Report to:

The Ministry of Planning

The Ministry of Agriculture
and Irrigation

A REVIEW OF

THE AGRICULTURAL RESEARCH SYSTEM

IN THE REPUBLIC OF IRAQ

July 1991

A Review of the Agricultural Research System in the Republic of Iraq

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ACRONYMS

ACSAD	Arab Center for the Studies of Arid Zones and Dry Lands
AgGDP	Agricultural Gross Domestic Product
AGRIS/ CARIS	Agricultural Research Information System/ Current Agricultural Research Information System
AIDO	Arab Industrial Development Organization
AOAD	Arab Organization for Agricultural Development
ATMS	Agricultural Technology Management System
AUFI	Arab Union for Food Industries
AWRRC	Agriculture and Water Resources Research Center
BSRC	Biological Sciences Research Center
CSR	Council of Scientific Research
DSC	Department Scientific Committee at SBAR
ESCWA	Economic and Social Commission for Western Asia
FABasU	Faculty of Agriculture, Basrah University
FABU	Faculty of Agriculture, Baghdad University
FAFMU	Faculty of Agriculture and Forestry, Mosul University
FAO	Food and Agriculture Organization of the United Nations
FASRC	Federation of Arab Scientific Research Councils
FVMBU	Faculty of Veterinary Medicine, Baghdad University
FVMMU	Faculty of Veterinary Medicine, Mosul University
GDP	Gross Domestic Product
GEBTC	Genetic Engineering and Biotechnology Center
ICARDA	International Center for Agricultural Research in the Dry Areas
ISNAR	International Service for National Agricultural Research
MAI	Ministry of Agriculture and Irrigation
MP	Ministry of Planning
SBAAR	State Board for Applied Agricultural Research
SBAARWR	State Board for Applied Agricultural Research and Water Resources
SBAR	State Board for Agricultural Research
SBAS	State Board for Agricultural Services
SRDC	Scientific Research Documentation Center
SSC	SBAR Scientific Committee
UNDP	United Nations Development Programme

CONCLUSIONS AND RECOMMENDATIONS

Summary

The Iraqi agricultural research system has a central role both in generating and transferring the technology required to meet the agricultural development challenge. It is essential for identifying technology problems and for developing and adapting appropriate technologies.

But agricultural technology is generally highly location-specific, its utility determined in agroecological, socio economic, and policy conditions. New agricultural technologies contribute little to sustainable growth in agricultural production if they are not adapted to local conditions, validated, and ultimately used by a sizable number of farmers. This points to the leadership role which the Iraqi agricultural research must inevitably assume in the technology generation and adaptation processes. The agricultural research leaders in the country must be in a position to reflect upon and influence the agricultural development policies, to define Iraqi agricultural research needs and priorities, to evaluate their findings and those of the global research community under local conditions, and to contribute to the technology transfer process through formal and informal linkages with extension and producers.

Whether primarily a technology generator or technology adaptor, the Iraqi research system must be strong and effective if it is to contribute significantly to agricultural development in the country. However, researchers cannot attain their fullest potential, no matter how well trained, without institutional support.

A strong and effective agricultural research system requires:

- a coherent research policy designed to meet agricultural development objectives;
- an organization and structure compatible with designated objectives and functions of research;
- the ability to communicate effectively with its clients, partners, and policymakers;
- an adequate resource size, i.e., human, financial, and physical, to conduct research activities;
- a coherent set of management processes which allow the system to mobilize and use its resources in a continuous and cost-effective way.

Within this concept of requirements for an efficient and effective research system, this review study was conducted by a National Study Team with backstopping from AOAD and ISNAR, and partial financial support from UNDP, to review and propose improvements in the areas of agricultural research organization and structure, resource management, policies and plans, and program management.

Organization and structure: Agricultural research in the country has undergone structural reorganization several times. At present SBAR is the major agricultural research institution and its mandate covers the whole country. It is a semi-autonomous national research institution directly responsible to the Minister of Agriculture and Irrigation. The three faculties of agriculture and two faculties of veterinary medicine are also involved in agricultural research.

Particular emphasis will have to be placed on structural organization, which will ensure effective research priority setting and allocation of resources, better coordination and implementation of multidisciplinary research activities to address priority areas in agricultural development plans. Thus, there is a need for establishing a centralized apex body where the budgetary resources for national agricultural research activities are provided as a single package. This approach calls for central resource allocation and decision making and detailed planning, but it also calls for decentralized planning and implementation of research activities. It has the advantage of facilitating a total policy for national agricultural research activities which minimizes abrupt shifts that can disrupt research continuity.

Mechanisms within SBAR should be developed to improve research program planning and implementation. This especially calls for establishing an internal management committee to help develop guidelines for research proposals, to coordinate research activities, to improve monitoring and evaluation of research, and to guide SBAR management.

Linkages between SBAR, extension, and farmers are mostly informal. The same could be said for linkages between SBAR, university research, and other sources of knowledge which are mainly informal. Thus, efforts should be made to continuously institutionalize linkages to improve the efficiency and effectiveness of research activities.

Research resource management: Managing human, financial, and physical resources well is vital to maintaining the productivity of the agricultural research system and, hence, to ensuring continuity of support from government.

The SBAR and university system have 1167 professional staff -- 606 with a Ph.D. degree and 561 an M.Sc. -- half of them are at the two faculties of agriculture of the Universities of Baghdad and Mosul. In 1989, SBAR had a professional staff of 682 -- 70 Ph.D. holders, 141 M.Sc.s, and 471 B.Sc.s -- supported by 225 diploma-holders and 159 secondary-school certificate-holders.

Salaries for SBAR staff are less than those of academic staff of the same qualifications at university. SBAR career development plans need to be improved to retain staff to perform their jobs efficiently.

In general, physical resources are adequate in buildings, land, and equipment. There is a need to improve utilization and maintenance of these resources, to develop efficient central support services, and to consolidate station networks.

Agricultural research in the country is mostly a public enterprise. Thus, the government finances research at SBAR and at the universities. While SBAR on-station research activities at SBAR are reasonably funded, on-farm research activities are less well-funded. Therefore, funding for on-station and on-farm research activities should be improved.

Research policies and plans: Research planning is practiced in the country through the five-year and annual planning exercises. The five-year research plan, 1986-90, contained 167 projects, covering 1793 more specific and detailed research problems. SBAR and CSR (before cancellation) were responsible for implementing 65% of the projects and problems, and the university systems and elsewhere were responsible for the rest. Problems and constraints encountered during plan implementation were identified to include communication problems in coordinating research activities, frequent turn-over of researchers, inadequate financial and human resources to implement research projects, and the liquidation of CSR and its research centers.

Annual planning of research is mainly a bottom-up approach which generally is not guided by a national agricultural research policy and strategy, or a long- or short-term research program.

Research program management: While teamwork has been practiced in preparing the five-year research plan, it is poor at implementation level. Departmental boundaries did not stimulate teamwork to implement research programs. Thus, multidisciplinary research should be organized across departments to improve the impact of research, especially commodity research where on-farm trials need this type of cooperation.

SBAR has implemented follow-up procedures for progress reporting on research activities, which are part of the government follow-up system. The latter is designed to meet government accounting and financial reporting requiements for implementing development projects. Research needs an efficient monitoring and evaluation system which should be an integrated part of research planning and implementation.

SBAR is organizing its administrative and financial information according to government procedures. Other types of information, such as library, technical information on research activites, and information on research program management are poorly managed at SBAR.

Recommendations

1. A centralized research policy body should be established to govern SBAR and agricultural research in the country. This apex body would be chaired by the Minister of Agriculture and Irrigation, with the following membership: representatives of the Ministries of Planning and Finance, the Director General of SBAR, deans of faculties of agriculture, and veterinary medicine, representatives of the Farmers Union, the Undersecretary, directors general of state boards for agricultural services, and representatives of the animal resources and veterinary services of the MAI.

The apex body would secure political support and financial and human resources for agricultural research, contribute to developing agricultural policies, determine research policies and strategies, set broad research priorities, approve the five-year research program, and organize the implementation of research policies and strategies.

2. An SBAR internal management committee should be established to develop guidelines for research proposals, approve the annual program and budget, coordinate research activities -- especially those of a multidisciplinary nature -- organize the implementation of research programs, improve the monitoring and evaluation system, and guide SBAR management.

3. Efforts should be made to continuously improve linkages between SBAR and extension for joint planning and follow-up of research trials, especially on-farm trials, for identification of farmers problems, and for joint on-farm validation and verification trials. Resources should be allocated to carry out joint activities to foster technology adaptation and transfer.

4. SBAR and universities should identify institutional mechanisms for collaboration and coordination of research activities.

5. Linkages with sources of knowledge should be improved, especially between SBAR and regional and international research. SBAR should develop collaborative programs for training, germplasm exchange, information exchange, and execution of joint research activities with relevant regional and international organizations. SBAR should participate in relevant intercountry, regional, and international relevant research networks.

6. Planning and development of human resources should be organized for SBAR to review its future program needs in terms of the various skills of research and research support staff. Staffing, training, and career plans should be developed.

7. To maintain and sustain a good physical resource set-up, SBAR should develop physical resource strategies to tackle issues such as the regionalization of the research station network to serve agroecological and production systems more efficiently; the maintenance and repair of buildings, land, and equipment; and keeping track of supplies and purchases.

8. Centralized research support services should be established at SBAR headquarters. These would include improving the germplasm bank, developing the SBAR library to become a central agricultural library and documentation center for the country, establishing a central workshop for the maintenance of scientific equipment, and establishing three central laboratories to serve researchers and the public -- (1) a laboratory for routine chemical analysis of food, feed, pesticides, and fertilizers, (2) a laboratory for experimental design, statistics, and data processing, and (3) a laboratory for soil testing and classification.

9. Financial resources should be enough to conduct on-station and on-farm trials and to purchase supplies needed for research. Salaries and allowances for researchers at SBAR should be similar to those of academic staff of similar qualifications at the universities.

10. To improve the planning process for agricultural research, a proposal for SBAR was developed. It includes the principles of formulating and implementing agricultural research strategy and program. An organizational framework for decision making in the planning process was proposed. The proposal called for a national research policy and strategy, as well as a long- and short-term program plan to be developed by national task forces.

11. Developing national commodity and noncommodity research programs should dictate the research planning processes to facilitate multidisciplinary research within SBAR and between SBAR and the universities. Research programs proposed to be considered are:

    - commodity research programs including improvement of cereals; industrial crops; oil seeds; forages and dry legumes; vegetables; fruit trees; dates and date palms; forestry; sheep, goats and rangeland; cattle; and fisheries;
    - non-commodity research programs including characterization of agroecological zones; irrigation and drainage; and macro-socioeconomics.

12. SBAR should organize multidisciplinary teams to implement research programs, especially for commodity research programs, for coordinating research activities across departments within SBAR and between SBAR and the universities.

13. SBAR should increase support for on-farm trials to improve testing and validating technologies and to conduct joint extension trials.

14. An improved monitoring and evaluation system should be developed to monitor and evaluate research activities. This system should be an integrated part of research planning and implementation.

15. An improved information technology system should be developed to improve the research program management information system and management of technical information on research activities.

INTRODUCTION

Origin of the Study

The Arab Organization for Agricultural Development (AOAD) and the International Service for National Agricultural Research (ISNAR) have jointly developed a project proposal entitled "Strengthening Agricultural Research Management in the Arab Countries (SARMAC)." The project objective is to assist national agricultural research systems (NARS) in Arab countries in their efforts to generate and adapt improved agricultural technologies through the development of stronger organizational and managerial capacity in these NARS. The SARMAC project proposal was endorsed by the Ministerial Council of AOAD in its 16th regular meeting held in Baghdad, Iraq, 1987.

In the first phase of the SARMAC project, the field study methodology was developed by the adaptation and integration of the guidelines for ISNAR reviews and evaluations of NARS, and the agricultural technology management system (ATMS) methodology. Thus, the field study methodology presented a number of tools which the country study teams could use in order to collect, analyze, and interpret data. The methodology was field tested through the review of ATMS in Sudan in late 1987, and a review report was prepared and presented to the Sudanese Minister of Agriculture and Natural Resources. A national seminar was held in August 1988 at AOAD headquarters to present and discuss findings. A final report covering the proceedings of the seminar and the review report was published and distributed in 1988.

Based on the response from NARS managers to the Sudan study, and in order to meet SARMAC objectives, AOAD and ISNAR developed the second phase of SARMAC which calls for preparation of three detailed country studies (Iraq, Yemen, and Algeria) during 1989-91, followed by three national seminars, one for each country, to discuss study findings and recommendations, and a regional workshop to discuss common issues and lessons learned from the four country studies. Phase II is a collaborative activity between the country, AOAD, and ISNAR. The United Nations Development Programme (UNDP) is assisting this phase by providing partial funding.

Composition of the National Study Team

The field studies were initiated in Iraq in late 1989, and in Yemen and Algeria in late 1990. As a result of AOAD efforts in contacting the Ministries of Agriculture, Planning, and Higher Education of Iraq, a National Study Team was formed as follows:

- Professor Waleed K. Al-Murrani, Animal Breeder, Faculty of Veterinary Medicine, and Director of Higher Studies and Scientific Affairs, Baghdad University; team leader representing the Ministry of Higher Education and Scientific Research.

- Dr. Fadhel A.R. Al-Tayar, Plant Breeder, State Board for Agricultural Research; team member representing the Ministry of Agriculture and Irrigation.

- Dr. Nazar Nouman Al-Ar baky, Insecticides Biochemist, Dates and Palm Dates Research Department, Agriculture and Water Resources Research Center; team member representing the Council of Scientific Research (before cancellation in late 1989).

- Mr. Qussay Mehdi Salah, Agricultural Economist, Agricultural Planning Commission; team member representing the Ministry of Planning.

Work Program

In a three-day preparatory workshop held in Baghdad, July 1989, an ISNAR/AOAD preparation team introduced and discussed with the National Study Team the field study methodology with the objective of adapting the methodology to the Iraq situation, to improve methods of collecting data, and to develop a schedule for implementing the study, holding a national workshop, and finalizing the report and the proceedings of the workshop. Unfortunately, the National Study Team, while implementing the study, was unable to distribute research institution and researcher questionnaires. That led to a modification of the study methodology. The National Study Team was requested to prepare a draft report on the Iraqi agricultural research system, using a modified checklist for diagnostic review of NARS which is part of the field study methodology. With backstopping from AOAD and ISNAR, the draft report was reviewed and typed at AOAD, and then re-reviewed and retyped at ISNAR.

AOAD received the draft report prepared by the national team in January 1991. The draft report was further reviewed and edited at AOAD headquarters.

In early June 1991, ISNAR received the draft report which had been reviewed by AOAD. ISNAR, during June and July, reviewed the draft report and prepared a revised version of the draft report which was sent to AOAD for final review before sending it to the National Study Team for presentation to both the Ministry of Planning and the Ministry of Agriculture and Irrigation of the Republic of Iraq for their consideration.

The review report covered an analysis of the country's agricultural sector (natural resource base, human resource base, agricultural production systems, plant production, animal production, fisheries production, and agricultural policies) and agricultural research (structure and organization, research resources management, research policies and plans, and research program management).

A set of recommendations was provided to improve agricultural research organization and structure, resources, policies, and program management.

THE AGRICULTURAL SECTOR

Introduction

Agriculture plays a very important role in the life and economy of Iraq by producing food, feed, and fibers, and by providing the capital needed for agriculture and for the remaining sectors of the economy. However, demand on agricultural products has increased sharply during the last three decades as a result of relatively high population growth rates, an increasing tendency for the rural population to migrate to urban areas, and changing food consumption habits.

Agriculture contributes about 13.5% into the gross domestic product (GDP). The Agricultural GDP (AgGDP) has fluctuated from 11.0%-15.4% of GDP during the period 1983-87. This fluctuation is attributed mainly to unfavorable climatic conditions, especially to rainfall amount and distribution, which affect rainfed crop production and pastures.

According to the rainfall, the availability of water for irrigation, and farming patterns, the country is dominated by four farming systems: (a) irrigated agriculture in which ground and underground waters are used; (b) mixed rainfed farming systems where annual rainfall exceeds 600 mm, involving a mixture of tree species in mountainous regions in the north with forests and mountain pastures predominant at higher elevations, and tree and annual cropping increasingly important at lower elevations; (c) annual rainfed farming systems where winter rainfall is between 250-600 mm a wheat-based system with rainfall between approximately 350-600 mm and a barley/livestock based system with rainfall between approximately 250-350 mm; and (d) communal grazing systems in the steppe area with annual rainfall about 200 mm.

The main agricultural commodity groups produced in the country are cereals, mainly wheat, barley, rice, and maize; oil seeds and industrial crops, including sugar beets, sugar cane, cotton, sesame, sunflowers, and tobacco; vegetables, including tomatoes, potatoes, cucurbits, and onions; fruits, including dates, citrus fruit, stonefruits, and pomes; livestock, including cattle, buffalo, goats, sheep, and poultry; and fisheries.

Twenty years ago, the country was almost self-sufficient in main staple foods, especially wheat. However, increasing demand and the low rainfall in the eighties have reduced self-sufficiency in wheat and barley to less than 30%. This situation has prompted the government to accord top priority to achieving self-sufficiency in food production. Thus, major steps have been undertaken since the mid-eighties to increase the efficiency of the agricultural sector. These steps include, among other things, refraining from interference in cropping patterns adopted by farmers which allow them to grow more profitable crops. Further, membership in cooperatives is left to individual choice. Some changes in the management of state farms have been introduced in order to improve their productivity. Farmers are provided with subsidized production inputs, financial loans, and attractive pricing policies. Free seeds, fertilizers, and machinery are also provided to farmers for on-farm research and extension trials.

Government is increasingly committing itself to improving both the technological structure and economic conditions of the agricultural sector. Development and diffusion of new technologies for the agricultural sector have received top priority in the Government's recent five-year plans, especially the 1981-1985 and 1986-1990 plans. This concern with technological solutions to the agricultural problems of how to increase productivity stems, in part, from the concern for self-sufficiency in food production. It is also based on the desire to make farming a profitable business in order to discourage the large rural population from migrating to urban areas, as well as being based on on the quest for intensive methods of land use. Thus, all improved potatoes, sugar beets, most wheat (in irrigated and high-rainfall areas), most barley (irrigated), most maize, soybeans and other introduced oil crops, and new varieties of food legumes, and other crops are developed and/or adapted by the Ministry of Agriculture and Irrigation (MAI) through its State Board for Agricultural Research (SBAR).

Natural Resource Base

Introduction

The Republic of Iraq is in southwest Asia, bounded by Turkey in the north, Iran in the east, Syria, Jordan, and Saudi Arabia in the west, and Kuwait, Saudi Arabia, and the Gulf in the south. Iraq lies between latitudes 29° 5' and 37° 22' north, and between 38° 45' and 48° 48' east.

The area of Iraq is 438,320 km². Topographically, it consists of three main regions (Figure 1):

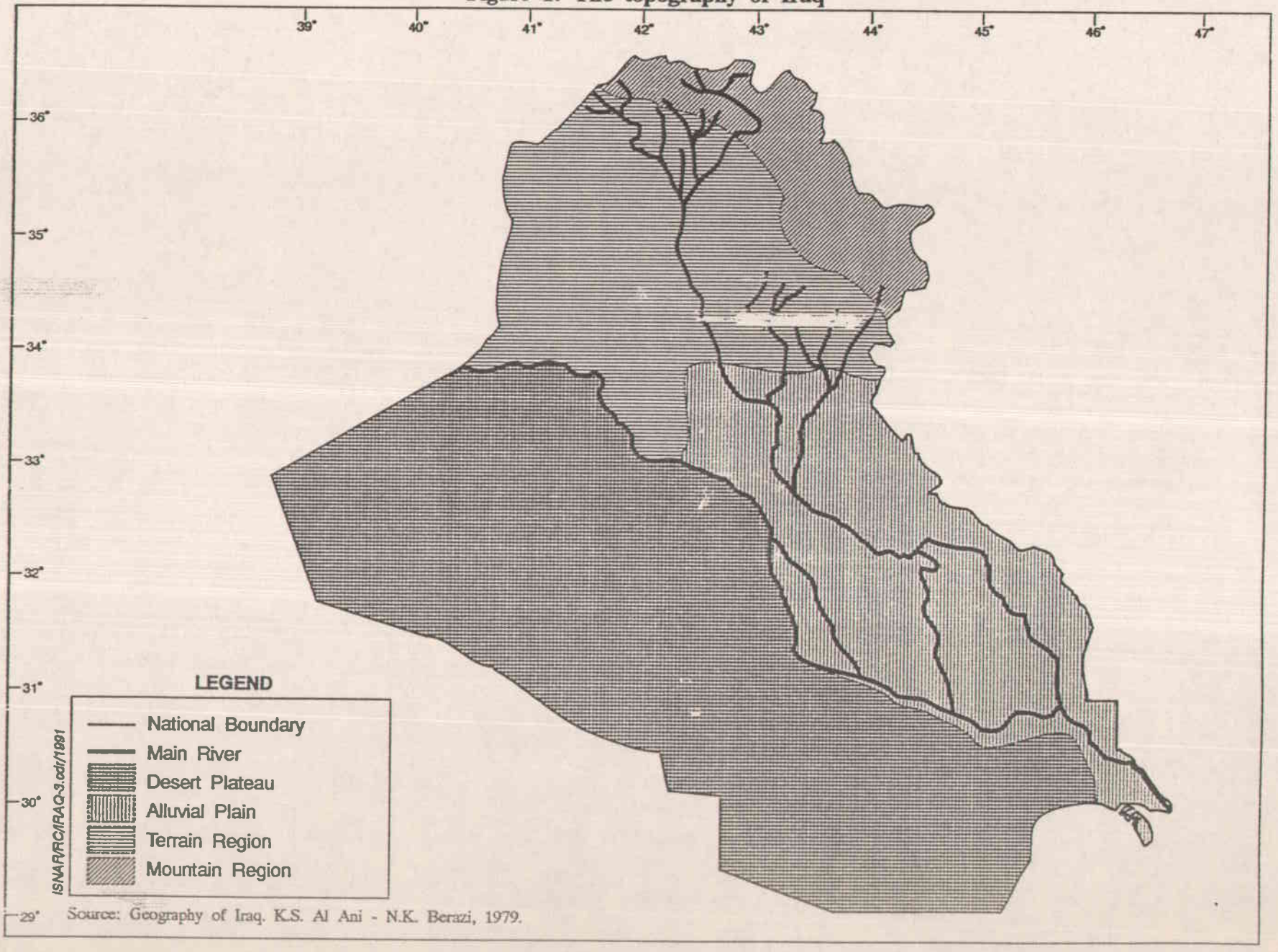
1. *The Mountainous Region*: This region is in the north and northeastern part of Iraq and extends into its joint boundaries with Syria in the west, Turkey in the north, and Iran in the east. It forms 20% of the area of Iraq. According to elevation and types of land and soils, the region could be divided into the high mountains and terrain.

   a) *The high mountains*: Chains in this part of the Zagros mountains are separated by valleys and plains with a number of small rivers pouring directly or indirectly into the Tigris river forming its basin. Elevations range from 500-3000 m with peaks, such as Hasarost, up to 3600 m. Elevation increases from the southwest to the highest in the north and northeast. The high part constitutes about a quarter of the mountainous region. Forests cover most of the region but there are frequent bare tops. Annual rainfall in this part exceeds 600 mm.

   b) *The terrain area*: It is a transitional region between low lands in the central part and south, and the high mountain chain. It accounts for about three-quarters of the mountainous region and consists of many chains of mountains of low altitude and hills which run parallel to the high mountain chain. Annual rainfall ranges between 250-600 mm. The area is suitable for annual and perennial crops.

2. *The Alluvial Plain:* It constitutes one-fifth of the area of the country, extending from the rectangle (about 650 km long and 250 km wide) between Balad on the Tigris river and Ramadi in the Tal Alaswad region on the Euphrates river in the north, the frontiers with Iran in the east, the desert plateau in the west, and the marshland and lake area in the south. It covers the vast plains between the two rivers, Tigris and Euphrates, from Baghdad to Basra and the Gulf. Elevation of this plain ranges between 0-100 m. This plain was formed as a result of river sedimentation.

Figure 1: The topography of Iraq



Source: Geography of Iraq. K.S. Al Ani - N.K. Berazi, 1979.

3. *The Desert Plateau:* It is situated in the western part of Iraq along the right side of the Euphrates River and comprises about 60% of the country. Its elevation ranges from 100-1000 m. Annual rainfall is less than 200 mm.

Climate

Iraq lies within the moderate northern hemisphere region. Its climate is continental and subtropical with rainfall in winter similar to that of the Mediterranean, which is characterized by cool to cold winters and hot to extremely hot, dry summers. The coldest winters occur in the northern parts of the country. In spring, there is a sharp rise in temperature and crops may experience first cold, then heat stress at the same location. The 1988 average temperature ranged from 18-24° C (Figure 2).

Rainfall is highly erratic in time, quantity, and location. It ranges from less than 100 mm to about 1000 mm/year, with 1988 average ranges from 50-800 mm (Figure 2). The variability in rainfall amount and distribution is reflected in the length of the growing season, which ranges from 0 to about 200 days, depending on precipitation and soil structure. The substantial variations in amount and distribution of rainfall increase the risk to rainfed crop production.

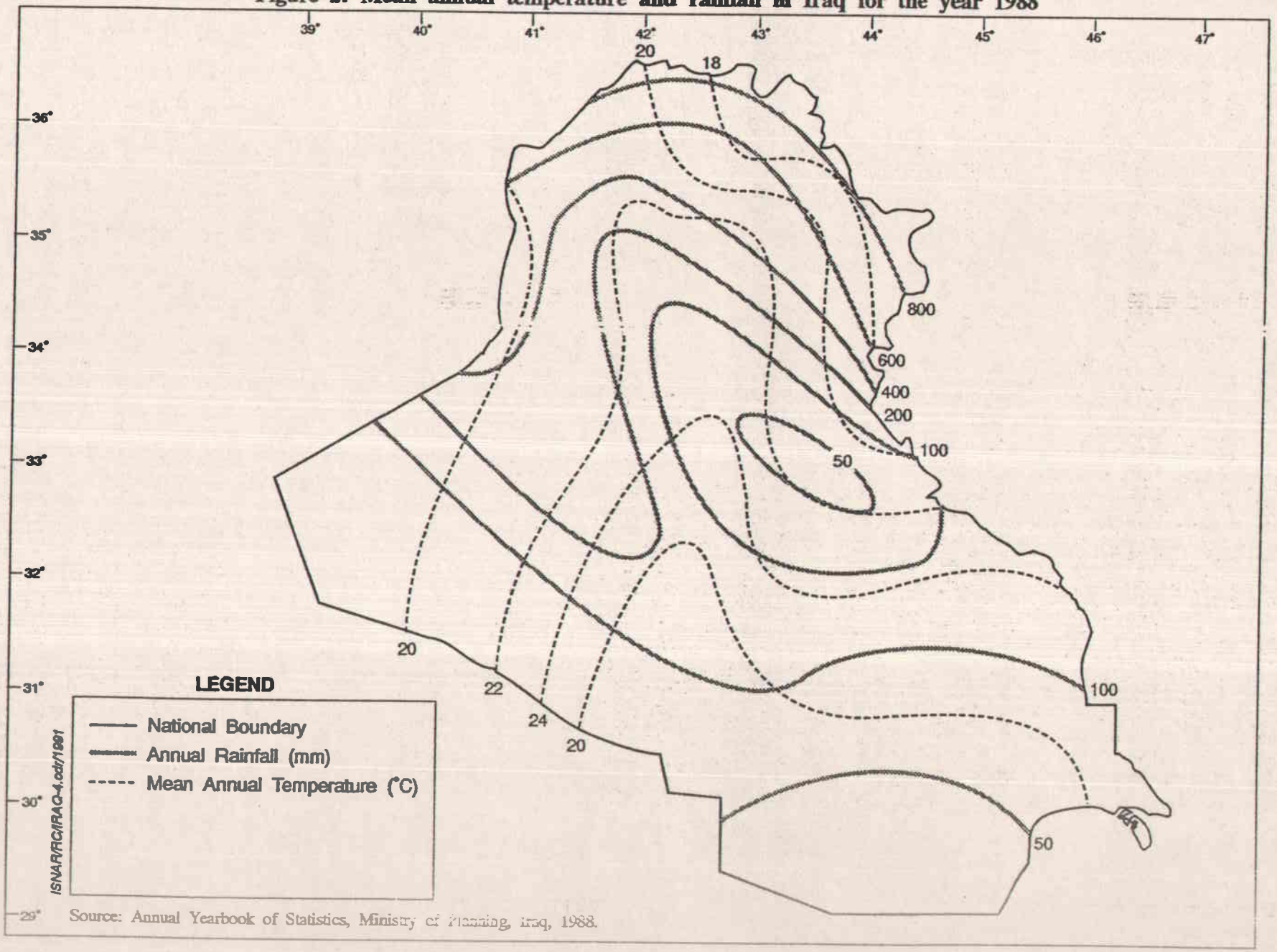
Climatically, the country could be divided into three climates:

a) *The mediterranean climate*: It covers the mountainous area in the northeast, characterized by cool winters and a rainy season extending from September to May, with rainfall ranging from 400-1000 mm/year. Its summer is dry with temperatures not exceeding 35° C.

b) *The steppe climate*: It is a transitional climate between the mediterranean climate in the north and northeast and the desert climate in the south and south-west. The area covered by this climate forms about one-sixth of the country's area. This climate prevails in the terrain region with rainfall ranging between 200-400 mm/year. Farming in this region is irrigated as well as rainfed when rainfall is high. In general, rainfall is enough to allow natural pastures to grow. Thus, this area is considered a grazing area.

c) *The desert climate*: It prevails in the sedimentary plain and western plateau which covers about 60% of the country's area. Annual rainfall ranges between 50-200 mm/year. It is characterized by extreme temperature variations between day and night and between summer and winter. Maximum temperature in summer could reach up to 45-50° C. However, temperature in winter is moderate and remains above the frost point. It could drop to the frost point for few nights per year.

Figure 2: Mean annual temperature and rainfall in Iraq for the year 1988



Source: Annual Yearbook of Statistics, Ministry of Planning, Iraq, 1988.

Soil and Land Resources

Soils: The country's soils are generally calcareous and low in phosphorus, nitrogen, and organic matter. In many areas, shallow soils limit the amount of available water for growing rainfed crops. Soil erosion caused by runoff and/or by winds during the dry summer is often serious. (Table 5 briefly describes soil types as well as vegetation and agroecological zones.)

The soil of the *southern* desert of Iraq consists of desert-type soil which is mainly sand and calcareous throughout. In some areas, the soil contains strong fragments of a gravel layer (desert pavement), developed at the surface due to wind action. Consequently sand dunes are formed. The parent materials of the sandy desert soil vary considerably, being stable or unconsolidated. This type of soil occurs in the arid areas with rainfall of less than 200 mm/year.

The *western* Iraq desert soil consists of a desert and lithosol soil type, which is a complex of strong desert soil and outcrops of unweathered materials consisting mainly of calcareous argillite, basalt, shabs, limestone, or clay beds with interstratified limestone.

In the *eastern* part of Iraq, lithosol and desert soils developed from mabs and gypsiferous sediments. Gypsum often occurs in outcrops while salt layers occur in concentrated basins. A large number of salt plugs and patches of saline soil also occur in this area.

The *Mesopotamian plain* consists mainly of alluvial soils which are medium to heavy textured and mostly calcareous. Soils in about 80% of the region are affected by salinity. Salty alluvial soils are alkaline and have developed under poor drainage conditions. They show a thin surface of light-colored material overlying a dark, heavy-textured alluvial soil.

Along the *west and southwest* coasts of Iraq, saline marshes exist. The soil in these marshes has high content of soluble salts and is heavy textured and strongly mottled.

In the area *bordering the Mesopotamian plain*, including Algiazirah, sierozem soil is the main type. It is pale to brown-gray, develops a weak organic layer at the surface, and is calcareous throughout. Calcareous pan may form deep in the soil and gypsum accumulation is very common. A desert gravel layer occurs frequently at the surface. The sierozem type of soil differs widely in clay content and structure according to the parent material, but it is comparatively higher in clay content than desert soils. It is formed from alkaline deposits, basalt, limestone, old alluvial material, and various metamorphic and igneous rocks.

Brown and reddish-brown soil occurs also in *the area Algiazirah*. These soils are characterized by their well-developed organic-matter layer overlying a brown to reddish-brown surface which merges into a calcareous horizon at a depth of 30-40 cm. This horizon is often hard and may contain lime concentrations. The pH of these

soils varies from 6.5 to 7.5. The brown and reddish-brown soils developed from chalks, sandstones, and loessial limestone, and they are medium to heavy textured. Chestnut soils occur in this area also.

In the *mountainous region* of Iraq, the main types of soils are brown and lithosol soils. Brown soils have the general morphology of brown and reddish-brown soils. They are shallow and stony and associated with lithosols and rock outcrops. Unweathered parent materials, normally limestones, are exposed over most of the area. Other materials present are shabs with interbedded calcareous clays. Reddish-brown soils are associated mainly with areas of rainfall between 200-400 mm/year, whereas brown soils are associated with medium rainfall areas (400-800 mm/year). Sierozem soils are associated with high rainfall (more than 800 mm/year).

Land resources: Agricultural land consisting of arable land, land under permanent crops, and permanent pastures forms about 22% and forest land forms about 3% of the total area of the country of 43,832 thousand ha (Table 1). The remaining area is desert, about 74%, and land under water, about 1%.

Table 1: Land Resource Structure (1000 ha)

Description	1972	1982	1989
Total area	43 832	43 832	43 832
Arable and permanent crops	5 160	5 450	5 450
Arable land	5 000	5 250	5 250
Permanent crops	160	200	200
Permanent pastures	4 000	4 000	4 000
Forest	1 930	1 910	1 890
Other land	32 647	32 377	32 397
Irrigated land	1 480 (1970)	1 750	2 538

Source: FAO: Yearbook Production, Volume 43, 1990.
FAO: Country Tables, 1989.

Irrigated area has increased during the last two decades from about 16% to 27% of the total agricultural land, or from about 29% to 47% of total arable and permanent-crop land (Table 1).

Water Resources

Rapid population growth coupled with expanding agriculture and industry increased the demand for water in the country. On the other hand, the construction of dams and other control structures on the upper reaches of the Euphrates and Tigris Rivers outside Iraq reduced their contribution to a large extent. This situation presented a challenge to Iraq for better utilization of water. Thus, Iraq has built several strategic dams and structures on the Tigris and Euphrates that added a new potential to land suitable for agriculture and should start to contribute in the near future.

The major three sources of water supply in Iraq are:
- surface water, which includes the Tigris and Euphrates and their tributaries;
- rain water;
- underground water.

Surface water: A large agricultural area in the northern region of Iraq, estimated at 375,000 ha, depends on river water for irrigation, and nearly all agricultural land in the central and southern parts of Iraq depends on river water, passively or mechanically conducted.

The length of the Tigris and Euphrates Rivers within Iraq, along with their tributaries, is shown in Table 2. The total highest annual flow of rivers in Iraq is about 77.5 billion m^3, and the lowest about 53.2 billion m^3. This brings the highest expected annual surface water supply to about 67.95 billion m^3.

The total surface water actually used is about 43.35 billion m^3, of which 39.53 billion m^3 is used for agricultural purposes, 1.76 billion m^3 for electricity production, 0.58 billion m^3 for industry, and 0.03 billion m^3 for fish production.

It is estimated that each hectare used for agricultural purposes needs about 7500 m^3/year of water. This means that the actual water resources available are only enough to cover the need of 4.625 million ha with 100% utilization of land.

Table 2: Length of Rivers within Iraq

River	Length (km)
Tigris	1 290
Euphrates	1 015
Greater Zab	230 (tributary of Tigris River)
Lesser Zab	250 (tributary of Tigris River)
Adhaim	150 (tributary of Tigris River)
Diala	300 (tributary of Tigris River)
Shatt Al-Arab	190 (tributary of Tigris River)

Rain water: Rainfall above 400 mm/year is considered one of the indicators of suitability for rainfed agriculture. In the northern region of Iraq, winter crops, especially wheat and barley, are cultivated in the "guaranteed" rainfall area of 500-800 mm/year. Sometimes grains are cultivated in the borderline land where rainfall averages between 400 and 600 mm/year.

Table 3 shows annual rainfall for the years 1978-1988 in four selected places: Baghdad in the middle, Mosul in the north, Rutba in the west, and Basrah in the south. A high variation of mean annual rainfall occurs between places and between years. In the Baghdad area, rainfall was highest in 1988 (182.9 mm/year) and lowest in 1987 (52.9 mm/year). In Mosul, the highest average was in 1988 (594.3 mm/year) and the lowest was in 1983 (252.7 mm/year). In Rutba, the highest was also in 1988 (263.6 mm/year) and the lowest was in 1978 (59.0 mm/year), whereas in Basrah, the highest rainfall was in 1986 (296.6 mm/year) and the lowest was in 1981 (84.0 mm/year).

Table 3: Annual Rainfall, 1978-1988

Year	Rainfall (mm)			
	Baghdad (middle)	Mosul (North)	Rutba (West)	Basrah (South)
1978	110.1	262.8	59.0	118.4
1979	78.0	334.4	79.7	152.9
1980	138.9	542.9	139.9	160.0
1981	109.9	371.9	63.7	84.0
1982	160.7	428.6	-	112.2
1983	57.8	252.7	69.8	99.9
1984	118.1	422.0	87.1	177.9
1985	90.8	300.9	122.1	140.1
1986	158.0	369.0	89.9	296.6
1987	52.9	341.6	90.5	87.1
1988	32.9	594.3	263.6	105.7

Source: Annual Abstract of Statistics, Ministry of Planning 1988, Iraq.

This variation has its effect on agricultural production, especially on rainfed agriculture.

Figure 2 illustrates the mean annual rainfall and mean annual temperature for 1988 and Table 4 shows total areas in the different rainfall zones.

About 22% of the country's area receives rainfall less than 100 mm/year, while about 63% receives between 100-300 mm/year. Only about 11% receives between 300-600 mm/year. Only about 5% receives more than 600 mm (Table 4).

Table 4: Total Areas of Different Rainfall Zones

Rainfall (mm)	Area (1000 km^2)	%
a. Less than 100	97.8	21.7
b. 100 - 300	282.0	62.7
c. 300 - 600	47.7	10.6
d. 600 - 1000	9.2	2.0
e. More than 1000	13.2	2.9

Source: Constraints of Cereals Production, AOAD, 1982.

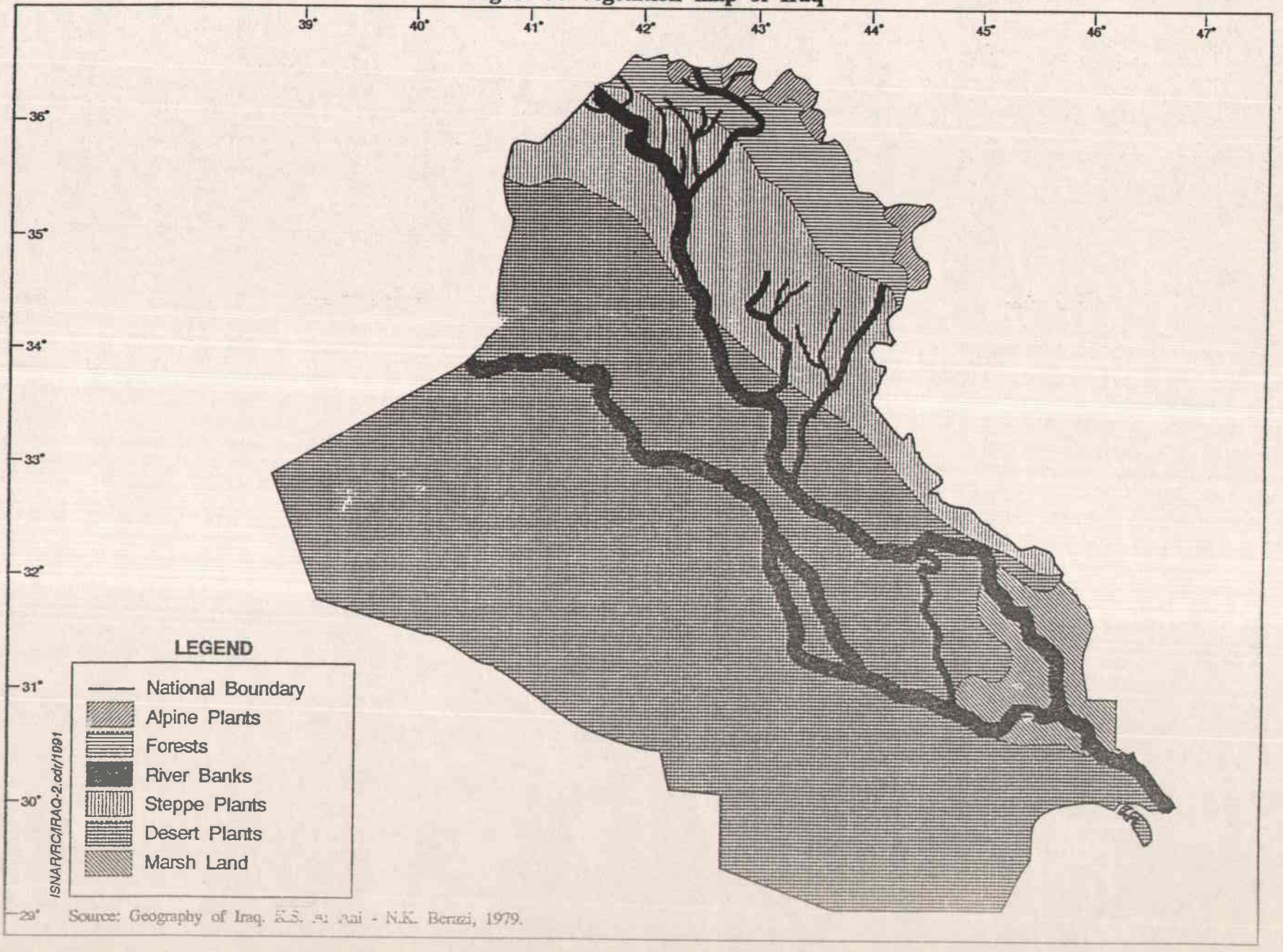
Underground water: Up till now, the use of underground water has been restricted to semi-desert areas in the western parts of the country. The number of wells in use was about 5000 in 1980, with an average production of each of 1.5 m^3/hour for six hours a day for 150 days a year. It was estimated that 1.5% of the total land suitable for agricultural production could be irrigated from underground water. This represents about 0.125 million ha which is enough to support about 20,000 producer families at about 6.25 ha/family.

Vegetation and Agroecological Zones

Soil, climate, land use, and cultivation are the main determinants of the geographic distribution of vegetation. The vegetation map of Iraq is shown in Figure 3.

Pastures: Areas covered with natural pastures constitute about 4 million ha. Pastures are of poor quality and have deteriorated, which is due to many causes such as expansion of rainfed agriculture to marginal land or to grazing areas, overgrazing, and inadequate range management. Pastures are distributed in low-rainfall areas as well as in the forest area, where they form about 30% of the forest area.

Figure 3: Vegetation map of Iraq



Source: Geography of Iraq. K.S. Al Jadi - N.K. Berazi, 1979.

Terrain region including river banks: Vegetation in this area consists of trees, shrubs, and herbs. Date palms and citrus trees are grown nearby.

Marshland region: It is situated south of the alluvial plain. Reed and cane grow heavily.

Desert region: Shortage of rainfall and high temperatures permit few plant species to grow. Among them are tamarisk, milfoil, zizyphus, thorns, and other desert plants.

Forests: Forests cover an area of about 1.5 million ha at an elevation between 500-2000 m. Dense forests cover 645,000 ha, while forests of average density cover 288,000 ha. In addition, open forests cover about 588,000 ha, and scale forests, around the banks of the Tigris and Euphrates, cover about 11,000 ha.

Continuous cutting of woods and heavy grazing by goats have caused parts of the plant coverage of the forest area deteriorate.

Agroecological zones: According to vegetation, rainfall, soils, and other factors, six major agroecological zones could be identified. Their main features are briefly included in Table 5 and Figure 3.

Fisheries

The country is endowed with marine and inland water resources. However, fish stocks are not adequately estimated, especially the marine stock, where there is an interdependence of fisheries belonging to neighboring countries and fisheries tend to move as one biological mass. Catches from the Gulf have declined during the eighties to become one-third of the inland catch. They declined from about 37,000 tons in 1979 to about 5000 tons in 1987; while catches from inland waters ranged from 15,500 tons in 1987 to 17,500 tons in 1980.

Species of economic importance are common carp (*Cyprinus carpio*) and freshwater and marine fishes nei (*Osteichthyes*). Other species of less importance include cape hakes (*Merluccius spp.*), threadfin beams (*Nemipterus spp.*), cape horse mackerel (*Trachurus capensis*), chub mackerel (*Scomber japonicus*), and *Sardinella* spp.

Table 5: Agroecological Characteristics

Characteristics	Soil Types	Ecological Zones\Vegetation	Agroecological Regions	Area (km^2)	% of Total land	Annual rainfall mm/year
Alluvial, saline, alluvial & salt marshes. Mostly calcareous throughout.	Medium- to heavy-textured soil. 80% of the region is affected with salinity.	Desert-type vegetation. At the upper part annual grasses & herbs are found; at the lower parts this depends on rainfall to a great extent.	Sedimentary plain (Mesopotamian plain)	55 000	21	50 - 200
The parent materials of the southern desert are mainly limestone & marbles. The western desert consists of calcareous argillite, basalt, shabs, limestone, or clay beds with interstratified limestone.	Sandy desert soil in the southern desert & lethosol soil type in the western desert.	Scanty rainfall plays a dominant role in the growth of short-lived herbaceous xerophytic adaptated to the drier areas.	Desert region	261 000	59	50 - 200
Mainly sierozem. It is pale to brown-gray. Formed from alkaline deposits from basalt, limestones, alluvial materials, & various metamorphic & igneous rocks. Brown & reddish-brown soils also occur which are developed from chalks, loosened lime, etc.	Different clay content & structure according to the parent materials; but in general the soil here is higher in clay content compared to desert soil.	Vegetation resembles desert type which is mainly annual grasses & herbs with a density dependent mainly on rainfall.	Terrain region	42 000	10	200 - 400
The main types of soil are brown & lithosol soils. They are shallow & stony & associated with lithosols & rocks. Unweathered parent materials of limestone, shabs calcareous clays.	Brown & lithosol brown-reddish soil exist mainly in areas of high rainfall Chestnut soil also occurs.	Virgin forests in some places. Most of the Mediterranean type & of Iran-Kurdian types in the higher tops.	Mountain Region	22 000	5	More than 400

Human Resource Base

Population

The population in 1990 by total, locality, segment, labor force, and agricultural labor force is shown in Table 6.

Table 6: Population of Iraq in 1990
(1,000)

Grouping	Total	Males	Females	Rural	Urban	Agric. Popul.	Non Agric.
By sex	18 920	9 642	9 278				
By locality	18 920			5 432	13 488		
By segment	18 920					3 879	15 041
By labor force	5 119	4 015	1 104				
By agricultural labor force	1 049	590	459				

Source: FAO AGROSTAT Files, 1991.

Size and annual growth rate: The Iraqi population increased from 4.8 million in 1947 to 6.3 million in 1957, 11.0 million in 1975, 13.3 million in 1980, to 18.9 million in 1990, with an average annual growth rate of 3.8%. The 1987 census indicated that about 55% of the population lives in the middle of the country, 30% in the north, and about 15% in the south.

Age and sex distribution: In the 1987 census, the average sex ratio for the entire population is 52% males and 48% females. These percentages fluctuate for all ages between 44%-55% for females and 45%-56% for males. Forty-six percent of the total population are less than 15 years old, 50% are between 15-60 years old, and about 4% are above 60 years old (Table 7). The average life expectancy at birth is estimated at 64 years.

Locality: While the rural population has increased by an annual growth rate of 1.6%, the urban population increased by 7.8% per year. This difference in annual growth rate changed the urban population from 56% in 1970 to 71% in 1990 (Table 8). In 1990, about 79% of the population were nonagricultural. Only about 21% was agricultural (Table 6).

Table 7: Population Distribution by Age and Sex - 1987 Census (1,000)

Age (Year)	Total Population	Males	%	Females	%
0 - 4	2 765	1 416	51	1 349	49
5 - 9	2 468	1 260	51	1 208	49
10 - 14	2 148	1 102	51	1 046	49
15 - 19	1 909	997	52	912	48
20 - 24	1 514	806	53	708	47
25 - 29	1 018	531	52	487	48
30 - 34	1 019	531	52	488	48
35 - 39	741	372	50	369	50
40 - 44	561	297	53	264	47
45 - 49	457	246	54	211	46
50 - 54	337	168	50	169	50
55 - 59	356	176	49	180	51
60 - 64	268	120	45	148	55
65 - 69	187	89	48	98	52
70 - 74	157	77	50	80	50
75 - 79	93	47	50	45	50
80 +	129	73	56	56	44
Total	16 127	8 308		7 819	

Source: Annual Abstract of Statistics, Ministry of Planning 1988.

Agricultural labor force: During the last two decades, the labor force formed about 26% of the total population with an annual growth almost equal to that of the population as a whole. In the same period the agricultural labor force was nearly stable in total number, about a million, but declined from 47% in 1970 down to 20% of the total labor force in 1990. At the same time, the male composition of the agricultural labor force declined from 95% to 56%; on the contrary, females have increased in number and therefore in percentage from 5% to 44% (Table 8). The replacement of male by female agricultural labor was a result of male migration from rural to urban areas where there are better employment opportunities and income incentives.

Table 8: Changes in Populations of the Country, Rural, Urban, Labor Force, and Agricultural Labor Force, 1970-1990 (1000)

Year	Country Population	Rural	%	Urban	%	Labor force	%	Agricultural Labor Force					
								Total	% of Labor force	Males	% of Total Ag. L.F.	Females	% of Total Ag. L.F.
1970	93,566	4,102	44	5,254	56	2,389	26	1,125	47	1,065	95	59	5
1975	11,020	4,256	39	6,764	61	2,890	26	1,073	37	880	82	193	18
1980	13,291	4,492	34	8,799	66	3,551	27	1,081	30	638	59	443	41
1985	15,898	4,887	31	11,011	69	4,259	27	1,043	24	616	59	427	41
1990	18,920	5,432	29	13,488	71	5,119	27	1,049	20	590	56	460	44

Source: FAO AGROSTAT Files, 1991.

Agricultural Production Systems

The area suitable for agricultural production in Iraq has been estimated at about 12 million ha; of which 10 million ha (83.3%) could be utilized for cultivation. Out of this area, 3.2 million ha are in the north and 6.8 million ha in the middle and southern parts of the country. Actually, only 5.75 million ha are actually in use. Because of the shifting cultivation system which is followed in traditional farming, the area in use is effectively reduced to 2.75-3.25 million ha, making the intensity of land used less than 100%. The intensity was estimated by about 70% in the rainfed areas and about 40% on the irrigated land.

Agricultural Production Subsectors

By land ownership: In accordance with agrarian reform and by the end of 1972, some 1.18 million ha had been redistributed to 100,000 families. By 1988, more than 300,000 families had received 2.7 million ha. The government has been promoting the growth of cooperatives and collective farms since 1969. By the end of 1987, there were 857 agricultural cooperatives. In 1984, there were 23 state farms covering 188,000 ha. However, as a result of the low performance of the agricultural sector, the government has encouraged measures to be taken to allow greater private-sector involvement in agriculture. By 1986, the area in state farms had fallen to about 50,000 ha. An incentive system was adopted to ease supply difficulties and to encourage farmers.

In mid 1987, the government announced that all state farms, including six dairy farms, were for sale or lease to investors or companies, providing that the land continued to be used for agriculture. However, available data concerning land ownership shows that about 1.6% of the land was being used for summer and winter crops on state farms, 1.7% as collective farms, 77.6% on cooperative farms, and 19% on private noncooperative farms (Table 9).

In 1979, the size distribution of land-holdings shows that about 75% of the number of holders have lands of less than 12.5 ha each. Their area covers 27.0% of the total agricultural land (Table 10).

By land use, methods of irrigation, and modes of cultivation:

1. *Land use:* It was mentioned earlier that the total agricultural land in use is about 11 million ha. Out of this, 46% is arable land, 2% is in permanent crops, 35% is in permanent pastures, and 17% is forests. The irrigated area is about 2.5 million ha, forming 47% of the total arable and permanent-crop land. Total land in cultivated, arable, and permanent crops increased during 1972-1989 by about 5%, while irrigated land rose during the same period by about 70% (Table 1).

Table 9: Distribution of Land by Ownership (1983 data)

Sector	Total area (1,000 ha)	
	Winter crops	Summer crops
State farms	35.8	9.5
Collective farms	22.5	24.7
Cooperatives	2022.2	102.6
Total Public sector	2080.5	136.8
Private sector	507.9	14.2

Table 10: Size Distribution of Agricultural Land-Holding, 1979

Size of land-holding (ha)	Holders			Area		
	Number	%	Cumulative %	(1,000 ha)	%	Cumulative %
< 0.25	12,200	2.6	2.6	1.5	0.0	0.0
0.25 - 2.5	109,700	23.3	25.9	134.3	2.1	2.2
2.5 - 7.5	129,800	27.6	53.5	594.6	9.5	11.6
7.5 - 12.5	108,900	23.1	76.6	966.5	15.4	27.0
12.5 - 20	54,100	11.5	88.1	763.0	12.1	39.2
20 - 30	25,200	5.4	93.5	593.8	9.5	48.6
30 - 50	19,100	4.1	97.6	650.2	10.3	59.0
50 - 100	5,600	1.2	98.8	392.3	6.2	65.2
100 - 150	1,800	0.4	99.2	220.5	3.5	68.7
150 - 250	1,600	0.3	99.5	305.0	4.9	73.6
250 - 400	900	0.2	99.7	281.3	4.5	78.1
400 - 500	400	0.1	99.8	157.5	2.5	80.6
> 500	1,100	0.2	100.0	1,218.7	19.4	100.0
	470,400	100.0		6,279.2	100.0	

Source: Yearbook of Agric. Statistics Vol. 6, 1986, AOAD.

2. *Methods of irrigation:* Irrigation from surface water is either by gravity or by pumping. Land irrigated by gravity consists of the majority of lands irrigated from new irrigation schemes. Pumps for irrigation are used frequently to pump water from rivers, canals, or underground waters.

3. *Modes of cultivation:* About 60% of the land under cultivation is cultivated annually, 36% is used for shifting cultivation (fallow), and about 4% for date palm trees and other fruit trees. Agriculture in the country is characterized by three different fallowing systems: in the north, farmers have to leave land fallow to restore soil fertility and moisture; in the south, land is left fallow because of salinity, and east, land is left fallow because of insufficient water.

By geographic region: In 1975, when 2.38 million ha were under cultivation, about 59% of the total cultivated area was in the north of the country and was used mainly for growing wheat and barley (about 79%). Vegetables were grown in about 21% of the cultivated area in this region.

In 1980, the total cultivated area was 2.76 million ha. About 69% of this area was in the northern region, where cereals, wheat and barley, occupied about 96%, and the remaining area was for vegetables.

The middle region of the country comes second in cultivated area and accounted for about 32% in 1975 and 24% in 1980. Wheat and barley were grown on about 82% of the cultivated area and vegetables on about 18%. In 1984, the cultivated area in this region formed about 23% of the total cultivated area in the country. Land intensity use in this region was about 93%.

The third region is the south where cultivated land forms about 7%-9% of the total cultivated land in the country. During the years 1975-1984, vegetable production covered about 14%. All cultivated land in this region is under irrigation.

By availability of water (irrigated and rainfed farming): One of the main constraints in agricultural production is the availability and management of water for irrigation use. In the northern region where both rainfed and irrigated agriculture are practiced, about 375,000 ha are under irrigation, and the remaining cultivated area is rainfed. About 250,000 ha of rainfed land are located in areas of more guaranteed rainfall of more than 500 mm/year. The rest of the rainfed cultivated land is in less-guaranteed rainfall zones, where barley and wheat are grown.

In the middle and southern parts of the country, agriculture depends on irrigation mainly from the Tigris and Euphrates Rivers and their tributaries. About 20%-30% of the agricultural area is out of production because of the rise of salinity resulting from poor drainage systems.

By seasonal distribution of annual crops: According to season, annual crops could be classified as winter and summer crops. In the north, winter field crops make up about 75% of the total area for winter field crops in the country. The middle and

south of the country come second and third in areas of winter field crops, respectively.

For winter vegetables, the middle region is a major producer, with about 75% of the vegetable winter crops. The southern region comes second, and the northern is third.

Regarding summer field and vegetable crops, the middle region comes first with more than 50% of the total summer field crops. The northern region comes second.

Plant Crop Production

Choices for growing plant crops or producing animal products are based on demand for these commodities, their production capacity, and their importance in the irrigated and rainfed production systems in the country. Therefore, about 10 commodity groups, seven in crop production and three in livestock production, could be classified. These are food and feed cereals, dry food legumes, oil seed and industrial crops, vegetables, fruit trees, forest trees, range and forest crops, sheep and goats, cattle and buffalo, and poultry.

Food and Feed Cereals

In 1990, cereals occupied about 80% of the total cultivated area, with wheat and barley occupying 94% of the cereal area, rice 3%, maize 2%, and others 1%. The total cereal area fluctuated during the last three decades from about 1-3 million ha with a mean of 2 million ha. Regarding production, wheat and barley formed about 85% of total cereal production, while rice, maize, and other cereals formed about 9%, 5%, and 1%, respectively (Table 11).

Cereal yields have shown very little change during the last two decades. In fact, wheat yields decreased from 887 kg/ha in 1969-71 to 851 kg/ha in 1988-90. Barley showed the same trend: its yield decreased from 1171 kg to 884 kg/ha. Rice yields, however, increased from 2731 kg to 2888 kg/ha during the same period (Table 12).

In 1980 to 1984, three-quarters of the wheat production came from rainfed areas. The remaining was from irrigated areas. For barley, 56% was produced in rainfed and 44% from irrigated area. Cereals Production Index has shown an increase in cereal production in 1990 up to 121.7% (1979-1981 = 100). On the contrary, cereals production per capita declined to 85.8% during the same period (Table 13).

The uncertainty of cereal production could be attributed mainly to low rainfall in the rainfed areas, poor seed varieties, inadequate cultural practices, and pest problems. Fluctuations in area and production of cereals are shown in Table 14.

Dry Food Legumes

In 1990, pulses occupied less than 1% of the total cultivated area. Dry food legumes consisted mainly of Phaseolus beans (50% of the total area in pulses), faba beans (20%), chickpeas (15%), and lentils (5%) (Table 11). Total area and production have dropped during the last three decades from 50,000 to 9,000 ha, and from 44,000 to 17,000 tons, respectively. Pulse yields did not change during the same period and remained low at 880 kg/ha (Table 12).

The production index has fallen to 63% in 1988 (1979-1981 = 100%) (Table 15).

Oil Seed and Industrial Crops

The main three traditional crops in this group are sesame, cotton, and tobacco. Newly introduced oil crops are soybeans and sunflowers. Sugarcane and sugar beets are grown in limited areas (Table 11).

Areas of sesame, sunflowers, and soybeans have doubled during the last decade, while the area and production of cotton have declined during the last two decades by three- to fourfold. This was accompanied by a slight increase in cotton yields (Tables 11, 12).

Sugar beets, sugarcane, and tobacco are becoming less important in the irrigated farming systems. On the contrary, sunflowers and soybeans, as newly introduced oil crops, are becoming more important.

The oil seed production index showed fluctuations during the period 1979-88 and reached its maximum, 157.1%, in 1988 (1979-81 = 100%) (Table 15). Most oil seed and industrial crops are grown under irrigation.

Vegetables

Most vegetables in the country are irrigated crops. There are two main commodity groups. The first is solanaceous crops, mainly tomatoes, potatoes, eggplants, and green peppers. In 1990 these were grown on about 77,000 ha, and produced about 1.1 million tons. The second is cucurbits, mainly cucumbers, melons, watermelons, and squash. In 1990, these were grown on about 119,000 ha, and produced about 1.39 million tons (Table 11).

The area planted to solanaceous and cucurbit crops has increased during the last three decades and reached its maximum during the last few years. In general, this increase was associated with yield increases which can be attributed to the introduction of new technologies, e.g., improved seeds, and to increased profitability to producers (Table 12).

A third important group is onions and garlic. These two crops are grown on about 17,000 ha and produce about 140,000 tons. The annual increase in dry onion yield for the last two decades was about 2.4%, compared with 3.1% for tomatoes (Table 12).

Other vegetables of less importance are cabbage and cauliflower, with an area of about 2,000 ha, producing about 22,000 tons. Green beans are grown on about 1000 ha, producing 3000 tons, and carrots on 1000 ha, producing 9000 tons.

Table 11: Area, Production, and Yield of Main Agricultural Crops in 1990
(Minimum, Maximum, and Mean for the Period 1961-1990)

Crop	Area (1,000 ha)	Production (1,000 tons)	Yield (tons/ha)	Area (1,000 ha) Minimum	Maximum	Mean
Cereals						
Wheat	975	805	0.8	493	1800	1215
Rice, paddy	75	200	2.7	25	109	63
Barley	1200	1000	0.8	396	1456	861
Maize	50	110	2.2	2	50	17
Other cereals	7	8	1.1	2	22	9
Total cereals	2307	2123	0.9	1083	2977	2164
Dry Legumes						
Dry beans	10	9	0.9	5	14	10
Dry fababeans	4	5	1.2	4	21	12
Chickpeas	3	2	0.7	3	24	9
Lentils	1	1	1.0	1	12	7
Total dry legumes	20	19	0.9	18	56	42
Oil & Industrial Crops						
Sesame	22	15	0.7	9	22	14
Cotton	7	15	2.1	7	37	23
Tobacco	3	3	1.0	2	17	12
Sugar cane	2	70	35.0	0	4	2
Sugar beets	1	9	9.0	0	4	2
Soybeans	1	2	2.0	0	1	0
Sunflowers	24	20	0.8	1	24	7
Vegetables						
Tomatoes	47	650	13.8	20	54	37
Potatoes	13	226	17.4	1	13	5
Eggplants	13	190	14.6	5	14	10
Green peppers	4	37	9.2	1	4	2
Cucumbers	38	345	9.1	9	45	23
Squash & pumpkins	5	50	10.0	3	8	5
Cantaloupes	29	320	11.0	8	40	20
Watermelons	47	675	14.4	21	54	40
Dry onions	15	130	8.7	7	20	13
Garlic	2	11	5.5	0	3	1
Total vegetables		3035				
Fruit Trees				Production (1,000 mt)		
Citrus		276		24	278	129
Dates		490		251	597	390
Grapes		470	Area	15	58	38
Apples		80		20	120	64
Pears		4		1	4	2
Peaches		29		2	30	16
Plums		35		2	35	17
Apricots		33		8	33	22
Almonds		0.75		0.30	0.75	0.53
Walnuts		2.4		1	2.5	2
Olives		4		2	10	6
Total fruits		1514		469	1514	947

Table 12: Trends in production, area, and yield of main crops*

Crop	Production (1,000 tons)		Area (1,000 ha)		Yield (kg/ha)	
	1969-1971	1988-1990	1969-1971	1988-1990	1969-1971	1988-1990
Cereals (Total)	2058	2070	1909	2131	1077	964
Wheat	1080	742	1216	868	887	851
Barley	692	1033	582	1142	1171	884
Paddy rice	268	191	97	66	2739	2888
Pulses (Total)	14	17	50	19	880	878
Seed cotton	13	14	33	9	1301	1714
Sunflowers	2	16	3	20	766	815
Vegetables (Total)	1875	2937	-	-	-	-
Tomatoes	305	639	34	45	8781	14307
Cucumbers	127	326	13	36	9586	9056
Watermelons	527	610	48	43	11071	14008
Cantaloupes	170	299	18	28	9445	10662
Dry onions	84	127	14	14	5994	8884
Fruits (Total)	653	1434	-	-	-	-
Dates	410	445	-	-	-	-
Grapes	75	455	17	57	4346	7935
Citrus	49	265	-	-	-	-

* Means calculated from FAO AGROSTAT FILES, 1991.

Fruit Trees

Fruit trees in the middle and south of the country are irrigated. In the north, irrigated and rainfed fruit trees are grown. The total area planted to fruit is estimated at about 200,000 ha, out of which grapes form about a quarter. Date palms, citrus, and grapes are the three main fruit crops in the country, forming about 80% of the total fruit production (Table 11).

Annual date production during the last three decades ranged from 251,000 to 597,000 (average 390,000) tons. Its production index in the eighties fell to 62.6% in 1988 (1979-81 = 100%) (Table 15). On the contrary, citrus fruits (mainly oranges, mandarins, and lemons) have increased during during the last three decades from 24,000 tons (1961) to 276,000 (1990) tons (from 14,000 to 180,000 for oranges; from 4000 to 79,000 for mandarins, and from 6000 to 17,000 tons for lemons). The same

Table 13: Production Index, 1990 (%)

	Production index (1979-1981 = 100)	Production per capita index (1979-1981 = 100)	Production Index, period 1961-1990 (1979-1981 = 100)		
			Minimum	Maximum	Mean
Agriculture	129.9	91.2	57.7	137.3	95.6
Food	131.0	92.0	56.5	137.1	95.1
Nonfood	80.6	56.7	69.5	175.6	118.6
Crops	146.1	102.7	47.7	159.6	96.3
Livestock production	119.3	83.6	68.0	119.3	91.3
Cereals	121.7	85.8	51.6	232.4	111.2
Meat	131.2	92.0	68.2	131.2	92.2
Milk	91.6	64.2	80.0	108.9	95.6

Source: FAO AGROSTAT Files, 1991.

Table 14: Area Harvested, and Production of Main Cereal Crops, 1970-1990

Crop	1970		1975		1980		1985		1990	
	A	P	A	P	A	P	A	P	A	P
Total Cereals	2087	2112	2020	1373	2291	1892	2977	2932	2307	2122
Wheat	1400	1183	1408	845	1374	976	1540	1406	975	805
Rice, Paddy	75	180	30	61	55	167	53	149	75	200
Barley	600	682	567	437	830	682	1357	1331	1200	1000
Maize	5	6	9	23	24	60	21	41	50	110

Source: FAO AGROSTAT Files, 1991.
Note: A = Area (1000 ha) and P = Production (1000 tons)

Table 15: Production Index of Crop Groups, 1979-1989
(1979-1981 = 100)

Year	Cereals	Oil Seeds	Tubers and Bulbs	Legumes	Industrial Crops	Vegetables	Fodder Crops	Fruits	Dates
1979	83.4	119.7	81.9	92.4	98.0	79.1	86.6	95.4	105.5
1980	105.1	92.9	106.3	100.7	94.9	102.8	95.1	91.9	118.4
1981	111.3	88.5	111.7	105.4	107.5	118.2	118.3	113.2	76.1
1982	113.1	89.7	96.9	104.0	108.8	138.8	95.6	119.7	73.5
1983	98.3	91.9	83.7	75.3	117.6	134.0	107.7	119.3	70.5
1984	61.5	99.6	106.3	71.2	106.7	161.5	76.0	125.3	50.1
1985	177.1	130.3	154.9	80.5	128.4	181.9	91.4	127.0	77.4
1986	123.2	134.2	138.7	95.0	123.1	163.3	78.6	125.1	85.5
1987	97.2	136.7	126.4	76.0	86.9	154.8	102.2	99.9	63.2
1988	136.8	157.1	127.4	63.0	36.9	150.4	69.2	148.2	62.6

Source: Yearbook of Statistics, 1988, Ministry of Planning, Iraq.

production trend seen for citrus could also apply to grape production in area as well as yield (Table 12). The grape area has increased during the seventies and eighties from 17,000 to 57,000 ha, the production from 75,000 to 455,000 tons, and yield from 4346 to 7935 kg/ha.

Other fruit crops of importance are stonefruits, with a production of about 97,000 tons, and apples and pears with about 84,000 tons (Table 11). Other tree crops of less importance are olives and walnuts.

Forest Trees

Forestry was mentioned earlier in this document as a natural resource base. However, poplar trees are grown in the northern region as an irrigated crop for wood products.

Production of roundwood has increased during the last three decades from 78,000 to 149,000 m^3. During the same period non-coniferous production ranged from 45,000 to 65,000 m^3, fuel wood between 55,000 to 99,000 m^3, paper and paperboards from 0 to 28,000 m^3, and industrial roundwood from 23,000 to 50,000 m^3.

The demand for forest products has increased and, thus, the import bill has increased from US$18.5 million (1961) to US$117.5 million (1989).

Range, Forage Crops, Straw, and Crop By-Products

The raising of ruminant livestock, especially sheep and goats, is heavily dependent on communal grazing rangelands in the steppe and mountain areas, as well as crop residues and fallow land, which account for 60%-80% of feed requirements. Production of forage crops in the rainfed areas is limited. However, production of irrigated forages and feed crops is associated with intensive livestock operations, especially in raising cattle and buffalo, fattening lamb, and in poultry production. Thus, concentrated and coarse grains, feed legumes, straw, and crop by-products are increasingly used to maintain herds. This growing demand for ruminant and poultry feed has not led to improved production of forage and feed crops but rather to a jump in feed imports.

Animal Production

Livestock production systems in the country vary from the traditional low input/low output traditional semi-nomadic types to the extreme of highly capital-intensive, modern farms. The former case is more typical for sheep and goats. Poultry production, however, tends toward the higher end of the scale with importation of technology, equipment, raw materials, and either hatching eggs or day-old chicks from the most highly productive hybrid lines. Cattle and buffalo production is between sheep and poultry in intensity, with those cattle kept mainly for draft and manure purposes being on the low-input side of the scale and intensive dairy systems coming close to poultry in the intensification of capital and production.

The intensive poultry and dairy cattle production systems are enterprises separate from crop production. In contrast, the production of crops and livestock in most small-scale production systems are interdependent.

Sheep and Goats

Sheep and goats are by far the most important and the most adapted to the climate and natural forage. They also fit well into the traditional semi-nomadic as well as the sedentary systems. In addition, lamb, mutton, and goat meat is the preferred source of animal protein. The milk and wool of sheep, and milk and hair of goats are important for family use and/or sale. The animals are easy to control, which is very important for small unfenced agricultural plots as well as the communal range. They are also easily transported to the closest market for selling.

The typical nutrition program for these animals consists of grazing range during six months of the year, grazing fallow land for three months, and consuming crop by-products, mainly wheat and barley straw, during the remaining three months. In years of low rainfall, the availability of these feed resources does not balance with animal numbers and supplemental feeding is necessary. Thus, the numbers of sheep and goats fluctuate. As a result of range deterioration and low rainfall, the number of sheep has dropped from about 13 million head in 1970 to about 9.6 million head in 1990 (the maximum number of sheep was 16.5 million head in 1983). The number of goats also declined from 2.3 million head in 1970 to 1.5 million head in 1990. ^The maximum number of goats was 3.4 million head in 1975. In 1983, the number of goats reached 3.4 million head. Table 16 shows the number of sheep and goats in 1986 and 1990.

The production index of red meat from sheep, goats, and cattle decreased during the eighties to 83.1% (1979-81 = 100%) (Table 17).

Table 16: Livestock, Total Numbers and Production, Fish Catch, and Honey Production, 1986 and 1990

ANIMAL	Total Numbers		Production									
			Meat		Milk		Wool		Eggs		Honey	
	1986	1990	1986	1990	1986	1990	1986	1990	1986	1990	1986	1990
Cattle	1578	1675	44	50	299	250	x	x	x	x	x	x
Buffalo	141	148	4	4	25	27	x	x	x	x	x	x
Sheep	8981	9600	20	26	170	175	16.4	16.8	x	x	x	x
Goats	1475	1650	7	10	70	77	x	x	x	x	x	x
Camels	60	59	n.a.	n.a.	n.a.	n.a.	x	x	x	x	x	x
Poultry	75	80	198	223	x	x	x	x	82	50	x	x
Fisheries, total catch	x	x	21	n.a.	x	x	x	x	x	x	x	x
- Inland waters	x	x	16	n.a.	x	x	x	x	x	x	x	x
- Marine	x	x	5	n.a.	x	x	x	x	x	x	x	x
Honey Bees	x	x	x	x	x	x	x	x	x	x	0.06	0.07

Total numbers of ruminants = 1,000 head
Total poultry = million head
Production of Meat, Milk, Wool, Eggs, Honey= 1,000 tons
Fish Catch = 1,000 tons

Source: FAO AGROSTAT Files, 1991; FAO Fisheries Yearbook: Catches, 1988.

Cattle and Buffalo

Production of cattle and buffalo meat and milk is less important than that of sheep. Cattle are found mostly in the higher rainfall areas and in specialized dairy herds in irrigated lands. Buffalo are found close to rivers and canals. Cattle and buffalo have higher individual nutritional needs and do not adapt easily to small land-holding, except for the "family cow or buffalo," which is considered necessary to supply milk to the farm family and to provide animal power if it is needed for small farms in the higher rainfall and irrigated areas.

Total number of cattle fluctuated during the last three decades from 1.1 million head in 1983 to 1.9 m heads in 1973, with mean of 1.6 million head. Cattle numbers in 1990 were about 1.7 million head (Table 16). There were 148,000 head of buffalo in 1990; their number reached its maximum, 288,000 head, in 1970.

Poultry

Poultry production increased rapidly in the last decade. In 1990, the 75 million chickens in the country produced 223,000 tons of meat and 82,000 tons of eggs (Table 16). The country is almost self-sufficient in meat and to a lesser extent in eggs. The poultry meat production index increased to 235.3% in 1989 (1979-1981 = 100), while eggs increased during the same period to 188.5% (Table 17).

The intensive poultry production systems require the importation of a high proportion of grains, animal and plant protein, certain vaccines, and breeder stock. The country is planning to produce the breeder stock locally, but a periodic infusion of new genetic strains is required by importation.

Table 17: Livestock Production Index (%) (1979-1981 = 100)

Year	Red Meat	White Meat	Milk	Eggs	Skins & Hides
1979	116.6	85.1	104.8	103.2	115.0
1980	98.0	97.6	95.6	100.0	98.5
1981	85.4	117.1	99.6	96.8	86.3
1982	85.7	194.8	94.4	98.3	78.6
1983	83.3	140.0	94.4	84.7	76.5
1984	94.7	201.5	94.4	85.3	87.0
1985	79.4	239.8	90.9	126.4	76.4
1986	74.3	236.4	88.2	169.3	69.1
1987	76.2	216.6	90.1	138.8	65.5
1988	58.2	217.6	85.6	126.3	51.6
1989	83.1	235.3	90.1	188.5	92.9

Source: Yearbook of Statistics, Ministry of Planning, 1988, 1989.

Fisheries Production

Fisheries catches from both in-land and marine waters increased from 16,100 tons in 1978 (17,500 tons from in-land waters and 8600 tons from marine waters) to 55,228 tons in 1979 (17,500 tons from in-land water and 37,728 tons from marine waters). The marine catches declined during the eighties down to about 5000 tons annually, while in-land catches were nearly stable, around 15,500 to 17,000 tons during the same period. In 1990, catches were 5000 tons from marine waters and 16,000 from in-land waters (Table 16).

Agricultural Policies

Agriculture in the National Economy

During the period 1983-1987, the agricultural gross domestic product (AgGDP) formed an annual average of 13.5% of the total gross domestic product (GDP). Manufacturing and mining formed 29.7%, services 38.5%, commerce 12.0%, and transport and communication 6.3% of the GDP. Therefore, agriculture was in third place after services and mining and manufacturing in contribution to GDP (Table 18). The index of real AgGDP in 1981 prices increased annually and reached 292.2% in 1987 (Table 19).

The contribution of plant production to the AgGDP in the eighties increased from 55.5% to 63.7%, while animal production and forestry decreased from 40.2 to 33.5% and from 2.0% to 0.4%, respectively.

Main agricultural development policies and goals, which are spelled out by the government, include the following:

1. To achieve a growth rate in agricultural production sufficient to meet the needs of the expanding population and to attain the projected level of self-sufficiency in some of the strategic food commodities such as wheat, barley, rice, meat, and vegetables.
2. To adopt all available control measures on water resources, as well as improved technologies in irrigation and land reclamation.
3. To generate balanced development in the different economic sectors.
4. To generate employment and a good standard of living for the rural population.
5. To encourage a wider contribution from the private sector by establishing private or mixed enterprises for agricultural production.
6. To increase the actual use of land suitable for agricultural production.
7. To expand wheat production and to properly utilize secured rainfed areas and reclaimed regions for that purpose.
8. To protect animal resources and to expand animal production by providing land, loans, and other inputs to the private sector.
9. To make available all requirements for expanding agricultural mechanization.
10. To devise proper pricing systems and subsidies to encourage agricultural production.

Table 18: Estimates of Components of Gross Domestic Products (GDP) at Current Producer Prices in Economic Activity (in Millions of Iraqi Dinars)

Sector	1983		1984		1985		1986		1987	
	Value	% Share	Value	% Share	Value	% Share	Value	% Share	Value	% Share
Agriculture	1,413.8	11.0	1,941.9	12.8	2,160.3	14.0	2,173.7	14.3	2,517.9	15.4
Commerce	1,565.0	12.1	1,854.4	12.3	1,931.1	12.5	1,916.3	12.6	1,713.0	10.5
Manufacturing and mining	3,852.4	29.9	4,820.9	31.8	4,909.6	31.7	3,821.1	25.1	4,903.9	30.1
Transport and communication	801.7	6.2	807.9	5.3	772.2	5.0	1,104.3	7.2	1,270.6	7.8
Government services	2,765.7	21.4	3,157.4	20.9	3,432.3	22.2	3,658.4	24.0	3,949.5	24.2
Other services	2,496.8	19.4	2,558.0	16.9	2,262.8	14.6	2,552.3	16.8	1,962.5	12.0
GDP	12,895.4	100.0	15,140.5	100.0	15,468.3	100.0	15,226.1	100.0	16,317.4	100.0

Source: Annual Abstract of Statistics, Ministry of Planning, 1988.

Note: Official Exchange rate: US$1 = Iraqi dinars (ID) 0.3145 (11 April 1988).

Table 19: Total GDP, Agricultural GDP and Index of Real Agricultural GDP (Million I.D., at 1981 Prices).

Year	1980	1981	1982	1983	1984	1985	1986	1987
Total GDP	15,794.7	10,611.8	12,898.4	12,895.4	15,140.5	15,468.3	15,226.1	16,317.4
AgGDP	741.9	955.0	1,277.8	1,413.8	1,941.9	2,160.3	2,173.7	2,517.9
Index of real AgGDP 1981 = 100	77.7	100.0	148.0	203.3	226.2	227.6	263.7	292.2

Source: Development of Agricultural Marketing in Iraq, AOAD, 1987, Annual Abstract of Statistics, Ministry of Planning, 1986, 1987, 1988, 1989.
Note: Offical Exchange Rate: US$ 1 = Iraqi Dinar (I.D.) 0.3145 (11 April 1988).

Table 20: Agricul ure's Share in the Overall Development Plan

Year	Agri ulture Share (Million I.D.)	Agriculture Share %	Actually used %
1970	28.0	24.0	n.a.
1975	207.5	19.3	48.0
1980	505.0	9.6	76.4
1981	681.0	10.1	76.1
1982	768.4	9.9	76.6
1983	494.3	9.0	n.a.

Source: Agriculture marketing in Iraq, AOAD, 1987.

Government Investments in Agriculture

Available data show that the agricultural share in the development plans declined from 24% in 1970 to 9% in 1983. In real money terms, total investment in agriculture has increased during the same period from 28 million Iraqi dinars (ID) in 1970 to 768.4 million and 494.3 million Iraqi dinars (ID) in 1982 and 1983, respectively. About three-quarters of allocated funds are actually used (Table 20).

The distribution of funds allo ated to agricultural development during 1970-74 consisted of 15.1% for storag projects, 42.1% irrigation and land reclamation, 13.0% agricultural production, 21.9% agricultural services, including research and extension, 5.4% agricultural marketing, and 2.2% for underground water utilization.

Import and Export Policies

Food consumption patterns in the country show that about two-thirds of calories consumed per capita per day come from cereals, of which 73%-80% from wheat and 13%-21% from rice. Cereals also provide about 85% of protein and about 20%-28% of daily fat requirements. The remaining requirements for calories, protein, and fat are obtained from other plant and animal products (Table 21).

The high rate of population growth, the low rate of growth in cereal production, and the improvement of per capita income have increased the demand for basic staple foods, i.e., cereals, vegetable oils, sugar, and animal products. Therefore, self-sufficiency has deteriorated during the last two decades, especially for cereals, pulses, mutton, and milk (Table 22). It declined for wheat from 93% in 1970 to 13% in 1989 (Table 23).

Table 21: Food Balance Intake: Calories, Protein and Fats.

Source	Calories per cap./day			Protein (grams) per cap./day			Fats (grams) per cap./day		
	1975	1980	1988	1975	1980	1988	1975	1980	1988
Vegetable products	2110	2382	2762	47.5	55.1	60.8	26.4	28.8	46.5
Cereals	1368	1670	1832	39.4	47.0	51.2	6.9	8.2	8.8
Wheat	1113	1230	1339	33.8	37.3	40.6	5.9	6.6	7.1
Rice	188	323	391	3.6	6.2	7.5	0.4	0.6	0.7
Sweeteners	354	304	334	-	-	-	-	-	-
Pulses	48	34	50	2.6	2.3	3.2	1.3	0.9	0.6
Vegetable oils	139	156	311	-	-	-	15.8	17.6	35.2
Vegetables	59	61	69	3.1	3.0	3.4	0.5	0.4	0.5
Fruits	119	115	127	1.3	1.4	1.6	0.5	0.5	0.5
Animal products	239	284	246	14.5	19.1	16.9	17.0	19.4	16.4
Meat	88	110	115	5.5	8.0	8.2	7.1	8.4	8.9
Animal fats	32	34	21	-	-	-	3.6	3.8	2.4
Milk	93	108	89	6.2	7.7	6.7	5.1	5.5	3.9
Eggs	16	17	16	1.2	1.3	1.2	1.2	1.2	1.2
Fish	4	8	2	0.6	1.3	0.3	0.1	0.3	0.1
Grand total	2349	2666	3008	62.1	74.2	77.7	43.4	48.2	62.9

Source: FAO AGROSTAT Files, 1991.

Table 22: Self-Sufficiency in Main Commodity Groups, 1970-1988

Commodity Group	1970				1980				1988				Projected
	P	E	I	% SS	P	E	I	% SS	P	E	I	% SS	% SS
	(1000 tons)				(1000 tons)				(1000 tons)				1990
Cereals	2073	38	105	97	1855	0	3010	38	2560	102	4543	37	47
Pulses	49	5	12	88	37	0	24	61	18	0	84	18	
Vegetable oils	13	1	100	12	10	0	98	9	9	0	314	3	33
Potatoes	20	0	23	47	97	0	55	64	144	0	59	71	
Cotton Lint	15	1	0	107	5	0	17	23	4	0	30	12	
Sugar	14	0	244	5	30	0	652	4	4	0	651	1	
Vegetables	1131	7	93	93	1312	8	112	93	1965	3	166	92	
Fruits	1213	364	21	139	1778	94	246	92	2057	111	74	102	
Animal fats	14	0	1	93	16	0	30	34	12	0	48	20	
Meat	116	0	1	99	175	0	132	57	278	0	145	66	
bovine	44	0	1	98	51	0	17	75	43	0	124	26	}80
sheep	49	0	0	100	56	0	14	80	24	0	15	62	}
poultry	18	0	0	100	60	0	100	38	209	0	6	97	117
Milk	559	0	62	90	580	0	517	53	563	0	748	43	61
Eggs	15	0	10	60	48	0	18	73	64	0	27	70	95

Source: Calculated from AGROSTAT Files, FAO.
Note: P = Production; E = Export; I = Import; SS = Self-sufficiency.

Table 23: Wheat Self-Sufficiency, 1970-1989

Year	Production (1,000 tons)	Export (1,000 tons)	Import (1,000 tons)	% Self-Sufficiency*
1970	1236	2	99	93
1975	845	5	568	60
1980	976	0	2177	31
1985	1406	0	2479	36
1986	1036	1	2421	30
1987	722	3	3077	19
1988	929	0	2918	24
1989	491	0	3300	13

Source: Calculated from AGROSTAT Files, FAO.

* % Self-Sufficiency = $\frac{\text{Production}}{\text{Production + Import - Export}} \times 100$

Projected self-sufficiency in wheat for 1990 was 45 %.

The import bill of agricultural products was about 2.4 billion dollars for 1990, of which food commodities formed about 81%, cereals made up about half of the food imports (about 32% wheat and wheat flour, 10% rice, 3% barley, and 4% maize) (Tables 24, 25).

Government targets for 1990 for improving self-sufficiency by increasing production of main commodity groups was not achieved (Table 22).

The Government has followed a trade policy to import the country's needs for agricultural commodities to establish a balance between availability and demand to a large extent, with the aim of increasing local production towards self-sufficiency in main commodities. The Government defined its role and that of the private sector in trade. While essential import handling was restricted to state authorities (especially of wheat, meat, vegetable oil, eggs, fruits, and vegetables), the private sector was restricted to retailing.

Technology Generation and Transfer Policies

Pricing and input policies: The Government is subsidizing the production of principal crops, i.e., wheat, barley, maize, rice, cotton, sugar beets, food legumes, and forage legumes, by providing producer subsidies for production inputs, i.e., seeds, fertilizers, and pesticides, and cash loans. Since 1987, loans for production were reduced because of greater contributions from the private sector in agricultural production when Government started to give a larger role to the private sector in production (Table 26).

Table 24: Agricultural, Food Product, and Main Commodity Groups Trade, 1970-1989 (Million $)

Product	1970		1975		1980		1985		1990	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
Total agricultural products	98	46	777	58	2030	71	2092	79	2464	77
Total food products	71	30	691	44	1805	58	1741	71	2008	46
Cereals	78	2	221	1	815	-	629	-	967	1
Vegetable oil and margarine	17	0.5	74	0.8	82	-	174	-	289	-
Sugar	22	-	251	-	367	-	116	-	235	-
Live animals and meat	0.4	-	33	-	233	-	395	-	293	-
Milk	4	-	22	-	84	-	121	-	98	-
Butter and cheese	0.8	-	5	-	50	-	87	-	26	-
Eggs	5	-	36	-	25	-	60	-	43	-

Source: FAO AGROSTAT Files, 1991.

Table 25: Trade in Main Agricultural Product for 1985 and 1989

Commodity	Import				Export			
	1985		1989		1985		1989	
	Q	V	Q	V	Q	V	Q	V
Cereals	3463	629	4891	967	0	0	15	10
Wheat	2096	309	3339	627				
Wheat flour	325	64	100	25				
Rice	500	175	542	196				
Barley	130	18	340	51	0	0	15	10
Maize	286	63	570	68				
Dry legumes	72	34	70	42				
Potatoes	20	5	31	10				
Tomatoes	8	2	25	7				
Onions	19	6	20	8				
Apples	32	15	15	9				
Dates					110	66	110	39
Citrus	38	21	19	11				
Beer	14	12	14	15				
Sugar	591	116	693	235				
Vegetable oils + margarine	245	178	305	170				
Tea	40	88	50	87				
Cakes and meal	155	38	319	109				
Tobacco	8	38	30	45				
Cotton lint	21	39	30	45				
Meat	232	374	141	290				
Milk	-	120	31	98				
Butter and cheese	48	87	8	20				
Eggs	50	60	14	43				
Animal fats	11	7	32	15				
Food excluding fish	-	1741	-	2008	-	71	-	46
Agricultural products	-	2092	-	2464	-	79	-	77

Source: FAO AGROSTAT Files, 1991. Note: Q = 1000 metric tons; V = millions $.

Table 26: Total Loans Offered by the Agricultural Cooperative Bank, 1984-1988 (Million $)

Year / Purpose	1984	1985	1986	1987	1988
Agricultural supply	45.7	44.6	45.2	40.9	16.9
Cooperative marketing	8.3	5.7	25.3	-	-
Machinery service	2.2	2.1	1.4	1.5	1.2
Poultry production	49.9	48.0	14.4	11.4	7.1
Farm animals	5.6	1.9	1.3	2.5	1.7
Agricultural machines	8.6	36.1	23.4	14.7	13.3
Orchard production	7.1	19.7	12.5	7.5	5.4
Land reclamation*	0.7	0.9	0.7	-	1.9
Other purposes	7.4	13.8	13.0	3.1	2.1
TOTAL	135.4	172.8	138.2	81.6	49.6

Source: Yearbook of Statistics, 1988, Ministry of Planning.

* Non-Government Land Reclamation Programs.

Government intervention po cies on pricing covers both producers and consumers. It provides prices to producers above the world price for wheat, barley, maize, rice, cotton, and sugar beets. It s bsidizes consumer prices for bread and flour, rice, sugar, vegetable oil, and red meat.

Seed policies: Production of improved seeds is the responsibility of SBAR. SBAR produces not only breeder seeds but foundation as well as certified seeds on its research station lands. However, the area covered by improved seed is between 12.5% to 24.6% for wheat, barley, and rice, and 53.2% for maize. All areas of cotton, sunflowers, and soybeans are planted with improved seeds (Table 27).

The Government provides water for irrigation, subsidizes machinery, produces and distributes animal vaccines, and controls the insect pests and diseases of main crops. The private sector owns about 98% of pumps, 95% of combines, and 97% of tractors. The remaining equipment is owned by state farms and cooperatives.

Transport, storage, and processing policies: Development plans have dealt with these issues by allocating financial resources for development projects under the agriculture, industry, and transport and communication sectors. Under the agricultural sector, post-harvest development projects in the seventies covered about 15% for storage projects and 5% for marketing.

Research and extension policies: Government is supporting research and extension by continuously improving their resource base. The five year plan 1986-90 placed considerable emphasis on improvement of the human and physical resource base for research, as well as for exten ion. However, there was a progressive increase in the centralization of agricultural research in the canceling of the AWRRC, and in the combining of water and oil research from the former Ministry of Irrigation with SBAR. SBAR has already u dergone very frequent reorganization in less than a decade with the objective of making its research more responsive to the needs of the agricultural sector. This reorganization and other aspects of research policy, organization, and management will be dealt with in the next few pages.

Table 27: Production of Improved Seed and Percentages of Total Cropped Area That Could Be Provided with Improved Seeds 1988.

1	2	3	4	5	6	7
	Area Sown (ha)	Production of Improved Seeds (tons)	Estimated Seed Rate per (kg/ha)	Potential for Area Planted (ha)	Total Area in Production 1988 (ha)	(5/6) (%)
Wheat	4,727	30,864	100 kg/ha	308,640	1,250,000	24.7*
Barley	8,465	20,416	100 kg/ha	204,160	1,250,000	16.3**
Rice	248	935	100 kg/ha	9,350	75,000	12.5**
Maize	1,514	1,280	32 kg/ha	40,000	75,000	53.3
Cotton (seeds)	2,500	2,118	40 kg/ha	21,180	22,000	100
Sunflower (hybrid)	-	160	8 kg/ha	20,000	20,000	100
Soybean	-	250	65 kg/ha	4,166	4,000	100

* The plan is to produce annually seeds for 1/4 of the area.
** The plan is to produce annually seeds for 1/5 of the area.

AGRICULTURAL RESEARCH

Historical Background

Agricultural research in Iraq, as well as other countries in the region, is of very recent origin, dating back for no more than 70 years. As early as the 1920s, and soon after the establishment of the first government of modern Iraq, the Ministry of Economics and Transport included in its organizational structure a Directorate General for Agriculture. The technical department of this directorate conducted many surveys and issued instructions to establish and organize issues concerning agricultural production. As a result of Directorate activities, many new crop varieties were introduced into the country. The department concentrated its activities on diagnosis and control of some plant pests and animal diseases, and started the first program for importing exotic bulls to improve local cattle strains. The first experiment stations, i.e., Abu Ghraib and Neinevah, and the Central Veterinary Laboratory were established by the Directorate.

In 1952, the first agricultural research body was created and named the "Directorate General of Agriculture Research and Projects." It consisted of six research departments: field crops, plant pathology, horticulture, botany and range, soils and agricultural chemistry, and entomology; two sections: fisheries and technical matters; and a central station at headquarters at Abu Ghraib. Animal husbandry, veterinary medicines, and forestry research were mandated to serve directorates within the Ministry of Agriculture (Figure 4).

Although the Directorate had a small staff (54 persons), four with a Ph.D. degree and seven M.Sc. degree holders, its research covered most of the main agricultural commodities.

In 1968, the Directorate was reorganized into seven independent research departments, each under a directorate general offering services and conducting research. The seven departments were cereal production, industrial crops, seed production, weed control, animal feed crops, water use and irrigation (established in 1977), and agricultural mechanization (established in 1978). In addition, 12 provincial research centers were established throughout the country (Figures 4, 5).

In the early seventies, several agricultural research centers were established as part of the then "Foundation of Scientific Research." These included the agricultural research center, biological research center, date palm research center, and natural resources research center. Soil and water research was affiliated to the then "State Organization for Soils and Land Reclamation," which in turn belonged to the then "Supreme Agricultural Council."

In 1976 the Foundation of Scientific Research was replaced by the Council of Scientific Research (CSR). The CSR was established as an autonomous organization affiliated to the Prime Minister's Office. The CSR was mandated to coordinate all

Figure 4: Changes of structural models of agricultural research during the last three decades

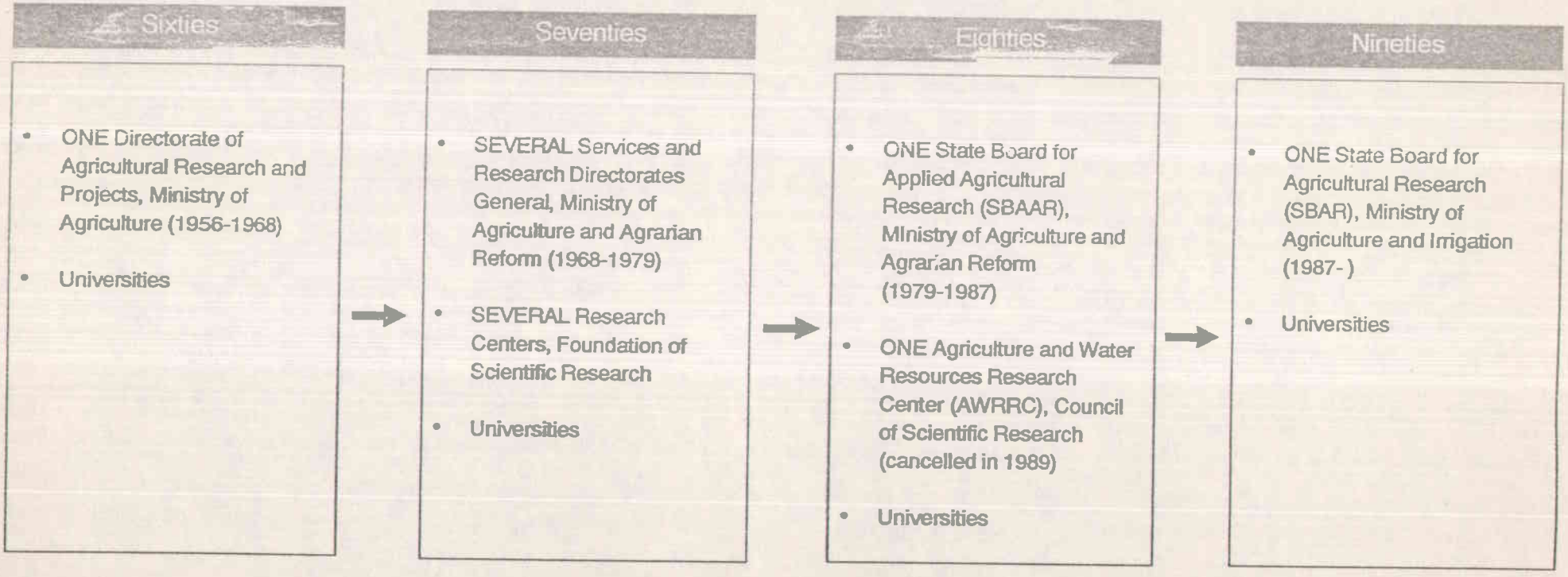
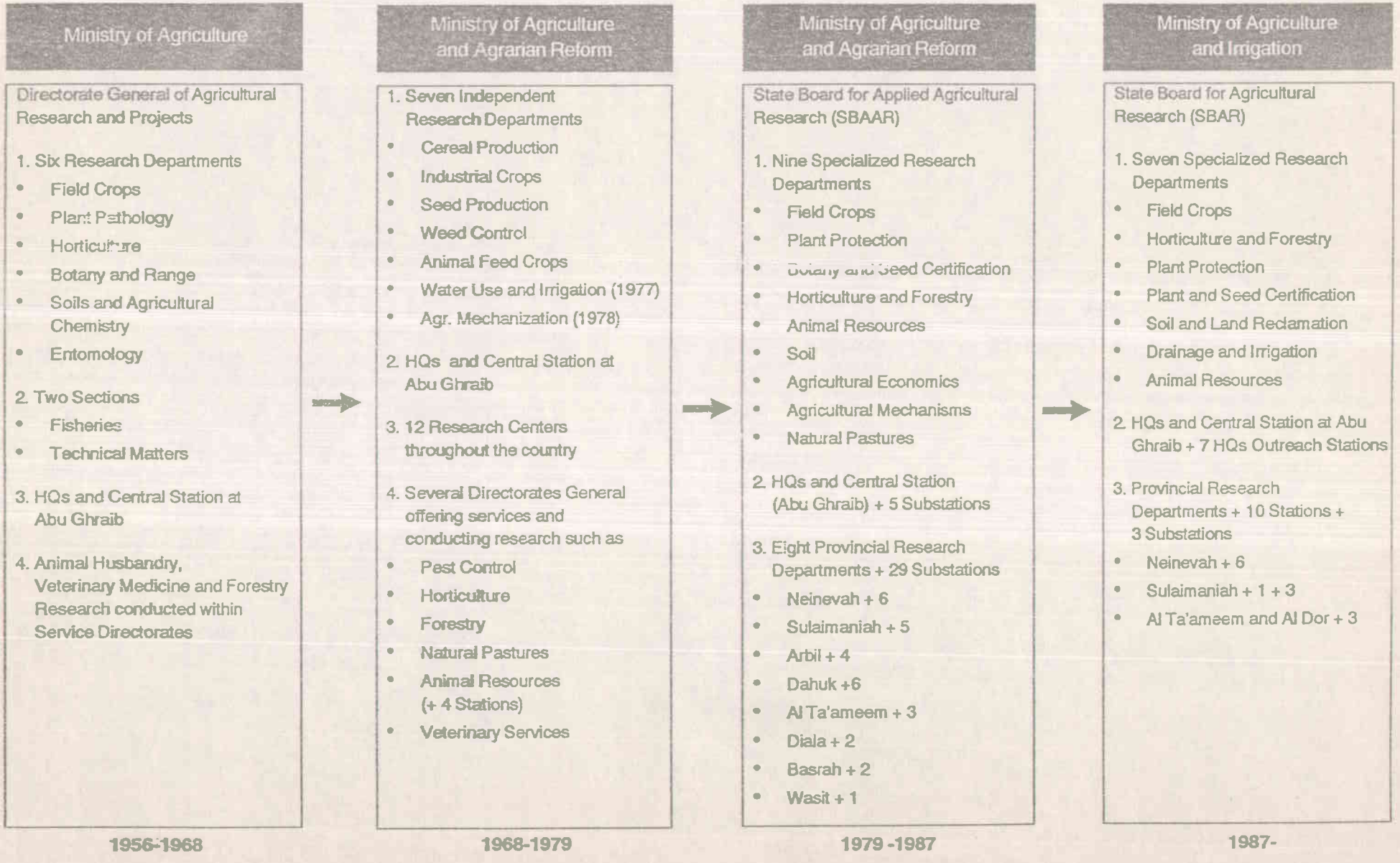


Figure 5: Structural changes of research organizations of the Ministry of Agriculture and Irrigation, 1956-1987



scientific research activities in the country, to carry out research in selected fields in its centers, and to monitor technology transfer. Seven research centers were affiliated with the CSR: the Agriculture and Water Resources Research Center (AWRRC), Biological Sciences Research Center (BSRC), Construction (Buildings) Research Center, Astronomy and Space Research Center, Solar Energy Research Center, Scientific Research Documentation Center (SRDC), and Petroleum Research Center. In the eighties the Genetic Engineering and Biotechnology Center (GEBTC) was established as an additional center to the CSR.

The CSR centers involved in agricultural research were AWRRC, BSRC, GEBTC, and SRDC.

The AWRRC was mandated to carry out applied agricultural research and to coordinate agricultural research in the country. It had five research departments, two research units, one committee, and 11 research stations. These were the Departments of Plant Protection, Soil and Land Reclamation, Water Resources, Animal Production, and Dates and Palm Research; the Economic Research and Studies Unit and the Planning and Monitoring Unit; the Research Outcome Implementation Committee; one central headquarters station, and 10 outreach stations, such as Dulmuj, Babel, and Basrah (Figure 6).

The BSRC was mandated to carry out mainly basic research in its five Departments of Cell Biology, Animal Science, Pollution, Microbiology, and Pharmaceutical Research. It also had a station of Fisheries and Aquatic Organisms (Figure 6).

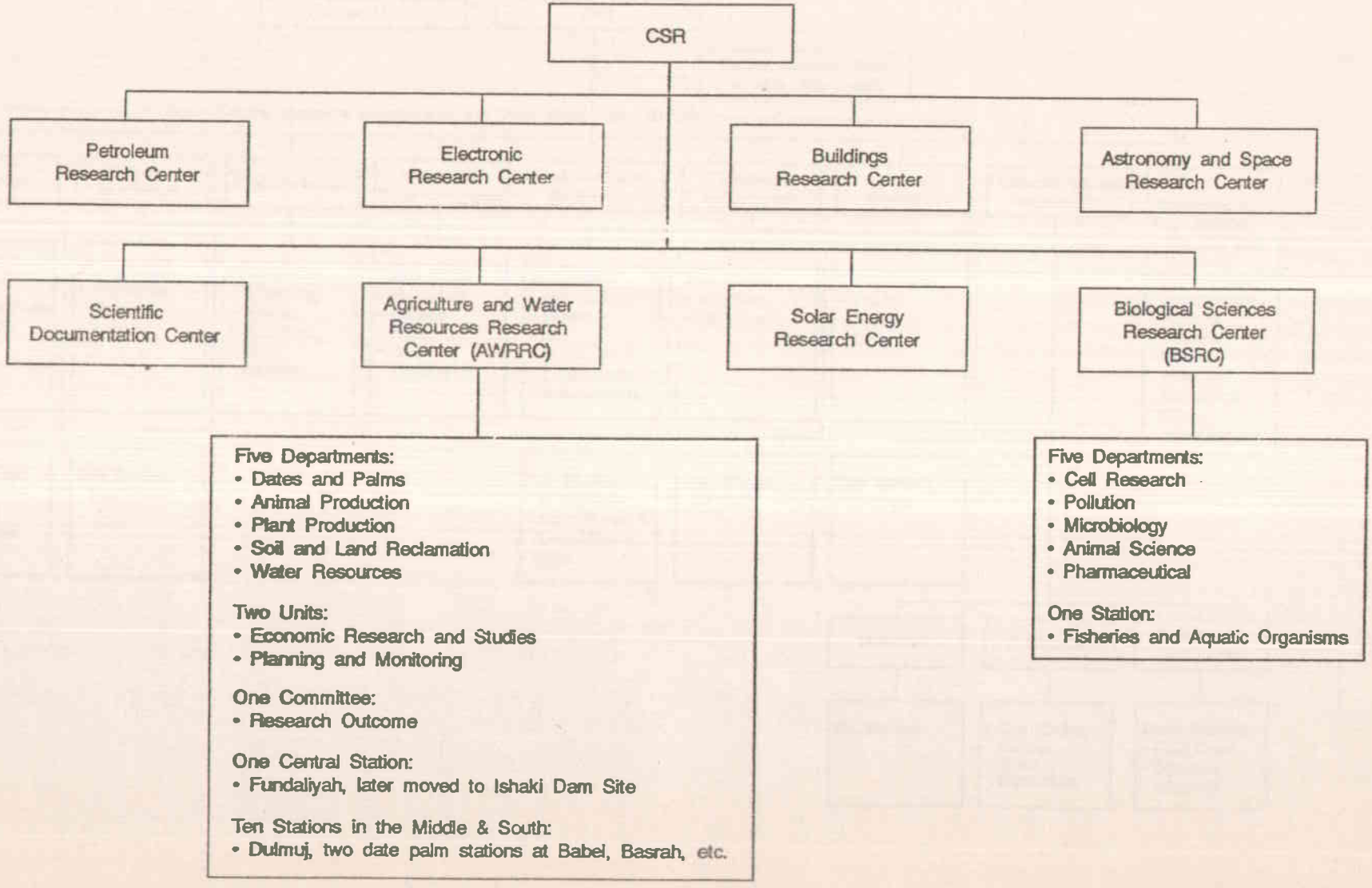
The SRDC was a documentation center for scientific research including agricultural research. It was the participating center in AGRIS/CARIS activities for agricultural research in the country.

During the late seventies and most of the eighties, AWRRC played an important role in planning agricultural research in the country, especially its contribution to developing the five-year research plan, 1986-1990. The CSR and its centers were canceled (liquidated) in November 1989. At that time agricultural research became the main responsibility of the Ministry of Agriculture and Irrigation.

In 1979, the State Board for Applied Agricultural Research (SBAAR) was established within then the Ministry of Agriculture and Agrarian Reform. It was established by merging several research departments at Abu Ghraib, the place where the first Directorate of Agricultural Research and Projects was located. Later the State Organization for Agricultural Mechanization, based at Swaira, was merged with SBAAR. Between 1980-1982, SBAAR established nine specialized research departments, five substations affiliated to the central station at Abu Ghraib, and eight provincial research departments (Figures 5, 7).

In 1987, the separate Ministries of Agriculture and Agrarian Reform and of Irrigation were combined in a single Ministry of Agriculture and Irrigation. Consequently, the Water and Soil Research Center of the former Ministry of Irrigation was transferred to SBAAR, which took an expanded title, "State Board for Applied Agricultural

Figure 6: Organizational structure of the Council of Scientific Research (CSR) and its two centers AWRRC and BSRC (before cancellation in late 1989)



Research and Water Resources" (SBAARWR). In early 1990, the title was reduced to "State Board for Agricultural Research" (SBAR). SBAR at present has seven research departments, a central station, seven headquarters outreach stations, and three provincial research departments within their 10 stations and three substations (Figure 5). SBAR is mandated with most fields of agricultural research with the exception of animal health, which is the responsibility of the "Veterinary Central Laboratories," and fisheries, which is mandated to the "State Board for Fish Production."

Agricultural research at the universities is carried out by academic staff and postgraduate students. The Faculties of Agriculture and Veterinary Medicine of the University of Baghdad were established in 1957, the Faculties of Agriculture and Forestry and of Veterinary Medicine of the University of Mosul were established in 1967, and the Faculty of Agriculture of the University of Basrah was established in 1964.

More information on agricultural research at SBAR and the universities will be dealt with later in this report.

Structure and Organization

Introduction

The structure and organization of a national agricultural research system critically influence the efficiency and effectiveness of research. They shape the way the system operates as well as its capacity to diagnose problems, assess world knowledge of improved technologies, mobilize human, physical and financial resources to conduct research, and perform other assigned functions to achieve the designated objectives.

Despite recent efforts to improve the performance of agricultural research in the country, agricultural research is facing difficulties in coordination within and among research institutions. While there is a tendency to see structural change as the solution to problems of efficiency and effectiveness of research, there is often a failure to understand how complicated organizational change can be. There is also often a failure to recognize the usefulness of improved management tools in achieving objectives that may be obtained through better approaches to strategic planning, program formulation, and implementation rather than through restructuring organizations.

It is clear from Figures 4 and 5 that structural changes of agricultural research in the country have gone through four stages, with the first three lasting about a decade each. The fourth and last stage started in the late eighties and consists of only one national agricultural research institution, SBAR, and the university system. Thus, this present stage of structure and organization will be discussed.

The State Board for Agricultural Research (SBAR)

As mentioned earlier, SBAR was established in its original form in 1979. It has already undergone frequent internal reorganization where several departments and research stations were combined or abolished (Figures 4, 5).

It is a government institution under the administrative control of the Ministry of Agriculture and Irrigation. Its mandate is to conduct agricultural research to improve agricultural production, of plants and animals, in the country.

SBAR responsibilities cover the following:

1. production or selection of improved varieties of different field crops suitable for various environmental and geographical regions in the country;

2. the production of a nucleus of certified seeds of different field crops and vegetables which the Iraqi Company for Seed Production, in turn, propagates and distributes at the two stages of seed registration and certification;

3. inspecting and certifying locally produced and imported seed;

4. conducting research to develop new agricultural technologies to improve production and to ensure proper use of resources;

5. conducting research on agricultural pests to develop the means to control them, and addressing quality-control issues concerning imported pesticides;

6. conducting research on soil and fertilizer use;

7. studying irrigation and drainage, and carrying out comparative studies on different irrigation techniques;

8. studying natural vegetation and conserving genetic resources;

9. conducting research to improve animal production;

10. developing nontraditional animal feed stuffs to improve the level of animal nutrition.

At present, the organizational structure of SBAR consists of seven research and five administrative departments at headquarters at Abu Ghraib, three provincial research departments at Neinevah, Sulaimaniah, and Al Ta'ameem and Al Dor, seven outreach headquarters stations affiliated to relevant departments, one central research farm at Abu Ghraib to serve research for all central departments, and 10 outreach stations and three substations affiliated with the three provincial research departments (Figure 7).

The central Research Departments are Field Crops, Horticulture and Forestry, Plant Protection, Plant and Seed Certification, Soil and Land Reclamation, Drainage and Irrigation, and Animal Resources. Each research department is divided in two to five research units. At the same time there are department outreach stations: one for rice, one for field crops, one for horticulture, one for soil, one for sand dunes and desertification, one for irrigation and drainage, and one for livestock (Figure 7).

The stations of the provincial research departments are mandated with multipurpose -- commodity and noncommodity research -- except for three that specialize in field crops, gypsisols, and animal resources at the Al Ta'ameem and Al Dor Department of Agricultural Research.

SBAR's central experiment farm of about 250 ha is located some 2 km from its headquarters at Abu Ghraib, where the central research departments are. The farm is irrigated by minor canals from the Euphrates River. Other agricultural service institutions with related interests located in the neighborhood include the headquarters of the State Board of Animal Resources, the Extension Training Center, the seed processing plant for vegetables, and cold storage for seed potatoes.

SBAR is administered by a director general (DG). In the early eighties, SBAR was governed by a board of outsiders which was chaired by the DG of SBAR with membership by representatives of other institutions, ministries, farmers' cooperatives, and state farms. All proposals submitted to the Ministry of Agriculture for approval must be routed through the board. This board was replaced by an internal SBAR scientific committee with the DG as the chairperson (members are directors of departments). The tasks of this committee are to discuss and approve the research program of SBAR.

Each technical department is directed by a senior scientist. In each department, either central of provincial, there is a department scientific committee chaired by the director of the department with membership by all project directors of the relevant departments, chiefs of department units, and selected experienced researchers.

In addition to the central technical departments, there are five administrative departments of Planning and Follow-up, Administration and Finance, Storage, Financial Control, and Field and Mechanical Factory Administration. The Department of Planning and Follow-up has an important role in documenting the reporting system on research program implementation and in preparing of the annual unified report on all SBAR research activities and results to be submitted through the DG of SBAR to the Directorate of Planning and Follow-up of the Ministry of Agriculture and Irrigation.

Table 28: Departments of the Three Faculties of Agriculture

Department\University	Baghdad	Mosul	Basrah
Plant Protection	x	x	x
Field Crops	x	x	
Soil Science	x	x	x
Agriculture Economics	x	x	
Agric. Extension	x	x	x
Agric. Mechanization	x	x	x
Animal Resources	x	x	x
Food Industries	x	x	x
Forestry		x	
Fish and Fish Production			x
Horticulture	x	x	x

The University System

Agricultural education in the country is in two levels:

- university level for obtaining B.Sc., M.Sc., and Ph.D. degrees;
- high technical institute-level offering Diploma degree which is less than B.Sc. degree.

Since 1988, each of the three high technical institutes has remained as an agricultural department. The annual enrollment is about 1000 students. The institutes are distributed in the north, the center, and the south.

Out of the 11 universities in the country, which are affiliated with the Ministry of Higher Education and Scientific Research, there are three universities that offer education in agriculture, and also two in veterinary medicine. These are Baghdad University in the center with Faculties of Agriculture and Veterinary Medicine, Mosul University in the north with a Faculty of Agriculture and Forestry and one of Veterinary Medicine, and Basrah University in the south with a Faculty of Agriculture.

Each of the faculties has several departments. The departments of the three faculties of agriculture are in Table 28.

The total number of students enrolled for the academic year 1990/91 at the three faculties of agriculture and the two faculties of veterinary medicine was 1990. Their distribution at faculties and specialization is shown in Table 29.

The faculties have postgraduate programs for students to obtain Ph.D. and M.Sc. degrees. The Faculty of Agriculture of the Baghdad University, for example, has offered the M.Sc. degree to 543 graduates and the Ph.D. degree to three graduates in various fields since the start of the postgraduate programs in the sixties up to March 1987 (Table 30).

Each faculty has laboratories and an experimental farm where academic staff and students carry out their laboratory and field research.

Other Organizations

1. Animal health research is mandated to veterinary laboratories and fisheries research is the responsibility of the State Board for Fisheries. However, Basrah University has a fish and submarine biology research center.

2. The Department of Agriculture of the Iraqi Atomic Energy Agency is mandated with research on the applications of radiation and isotopes in agriculture.

3. Private-sector research is limited and is carried out in collaboration with public research, e.g., research on introduction of hybrid seeds, pesticides, agricultural

machinery, and fertilizers.

4. International and regional organizations -- Baghdad hosts the Economic and Social Commission for Western Asia (ESCWA), Federation of Arab Scientific Research Councils (FASRC), Arab Union for Food Industries (AUFI), Arab Industrial Development Organization (AIDO), and the country office for AOAD. These organizations carry out desk research and produce valuable research outputs.

Table 29a: Enrollment of Students at the Faculties of Agriculture and Veterinary Sciences

University	Faculty	No. of Students
Baghdad	Agriculture	680
	Veterinary Medicine	150
Mosul	Agriculture and Forestry	700
	Veterinary Medicine	100
Basrah	Agriculture	360
TOTAL		1990

Table 29b: Distribution of Students According to Specialization, Academic Year 1990/91

Specialization	% within Total Enrollment (excl. Veterinary Sciences)	% within Total Enrollment (incl. Veterinary Sciences)
Vet. Sciences	-	11.1
Animal Resources	16.0	14.3
Food Industries	8.0	8.0
Extension	4.4	4.0
Ag. Economics	5.0	4.5
Plant Production (all disciplines)	66.6	58.1
	100.0	100.0

Agricultural Research Linkages

One of the basic duties of research institutions is to organize communication channels with a wide range of research partners within and among research institutions in the country, outside the country, and with their major clients in the country -- policymakers, and the technology-using and -transfer system. These linkages have various characteristics depending on the type of linkages and whether it is with partners in the sources of knowledge or with various clients.

Table 30: Ph.D. and M.Sc. Graduates at the Faculty of Agriculture, University of Baghdad, Starting in the Sixties to March 1987

Department	Number of Postgraduates	
	M.Sc.	Ph.D.
Soil Science	77	-
Field Crops	73	2
Horticulture	56	-
Animal Production	96	-
Plant Protection	82	-
Food Industries	88	1
Agricultural Economics	45	-
Agricultural Extension & Education	26	-
TOTAL	543	3

Source: Al Azawi, A.F. and Al Younes, A.H.A., 1987. In Proceedings of a Workshop in Developing National Agricultural Research Centers, Baghdad, Iraq, December 1987.

In addition to the various characteristics, channels, and types of linkages, partners in the linkage process generally vary greatly in their competence and commitment to collaboration. Therefore, the nature of linkages varies from simple to quite complex, and from country to country. For research implementation, linkages of importance have been identified with service institutions of the MAI, farmers and farmers' associations, and with sources of knowledge such as university research and regional and international research organizations.

Linkages with MAI, extension, and farmers: Informal and formal linkages are taking place at various levels and institutions of MAI.

1. At the policy level, the MAI guides SBAR research, approves its research program, and allocates resources. SBAR has to report to MAI on the outcome of

research activities through the MAI Directorate of Planning and Follow-up.

2. The State Board for Agricultural Services (SBAS): Extension is the responsibility of SBAS (Formerly State Board for Training and Extension). Considerable emphasis is placed on the training of extension workers and on the use of modern communication media, field visit, and field days at research stations to improve the links between research, extension workers, and farmers.

Extension has already undergone frequent reorganization during the last two decades. In the late sixties, the Department of Agricultural Extension was transformed to the Directorate of Agricultural Extension. In the late seventies, the State Establishment for Peasants Education and Extension was created by combining the State Establishment of Peasants Education and the Directorate General for Agricultural Extension. In the early eighties, the State Board for Training and Extension was established; it was replaced in the late eighties by the State Board for Agricultural Services.

Extension is practiced through extension plots/trials, training, and audiovisual and educational techniques. Extension activities also cover rural women and rural development activities.

There were many attempts to improve linkages between SBAR research and extension. Among these was a coordinating committee that was set up in 1984, consisting of representatives from SBAR, extension, and the Union of Cooperatives, to advise on the application of approved technological packages on state farms and selected private farms. However, it was already felt that some more efficient, more direct link than this committee was required between research and extension.

The basic conclusion to be drawn is that there is a great need to institutionalize research-extension linkages. It is well recognized that both researchers and extension workers have an important role in identifying farming problems at farmer and national levels and in conducting joint on-farm trials to test and validate adopted technology. Thus, every effort should be made to continuously improve the institutional mechanisms for the following:

- joint planning and follow-up;
- identification of farmers' problems;
- joint on-farm validation/verification trials;
- mobility of research and extension staff;
- funding to implement joint activities.

Linkages with sources of knowledge: Agricultural research is not an isolated effort; on the contrary, it is an integral part of a world complex of agricultural research ranging from academic and basic research at a global level to strategic, applied, and adaptive research to final testing of new technologies on farmers' fields. These activities generate a vast pool of information on which national research can and should draw to avoid wasteful duplication of effort. In turn, information generated in national research should be an integral part of this pool of knowledge. But this depends on

the existence of mechanisms for information exchange that make such interchange possible. Therefore, it is important for research institutions to maintain strong linkages with other research activities, in particular to maintain linkages with other national sources of knowledge (i.e., university research) and external sources of knowledge (i.e., regional and international research organizations and external national research organizations).

1. *Linkages of SBAR with university research:* The faculties of agriculture and of veterinary medicine have a large pool of 956 scientists with Ph.D. and M.Sc. degrees (see Tables 31, 34). In addition to teaching, scientists at universities carry out research and/or supervise postgraduate students' research.

   At present, collaboration between SBAR and university research is limited to postgraduate students' research and other formal and informal means of collaboration. Collaboration is usually on a scientist-to-scientist basis and is informal in nature. Despite the fact that SBAR leaders and scientists have been willing to seek greater collaboration, the separation of institutions within different ministries, the different criteria for hiring and promoting staff, different tasks, and different conditions of service have made it difficult to have a movement of research staff between universities and SBAR, and to conduct efficient and effective collaborative research. Consequently, SBAR and the universities should identify mechanisms for collaboration and coordination of agricultural research.

2. *Linkages of SBAR with regional and international research organizations:* SBAR's collaboration with regional and international research organizations is weak. An agreement of collaboration between SBAR and the International Center for Agricultural Research in the Dry Areas (ICARDA) was signed in September 1986 with the objectives of exchanging scientists, technologies, germplasm, and breeding materials, and the import and export of other items relevant to the cooperative research program of ICARDA-mandated commodities, i.e., wheat, barley, fababeans, lentils, and chickpeas.

   SBAR collaborates with the Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD).

   SBAR cooperates with other international organizations such as FAO and UNDP.

3. *Linkages with external national research organizations:* There were many attempts to establish networks with intercountry research programs. Networks are efficient interinstitutional arrangements for developing the technological capabilities of their members. The establishment of networks among researchers in the region has been the object of many serious efforts. Iraq has hosted the FAO regional research network on palms and dates and has participated in a few others.

Recommendations

As mentioned earlier, agricultural research in the country has undergone structural reorganization several times. At present, SBAR is the major agricultural research institution and its mandate covers the whole country. It is a semi-autonomous national research organization directly responsible to the Minister of Agriculture and Irrigation.

The three faculties of agriculture and two faculties of veterinary medicine are also involved in agricultural research. Particular emphasis will have to be on structural organization that will ensure effective research priority setting and allocation of resources, better coordination and implementation of multidisciplinary research activities to address priority areas in agricultural development plans.

1. Wen coordination of agricultural research is low or absent, resources are made available directly to research institutions. The overall national agricultural research budget becomes the sum of the research institution budgets. This situation is characterized by the tendency to ignore long-term planning of agricultural research. Therefore, research budgets are easily sacrificed in times of budgetary stringency. Thus, there is a need to establish a centralized body where the budgetary resources for national agricultural research are provided as a single package. This approach calls for centralized resource allocation and decision making and detailed planning, but decentralized research activity planning and implementation. It has the advantage of facilitating a total policy for national agricultural research activities that minimizes abrupt shifts that can disrupt research continuity. It should also relate research directly to overall national agricultural development objectives and make evident the relative weights of national research priorities and changes among them. It ensures high coordination in the determination and implementation of national agricultural research policies.

   A *centralized research policy body* at the level of the Ministry of Agriculture and Irrigation could be established to govern SBAR and agricultural research in the country. It could be called "SBAR: Council of Agricultural Research". The Council is chaired by the Minister of Agriculture and Irrigation. The Council's memberships would include representatives from the decision-making level of Ministry of Agriculture (the Under-Secretary and directors general of the state boards for agricultural services, and animal resources and veterinary services) and from the Ministries of Planning and Finance. It would also include the DG os SBAR, the deans of the faculties of agriculture and veterinary medicine, and representatives of farmers' unions. The Director General of SBAR would be the Executive Secretary of this council with the task of coordinating implementation of council policies and decisions.
   The major functions of the proposed council would be:

   - to secure political support for agricultural research;
   - to secure financial and human resources;
   - to determine research policy and strategy by developing clear statements of

research objectives;
- to set broad research priorities and rationalize resource allocations;
- to approve five-year program and budget plans;
- to organize the implementation of strategy, program, and budget plans;
- to participate in the development of articulated development policy.

Guidelines of procedures, arrangements, and policies for the council to function properly should be developed.

2. Establishing an internal management committee for SBAR with the following major functions:

   - to develop guidelines for research proposals, within the research strategy, operational and budget plans, with details for a provisional budget and allocation of funds;
   - to approve the annual program and budget;
   - to coordinate research activities;
   - to organize implementation of research programs;
   - to improve monitoring and evaluation systems;
   - to guide SBAR management.

3. Organizing the implementation of the research strategy, formulating and implementing the research program, formulating an annual program, and forming multidisciplinary research programs to execute commodity and noncommodity research will be dealt with and recommended under policy, planning, and programming. Similarly, organizing resource management will be discussed later in the relevant section.

4. Efforts should be made to continuously improve the institutional mechanisms for linkages between SBAR and extension for joint planning and follow-up of research trials, especially on-farm trials; for identification of farmers' problems; and joint on-farm validation/verification trials. Resources should be allocated to carry out joint activities to foster the technology-adaptation and -transfer processes.

5. SBAR and the universities should identify mechanisms for collaboration and coordination of research activities.

6. Linkages between SBAR and regional and international research organizations should be strengthened. In addition to SBAR collaboration with ICARDA and ACSAD, SBAR should develop a program of collaboration for training, germplasm exchange, and executing joint research activities with international centers concerned with research on wheat, maize, sorghum, oil seeds, water management, and other relevant areas.

   SBAR should consider participating in regional intercountry research networks.

Research Resource Management

The management of human, physical (materials), and financial resources is one of the most important jobs of research managers. Managing these resources well is vital to maintaining the productivity of the agricultural research system, and hence to ensuring continuity of support from policymakers. The resource management challenge in agricultural research is particularly clear with regard to human resources since most national agricultural research systems spend more than 60% of their recurrent budgets on salaries.

Human Resources

Qualification and distribution: The SBAR and university system (faculties of agriculture and veterinary medicine) have 1167 professional staff (606 with Ph.D. degrees and 561 M.Sc. degrees); about half of them are at the two faculties of agriculture at the Universities of Baghdad and Mosul (Table 31; Figure 8).

In 1989, SBAR had a professional staff of 682, of which 70 were Ph.D.-holders, 141 had an M.Sc. degree, and 471 had a B.Sc., making the qualification index 0.31. These are assisted by 225 diploma-holders and 159 secondary school certificate-holders, making the total of professional and technical support staff 1066. The ratio of technical support staff to professional staff for 1989 was 0.56 (Table 32).

Table 31: Number of Scientists at SBAR and the Universities

Institution	Ph.D.	M.Sc.	Total
SBAR	70	141	211
Faculty of Agriculture, Baghdad University (FABU)	186	102	288
Faculty of Veterinary Medicine, Baghdad University (FVMBU)	87	89	176
Faculty of Agriculture & Forestry, Mosul University (FAFMU)	150	131	281
Faculty of Veterinary Medicine, Mosul University (FVMMU)	52	45	97
Faculty of Agriculture, Basrah University (FABasU)	61	53	114
TOTAL	606	561	1167

Note: SBAR in 1989; Universities in 1990.

About a quarter of the SBAR technical staff is at three provincial research departments and their stations, while the other three-quarters are at the SBAR headquarters and its outreach stations (Table 33).

The SBAR technical staff has grown during the eighties from 471 in 1983 to 1066 in 1989. Ph.D.- and B.Sc.-holders nearly doubled, and M.Sc.-holders increased by nearly fivefold during the same period (Table 32).

The total academic staff at the faculties of agriculture and veterinary medicine for the academic year 1990/91 was 356; about 56% of them are Ph.D.-holders and 44% have an M.Sc. (Table 34).

Scientists at SBAR are classified as agricultural engineers with a B.Sc. degree, and as researchers and senior researchers with M.Sc. and Ph.D. degrees. Academic staff at universities are classified as assistant teachers with an M.Sc. degree, as teachers with M.Sc. and Ph.D. degrees, and as assistant professors and professors with Ph.D. degrees.

Figure 8: Distribution of total Ph.D. and M.Sc. holders (n = 1167) (SBAR in 1989, Faculties in 1990)

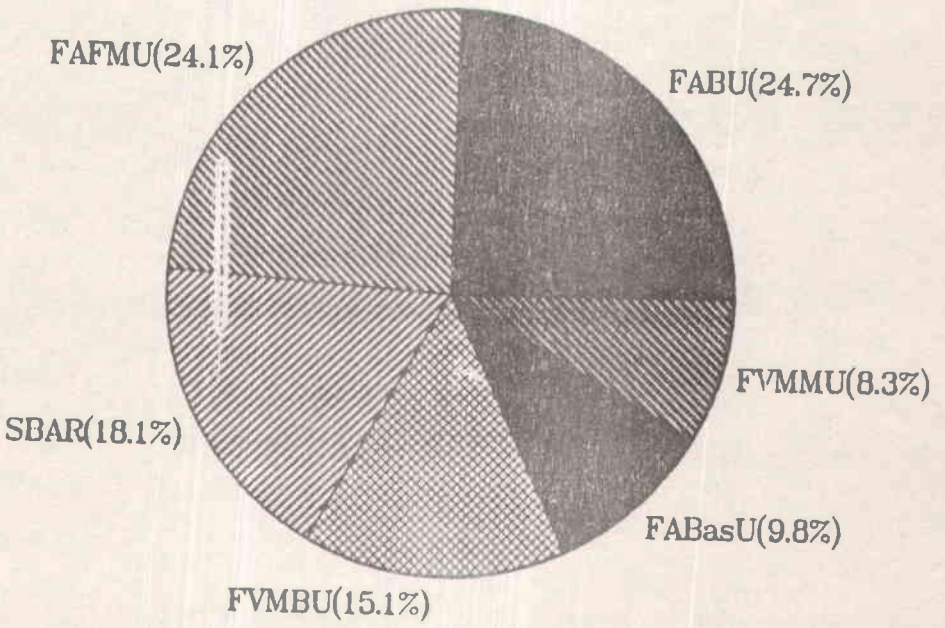


Table 32: SBAR Staff, 1983 - 1989

Year	Ph.D.	M.Sc.	B.Sc	Subtotal	QI	Diploma	Secondary	RTS	Total
1983	43	29	231	303	0.24	90	78	0.55	471
1984	46	28	295	369	0.20	128	108	0.64	605
1986	72	115	353	540	0.35	131	156	0.53	827
1987	65	131	386	582	0.34	210	154	0.62	946
1988	68	128	8	204	0.96	371	147	2.53	722
1989	70	141	471	682	0.31	225	159	0.56	1066

Note: QI (Qualification Index) = Ph.D. + M.Sc./Subtotal.

RTS = Ratio of Technical Support (Dip. + Second.) to Ph.D. + M.Sc. + B.Sc.

Table 33: Distribution of SBAR Technical Staff, 1989

Department	Ph.D. + M.Sc. + B.Sc. + Diploma
1. HQs + HQs outreach stations	
Field Crops Department and its stations	105
Plant Protection Department	45
Soil and Land Reclamation Department and its stations	248
Animal Resources Department and its station	76
Plant and Seed Certification Department	33
Drainage and Irrigation Department and its station	43
2. Provincial Research Departments and their stations	
Nenevah and its stations	204
Sulaimaniah and its stations	48
Al Ta'ameem and Al Dor and its stations	59
SUBTOTAL	861
3. Others including Horticulture and Forestry Department and its stations and SBAR Management	46
4. Secondary School Certificate Holders	159
TOTAL Technical Staff	1066

Table 34: Distribution of Academic Staff at the Colleges of Agriculture and Veterinary Sciences, Academic Year 1990/91

University	College	Professor	Assistant Professor	Teacher	Assistant Teacher	Total Academic Staff No.	Ph.D.	M.Sc.
Baghdad	Agriculture	20	103	112	53	288	186	102
	Veterinary Medicine	13	30	69	64	176	87	89
Mosul	Agriculture and Forestry	7	65	128	81	281	150	131
	Veterinary Medicine	3	17	44	33	97	52	45
Basrah	Agriculture	1	29	43	41	114	61	53
	TOTAL	44	244	396	272	956	536	420

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Conditions of service: Salaries of technical staff at SBAR are similar to salary scales in other sectors of civil service. Recognizing the special nature of research and its requirements in regard to qualification and experience, the Government has recently approved a financial incentive plan for SBAR research staff in the form of an allowance of 95% above their base salaries. However, this has not yet been implemented, and it is less than other incentive schemes already in operation for academic staff of similar qualifications at the university.

Training: In-service training of SBAR staff increased in the eighties both in-country and abroad. In 1989, 161 technical staffmembers attended training courses, 111 in-country and 50 abroad (Table 35). SBAR scientists also participate in scientific meetings. The average annual contribution in these meetings is 28 contributions/year for the period 1985-89.

For postgraduate degree training, the faculties of agriculture in the country trained most of the M.Sc. and few of the Ph.D. scientists at SBAR. The postgraduate training programs at the universities ensure that future vacancies at SBAR will be filled by scientists with the required training.

Table 35: In-service Training of SBAR Staff, 1983-1989

Year	No. of Trainees	
	In-country	Abroad
1983	-	6
1984	30	6
1985	8	7
1986	25	11
1987	106	15
1988	80	30
1989	111	50

Physical Resources

Stations and mandates: The consistency and quality of physical resources has a great influence on the quality of the research output. Thus, the physical resources available to agricultural research in the country have grown up during the last three decades in quantity and quality. Research stations have increased in number to cover almost all provinces and agroecological zones. During the eighties, the station network has

undergone reorganization several times. At present, SBAR has consolidated stations into smaller numbers and area. The station network includes the central research farm at Abu Ghraib, about 1750 ha in 1983 and reduced later to 250 ha. It is located close to SBAR headquarters. There are seven headquarters outreach stations and 10 stations for the provincial research departments of Neinevah, Sulaimaniah, and Al Ta'ameem and Al Dor. The location, affiliation, area and mandate of these stations are in Table 36.

The station network covers irrigated and rainfed systems with mandates to conduct multipurpose field and laboratory research -- commodity and non-commodity -- multi-commodity, one-commodity (rice), and non-commodity -- sand dunes and desertification, gypsisols, and drainage and irrigation.

The farm operations on the central research farm at Abu Ghraib are centralized in the office of the SBAR Director General. Farm operations in other stations are administered directly by the directors of the stations.

Lands: The total area available for field trials in the station network is about 1125 ha. The remaining area in these stations of about 2000 ha is for propagation of foundation seed. The land resources are irrigated and/or rainfed.

Buildings: New central laboratories, consisting of 150 air-conditioned and well-equipped rooms, were built in the late eighties at the SBAR central farm to house most of the central departments. They were physically located at a distance from each other because of their independent identity before the merger and establishment of SBAR in 1979. There are some laboratory buildings in the provincial research departments and outreach stations. New glasshouse facilities were also built in the late eighties: three units at SBAR headquarters and two units at the provincial research stations, one for the north and one for the south.

Equipment: While SBAR headquarters are well-equipped, outreach stations are inadequately equipped in terms of field and laboratory facilities.

Central support: Research support services include a statistics, data processing, and socioeconomic service unit, a centralized agricultural library and documentation center, maintenance of scientific instruments, and seed banks. SBAR lacks adequate central support services for researchers and the public; thus, there is a need to strengthen this kind of service to improve research output.

Financial Resources

Expenditures on agricultural research in the country are mainly public funds. Agricultural research institutions receive funds from the ordinary annual and development budgets. While the ordinary budget covers salaries of staff and direct and indirect operational costs, the development budget, covers specific research projects that make up part of the five-year research plan (Table 37). The five-year plan for 1986-90 allocated more than US$ 68 million to develop adequate staff and

Table 36: Location, Affiliation, Area, and Mandate of SBAR Research Stations

Location	Affiliation	Region	Mohafaza (province)	Area (ha)		Mandate
				Irrigated	Rainfed	
HQs						
Abu Ghraib	SBAR management	Central	The Capital	250	-	Multipurpose
Mishkhab	Field Crops Research Department	Central	Najaf	62		Rice
?	Field Crops Research Department					Field crops
?	Horticulture & Forestry Research Department					
Al Wahda	Soil & Land Reclamation Research Department					
Bijah	Soil & Land Reclamation Research Department		Salahdin			Sand dunes & Desertification
Al Raid	Drainage & Irrigation Research Department					Drainage & Irrigation
Al Shula	Animal Resources Research Department					
PROVINCIAL						
6 Stations	Neinevah Department of Agricultural Research	Northern	Neinevah			Multipurpose
Bakrajo	Sulaimaniah Department of Agricultural Research	Northern	Sulaimaniah		80	Multipurpose
3 Stations	Al Ta'ameem and Al Dor Department of Agr. Res.					Multipurpose

Table 37: Shares of Funds Allocated and Spent for Special Research Projects 1988 and 1989 (%)

Special Project	1988		1989	
	Share of total allocation	Spent within allocated share	Share of total allocation	Spent within allocated share
Soil and Water Research	11.3	100	10.7	100
Gypsisols	7.5	57	3.9	87
Plant Breeding and Seed Certification	28.2	35	15.7	65
Potato Production in Northern Iraq	5.2	14	2.9	8
Animal Resources	28.3	34	18.3	53
Entomology and Plant Pathology	11.4	87	3.4	29
Rainfed Land Development	5.3	56	3.9	52
Soil Fertility and Fertilization	1.5	68	2.4	26
Water Research Center (Establishment)	-	-	24.4	47
Water Balance Project	-	-	7.6	97
Vertical Drainage Project	-	-	6.6	36
TOTAL	98.7		99.8	
Average Spent		56		55

facilities for agricultural research. Annual recurrent expenditures on agricultural research in the country were estimated at about US$ 18 million in 1984, about 0.4% of AgGDP.

Data on operational costs to conduct on-station and on-farm trials are not available. However, in many national agricultural research systems, the salary costs are between 60%-70% of the total annual budget, sometimes even 80% or more in exceptional cases; while direct operational costs (including operational and experimental inputs) vary between 15%-35% of the total budget. The remaining 5%-15% is for overhead costs (indirect operational costs). These ratios are efficient if the budget level is high enough to pay good salaries to the research staff (50%-60% of the total budget) and still provide enough operational funds to use equipment efficiently, to conduct reliable on-station and on-farm experiments and studies, and to ensure the required mobility of staff.

External financial support to the research programs in the country is limited.

Recommendations

1. Planning and development of human resources should be organized for SBAR to review future program needs in terms of the various skills of research and research support staff.

2. Staffing, training, and career plans should be developed. Establishing such plans will assist research institutions in maintaining dedicated and efficient staff. Provisions for in-service training, including research management, sabbatical leaves, and attending research conferences, workshops, and seminars will also help in maintaining high-quality staff. In-service training programs should be developed for support staff in various fields of work.

3. Salaries and allowances for researchers at SBAR should be parallel to those of the academic staff of similar qualification and experience at universities.

4. In making decisions about type and number of stations, support services, and equipment, a fundamental consideration is long-term sustainability, of the country's resources. Therefore, the objective should be to maintain efficient and effective research consolidation and to regionalize research stations to serve agroecological and production systems rather than administrative provinces.

5. Centralized research support services should be established at SBAR headquarters. These would include the following:

   a) Improving the germplasm bank. The country is experiencing rapid modernization in agriculture with the consequent loss of traditional cultivars and wild plant genetic resources. Therefore, collection, conservation, evaluation, and documentation of genetic resources in the country should be a high-priority target.

b) Developing the SBAR library to become a central agricultural library and documentation center for the country. The flood of information and choices of systems and machines are reasons to centralize and strengthen a central agricultural library and documentation center.

c) Establishing three central laboratories at SBAR to serve researchers in implementing and interpreting the results of their experiments and studies and for public services. These would include a laboratory for routine chemical analysis of food, feed, pesticides, and fertilizers; a laboratory for experimental design, statistics and data processing; and a laboratory for soil testing and classification.

d) Establishing a central workshop for maintenance of scientific instruments. Researchers and managers frequently experience difficulties in identifying the correct scientific instruments to conduct research, instruments that are suitable and reliable. Often, when instruments are identified and purchased, frustration occurs when these instruments cannot be maintained. Thus, maintenance of expensive and sophisticated scientific instruments should be consolidated and centralized in this proposed central workshop.

6. A maintenance strategy should be developed by SBAR to maintain existing buildings, land, and all types of equipment.

7. Financial resources should be enough to conduct on-station and on-farm trials, and to purchase supplies needed for research.

Research Policies and Plans

Introduction

As mentioned earlier, agricultural development policies and goals in Iraq include:

- using water resources optimally;
- increasing agricultural production and productivity and achieving the projected level of self-sufficiency in some strategic food and feed commodities, e.g., wheat, barley, rice, oilseeds, vegetables, and animal products;
- intensifying agricultural in rainfed and irrigated land;
- generating employment for the rural population.

These policies and goals have implications for the agricultural research policies and the research program of SBAR and the university system. Broad responsibilities should be given to SBAR (see page 54) including:

- improving the varieties of various field crops suitable for different agroecological regions in the country;
- producing a nucleus certified seeds;
- inspecting and certifying seeds;
- improving animal production;
- improving production and productivity in a sustainable resource base;
- improving the use of land and water resources.

In implementing these responsibilities, emphasis has been given to plant breeding for developing wheat, barley, rice, maize, oil seeds, cotton, citrus, grapes, apples, onions, tomatoes, potatoes, and others, as well as for improved cultural practices and control of pests, diseases, and weeds. Emphasis has also been given to animal resources and to soil, irrigation, and land-reclamation research.

For example, as a result of research efforts, improved varieties of wheat, barley, rice, and maize have been introduced. Chemical control of date and date palm pests has increased production by 25%. Chemical seed dressing against fungal diseases of wheat and barley has increased yield by 30%.

Research Priorities and Five-Year Plans

Efficient planning helps researchers and research managers maintain the quality and relevance of the research program to the institution mandate and clients. The research institution is part of the government system which provides its financial resources; thus, program planning must be consistent with the goals and planning procedures of the government. National agricultural research institutions are generally finding themselves under increasing pressure to justify their requests for resources because of the increasing scarcity of funds and competing demand from

research and services within the agricultural sector as well as from other sectors. This competition, along with the uncertainty of returns to investment in many research activities, especially long-term ones, has increased the pressure to have a clear rationale for carrying out different research activities. Thus, agricultural research institutions have been requested to submit five-year research plans as a means of analyzing their response to these pressures as well as of improving research outputs to serve development in the country.

A scientific research strategy up to the year 2000 including agricultural research was prepared in 1980 by the Council of Scientific Research (CSR). The strategy in agricultural and water resources research focused on the following objectives:

- improving methods for developing, using, and sustaining renewable natural resources including soil and water;
- increasing production and yield and developing new technologies for modern agriculture;
- developing livestock and increasing its productivity;
- developing agricultural systems;
- developing human resources for agricultural production.

The second five-year plan for agricultural research, 1986-90, was supervised and coordinated by the CSR through a high-level committee chaired by the DG of AWRRC with representatives of SBAR, the faculties of agriculture and veterinary medicine, and the Ministry of Planning. The committee approved and distributed the responsibilities for each project to the research institutions. The plan was approved by "higher" authorities before implementation. The process consisted of:

- preparation of questionnaires for identification of constraints of agricultural production and research problems, preparation of a human resource inventory, and estimation of available research inputs;

- distribution of questionnaires to research institutions and research beneficiaries --- concerned ministries and offices, SBAR, faculties of agriculture and veterinary medicine, the private sector, and others;

- formulation of 13 specialized committees for field crops; horticulture and forestry; range and plant ecology; date palm and dates; crop protection; developing and improving ruminants; poultry; animal health; soil and land reclamation; agricultural mechanization; agricultural economics, extension and integrated rural development; and processing agricultural product;

- formulation of a coordinating committee consisting of a plan coordinator and 13 conveners of the specialized committees;

- twelve specialized seminars to identify research project proposals in the 13 research fields;

- preparation of the five-year research plan. The plan contained main principles, prospects, and criteria for research proposals and main commodities. The project proposals covered 12 areas consisting of legume crops (chickpeas, lentils, mash, groundnuts, and faba beans), industrial crops (sunflowers, rapeseed, tobacco, and sugarcane), date palm and dates, protected farming for vegetables and ornamentals, forage crops and range, animal production (ruminants and poultry), soil resources, agricultural mechanization, agricultural extension and integrated rural development, agricultural economics, and pricing and production policies, and agricultural product processing. It also included six special projects on jojoba plants, farming without soil, date palm mechanization, embryo transplanting, poultry breed stock, and integrated rural development in the Al Ahwar.

- planning of each research project was led by a coordinator with a Ph.D. degree and at least five years of experience in research and two or more published papers, or with an M.Sc. degree with at least 10 years of experience and five or more published papers. The planning at commodity level to identify specific detailed research problems was carried out by team members familiar with the commodity who were from different specializations and led by a selected team leader.

- each research project was documented with a code number covering the agricultural sector, institution, department (or center), research area, and project.

The problems and constraints encountered in answering the questionnaires consisted of researchers being reluctant to reveal their opinions, communication difficulties with researchers, inadequacy of transportation collect information, inadequacy of financial resources to cover seminar costs, and at the same time, researchers being burdened to fill in other prepared questionnaires for other purposes.

The five-year research plan, 1986-90, contained 167 projects, covering 1793 more specific and detailed research problems. The CSR and SBAR were responsible for implementing 65% of the projects and problems, and rest were the responsibility of the university system and other organizations. About 90% of the 1793 specific research problems were in six areas: animal production and health (466), soil and land reclamation (298), horticulture (274), field crops (228), plant protection (206), and date palm and dates (133).

Research thrusts in each area consisted of improving local breeds of cattle and sheep, by-products for animal feed, improvement of local poultry breeds, and evaluation of exotic poultry breeds in the area of animal production and health; micro-nutrients, fertilizer use, nitrogen fixation and use of groundwater and drainage water in the area of soil and land reclamation; improving local varieties of vegetables and fruits, selection of exotic varieties, and certifying vegetable seeds in the area of horticulture; improving local varieties, selection of exotic varieties, and studying cultural practices for wheat, barley, maize, rice, alfalfa, sunflowers, soybeans, and cotton in the area of field crops; surveying plant pests, conducting pesticide trials and biological control studies in the area of plant protection; and tissue culture propagation and improved cultural practices, including mechanization, in the area of date palm and dates.

Problems and constraints encountered during plan implementation included communication problems in coordinating research activities, frequent turnover of researchers, inadequate financial and human resources to implement research projects, and the liquidation of the CSR and its research centers.

Planning at SBAR

Each of the central and provincial research departments of SBAR has a "Department Scientific Committee" (DSC). The DSC is chaired by the head of the relevant department with memberships by chiefs of department units, project directors, and some experienced researchers.

After the formulation of the research project proposal by the researchers , it is presented by the project directors to the DSC for discussion and approval.

The approved project proposals are then submitted by the director of the department to the SBAR Scientific Committee (SSC), chaired by the DG of SBAR, for discussion and approval. The DG of SBAR submits the approved project proposals, which in aggregation form the annual and five-year plans, to MAI and MP for final approval and allocation of funds on an annual and five-year basis.

These steps are illustrated in Figure 9, which indicates the levels at which decisions are made and the information base upon which preparation and discussion of the project proposals depend. It is mainly a bottom-up research planning system where individual researchers work out their projects from the perspective of farming problems. The individual projects would be aggregated to match approximately with national needs. This planning system is also developed from top-down instructions from "higher" authorities and MAI, and suggestions from the DG of SBAR. It is guided neither by a national agricultural research policy and strategy, nor by long- and short-term research programs.

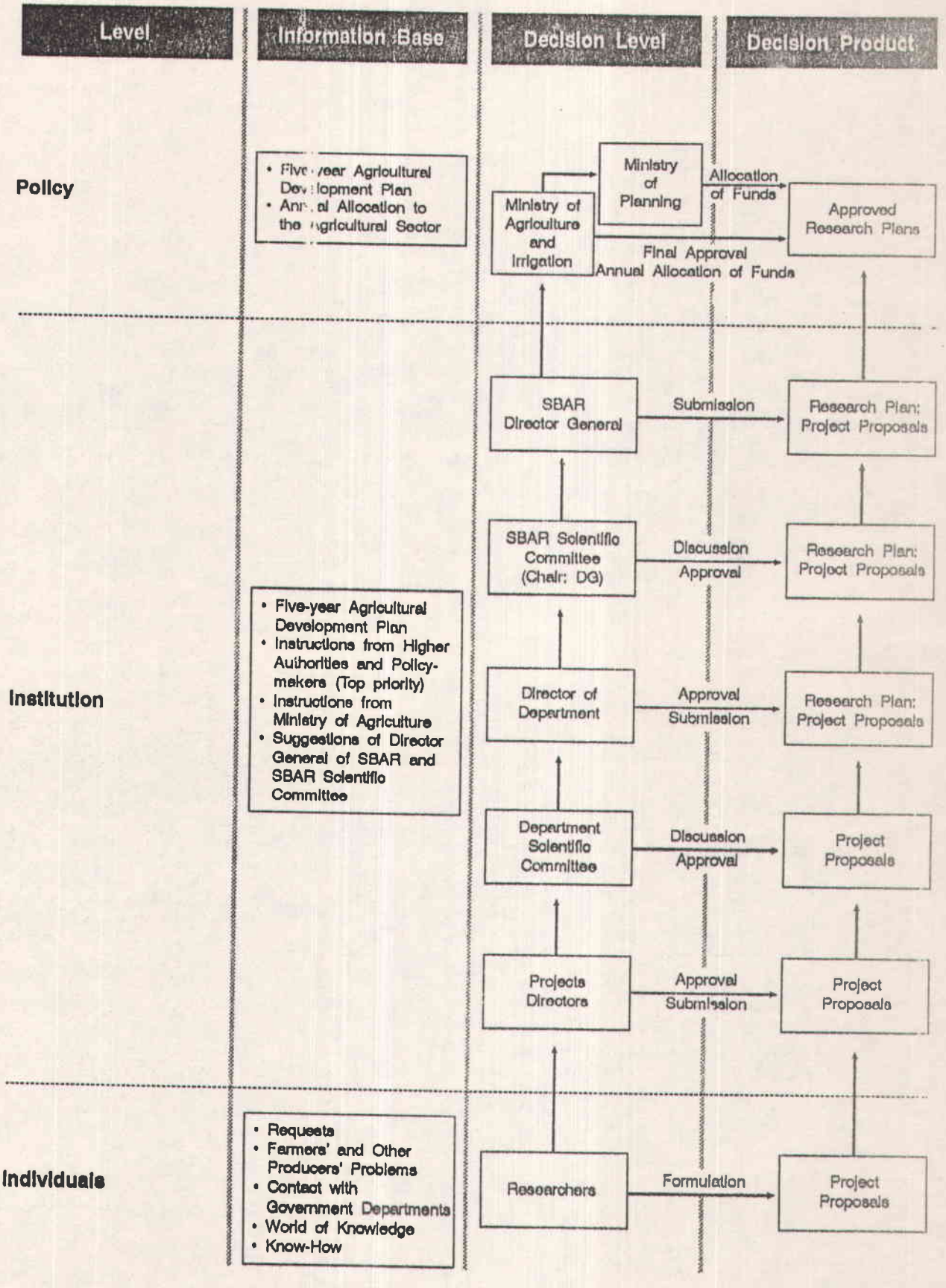
After the final approval of the annual and five-year research plans, funds are allocated to SBAR departments to be used under the supervision of research project directors.

Improving the Planning Process

Planning is a set of approaches that when followed, make research institutions more efficient and effective -- efficient in utilizing human, financial, and physical resources, -- and effective in tackling the main problems of agricultural development in the country.

The main task of research managers is to develop a research program relevant to the mandate of the research institution and to the beneficiaries of research results. Efficient planning helps in achieving this task.

Figure 9: Five-year and annual planning of research activities at SBAR



Two sets of five documents should be prepared through the program-planning process at the national and institution level.

The first set is concerned with *three* documents to be prepared for government planning and finance purposes, while the second set is concerned with *two* detailed programming documents to be prepared as operational plans for the research to be implemented to achieve its goals and objectives.

The preparation of the *first set*, the three government documents, is guided by two major government documents to prepare the planning documents of the research institute for financing its research activities. These documents include:

1. The national economic development plan which establishes the guidelines by which research institutions prepare and present to the government *strategic* and *five-year research plans* as parts of the agricultural development strategy and five-year plan, respectively;

2. the government procedures for resource allocations which guide research institutions in preparing and presenting their *annual program and budget* for support from the government.

The *second set* includes the preparation of:

1. *a long- and short-term research program plan* document, the preparation of which is guided by the national research strategy, world knowledge, and technical possibilities;

2. a detailed *annual research program* (action plan: experiments and study proposals), the preparation of which is guided by long- and short-term research programs, world knowledge of current results, and client circumstances.

The short-term research program will guide the preparation of the five-year plan for research to be submitted as part of the agricultural development plan, and the annual research program will guide the preparation of the annual budget (see Figure 10).

Research institutions in the country lack a national *agricultural research policy and strategy* to guide the preparation of *a detailed long- and short-term research program* covering research activities on which *five-year* and *annual plans* are prepared.

A proposal for SBAR to improve its planning process is given in Figure 10. The proposal calls for formulation of a national agricultural research policy and strategy and long- and short-term research program.

Nowadays science is considered more as "strategic opportunity." Such a perspective, emphasizing as it does the search for opportunities, leads to particular concern about the requirements of conducting research and the effective implementation of research priorities. With increasing demand to which research must respond, researchers can

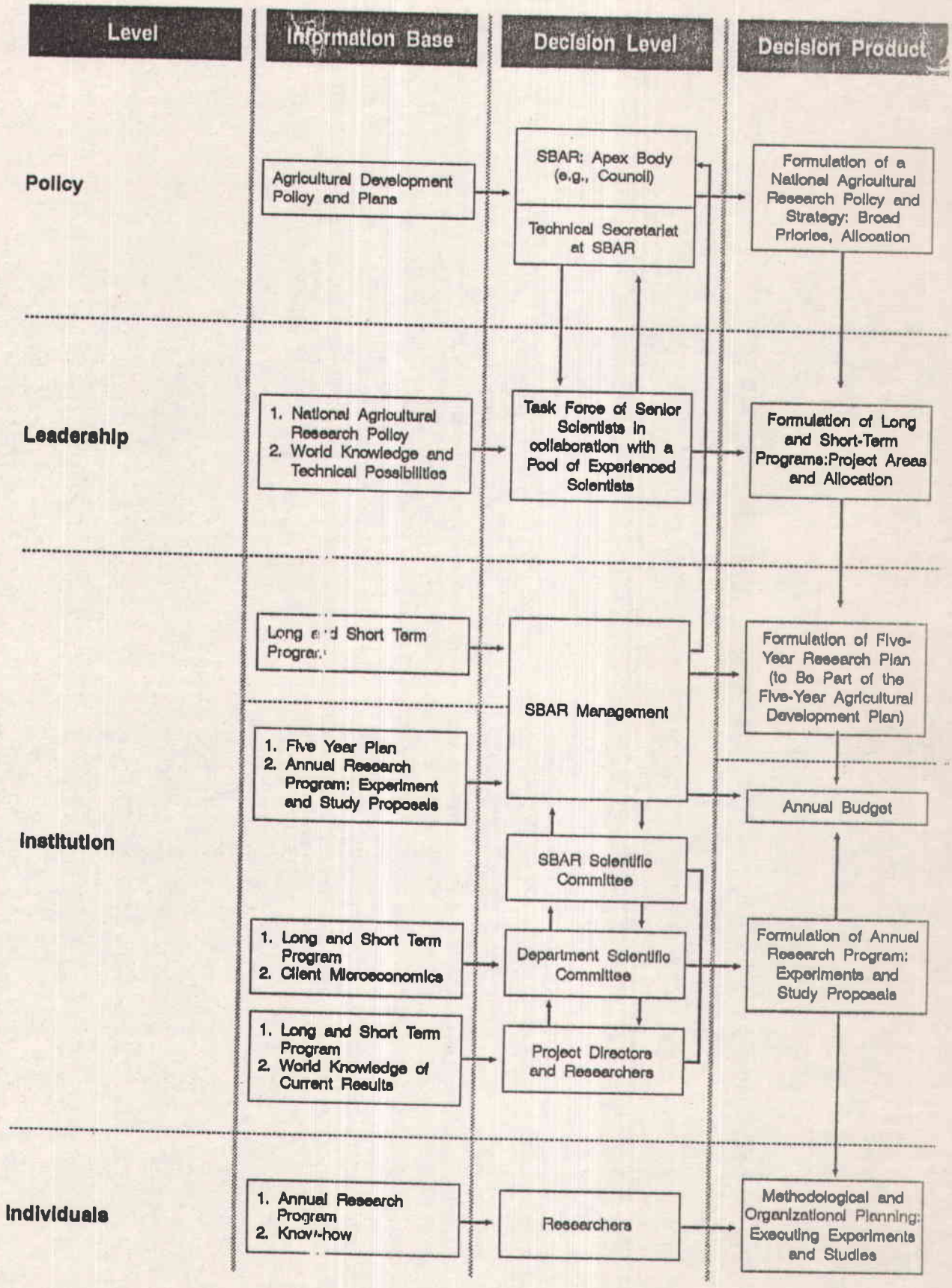
no longer afford to plan and manage it in a random manner. Thus, research has to be very closely tied to strategic business planning, i.e., "strategic opportunity" planning. In this approach, a national agricultural research strategy may be outlined and the budget allocated in accordance with priority choices determined by groups or committees.

The research choices in a strategic plan are distributed among types, kinds, duration, and areas of agricultural research.

Types of research could be classified as basic, strategic, applied, and adaptive research. *Kinds* of research include on-station, out-station, and on-farm research activities. *Duration* deals with the time span of research activity, which could be short-term -- less than one to five years -- or long-term -- more than five or 10 years. *Areas* of research cover commodity and noncommodity research. Commodity research on crops, forestry livestock, and fisheries is carried out to improve production and productivity through research on genetic improvement as well as production and protection factors. There is also post-harvest research which covers agricultural products transport, marketing, storage, processing, and human nutrition. Non-ommodity research covers ecology and natural resources as well as macro-level socioeconomic research.

Therefore, strategic options and a broad allocation of resources have to be determined in a time frame of 10-20 years. SBAR, through its proposed apex body (Figure 10), should take the lead in a strategic planning exercise to guide future research activities in the country. This exercise will be followed by a formulation of the long- and short-term research program in which research areas are identified and resources allocated to them.

Figure 10: Principles of formulating and implementing agricultural research strategy and program: A proposal for SBAR



Recommendations

1. The SBAR mandate or mission statement should be reviewed to include some critical points, such as:

   - SBAR is the sole national institution mandated to carry out agricultural research;
   - SBAR carries out commodity research -- crop (field, fruit, and vegetable), forestry, livestock, and fisheries -- and noncommodity research -- agroecological, natural resource (mainly soil and water) and socioeconomic -- to develop appropriate technologies;
   - SBAR contributes in the technology-transfer and adoption processes in the country.

2. To improve the planning process of agricultural research, a proposal to SBAR was developed. It includes the principles of formulating and implementing an agricultural research strategy and program. An organizational framework for decision making in the planning process was proposed.

3. Planning of agricultural research should not be driven by structural organization, but rather by functional organization. Thus, national commodity and noncommodity research programs should dictate the planning of research programs to facilitate multidisciplinary research within SBAR and between SBAR and the universities. Research programs to improve agricultural commodities could include improvement of cereals; industrial crops; oil seeds; forages and dry legumes; vegetables; fruit trees; date palm and dates; forestry; sheep, goats, and rangeland; cattle; and fisheries research programs. Noncommodity research programs of a macro-level nature could include agroecological zone characterization, irrigation and drainage, and macro socioeconomics.

Research Program Management

Implementing the Research Program

During the period 1983-89, SBAR has conducted a total of 2016 research projects. About three-quarters of these activities were in three areas: field crops, horticulture and forestry, and plant protection. Since 1987 new research areas -- soil and water -- have been assigned to SBAR, and old research areas, such as agricultural mechanization and natural pastures, have been terminated (Table 38).

Within the field crops research area, cereals research formed about 53%, followed by industrial crops (about 25%). Within overall research, cereals, as a commodity group, formed about 15% of the total research project during the same period (Table 39).

Regarding the animal resources area, research projects ranged from 18 to 30 projects per year. Sheep and poultry consisted of about 70% of total projects in this area (Tables 38, 39).

At the universities system, research activities are performed by academic staff and M.Sc. and Ph.D. students. Research carried out by postgraduate students, in partial fulfillment of obtaining a postgraduate degree, constituted 40%-50% of the total research conducted by the faculties of agriculture and veterinary medicine. About 60% of the total time of academic staff is devoted to research and other scientific activities; about half of this time is for research. For example, the faculties of agriculture and veterinary medicine of the University of Baghdad were assigned to implement 1427 and 429 research projects during the five-year research plan 1986-90, an average of 9.6 and 6.7 research projects per full-time equivalent researcher, respectively.

Initiation and implementation of research projects at the university is the responsibility of the academic staff members. Sometimes, research ideas are driven through government sources. Most university research results are published in scientific journals or presented in scientific meetings.

Research projects are implemented at SBAR under the supervision of relevant research project directors at headquarters and/or at agricultural research stations.

Teamwork: While teamwork has been achieved in preparing SBAR research projects for the five-year plan, it is poor at the implementation level. Implementation is restricted by institution, department, and unit structure boundaries within SBAR and between SBAR and the universities. It has been well documented that agricultural research achievements are normally the result of teamwork, where researchers from different disciplines are provided with the maximum opportunity for meeting, exchanging ideas, and working together. A good example of this is in the case of livestock production research. The animal in its environment, a combination of soil, climate and plant life, forms a complex whole of which none of the components can

Table 38: SBAR Research Projects Conducted during 1983-1989

Research Area	1983		1984		1985		1986		1987		1988		1989		Total	
	...	...	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Field Crops	48	28.4	80	27.3	128	39.4	58	20.9	56	15.6	91	27.9	111	41.7	572	28.4
Horticulture & Forestry	34	20.1	61	20.8	76	23.4	86	31.0	111	30.8	56	17.2	34	12.8	458	22.7
Animal Resources	18	10.6	30	10.2	20	6.1	30	10.8	29	8.1	34	10.4	23	8.7	184	9.1
Plant Protection	47	27.8	78	26.6	60	18.5	54	19.5	70	19.4	75	23.0	70	26.3	454	22.5
Soil	14	8.3	31	10.6	25	7.7	41	14.8	41	11.4	35	10.7	10	3.8	197	9.8
Gypsisols	-	-	-	-	-	-	-	-	16	4.4	10	3.1	2	0.7	28	1.4
Land Reclamation & Irrigation	-	-	-	-	-	-	-	-	15	4.2	20	6.2	14	5.3	49	2.4
Agricultural Mechanization	3	1.8	3	1.0	3	0.9	3	1.0	13	3.6	-	-	-	-	25	1.3
Plant & Seed Certification	3	1.8	9	3.1	10	3.1	5	1.8	9	2.5	5	1.5	2	0.7	43	2.1
Natural Pastures	2	1.2	1	0.4	3	0.9	-	-	-	-	-	-	-	-	6	0.3
TOTAL	169	100.0	293	100.0	325	100.0	277	100.0	360	100.0	326	100.0	266	100.0	2016	100.0

Table 39: Distribution of SBAR Research Projects between Commodities and Disciplines within Research Areas, and within Overall Research Activities for the Period 1983-1989

Research Area	Total Projects 1983-1989	Commodity/ Discipline	Within Research Area (%)	Within Overall Research (%)
Field Crops	571	Industrial crops	24.6	7.1
		Animal Feed & Beans	19.9	5.8
		Maize	17.3	5.0
		Wheat	16.0	4.7
		Rice	10.7	3.1
		Barley	9.4	2.7
		Others	2.1	
Horticulture & Forestry	458	Vegetables	29.7	10.1
		Forestry	44.6	6.7
		Fruits	25.7	5.8
Animal Resources & Health	184	Sheep	38.1	3.5
		Poultry	32.6	3.0
		Physiology	15.7	1.5
		Cattle	13.6	1.3
Plant Protection	454	Entomology	52.1	11.2
		Pathology	37.5	8.1
		Weeds	10.0	2.2
Soil, Gypsisols, Land Reclamation & Irrigation	271	Fertility & Nutrition	32.5	4.5
		Soil Management	21.5	3.0
		Reclamation & Irrigation	17.9	2.3
		Microbiology	17.9	2.3
		Gypsisols	10.2	1.4
Plant & Seed Certification	43	Botany	100.0	2.2
Agricultural Mechanization	25	Agricultural Mechanization	100.0	1.3
Natural Pastures	6	Range	100.0	0.3
Others				0.9
TOTAL	2016			100.0

5. research program management information.

Earlier, the first category was dealt with under central support services in the physical resources section, where it was recommended that a national agricultural library and documentation center be established.

Administrative and financial information are managed according to government procedures and regulations. However, use of modern information technology will assist research managers in dealing more efficiently with these types of information.

Technical information on research activities will assist researchers in monitoring, evaluating, and executing research activities.

Lack of information on research program management can be a major impediment to effective management of research programs. Research managers need to know exactly what experiments their researchers are doing, with which facilities, and at what costs. Without this type of information, research managers cannot perform, or improve, essential functions such as planning, programming, monitoring, and evaluation of agricultural research activities.

For improving the availability of technical information on research activities and research program management to researchers, research managers, and decision makers, modern information technology could be used successfully.

SBAR has a good recording system for keeping track of what funds are available and what research is being done, but these records are kept by different people at different locations and used for totally different purposes. SBAR has to be concerned about gathering diverse information to help improve planning, programming, monitoring, and evaluation of its research program. The product of the information-gathering exercise is called a management information system. It puts the various types of information required for research management into one system. This system relates budgets and personnel information to research activities.

Recommendations

1. SBAR should organize multidisciplinary teams to implement research programs, especially for commodity improvement, as well as for implementing research activities across departments within SBAR (intrainstitutional) and between SBAR and the universities (interinstitutional).

2. SBAR should increase the share of funding for on-farm trials to test and validate technologies and to conduct joint trials with extension.

3. An improved monitoring and evaluation system should be developed to monitor and evaluate research activities to make them more relevant and of higher quality to serve development processes. This system should be an integrated part of the research planning and implementation process and should include efficient periodic recording, analysis, reporting, and storage of data to be used for research management purposes.

4. An improved information technology system should be developed to improve management of research program information and management of technical information on research activities.