSAL 2 (LONG TERM)



(1) See organization chart P1 for links and responsibility structure

(2) At some CRRAs and in association with the Plant Improvement Department

6. THE LONG TERM: SUBSEQUENT RESUMPTION OF THE MASTER PLAN

INRA should not confine its concerns to the short and medium terms. It is important for it to plan its long-term future in broad outline so that it can grow in a controlled manner during the intervening period and - perhaps most important of all - so that it is in a better position to persuade the national and possibly also foreign authorities of advantages of this growth and hence that it is appropriate to fund it. This was the objective of the Master Plan which should be resumed on an improved basis in the medium term, when INRA will have succeeded in improving its operations, its results, and its acceptance at the national level.

After three or four years' experience of practical programming, during which time the Program Commissions and the Regional Agricultural Research Committees would have been operational, INRA would have acquired a better perception of the country's development needs and a greater capacity to translate them into research activities. The Institute would take advantage of this in determining the general pattern of its work, but could also utilize its experience by taking a more active part in the definition of development needs on qualified national bodies such as that responsible for the plan. It would then be easier for INRA to refer to needs which will to some extent have been made more explicit by its own involvement, and in return, it would be liable to receive greater support from these top "decision-making" authorities.

Similarly, with accumulated experience in programming, with its periodic evaluation of programs and resources, INRA will be better prepared to formulate proposals for action with better arguments and better support from other institutions, which are associated in program implementation and/or users of its results. Savings would result from such a system in which earmarked resources can be justified and utilized optimally.

All this means that a Master Plan would be even more consistent with the needs and resources of the country, and hence better received; that the Institute would already have established a basis of credibility through its renewal and reorganization efforts, its first new results and its better integration into the national "environment". The Master Plan should therefore be drawn up once INRA is assured of the backing of other national institutions, when these would view research growth as an essential necessity in achieving their own objectives. It is ultimately these institutions which should justify the need for it at the level of the Ministry of the Plan and MARA.

7. SUMMARY OF PROPOSALS IN ORDER OF PRIORITY

The numerous proposals presented in part three of this report concerning various structural, functional, and relational aspects of INRA, are focused around two central themes.

The first concerns the continuation of the action already undertaken to secure a better adaptation of research to development needs in both the objectives and the conduct of research. All proposals related to programming by objectives and on regionalization should contribute to this theme, in particular by establishing an organized and methodical strengthening of INRA's relations with its "environment". However, this effort should not detach INRA from its continuing scientific role in long-term prospective research and its collaboration with IAV, which should be closer than the draft agreement suggests.

The second motivation theme is improved management of the total human and physical resources. Here again, programming by objectives (PBO) should play an important part, arising from periodic evaluation of programs and their resources. Emphasis has been placed on well-qualified human resources, starting with those already at work at INRA, as they form the Institute's principal asset. This asset must be preserved and consolidated by improved working conditions to increase motivation (scientific and career) and responsibility, and to facilitate day-to-day operation activities. These points should be considered as essential preliminaries to subsequent rapid growth.

The proposals put forward will call for attentive and critical examination on the part of the governing body of INRA and the relevant Moroccan authorities. Their time horizons are all limited to the short and medium terms, although in some cases the implications reach further into the future.

In the short term (1-2 years), the following recommendations are the most urgent in terms of both time and content:

- final "adjustments" to be made on staff status (see Section 3.3);

- introduction of programming by objectives (PBO), which would be reflected mainly in the clustering of applied research activities, hitherto carried out at the discipline-based "stations", around commodity-based and production-system-based research programs. These "new programs" would mean a recentering of INRA's activities, and insofar as they would mean the new administrative units of INRA, they would entail appreciable changes in the total structure and functioning of the Institute;

- pruning the provincial network of research centers and experiment stations, including the demonstration farms (fermes d'application) and simplification of budgetary procedures;

- organizing seminars on research-development linkages and production systems, directed principally towards the most senior staff of INRA heads of discipline-based departments, heads of CRRAs (regional agricultural research centers), and staff in charge of the "new programs";

- establishing an efficient documentation service;

- building up joint research laboratories at IAV in disciplines in which INRA has the greatest deficiencies in staff (plant breeding and genetics, animal husbandry, agricultural engineering, social and economic sciences);

- finally, organizing a specific evaluation proposal mission in relation to seed multiplication and gene bank problems (see Annex 7).

All these short-term measures are within the financial possibility of INRA, especially if it benefits from the support of foreign cooperation for the introduction of the PBO, the organization of the recommended seminars, and renewal of the documentation service.

In the medium term (2-4 years) the recommendations are as follows:

- completion of the introduction of programming by objectives (PBO), with the setting up of "Program Commissions" (if possible in common with IAV) and Regional Committees for Agricultural Research (at least in the largest CRRAs), organization of annual programming cycles; preparation of "program-budgets" and some organizational changes (Chart P2);

- balanced decentralization of programs, to facilitate regionalization of research and resources;

- continuation of permanent training of senior staff, and selection and training of young researchers;

- finally, the resumption of the long-term Master Plan: with the practice of programming by objectives, INRA would have a better perception of development needs, a greater capability to translate them into research topics and to formulate requests, supported by sound justifications, as economical as possible and backed up by other institutions.

On this medium-term time scale, costs would, of course, be higher; most of the costs would be accounted for by a growth, which is essential if research is to be able to make a significant contribution to solving the increasingly acute problems of development; a growth, however, that should be soundly based and fully justified by the renewal of INRA and its new accomplishements.

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ANNEX 1

TERMS OF REFERENCE, COMPOSITION AND DEVELOPMENT OF THE MISSION

1. TERMS OF REFERENCE OF THE MISSION

The main objectives and terms of reference of the ISNAR Mission, conducted in cooperation with INRA's research staff, were as follows:

1) The conduct of a critical evaluation of the progress of INRA's Master Plan for Agricultural Research [Plan Directeur de la Recherche Agronomique],[1] particular attention being devoted to the following:

- the establishment of a working methodology intended to facilitate the assessment of priorities and determination of the research program's

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[1] The Master Plan, partly achieved in 1981, intended to define the following points:

1) the major research objectives;
2) the research priorities;
3) the list of research programs (problems with priorities assigned to commodities, farming systems, and other objectives);
4) content of the research programs:
   - research projects constituting the programs,
   - location of these projects at national, regional, or provincial level;
5) compilation of INRA's organizational chart on the basis of the above;
6) identification of joint research projects with the services or bodies responsible for agricultural extension;
7) identification of joint research projects with the higher education institutions (Institut Hassan II and the University);
8) estimation of research staff (scientific, technical, and administrative) required to implement the research programs and projects identified as above;
9) estimation of the infrastructures and equipment (scientific, agricultural, and other) required for the same programs and projects;
10) timetable for the implementation and development of the research programs having regard to the possibilities of assignment and training of the various staff groups;
11) finalization of the research programming, evaluation, and budgeting procedures.

objectives, in particular the intra-sector priorities[2] based on farming systems;

- the organization of INRA's structures - in particular, the structures of the administrative, and management units and the program planning, evaluation, and guidance units, and the implementation of all the Institute's activities.

2) The study of possible integration of farming systems into the overall research objectives, and determination of these objectives, methods of and conditions for the establishment of a research program on farming systems.

3) The conduct of a study with a view to the establishment of a Master Plan with emphasis on:

- methodologies for the assessment of manpower needs, infrastructure and equipment requirements, and timetables;

- consultation structures and types of collaboration with services and other bodies responsible for agricultural extension and higher education institutions;

- establishment of research programming procedures and periodic, ongoing program evaluation; evaluation procedures for research operations and staff requirements; and budgeting framework for research activities and research units.

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(2) The crop research programs and operations covered by items 3 and 4 of the Master Plan should be reviewed in the context of prior consultations with the other research institutions as well as with senior officials responsible for agricultural development, as these programs have not taken any account of the current work of other research and development institutions.

The priorities of the crop intra-sector research activities to be undertaken in the commodity-oriented programs cannot be set independently from the farming systems to which they are associated. It is essential for these intra-sectoral priorities to be set as an initial component of a programming methodology based on user-expressed needs and an analysis of the production constraints and inter-sectoral interactions within each system.

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2. COMPOSITION OF THE MISSION

The Mission was made up of two members of ISNAR staff and five consultants:

Dr. Pierre Antoine	Agronomist and pedologist, Program Officer of IADS, consultant to ISNAR.
Dr. Joseph Casas	Agronomist and economist, Research Officer [chargé de recherche], at INRA Montpellier (France), consultant to ISNAR.
Dr. René Devred	Agronomist, forester, and botanist, ISNAR Senior Research Officer and Leader of the Mission.
Dr. Donald Humpal	Agronomist, Development Alternatives Inc., Assistant lecturer at the University of California at Davis, consultant to ISNAR.
Dr. François Labouesse	Agronomist and economist, Research Officer [chargé de recherche] at INRA Montpellier (France), consultant to ISNAR.
Dr. Josette Murphy	Sociologist and economist, ISNAR Senior Research Officer.
Dr. Jean-Pierre Trouchaud	Geographer, Director of Research at ORSTOM (France), consultant to ISNAR.

This team encompassed a wide range of scientific and technical disciplines, specialities, and professional experiences in the fields of management and organization, agricultural research programming and evaluation, higher education and research training and research, extension, and development relationships.

3. DEVELOPMENT OF THE MISSION AND ACKNOWLEDGMENTS

After a preparatory meeting at ISNAR Headquarters from 9 to 12 January 1984, the mission spent the period from 15 January to 14 February 1984 in Morocco.

The mission visited a large number of bodies and institutions directly or indirectly associated with the agricultural research and development systems. Throughout its stay in Morocco, the mission benefitted from the assistance and collaboration of a team of INRA scientists consisting of Mr. M. Cohen, Head of the Data Processing Service; Mr. A. El Idrissi, Head of Saharan Agriculture; Mr. A. Kissi, Head of the Regional Agricultural Research Center (CRRA) of the Gharb; Mr. E.M. Zouttane, Head of the CRRA at Settat; Mr. M. Hmimina, Head of the CRRA at Meknès; Mr. S. Bennani, Head of Central Plant Protection Station; Mr. A Squalli, Head of the Central Crop Improvement Station; Mr. Osghiri, Head of the Ecology Service; Mr. S. Mouatadid, Head of the Animal Husbandry Service; Mr. Amri, Head of the Winter Cereals Station; and Mr. M. Barri, member of the Central Forage Crops Station.

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The detailed timetable of the mission's work is given in Annex 2.

After its visit to Morocco, the mission met on several occasions at ISNAR Headquarters to process the large volume of information gathered and to compile this report.

ANNEX 2

TIMETABLE OF THE MISSION

15/01/84 . Arrival in Rabat of Mrs. J. Murphy, Mr. P. Antoine, Mr. J. Casas, Mr. D. Humpal, and Mr. F. Labouesse, who were received by Mr. Ez Zahraoui, Director of Experimental Studies, and Mr. Cohen, Head of INRA's Data Processing Bureau.

16/01 . Meeting at INRA Headquarters under the chairmanship of Mr. H. Faraj and Mr. M. Laazzaoui, Secretary General of INRA, between the ISNAR team and the members of INRA[3] associated with the ISNAR mission, comprising: Mr. Cohen, Head of INRA's Data Processing Bureau; Mr. A.L. El Idrissi, Head of the Saharan Agriculture Program; Mr. A. Kissi, Head of the CRRA of the Gharb; Mr. Zouttane, Head of the CRRA at Settat and of the Rainfed Farming Project; Mr. M. Hmimina, Head of the Meknès CRRA; Mr. Bennani, Head of the Central Plant Protection Station; Mr. A. Squalli, Head of the Central Crop Improvement Station; Mr. Osghiri, Head of the Ecology Service; Mr. M. Mouatadid, Head of the Animal Husbandry Service and Head of the Central Apiculture Station; Mr. Amri, Head of the Central Winter Cereals Station; and Mr. A. Barri, Head of the Central Forage Crops Station.

. Introduction to INRA and discussion of the work program.

. Visit to MARA's Directorate of Plant Production with Mr. Rami, Director, and Mr. Bekkari, of the Studies and Project Division.

17/01 . Introduction to INRA's Animal Husbandry Service by Mr. Mouatadid.

. Visit to MARA's Directorate of Livestock Production with Mr. Marsile, Director, Mr. A. Bentouhami, Mr. A. Belkhel, and Mr. Kammouni.

. Introduction to INRA's Genetic Improvement Station.

. Visit to the Société Nationale de Commercialisation des Semences (SONACOS) - Mr. Bouzoubâa, Director of SONACOS.

18/01 . Introduction to INRA's Plant Protection Station.

. Visit to MARA's Department of Plant Production, Technical Control and Fraud Prevention (DPVCTRF) - Mr. Lakhder, Mr. Tourkmani, and Mr. Hafraoui.

. Introduction to INRA's Central Crop Improvement Station.

. Arrival in Morocco of Mr. R. Devred, Leader of the ISNAR mission.

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(3) Representatives of the INRA team accompanied the members of the ISNAR team at all meetings and in all contacts.

19/01
- Introduction to the Association of Agricultural Scientists [Association des Ingénieurs de la Recherche Agronomique].
- Visit to the "Société de Gestion des Terres Agricoles (SOGETA)" - Mr. Labhil, Director.
- Description of INRA's Forage Crops Project by Mr. Bari.
- Visit to the "Société De Développement Agricole (SODEA)" - Mr. Mniani, Coordinator of Production and Development of SODEA.
- Working meetings on the staff files (Mrs. J. Murphy; Mr. J. Casas).

20/01
- Visit to the "Société Nationale du Développement de l'Elevage (SNDE)"; Mr. Sbihi.
- Visit to the "Caisse Nationale du Crédit Agricole" (Mrs. J. Murphy; Mr. J. Casas).
- Visit to MARA's Directorate of Agricultural Extension and Agrarian Reform - Mr. Medouar, Head of the Agricultural Extension Service, and Mr. El Haibidi Miloud, Head of the Agricultural Extension Bureau.
- Invitation to the IAV Club with Mr. Bekkali, Director of the Institut Agronomique et Vétérinaire Hassan II; Mr. Firdawcy, Director of Education; Mr. P. Pascon, Professor of Sociology; Mr. Tantaoui, Director of Scientific Research (all from IAV); and Mr. M. Purvis, Agricultural Programs Officer (USAID).

21/01
- Meeting of the entire INRA-ISNAR team with Mr. H. Faraj, Director, and Mr. Laazzaoui, General Secretary.
- First review and exchange of opinions on the mission program.
- Meeting with Mr. M. Purvis, USAID.

22/01
- Review of the first week of observations of INRA (Mr. R. Devred).
- Departure of Mr. J. Casas for Montpellier.
- Meeting of the entire ISNAR team to lay down the draft structure of the report, to collate the documentation and to organize the Mission's travel program.

23/01
- Meeting at the Regional Agricultural Development Agency (ORMVA) of the Gharb - Mr. Louah, Head of Equipment Service.
- Meeting at the Provincial Directorate of Agriculture of the Gharb.
- Visit to the Technical Sugarcane Center - Mr. A. Madrane, Director; Mr. F. Hesse, Head of GTZ Project; Mr. Ngying Sebung, Head of Experimentation; Mr. Y. Ouabrahim, Head of the Technical Sugar Bureau [Bureau Technique du Sucre]; Mr. J. Enahari, Experimentation Officer.
- Visit to the "Société Coopérative Agricole de Rizerie (SCARI)".
- Visit to the Development Center (CMV) at Mechra Bel Ksiri.
- Visit to a citrus plantation.

24/01
- Visit to the Regional Agricultural Research Center of the Gharb at Kenitra - Mr. A. Kissi, Head of the Center and his colleagues at the CRRA.
- Visit to the Central Citrus Fruit Research Station at El-Menzeh - Mr. E.B. Nador, Director.
- Visit to the Experiment Station at Sidi Allal Tazi - Mr. El Hakimi, Head of Station.
- Departure for Chefchaouen.

25/01
- Meeting at the Provincial Directorate of Agriculture of the Province of Chefchaouen - Mr. El Ghazi, Director; Mr. Karimi Abdellah, Head of the Livestock Production Service; Mr. Chakib Ahmed, Head of the Agricultural Development Service; Mr. Dak M., Forestry and Water Resources Scientist [Ingénieur des Eaux et Forêts] of Chefchaouen; and also Mr. El Akel, Director of the Tangier CRRA; Mr. Abdelkader, in charge of RIF Agriculture at the Tangier CRRA; Mr. Taoui A. and Mr. Alami of the Tangier CRRA.
- Visit to the Upper Loukkos area; Mr. Haddade, Head of the CT (Works Center) at Mokrissat.
- Visit to the Zaz area.
- Departure for Larache.

26/01
- Visit to INRA's Tea Station at Larache with Mr. Hammou, member of INRA's research staff, and Mr. El Akel.
- Visit to the Loukkos ORMVA at Ksar El Kebir - Mr. Safine, Director; Mr. E. Moundi; Mr. D. Retouk; Mr. O. Roussel; Mr. A. Chlouchi (Mr. R. Devred and Mr. P. Antoine).
- Visit to SNEDE's Zouada farm - Mr. Bou Ammar, SNDE scientist; Mr. Jaritz, GTZ Adviser; and Mr. A. Barri (Mrs. J. Murphy, Mr. D. Humpal, and Mr. F. Labouesse).
- Lunch at the Loukkos ORMVA.
- Visit to the Experiment Stations in the Loukkos Action zone.
- Departure for Fez (Mr. R. Devred, Mr. P. Antoine, and Mr. F. Labouesse).
- Departure for Rabat (Mrs. J. Murphy and Mr. D. Humpal).

27/01
a) Mr. R. Devred, Mr. P. Antoine, and Mr. F. Labouesse:
- Meeting at the Provincial Directorate of Agriculture at Fez - Mr. Fassi.
- Visit to the Douyet Experiment Station with Mr. Ben Halima, Director of the Station.
- Visit to the Fez-Karia-Tissa Integrated Project with Mr. Marghi, Project Director.
- Visit to INRA's Karia Station and the Technical Assistants' School [Ecole des Adjoints Techniques].

b) Mrs. J. Murphy and Mr. D. Humpal:
- Discussions with Mr. J. Grayzel and Mr. Crawford of USAID on evaluation of the AID Range Management Improvement Project.
- Discussions with Mr. Purvis of USAID on the Rainfed Farming Project.

- Visit to the Guich Central Winter Cereals Station - Mr. Amri.
- Visit to the Guich Central Food Legumes Station - Mr. B. Sakr.
- Visit to the Central Forage Crops Station - Mr. Bounjmate and Mr. A. Barri.
- Visit to the Central Cereals Station - Mr. B. Sali and Mr. A. Selmani.
- Visit to the INRA Library.
- Visit to the FAO Horizontal Resistance Project.

28/01
- INRA-ISNAR meeting:
  Determination of travel itinerary in the south of the country, and request for additional information.
- Meeting with the Association of Agricultural Scientists [Association des Ingénieurs Agronomes].
- Working meeting of the ISNAR team; drafting of notes and discussion of important points for the Round Table and preparation of report.

29/01
- Working meeting of ISNAR team:
  Drafting of report framework and discussion on major topics.

30/01

a) Mrs. J. Murphy and Mr. D. Humpal (team B):
- Visit to National Documentation Center - Mr. M. Essaidy.
- Visit to Central Oil Plants Station - Mr. Bougerar.
- Visit to Central Textile Plants Station - Mr. A. Bentaleb, Head of Station, and Mr. M. Benchabba.

b) Mr. R. Devred and Mr. P. Antoine (Team A):
- Meeting at the Provincial Directorate of Agriculture at Meknès with Mr. Kabbaj, Director, and his staff.
- Visit to the Meknès CRRA - Mr. Hmimina, Director of the Center and his staff.
- Lunch at the Meknès Horticulture School - Mr. Nadir, Director.
- Visit to the National Agriculture School [Ecole Nationale d'Agriculture] at Meknès - Mr. Abouyoub, Director.
- Visit to the Nationl Center for Extension Studies and Research [Centre National d'Etudes et de Recherche en Vulgarisation].
- Departure of Team A for Meknès and Azrou (see note below) to visit the Saharan South-East.

31/01

a) Team A:
Travel to Azrou and Errachidia, stopping in the various ecosystems.

b) Teams B and C:
- Visit to the Béni Yakhlef Experiment Station at Ellouizia.
- Visit to a demonstration trial site for winter chickpeas.
- Visit to the El Hassan II Agrarian Reform Cooperative.
- Visit to the "Ecole du Prince Héritier Sidi Mohamed".

- Visit to the Casablanca Provincial Directorate of Agriculture - Mr. Jaïdi Abbès, Director; Mr. H. Bouaicha (OCE); Mr. M. El Miloudi; Mr. H. El Hadouti; and Mr. I. Abdeljalil.
- Visit to the Vegetable Demonstration and Training Center - Mr. M. Cherkaoui.
- Visit to the INRA Vegetable Crops Production Station at DAR Bouazza, with Mr. El Faiz, Director of the Station.

01/02 a) Team A at Errachidia

- Visit to the INRA Station at Errachidia - Mr. Kefal, Station Manager.
- Visit to the Tafilalet ORMVA - Mr. Sabari, Director; Mr. Hajaj, Head of the Agricultural Production Service.
- Visit to the Goulmima Palm Plantation (oasis).
- Visit to the Erfoud Palm Plantation (oasis).
- Visit to the Ziz Valley.

b) Teams B and C

- Visit to the Settat Provincial Directorate of Agriculture - Mr. A. El Haimer, Director.
- Visit to the Rainfed Farming Center at Settat - Mr. M. Zouttane, Head of the Center; Dr. D. Watts, Representative of the Mid-Western Consortium of Agricultural Colleges (USAID Project).
- Visit to the Sidi El Aïdi Station.

02/02 a) Team A

- Travel from Errachidia to Béni-Mellal.
- Visit to a CT [Works Center] at Midelt.
- Observation of ecosystems on the way.

b) Team B

- Meeting at the Marrakesh CRRA - Mr. B. Jermoumi, Director of the Marrakesh DPA; Mr. L. Beldahri, Director of the El-Delar DPA; Mr. B. El Bakkouchi, Marrakesh Development Service [Service de Mise en Valeur]; Mr. M. Jamili, ORMVA of the Haouz; Mr. R. Eharsut, ORMVA of the Haouz.
- Visit to the Saharan Agriculture Laboratory; Mr. S. Saîdi at the Menera Station.
- Visit to the Tessaout Station - Mr. L. Aouad.
- Visit to the Ras-el-Aïn Experimental Agricultural Development Station - Mr. R. Cherrat, Head of the Agricultural Production Service; Mr. Jamili, Head of the Plant Protection Bureau.

Note: The ISNAR mission divided into three teams during the Period 31 January to 3 February:
Team A: Mr. Devred and Mr. Antoine (with Mr. Idrissi and Mr. Mouatadit).
Team B: Mrs. Murphy and Mr. Humpal (with the INRA group).
Team C: Mr. Labouesse (with Mr. El Amri).

c) Team C

. Visit to the Aït Melloul Station (Souss); Mr. A. Benjamâa, Director of the Agadir CRRA and Director of the Central Vegetable Crops Station.

. Visit to the Agadir Horticultural Complex of IAV Hassan II - Mr. Hilali, Director of the IAV Complex; Mr. A. Benjamâa, Director of the Agadir CRRA.

. Visit to the Melk-Zhar Station in the Massa area - Mr. A. Benjamâa, Director of the Agadir CRRA; Mr. Chajia, Director of the Melk-Zhar Station; Mr. Alaoui, in charge of greenhouse vegetable crops trials; Mr. Eddoudi, Plant Pathologist.

03/02 a) Team A:

. Visit to the Beni-Mellal CRRA at Afourer; Mr. A. Hilal, Head of the Beni-Mellal CRRA; Mr. A. Chryaa, Head of the Deroua Experiment Station - Mr. A. Doukkar, Deroua Experiment Station; Mr. O. Tarzouti, Deroua Experiment Station; Mr. L. Jadd, Head of the Cotton Research Station; Mr. R. Ouaïcha, in charge of the Regional Horticulture Station; Mr. H. Bel Aouja, Tadla Regional Center; Mr. Zaoui, Deputy Administrator [Administrateur Adjoint]; Mr. M. Chalet Technical Assistant [Adjoint Technique] at the Cotton Station.

. Visit to the Deroua Experiment Station.

. Return to Rabat.

b) Team B:

. Visit to the Merchouch Experiment Station - Mr. Bouzaid, Station Manager.

. Return to Rabat.

c) Team C:

. Return to Rabat by the coast road through the regions of Haha, Chiadma, Abda, Doukkala, and Basse Chaouia.

04/02 . Meeting with Mr. Massing and Mr. A. Kruisdijk, GOPA team.

. Meeting of ISNAR team: preparation of Round Tables.

05/02 . Meeting of ISNAR team, general discussion.

. Arrival of Mr. J.P. Trouchaud.

06/02 . Meeting with the Association of Technical Assistants [Association des Adjoints Techniques] - Mr. Sobhy; Mr. El Kably and Mr. Pister, with Mrs. J. Murphy and Mr. D. Humpal.

. Meeting at INRA with Mr. Cohen, Head of P.E.I., Mr. J-P. Trouchaud and Mr. R. Devred.

. Meeting at the Directorate of Forestry and Water Resources Research (SREF) and visit to the Forestry Research Station (Mr. P. Antoine and Mr. D. Humpal) with Mr. Tamri, Director of DREF; Dr. Mandouri, Soil Science and Ecology; Mr. El Atari Thami, Head of the Forest Genetic Improvement Service; Mr. El Yousfi, Head of the SRFs (Forestry Research Station's Silviculture and Soil Science Service); Mr. M. Jamaï; Mr. Fechial; Mr. M. Raggabi; Mr. A. El Bia; Mr. A. Khaïtari; Mr. M. Aboukouh; Mr. M. Chikiria - all from the SRF.

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- Meeting at the Directorate of Higher Education and Agricultural Research (Mrs. J. Murphy, Mr. D. Humpal and Mr. F. Labouesse) with Mr. Mouline, Director, and Mr. Naçaf.
- Meeting at the Institut Agronomique et Vétérinaire Hassan II with Mr. E. Tantaoui, Director of Research at IAV; Mr. A. Dekkak, Director of the Veterinary Section; Mr. F. Guessous, Secretary of the Department of Animal Production; Mr. A. Besri, Secretary of the Plant Protection Department; Mr. L. Walali, Teacher; Mr. P. Pascon, Professor of Sociology; Mr. M. Stitou, Secretary of the Soil Science Department.

07/02
- Meeting at the Ministry of Planning (Directorate of Planning) - Mr. A. Benzidan, Head of the Human Resources Planning Division (Mr. R. Devred, Mr. P. Antoine, and Mr. J-P. Trouchaud).
- Visit to the El Koudia Experiment Station - Mr. Mouatadid, Head of the Station and of the Animal Husbandry Department (Mrs. J. Murphy, Mr. D. Humpal, and Mr. F. Labouesse).
- Meeting at the Ministry of Finance (Directorate of the Budget): Mr. Bougroum, Head of the Public Projects Financing Service (Mr. J-P. Trouchaud, and Mr. R. Devred).
- Meeting with Mr. F. Reeb of the World Bank and Mr. C. Brochu of the FAO (Mr. P. Antoine, Mr. J-P. Trouchaud and Mr. R. Devred).

08/02
- Meeting at MARA (Directorate of Planning and Economic Affairs) - Mr. Guedira, Head of the Economic Affairs Division (Mr. J-P. Trouchaud and Mr. R. Devred).
- Visit to the Faculty of Sciences (canceled).

09/02
- Meeting at the Ministry of the Interior (Department of Rural Affairs) - Mr. D. Toulali, Director of the Department; Mr. Al Ghorfi, Head of Rural Affairs for Development.
- Team meeting to prepare the Round Tables.

10/02
- Preparation of Round Tables.
- First Round Table, chaired by Mr. H. Faraj, Director - with Mr. Laazzaoui, Secretary General; Mr. Ez Zahraoui, Director of Studies and Experimentation; Mr. M. Knettouch, Director of Administrative Services; Mr. M. Cohen, Head of PEI; and all the members of the INRA and ISNAR teams.

11/02
- Second Round Table (same participants).

12/02
- Meeting with Mr. Massing, Head of the GOPA mission, in charge of the Master Plan for Agricultural Extension; Mr. A. Kruisdijk, GOPA consultant; Mr. D. Johnson, Representative of the University of Minnesota Project at IAV (Mr. P. Antoine, Mr. D. Humpal, and Mr. R. Devred).

13/02
- Third Round Table (same participants).

14/02
- Departure from Rabat for The Hague via Paris.

ANNEX 3

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ANNEX 4

DECREES[5]

I Dahir no. 1-81-204 of joumada II 1401 (8 April 1981) promulgating Law no. 40-80 establishing the National Institute for Agricultural Research

PRAISE BE TO GOD ALONE!

(Great Seal of His Majesty Hassan II)

Be it known by these presents - whose content may God elevate and strengthen!

That Our Sharifian Majesty,

Having regard to the Constitution, and in particular Article 26 thereof,

HAS DECIDED AS FOLLOWS:

Article One. - Law no. 40-80 establishing the National Institute for Agricultural Research, adopted by the Chamber of Representatives on 21 safar 1401 (29 December 1980), the tenor of which follows, is hereby promulgated:

Law no. 40-80 establishing the National Institute for Agricultural Research (I.N.R.A.)

TITLE ONE

Name and subject

Article One. - A public establishment having the status of a legal entity and with financial autonomy is hereby formed under the name National Institute for Agricultural Research [Institut National de la Recherche Agronomique (INRA)].

The Institute shall be under the control of the State, with a view to insuring that the competent bodies of the Institute observe the provisions of this Law, and in particular those concerning the responsibilities attributed to this institution, and, in general, that the legislation and regulations concerning public establishments are applied.

INRA shall also be subject to the State financial control applicable to public establishments in pursuance of the legislation in force.

Article 2. - The functions of INRA shall be:

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(5) Non-official translation of the original text in French.

1. To carry out scientific, technical, and economic research on the subject of the development of agriculture and livestock production;

2. To make forecasts, especially concerning the natural environment or relating to the improvement of plant or animal production;

3. To undertake, either on its own initiative or at the request of individuals, tests of new crops and crops to be improved and on animal production, and in general to conduct all forms of agricultural experimentation or experimentation relating to the development of techniques for the processing and utilization of plant and animal products;

4. Within its field of competence, to monitor research, studies, or other work conducted on behalf of public agencies;

5. To disseminate documentation on its own research and research carried out abroad;

6. To examine and determine scientifically the practical procedures for application of the results of its research and, in this context, to advise the bodies responsible for agricultural extension and farmers;

7. To market the results of its research, studies, and other work.

TITLE II

Administrative organization

Article 3. - The National Institute for Agricultural Research shall be administered by an Executive Board [Conseil d'Administration] including not only representatives of the Government but also the President of the Federation of Chambers of Agriculture and representatives of the relevant sector organizations.

Article 4. - The Executive Board shall have assigned to it all powers and functions necessary for the administration of the Institute; it may delegate a part of its powers to a Technical Committee including representatives of the Government and of the agricultural organizations.

Article 5. - The proceedings of the Executive Board shall be valid when at least half of its members are present.

Decisions shall be taken by majority vote. In the event of a tie, the Chairman shall have the casting vote.

Article 6. - The Institute shall be managed by a Director [directeur] assisted by a Secretary General.

The Director shall have all powers and functions necessary for the management for the Institute.

He shall implement the decisions of the Executive Board and, where appropriate, of the Technical Committee.

The Executive Board may delegate powers to him for the handling of specific matters.

He may delegate a part of his powers and functions to the managing staff of the Institute.

The Director may delegate a part of his powers and functions to the Secretary General. If the Director is absent or indisposed the Secretary General shall take his place.

TITLE III

Financial provisions

Article 7. - The Institute's budget shall comprise:

a) Income:

- the proceeds and profits of its assets;
- the proceeds and profits from the provision of its services and the marketing of the results of its research, studies, and other work;
- the products of parafiscal charges or other levies charged for its benefit by the legislation or regulations in force;
- State subsidies;
- refundable advances from the Treasury and public or private bodies and loans authorized in accordance with the regulations in force;
- subsidies other than those mentioned in item 4. above, gifts, legacies, and miscellaneous proceeds.

b) Expenditure:

- the Institute's expenditure on operation and equipment;

- repayment of advances and loans;

- any other expenditure which it may be required to meet.

Article 8. - The Institute shall keep its accounts and conduct its revenue and payment transactions according to the law and commercial usage.

ARTICLE 2. - This present Dahir shall be published in the Official Gazette [Bulletin officiel].

Done at Marrakesh, Joumada II 1401 (8 April 1981).

Contersigned:

The Prime Minister,
MAATI BOUABID

II Decree no. 2-81-348 of Joumada I 1402 (22 March 1982) made for the purpose of implementation of Law no. 40-80 establishing the National Institute for Agricultural Research (I.N.R.A.) promulgated by Dahir no. 1-81-204 of 3 joumada II 1401 (8 April 1981)

THE PRIME MINISTER

Having regard to Law no. 40-80 establishing the National Institute for Agricultural Research (I.N.R.A.) promulgated by Dahir no. 1-81-204 of 3 joumada II 1401 (8 April 1981);

Having regard to the Dahir concerning Law no. 1-77-185 of 5 chaoual, 1397 (19 September 1977) concerning the chairmanship of the Executive Boards [conseils d'administration] of the national and regional public establishments;

Having regard to Royal Decree no. 330-66 of 10 moharrem 1387 (21 April 1967) laying down general regulations for public accounting, as amended;

Having regard to the decision of the Constitutional Chamber of the Supreme Court no. 14 of 6 joumada II 1399 (3 May 1979);

After examination by the Council of Ministers meeting on 16 rebia I 1402 (12 January 1982),

DECREES

Article 1. - The seat of the National Institute for Agricultural Research (I.N.R.A.) shall be at Rabat.

Article 2. - State supervision over the National Institute for Agricultural Research (I.N.R.A.) shall be exercised by the Minister of Agriculture and Agrarian Reform subject to the powers and functions vested in the Minister of Finance by the laws and regulations applicable to public establishments.

Article 3. - The Executive Board [conseil d'administration] of the National Institute for Agricultural Research shall be chaired by the Prime Minister or the Government authority delegated by him for that purpose, and shall also include the following members:

- the Minister of Agriculture and Agrarian Reform;
- the Minister of Finance or his representative;
- the Government authority responsible for the Plan or his representative;
- the Government authority responsible for higher education and scientific research or his representative;
- the Minister of the Interior or his representative;
- the Minister of Health or his representative;
- the President of the Federation of Chambers of Agriculture;

- two representatives of the associations of producers appointed each year by order of the Minister of Agriculture and Agrarian Reform upon a nomination by these associations.

The following shall also be present in an advisory capacity:

- the Secretary General of the Ministry of Agriculture and Agrarian Reform;

- the Director of Agricultural Education and Research at the Ministry of Agriculture and Agrarian Reform;

- the other Directors of the Central Administrations of the Ministry of Agriculture and Agrarian Reform;

- the Director of the Institute who acts as Secretary at meeting;

- any qualified person called upon by the Chairman to sit on the Board.

Article 4. - The Board shall meet, when convened by its Chairman, as frequently as is required by the needs of the Institute and not less than twice a year:

a) before 31 May in each year to examine technical matters for which it is responsible and to make up the accounts for the previous fiscal year;

b) before 15 October in each year to deal with financial matters and in particular to decide on the forward program and budget of the Institute for the next fiscal year.

At least half of the members of the Board must be present in order for it to proceed validly, and its decisions shall be taken by majority vote - the Chairman shall have the deciding vote in the event of a tie - all in accordance with Article 5 of the aforementioned Law no. 40-80.

Article 5. - The Executive Board shall have assigned to it all powers and functions necessary for the administration of the Institute, and, in particular:

- it shall decide on the research, study and control programs falling within the purview of the Institute's assigned activities, including those to be implemented on behalf of public and private bodies;

- it shall fix the budget and the methods and procedures of financing;

- it shall officially make up the accounts for the previous financial year;

- it shall propose or fix the scales of charges for the Institute's services and the prices of its publications, having regard to whether these services and charges are or are not subject to the price control legislation and regulations;

- it shall draw up the Institute's staff regulations and have them approved in accordance with the requirements of the legislation in force on the staffs of public establishments.

Article 6. - The Technical Committee, chaired by the Director of Agricultural Education and Research at the Ministry of Agriculture and Agrarian Reform, shall be made up of the following members:

- a representative of the Minister of Finance;

- a representative of the Federation of Chambers of Agriculture;

- a representative of the National Scientific and Technical Research Coordinating and Planning Center;

- the Director of Plant Production at the Ministry of Agriculture and Agrarian Reform or his representative.

The Director of the Institute shall attend meetings of the Committee in an advisory capacity and shall act as its Secretary.

Any qualified person may be called upon by the Chairman to sit on the Technical Committee in an advisory capacity.

Article 7. - The Technical Committee shall meet as frequently as is required by the needs of the Institute and not less than four times a year.

Its proceedings shall be valid when at least half of its members are present. Its decisions, where appropriate, shall be taken by majority vote. In the event of a tie, the Chairman shall have the deciding vote.

Article 8. - The Technical Committee shall, between meetings of the Executive Board, handle the matters delegated to it by the Board.

Article 9. - The Director of the Institute shall be appointed in accordance with the legislation in force.

He shall manage the Institute and act on its behalf in accordance with the provisions of Article 6 of the aforementioned Law no. 40-80; in particular:

- he shall perform or authorize all acts or operations relevant to the object of the Institute, which he shall represent before the State, any public or private administration, and all third parties;

- he shall perform all precautionary acts;

- he shall represent the Institute in courts of law but may institute legal proceedings only with the authorization of the Executive Board;

- he shall recruit and appoint staff in accordance with the provisions of the staff regulations;

- he shall undertake expenditure by act, purchasing contract or other contract, cause accounts to be kept of expenditure undertaken, settle and record the expenditure and revenue of the Institute and issue the relevant payment orders and revenue certificates to the Accountant.

Article 2. - The Minister of Cultural Affairs shall be responsible for the implementation of the present Decree, which shall be published in the official Gazette [Bulletin officiel].

Done at Rabat, 25 joumada I 1402 (22 March 1982].

MAATI BOUABIB

Countersigned:

The Minister
of Cultural Affairs
SID BELBACHIR

ANNEX 5

MOROCCAN SOILS AND THE IMPACT OF MAN ON THE LANDSCAPES AND SOILS OF MOROCCO

General context of soil formation

In regions which, like Northern Africa, were not covered by glacial deposits, the landscapes and soils have often evolved freely over tens of thousands of years, during which more or less substantial changes in climate or vegetation have taken place. During the course of their prolonged evolution, the soils have acquired varied morphological and chemical characteristics which reflect each successive combination of ecological conditions and bear the marks of a long and complicated geomorphological history.

Although the history of ancient climates is not yet very well known, there seems to be little doubt that the present climate is not sufficiently aggressive to explain the considerable differentiation of some soils observed in arid areas (for instance, petrocalcic horizons (calcrete) or rubifaction not due to lithochromic parent materials). However, any attempt to explain the entire morphology of Moroccan soils solely on the basis of paleoclimates would take too little account of the important effect of time, which may give rise to substantial soil differentiation over a period of ten or twenty thousand years, even in a moderately aggressive climatic environment.

Regarding the present soil-forming factors, it is the case that in Morocco, as indeed everywhere else, successive mesoclimates have generally molded the major processes of soil formation and the type of evolution of soils (formation of petrocalcic horizons, rubifaction, etc.), thus differentiating the principal regions of the country from each other. However, probably to a greater extent in the Mediterranean regions than elsewhere, the most critical pedogenic factors which enable us to understand soil development within a given region are the parent material and the relief.

Indeed, the soils and landscapes of Morocco have been evolving for a long time, and during this long period of development and maturation very specific relationships between the properties of the parent materials, the characteristics of the relief, and soil typology have emerged. In this respect, a good knowledge of geology and geomorphology is the pedologist's most precious tool in the field, as it allows the pedological provinces within a given region to be unfailingly differentiated.

The geology of Morocco is extremely varied. A large number of stages or deposits are observed, extending in age from the Precambrian to the recent Quaternary. Moreover, in addition to the wide variety of

metamorphic or sedimentary rocks, among which the calcareous rocks are the most important, there are also eruptive rocks such as basalts, dolerites, granites, etc.

From the agricultural point of view, the large plains with high potential productivity are formed primarily from loose alluvial and colluvial materials; their texture is predominantly loamy or argillaceous, frequently containing large quantities of finely divided limestone (e.g., the Gharb, Tadla, Moulouya, etc.).

Finally, having regard to population pressure and increased demand for food and energy, man has played an increasingly important part in the evolution of the Mediterranean soils and landscapes in the last few centuries, and in particular during the last fifty years. In this respect, the role of man is more crucial in Morocco than in most temperate or humid tropical zones owing to the extreme susceptibility to erosion of most of the country's geomorphological complexes.

Physical and chemical properties of Moroccan soils

With regard to soil-plant relationships, the Mediterranean regions differ from the temperate or humid tropical regions in that physical constraints (in particular, maintenance of a sufficient reserve of water) are more important than chemical ones. This is true particularly in the regions of marginal rainfall where cereals are grown, where the great annual variability of the rains determines, more than any other factor, the success or failure of the year's crop.

Water is present in the soil in accordance with annual cycles (water regimes), which are not yet fully known and do not correspond exactly to rainfall cycles. The pedoclimate or, in general, the useful reserve of water for plant growth, also depends on such varied factors as soil texture, plant cover, exposure, slope, and soil depth. In the semi-arid or arid zones, some lower slopes or basins which are not waterlogged sometimes have sufficient available water for rainfed agriculture of the "favorable bour" agriculture type, as a result of lateral water movements within the soil, in the direction of the slope. Along the coast, concealed precipitation is also not negligible, especially on the seaboard from Rabat to the south of Agadir.

Of course, the annual cycles do not relate solely to humidity and temperature. The considerable variability of these two parameters during the course of the year gives rise to other major changes in the physical and chemical characteristics of the soil. For example, muddy fields which are unstructured or have a massive structure in winter exhibit wide dessication cracks in summer. The pH of the soil, measured at different times of the year, will also reflect substantial variations in the chemical environment. The concentrations of inorganic nitrogen, exchangeable potassium, organic matter, and soluble salts will also vary, while the luxuriant vegetation which imparts such brilliant colors to winter and spring gives way in the drier months to bare, scorched areas.

These alternations of wet and dry conditions during the year result in specific trends in the soil-forming processes, such as the formation of vertisols in very fine-textured materials or the development of profiles of bright red color, with frequent accumulations of clay or carbonates in medium-textured or coarser materials.

The soils of Morocco, especially in the regions subject to considerable erosion or the semi-arid and arid regions (where the petrocalcic horizons are most frequent), are often very shallow; this impedes their utilization for agricultural purposes, the spreading of plant root systems and the formation of water reserves in the soil. Irrigation of these shallow soils is obviously difficult, and high capital investment is necessary for their development (subsoiling, etc.).

Moroccan soils are seldom acid, except in some geological regions of the north of the country, such as the Central Plateau, the Mamora, and the Rif, where the aggressive climate and the nature of the parent rock have contributed to the formation of soils with pH values around 5.

The vast majority of Moroccan soils contain limestone, and the areas of accumulation may take the form either of "calcic" or of "petrocalcic" (indurated) horizons; except in the case of the "Red Mediterranean" soils, most soils which contain limestone are calcareous right up to the surface. Hence it may be said that the most common soil pH values in Morocco are in the range 7 to 8.5.

As regards chemical fertility proper, the problems will of course vary with the soil typology and the agricultural use of the soils concerned. However, with rare exceptions, organic matter content is generally low: 2-3% in soils regarded as highly fertile (in the surface horizon), and less in most other soils. The application of nitrogen fertilizers is therefore essential for intensive cultivation, particularly as the organic matter is often highly polymerized and stabilized by inorganic colloids, as a result of which the nitrogen is less readily mineralizable (e.g., in vertisols).

Phosphorus is the other main limiting element in most soils owing to its ease of retrogadation or fixation in acid soils (when it reacts with iron and aluminium) or high-pH soils (when it reacts with calcium derived from the limestone).

The need for fertilizers containing potassium is not usually a serious problem, as many soils are very well supplied with that nutrient.

Little research has been conducted on trace elements, particularly as they are unlikely to present a serious problem in crops until the major difficulties with nitrogen and phosphorus have been overcome. However, chlorosis is frequently observed in plants grown in high-pH soils.

Then there are the relatively localized problems of salinity or alkalinization, encountered mainly in the irrigated areas (Gharb, Tafilalt, Tadla, etc.) or the regions where vegetable crops are grown (Casablanca, El Jadida, etc.), which are due chiefly to poor control of saline groundwater or the inappropriate use of poor-quality irrigation water.

The impact of man on the landscapes and soils of Morocco

While man played virtually no part in the processes of soil formation from the initial stages of pedogenesis until recent times, the situation is quite the reverse at the present time, the traces of his actions being manifest in practically all the soils of Morocco.

In fact, with the increase in energy and food requirements and owing to the adoption of modern agricultural techniques, the environment has changed so drastically during the last two or three centuries that man may be said to have become the main soil-forming factor. Man is an "artificial" factor in that he modifies the environment primarily for "social" reasons, so that the changes observed today in the soils are adverse (soil deterioration or regression), and often abrupt on a pedological timescale. These changes involve the typical processes of periods of rhexistasis (Erhart), during which the delicate balance between the soil and vegetation, and hence the soil itself, are profoundly affected.

The direct effects of agricultural land use in Morocco are, for example, mixing of the surface horizons of the soil, reduction of the proportions of organic matter in the humus layer (falling below 3% in isohumic soils and 2% in vertisols), an increase in soil surface temperature and substantial changes in soil moisture characteristics and evaporation (particularly in irrigated and artificially drained regions).

The main indirect effects of man's influence on the environment and the properties of the soil are accelerated soil erosion, cumulization and degradation, and desertification.

Accelerated erosion is a serious problem in the hills or mountains where average rainfall is about 700 mm or more per year (e.g., the Rif, the Middle Atlas, the Pre-Rif, etc.), and where the natural forest vegetation has been used as an energy source or has been cleared and replaced by crops to meet the population's food requirements.

In friable materials such as marls, land clearance often gives rise to mass movement (solifluction) which may shift earth masses weighing dozens of tons per square kilometer, or the development of ravines and gullies which may ultimately turn the original landscape into a badland. Vigorous sheet erosion also takes place when crops are grown in marly soil. Entire landscapes in the Pre-Rif region are currently exhibiting all the characteristics of these regressive evolutionary processes. Runoff water gradually carries off to the rivers a high proportion of the surface horizons of the soil, or even the subsurface horizons, formed under the climax vegetation. Land studies conducted at the Wadi M'da Station in the north of Morocco (Heusch, 1970) show that soils may lose about six times as much material through surface erosion as soils with sparse natural vegetation. The same study also shows that plowed fields are much more susceptible to erosion than unplowed fields left fallow (about twice as susceptible in the case of traditional plowed soils and eight times as susceptible in soils plowed by tractors). Accelerated erosion is not only responsible for frequent movement of soil masses on steep slopes but is also more active on river banks. Destabilization of the banks obviously makes solifluction on the slopes more critical.

In cleared soils formed from a more compact parent material (hard limestone, sandstone, etc.), erosion is perhaps not quite as intense in terms of tons per square kilometer, but will gradually result in stripping of the uppermost horizons of the soil, and ultimately of the entire soil, as has occurred for example on the long limestone crest of the Rif region.

Cumulization processes and flooding are a frequent consequence of accelerated erosion. Sediments entrained by runoff accumulate at the bottom of slopes or are carried directly into the rivers. Soils which undergo increasingly severe erosion and are covered excessively thinly with vegetation gradually cease to be able to absorb all the rainwater, so that sudden increases in river water levels give rise to increasingly frequent flooding in some of the alluvial plains of Morocco (e.g., the Gharb region). The average life of dams built to control flooding or provide drinking or irrigation water is sometimes critically reduced (15 to 35 years in the north of Morocco).

It is not easy to solve these water erosion problems owing to the powerful social pressures (the need to produce food or find energy, and the difficulty of moving entire populations in order to avoid the situations mentioned). Evidently, from the technical point of view, reforestation is essential for erosion control. However, reforestation will not overnight replace the precious soil which has been carried away, and it will not solve the majority of the social problems.

Soil degradation, another effect of erosion, takes different forms according to the climate prevailing in the various parts of the country. In the cultivated areas, modern agricultural techniques - in particular, the use of the disk plow - may increase soil compaction, reduce water infiltration, and adversely affect the soil structure. In soils with indurated "petrocalcic" horizons, deep plowing may bring about an improvement (by increasing the useful depth of the soil), but may also cause excess concentrations of lime in the surface horizons, which are often already saturated with limestone. In the more arid zones, overgrazing, largely due to population pressure, also adversely affects the soil structure and water infiltration. It may cause the gradual disappearance of the climax plant species and a reduction in plant cover, resulting in increased runoff and susceptibility to wind erosion. In irrigated areas, the change in the moisture characteristics, combined with insufficient drainage, too often causes the water table to rise. Since the groundwater contains salts in most of the irrigated areas, salinization or even alkalinization may affect large areas; this has occurred in the Moulouya, Gharb, Tadla, and Tafilalt regions. In the Tafilalt, for example, oases which were once fertile may be lost and gradually replaced by desert.

The overall process of soil degradation, coupled with over-exploitation of existing vegetation, may in the semi-arid or arid regions of the country give rise to the development of steppes or desertification. For instance, surveys carried out in North Africa since the beginning of the 1970s show that the area of forest has decreased substantially, with

degradation of the climax vegetation of the steppes, accompanied by increases in the incidence of plants such as Artemisia herba alba, Plantago albicans, and miscellaneous varieties of Stipa. It is also becoming common knowledge that, for climatic reasons and because of the action of man, the Sahara is at present advancing on both its northern and southern flanks and that the Moroccan territories at the edge of this large desert are not being spared by this encroachment.

Topics for research

As indicated above, there are many subjects for research which could be investigated more thoroughly in order to obtain a better knowledge of the natural environment in Morocco.

The serious problems of erosion and soil conservation obviously call for particular attention (some of these should indeed be tackled in combination with forestry research). Then there is the great importance of the water content of the various soil types and its variation with time (regimes), with relief, with plant cover, and with soil utilization.

The effects of modern agricultural techniques on the properties of the soil constitute another group of research topics to which little attention has hitherto been devoted; for example, the effect of irrigation on the leaching of nutrients, the movement of clay colloids in the soil profile, the formation of irrigation crusts, breakdown of structure, etc., or the impact of the use of large-scale equipment on the physical properties of the soil (structure, crusts due to plowing, etc.).

With regard to soil fertility and the use of fertilizers, much work remains to be done on the maintenance of fertility. It is also necessary to establish and disseminate specific standards for each ecosystem, type of soil and crop, and, for example, to gather more information about trace elements and biological nitrogen fixation.

Finally, surveys (soil, climate, etc.) must be continued in accordance with national priorities and the development programs in hand.

ANNEX 6

PRESERVATION AND ENRICHMENT OF THE GENETIC STOCKS

1. The establishment, enrichment, and maintenance of national genetic collections are activities of paramount importance for the future of Moroccan agriculture. These collections are at present being established and enriched in the fields of perennial crops, forage crops and pastoral crops and forest species, with regard to which the "Institut Chérifien" appears to be playing an important part. On the other hand, special efforts should be devoted to genetic collections of the main food crops; more particularly, cereals and food legumes, a large part of the old collections of which has been lost. Under the auspices of the International Board for Plant Genetic Resources (IBPGR) within the FAO, a huge pool of genetic resources from which INRA could benefit is maintained and developed on a worldwide scale by the international centers of the CGIAR and the research institutions of a number of countries (INRA France, USDA in the USA, the CSIRO in Australia, etc.).

2. Owing to the wide variety of its agricultural, pedological, and climatic conditions, and of its farming systems, Morocco is in a particularly favorable position to hold an extremely diversified range of genetic resources. INRA's Department of Plant Improvement should set up as comprehensive as possible a genetic collection, mainly for cereals (barley: 2.4 million ha, durum wheat 1.5 million ha, soft wheat 0.55 million ha sown each year), which represent over 80% of the area under cultivation and account for over half the money value of plant production. The problem is most serious for the varieties of barley and durum wheat, which are the main cereals of the marginal areas of rainfed agriculture and the traditional farming systems, for which only about ten varieties are commonly used by farmers.

3. Sustained efforts should be made for the survey, enrichment, and preservation of genetic resources in Morocco. Priority should be given to the establishment of an Introductions and Genetic Collections Service (SICG) and decentralized genetic collections at Regional Centers (CRRAs) and specialized Regional Stations (National Centers).

It would be logical for the Introductions and Genetic Collections Service to be located within the Plant Improvement Department (see Annex 12) in Rabat, owing to its vital role in the variety improvement programs and the need for close and compulsory cooperation between SICG and the Quarantine Service of the Department of Plant Protection. SICG's main function would be to maintain, enrich, and preserve the genetic collections and to act as a central coordinating body for all information, observation, and biogenetic data on all species, varieties, and cultivars, whether indigenous or introduced to Morocco. The genetic collections proper will, of course, be decentralized to the CRRAs according to the geographical location of the sectoral (commodity) programs (citrus at El-Menzeh; other fruit-trees at Aïnt Taoujdate-Meknes; vegetable crops at Agadir, etc.) attached to them or to the specialized regional stations (National Centers).

The Introduction and Genetic Collections Service, being an indispensable scientific support service to genetic and varietal improvement programs as well as to the Foundation Stock Seed Service of INRA, should be closely linked to the activities performed by the Quarantine Service of the Plant Protection Department and to the work conducted by the DPVCTRF.

4. The specialized mission recommended within the activities of the Foundation Stock Seed Multiplication Service (SMSB) as described in Annex 7, should also review all of the problems relevant to the Introduction and Genetic Collections Service of the Plant Improvement Department.

The International Board for Plant Genetic Resources (IBPGR), located in FAO (Rome), and the Plant Introduction Services of the CSIRO (Australia) and of the USDA Center (USA) could be consulted.

ANNEX 7

MULTIPLICATION AND CONDITIONING OF FOUNDATION STOCK SEED

1. PRESENT SITUATION

INRA is responsible for the production, multiplication, and conditioning of foundation stock seed. This activity takes up a high proportion of its capacity and its human and financial resources. The production of "foundation stock seeds for distribution" and their multiplication (G1 and G2) on a sufficient scale for subsequent multiplication is the responsibility of a research institution.

However, the multiplication and conditioning of foundation stock seeds of annual crops, cereals, food legumes, oilseed plants, forage crops, and miscellaneous industrial crops are activities whose organization and management are excessively burdensome for a research institution. The management of such activities is generally entrusted to a specialized state agency, a para-statal institution, or even a private body. All the CRRAs are engaged in the production of seed or plant material; however, large-scale multiplication, requiring substantial equipment and large-scale conditioning and storage facilities, is entrusted to some Regional Centers (Kenitra, Fez, Khemisset, El Jadida, and Beni-Mellal) and the main stations associated with them (Douyet, Merchouch, Deroua and Afourer).

The CRRA and Station Managers reckon that 30-40% of the operating budgets and 40-60% of the areas under cultivation are devoted to the multiplication of foundation stock seed (see Table 1).

Production of foundation stock seed - 16,776 quintals for various crops in 1981-82 - occupied a total area of 1,925 ha; this represents over 25% of INRA's land resources (see Table 2).

These proportions appear prohibitive for a research institution which already lacks the human and financial resources needed for its own research programs. Again, the Law and Implementing Decree establishing INRA (see Annex 4) do not mention seed multiplication on this scale as one of the essential functions of the Institute.

2. HISTORICAL BACKGROUND

The importance attached to seed multiplication by a research institution such as INRA is attributable to historical and other factors.

The historical factors date back to 1919, when responsibility for agricultural research was vested in an Agricultural Experimentation Service which also had to produce foundation stock seeds, and to multiply them on a massive scale for distribution, because there were no other

state bodies or specialized structures at the time. This function was strengthened in 1957-58, when the Agricultural Research and Experimentation Service decided to set up a Seed Testing and Production Control Station.

In the days when research was carried out by a Directorate of Agricultural Research (DRA) within MARA, a Technical Control and Seed and Plant Multiplication Service was set up within DRA, which thus assumed responsibility for multiplication of foundation stock seed and plant material, an activity which became more and more important in the 1960s and 1970s. As an appropriate function of research activities in the field of genetic and varietal improvement, the production and multiplication of foundation stock seeds (breeder seeds) expanded gradually. Also responsible for quarantine and introduction services, the maintenance of the national catalog of varieties, and the control of seed quality, the DRA was therefore the obvious choice for undertaking the large-scale multiplication of foundation stock seeds for agriculture's growing needs.

In 1981, after INRA was established as a semi-autonomous body under the control of MARA, some of the functions mentioned above were transferred to the Directorate of Plant Production, Technical Control and Prevention of Fraud (DPVCTRF). Multiplication of foundation stock seeds continued to be performed by INRA, as the Institute already had the necessary stations, infrastructures, and equipment.

Aside from these historical factors, the argument put forward in favor of the retention of this activity is that seed multiplication provides INRA with substantial revenues and justifies the granting of requested budgets in view of INRA's involvement in large-scale multiplication of winter cereals. However, in the opinion of all those responsible for seed multiplication, this operation is conducted at a loss. It is said that large stocks often remain undisposed of at INRA's major storage facilities (Douyet and Merchouch) when they cannot be marketed by SONACOS.

At any rate, INRA satisfies only 40% of the country's demand for foundation stock seed.

3. INRA AND THE SEED MULTIPLICATION SYSTEM

The procedures of varietal selection and seed multiplication before the improved, tested, and certified seeds reach the farmer are relatively complex. A simplified diagram of these operations in Morocco is given in Figure 1.

Varietal selection is based on the collection of Moroccan genetic stock, genetic resources from abroad, and the work of selection and genetic improvement. Plant improvement has been the most important factor in winter cereals, for which nearly 100% of the improved seed varieties have been selected or created by INRA. Conversely, introductions have been more important in varieties of sugar beet, potatoes, oilseed plants, and most varieties of maize (see Table 3). Introduction is also the main source of newly created varieties for all vegetable crops.

Table 1 - AREAS DEVOTED TO SEED MULTIPLICATION AT SOME OF INRA's EXPERIMENT STATIONS

Regional Center (CRRA)	Total area of stations	Useful agricultural area ha[e]	Area devoted to seed	%
Kenitra all stations	991	± 700[c]	438[a]	57
Fez Douyet	400	± 350[c]	258[a]	71
Khemisset Merchouch	1,110	908[c]	500[a]	53
El Jadida	320	± 250[c]	150[b]	75
Beni Mellal				
Deroua	415	± 380[c]	320[b]	84
Afourer	250	± 200[c]	150[b]	75
Other stations[d]	-	-	-	-

(a) Figures obtained from activity reports.
(b) Approximate figures supplied by scientists.
(c) Figures calculated from activity reports or by extrapolation.
(d) Figures not available.
(e) The useful agricultural area includes all sown land and land in use for rotation cropping, including fallow land and unused spare land.

Table 2 - FOUNDATION STOCK SEED PRODUCTION AT INRA 1981/82

CROP	Area (ha)	Certified production (quintals)
Durum wheat	544	4,827
Soft wheat	384	7,445
Barley	118	1,359
Oats	31	286
Maize	49	111
Rice	7	374
Fodder legumes	477	1,298
Food legumes	149	606
Industrial plants	166	470
TOTAL	1,925	16,776

Source: Annex "Foundation stock seed production results" ["Réalisation en production de semence de base"]. Conseil d'Administration. INRA-Rabat. July 1983.

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Table 3 - PERCENTAGES OF VARIETIES ORIGINATING FROM INRA AND FROM EXTERNAL SOURCES (APPROXIMATE FIGURES)[a]

CROP	INRA VARIETIES	EXTERNAL VARIETIES
Winter cereals	100%[b]	-
Beets	-	100%
Potatoes	-	100%
Maize	20%	80%
Oilseed plants	-	100%[c]

Source: Interview with senior DPVCTRF staff on 18 January 1984.

(a) Provisional estimates supplied in discussion.
(b) These are varieties officially recognized and registered by DPVCTRF. The large State corporations and private companies import and sometimes multiply varieties which bypass the official channels.
(c) The varieties of oilseed plants are imported.

In theory, no seed or other plant propagation material may be imported without the consent of DPVCTRF. However, owing to administrative delays, import formalities and the relatively long time taken for variety testing and approval, DPVCTRF is often bypassed, imported seeds being directly multiplied and distributed to farmers.

In the case of some crops (potatoes, tomatoes, peppers, and some other early vegetables), there are faster variety testing and approval procedures, with prior arrangements between DPVCTRF and the foreign companies in particular when these not only supply but also export and market the product in Europe. The registration of tested varieties is usually conducted by the Office de Commercialisation et d'Exportation (OCE), State corporations, and associations of early vegetable producers, who take part in development projects in this sector. After one or two years of testing, the varieties chosen may be imported and distributed to growers. In the case of potatoes, large quantities of seed are imported and then multiplied directly by farmers.

The official selection, adaptation, catalog registration, and multiplication procedures take too long for the growers: there are several levels of observation tests, preliminary yield tests, intermediate tests, and advanced tests before a new variety can be

registered for catalog tests, which are themselves relatively prolonged. For this reason the rate of emergence of new varieties is very slow.

As Figure 1 shows, seed multiplication takes place in three stages. INRA's seed breeder produces the "breeder seed", which is then multiplied. INRA currently multiplies foundation stock seeds from G1(*) to G4 and then R1 and R2.(*) Multiplication of certified seeds is the responsibility of the "Société Nationale de la Commercialisation des Semences (SONACOS), which contracts out seed multiplication and does the conditioning and the marketing of the certified seed. DPVCTRF is responsible for quality control, inspection, and approval of all certified seed after conditioning and prior to distribution to farmers.

The following two bodies are responsible for coordination between selection and seed multiplication:

- the Plant Selection Commission, which determines the varieties to be registered in the national catalog;

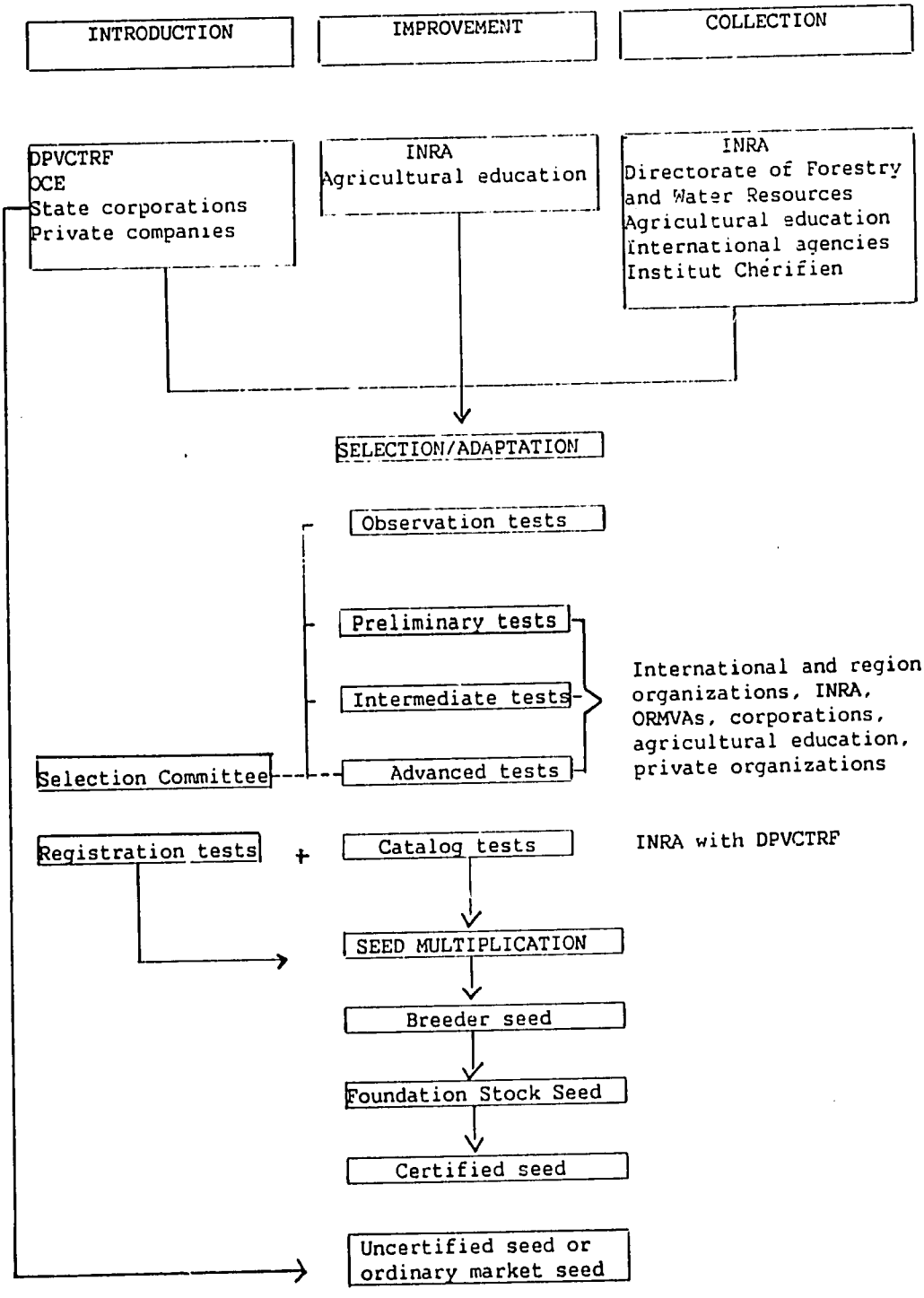
- the National Seed Committee, which decides on Morocco's seed requirements in terms of species and variety as well as the phasing of imports and short-, medium-, and long-term production.

These MARA bodies, on which INRA, SONACOS, DPVCTRF, and MARA's Directorates for Plant Production and Agricultural Extension are represented, meet annually. The system as a whole is intended to yield a smoothly operating and coordinated program of seed multiplication, but most of the varieties issuing from the selection programs fail to meet all the farmers' requirements, and not all of them find purchasers in the market.

The rate of seed renewal is a measure of the conformity of the varieties to market requirements. In the case of durum wheat, the present rate of seed renewal is relatively slow, while the rate for barley seed - barley being a species of vital importance in the arid parts of the country - has never been calculated. However, the 1969 Investment Code greatly favored the multiplication of soft wheat seed, no subsidy being granted for the multiplication of certified barley seed (barley giving half the yield of wheat and bringing half the price of wheat on the market). This explains why even those with the necessary infrastructure and technical facilities to multiply seeds do not contract with SONACOS to produce barley varieties. This problem will probably be solved when INRA's research programs ultimately yield barley varieties more suited to farmers' requirements and the traditional cultivation systems prevailing under the various agroclimatic and sociotechnical conditions (see Annex 10).

(*) G= generation. R= reproduction.

Figure 1. GENERAL DIAGRAM OF VARIETAL SELECTION AND SEED MULTIPLICATION IN MOROCCO



4. CHANGES IN OBJECTIVES

The multiplication of advanced generations of foundation stock seed at present takes up excessive material and human resources and does not allow INRA to perform the four vital functions required for seed research, viz:

- to safeguard the genetic stock (see Annex 6);
- to ensure sufficient production of seeds of selected varieties for registration in the catalog and for distribution;
- to supply in sufficient quantities stock breeder seeds of improved varieties conforming to market requirements in order to meet the needs of foundation stock seed and certified seed multiplication;
- to improve techniques regarding seed control and physiology and the administrative and legal procedures for seed multiplication in cooperation with DPVCTRF.

These four functions are directed towards the attainment of specific objectives and are a responsibility of research. The multiplication of advanced generations of foundation stock seed is the responsibility of one or more specialized bodies designed and equipped to perform activities of this kind. These are two very different types of operations; the former is a scientific matter for which INRA is and should be responsible, while the latter is a matter of mass production, highly specialized and directed towards the market, and should be undertaken by a body specifically established for the purpose (e.g., SONACOS).

5. SUGGESTIONS

The separation between activities involving stock breeder seeds - a research function - and those concerned with the multiplication of foundation stock seed - the responsibility of a specialized body - should be implemented in two stages:

- separation of the two activities within the structure of INRA;
- transfer of INRA's current seed activities to one or several organizations.

5.1 Separation of the budget and management system for foundation stock seed production from the research function can be achieved by the establishment of a Foundation Stock Seed Multiplication Service (SMSB) at INRA, under the responsibility of the Director of Regional Centers.

The phasing of the separation could be as follows:

- organization of a special mission on genetic resources (see Annex 6) and seed multiplication (breeder seed and foundation stock seed) in Morocco, with a view to determining the respective functions and responsibilities of INRA (breeder seeds) and of a specialized body (multiplication of foundation stock seed);

- drafting, by INRA and SONACOS, together of a foundation stock seed multiplication program based on user demand (varieties with precisely specified technical and commercial characteristics) and on the conclusions of the mission mentioned above;

- cost-benefit study of foundation stock seed multiplication at INRA; preparation of a budget and management system for the resources and infrastructures (restructuring plan) of a Foundation Stock Seed Multiplication Service (stock breeder seeds from G1 to G3 or G2 depending on species), this Service being entirely separate from the research activities;

- conclusion of an agreement with SONACOS and/or other competent bodies for large-scale multiplication of foundation stock seed (G4, and then G3 and R1 - R2) and the operational methods and procedures to be set-up for each species.

5.2 These suggestions entail a number of changes in INRA's activities:

- reorientation, concentration, and consolidation of seed multiplication activities in a limited number of stations specializing in this activity (more autonomous and market-oriented management) based on a cost-benefit study;

- amendment of staff regulations to take account of the career profiles and vocational skills required for management of seed multiplication: management of research is different from that of seed production.

In accordance with the development of research programs, technical, legal, and financial modes of operation of INRA's activities in seed multiplication and agreements with the specialized bodies, the whole of the national foundation stock seed production system will have to be reviewed. The role, functions, and place of the Foundation Stock Seed Multiplication Service will need to be reconsidered so as to enable agricultural research to concentrate its effort in widening and diversifying the genetic stock (see Annex 6) and to conduct more aggressive selection and genetic improvement programs directed to a greater extent towards regional requirements (see Annex 10).

5.3 INRA is strongly recommended to consider the organization of one or more specialized missions aiming to improve its genetic resources (see Annex 6) and foundation stock seed multiplication in different production sectors, in close collaboration with the International Board for Plant Genetic Resources (IBPGR), the international centers of the CGIAR, FAO, bilateral institutions such as INRA-France, GTZ, the Plant Introduction Service of the CSIRO (Australia), the USDA (USA), and other specialized institutions.

ANNEX 8

CRITICAL EXAMINATION OF THE CONCEPT AND PRACTICE OF DEMONSTRATION TRIALS

1. GENERAL COMMENTS

The expression "demonstration trials", which was frequently used during the Mission, contains a contradiction in terms. A trial is always an attempt to verify a hypothesis, to find an explanation or method of working, or to seek the best between a number of alternative solutions. The logical meaning of a demonstration is to teach and to persuade people of the efficacy of a solution or result obtained by trials or experimentation. The possible meaning of the term "demonstration trials" would be on different methods of demonstration, but this is not how the term is used.

The "demonstration trials" conducted in Morocco belong neither to experimental research nor to agricultural extension. They are demonstrations of unverified results, which have the undesired effect of short-circuiting research and extension activities.

Demonstration trials, in practice, are usually non-replication side-by-side comparisons, of cropping techniques, crop varieties and cultivars assumed to be better than traditional varieties and cultivation practices. They are generally carried out by the Centres de Travaux and the Offices de Mise en Valeur.

Although introduced with the best intentions, "demonstration trials" are dangerous, ineffective, and ultimately counterproductive. Their practice has many serious disadvantages, which reduce their effectiveness:

- The farmers' involvement in the design of the "trials" is virtually nonexistent, especially as regards identification of the cultivars, cropping practices, or cultivation techniques which are supposed to correct or replace those of the farmers. The farmers' involvement is in most cases confined to their consent or permission for the "demonstration" to be conducted on their own farmlands.

- The objectives of the trial and of the demonstration are confused. Are they intended to provide research with experimental sites for testing on-station technological innovations; to serve as an operational link between research and advisory services; or to spearhead research results where local extension services are weak or non-existent?

- There is no formal evaluation procedure that feeds back into this hybrid concept whereby subsequent trials might be modified. Reports mention impacts on production, although the participating farmers do not appear to be involved in the detailed analysis of the results. There is little evidence of follow-up of these demonstrations to obtain farmers' reactions and comments in order to continue, to

modify, or to drop the demonstrations. In addition to these general problems, there are others associated with the methodology of the "demonstration trials" which reveal their ambiguity. More important is the question of where the role of research ends and the role of extension and development services begins.

While both research and extension must maintain contact with farmers, the nature of this contact and target objectives are very different. The scientist endeavors to identify constraints and means to resolve them. The information he requires must enable him to develop experimentally verifiable hypotheses. His task is to extend experiments whereby he can confirm or invalidate these hypotheses. His task is to provide technical innovations (cultivars, cultivation practices, methods of fertilizer application, rotations, etc.), which can be proved to have a positive impact on production and are attractive to producers.

The extension worker has the same general problem-solving orientation as the research worker, but his function is not to test different technologies but to impart information by all possible communication techniques - including "demonstrations" - on technologies which have already undergone all experimental and adaptation trials under current conditions of production.

In addition to its role in the dissemination and communication of agricultural techniques confirmed by research, extension is also responsible for a range of services concerning the organization of producers' cooperatives, liaison between MARA and the farmers' associations, land redistribution, management of local input distribution services (Centres de Travaux), and other control and support services to development.

The trials - i.e., experimental research - are the responsibility of the research system, and success is achieved only by delivering an "end product". Demonstrations are the domain of extension and can only begin once there is an "end product" confirmed by research. These two functions - research and extension - are closely inter-related, but it is important not to confuse their respective responsibilities and approaches.

2. CASE STUDY OF TWO "DEMONSTRATION TRIALS"

2.1 DEMONSTRATION TRIAL ON A VARIETY OF WINTER CHICKPEAS - BENI-YAKHLEF (FORMERLY EL LOUIZIA) EXPERIMENT STATION AND FARMERS' FIELDS AT THE HASSANIYA I COOPERATIVE

Chickpeas in Morocco have traditionally been a spring crop. However, yields are low because rainfall is so irregular. INRA has introduced and evaluated varieties of winter chickpeas and has initiated a hybridization program with a view to incorporating this legume into the rotations during winter instead of the fallow which follows the growing of cereals in the rainfed "bour" agriculture zones.

As a part of the "food grain legumes" program, a technician from the Beni-Yakhlef Experiment Station contacted the Director of the Hassaniya I Cooperative and asked for a plot of land to carry out a "demonstration trial" of four winter chickpea varieties. The Director (employed by the Directorate of Agricultural Extension and Agrarian Reform) chose a site for this trial a few hundred meters from the Cooperative office. Two erect-spreading-habit varieties were sown in early December 1983. At the end of January the chickpeas were well established, with the erect-habit varieties showing some advantages, probably because of their ability to compete with weeds.

Discussions with the technician responsible for the demonstration revealed that no date had been set aside for the farmers of the Cooperative to visit the site, to discuss the objectives, method, or results expected from the demonstration. The farmer on whose land the trial was being conducted was described as a "hesitant volunteer"; he received the site planted and supplied with fertilizer, and in return was asked to care for the crop until harvest. The production would be the property of the farmer.

The discussions with the Director and some members of the Cooperative indicated some interest in this demonstration. However, they would have preferred the research station to organize trials on winter cereals and forage crop production.

This "demonstration trial" of winter chickpeas was not only valueless for the research purposes but also of no interest to farmers in terms of demonstration. As a trial for varietal adaptation, it would have been better to conduct it at the research station under controlled and biometrically valid conditions. As a demonstration, since the trial was irrelevant to the priorities of the Cooperative's farmers, it ultimately did not achieve its objective.

Nevertheless, useful information could have been obtained if the researchers at the station, the members of the Cooperative, and the farmers had met at the trial site to discuss their problems with this crop and why the weed problem exists. They might have jointly identified priorities and research topics more relevant to the conduct of a research program whose results would help advance progress toward growing chickpeas under rainfed farming conditions.

2.2 DEMONSTRATION TRIALS ON AN IMPROVED BREAD WHEAT PRODUCTION PACKAGE - TESSAOUT EXPERIMENT STATION AND FARMERS' FIELDS IN THE IRRIGATED AREA OF THE ORMVA OF THE HAOUZ

Morocco imports large quantities of wheat every year. The current drought has aggravated the problem due to crop failures in the dryland zones of the country. Vast investments have led to the construction of important irrigation systems throughout the country, to meet the objectives of reducing cereal imports and crop losses from drought. Reduction of wheat imports is the first priority of the development plans for the agricultural sector. Consequently, INRA has devoted considerable effort to cereal variety improvement, study of yield-increasing growing practices, and developing plant protecting methods. The ORMVA of the

Haouz is responsible for the development and management of the irrigation facilities in the arid plains surrounding Marrakesh. Extension work in the irrigated area is the responsibility of the Development Centers (CMVs). INRA's Tessaout station cooperates with the CMVs in the installation of "demonstration trials" on improved cereal production practices.

The two farmers cooperating in the "demonstration trials" were chosen by the staff of the CMVs. The sites occupy areas of 0.5 to 1 hectare, as one of the demonstrations is related to mechanization activities. Station and CMV staff work together to establish the demonstrations, which seek to show the superiority of the improved package of practices as compared to those practices by farmers. Table 4 gives the comparison of the practices being demonstrated with those currently used by farmers.

The two farmers interviewed after the trial doubted that they would be able to use the demonstrated production techniques, for the following five main reasons.

The first one mentioned was the cash cost of the operation: the new practices proposed entailed an expenditure of about 750 dirhams instead of the 450 dirhams usually spent by the farmer (a 66% increase).

Table 4 - COMPARISON OF DEMONSTRATED TECHNIQUES AND FARMERS' NORMAL PRACTICES

ACTIVITIES	DEMONSTRATION TRIAL	FARMERS' PRACTICES
Land preparation	Reversible moldboard plow	Cover crop disk
Fertilizer application	Broadcasting and disk plow with INRA-blended NPK.	NPK with cover crop or none
Sowing	Certified seed of varieties Nesma, Potam, Siete Cerros 5/70-32, grain drilled in rows.	Seed supplied by the farmer himself or Nesma, broadcast and covered by disk harrow.
Weeding	Herbicide.	Weeds hand pulled for fodder.

The second reason concerns water availability. The last two extremely dry years have reduced reservoir levels to such an extent that the surface areas farmed under irrigation had to be decreased, along with sowing-density reductions. There was a real risk that crop yields might be impaired more by water shortage than by lack of other production factors.

The third reason related to the equipment used: reversible moldboard plows and the grain drills used in the trials are not available for hire by small farmers.

The fourth reason concerns the mixture of fertilizers used in the trials, which is neither produced nor sold by FERTIMA (National para-statal fertilizer selling organization).

The fifth reason, which is the most important from the point of view of farming systems, relates to herbicide application. Apart from its cost, herbicide application reduces the availability of weeds used as feed during the early part of the winter growing season. This is a major disadvantage of the proposed system, owing to the lack of standing feed in the valley and in the natural ranges of the region.

This "demonstration trial" of production practices is another example of a hybrid operation doomed to failure. The trial was established on a farmer's field without a preliminary survey to identify current constraints and without reference to the farmer's ability to adopt the proposed improved cropping practices.

3. CONCLUSIONS

The "demonstration trial" is a double-target operation involving two components: research or experimentation (the trial), and extension or transfer of techniques (the demonstration). As a research operation, the trial is valueless, since it is inappropriate to a true scientific approach to solving farmers' priority problems. As an extension operation, the demonstration is useless, since it is premature and liable to impair the credibility of agricultural extension in the eyes of farmers.

These two operations are necessarily sequential and cannot be combined into a single one. This does not preclude coordination and joint action of research and extension in these two distinct operations - on the contrary.

The on-farm experimental research methodology, combining scientists, extension workers, and farmers, is described in Annex 10, on farming systems research.

ANNEX 9

RAINFED FARMING

1. The "arid and semi-arid zone research program" (rainfed farming program) is funded by the Moroccan Government and by USAID. The rainfed farming program is based at Settat, and its responsibilities embrace the development and adaptation of technologies aimed at increasing the production of cereals, legumes, and forage crop plants in regions with mean annual rainfall in the range 250-450 mm. USAID is funding applied agricultural research, socio-economic research, the training of MScs and PhD, MIAC[6] technical assistance, construction, and equipment.

2. The objective of the project is to strengthen the capability of INRA and other research institutions in the field of multidisciplinary research on small farmers' production constraints. Since most of the country's cereals and meat production come from these marginal areas, the Moroccan Government has assigned high priority to these regions in its Five-Year Development Plan. Owing to the value and importance of research on traditional production systems, USAID has decided to increase the funding of this program by $ 4 million, to an aggregate amount of over $ 26 million.

3. The current status of the project is the result of a number of independent actions which have only been coordinated in the last three years: it was only in December 1981 that a Regional Agricultural Research Center was set up in Settat, covering the Provinces of Settat, Casablanca and Ben Slimane. The five Experiment Stations which already existed in the region were assigned to the new CRRA of Settat, as well as the Rainfed Farming Research Center funded by the INRA-USAID Rainfed Farming Project. Under the aegis of this project, a number of administrative buildings and laboratories are now being constructed and experimental fields established near the town of Settat.

The research program of the Rainfed Project commenced in 1981 at two stations of the Marrakesh CRRA.

4. The Department of Rural Development of IAV Hassan II conducted a number of socio-economic surveys in 1977 and 1978 in the Haute Chaouia and in the District of Béni-Meskine. These sample surveys were carried

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(6) MIAC = Mid-Western Consortium of Agricultural Colleges.

out by students for their degree theses and were designed to describe plant and animal production techniques in four geographical areas with different types of soil. A survey of prices charged on five local markets was also conducted. With the assistance of the Rainfed Farming Program, a sample of 51 family farms was studied by the IAV students and directed by an INRA socio-economist in 1981. The information gathered over a period of five years is now in the process of analysis, but a preliminary report circulated in April 1983 describes the soil types, crop rotations, production techniques, yields, livestock herd composition, etc., in these four areas.

5. The agricultural and socio-economic research programs have hitherto been completely separate. There has not yet been a complete multidisciplinary analysis of the entire complex of agricultural trials and socio-economic components. The sole formal link which used to exist between the agricultural and socio-economic scientists was recently severed when INRA's only socio-economist left that institution to join IAV. The agricultural personnel of INRA and MIAC have concentrated on initiation of the Rainfed Farming Program and acquisition of the basic agropedological data required for conducting on-station research programs. Again, since scholarship holders returning from study in the United States must concentrate their work on subjects suitable for their doctoral theses, little effort has been deployed in the field of multidisciplinary research.

6. The results of the Chaouia study of 51 family farms were presented at a seminar on rainfed farming held in Rabat in April 1983. However, except for a recommendation by the Central Forage Crop Plants Station on grazing fallow land by the introduction of Medicago species, the results of the seminar do not appear to have significantly influenced the discussions about future rainfed farming research. One possible reason for this may be the distrust of socio-economists by the agronomists, who may have felt that socio-economic research was biased too much in favor of the small farmer and that the surveys did not answer what they felt to be the most important questions. Nevertheless, the published results of the survey showed that the areas of the peasant farms studied were on average three times as large as those of the Chaouia farms. And, after all, the objective of the joint INRA-USAID Rainfed Farming Project is to increase the production capacity of the small farmer.

7. The real problem seems to be difficulties in the coordination of the many different and sometimes contradictory activities and objectives of the various rainfed farming programs.

Some of the relevant factors are as follows:

- Government policy aiming principally at improving cereal production in the semi-arid regions, seeking quick results by concentration on the largest farms (over 10 ha), who are easier to approach by the Government's development services, as opposed to a Government policy of helping small farmers, which would have slower effects and would involve higher costs per farm and per unit increase in production;

- project providing potential subjects for research theses for students who have been trained in the United States and whose doctoral theses are largely based on a single discipline, as opposed to topics directed towards the development of interdisciplinary research capacities mainly focused on practical applications and on-farm research; a kind of work which is not so suitable as a subject for a doctoral dissertation;

- socio-economists who wish to confine their activities to the gathering and analysis of information, as opposed to the agronomists' wishes, who expect from them a more direct participation to facilite the adoption and the promotion of technologies currently under review;

- work schedules which require research workers to be present for long periods in the field, and hence to be assigned to the Regional Centers, as opposed to work schedules justifying prolonged periods or permanent assignment to headquarters in Rabat.

8. Although everyone concerned about and interested in rainfed traditional farming research and development systems has the same objective - improvement of the farmers' production and welfare - there is at present no consensus on a common methodology for analysis of problems of this type of agriculture with the farmers' participation.

Most commodity or disciplinary-based researchers consider that their main role is modernization of farms by the development of new technologies to maximize production. Even recognizing the value of these objectives, these research workers do not seem to accord sufficient importance to other production criteria essential to maintaining the coherence of the farming systems they endeavor to improve.

One example among others is the introduction of new varieties of barley, durum wheat, and soft wheat. The scientists are constantly referring to selection criteria for maximum yields, whereas those responsible for seed marketing point out that they have great difficulty in selling the high-yielding cereal varieties, because the size and color of the grains of these varieties are not always what the farmers want. The research workers' priorities and breeding criteria are not necessarily those which suit the farmers.

Aside from morphological and organoleptic characteristics, farmers mainly require varieties with larger ecological adaptability and more constant average yields, as they care more about production stability than high performance.

The socio-economists, for their part, seem to be more interested in small farmers' problems but are perhaps unable to clearly define who they are, what access they have or should have to agricultural services, and why each acts or reacts differently.

9. Action is to be taken on two fronts to bring together the socio-economic and applied-agriculture research programs. One concerns the strengthening of the American technical aid project on Rainfed Farming by including two additional specialists, one on farming systems and one on production economics. The second concerns a "Clearing House" ["Centre de Conjoncture"], to be set up under the Development Department of IAV, which will act as a central coordinating service for surveys and data retrieval. It will endeavor to extend the diagnostic studies to other semi-arid regions, to supply information on agroclimatic conditions, inputs and farmers' market conditions, and will conduct special socio-economic surveys on arid-zone agricultural problems.

10. While INRA and IAV were working on rainfed farming problems (1977-78 and 1981), MARA's Directorate of Plant Production (DPV) was conducting its own "experimental" program in the arid and semi-arid regions, and had indeed been doing so since 1973. On the basis of a bibliography of agricultural techniques in arid regions, DPV identified 48 agricultural practices which seemed to be relevant. Unreplicated treatments covering one-hectare trials in four sites during a single growing season provided, of course, no useful information and were abandoned after the 1974-75 season. Another large-scale trial, comparing plowing and mechanical sowing by disk harrow and broadcasting, was started and abandoned in 1975-76. A new program of trials was initiated in 1976, including the following three phases:

- "technical pathways trials", comparing (without replication) different types of treatments on different sites located in arid and semi-arid regions (1976-77);

- "analytical trials", in full "randomized" blocks with four replications (1979-80);

- "multifactorial trials", to be carried out up to 1986-87.

Simultaneously with the above program, DPV conducted a two-year program (1979-81) at 50 different sites, associating sowing dates with the most promising techniques resulting from the "technical pathway trials". A rotation trial was carried out during the same period at Settat, to observe crop rotation effects upon yields. Finally, DPV has also carried out several varietal adaptation trials in cooperation with INRA's Central Winter Cereals and Forage Crops Plants Station.

DPV has its own operational farm units in the arid region, called "cellule aridoculture", working through the "Centres de Travaux" responsible for the administrative management of these programs.

11. Other bodies, for example ACSAD and the research stations of the Directorate of Water and Forests, are also engaged in research on rainfed farming. Although so many research institutions are all working on rainfed farming problems, there is no consultation for joint programming nor coordination of operations at the field level. Presented in crude form, without any attempt to arrive at an overall synthesis, results are difficult to analyze, to interpret, and to communicate.

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The large number of and diversified rainfed farming research operations confirm the importance attached by Morocco to the development of rainfed agricultural systems. Unfortunately, all these research efforts are scattered and lack cohesion in regard to both objectives and strategies. They are conducted along different approaches, without any prior methodological consensus, and without any clear idea of who will benefit from them.

12. Within such a confused situation, the only valid recommendations are for:

- a more precise definition of the role and responsabilities of each institution (INRA, MIAC, IAV, DPV, etc.);
- establishement of research priorities and objectives based on identified technical and socio-economic constraints;
- pooling of endeavors and resources wherever possible;
- adoption of a joint methodological approach (see Annexes 10 and 14).

The following interim measures could be adopted in the short term without causing excessive upheavals (such as institutional restructuring and complete program recasting).

Rainfed farming research. INRA and its Rainfed Farming Project, IAV Hassan II, and DPV should coordinate their activities. To prepare for more open cooperation and coordination of effort, these institutions should together:

- identify apparent conflicts of interest (institutional conflicts) between them and take the necessary remedial action;
- determine the fields in which they differ in concepts and methodologies and tackle these problems as research topics (professional conflicts);
- conduct, through inter-institutional teams (INRA, IAV, Rainfed Farming Project, DPV), socio-economic and agrotechnical research directed to a greater extent towards production constraints identified by farmer target groups.

Research at Central Forage Crops Plants Station of INRA. The program financed by GTZ offers substantial opportunity for increasing the production of the large livestock farms. These research programs, based on industrial-type livestock farming systems are, however, penalized by lack of economic analysis. The research on forage crops should be extended to all other ranch and pasture crops better associated and integrated with farming systems research, particularly in the arid lands rainfed farming program, and more oriented towards small farmers' herdsmen's problems of the agropastoral region in the semi-arid and mountainous zones of the country.

ANNEX 10

FARMING SYSTEMS RESEARCH: GENERAL ASPECTS AND APPLICATION TO THE MOROCCAN CONTEXT

For a long time agricultural research in Morocco has been conducted along conventional lines, concentrating on problems whose solution was supposed to bring about substantial and rapid gains in productivity, but without devoting much attention either to the conditions underlying these problems or to the practical applicability of the solutions proposed. As a result, much of Moroccan agriculture remained neglected by research, and where it was carried out, research has not always been as effective as expected.

This situation is quite common and has been observed in other countries as well. In most countries research began with the study of the local environment and an inventory of resources, followed by the development of those resources which were located in the most favorable physical and social environments. The limitations of this classic approach have led to the development of a new type of research during the last fifteen years Farming systems research far from detracting from the classic approach, makes better use of it.

The Main Report notes in several places the considerable progress that is currently being made in this area in Morocco. This discussion of the subject deals only with certain general aspects of the nature and form of this new research approach which, because it is still evolving and cannot be codified, is already giving rise to different conceptions and "schools of thought". We shall begin with some consideration of the reasons for this type of research and its field of application, and then discuss certain specific aspects of the approach. Finally, we will propose a methodological approach for the development of such research in the Moroccan context.

1. REASONS FOR A NEW SCIENTIFIC APPROACH

Farming Systems Research (FSR) in no way conflicts with the classical research approach based on commodities or disciplines; the two approaches operate in different circumstances.

For highly productive and specialized farming (monoculture, cash crop plantations, industrial livestock production, etc.) and farm management mainly market-oriented and based mainly on economic considerations, the impact of innovations is fairly easy to predict, and results can be obtained quickly, provided that they conform to these economic constraints. Determinants other than those of productivity are then less important in the decision-making process for these farmers.

However, in forms of agriculture which, for various reasons, depend on combinations of different commodities - or are the result of a social system where income is not the only or even the main objective (but mainly food self-sufficiency, attachment to a lifestyle or form of social organization, etc.) - changes in methods of production are more difficult to bring about and can only be implemented if a large number of conditions are satisfied. For this reason the type of research to be undertaken must be based first and foremost on a good knowledge of these forms of agriculture and how they function technically and socially.

At the technical level, for instance, mixed (non-specialized) systems combine a number of commodities with different objectives but often with complex interrelationships. Action on one part of the system has repercussions on others, resulting in bottlenecks which are not evident at first sight. Hence the entire production system must be studied as a simultaneous system in which all factors are interdependent. Resources and means of production, physical constraints and the risks, the commodities themselves with their complementarities and competition, cropping and labor schedules, maintenance of crops, means of upgrading soil fertility, product characteristics and their on-farm use or marketing, are all interdependent, and their coherence must be established.

This coherence is itself determined by the system of constraints and objectives to which the farmer and his family are subject. Unlike modern forms of agricultural activity, where farming is seen as an enterprise, and the farm is an economic production unit, separate from the family as a social production unit, here the two are not separate entities. Running a traditional farm involves a very wide range of factors, relating not only to technical and economic issues (income, self-sufficiency in supplies, etc.) but also to patrimonial, sociocultural, and other factors. The family is generally engaged in social activities, to which the agricultural component must yield place. The family is the main vehicle for transmitting knowledge, technical and practical. It is therefore impossible to understand these forms of agriculture without an adequate knowledge of how the families cope with their subsistence, reproduce their way of living, react to progress and new opportunities, etc.

A further step must be taken, to underline an important feature of these forms of agriculture which are only partially within the market economy. They remain caught up in very specific and highly integrated social structures characterized by strong social relationships which influence access to production factors (in particular, land); impose some types of exchange (labor) while prohibiting others; and induce various forms of solidarity and obligations. They also maintain specific forms of power and control over local resources and endeavor to reproduce social structures whose rigidity and extent varies in individual cases. Finally, these local structures are themselves involved within the dynamic trends resulting from changes which are taking place in their national environment and in the international environment (population flows; expansion of the State and establishment of a local administration; changes in social relations; etc.). Whether one likes it or not, any technical intervention will be confronted with constraints and local interests; ignoring this will necessarily lead to failure.

For these reasons the role of research on forms of agriculture which are not mainly market oriented is very different and in some respects more complex than in other forms of agriculture. Here the aim of research is not technical innovation only, as in the classical approach, but also to identify appropriate innovations or coherent combinations of innovations and their conditions of application.

There is no doubt that the complexity of these traditional (non-market) agricultural systems is among the main reasons why research has hitherto either neglected them or has often failed when it has turned to them. However, they represent a very important part - probably the majority - of Morocco's agricultural potential, the reason why it is impossible to continue to neglect them.

We shall now attempt to define in what ways this research concept differs from the conventional approach.

2. SOME SPECIFIC FEATURES OF FSR

The first point to be made is that farming systems research forms part of a multidisciplinary approach involving experts in a number of fields: agronomists, crop production and livestock specialists, economists, sociologists, etc. Each first tries to identify the problems related to his own discipline, but they all must set them within the framework of the overall situation to be investigated. Hence there is a two-way flow of interaction between mono- and joint pluri-disciplinary research phases, yielding an increasingly more accurate and more comprehensive picture of the observed reality. During these joint phases each scientist has an opportunity to readjust his work in relation to others, to reformulate his hypotheses or to make new ones, etc. Each problem becomes clearer only when situated in its own context. Each discipline needs the insights from other disciplines for proper formulation of its own problems.

It is also on the basis of these progressive in-depth diagnoses that evolving situations and research needs might be jointly reviewed. More often than in conventional research, the identification of these needs is the result of team work: the multiplicity of determinant elements involved in FSR calls for a more rigorous, concerted, scientific, global, and time-consuming approach.

However, from the start, opportunities exist for limited but straightforward solutions to be given to the farmers, provided that these are appropriate and practical. A start must be made somewhere; farmers expect immediate help and as a rule do not perceive the length of time required by research. Moreover, these initial interventions may act as indicators in the research process itself, as will be shown later on.

What is essential in the first instance is a diagnostic stage free of any operational concerns, leading to a thorough understanding of the reasons farmers act in ways for which the justifications are not always apparent. This proposal implies the basic assumption of any FSR - that the production behavior of the farmer, even if its technical and economic rationale are not obvious, is nevertheless coherent and reasonable and cannot merely be discarded or rejected as old-fashioned or backward. On the contrary, the discovery of this rationale will help the outside observer to fully understand the system of constraints and contingencies to which the farmer is subject, and possibly to find ways of changing this system with prospects of success. After all, a farmer may accept any intervention provided it does not conflict with the coherence of his system, it helps to alleviate shortcomings, or it brings about sufficient and appropriate means to overcome the contradictions to which it gives rise.

The production system, a technical combination of production factors and commodities, is precisely the result of farming system's constraints to which farmers react through the combination of several technical pathways and sequential decisions. It is the raw material which the observer - or rather the team of observers - must grasp and analyze.

In this approach, the farmer thus becomes a privileged partner of the research team. Even if he is not always able to explain his decisions and to justify his practices, the comments he makes on them constitute valuable information, the basic material that scientists must collect and analyze. He responds to given situations, and his acts are always the result of constraints to bypass. The farmer expresses the implicit logic which motivates him. The same applies when proposals are made to him or when modifications occur in the environment. His dissents, his endeavors, the way he attempts them, their results, and also their repercussions on the rest of the system form part of the information to be collected.

However, the traditional approaches of scientific activities, - experimentation in particular - also have their place in FSR, but their functions and forms are more diversified and need to be specified.

First of all, a sufficient knowledge of the potential and local characteristics of the environment is required, irrespective of how these are currently exploited by local farmers. This may justify certain programs of measurements and trials under controlled-environment conditions.

Other conventional research, under controlled-environment conditions, may follow from the diagnosis made of the farmers' mode of operation, which may indicate the need for varieties with specific characteristics, not identified from current breeding programs.

An original feature of farming systems research is the need to conduct on-farm trials and experiments in true farmers' fields situations. These are not demonstrations, intended to extend to farmers ready-made innovations derived from experimental stations or theoretical laboratory schemes.

On the contrary, on-farm research aims to explore, through dialogs with farmers, all solutions which, on the basis of the first diagnosis, seem to be advantageous. These attempts facilitate progress in subsequent diagnoses and in testing the value of working hypotheses to be confirmed from thorough investigations at experiment stations or laboratories. They also ensure producers' interest and the active participation of farmers themselves; to provide them with prompt results without having to wait for the end of the program, which may be far in the future.

Farmers are not the only partners. Collaboration with development services, in particular the extension service, is also required. First of all, as in the case of the farmers, it is not very satisfactory to supply these services with ready-made solutions once the program has been completed. They will be more able to work out effective extension and development methods when they have followed and understand the process by which solutions have been arrived at by research. In addition, like the researchers, extensionists must experience the specific situation and rationale of groups of farmers with whom they have not previously been in contact. If they have a good knowledge of the region they serve, they would provide valuable information to the research team, especially during the initial phase. By virtue of their competence, they may also play a useful part in certain stages of the new approach, such as contact with farmers, follow-up, etc., thereby increasing the opportunities for intervention by the team.

3. METHODOLOGICAL APPROACH

The methodological approach of FSR involves a number of consecutive phases of studies, diagnosis, experimentations, and progressive evaluations, which begin and end with the farmers themselves.

The order of the operational phases is very flexible, the intensity of each depending on the nature and variability of the systems under investigation. This order must be matched to each individual situation and in accordance with its specific features. There is no standard methodology. Phases are cyclical and not sequential - i.e., they proceed by successive analysis and syntheses, each on a deeper level than the preceding one. The descriptive phase of the agricultural systems, and the phase of diagnosis of constraints, may be of short duration or extend over a number of years, depending on the objectives or difficulties of data gathering and interpretation. Faster alternatives exist for analysis and descriptive phases as well as for those related to the diagnosis constraints and opportunities for action.

The on-farm experiment phases conducted, either in cooperation with or directly by the farmers themselves, may take one or more growing seasons. On-station research to develop specific techniques or to generate new technologies may of course extend over many years (e.g., new varieties).

3.1 The initial phase is a descriptive one, embracing the typology of existing systems, during which it is possible to identify common and similar recommendations applicable to homogeneous agricultural regions or farmer target groups. This initial characterization is gradually upgraded through continuous progress of sociotechnical surveys and trials conducted on the farmers' fields.

The work of describing and classifying farming systems leads to the identification, in close cooperation with farmers, of a first list of problems and constraints and their order of importance.

Separate lists are established for problems identified by the farmers and those identified by the FSR team. Farmers often have different opinions and arguments from scientists as to the nature and relative importance of the constraints and problems confronting them. For example, while soil erosion may be perceived by the scientists in the Haut Loukkos as the main problem of the cereal production systems in the mountains, farmers for their part are more likely to emphasize the insufficiency of commercial outlets or the lack of credit for production as their main constraints. Late sowing and the presence of weeds are regarded by the scientists as the main components of the decrease in wheat yields in the semi-arid regions, while farmers attach more importance to the use of weeds as feed at the beginning of the season. The key issue here is that constraints and problems must be identified jointly by farmers and scientists so that research topics can be defined better on the basis of the true development priorities and that the "recommendation domains"(7) closest to the farmers' concerns can be formulated quickly.

3.2 For optimum solution to problems identified by farmers and the FSR team, the identification of biological and agro-socioeconomic research to be undertaken must be conducted in close consultation with research specialists, senior extension workers, and the development services of the region. Together they analyze the different working hypotheses, the appropriateness of improving current agricultural techniques, the need to generate new production techniques, and the prospects of these being accepted and adopted by the farmers. Relatively simple changes can often be made to existing technologies and cropping practices, or available technologies can be adapted. In other cases, in cooperation with local experiment stations, more detailed surveys must be carried out, new technologies must be developed, and more appropriate strategies must be devised to conduct on-farm experimentation.

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(7) A group of recommendations concerning technical improvements which are different but complementary for one and the same homogeneous group of farmers of a homogeneous agricultural region.

The main objectives of this phase are to draw up a working plan and timetables, to secure the necessary resources, to specify the procedures for analysis and interpretation of the trials, to lay down a system of ongoing evaluation of activities in progress and possibly to make changes to the initial recommendations on the basis of farmers' reactions, capacities, and performances.

3.3 Implementation and evaluation of the technologies recommended by the FSR methodology may be conducted by research at three levels:

- research based on crops, commodities, and disciplines at experiment stations and laboratories, where new agrotechnical problems need to be solved or when uncertainties remain as to the possibility of adapting a new technology, plant or animal material (a new variety or animal breed);

- on-farm experiment research or on-farm trials conducted by scientists with the participation of farmers, in a large number of experiment situations or within regional networks, to analyze the impacts of some production factor variability (e.g., access to inputs, variability of labor/capital ratios, etc.);

- on-farm trials carried out entirely by farmers without the involvement of research workers, with the view:

  . to determining the exact reasons for the adoption or rejection of technologies by farmers representating different types of farms in a specific area (degree of acceptance);

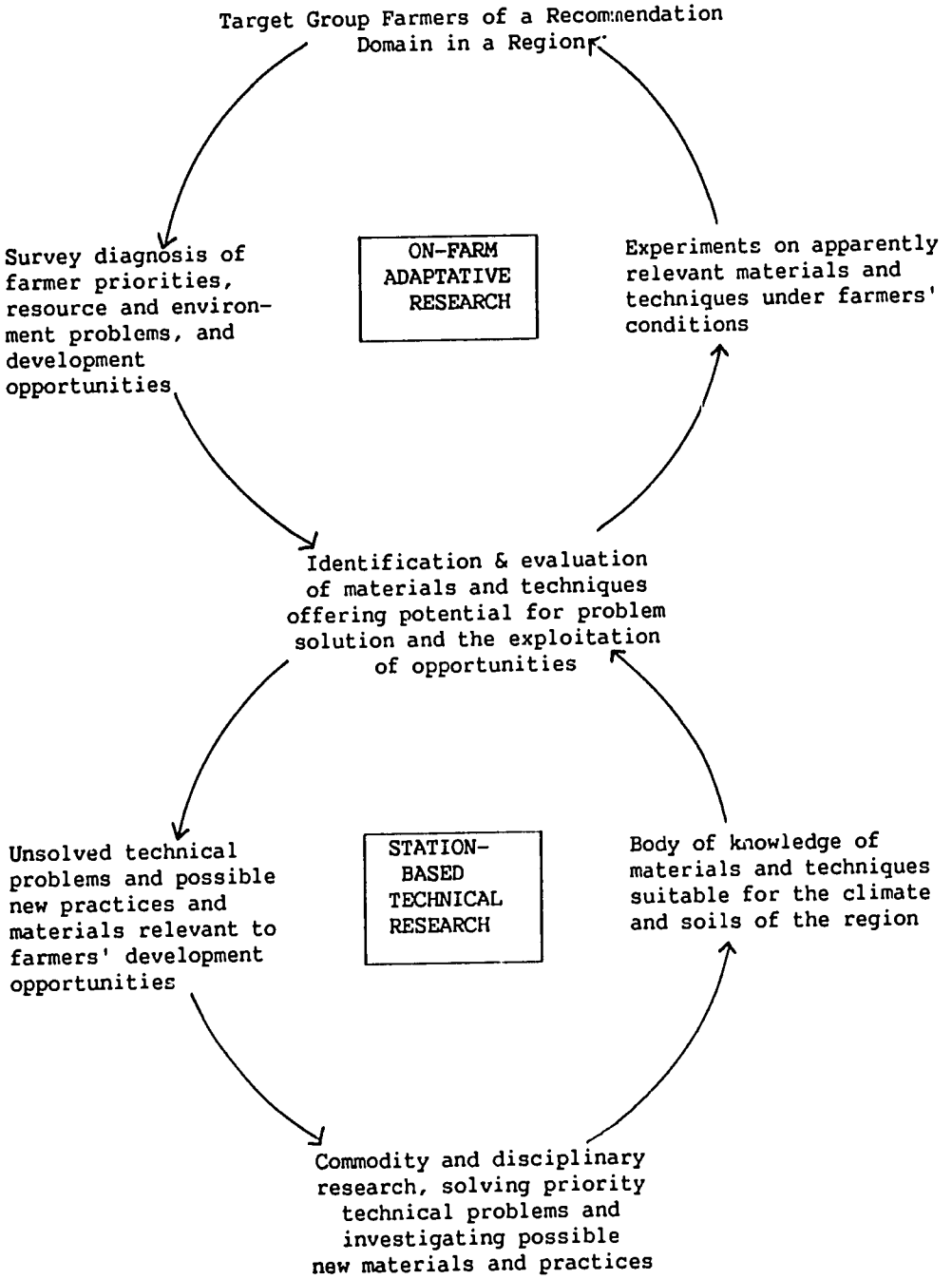
  . to sharpening the specificity of the recommendation domains for homogeneous regions or groups of farmers;

  . to testing the most effective methods to be used by extension and development support services in their demonstration campaigns.

Coordination of these three levels of action is important to assessing the most appropriate technologies in each case, as shown in the following diagram (see Figure 2). It indicates that the specificity of the problems and possible solutions to them must be identified under actual conditions of production and not only by on-station research workers. The diagram also brings out the need for a constant two-way flow of information and feedback between on-station research (commodities and disciplines) and on-farm experimentation conducted in farmers' fields.

3.4 The analysis of data and results from farm surveys, on-station research, and on-farm trials must be compared, analyzed, and interpreted quickly. One of the main problems of FSR is the maintenance of a relatively simple and effective system of data collection and analysis to evaluate technologies tested. Excessive accumulation of voluminous data,

Figure 2 . COORDINATION OF THE THREE LEVELS OF ACTION



Source: M.P. Collinson, "Farming Systems Research in Eastern Africa" (Fig. 1).

most of which are often insufficiently meaningful for fast and accurate interpretation of the results, should be avoided. Attempts to analyze all variables and components of production systems result in a massive accumulation of data which cannot be interpreted quickly. This is one of the most serious pitfalls of the FSR approach.

Experience has shown that surveys properly conducted by groups of specialists (biologists, agronomists, sociologists, economists, and extensionists) with the farmers can quickly and easily identify their main constraints and bottlenecks. Farmers' experience and intuition get closer to assessing the relative importance of priority problems or in specifying the recommendation domains and technical innovations to be investigated than do thorough surveys.

Quantifiable and measurable data, such as the dates and duration of field work, cropping timetables, superficies, use of inputs and their relevant constraints, etc., as well as socio-economic information directly related to the constraints identified by the farmers, are generally the basic data which prove to be the most useful for drafting and preparing FSR programs. The selective choice of information to be gathered and the fast interpretation and evaluation of the data by the entire FSR team are just as important as, if not more so than, the sum of all the information gathered. Frequent and periodic reassessment of the data collected and their validity is essential in order to insure that a FSR program remains in line with its objectives and stays within reasonable operational limits.

3.5 If the research is to succeed, it is essential for results obtained from on-farm trials conducted with and by the farmers and from on-station research to be evaluated repeatedly and frequently called into question. This represents in effect a "self-extension" of results by farmers and the maintenance of a constant and updated two-way flow of information between scientists, farmers, extension workers, and the personnel responsible for agricultural development.

3.6 The methodological approach described above is neither absolute nor linear, but is cyclical and is therefore adaptable to the new situations to which it gives rise as it proceeds. Each cycle allows a closer approach to be made from a better knowledge of the situations through surveys and diagnosis adjustments based on prior experience.

3.7 The triangular partnership between research, extension, and farmers is reinforced by each partner during the process, so that each function has the importance to which it is entitled. On-station experimentation under the responsibility of "research" is essential for the development of new technologies and the establishment of intrasectoral priorities (see Annex 1, Terms of Reference 1, footnote [2]).

The trials carried out by the farmers constitute a privileged link between research, agricultural extension, and the development services. They form the basis for large-scale extension work and the organization of development support services. Hence, it is a cyclical, repetitive, and progressive process, in which the farmers and their families are directly involved in research orientation, the evaluaton of its results, and, in lining up the activities of extension and development services.

4. FSR AT INRA

The FSR approach to conducting research programs is essential because it will enable INRA:

- to more effectively perform the functions assigned to it by the Dahir (see Annex 4), viz, "to examine and determine scientifically the practical procedures for application of results of its research and, in this context. to advise the bodies responsible for agricultural extension and farmers";

- to direct its research programs toward various objectives, and in particular those of the Government's development policy, regional balance and self-sufficiency in food; for these purposes it is necessary to improve the traditional systems and production conditions of the small farmers, who are responsible for over 80% of Morocco's production of cereals and livestock products;

- to strengthen its position and influence in the Governmental agricultural development systen and strategies;

- to consolidate its credibility with its supervisory Ministry and other ministries responsible for the development of rural communities.

The "Rainfed Farming Project" assigned to INRA and, to a certain extent, also the programs conducted by the Central Saharan Agriculture Station (SCAS) are at present the only ones directed to farming systems research. However, after several years of existence, these projects are still facing some difficulties (see Annex 9) which derived from the implications of FSR on the management of a research institute.

These implications principally concern structures, training of scientists, management procedures, and programming. For example, it is desirable for structures and management responsibilities to be decentralized to a limited number of regional operation bases having a critical number of scientists organized in mobile multidisciplinary teams in constant contact with the farmers.

The FSR approach calls for highly experienced scientists and technicians well versed in the multidisciplinary approach to agricultural problems. Closer cooperation with IAV (the recent cooperation agreement) and greater participation by INRA in the training programs of the

international centers (ICRISAT, CIMMYT, CIAT, ILCA, ICARDA) and the bilateral institutions (INRA-Montpellier, etc.) could enable INRA to diversify the training of its scientists and gradually to establish a body of experts specializing in this type of research.

To a greater extent than other procedures, the management procedures necessary for the performance of such work call for the decentralization of powers and responsibilities; a personnel management system providing greater incentives (special allowances, bonuses for working in the field, accommodation facilities, etc.); an effective logistics service; and a flexible budget system (a posteriori budget control system).

FSR has important implications for the programming and implementation of the programs. Presently, INRA's research is conducted through bimodal operational approaches, one commodity and one discipline, or through programs organized around a single production. Although this conventional approach obviously yields technical innovations, these do not give enough importance to the technical and socio-economic profiles required for their integration into the farming systems.

The adoption of a farming system approach to research entails changes in research concepts and objectives. To a greater extent FSR is directed towards improving the entire range of a system's components rather than each of these components individually. FSR therefore represents a more general approach; it begins by trying to understand the interrelations of all the parts of a system, starting first with men, who manage it with the means at their disposal and the constraints imposed by the environment.

The integration of these two different but complementary approaches calls for programming methods and procedures whereby the objectives and the means can be matched more precisely and in greater detail (e.g., a "program-budget").

5. CONCLUSIONS

FSR methodology induces farmers, scientists and extension workers to work together, to identify the constraints and to test the most appropriate technological alternatives. The programs defined by FSR can be used as a basis for guiding thematic programs and sectoral programs, and in particular for better assessing sectoral and intra-sectoral priorities. In view of the complementarity of thematic sectoral (commodity) and farming systems programs, it is desirable that political and institutional decisions be made jointly so as to better define agricultural development objectives (political decisions) and priorities, and to optimize resource allocation among various programs (professional and institutional decisions).

Farming systems research has many advantages and is an effective approach focusing agricultural research on problems of direct interest to farmers.

The FSR approach is particularly useful to traditional agriculture systems with mixed and associated crops, combined crop and livestock farming systems, and specially for subsistence agriculture systems under marginal conditions of production.

Because of the wide diversity of agricultural systems in Morocco - particularly in traditional rainfed farming systems and Saharian agriculture, INRA's research programs should be strengthened along a farming system perspective.

In view of the implications of such a strengthening in terms of training of specialists, the formation of multidisciplinary teams, the mobility of scientists, the decentralization of research operations, budgetary flexibility and other matters mentioned in this Report, it is suggested that INRA engage itself progressively in FSR and in accordance with its planning and resources capabilities. The FSR approach is not a panacea. It is not applicable in all circumstances, and it certainly does not preclude the conventional system currently in use at INRA, which is perfectly suitable for monocrop systems, large perennial plantation systems, or intensive industrial or commercial-type farming systems.

National agricultural research in Morocco must be able to master these two approaches simultaneously. For the reasons mentioned above, it is suggested that INRA should develop its FSR on a gradual basis, as follows (recommendations given for illustration only):

- strengthening and better integration of the programs and staff engaged in the Rainfed Farming Project and the activities of Settat Regional Center;

- gradual formation of an INRA/IAV team of scientists specializing in FSR, and strengthening of in-service training, with short-term training courses for other INRA scientists and technicians at the international agricultural research centers (IARCs); strengthening of commodity-based and discipline-based research programs in accordance with technical and socio-economic profiles identified during diagnostic surveys;

- establishment of the IAV "Centre de Conjoncture" in collaboration with INRA's Data Processing and Statistical Analysis Bureau;

- gradual consolidation of INRA's involvement in the Rainfed Farming Project and extension of activities of this Project to traditional farming systems in other unfavorable rainfed areas with different levels of rainfall and with the return of INRA's newly trained scientists;

- consultations, technical meetings, and working groups on the integration of FSR, commodity-based and discipline-based research in cooperation with bilateral and international institutions;

- gradual alignment of INRA's research management and programming system with this dual approach (FSR/conventional subject and commodity research);

- gradual extension of FSR activities and programs to other systems of farming (irrigation, intensive controlled systems, etc.);

- active participation of INRA scientists in international meetings and greater cooperation with the international centers (CGIAR), bilateral institutions (e.g., INRA-Montpellier) foreign universities specializing in FSR, such as East Anglia (UK), Michigan State , Purdue, etc. (USA), and the University of Florida's Farming Systems Support Project (FSSP) (USA).

ANNEX 11

DIRECTORATE FOR INFORMATION AND TRAINING

This Directorate would comprise a number of support services essential to research management, internal organization, and contacts with the outside world. It would be under the control of the General Secretariat and would include the following services:

- information and documentation service;
- publications service;
- communications and external relations service;
- education and training service.

These services would work together closely with all of INRA's Directorates - in particular, the Directorate of Programming, the scientific departments, and the Directorate of the CRRAs (Regional Agricultural Research Centers).

1. INFORMATION AND DOCUMENTATION SERVICE

1.1 Morocco has a National Documentation Center, attached to the Ministry of Planning, whose functions and services cover all of the country's requirements. This Center plays a coordinating role between the national and regional establishments and worldwide information systems such as UNESCO's general information program and the international systems specializing in agriculture (AGRIS and CARIS) in conjunction with FAO.

Because the National Documentation Center (CND) exists, this does not mean that INRA should ignore documentation problems or leave the entire responsibility for information and documentation services in the field of agricultural research to CND. However, the existence of CND would enable an Information and Documentation Service (SID) of INRA to specialize to a greater extent in the field of scientific information, agricultural technology transfer and exchanges, and the compilation of a specialized bibliography of agricultural sciences and research.

1.2 INRA's Information and Documentation Service (SID) would work together very closely with CND, not only to avoid duplication of effort but also, and in particular, in order to widen national documentary coverage to encompass all scientific specialties and agricultural research activities.

SID's main task would be to establish a central library at its new buildings at Rabat and specialized, decentralized documentation centers at the CRRAs and Regional Stations. SID would be an essential instrument for the management of knowledge, the guidance and conduct of the research programs and a continuous exchange of information, both within INRA and with the international scientific community.

1.3 SID, working closely with CND, would have the following functions:

- collection, cataloging, and holding of the stock of documentation and archives of all publications, reports, and working documents resulting from agricultural research activities;

- establishment of a specialized central library containing the main fundamental publications and reference works, journals, and periodicals relating to agricultural research and the development of agricultural sciences and techniques;

- organization of a document exchange and reproduction service (photocopying, microfiches, etc.) for INRA's own needs, distribution, updating, and inventoring of the scattered bibliographic documentation held by the network of CRRAs and Regional Stations distributed throughout the country;

- maintaining an information system on the research programs, operations, and activities in progress throughtout the country, as a frame of reference for the periodic reports, annual reports, mission reports, and other technical documents compiled for all research activities, in cooperation with the Secretariat of the Directorate of Programming;

- participation through CND in FAO's AGRIS and CARIS documentation systems and in other specialized international, regional, and bilateral systems, and involvement in the forging of links and the establishement of ongoing exchanges with agricultural research institutions in other countries with similar agricultural, ecological, and climatic conditions to those of Morocco (Mediterranean climates);

- organization, in cooperation with the Data Processing and Statistical Analysis Bureau and CND, of a central computerized service (using office automation and information technology) for bibliographic selection and individually tailored documentation and bibliographic services in accordance with user interest profiles (scientists, extension workers, farmers, agroindustries, etc.);

- raising the level of staff technical competence, activation of the internal flow of documentation, and helping scientists and technicians, research teams, program (or project) leaders, scientific departments, CRRAs and Regional Stations to gain access to general scientific information and information corresponding to their interest profiles (question-and-answer service in cooperation with CND);

- transfer to microfiche of archival documentation of past agricultural research (cf. the archives of INRA France, ORSTOM, and the GERDAT institutes);

- cooperation with the other services of the Directorate of Back-up Services in program management and the training of the Institute's senior scientific and technical staff.

2. PUBLICATIONS SERVICE

2.1 A national agricultural research institution of the size of INRA should publish its work regularly and distribute as widely as possible its scientifc output and the results of its research, either under its own banner or in collaboration with internationally reputed scientific periodicals and journals.

Several principles could be adopted for these purposes:

- all INRA scientists should publish their work, either individually or collectively;

- technicians should be encouraged to publish their personal work under their own name, without interference or undue claim to publish by their supervisors;

- research results should be published as quickly as possible, but without sacrificing the quality and scientific accuracy of the work;

- the presentation of the activities and results should conform to user requirements.

2.2 INRA could have a range of different types of publications, such as:

General information publications

- a regular information bulletin (published monthly or quarterly) to inform correspondents of all activities conducted or planned by the institute;

- "Technical Data Sheets" ["Fiches Techniques"] drawn up individually for each region and updated regularly (CRRAs) by FSR teams, scientists, and extension workers (see Annex 14), intended for mass extension and development;

- an "Annual Report" summarizing the main events of the year and in particular the principal work in progress and results already obtained. This publication could be a special or enlarged edition of the information bulletin addressed to all the Institute's correspondents.

Scientific and technical publications

Technical and general scientific articles, reports of INRA work and colloquia could be published in the "Cahiers de la Recherche Agronomique", which ceased publication more than two years ago but ought to appear regularly to meet the needs of a wide readership of scientists and agricultural development specialists. The "Cahiers" could also publish articles by expatriate scientists of interest to Morocco, and could also print INRA's Annual Report, as in the past.

INRA should as soon as possible have a series of scientific and technical publications enabling it to put together, under a single cover in the name of the Institute, the principal works and publications on the Institute's scientific and technical research.

3. COMMUNICATIONS AND EXTERNAL RELATIONS SERVICE

3.1 Owing to the complexity and specialization of agricultural research, the fast pace of progress in science and technology, and the need to update and develop the knowledge of the staff, a research institution must attach paramount importance to the establishment of a system of communication and relations with the outside world.

It is indeed vital for a research system to establish and maintain a constant two-way flow of information at various levels of the organization.

The functional needs of communications between research and the other research and development institutions and structures differ with the nature of the relevant messages, the objectives, and the motivations and interests of the parties concerned.

INRA should organize its communication system at the following different levels:

- internal communication within the institute;
- communication between the institute and national research;
- communication with the international scientific community;
- communication between INRA and the political decision-makers;
- communication with the development structures and users.

3.2 COMMUNICATION WITHIN INRA

Scientific intra-institutional communications are relatively small in scale at INRA owing to the disparate nature of the Institute's activities, the dispersion of its programs into a large number of

isolated undertakings, the compartmentalization and unwieldiness of its structures, and the individualism and personalization of its research activities.

INRA should organize regular technical meetings or seminars on particular aspects of its programs which call for reflection, critical analysis, and objective assessment. INRA should systematically take advantage of visits by specialists (consultants and other visitors) and the presence in the country of expatriate experts to organize improvised scientific, technical general meetings, workshops, colloquia, and seminars for all staff, to enable everyone to participate in all the activities of the Institute and to allow each scientist to benefit from the knowledge of the others, and to familiarize himself with the latest developments in science and with the activities of the international scientific community.

Staff meetings should be organized regularly to enable everyone to keep up-to-date with progress achieved in each field, to provide staff with regular information on current activities, particular events, and planned activities. Information of this kind would contribute greatly to giving each member of staff a feeling of belonging to his institution and of involvement in the achievement of its objectives.

Each meeting would be an occasion for a general address on activities of a department, research groups or teams, or on the personal work of a scientist. This would be followed by open debates with the intention of promoting general staff training. The Communication Service, in cooperation with the Director of Planning, the Director of CRRAs, and the Heads of Departments, would be responsible for organizing these meetings and circulating a summary of the discussions and any conclusions to all the Institute's scientific and technical staff, and in particular to those who were not present.

3.3 COMMUNICATION BETWEEN INRA AND NATIONAL RESEARCH

There are few inter-institutional communications and meetings organized on the basis of joint programs between INRA and the other research institutions (IAV, agroforestry research, etc.) and development agencies which carry out their own research activities (SNDE, SOGETA, SODEA, etc.).

INRA should take the initiative to organize exchanges of information and working groups on its programs and on multidisciplinary topics covering more than one scientific department (of both INRA and IAV), on research problems on specific fields of production (e.g., INRA-SNDE in animal husbandry) or on problems specific to regional agricultural development (e.g., watershed management of the Upper Loukkos). Working groups should be organized:

- prior to the establishment of programs, to facilitate specification of objectives, strategies, resources, and cooperation agreements on joint action;

- during the operational phases in the field, to keep track of the progress of work and make any necessary adjustments;

- at the completion of research projects, to allow objective evaluation of results and joint formulation of follow-up proposals.

The main objective of communications between national research institutions (INRA, IAV, Faculty of Sciences, etc.) and between the research institutions and the experimentation services of the development agencies (SNDE, SOGETA, National Sugar Cane Center, etc.) would be a better determination of the research objectives, the strengthening of scientific and technical capabilities, the avoidance of duplication of effort, and - in particular - furtherance of mutual understanding to facilitate cooperation (see Annex 14).

3.4 COMMUNICATION WITH THE INTERNATIONAL SCIENTIFIC COMMUNITY

INRA is conducting "research projects" in cooperation with foreign institutions (see Part Two, Section 7.2) with bilateral technical assistance. There are projects based on commodities (e.g., forage and sugar crops with GTZ), on various types of programs (the Rainfed Farming Project with USAID), or involving the strengthening of stations and programs (e.g., Spain). There are also cooperative projects on variety testing, both regionally based (e.g., ACSAD) and internationally based (e.g., FAO's seed production project); or discipline-based research (e.g., the project on horizontal resistance to pests and plant diseases with FAO); etc. Direct cooperation based on "research projects" and the establishment of cooperation agreements are obviously privileged forms of relations and communications to be further strengthened and developed in the future. However, the conventional model of a "project"[8] is only efficient if it is completely integrated in the management and programming system of the institution to which it is attached.

All the benefits of a "project" (experts, funding, equipment, vehicles, scholarships, etc.) become manifest only if the working relations between the Institute's scientists and those of the "project" are harmoniously integrated. The Communications and External Relations Service would be responsible for assuring the integration and participation of external scientists in the life of the Institute.

In addition to already established "projects" and relations, INRA's Communications and External Relations Service would endeavor to

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(8) The quotes are used in this report for "projects" supported from external resources to distinguish them from projects as program-elements of a national agricultural research program.

intensify, broaden, and maintain ongoing contacts, exchanges of information, and relations with all research institutions potentially capable of giving scientific and technical support and contributing to the development of the Institute's programs and activities.

INRA should make more systematic and better-organized efforts to broaden and intensify its relations and exchanges and to secure the collaboration, cooperation, and more active participation of external research institutions to support its programs. The following institutions could be involved in this connection:

- the network of international centers and research programs run by the Consultative Group for International Agricultural Research (CGIAR), specifically:

  . the International Board for Plant Genetic Resources (IBPGR) and FAO's Crop Ecology and Breeding Resources Group (preservation, enrichment, and organization of INRA's breeding resources);

  . the International Center for Agricultural Research in the Dryland Areas (ICARDA) (cropping systems in the rainfed ["bour"] agriculture, cereals, food legumes, and forage crops);

  . the International Cropping Research Institute for the Semi-Arid Tropics (ICRISAT) (cropping systems, chickpeas, millet, sorghum, groundnuts);

  . the International Livestock Center for Africa (ILCA) (livestock production systems for cattle, sheep, and goats);

  . the International Center for Maize and Wheat Improvement (CIMMYT) (intensification of wheat, barley, and maize improvement programs);

  . the International Potato Center (CIP) (potato production improvement program at Agadir);

  . the International Service for National Agricultural Research (ISNAR) (strengthening of the INRA management system and follow-up of the recommendations of this report);

- the international agencies of the United Nations; specifically, FAO, the Investment Center, the World Bank, and IFAD, as well as UNIDO (development of the value-added of by-products and agroindustries) and UNESCO (scientific training and development of sciences in general);

- international and multilateral organizations such as OECD, EEC, and EDF;

- regional organizations such as ACSAD, AFESD, AOAD, and the other research assistance and funding agencies of the Arab world;

- bilateral institutions.

INRA's research programs are already closely associated with bilateral technical assistance agencies from the United States (USAID), the Federal Republic of Germany (GTZ), France (INRA-France) and Spain (INIA). INRA could broaden its cooperation with these countries considerably. New contacts can be sought with other countries and research institutions, such as CSIRO in Australia, IDRC in Canada, the University of Bari in Italy, and many other official, semiofficial, or private bodies as well as scientific and professional associations.

Promotion of communications and professional relations between INRA and scientists and specialists of world standing in all scientific and technical fields relevant to Moroccan agricultural research, encouragement of personal relations and broadening of direct contacts between INRA research staff and their national and foreign counterparts would be among the most important functions of the Institute's Communications and External Relations Service.

3.5 COMMUNICATIONS BETWEEN RESEARCH AND THE COUNTRY'S POLITICAL INSTITUTIONS

It is a matter of the utmost importance to establish a more open dialogue and to forge more consistent links between the policy-makers and those in charge of agricultural development and research. Those responsible for research should inform the political authorities of the following:

- the role, potential, and limitations of research as an instrument of agricultural development;
- the constraints and difficulties encountered by research in trying to achieve the objectives and to respond to decisions taken by political authorities;
- the effort deployed, the results obtained, the progress of work, and the scientific advances achieved by research, so as to help the policy-makers take more appropriate decisions and adopt more appropriate development strategies.

They should also prepare more in-depth documentation on the most favorable opportunities for the involvement of the political authorities in strengthening agricultural research and in mobilizing the essential means and resources required to implement their programs.

The question is mainly to inform and alert the political authorities of the potential economic value of research but also of its limitations; to supply them with scientific arguments and technological alternatives to enable them to defend choices, make more appropriate judgments, and to better assess priorities, objectives, and final goals of national and regional policies of agricultural development.

If they were better informed of the realities, difficulties, and time scales of research, the political decision-makers could act more firmly and with more conviction to defend and justify the resources to be granted to research in the service of development.

3.6 COMMUNICATIONS WITH DEVELOPMENT STRUCTURES AND USERS

Relations between INRA and those in charge of agricultural development have been mentioned on a number of occasions in this report. The internal coordination structures proposed in the Directorate of Planning, the Regional Committees, the Program Commissions, and the Scientific and Technical Council of INRA, together with all the meetings and ad hoc working groups, constitute the permanent mechanisms of consultation, information exchange, and liaison between research and all the agricultural development structures, specifically, between scientists, extension workers, and users of the research, farmers, and the agroindustries (see Annex 14).

The responsibilities for the organization and satisfactory working of these communication structures have been specified in each individual case and are obviously not a matter that falls within the direct competence of the Communications Service. However, the Communications Service can play a part on the technical level and, in particular, with regard to the methodology of the organization and dynamics of the technical meetings, as well as in the choice and development of the most appropriate methods and procedures of communication for the relevant objectives and professional profiles of those concerned.

For this reason the Service should maintain constant contacts with, and supply regular information (through the Information Bulletin) to, all official personalities of the Government and Ministries, Directorates of Ministries, provincial and regional authorities, Government, semi-governmental, and private institutions, representatives of Chambers of Commerce, sector associations, agricultural cooperatives, rural authorities and groups, etc., involved at various levels and engaged in professional relations with the Institute.

3.7 RESPONSIBILITIES AND STRUCTURE OF THE COMMUNICATIONS AND EXTERNAL RELATIONS SERVICE

The objectives and responsibilities of the Communications and External Relations Service are defined by its name. It would constitute INRA's "open-door" to the outside world - an instrument of communication with the persons, institutions, and countries having working relations with the Institute.

Research management systems in English-speaking countries often assign a wider role to "communication" and public relations activities than those in French-speaking countries. A Service of this kind would be appropriate for INRA owing to the variety of professional profiles,

responsibility levels, and large number of parties with whom INRA must maintain good relations.

It would be premature to make in this report a more detailed study of the organization, internal structures, and management of this Service.

However, with two or three staff, the Service could initially undertake the following two activities:

- communication science and techniques activities, directed towards:
  - . methods and techniques of communication and organization of scientific and technical meetings (technical advice);
  - . audiovisual techniques and working relations with the mass media (radio, TV, press);
  - . organization of and participation in conferences and meetings;
- logistic support for communication, viz:
  - . computerized lists and files of correspondents;
  - . photo library and audiovisual equipments;
  - . despatch services and cooperation with other support services.

A more detailed study of the organization and management of a communications and public relations service (internal and external) could in due time be carried out by a specialized ISNAR mission.

4. EDUCATION AND TRAINING SERVICE

This service would be responsible for all activities in the field of planning and management of the training of senior scientific and technical staff, vocational guidance, and improvement of the intellectual potential of INRA and the scientific and technical knowledge of the staff.

Its principal functions would be as follows:

- organization and planning of staff training and keeping of updated records of staff in training;
- implementation follow-up and evaluation of studies, training courses, and fellowship training programs;
- organization of training sessions and training courses for scientists;
- promotion of in-service training;

- organization of missions, seminars, and training programs in the various fields of specialization and particularly in those concerned with research management;

- liaison with national, bilateral, regional, and international institutions for scientific and technical education and training;

- organization of Institute staff participation in training programs organized by the specialized institutions and the international scientific community;

- all activities connected with management of the scientific, technical, administrative, and professional capacities of INRA's staff.

The Education and Training Service would work closely together with the Directorate of Programming, the Scientific Departments, the Directorate of Regional Centers, the other Services of the Directorate for Information as well as the Personnel Service of the Directorate for Administrative and Financial Affairs.

The organization of the Education and Training Service would be worked out in greater detail by a mission specializing in human resources planning and personnel management.

ANNEX 12

DISCIPLINE-BASED DEPARTMENTS: ILLUSTRATIVE DISCUSSION OF THEIR POSSIBLE LONG-TERM ACTIVITIES

The scientific departments are administrative units in which all scientists are grouped according to their professional training in various disciplines and specific fields of specialization, all relevant to similar subject matter, concepts, and working methods. Each department, grouping a critical mass of scientists with similar professional and scientific background, may be subdivided into different structural subunits (divisions, sections, groups, etc.) as required. However, administrative subdivisions not supported by scientific management justifications and operational management requirements should be avoided.

The scientific departments, grouping all the research staff and the scientific and technical administrative units, are the permanent structures responsible for all the research functions. The scientific departments are responsible for keeping track of scientific advances, developing scientific working methods, and adjusting scientific activities to programs needs and developments. They are interactive structures (interdisciplinary cooperation), open to cooperation with the international scientific community. They are the basis from which to draw scientific expertise to organize multidisciplinary teams as required by individual programs.

To develop and support their operational activities, the scientific departments have discipline-based research laboratories, which are the common scientific and technical instruments for the entire national research system. Aside from their main research activities, these laboratories should also, as far as possible, perform consultation services (analysis, taxonomic identification, survey, technical diagnoses, etc.) at the request of the development services and users (farmers, agroindustries, etc.).

Scientific departments are led by Heads of Departments, whose main responsibilities are:

- scientific and technical supervision of their department, management of discipline-based research programs and disciplinary fields of specialization, laboratories, scientific and technical services attached to their respective departments;

- supervision, execution, coordination, monitoring, and scientific evaluation of all research activities conducted by the staff of their department, including outposted staff to the CRRAs;

- assignment of the scientific and technical staff of their department to various national and regional programs;

- scientific monitoring and evaluation of the work of the research staff and assessing staff requirements of their departments;

- representation of their department in the establishment of the programs and participation in the appointment of program leaders;

- organization and motivation of interdisciplinary research in cooperation with the other departments; helping their scientists to develop new methodologies and technologies; maintain working links, relations, and close collaboration with the scientific community;

- promotion of the professional careers, scientific and technical skills of the scientists and technicians in their department and encouraging them to publish the results of their work;

- management of their department and submission of progress reports of the research and other work conducted by their departments.

Eight departments were described in the main report; for the sake of illustration, the main disciplines and research laboratories for which they could be made responsible in the long term are set out below for each.[9]

1. DEPARTMENT OF THE PHYSICAL ENVIRONMENT

The Department of the Physical Environment, which is responsible for investigation of the main components of the natural environment, embraces the following three disciplines: agroclimatology, pedology, and the botanical sciences. Morocco has a very wide variety of natural ecosystems, so that the environmental sciences are very important; for this reason, the following three administrative divisions could be set up in the long term, in accordance with the development of INRA's capabilities.

1.1 AGROCLIMATOLOGY DIVISION

Studies of agroclimates (data analysis of INRA's ecoclimatological network and of the national synoptic network), studies of microclimates and bioclimatic correlations (effect of climates on production), the

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(9) The scientific and technical disciplines and the laboratories and research activities of the scientific departments are given for illustration only; the list is neither comprehensive nor final.

water balance, the energy balance and evapotranspiration; multidisciplinary thematic research on soil-water-plant relations, the effect of climatic factors and seasonal rhythms on production factors, population dynamics of insects and predators in accordance with biometeorological variations (biological cycles); ecophysiology of crop species and varieties and the potentials of agricultural systems; rainfed farming techniques; desertification problems; the effect of agroclimatic variability on farming systems: yield forecasting (agrometeorology); hydroclimatology (inventories) and hydrometeorology (forecasting); etc.

This Division would be responsible for the Agroclimatology Laboratory (agroclimatic data bank and statistical interpretation of agroclimatic data) and a Biometeorology and Phytosanitary Warning Service (radio and TV) in cooperation with the Plant Protection Department.

1.2 PEDOLOGY DIVISION (AGROLOGY AND SOIL SCIENCE)

Taxonomy and survey, pedogenesis, pedoclimate; soil morphology, physics and physical chemistry (water dynamics), surface chemistry (cations) and structure of clays and associated minerals (colloids). Soil mineralogy and microbiology (microbial ecology and biochemistry); fertility and the use of fertilizers; soil surveying and mapping; soil conservation and erodibility; etc.

In cooperation with the other divisions of the department and other scientific departments, the Division will be involved in all programs relating to water dynamics, the evolution of nutrients, and the use of inorganic and organic fertilizers, the behavior of cultivated soils in different agricultural systems, and all research to which soil factors are relevant.

The Division will be responsible for the soil and leaf analysis laboratory, the soil microbiology and Rhizobia laboratory, the trace elements laboratory, the radioisotopes laboratory (decentralized to Tangier), and the routine analytical laboratories located at the CRRAs.

1.3 ECOLOGY AND PLANT PHYSIOLOGY DIVISION (BOTANICAL SCIENCES)

Plant taxonomy, plant survey, plant morphology (application of pruning in arboriculture); phytosociology and mapping (pedobotanic correlations); ecology applied to cultivated plants (autoecology) and associated crops (agricultural synecology); crop physio-ecology; economic botany; inventory of plant species adapted to arid regions and suitable for rehabilitation of desert areas; etc.

The Division will be responsible for the taxonomy, phytosociology, plant morphology, and plant physiology laboratory. In cooperation with the

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other departments, it will undertake interdisciplinary monographs of the environment (natural rangelands), studies related to environmental conservation (desertification) and the potential of natural biotopes.

2. DEPARTMENT OF PLANT IMPROVEMENT

Gene banks, and central and regional genetic collections, cytogenetics, floral biology, genetics and varietal improvement (research methods and techniques of genetic improvement), either centralized at Rabat or decentralized to the CRRAs according to the type of program (commmodity or farming systems research).

Forage crops at present fall within the competence of this Department, but the research programs on forage and range management crops and the improvement of natural ranges must be undertaken jointly with the other departments; in particular, the Departments of Animal Husbandry and Agronomy.

The Department also includes decentralized tissue culture laboratories in the various regions, (in line with the major commodity programs in the region) and a number of laboratories and services working on plant introduction (see Annex 6) (in cooperation with the Quarantine Service), seed control and certification (see Annex 7) (breeder seed and stock seed), etc. The Department would also have a cereal bread-making laboratory (for assessment of baking value), run in cooperation with the Department of Agricultural Technology.

3. DEPARTMENT OF PLANT PROTECTION

Plant pathology, mycology, virology, bacteriology, nematology; agricultural entomology, taxonomy, ethology, biological control, integrated pest control, etc.; weed science, weed control, and phytopharmacy; rodents and other pests; etc.

The Department will be responsible for the central laboratories at Rabat and those decentralized to the CRRAs (Meknés bacteriology laboratory). It should also provide special services such as periodic forecasting of information and the issuing of phytosanitary warnings in cooperation with the Agroclimatology Division and the relevant services of MARA, those of the Ministry of Communications (radio and TV), and of the Quarantine Services.

4. DEPARTMENT OF AGRONOMY (CROP SCIENCES AND CROPPING SYSTEMS)

Phenology and phenograms of species and varieties; cropping schedules (timing of field work, cropping techniques and practices, etc.); crop husbandry, typology, and technical constraints of cropping by regions (rotation systems and associated crops); improvement of cropping

systems, cropping techniques and practices in mixed farming systems or systems associated with livestock production and silviculture (agroforestry systems); etc.

This Department would work closely with the Department of Plant Improvement and the Department of Socioeconomics; for this reason, it will be largely decentralized to the CRRAs, according to the nature, specificity and location of the crop or systems-oriented programs (irrigated agriculture - e.g., Gharb; rainfed agriculture - e.g., Settat; intensive and controlled vegetable production systems - e.g., Agadir; etc.).

5. ANIMAL HUSBANDRY DEPARTMENT

Animal genetics, research on local and imported breeds; genetic improvement (crossing techniques); animal physiology, nutrition, and reproduction physiology (artificial insemination); livestock production systems, typology of farming systems (cattle, sheep, goats, and camels) by individual regions and systems (intensive, semi-intensive, and extensive); animal traction; animal health and animal pathology (in cooperation with IAV and MARA's Animal Health Division); nutrition and feeding, utilization of forage and range crops, tabulation of feeding standards, systems and methods of range management, pastoral systems and range management as assigned to the CRRAs; poultry raising, beekeeping, sericiculture, etc.

This Department would also be responsible for the feed digestibility laboratory (e.g., at Deroua), regional health and veterinary medicine laboratories (in cooperation with IAV).

6. DEPARTMENT OF AGRICULTURAL TECHNOLOGY

Food and nutrition technology; technology of starch products, oils, and fats; storage and preservation technology; technology of plant and animal products and byproducts; technology of the processing, packing, and added-value to agriculture products; etc.

The Department of Agricultural Technology would be responsible for the microbiology and fermentation laboratory, the technology laboratories specializing in each type of product (citrus technology at El Menzeh, textile technology at Afourèr, etc.). It could also be responsible for the central general chemistry, technological chemistry, and biochemistry laboratories.

7. DEPARTMENT OF AGRICULTURAL ENGINEERING

This Department does not exist at present. However, owing to the importance of irrigation (and drainage), small-scale water engineering

works, animal traction, small-scale machinery, and traditional agricultural implements, the creation of this Department should be provided for in the Master Plan in the medium term, as an expansion of the agricultural engineering unit currently proposed.

This Department will be concerned principally with research in the disciplines connected with agricultural water engineering (silting), irrigation and drainage techniques, water management, irrigation systems and the entire complex of problems related to groundwater and surface water (small-scale water engineering works only) conservation and use, and watershed studies; small-scale agricultural implements (both hand and animal-powered) and craft production of tools and implements; small-scale agricultural machinery and intermediate agricultural machinery; agricultural infrastructures, construction, and buildings; etc.

This Department would be in charge of the farm machinery laboratory and the hydrological data interpretation laboratory, in cooperation with other Departments (Agroclimatology) and the relevant Directorates of MARA.

8. DEPARTMENT OF SOCIOECONOMICS

This Department does not yet exist at INRA owing to the lack of scientists specializing in socioeconomics. The socioeconomics units proposed in the report should be set up as soon as possible.

This Department will undertake socioeconomic studies of the agricultural and farming systems (see Annexes 10 and 14), analysis, diagnosis and identification of the economic and sociotechnical constraints of the farming systems; specific economic research, cost-benefit analysis, market analyses of raw and value-added agricultural products; specialized thematic macro-economic level studies on main products, factors of production, problems of regional agricultural economics, interregional competition, and international economic relations (e.g., with EEC). In the area of social sciences, the Department will undertake studies of social problems and constraints relevant to agriculture development at national, regional, and local levels; research on social environments, anthropocultural behavior, farmers' reactions to the adoption of new technologies and communication techniques; and the entire complex of conditions for the improvement of living conditions and life in the rural environment.

In cooperation with the other scientific departments and the Data Processing and Statistical Analysis Bureau, the Department of Socioeconomics will be responsible for organizing and developing a central laboratory for the analysis and interpretation of farming systems research socio-economic data.

ANNEX 13

DATA PROCESSING AND STATISTICAL ANALYSIS BUREAU

INRA has a central Data Processing and Statistical Analysis Service, which is responsible for computer processing of the Institute's accounts, personnel administration, the design of experimental layouts and statistical analysis of research results. All these functions are performed with a microcomputer (16K WANG), whose capacity is insufficient for INRA's present needs. The Central Data Processing Service also has insufficient staff and its working procedures - especially in the analysis and interpretation of results - are too slow.

A Master Plan for Data Processing drawn up by INRA includes the following proposals:

- improvement of hardware and increase in staff numbers.
- centralization of all functions (administrative, financial, and statistical analysis) under the responsibility of a single person;
- centralization of hardware, with terminals at outstations (teleprocessing).

Without getting into more computer technical considerations, which is beyond the mission's responsibility, and confining ourselves only to scientific biometrical analysis, the following proposals are suggested:

- the creation of a Data Processing and Statistical Analysis Bureau under a single Head attached to the General Secretariat but having three separate Services:
  - an Administrative and Financial Management Service, associated with the Department of Administrative and Financial Affairs;
  - a Programming Management Service, associated with the Directorate of Programming;
  - a Scientific Management Service, associated with the scientific departments and the Directorates of Research Support Services;
- the reinforcement of available hardware with larger-capacity computers at Headquarters and software appropriate for each Service and compatible with decentralized minicomputers at the CRRAs, with a view to more flexible and more appropriate data processing management to facilitate different forms of use and satisfy user requirements;

- the adaptation of the AGRIS and CARIS systems of classification, already used by the National Documentation Center, for use with all the documentation and bibliographic search services, and computerization of the catalogs of INRA's library;

- a more detailed study of hardware and software adaptations to perform statistical analysis work beyond the present experimental layouts and statistical designs, far too limited for current scientific needs (Scientific Management Service); and to serve programming methods and procedures (Program Management Service);

- widening the choice and the use of relevant statistical analysis and biometrical designs most appropriate to experimental conditions, and rationalization and standardization of procedures for gathering and recording data for statistical analysis (multiple-copy forms), so as to avoid transcription errors, to facilitate data transmission, monitoring and checking and to speed up statistical interpretation and transmission of results;

- the above general suggestions and proposals put forward by INRA in its Master Plan for Data Processing should be studied by an expert mission.

ANNEX 14

LINKS BETWEEN RESEARCH AND DEVELOPMENT[10]

1. INTRODUCTION

The relations between research and development are extremely varied and many-faceted. In some cases they are effective and well developed (vegetable crops and citrus), while in others they are relatively weak or unsatisfactory (rainfed farming); the extent of these relations depends on a number of factors and circumstances specific to each individual case. An exhaustive study of the relations between research and development would be beyond the scope of this mission, and only a few specific cases are discussed briefly below.

2. PRESENT STATUS OF RELATIONS BETWEEN RESEARCH AND DEVELOPMENT

2.1 THE DEVELOPMENT CORPORATIONS all have two functions: increasing production along business lines, and serving the interests of their partners - farmers and agro-industries - by the development and transfer of production technologies and management techniques. For reasons of profitability and productivity, the development corporations do not take much interest in long-term research. Since they are compelled to obtain quick results, they have set up their own "Experimentation Services" to conduct the research essential to their immediate development objectives.

The corporations responsible for the development of a sector (vegetable crops, citrus, livestock, etc.) or a specific product (sugarcane, rice, olive oil) generally establish very good formal and functional relations with national research, but also with counterpart institutions abroad, often, as it happens, in the context of their commercial relations. In the other sectors, research and development operations by the experimentation services of the development corporations are carried out on the basis of different levels of relations with research; these are excellent when based on personal relations, effective when common interests are involved, but in most cases weak or non-existent.

The difficulties which arise are attributed to research deficiencies, either genuine or alleged by staff in charge of development (absence,

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(10) The entire complex of services concerned with agricultural development - in particular, agricultural extension.

inadequacy, or unsuitability of results), and to impatience associated with the desire to achieve rapid results or to transfer foreign technologies considered by research as inappropriate. Such relations are sometimes induced by external technical cooperation (bilateral or international), where the relevant agencies endeavor to make their action more effective by privileging and reinforcing the functions of their direct partners, sometimes to the detriment of other national institutions.

Where research fits in well with users' short-term needs and requirements, development corporations often wish closer cooperation with research and are even prepared to finance joint operations (e.g., INRA, GTZ, SNDE in the case of forage crops).

2.2 MARA, ITS DIRECTORATES AND SUPPORTING SERVICES (extension, agrarian reform, supply of inputs, credit, cooperation, etc.) and the other Ministries involved in agricultural development are responsible for the implementation and general supervision of the development programs over time scales fixed by the Five-Year Plans. The Provincial Directorate of Agriculture (DPAs), the ORMVAs in the irrigated areas, the CTs in the rainfed ("bour") agriculture areas, and all the services provided by the Directorate of Agricultural Extension and Agrarian Reform are the principal Government instruments for relations between research, extension, and development. At their respective levels of responsibility, they all have the function of short-term implementation of precise and specific programs in individual Provinces (DPAs) or regions (integrated development projects) or in connection with a specific type of commodity, etc.

However, agricultural research cannot readily adapt itself to the relatively short time-scales required by development, particularly as it faces demands from all quarters and has only limited resources, so that it cannot concentrate its efforts solely on the sectors or aspects directly relevant to development. The diversity of commodities, regions, farming and marketing systems, and agricultural development patterns in Morocco justifies:

- the multiplicity of objectives and programs and the dispersion of the research effort;
- the inevitable deficiencies in some production sectors;
- the impossibility of acceding to all requests for cooperation;
- the relatively large number of ways in which research-derived technological improvements and innovations are adopted, and the different types of impact thereby achieved; etc.

The relations between agricultural research and the development services of the DPAs (extension, ORMVAs, CTs, etc.) vary from province to province, but also according to the scale of production and nature of the relevant crops, the presence or absence of regional development projects, etc.

In the regions where citrus and vegetable crops are grown, the economic, social, and hence also political interests of the region depend so greatly on the profitability of these types of production that the DPAs and the development services cooperate very actively in INRA's research in these sectors. The ORMVAs, which are very powerful and are well provided with qualified staff in the regions dominated by major irrigated-agriculture development projects, are more dynamic and display more confidence in the conduct of their own research, confining their cooperation with INRA to formal coordination rather than genuine active participation.

In the less-favored regions, the CTs, being less well-endowed with qualified staff and less effective in their performance, must, since they lack the substantial resources granted to the ORMVAs, rely on more operational forms of cooperation with research.

This very sharp distinction is reflected principally in a difference of interests between research, extension, and development and the forms of interfaces to be established between them, but also in the adoption of different methodologies, operational strategies, and working relationships between research and extension.

2.3 THE DIRECTORATE FOR RURAL AFFAIRS OF THE MINISTRY OF THE INTERIOR has the heavy responsibility for the development of collective land (12 million ha) and the traditional communities (4 million persons). The development complexity of collective land, which is carried out in cooperation with MARA, raises many problems associated with social and technical constraints. Subject to the strengthening of research on farming systems (see Annex 10), the establishment of a Department of Socioeconomics and the intensification of the rainfed farming research programs (cereals and livestock production), as recommended in the report, will allow to broadened cooperation and links between research and development as desired by the Ministry of the Interior.

3. PROPOSALS ON RELATIONS BETWEEN RESEARCH, DEVELOPMENT, AND PRODUCTION

3.1 ONGOING DIALOGUE BETWEEN RESEARCH AND DEVELOPMENT

No one any longer needs to be convinced of the importance of research for development. It is essential to insure that the ministries responsible for the agricultural sector can participate in the determination of research policy, voice their concerns, steer the objectives, and check whether the programs have been implemented in accordance with the decisions taken (see Annexes 11 and 15).

The problem is to ensure, at levels beyond the Executive Board and Technical Committee of INRA, that MARA and the other technical ministries play a more comprehensive role in the setting of priorities and objectives and the implementation of research programs, by more active participation in the process of programming at the Institute.

The functional framework needed to insure this interaction between development and research is precisely within the programming system. MARA and the other ministries represented on INRA's Executive Board could appoint a "Scientific Advisor", whose main function would be to provide for continuous liaison and active representation of his ministry in the programming procedures, program implementation and follow-up, evaluation of results, and in decisions about the strategy to be adopted to translate these results in terms of production. With the agreement of his ministry, the Scientific Advisor could be assisted by one or more specialists from directorates or institutions belonging to his ministry who could help him in participation in meetings and in specialized working groups organized by INRA.

This interaction could also take the form of resource allocation (human and financial) from the ministerial directorates or from large integrated development projects in order to finance or reinforce the implementation of joint programs or operations carried out under specific agreements.

3.2 BETTER ORGANIZATION OF JOINT OPERATIONAL ACTIVITIES BY RESEARCH AND AGRICULTURAL EXTENSION

Close links between scientists and extension workers are essential, but are not in themselves sufficient for operational collaboration between research and extension.

The mistaken concept of linear relations between research, extension, and the farmer, and participation of extension specialists in the research teams and operations in cooperation with the farmers, has been discussed at length in Annex 10, on the methodology of FSR, and in Annex 8, in which "demonstration trials" were critically analyzed.

Some senior development staff (ORMVA and corporation Directors) have stated that they cannot accept the results of research without "verifying" them in the rural situation and where appropriate modifying them through their own experimentation services. This view is warranted in the present context of "demonstration trials" and the conventional organization of research on the basis of individual crops or disciplines at the experiment station. It will cease to be valid when the new approach proposed for the management of INRA research becomes operational.

The research and trials presently carried out by the development agencies (corporations, ORMVAs, CTs, etc.) must be conducted under the aegis and the scientific control of INRA. The program of FSR and research conducted on a cooperative basis between INRA and the development institutions on "experiment sites" chosen jointly under

actual production conditions no longer justifies the distrust of those responsible for development.

Again, particularly in a country like Morocco, it is unacceptable for an agricultural research institution to consider its work to be finished when it has found a "theoretical" solution to a given problem in the laboratory or at the research station, leaving the "client" to adapt the results to their agricultural practices. INRA must discharge all its responsibilities - in particular, the one to provide solutions, results, and products whose on-farm applicability have been proved. Research will not have performed its function and discharged its full responsibility if it has not been able to produce results directly applicable under actual development conditions.

Furthermore, experimentation under current production conditions can help to strengthen relations at different levels between research and extension, by associating extension specialists to multidisciplinary research teams.

3.3 ACTIVE PARTICIPATION OF FARMERS IN THE RELATIONS BETWEEN RESEARCH AND PRODUCTION

Direct, ongoing relations between scientists and producers, from the small farmers of the traditional communities to the large landowners, are essential if research is to be brought into line with the realities of development and the different groups of farmers.

Relations with the farmers who have tenure security and the owners of large-scale agro-industrial plantations do not present any major difficulties. There are large agricultural associations and well-organized producer cooperatives for the main industrial and export crops, which, through the Chambers of Commerce, maintain close and effective links with research and the development services (e.g., in citrus cultivation, tree fruits, winter vegetable crops, and other sectors).

The main relationship problems between research and production arise with the landless farmers, nomadic herdsmen, small farmers on collective land, and the deprived farmers in the arid and semi-arid zones. The first difficulty arises from the extension and development services, who feel that the research workers should remain at their experiment station and that it is the responsibility of the extention worker to carry on dialogue and forge links between research and the farmers. These services often perceive this direct relationship between the scientists and the farmers as a means of by-passing the extension workers and of demoting them to a secondary role or to mere purveyors of routine services.

However, this direct relationship between the scientist and the farmer is essential not only to research but also to agricultural extension; after all, the latter is one of the participants in this triangular

relationship between research, the farmer, and the extension worker, which shows that the three partners are of equal status (see Annex 10). The expressions of pre-extension, pilot, or demonstration farms, "demonstration trials", model or experiment farms, etc., should not be used, as they are merely hybrid concepts or structures which do not contribute to research, nor to extension, as they leave out the farmer, who at any rate does not recognize himself in these "prefabricated" models.

On-farm trials and direct partnership associations between research and extension workers with the farmers, as described in the discussion on farming systems research (see Annex 10), offer many opportunities for contacts, joint participation and liaison; beyond which ultimately the teamwork is the most important point.

The active participation of the farmers in the drafting of the research and extension programs is very important, particularly at the local and regional levels. The main difficulty in this participation in the research programming process is the absence or weakness of institutions able to genuinely represent the interests of the small farmers, who account for the vast majority of Morocco's agricultural producers. Wealthy farmers, influential leaders, and "selected" farmers among the more active ones cannot validly represent the farmers' world in the research programming structures.

The optimum form of participation of small- and medium-sized farmers in this process is one that starts at the level of on-farm FSR teams, where a large number of farmers talk freely with the scientists and together analyze their problems, constraints, preferences, and conceptions.

The methods proposed for a bottom-up approach to research programming, based on the regional programming structures (Regional Committees of the CRRAs) and the active participation of the farming community and those responsible for development (FSR approach) in conceiving research, offer the best guarantee for strengthening research, extension, and development interfaces.

Good "bilateral" relations between research and development (including extension), on the one hand, and between research and production (the farmers), on the other, are not sufficient.

Only the active and responsible involvement of the three functions in the research programming and implementation processes can ensure the cohesion of the interfaces between research, development, and production.

ANNEX 15

PROGRAMMING BY OBJECTIVES: THE PROGRAMMING CYCLE, PROGRAM DATA SHEETS, AND OPERATION DATA SHEETS

This Annex gives a brief description of the programming cycle and presents and discusses the program[11] data sheets and operation[12] data sheets.

1. PROGRAMMING CYCLE

The entire programming complex, represented by the procedures of programming, establishment of programs, periodic evaluation and adjustment of research programs and operations, is an ongoing, cyclical process which must form part of the overall calendar for national budgetary examination.

The interactions among the various chronological stages and decision-making processes at the political, institutional, and professional levels are not all sequential; some of these call for a two-way dialogue and consultation. The political level (the establishment of major options, general priorities, overall budget, etc.) is linked to the institution level (establishment of broad outlines and balance of programs, research priorities, strategies for action) and to the professional level (choice of activities, scientific methodology, operational and implementation procedures). In the accompanying diagram the circuits for internal dialogue and consultation are indicated by double arrows; specifically, between political and institutional decisions (a and b; j and k); institutional and professional decisions (b and c; d and e; g and h); and professional decisions between scientists, users, and those responsible for development.

The Directorate of Programming plays a central and decisive part in this process: it drives the cycle as a whole, performs the standardized preparation of information (program and operation data-sheets), and acts as a secretariat for the Program Commissions.

Without misrepresenting public administration, legal and financial procedures, and rules of operation currently in force, the annual

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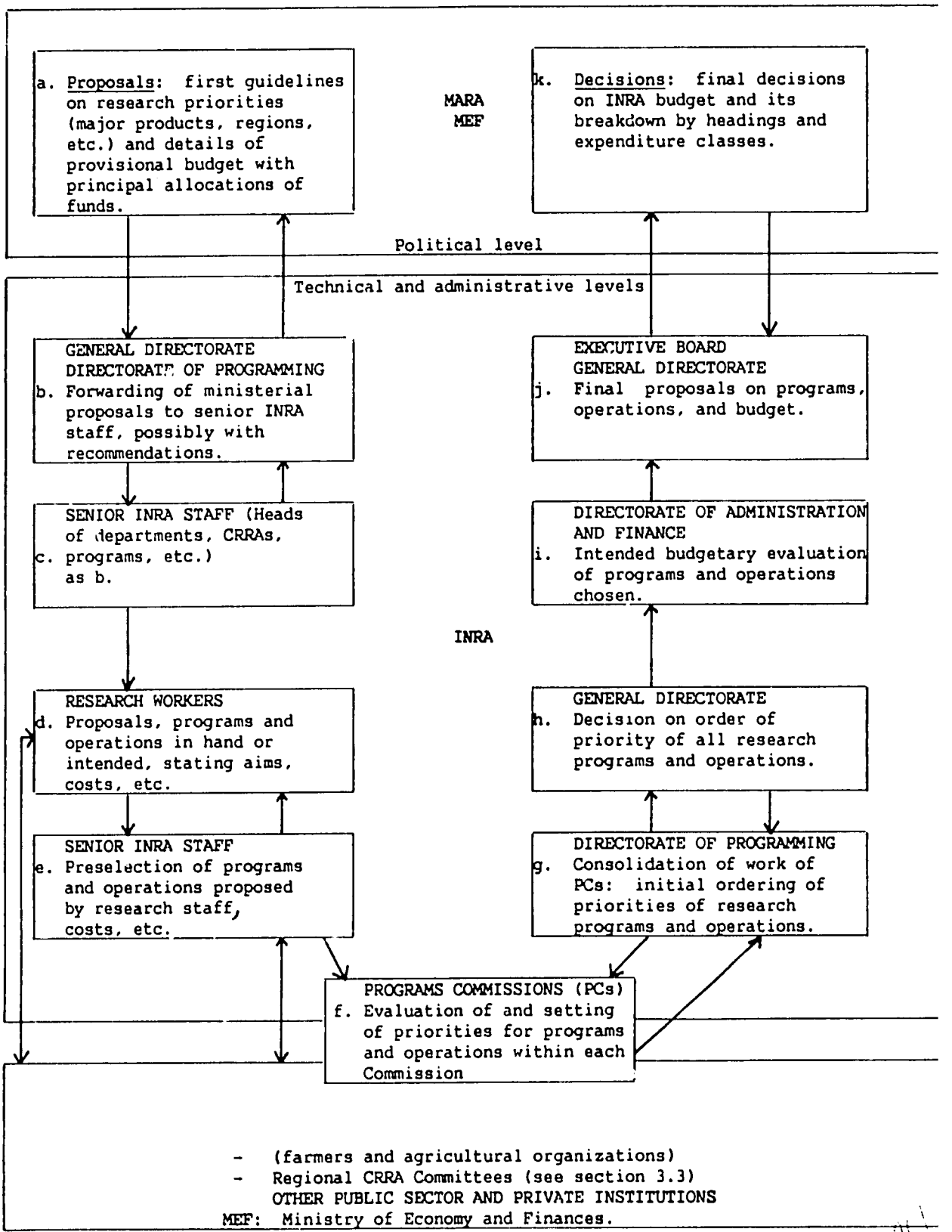
(11) Program (see page 87 Vol. I).
(12) Operation (see page 87, Vol. 1).

PRINCIPLES OF THE ANNUAL PROGRAMMING CYCLE AT INRA



programming cycle could be approximately described as follow:

a) The Ministry of Agriculture and Agrarian Reform (and the other ministries represented on INRA's Executive Board) lays down the major options and national strategies of agriculture development, issues directives on the priorities to be set for research (major commodity groups, regional balance, etc.), and specifies a prospective overall budget allocation and the main budget sub-allocations. Once the process has been initiated, such decisions are taken on the basis of results obtained and of the progress achieved from the program-budget of the previous year and on new proposals formulated by the Executive Board (see item j below).

b) These directives and guidelines, communicated to INRA through its Executive Board, are taken into consideration by the Technical Committee, the General Directorate, and the Directorate of Programming, possibly after negotiations (cycle a - b) and by taking into account the views of INRA's Scientific and Technical Council.

c) The proposals, together with more specific recommendations by the Director General and the Director of Programming, are analyzed by the senior supervisory staff of the Institute (cycle b - c).

d) The Heads of Departments, Program and Operations Leaders, Heads of CRRAs and scientists - according to their professional fields, their participation in the work of Program Commissions, their contact with the agricultural world and development institutions (public sector and private institutions) - prepare proposals for programs (projects) and operations (maintenance, amendment, strengthening, or elimination of former programs and operations and introduction of new ones), specifying the objectives, costs, etc., to allow programs to be brought into line with the directives issued to them.

e) These proposals are discussed with senior INRA staff (Directors and senior supervisory staff) with a view to pre-selecting those proposals that take into account:

   - the views and wishes expressed by the users (Regional Committees),
   - the possible consequences they might have on current programs, and
   - resource availability, funds (overall budget), and scientific and technical staff (cycle d - e).

f) The above proposals for research programs and operations are forwarded to the Directorate of Programming for evaluation, ranking by order of priority, and determination of programs and their contents (see sections 2.1, 2.2 and 3.4) by the scientific departments, the Directorate of Regional Centers, and the Program and Operations Leaders, through the Program Commissions and in close cooperation with the Regional Committees of the CRRAs (farmers and sectoral organizations) and the working groups set up within the Commissions (cycles e - f - g).

g) On the basis of the Commissions' work, the documentation prepared (program and operation data sheets), and the minutes of each Commission's proceedings, the Directorate of Programming will be able to make an initial overall assessment of current and future activities and to prepare a file for each program, indicating the priority activities (operations to be continued at their present funding level, operations to be strengthened, new operations to be undertaken, operations completed or to be terminated, etc.).

h) These completed program files are forwarded to the General Directorate for examination and for decisions to be taken at a meeting of the Directorate of INRA (Director General, Secretary General, the Technical Directorates, etc.) or of the Technical Committee, at which the Director in charge of the Programming Directorate presents the whole of the file for overall coherence verification (cycle g - h).

i) The programs finally approved by the General Directorate are forwarded to the Directorate for Administrative and Financial Affairs (which also takes part in the work of the Commissions) for checking, adjustment, and verification of budget allocations.

j) The program-budget approved by the Director General is presented (cycle j - k) to the Executive Board at an annual meeting at the end of the programming cycle. This presentation includes a brief presentation on the research in progress and its results, accompanied by a detailed analysis of new proposals, taking account of the objectives and directives of the Ministry of Agriculture and Agrarian Reform.

k) The program-budget approved by the Executive Board is forwarded to the Ministry of Agriculture and Agrarian Reform (see item a at the beginning of the cycle).

Once the cycle is under way, the programming procedures are greatly simplified through subsequent cycles by gradual adaptation and adjustment of procedures and the running-in of the programming machinery. Procedures at the interfaces (double arrows) also become easier with the progressive developments achieved by programming mechanisms and research support services - especially the communications services (see Annex 11).

The annual programming cycles cannot be allowed to call into question each year all the research programs and operations currently under implementation. Whatever the duration of the programs (medium or long term) or their respective operations (short and medium term), they should normally be approved for a minimum period of three years, as it seems unrealistic to obtain significant and reliable results in the field of agricultural research in a shorter period of time. It is also inappropriate to make frequent changes or amendments to programs in hand or to anticipate a too distant future. Once this principle is accepted, it is neither necessary nor desirable to re-evaluate all research programs and operations each year. It is sufficient for each annual programming cycle to keep track of the status of activities, to monitor

progress achieved, and to evaluate programs and operations which come to an end every three years; and on the basis of this revision to take essential decisions as to curtailing or to pursuing them for a further period, with changes as necessary.

If this procedure is adopted, the annual evaluation work of the programs will be concerned only with a relatively small number of new topics submitted by the research staff and with approximately a third of the current activities, thus saving a great deal of the Commissions' time and permitting a more in-depth evaluation of the whole program.

The above theoretical outline of the annual programming cycle has been described for illustrative purposes only. It must be adapted to evolving programming procedures as dictated by experience and current practice. The outline arrangements will have to be reviewed as soon as the National Scientific Research Coordination and Programming Center (CNCPRST) at the Ministry of Planning and the Directorate of Agricultural Education and Research becomes operational. The former intends to be responsible for the promotion and coordination of all research conducted in Morocco, while the latter will be in charge of the overall coordination of the various research institutions within the Ministry of Agriculture and Agrarian Reform.

2. THE PROGRAM[13] DATA SHEETS

The proposed program data sheet satisfies the following two requirements:

- it should include only essential information for the dual purposes of immediate inventory and programming;

- it should be a flexible framework, capable of subsequent amendments in accordance with practical requirements and any eventual methodological improvements.

The headings of the program data sheet relate to two categories of information:

- external data - i.e., the program as it may be perceived outside INRA by the many partners concerned;

- internal data on the organization of the scientific activity itself, mainly within INRA (possibly and partially outside, in the case of joint programs).

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[13] Program has been used in its generic meaning, including any level of program aggregation (major program, program, sub-program, project, etc.) (see also page 87, Vol. I).

2.1 SPECIMEN PROGRAM DATA SHEET

INRA PROGRAM DATA SHEET - YEAR 198..

---

1. PROGRAM TITLE:

---

2. POSITION IN ORGANIZATION - CODE:

(a) (b) (c) (d)

---

3. EXPECTED RESULTS OR PRODUCTS:

---

4. RESEARCH USERS:	TARGET GROUP
- decision-making bodies:	-
- development staff:	-
- training organizations:	-
- other research team or body:	-

---

5. LINKS WITH DEVELOPMENT:

- with a specific project (in progress or planned):
- with an objective or major aspect of national development:
- with a (perspective) development "problem":

INRA PROGRAM DATA SHEET - YEAR 198..

6. GEOGRAPHICAL FIELD OF APPLICATION OF RESULTS:

- part or whole of the national territory
- international impact (other country, region, zone, etc.)

7. EXTERNAL COLLABORATION AND SCIENTIFIC LINKS:

- collaboration:
- links:

8. PROGRAM CONTENT:

Code	Operation title	Status	Timetable		Importance of operation in program	Geographical location
			start	end completion		
1	2	3		4	5	6

9. PROGRAM TIMETABLE:

INRA PROGRAM DATA SHEET - YEAR 198..

10. PRESENT SCIENTIFIC PERSONNEL:

Operation code	Identity	Discipline	Qualification	Administr. assignment	Months of Research	
					present year	next year
1	2	3	4	5	6	
SCIENTIFIC PERSONNEL TO BE RECRUITED AND TRAINED						

Total program input required

2.2 EXPLANATORY NOTES ON THE PROGRAM DATA SHEET

INRA INSTRUCTIONS FOR DRAWING UP PROGRAM DATA SHEETS

This section specifies the contents of the program data sheet and gives details of the entries to be made in it.

A - EXTERNAL DATA

1. PROGRAM TITLE:

The title must be brief and concise, consisting of the key words considered essential to identify the scientific activity.

2. POSITION IN THE ORGANIZATION - CODE:

This entry specifies the situation of the program within the organizational structure of INRA; the following code categories are to be used:

A: type of program in the organization (3 types sector/discipline; production sector; regional);
B: number of program in type;
C: subprogram in main program where appropriate;
D: assignment structure (scientific department, main CRRA of assignment).

3. EXPECTED RESULTS OR PRODUCTS:

Describe in a few lines the results or products expected; they must fit into one of the following five classes:

- new knowledge (the most frequent case in fundamental research);
- inventories;
- research methodology (developed for the program);
- training (application of a given result to a given training cycle);
- techniques or technology (principally applied research: variety and method of cropping; control method and method of application; varietal profile and its integration in a production system; etc.).

4. RESEARCH USERS:

This heading adds more detail to the previous one; it identifies the actual or potential users of the research in three fields:

- economic and social development

  . decision-making bodies (ministries; services acting in their capacities of conception, organization, and regulation);

  . direct public or private economic entities (State corporation, sector grouping or cooperative, agricultural, agroindustrial or commercial firm, etc.).

The "target group" specifies who will eventually benefit from the results and products of research: rural or urban population groups, all the population; specific socio-occupational group (wage-earners in the primary sectors; small- or medium-sized peasant farms; large agricultural or industrial production units; etc.).

- training

  . educational bodies - specify level and nature (secondary education, agricultural college, university, technical education, specialist education, professional education, etc.).

- research

  . another team in INRA or other institution (national or foreign) which may use the results of the program (links between fundamental and applied research).

5. LINKS WITH DEVELOPMENT:

Links with the program can be identified at increasing levels of generality:

- with a specific development project, action in progress or forthcoming, planned, localized, structured, funded, etc. (e.g., a project for the development of rice-growing in a given valley);

- with a more general, often sectoral, objective or major aspect of development, combining a number of current or long-term projects (e.g., 30% increase in the production of a given crop; food self-sufficiency in the meat products sector; etc.);

- with a more or less familiar and explicit development "problem", which has not yet found a precise solution in development policy (e.g., extension of a particular crop on a particular type of soil hitherto unexploited; development of a particular national product for import substitution; etc.). On this basis the program may be prospective and may give rise to new development objectives or aspects.

6. GEOGRAPHICAL FIELD OF APPLICATION:

Specify the impact of the program results or products at different levels:

- within the country, areas of varying sizes: project area, administrative unit, agroecological region, etc.

- outside the country: major climatic zone, other country, regional complex, etc.

7. EXTERNAL COLLABORATION AND SCIENTIFIC LINKS:

Two types of relations must be distinguished:

- collaboration with other bodies (national, foreign or international) initiated by the program, which must be identified with details of the operations in the internal data of the program;

- normal scientific links instituted by the program, which should be noted according to their specific nature (exchanges, training courses, missions, colloquia, methods, bibliography, documentation, support, supervision of work, etc.), the identity of the relevant correspondent and body being specified.

B - INTERNAL DATA

8. PROGRAM CONTENT:

The content data must be specified in the following subheadings:

8.1 Coding of the program operations, coded from 01 to "X" in a sequential order.

8.2 Operation

An operation in the program constitutes the basic unit of scientific activity, in several respects:

- An operation will normally fall under one discipline only, the program consisting of several operations in the same discipline (monodisciplinary program) or of number of operations in different disciplines (multidisciplinary program); the principle is not absolute and exceptions are possible.

- Chronologically, it is immaterial whether the operations are carried out consecutively or simultaneously.

- Normally, a scientist is responsible for an operation, which he conducts on his own initiative and by his own approach or methodology. However, a scientist may carry on a number of operations, either in the same program or in different programs (in the latter case: activity dispersion index); an operation may also be conducted by two or more scientists in the same program or different programs.

In terms of financing, with budgeting by objective, the operation also represents the basic unit framework for evaluation of operating costs; addition of the operation costs gives the program cost.

To sum up, column 8.2 must clearly and concisely show the titles of the operations.

8.3 Status

This will be indicated by three abbreviations:

- ter. = operation completed,
- en cours = operation in progress,
- nouv. = new operation, to be initiated this year or next.

8.4 Timetable

This heading is essential.

The following should be noted: Year (or month) of commencement of operation
Intended year (or month) of completion of operation (best possible estimate)

The program timetable (totals line) will be bounded by the year of commencement of the first operation and the anticipated year of completion of the last operation.

8.5 Importance of operation in program

What is required is an objective evaluation of the contribution of the output of the operation to the achievement of the overall program output.

A three-level code is to be used for entries in this column:

1= essential operation (in the absence of which the program cannot be implemented);
2= operation useful or very useful for the implementation of the program;
3= useful supplementary operation, omission of which would not call the implementation of the program into question.

8.6 Geographical location

Here the actual place where the research is carried out should be specified; in most cases this will be a scientific infrastructural unit: a center, station, laboratory, trial network, experimental site, etc.

9. PROGRAM TIMETABLE:

This is determined by the date of commencement of the first operation and the anticipated date of completion of the last operation.

10. SCIENTIFIC PERSONNEL:

A distinction should be made between existing scientific personnel and staff to be recruited and trained.

10.1 Repetition of code

This is the operation code given immediately above. The intention is to specify the link between the individual scientist and the operation.

10.2 Identity

The full name should be written in capital letters. If a staff member takes part in several different operations in the program, each should have a line of his own, identified by the code repetition.

Example:	Operation code (repeat)	: Identity
	01	: Mr. X
	03	: Mr. X
	06	: Mr. X

The name of the scientist in charge of the program should be underlined.

10.3 Discipline or specialization

The training discipline of the scientists should be entered here; avoid excessively general terms ("agriculture") and, conversely, overspecialized description.

10.4 Qualification

A limited number of simple categories should be entered as follows:

Sc	: full-time scientists;
Tr Sc	: teacher/scientists (University);
Sc t	: scientists in training;
T	: technician;
L	: skilled workman/laborer.

(The last two categories can be combined for an entire program - e.g., 2 technicians ..., 2 laborers).

10.5 Administrative assignment

The internal assignment to the Institute can be given (e.g., a particular Department). The institution to which the scientist is attached may also be specified in the many cases of external collaboration (secondment, detachment, training courses, etc.).

10.6 Man-Months of research (present year and next year)

The actual periods of research activity (expressed in months) should be entered here as accurately as possible. The answer should exclude: periods on leave, periods devoted to activities other than research (teaching, administration/management, other services, and development support activity).

3. OPERATION[14] DATA RECORDS

The operations making up the program have already been partially identified and characterized in the internal data of the program data record. The purpose of the operation data record is to specify these internal data in more detail.

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[14] An Operation is the smallest implementation unit of a Program (or Project) performed by one research scientist, further divided into Actions, the lowest identifiable working units of a research scientist's Operation. (see also page 87, Vol. I).

3.1 SPECIMEN OPERATION DATA SHEETS

INRA PROGRAM DATA SHEET - YEAR 198..

---

1. TITLE OF OPERATION: Code in program

---

2. REFERENCE PROGRAM: Program code

Title:

---

3. EXPECTED RESULTS OR PRODUCTS:

---

4. SPECIFIC CONTRIBUTION TO PROGRAM OF REFERENCE:

---

5. LINKS WITH THE OTHER PROGRAM OPERATIONS:

- prior to all other operations
- dependent on one or more operations
- weak or insignificant links

---

6. GEOGRAPHICAL LOCATION:

INRA PROGRAM DATA SHEET - YEAR 198..

7. INTENDED COMPONENT ACTIONS AND TIMETABLE:	Beginning		End	
	m.	y.	m.	y.
-				
-				
-				
-				
-				
-				
-				
-				
-				

8. RELEVANT STAFF: existing (A) or to be recruited (B):

	Name	Discipline	Qualification	Assignment
A				
B				

9. EXTERNAL LINKS:

3.2 EXPLANATORY NOTES ON THE OPERATIONS DATA SHEET

INRA INSTRUCTIONS FOR COMPLETION OF OPERATION DATA SHEETS

These notes describe the contents of the operation data sheet and indicate how it should be completed.

1. TITLE OF OPERATION:

This should be formulated briefly and concisely; the operation code in the program should be numbered from 01 to "X" in a sequential order.

2. REFERENCE PROGRAM:

The title of the program to which the operation belongs, and its code, should be repeated here.

3. EXPECTED RESULTS OR PRODUCTS:

Describe in a few lines the characteristics of the results or products, whether scientific or technical (in the latter case, quantify as far as possible; e.g., plant material characterized by a given yield potential, vegetative cycle length, farming system, etc.).

4. CONTRIBUTION TO PROGRAM OF REFERENCE:

This heading supplements the previous one; indicate the specific contribution of the operation to the program product, and explain the nature and importance of the link between the overall program output and the part attributable to the output of the operation.

5. LINKS WITH THE OTHER PROGRAM OPERATIONS:

Tick one of the three boxes according to the type of link.

6. GEOGRAPHICAL LOCATION:

Place where the research takes place; use a standard term; this will usually be a scientific infrastructure unit (Regional Center of ..., Station of ..., Experimental Site of ...).

7. INTENDED COMPONENT ACTIONS AND TIMETABLE:

The component research actions which consecutively or simultaneously contribute to the achievement of the operation; their interrelations are left to the initiative of the scientist and depend on the method used.

Example: soil survey on the Plateau of X:

- area reconnaissance and determination of a sampling plan;
- soil sampling;
- laboratory analysis;
- supplementary sampling;
- interpretation of results, synthesis, mapping and preliminary report.

The anticipated timetable for each action must be specified on each line, if possible to the nearest month.

8. RELEVANT STAFF:

Normally an operation will be the responsibility of a single scientist, but often a number of scientists may be associated in the case of multidisciplinary operations, very large operations, very urgent operations, or for the purposes of research training in the case of a new scientist assisted by a senior, etc.

The staff concerned are to be identified by entries in the columns for name, discipline, qualification, and administrative assignment; in section A for existing staff and in section B for staff to be recruited and trained.

Where a staff member is not yet identified and is still to be recruited for a new operation, a note giving a detailed description of the required profile may be attached to the operation data sheet.

9. EXTERNAL LINKS:

Scientific linkages should be specified, both with other national institutions (for other scientist(s) or team(s) working on the same topic) or with foreign countries (participation in a regional or international program, etc.).

ANNEX 16

LIST OF ACRONYMS

ACSAD	Arab Center for the Study of Arid Zones and Dry Lands
ADF	African Development Fund
AFDB	African Development Bank
AFESD	Arab Fund for Economic and Social Development
AID	Agency for International Development (USA)
AGRIS	International Information System for Agricultural Sciences and Technology
AOAD	Arab Organization for Agricultural Development
ARS	Académie Royale des Sciences [Royal Academy of Sciences]
ASPAM	Association Syndicale des Producteurs d'Agrumes et de Maraîchage [Sector Association of Citrus and Vegetable Crop Producers]
AVRDC	Asian Vegetable Research and Development Center
BTIB	Bureau de Traitement Informatique et de Biométrie [Data Processing and Statistical Analysis Bureau]
CA	Conseil d'Administration [Executive Board]
CAFRA	Centres Régionaux d'Animation et de Formation des Jeunes Agriculteurs [Regional Centers for the Motivation and Training of Young Farmers]
CARIS	Current Agricultural Research Information System
CEE	European Economic Community
CIAT	Centro Internacional de Agricultura Tropical [International Center for Tropical Agriculture]
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo [International Center for Maize and Wheat Improvement]
CIP	Centro Internacional de la Papa [International Potato Center]
CMV	Centre de Mise en Valeur
CNCA	Caisse Nationale de Crédit Agricole [National Agricultural Credit Institution]
CND	Centre National de Documentation [National Documentation Center]
CNERV	Centre National d'Etude de Recherche en Vulgarisation [National Center for the Study of Research on Agricultural Extension]
CNRA	Centre National de la Recherche Agronomique [National Agricultural Research Center]
CNCPRST	Centre National de Coordination et de Planification de la Recherche Scientifique et Technique [National Center for the Coordination and Planning of Scientific and Technical Research]
CNCS	Centre National de la Canne à Sucre [National Sugarcane Center]
CNS	Comité National des Semences [National Seed Committee]
COI	Conseil Oléicole International
COMAGRI	Compagnie Marocaine d'Agriculture [Moroccan Agriculture Company]
COMAPRA	Compagnie Marocaine des Produits Agricoles [Moroccan Agricultural Products Company]
CRAFA	Centre Régionaux d'Animation et de Formation des Jeunes Agriculteurs [Regional Centers for the Motivation and Training of Young Farmers]

CRRA	Centre Régional de Recherche Agronomique [Regional Agricultural Research Center]
CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
CSP	Commission de Sélection des Plantes [Plant Selection Commission]
CST	Conseil Scientifique et Technique [Scientific and Technical Council]
CT	Comité Technique [Technical Committee]; Centre de Travaux [Works Center]
CUMA	Coopérative d'Utilisation en Commun de Matériel Agricole [Cooperative for the Joint Use of Agricultural Equipement]
DEA	Direction de l'Elevage [Directorate of Livestock Production]
DEF	Direction des Eaux et Forêts [Directorate of Forestry and Water Resources]
DMSB	Division de Multiplication des Semences de Base [Foundation Seed Multiplication Division]
DPA	Direction Provinciale de l'Agriculture [Provincial Directorate of Agriculture]
DPV	Direction de la Production Végétale [Directorate of Plant Production]
DRA	Direction de la Recherche Agronomique [Directorate of Agricultural Research]
DREF	Direction de la Recherche des Eaux et Forêts [Directorate of Forestry and Water Resources]
DRS	Direction de la Recherche Scientifique [Directorate of Scientific Research]
DPVCTRF	Direction de la Protection Végétale, du Contrôle Technique et de la Répression des Fraudes [Direction of Plant Protection, Technical Control and Prevention of Fraud]
ENA	Ecole Nationale d'Agriculture [National School of Agriculture]
ENSA	Ecole Nationale Supérieure d'Agronomie [Higher National School of Agriculture]
FAO	Food and Agriculture Organisation of the United Nations
FDPS	Fonds de Développement des Provinces Sahariennes [Saharan Provinces Development Fund]
FED	Fonds Européen de Développement [European Development Fund]
FERTIMA	Fertilisation au Maroc [Fertilizers in Morocco]
FIDA	Fonds International pour le Développement Agricole [International Fund for Agricultural Development]
FRP	Federal Republic of Germany
FSR	Farming Systems Research
FSSP	Farming Systems Support Project (University of Florida)
GERDAT	Groupement d'Etudes et de Recherches pour le Développement de l'Agronomie Tropicale [Study and Research Group on the Development of Tropical Agriculture] (France)
GOPA	Gesellschaft für Organisation, Planung und Ausbildung GmbH (Germany)
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (Germany)
IARC	International Agricultural Research Center
IAV	Institut Agronomique et Vétérinaire Hassan II (Morocco)
IBPGR	International Board for Plant Genetic Resources
ICARDA	International Center for Agricultural Research in the Semi-Arid Tropics
ICRAF	International Council for Research in Agro-Forestry

ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
IDRC	International Development Research Centre (Canada)
IFAC	Institut des Fruits et Agrumes Coloniaux [Institute of Colonial Fruits and Citrus]
IITA	International Institute for Tropical Agriculture (France)
ILCA	International Livestock Centre for Africa
INIA	Instituto Nacional de Investigaciones Agrarias
INSTRUPA	Institut für Strukturforschung und Planing GmbH (Germany)
INRA	Institut National de la Recherche Agronomique [National Institute for Agricultural Research] (Maroc)
INRA	Institut National de la Recherche Agronomique [National Institute for Agricultural Research] (France)
IRCT	Institut de Recherche sur le Coton et les Textiles [Cotton and Textiles Research Institute] (France)
IRRI	International Rice Research Institute
ISDB	Islamic Development Bank
ISNAR	International Service for National Agricultural Research
KFAED	Kuwait Fund for Arab Economic Development
MARA	Ministère de l'Agriculture et de la Réforme Agraire [Ministry of Agriculture and Agrarian Reform]
MIAC	Mid-Western Consortium of Agricultural Colleges (USA)
OAA	Organisation des Nations Unies pour l'Alimentation et l'Agriculture
OCE	Office de Commercialisation et d'Exportation [Marketing and Export Agency]
OCP	Office Chérifien des Phosphates [Moroccan Phosphates Agency]
ODI	Office de Développement Industriel [Industrial Development Agency]
OECD	Organization for Economic Cooperation and Development
OFPPT	Office de la Formation Professionnelle et de la Promotion du Travail [Agency for Vocational Training and Work Promotion]
OILB	Organisation Internationale de Lutte Biologique [International Organization of Biological Pest Control]
ONEP	Office National de l'Eau Potable [National Drinking Water Agency]
ONICL	Office National Interprofessionnel des Céréales et des Légumineuses [National Intersectoral Agency for Cereals and Legumes]
OPEC	Organization of Petroleum Exporting Countries
ORMVA	Office Régional de Mise en Valeur Agricole [Regional Agricultural Development Agency]
ORSTOM	Office de la Recherche Scientifique et Technique d'Outre-Mer [Agency for Overseas Scientific and Technical Research] (France)
SASMA	Société Agricole de Services du Maroc [Moroccan Agricultural Services Corporation]
SAU	Superficie Agricole Utile [Useful Agricultural Area]
SCAR	Société Coopérative de Rizerie [Cooperative Rice Mill Corporation]
SCAS	Station Centrale d'Agronomie Saharienne [Central Saharan Agriculture Station]
SCI	Service Central d'Introductions [Central Introductions Service]

SECPS	Station d'Essai et de Contrôle de la Production des Semences [Seed Production Testing and Control Station]
SFD	Saudi Fund for Development
SNDE	Société Nationale de Développement d'Elevage [National Livestock Production Development Corporation]
SODEA	Société de Développement Agricole [Agricultural Development Corporation]
SOGETA	Société de Gestion des Terres Agricoles [Agricultural Land Management Corporation]
SONACOS	Société Nationale de Commercialisation des Semences [National Seed Marketing Corporation]
SRAEA	Service de la Recherche Agronomique et de l'Expérimentation Agricole [Agricultural Research and Experimentation Service]
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
USDA	United States Department of Agriculture