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Report on the national system of agricultural research in Tunisia

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Agricultural research is quite well established in Tunisia as its origins go back,to the beginning of the century. Initially limited to the cereal sector, it progressively diversified after the Second World War, and especially after independence.

Over the last 30 years, agricultural research institutions have benefited from generous financial resources which have enabled them to create new laboratories, to reinforce priority activities, to diversify objectives taking development imperatives into account and to obtain appreciable results in numerous fields such as cereals, arboriculture, vegetable cultivation, irrigation, sheepbreeding and range development.

New research establishments have been created in the regions, and specialized regional centres have been set up by existing institutes so as to bring together research activities in production and agriculture zones.

Despite these efforts, agricultural research continues to come up against serious difficulties, such as the lack of researchers and their over-mobility, the non-existence of a planning, programming and evaluation system, the lack of coordination at a national level, and management and financial techniques that are ill adapted since they do not take into account the demands and activities of research.

I - Agricultural research institutions

In Tunisia, research is divided up amongst numerous institutes, organizations and services that come under the Ministry of Agriculture. Other establishments that come under the Ministry of Higher Education and Scientific Research also undertake research projects that are directly linked to agriculture. We will confine ourselves here to those that depend on the Ministry of Agriculture.

1. Agricultural research establishments

A. National Tunisian Institute of Agricultural Research (INRAT)

Created in 1913 as the Tunisian Botanical Service and transformed in 1933 to the Tunisian Botanical and Agricultural Service, INRAT was set up in 1961. It is a public institution with administrative and financial autonomy.

In 1977 its mandate was redefined as follows:

- to undertake any research connected with plant and animal production and processing including rural economics and sociology,

- to contribute to activities concerned with extension work,

- to participate in student training and proficiency courses for agricultural technicians.

INRAT is organized into six departments (Ecology and Agronomy, Large-scale Farming, Horticulture, Zootechnology, Plant Conservation, Rural Economics and Sociology) which group about 20 laboratories specialized according to production sector or scientific discipline.

The Institute disposes of a large infrastructure of Regional Centres and Experimentation Stations, 22 in all covering all the agro-ecological zones of the country and totalling 3,500 ha.

The Institute is directed by a Director backed up by a Scientific and Technical Committee made up of department heads who are elected for a period of three years. The role of this Committee is to ensure the organization of the Institute's scientific activities and to attend to the distribution of resources and the efficient functioning of research units.

An Institute Board, presided over by the Ministry of Agriculture, theoretically meets once a year in order to examine results and define the various priority directions. It groups together members from outside the Institute representing the various technical departments in the Ministry and development bodies.

INRAT employs around 800 people of whom 75 are engineers, 100 are technicians, 20 are administrators, and 600 are workers of all categories. The whole workforce is directly remunerated by the Ministry of Agriculture, while the Institute directly manages the operating and equipment budgets.

The Institute's operating budget totals 500,000 Tunisian dinars, of which approximately half comes from its own revenue, and the equipment budget varies from one year to the next from 0 to 600,000 dinars.

B. Research Centre for Agricultural Engineering (CRGR)

Created in 1962, this Centre has, since 1974, regrouped the structures of the research project on briny water (CRUESI, 1964-1970) and of the project on improvements in irrigation and drainage techniques (CATID, 1969-1974).

It was created by a finance act, and has no statutes defining its organization or functioning.

Its mandate is:

- to contribute to an improvement in the use of irrigation water,

- to direct the choice of equipment and of rural infrastructure,

- to contribute to the rehabilitation of traditional agricultural irrigation,

- to define the conditions for the use of brackish water in agriculture.

CRGR is organized in sections (agronomy, machinery, sericulture) and consists of specialized laboratories (chemistry, plant physiology and soil physics).

More recently, a microbiology laboratory has been created within the framework of the new project entrusted to CRGR on the use of waste water in agriculture.

Activities are organized in project form and are often pluridisciplinary and correspond to research projects: water economy, brackish and waste water, energy sources.

CRGR employs 17 research engineers.

C. National Institute for Forestry Research (INRF)

The Institute of Reafforestation in Tunis (IRT) was created in 1966, and was replaced in 1976 by INRF which took over research into forests, the range lands, Spanish grass, the environment and nature conservation.

Its task is:

- to contribute to the growth and improvement of forestry, breeding and grass production,

- to be responsible for the choice of forest trees and reafforestation techniques,

- to develop methods of protection against forest insects and diseases.

The Institute comprises five departments (Forest and Breeding Ecology, Forest Production, Economy, CES, Environment) each of which is made up of specialized laboratories, three regional centres and a national network of arboretums and experimental plots of land (1,100 ha in all).

The scientific personnel is reduced to 15 research engineers representing half the total number of staff of the Institute at the time of the IRT. The majority of research engineers work in the ecology and production department.

D. Institute of Arid Regions (IRA)

IRA was created in 1976 and took over research which had been carried out in 1969 in Gabès on ranges and oases, in order to provide for the needs of agricultural development in the south and conservation of the environment from erosion and desertification.

Its status is that of a public institution of an industrial and commercial nature which allows for great flexibility both in its functioning and management. It is directed by a Chairman and Managing Director, backed up by an Administrative and a Scientific Board.

The IRA's task is:

- to undertake all research concerning the field of agriculture in arid regions,

- to make a synthesis of work and studies so as to suggest models for development of these regions,

- to contribute to extension programs and campaigns to make the masses aware of the problem,

- to contribute to campaigns of executive training.

The Institute has relatively large material resources at its disposal. Apart from its head office in Medenine, IRA has its regional office in Gabès, and four separate experimental stations and five observation plots. A new station is being set up at Kebili for the study of oases.

E. The Olive Tree Institute

The Olive Tree Institute (IO) was created in 1982 with the status of a public institution of an administrative nature, with a general mission to promote oleiculture.

Its mission is:

- to contribute to defining all strategies concerning the development of the oleiculture sector,

- to carry out research into oleiculture production and oleitechnique,

- to carry out technical and economic studies,

- to ensure, in collaboration with other Ministry services, the analysis of results and their publication and diffusion,

- to organize extension programs and demonstration campaigns,

Its head office at Sfax contains two departments:

- study and research,

- extension and follow-up.

At a regional level, the Institute has research, experimentation and extension stations at its disposal in Sousse and Tunis.

It has 15 research engineers, most of whom are from the Oil Office and INRAT.

2. Higher Education Institutions in Agriculture

Until the beginning of the 1970s, Tunisia only had the one Agricultural Engineering School (INAT), but it now has several such institutions for higher education:

- National Agricultural Institute of Tunis (1898): agronomy, breeding, economy, agricultural engineering,

- National School for Veterinary Medicine (ENMY) (1974), at Sidi Thabet,

- ESH of Chott Meriem, near Sousse (1975): horticulture,

- ESIER of Medjez el Bad (1976): agricultural engineering,

- ESA of Kef (1983): large-scale farming,

- ESA of Moghrane (1983): management, rural economy,

- ESA of Mateur (1984): breeding,

- ESIA of Tunis (1980): food industry.

All these institutions, and especially INAT, ENMV, ESH and ESAK, have highly qualified scientific personnel and a large infrastructure which enables them to undertake research programs to be conducted as much by the teachers as by the students. INAT and ESAK carry out, in particular, research and development projects with financial backing from international cooperation. Numerous research projects come within the framework of training suffer from lack of continuity and means. These institutions do not have sufficient research funds.

3. Research and Service Establishments

Some technical departments in the Ministry of Agriculture have services and laboratories for research and service at their disposal. These activities are integrated into the administration, and have few links with research institutions.

The Department of Animal Production has under its supervision an Institute of Veterinary Research (IRVT), created in 1968, but which only began to function properly in 1980 with the recruitment of 20 young veterinarians. Its task is to diagnose infectious diseases, to carry out epidemiological surveys, to supervise the control of foodstuffs of animal origin, and to manufacture vaccines and serums.

The Department of Soil Resources contains a soils division with a laboratory of soils analysis which carries out studies with a view to improved soil use and conservation. Its activities concern cartography, geomorphology, ectaphology and analysis, and remote sensing.

The Water Resources Department undertakes numerous studies of a hydrological nature. Apart from the evaluation of the potential of the top and lower layers, this department is responsible for the exploitation of water and manages the whole country's water resources.

The Plant Production Department has recently created service laboratories for the quality control of seed as well as soil and pesticide analyses. Moreover the Plant Conservation Services, which depend on this department, carry out tests on different pesticides with a view to their approval.

4. Research in Agencies

Agencies are organizations of a commercial nature, and belong to three main types:

- agencies for the development of irrigated plots,

- commercial agencies according to product (cereals, livestock, oil, wine),

- agencies for integrated rural development.

Twenty in all, these agencies have developed research activities running from small experimental programs to research centres such as the Centre for Caprine Research and the Apiculture Research Centre.

The majority of the programs are entrusted to foreign personnel within the framework of international cooperation, and only rarely are any of the official agricultural research institutions asked to collaborate, which has led to a lack of stability in programs, and an absence of continuity in the projects set up.

Despite the means at their disposal, and the great flexibility they enjoy, these agencies play only a secondary role in the national system of agricultural research.

Certain agencies have begun to try to collaborate with research institutions by proposing "financial backing" for certain programs.

5. Private Research

Private research is totally absent from the agricultural food products sector. Some private companies such as the Sugar Complex or the Tunisian Cotton Company finance very modest experimentation programs for the development of the products that they handle.

The fertilizer and pesticide industry undertakes no research.

Private organizations for seed and seedling multiplication (cooperatives, tree nurseries) use research products but do not develop any research activities or contribute to any financing of products despite numerous attempts made by certain research institutes, notably INRAT.

II - Relations between the national network and other activities

1. Relations with agricultural training colleges

There are no institutionalized links between research institutes and higher agricultural training colleges. Sporadically, and on a purely personal basis, there have been joint activities between teachers and researchers, mainly within the framework of research work by students preparing their doctorates who are specializing.

Recently, pluridisciplinary research projects have been set up and have tried to associate teachers and researchers. Co-habitation has not proved successful, and the common projects have turned into either training college projects or research institute projects.

One cannot even talk of coordination between research and training structures, since neither one nor the other is present at meetings of the internal bodies of the institutions, and the supreme Board of Agricultural Research, created in 1977, has only met twice without effect.

Thus one may affirm that research activities carried out in research institutes and in agricultural training colleges are almost totally independent of each other. In the first, one notes the existence of a board infrastructure and definite human potential which is blocked by lack of motivation, and in the second a high level of scientific potential, but without resources and not really committed to research activities.

2. Relations with the University

The remarks made above also apply in the case of other higher education structures.

Working relations have been established at a personal level, but not between institutions. In 1980, the Ministry of Higher Education and Scientific Research launched major "National Research Programs" on varied themes of which some are directly linked to agriculture (water, power for example), but the participation of "agricultural researchers" has been very limited and these have, for the most part evolved into permanent research centres within the National Institute for Scientific and Technical Research (INRS), which depends on the Ministry of Higher Education. This Ministry, together with agricultural researchers, has tried to place the Institutes of Agricultural Research under the double supervision of the Ministry of Higher Education and the Ministry of Agriculture, but the latter has preferred to keep total control of its structures, which has not facilitated the establishment of working relationships between researchers and teachers in the two departments.

3. Relations with agricultural organizations

In Tunisia, extension activities come under the Ministry of Agriculture's technical services. Schematically, three types of activities emerge:

a) Mass education through the publishing of brochures, radio and television programs, and the organization of demonstration days and seminars; researchers participate quite actively in these various activities.

b) On-the-spot extension work mainly ensured by the Plant and Animal Production Departments. Research is only incidentally associated with this through its participation in the retraining of extension agents.

The agencies for the development of irrigated areas are responsible for extension activities limited to their zones of activity. Some agencies have drawn up conventions with research institutes particularly to create "back-up" stations whose task it is to carry out experimentation and demonstration.

c) Extension work via development projects or supervised funded projects. If the former have tried to associate researchers, especially economists, in their development activities, this is not the case for the latter which have practically no connection with research.

As for the farmers, they are grouped in a single organization: the National Union of Farmers, which only requires the participation of researchers in occasional chairing of round tables or seminars, or to ask them to contribute technical articles to be published in specialized journals edited by the Union. Little on-the-spot extension work is undertaken by the latter.

Since 1982, some researchers (economists, agronomists and zootechnicians) have developed

research projects on production systems which bring together both extension agents and farmers. Thus these projects are directly linked with extension and development.

III - National organization of agricultural research

Agricultural research establishments are under the sole administrative supervision of the Ministry of Agriculture. Among the seven research establishments, four are under the sole administrative supervision of the Department of Teaching, Research and Extension (DERV), which has a division of research which is in principle responsible for coordination. These four institutions are INRAT, CRGR, INRF and IO.

The two other institutions depend on other Ministry of Agriculture administrative structures. INRV is attached to the Department of Animal Production and as for IRA, its situation is somewhat uncertain since it is sometimes attached to DERV, and at other times directly to the Ministry.

National coordination is theoretically ensured by the Supreme Research Council in the agricultural field, created in 1977. With no definite structure or permanent secretariat, the only two meetings held by the Council however have not been followed up, and it has not met since 1980.

The institute boards have not met either, for some years, to direct programs into priority areas.

Program direction is essentially decided by the institutes and researchers themselves, drawing their inspiration from the national development plan and starting from personal knowledge of the terrain and problems that farmers have come up against.

As a result, the Ministry of Agriculture's control of research programs is extremely ineffectual. Certain institutes undertake programs that are not part of their mandate (hence much duplication of projects). Other programs which have said all they had to say, continue indefinitely. There is no procedure or system of evaluation of programs to enable a decision to be taken as to whether they should continue or stop.

As for resources, they are allocated to the institutions, and not according to theme or research programs.

Personnel management is totally outside the institutes' authority, since salaries, promotion and sanctions are the responsibility of the Ministry's Department of Administrative Affairs. The institutes do not have either posts that are suited to their needs or a well-defined status for executives. Recruitment is successful or unsuccessful, depending on somewhat irrational mechanisms, and there have been severe restrictions over the last few years.

Thus the budgets managed by the institutes are limited to the operating and equipment budgets. The allocation of these funds is made within the agriculture budget, and there is fierce competition with other sectors of activity. In this domain as well, there is no rational method in budget allocation, given the programs effectively proposed.

At present ISNAR is undertaking, together with a Tunisian team, a study of the system of agricultural research, in order to evaluate existing structures and programs and provide the government with reorganization proposals and an overall research plan for the next ten years. A draft of this study has been submitted to the Tunisian authorities. In this report, we do not intend to cover the reorganization alternatives proposed by INSAR.

IV - Human resources

1. Scientists

Table 1 shows the development of the number of researchers in the main institutions attached to DERV.

If we add the researchers working in other research and study institutions, this comes to a total of 200 researchers in the whole Ministry of Agriculture.

Among this total, it should be noted that for the most part it is made up of young researchers who have less than ten years experience in research. In fact, **Table 1** hides this lack of stability among researchers. Thus INRAT which, in 1971 counted 37 Tunisian researchers, had around 130

researchers in 1985, if one adds the 57 researchers who left during this same period.

As for higher education institutions, the number of experienced teachers represents only half of this total, of whom only 70, according to the INSAR study on agricultural research in Tunisia, effectively contribute to research programs, that is the equivalent of 35 full-time researchers (on the basis of 1/2 researcher per teacher).

Researchers do not have a special status, neither on the agricultural level, nor on that of higher education. Agricultural researchers come under the general status of technical executive applied to the whole engineering profession, or the status of laboratory executives, which is in any event identical to the former.

There is a large difference in salaries between research engineers and teachers. The latter, aligned on the higher education salary scale, with the equivalent diploma and seniority, receive double or more than double the salary of researchers. This difference is essentially due to the fact that teachers receive an indemnity and research bonus to which researchers are not entitled, receiving in exchange a "technical" indemnity that is five times less.

Engineers who have a civil service post and administrative civil servants receive acting allowances and allowances in kind (accommodation, car) which place them between the teachers and the researchers.

As for the private sector, engineers' salaries can often overtake those of teachers.

Researchers are recruited directly, without open examination, according to the budgetary provisions of the Ministry of Agriculture.

Promotion is subject to the same criteria as the Ministry's Central Administration, that is taking into consideration annual grades and seniority, but not the projects carried out, publications or research program results.

The country's training programmes are carried out in the various higher education establishments, whether agricultural or university; research work often takes place in research institution laboratories. Researchers are also trained in European countries (France and Belgium) or in the USA, especially at the beginning of their careers.

Recruitment of good researchers often comes up against the fierce competition that exists in other domains, especially teaching and the private sector. These same problems also exist as far as keeping the best elements is concerned, because of the lack of motivation and career prospects.

2. Other personnel

The technical personnel in the five institutes attached to the DERV comprises approximately 200 officials who belong to three training levels: Assistant Engineer (*Baccalauréat* + 2 years); Technical Assistant (*Baccalauréat* level); and Technical official (Secondary School Certificate). They come under the regime of technical executives which is applicable to all the technical Ministries.

The administrative personnel is made up of administrative officials: administrators, secretaries, clerks and typists, who come under the General Civil Service Regime which is applicable to this personnel in all public administration services, and workers/book-keepers acting as clerks or typists.

There are approximately 80 officials who carry out mainly office work in the five institutes.

Manual workers are divided into two categories:

- permanent workers, whose number is around 1,000 for the five institutes, are used in the laboratories, experimentation stations and various common services; and

- occasional workers who are recruited temporarily during peak periods. They receive a salary equivalent to the SMAG (minimum agricultural wage) earned by unqualified agricultural workers.

Permanent manual workers are covered by national insurance, have job security and are entitled to a pension. The salary varies according to speciality, and can reach, all bonuses included, three times the SMAG.

V - Material resources

1. Infrastructure

The basic infrastructure of each institution has been described in the first chapter. The main installations and the network of centres is summed up in **Figure 1**.

A heavy concentration of laboratories and resources can be found in Tunis. Agricultural research possesses a large network of regional stations which represent different agro-ecological zones throughout the country. However, these stations are managed by central offices, are insufficiently equipped, and have few researchers.

Regional stations back up the experimentation laboratories. Here the basic plant material is produced, which is then distributed to multpliers and genetically improved animals for reproduction purposes.

2. Equipment and services

Central office buildings and recently created centres are in general highly satisfactory and functional. On the other hand, most structures in the stations, with a few exceptions, are out of date and ill adapted. The breeding stations in particular lack functional sheep pens or cowsheds, hence serious problems in controlling animal hygiene.

There is plenty of laboratory equipment, and, indeed, often a surplus. It is renewed in satisfactory conditions, and is often provided by foreign aid backers.

On the other hand, agricultural equipment in experimentation stations is insufficient and often in bad condition. Some machines and tractors date back to 20 years ago and more, and repairs are both costly and difficult because of the non-availability of spare parts.

The lack of vehicules constitutes a real bottleneck, even more so since the dispersed experimentation network necessitates frequent travelling on the part of researchers and technicians. Only the laboratories involved in cooperation programs have suitable means of transport.

Today, research programs backed by cooperation aid are the best supplied in work resources.

The institutes, and especially the older ones, edit different types of publications. INRAT annals have been published without interruption since the creation of the Institute. Among the other publications are the INRAT Technical Documents, the CRGR Notebooks, and IRA's Forestry Annals and Documents and Studies.

As far as documentation is concerned, INRAT, CRGR and IRA have large, functional libraries at their disposal. INRAT's documentation service, in particular, keeps up exchanges with nearly 400 institutions or editors of agricultural journals.

Data processing equipment only entered research institutes very recently. In 1986, it is planned to set up a computer centre at DERV for all teaching and research institutions.

3 Financial Resources

The operating budgets allocated to research institutions during the last four years are shown in **Table 2**.

It should be pointed out that IRA's budget includes personnel salaries, which is not the case for other institutions where all the personnel, with the exception of occasional manpower, is directly remunerated by the Ministry of Agriculture.

The rate of growth of the operating budget has been, on average, 10% per year, which just covers the increase in product and service prices, but is not sufficient to cover demands created by an expansion of activity and the creation of new units.

The equipment budgets allocated to the five main research institutions during the four years can be seen in **Table 3**.

These budgets, which vary greatly from one year to the next, cover construction costs and the purchase of various sorts of equipment.

The sums indicated represent the institutes' resources from their own revenues and from State subsidies. If we add the salaries and budgets from the two other Ministry of Agriculture research establishments (INRV and INSTOP), the global volume assigned to these institutions must be in the region of seven million dinars.

According to the ISNAR study, this figure should amount to around ten million dinars if one adds the portion - which is difficult to assess - from research in advanced agricultural training, and the agencies. This same study estimated the contribution from international aid at three million dinars per year, but nearly half this sum is allocated to the agencies and mainly comprises experts' salaries.

Thus the global budget allocated to the national research system seems quite high (13 million dinars) if one compares it proportionally to other countries. Research expenditure represents 1.5% of the GNAP, a figure equal to that recorded for Western Europe, according to ISNAR. The number of scientists per million cultivated hectares is, on the other hand, among the lowest figures quoted by ISNAR: approximately 40 scientists in Tunisia, as opposed to 206 for the same region in Western Europe.

One can draw the following conclusions:

- the impact of agricultural research in Tunisia is considerable,

- the relatively large means are very dispersed,

- salaries absorb 75 to 80% of resources, with unqualified personnel salaries dominating (workers and back-up administration services),

- there is an over-extended network of experimentation stations, and thus a high cost of research,

- there are insufficient operating funds,

- there is poor distribution of financial resources among the institutions themselves, and among research programs in each institution,

- international aid is not always channelled into priority programs because of the lack of coordination and power of decision in programming activities.

Moreover, the "topheaviness" and rigidity of management procedures completely ill adapted to research and experimentation activities should be pointed out. Apart from the highly centralized management system (the Director is the sole organizer of the Institute), purchases and expenditures are submitted for the prior authorization of Expenditure Control and - in the case of equipment funds - pass via complex administrative circuits that make them almost unusable.

Only IRA, which benefits from an EPIC status, has no management problems.

VI - Research programs and results

1. Choice of program orientation

As has been mentioned above, the authorities whose task it is to define research orientation are the Supreme Research Council in the agricultural field, and the Institute Boards, or in the case of IRA the Administrative Board.

Faced with the inefficiency of the Supreme Council and the Institute Boards, choices are made by the institutions themselves and by the researchers.

Because of the multiplicity of the institutions and the lack of coordination and control of research programming, we come across much overlapping and duplication of programs, and non-respect of the institution mandates. Instead of distributing jobs according to the vocation of the institutions, and establishing inter-institutional complementary programs, research institutions are in competition with each other, and development organizations try to duplicate research by creating their own experimentation and research structure.

2. Definition of programs

The detailed definition of programs is the work of researchers themselves. The majority of the programs are made up of individual programs. This situation is essentially due to the small number of researchers and the lack of a concerted interdisciplinary effort (several laboratories have only had one researcher for many years). The establishment directors and Scientific and Technical Committees also bear responsibility for the situation.

In the rare cases of pluridisciplinary programs developed over the course of the last three years, almost systematically project coordination and management committees have been set up which bring together members of the administration and researchers. In these cases, it is still the

researchers and participants in the projects who elaborate a detailed work plan and who develop the budgets that are necessary for the realization of the projects.

The Ministry of Agriculture's system of budgeting and allocation of resources does not at all take into account the programs suggested, and does not involve detailed discussion of the programs for each team.

3. Socio-economic aspects

Research programs have never seriously considered the socio-economic aspects until the creation of the INAT Chair of Economics and at the beginning of the 1970s the INRAT Laboratory of Agricultural Economics.

IRA – a more recent creation – has most often taken into account the socio-economic factor, both at the research program level on the development of arid regions, and that of development and the struggle against desertification.

At present, INRAT, INAT and the Moghrane ESA have a team of experienced sociologists and economists which has been able to develop, especially over the last three years, research and development projects where the socio-economic dimension has as important a place as the Agricultural and technical aspects at the triple level of farming, the region and the country.

4. Influence of international aid

Bilateral and international aid is fairly diversified and does not obey a general rule, but it can be said that it is often badly channelled and does not always correspond to the themes that are judged to have priority at the national level.

However, such aid is always appreciated by everyone firstly because it brings in appreciable financial resources but also because it allows for very flexible expenditure modes that the administration cannot set up.

Certain cooperation projects are reduced to simple financial backing of a laboratory or a research team, without having a great impact on project orientation, which remains a prerogative of local officials, even if it is discussed in mixed coordination committees. On the other hand, other projects are the subject of detailed methodological and directive discussions with foreign partners which directly influence research channels. In general, it is a question of projects that require large financial resources.

Finally, some development projects are for the most part created and realized by foreign partners. In these cases the national authorities have very little influence on the direction of these activities.

5. Evaluation of results

There is no real system of evaluation of agricultural research results. The effort made by teams or individual researchers is not at all taken into account for the promotion of personnel, nor to encourage these programs by allocating more substantial material means. A very summary and not very objective evaluation of each individual is made by the Director of the institution in order to attribute the annual mark or the productivity bonus mark; but one cannot consider this to be a real evaluation procedure.

Globally, in official Ministry of Agriculture and planning reports, the essential role played by agricultural research and the important results it has had in the evaluation of the country's potential are acknowledged, including the creation of highly productive varieties and the refinement of certain agricultural techniques such as irrigation, fertilization and phytosanitary protection.

In the absence of a precise evaluation of these results, many think that they are very limited given the means used to obtain them. But nobody has ever tried to measure the impact of these results on the level of agricultural development (real and potential impact).

6. Distribution of scientists by group

The study in progress at ISNAR has tried to divide up the scientists by main agricultural sector or discipline, inspired by a study made on this subject by the National Centre of Agricultural Documentation within the framework of the survey by CARIS of FAO. The main conclusion of this work is reproduced in **Table 4.**

These figures are of limited value for they depend on declarations made by the researchers without taking into consideration the time devoted to different operations. Moreover, the number of researchers and their distribution have noticeably varied since 1983.

The examination of the distribution of researchers according to discipline brings out shortages in the following sectors: technology and agro-food industry; renewable energy; and agronomy (work on soil and rotation of crops).

In other leading disciplines such as molecular biology, biotechnology applied to the improvement of plants, nuclear power applied to plant nutrition and animal health, remote sensing, no research is undertaken in these fields within agricultural research institutes.

7. Themes proposed for cooperation with ICAMAS

Certain research teams can be considered vital for Mediterranean agriculture. They have already been the subject of more or less developed projects in countries in the region and whose common implementation through the exchange of information and results could rapidly contribute to the improvement of the level of technological and scientific knowledge for the entire Mediterranean Agricultural community. These exchanges and transfer of knowledge could be realized by the organization of: thematic technical and scientific seminars, regional reorientation courses, cooperative research networks by priority theme or product.

Suggested themes could be the following:

- development of research methodologies for the improvement of cereals and legumes in a semi-arid environment,

- techniques of the use of irrigation water, water conservation and optimalization of use,

- breeding in semi-arid areas,

- forests and Mediterranean agro-forestry,

- arboriculture for the development of regions low in water resources,

- determined fight against pests that devastate crops,

- conservation of Mediterranean phytogenetic resources,

- development of agricultural products and sub-products.

Other research themes have not been very well developed in southern Mediterranean countries, but on the other hand are quite advanced in northern countries. Without setting up sophisticated bio-energy laboratories or genetic engineering, it would be a good idea to make an effort to train young researchers in southern Mediterranean countries in these ultra-modern techniques, so that they will be in a position to get the maximum profit by their application in the field of agriculture. Among the most important themes to be considered in this respect, we can cite:

- *in vitro* cultivation and micro-propagation,

- genetic engineering,

- enzyme engineering,

- transfer of animal embryos,

- remote sensing.

In the Mediterranean, ICAMAS can play a dominant role in the diffusion of advanced technologies for researcher training, the organization of meetings and scientific study travels, and the development of cooperative projects in this field with those partners who so wish.