

**ORGANIZATION AND STRUCTURE
OF
ARAB NATIONAL AGRICULTURAL
RESEARCH SYSTEMS (NARS)**

by

Ghazi Hariri

ISNAR

International Service for National Agricultural Research

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ORGANIZATION AND STRUCTURE OF ARAB NARS

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ACRONYMS

AAAID	Arab Authority for Agricultural Investment and Development (Sudan)
AAFRA	Agriculture Affairs and Fish Resources Authority (Kuwait)
AAU	Arab Agronomists Union (Syria)
ACDRDCD	Arab Center for Desert Research and Desert Communities Development (Libya)
ACOLID	Arab Company for Livestock Development (Syria)
ACSAD	Arab Center for the Studies of Arid Zones and Dry Lands (Syria)
AERI	Agricultural Economics Research Institute (Egypt)
AFAA	Association of Faculties of Agriculture in Africa (Morocco)
AFCFP	Arab Federation of Chemical Fertilizers Producers (Kuwait)
AFESD	Arab Fund for Economic and Social Development (Kuwait)
AGFUND	The Arab Gulf Programme for United Nations Development Organizations (Saudi Arabia)
AIDO	Arab Industrial Development Organization (Iraq)
ALECSO	Arab League Educational, Cultural and Scientific Organization (Tunisia)
AOAD	Arab Organization for Agricultural Development (Sudan and offices in Algeria, Libya, Mauritania, Morocco, Egypt, Iraq, Jordan, Syria, and Yemen AR)
AOAS	Arab Organization of Administrative Sciences (Jordan)
API	Arab Planning Institute (Kuwait)
APRA	Animal Production Research Administration (Sudan)
ARA	Agricultural Research Authority (Yemen AR)
ARC	Agricultural Research Centre (Egypt)
ARC	Agricultural Research Centre (Libya)
ARC	Agricultural Research Corporation (Sudan)
ARC	Agricultural Research Centre (U.A. Emirates)
AREC	Agriculture Research and Extension Council (Yemen PDR)
ARI	Agricultural Research Institute (Lebanon)
ASMAE	Advanced School for Mediterranean Agronomic Engineers of the Saint Joseph University (Lebanon)
ASRT	Academy of Scientific Research and Technology (Egypt)
AUC	American University of Cairo (Egypt)
AUFI	Arab Union for Food Industries (Iraq)
AWRRC	Agriculture and Water Resources Research Centre, CSR (Iraq)
BCSR	Bahrain Center for Studies and Research
BIRH	Bureau de l'Inventaire des Recherches Hydrologiques (Tunisia)
BSRC	Biological Sciences Research Centre, CSR (Iraq)
CAAR	Committee for Arab Agricultural Research, AFESD (Kuwait)
CAEU	Council of Arab Economic Unity (Jordan)
CAFRAD	Centre Africain de Formation et de Recherches Administratives pour le Développement (Morocco)
CARS	Central Agricultural Research Station, Afgoi (Somalia)
CCSR	Central Corporation for Scientific Research (Yemen PDR)
CDA	Centre de Documentation Agricole (Djibouti)
CDIS	Centre de Documentation et d'Information Scientifique, NCSR (Lebanon)

CGP Commissariat Général à la Pêche (Tunisia)

CIP Centro Internacional de la Papa (Tunisia office)

CL Central Laboratories, MAF (U.A. Emirates)

CNCRAV Commission Nationale Consultative au Recherche Agronomique et Vétérinaire (Mauritania)

CND Centre National de Documentation (Morocco)

CNDA Centre National de Documentation Agricole (Algeria)

CNDA Centre National de Documentation Agricole (Tunisia)

CNERV Centre National d'Elevage et de Recherches Vétérinaires (Mauritania)

CNRA Centre National de Recherche Agronomique, INRA, El Harrach (Algeria)

CNRADA Centre National de Recherche Agronomique et de Développement Agricole (Mauritania)

CNROP Centre National de Recherche Oceanographie et de Pêche (Mauritania)

CNRZ Centre National de Recherche Zootechnique, INRA, Babar-Ali (Algeria)

CRGR Centre de Recherche du Génie Rural (Tunisia)

CRRA Centre Regional de la Recherche Agronomique, INRA (Morocco)

CSR Council of Scientific Research (Iraq)

CSRDA Scientific Council for Research and Development (Algeria)

CSRDA Conseil Supérieur de la Recherche dan le Domaine Agricole (Tunisia)

DA Department of Agriculture (Djibouti)

DAR Department of Agricultural Research (Bahrain)

DAR Directorate of Agricultural Research (Oman)

DAR Directorate of Agricultural Research (Saudi Arabia)

DAR Directorate of Agricultural Research (Somalia)

DASR Directorate of Agricultural Scientific Research (Syria)

DAWR Department of Agriculture and Water Research (Qatar)

DCB Directorate of Cotton Bureau (Syria)

DERV Direction de l'Enseignement de la Recherche et de la Vulgarisation (Tunisia)

DIWU Directorate of Irrigation and Water Uses (Syria)

DMERC Desert and Marine Environment Research Center, United Arab Emirates University (U.A. Emirates)

DPRC Date Palm Research Center, FASFKFU (Saudi Arabia)

DRE Department of Research and Extension (Yemen PDR)

DRES Direction des Ressources en Eau et en Sol (Tunisia)

DRFV Direction de la Recherche de la Formation et de la Vulgarisation (Algeria)

DRI Desert Research Institute (Egypt)

DRS Division de Ressources en Sols (Tunisia)

DS Directorate of Soils (Syria)

DYDCA Democratic Yemeni Documentation Centre for Agriculture (Yemen PDR)

EDICA Egyptian Documentation and Information Centre for Agriculture (Egypt)

EGRT Ecole de Génie Rurale et de Topographie (Morocco)

ENAL Egyptian National Agricultural Library (Egypt)

ENFI Ecole National Forestière d'Ingenieurs (Morocco)

ENFVA Ecole Nationale de Formulation et de Vulgarisation Agricole (Mauritania)

ENMV Ecole National de Médecine Vétérinaire (Tunisia)

ENSA Ecole National Supérieure d'Agronomie (Morocco)
 ENV Ecole Nationale Vétérinaire (Algeria)
 ESCWA Economic and Social Commission for Western Asia (Iraq)
 FAAISU Faculty of Agriculture, Ain Shams University (Egypt)
 FAALU Faculty of Agriculture, Alexandria University (Egypt)
 FAASU Faculty of Agriculture, Assiut University (Egypt)
 FAAU Faculty of Agriculture, Aleppo University (Syria)
 FAAU Faculty of Agriculture, Aden University (Yemen PDR)
 FAAUD Faculty of Agriculture, Aleppo University, Dierz Zor (Syria)
 FAAZU Faculty of Agriculture, Azhar University (Egypt)
 FABAU Faculty of Agriculture, Basrah University (Iraq)
 FABU Faculty of Agriculture, Baghdad University (Iraq)
 FACU Faculty of Agriculture, Cairo University (Egypt)
 FADU Faculty of Agriculture, Damascus University (Syria)
 FAFMU Faculty of Agriculture and Forestry, Mosul University (Iraq)
 FAFSAUB Faculty of Agriculture and Food Sciences, American University of Beirut (Lebanon)
 FAFU Faculty of Agriculture, Fayoum University (Egypt)
 FAFU Faculty of Agriculture, Al Fatah University, Tripoli (Libya)
 FAGYU Faculty of Agriculture, Gar Yunes University, Al Bida (Libya)
 FAJUST Faculty of Agriculture and Veterinary Medicine, Jordan University for Science and Technology (Jordan)
 FAKSU Faculty of Agriculture, King Saud University (Saudi Arabia)
 FAKU Faculty of Agriculture, Khartoum University (Sudan)
 FALU Faculty of Agriculture, Lebanese University (Lebanon)
 FAMAU Faculty of Agriculture, Mansoura University (Egypt)
 FAMOU Faculty of Agriculture, Monofia University (Egypt)
 FAMU Faculty of Agriculture, Minia University (Egypt)
 FAQU Faculty of Agriculture, Qualubeya University (Egypt)
 FASAGU Faculty of Applied Sciences, Arabian Gulf University (Bahrain)
 FASCU Faculty of Agriculture, Suez Canal University (Egypt)
 FASFKFU Faculty of Agricultural Sciences and Food, King Faisal University (Saudi Arabia)
 FASGU Faculty of Agricultural Sciences, Gezira University (Sudan)
 FASQU Faculty of Agriculture, Sultan Qaboos University (Oman)
 FASRC Federation of Arab Scientific Research Councils (Iraq)
 FASU Faculty of Agriculture, Sanaá University (Yemen AR)
 FATU Faculty of Agriculture, Teshreen University (Syria)
 FATU Faculty of Agriculture, Tanta University (Egypt)
 FAUAEU Faculty of Agricultural Sciences, United Arab Emirates University
 FAUJ Faculty of Agriculture, University of Jordan (Jordan)
 FAUS Faculty of Agriculture, University of Somalia (Somalia)
 FAVMKSU Faculty of Agriculture and Veterinary Medicine, King Saud University, Qassim (Saudi Arabia)
 FAZU Faculty of Agriculture, Zagazig University (Egypt)
 FCSHU Faculty of Cotton Sciences, Helwan University (Egypt)
 FNRESJU Faculty of Natural Resources and Environmental Studies, Juba University (Sudan)
 FRC Food Research Centre, ARC (Sudan)
 FRTD Foreign Relations and Technical Division, AGRIS National Center (Kuwait)

FS Facultes des Sciences (Tunisia)
 FSKU Faculty of Science, Kuwait University
 FVMALU Faculty of Veterinary Medicine, Alexandria University (Egypt)
 FVMASU Faculty of Veterinary Medicine, Assiut University (Egypt)
 FVMASUS Faculty of Veterinary Medicine and Animal Science, University of Somalia (Somalia)
 FVMBU Faculty of Veterinary Medicine, Baghdad University (Iraq)
 FVMBU Faculty of Veterinary Medicine, Baath University (Syria)
 FVMCU Faculty of Veterinary Medicine, Cairo University (Egypt)
 FVMFU Faculty of Veterinary Medicine, Al Fatah University, Tripoli (Libya)
 FVMKFU Faculty of Veterinary Medicine, King Faisal University (Saudi Arabia)
 FVMKU Faculty of Veterinary Medicine, Khartoum University (Sudan)
 FVMMU Faculty of Veterinary Medicine, Mosul University (Iraq)
 FVMZU Faculty of Veterinary Medicine, Zagazig University (Egypt)
 GARS Gezira Agricultural Research Station, ARC (Sudan)
 GEBTRC Genetic Engineering and Biotechnology Research Center, CSR (Iraq)
 GCC Gulf Cooperation Council (Saudi Arabia)
 HCR Haut Commissariat de la Recherche (Algeria)
 IAHKU Institute of Animal Husbandry, Khartoum University (Sudan)
 IAV Institut Agronomique et Vétérinaire Hassan II (Morocco)
 ICARDA International Center for Agricultural Research in the Dry Areas (Syria and offices in Tunisia, Egypt, Jordan, and Lebanon)
 ICRD International Centre for Rural Development (Egypt)
 IDB Islamic Development Bank (Saudi Arabia)
 IDRC International Development Research Centre (Egypt office)
 INA Institut National Agronomique (Algeria)
 INAT Institut National Agronomique du Tunis (Tunisia)
 INES Institut National d'Enseignement Supérieur (Blida, Tiaret, Batna, Mascara, Chlef in Algeria)
 INFS Institut National de Formation Supérieure (Algeria)
 INPV Institut National de la Protection des Végétaux (Algeria)
 INRA Institut National de la Recherche Agronomique (Algeria)
 INRA Institut National de la Recherche Agronomique (Morocco)
 INRA-EB Institut National de la Recherche Agronomique -- Executive Board (Morocco)
 INRA-TC Institut National de la Recherche Agronomique -- Technical Committee (Morocco)
 INRAT Institut National de la Recherche Agronomique de Tunisie (Tunisia)
 INRF Institut National de la Recherche Forestière (Algeria)
 INRF Institut National des Recherches Forestières (Tunisia)
 INSA Institut National de la Santé Animale (Algeria)
 ITCCMI Institut Technique des Cultures Maraichères et Industrielles (Algeria)
 ITAFV Institut Technique de l'Arboriculture Fruitière et de la Viticulture (Algeria)
 ITEBO Institut Technique de l'Élevage Bovin et Ovin (Algeria)
 ITDAS Institut Technique de Développement de l'Agronomie Saharienne (Algeria)
 ITGC Institut Technique de Grandes Culture (Algeria)

ITPE Institut Technique des Petits Elevages (Algeria)
 INSID Institut National des Sols, de l'Irrigation et du Drainage (Algeria)
 INSTOP Institut National Scientific et Technique d'Océanographie et de Pêche (Tunisia)
 IO Institut de l'Olivier (Tunisia)
 IOF Institute of Oceanography and Fisheries, ASRT (Egypt)
 IRA Institut des Régions Arides (Tunisia)
 IRRRI International Rice Research Institute (Egypt office)
 IRVT Institut de Recherche Vétérinaire de Tunisie (Tunisia)
 ISERST Institut Supérieure d'Etude et Recherche Scientifiques et Techniques (Djibouti)
 ITA Institut de Technologie Agricole (Algeria)
 ITAS Institut de Technologie d'Agriculture Saharienne (Algeria)
 KACST King Abdel Aziz City for Science and Technology (Saudi Arabia)
 KFAS Kuwait Foundation for Advancement of Science (Kuwait)
 KISR Kuwait Institute for Scientific Research
 LR Livestock Research, MLFR (Somalia)
 MA Ministry of Agriculture (Egypt)
 MA Ministry of Agriculture (Jordan)
 MA Ministry of Agriculture (Lebanon)
 MA Ministry of Agriculture (Somalia)
 MA Ministry of Agriculture (Tunisia)
 MAAR Ministry of Agriculture and Agrarian Reform (Morocco)
 MAAR Ministry of Agriculture and Agrarian Reform (Syria)
 MAAR Ministry of Agriculture and Agrarian Reform (Yemen PDR)
 MAF Ministry of Agriculture and Fisheries (Oman)
 MAF Ministry of Agriculture and Fisheries (U.A. Emirates)
 MAF Ministry of Agriculture and Fisheries (Yemen AR)
 MAI Ministry of Agriculture and Irrigation (Iraq)
 MANR Ministry of Agriculture and Natural Resources (Sudan)
 MAP Ministère de l'Agriculture et de la Pêche (Algeria)
 MAR Ministry of Animal Resources (Sudan)
 MARD Ministry of Agriculture and Rural Development (Djibouti)
 MAW Ministry of Agriculture and Water (Saudi Arabia)
 MFEP Ministry of Finance and Economic Planning (Sudan)
 MIA Ministry of Industry and Agriculture (Qatar)
 MLFR Ministry of Livestock, Forestry and Range (Somalia)
 MPW Ministry of Public Works (Kuwait)
 MRD Ministry of Rural Development (Mauritania)
 MSARC Marine Sciences Research and Resources Centre (Yemen PDR)
 MTA Ministry of Trade and Agriculture (Bahrain)
 NADC National Agricultural Documentation Centre, DASR (Syria)
 NCAD National Center for Agricultural Documentation (Jordan)
 NCARTT National Centre for Agricultural Research and Technology Transfer (Jordan)
 NCR National Council for Research (Sudan)
 NCSR National Council for Scientific Research (Lebanon)
 NI National Institutes (Algeria)
 NRC National Research Center, ASRT (Egypt)
 OMUAS Omar Al-Mokhtar University for Agricultural Sciences (Libya)
 PCSSR Popular Committee Secretariat for Scientific Research (Libya)
 PDRI Plant Diseases Research Institute, ARC (Egypt)

PPL	Plant Protection Laboratory, MAF (Oman)
PPRI	Plant Protection Research Institute, ARC (Egypt)
RAWRC	Regional Agriculture and Water Research Center, MAW (Saudi Arabia)
SARCQU	Scientific and Applied Research Centre, Qatar University (Qatar)
SBAAWRR	State Board for Applied Agricultural and Water Resources Research (Iraq)
SCR	Scientific Council for Research (Algeria)
SCS	Supreme Council of Sciences (Syria)
SCST	Supreme Council of Sciences and Technology (Jordan)
SDC	Scientific Documentation Center, CSR (Iraq)
SERC	Solar Energy Research Center, CSR (Iraq)
SVI	Serum and Vaccine Institute (Somalia)
SWL	Soil and Water Laboratory, MAF (Oman)
SWRI	Soils and Water Research Institute, ARC (Egypt)
TI	Technological Institutes (Algeria)
TRI	Tobacco Research Institute (Syria)
UAU	Union of Arab Universities
UCCIAAC	Union of Chambers of Commerce, Industry, and Agriculture for Arab Countries (Lebanon)
VRLA	Veterinary Research and Laboratories Administration (Sudan)
WRC	Water Research Centre (Egypt)

Chapter 1.

INTRODUCTION

The ways in which governments deal with research tend broadly to reflect how they deal with everything else. Thus, debating about how to organize agricultural research is dominated by more general political and administrative traditions and philosophies.

It is generally recognized that agricultural research is a creative activity. One that needs a different kind of organization and management culture, and that has to be fostered.

A national agricultural research system (NARS), in a broad sense, includes all those institutions involved in agricultural research in the country. The structure and organization of a NARS refer to the system's internal organizational structure, as well as to its external linkages with its environment. Through these institutional forms and mechanisms, human, physical, financial, and information resources are brought together to achieve certain outputs and goals.

Structure and organization relate to (a) the status of research service in terms of decision making and its role in formulating research policy and plans; (b) the relationships of research implementation units, including the coordination of activities and the formulation and implementation of research programs of wider interest with interinstitutional collaboration involving research station networks; (c) the communication of research outputs to various clients of research; (d) the authority and responsibility of scientists; and (e) the degree of complexity influencing communication within the structure.

Structure and organization also include the size of the system, the number and types of research institutions, their responsibilities and mandates, their relative degree of autonomy and control over decision making, their mechanisms for governance and resource acquisition, their division of labor, the patterns they follow in communicating and working with each other, the channels for information flow within the system, and the internal organization of research within individual institutions and research stations.

The purpose of this study is to assist in generating conscious reflection on and discussion of appropriate organizational patterns within the Arab NARS. This will, in turn, stimulate agricultural research to serve agricultural development.

The study is based upon experience gained through working with Arab countries and from available literature. There is value in comparing the organizational pattern in one country with that in another, despite the fact that what works in one environment will not necessarily work in another. However, comparative analysis can disclose institutional arrangements that may be worth modifying and adopting.

The approach taken in this study seeks to impose a framework for comparison. The basis of the framework is to identify certain functions that are likely to be required by all agricultural research organizational patterns for stimulating agricultural research to serve development. It should also consider how those functions are performed in each country. One can examine the type of research institutions and their structural diversity, responsibilities in research policy formulation and implementation, research program formulation and implementation, organizational linkages of the implementation units, and autonomy and control of implementation units.

Chapter 2.

GEOGRAPHIC, DEMOGRAPHIC AND AGROECOLOGICAL CHARACTERISTICS
OF ARAB COUNTRIES: AN OVERVIEW

The Arab countries are geographically widespread and demographically and economically diverse (Table 1).

Arab countries may be classified in four geographic subregions:

- a. North Africa: Algeria, Libya, Mauritania, Morocco, and Tunisia;
- b. Nile Valley and East Africa: Djibouti, Egypt, Somalia, and Sudan;
- c. Fertile Crescent: Iraq, Jordan, Lebanon, and Syria;
- d. Arabian Peninsula: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, U. A. Emirates, Yemen AR, and Yemen PDR.

Populations range from 0.3-2 million for Bahrain, Kuwait, Mauritania, Oman, Qatar, and the U. A. Emirates; 2-10 million for Jordan, Lebanon, Libya, Somalia, Tunisia, Yemen AR, and Yemen PDR; to 10 - 50 million for Algeria, Egypt, Iraq, Morocco, Saudi Arabia, Sudan, and Syria (Table 1). Per capita gross national product (GNP) ranges from less than US\$ 1000 for Egypt, Mauritania, Morocco, Somalia, Sudan, Yemen AR, and Yemen PDR; US\$ 1000-US\$ 2000 for Jordan, Syria, and Tunisia; to more than US\$ 2000 for Algeria, Bahrain, Kuwait, Libya, Oman, Qatar, Saudi Arabia, and U. A. Emirates.

Arable lands vary from about 1-4 thousand hectares for Bahrain, Djibouti, Kuwait, and Qatar; 17-47 thousand hectares for Oman and U. A. Emirates; about 200-400 thousand hectares for Jordan, Lebanon, Mauritania, and Yemen PDR; to more than one million hectares for Algeria, Egypt, Iraq, Libya, Morocco, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, and Yemen AR (Table 1).

The agricultural share of the gross domestic product (GDP) ranges from 1-2 percent for Bahrain, Kuwait, Qatar, and U. A. Emirates; 2-10 percent for Algeria, Djibouti, Jordan, Lebanon, Libya, Oman, and Saudi Arabia; 10-30 percent for Egypt, Iraq, Mauritania, Morocco, Sudan, Syria, Tunisia, Yemen AR, and Yemen PDR; and more than 40 percent for Somalia.

Rainfed areas account for about three-quarters of the total cropping area. There is substantial variation in rainfall between years as well as between areas. The limits of agricultural land have been reached in all countries, except in Sudan where the quality of most land reserves is relatively inferior. Therefore, agricultural production in the region is constrained by land and water resources. Increases in production can come about essentially through yield, cropping intensity, and increases in irrigated areas. This implies higher use of improved technologies, more intensive use of land (particularly reduced fallow) and an increase in harvested irrigated areas.

Cereals cover the largest area in the region. The two main cereals are wheat and barley. The yield of cereals is very low and amounts to only 1.12 tons/hectare. The use of new technology could increase yields of wheat, barley, and sorghum by up to 70 percent.

Table 1: Regional Profile

Country	Population		Land				Basic Economic Indicators					
	Total Population 1985 (1000's)	% Agricultural Population 1985 ***	Arable Land and Permanent Crops (1000's ha)	Irrigated Land (1000's ha)	Rainfed Land (1000's ha)	1985	GDP Million U.S.\$ 1984	Agricultural % GDP 1984	GDP ***	GNP/ Capita 1984 US\$	Ag. Imports 100000 U.S. \$ 1984 **	Ag. Exports 100000 U.S. \$ 1984 **
North Africa												
ALGERIA	21718	26.31%	7610	338	7272		41035	9.64%		2410	20631	479
LIBYAN ARAB REP.	3605	14.46%	2127	234	1893		31113	2.40%		8520	12395	na
MAURITANIA	1888	67.06%	195	8	187		661	30.41%		450	1149	331
MOROCCO	21941	40.89%	8401	523	7878		12144	16.66%		670	8740	3101
TUNISIA	7081	29.12%	4923	215	4708		6942	15.23%		1270	5242	1447
sub-Total	56233	35.57%	23256	1318	21938		91895	14.87%		2664	48157	5358
Nile valley and East Africa												
DJIBOUTI *	354	40.11%	1	1	0		535	7.65%		NA	737	na
EGYPT	46908	43.05%	2486	2486	0		43975	19.91%		720	38961	7520
SOMALIA	4653	72.95%	1071	180	891		1201	49.29%		260	1657	503
SUDAN	21550	65.89%	12478	1700	10778		6920	29.61%		360	2429	6038
sub-Total	73111	55.50%	16035	4366	11669		52631	26.62%		447	43784	14061
Fertile Crescent												
IRAQ	15898	24.49%	5450	1750	3700		40915	11.65%		NA	27034	260
JORDAN	3515	7.85%	418	43	375		3434	8.42%		1570	6312	1352
LEBANON	2668	11.64%	300	86	214		2382	8.86%		NA	6032	1368
SYRIAN ARAB REP.	10505	27.46%	5623	652	4971		19142	19.86%		1620	7809	4109
sub-Total	32586	17.86%	11791	2531	9260		65873	12.20%		1595	47187	7089

Table 1: Regional Profile

Arabian Peninsula										
BAHRAIN *	400 (1984)	19.29%(1984)	3	3	0	5191	1.08%	10470	2777	130
KUWAIT	1811	1.64%	3	1	2	21707	1.43%	16720	11996	1253
OMAN	1242	45.10%	47	41	6	8724	2.96%	6490	4178	315
QATAR	315	2.19%	4	0	4	7356	0.82%	19810	2622	na
SAUDI ARABIA	11542	43.78%	1175	415	760	96265	2.94%	10530	52778	942
UNITED ARAB EM.	1327	3.46%	17	5	12	28118	1.31%	21920	9497	1235
YEMEN, ARAB REP.	6848	65.82%	1351	247	1104	3358	20.76%	550	4694	117
YEMEN, P.D.R.	2137	36.31%	167	62	105	822	13.02%	550	2727	100

sub-Total	25222	27.20%	2764	771	1993	166350	5.54%	10880	88492	3962
Total	187152		53846	8986	44860	376214		1187	226883	30470

Sources:

Population: ISNAR Database, Supplementary files. Compiled from FAO

Land: ISNAR Database, Supplementary files. Compiled From FAO tapes and Production Yearbook 1986, Vol. 40.

Finances: Gross Domestic Product: Unified Arab Economic Report, 1986 (Factor Cost)

GNP per Capita: World Development Report, 1986

Imports and Exports: FAO Trade Yearbook 1986, Vol. 40

Note: * Population and Land figures for Djibouti and Bahrain (1984) AOAD's yearbook of Agricultural Statistics, 1986

** Import/Export data quoted as current U.S. \$ by FAO

*** sub-Totals represent regional averages

In the early eighties the production of vegetable oil increased annually by 1.1 percent, while yields fell from 1.38 to 1.25 tons/hectare. Sugar production, from both cane and beets, increased annually by 5.7 percent with a rise in yield from 5.54 to 5.32 tons/hectare.

Livestock products are consumed in the region at a higher per capita level than in other developing countries. Increases in livestock productivity are also important. These increases are expected to come from improvement of carcass weight, herdsize and increases in the off-take rate. The shift to intensive livestock production will allow lower inputs to go for maintenance and more for productivity, and will also reduce the dependence on the fragile grazing resources on the steppes and marginal lands.

Production increases in wheat, feedstuffs, and livestock are dependent upon using the scarce water resources more efficiently and in combination with other inputs in order to raise both yields and cropping intensity.

In conclusion, the Arab region's food security situation has been affected by the persistent decline in its self-sufficiency during the seventies and eighties. The severe instability of agricultural production, especially in rainfed farming, and reliance on world markets to fill the gap in the region's food and feed deficits, call for a major effort to improve food- and feed-supply management systems. The deficits are particularly important in cereals (food and feedstuffs), vegetable oils, sugar, and livestock products.

Self-sufficiency in the main commodities of the region is the lowest among major regions of the world, and does not exceed 55 percent. Half of the agricultural import bill goes for cereals, two-thirds of which is wheat.

Each country will have to decide for itself what the most efficient way of ensuring food security is: increased self-sufficiency through domestic production, increased trade, or reliance on food aid where freely available. Obviously, the decision will affect the goals of the research system in terms of commodities, regions, and classes of farmers that it targets. Increased food self-sufficiency will involve research, extension, and input costs which must be balanced against the benefits of reduced dependency. At the same time, it may affect the balance of resources devoted to irrigated versus rainfed areas, the particular crops that are emphasized, and the employment that will be generated. The research system should be in a position to respond to these needs.

Chapter 3.

AGRICULTURAL RESEARCH INSTITUTIONS

3.1 Number and Type of Agricultural Research Institutions

It is important that we begin to define the institutions that form the national agricultural research system in the country. In a broad sense the NARS consists of all those institutions carrying out agricultural research in various fields in the country. These institutions are often diverse and are distributed in various government and nonprofit institutions -- noneducational and educational -- commercial institutions having close links with agribusiness, development projects with research components, and nonprofit regional and international research institutions having their headquarters or offices in the country under consideration (Table 2).

For practical purposes, the core of the NARS to be dealt with in this study is restricted more to nonprofit government institutions which are funded to generate improved production technologies to provide support to the government agricultural development programs and to the need of farmers.

3.2 Historical Background and Development

Historically, an agricultural research service was established in many Arab countries to focus on a relatively small number of export crops, such as cotton in Egypt (1897), Sudan (1902), Syria (1952), and Yemen PDR (1955); wheat in Syria (1920s); datepalm in Iraq; and vines in Algeria. During the past 30 years, a number of Arab countries have made significant progress in agricultural research, while others are in their early stages of development.

In tracing the historical background of national agricultural research in the region, certain organizational similarities in the stages of development become apparent. Agricultural research has developed through three stages.

- a. In the early stages a department of agriculture was first attached to one of the existing ministries. The department was chiefly concerned with agricultural services -- regulatory, control, and development programs -- and rarely undertook true research work, although it may have been responsible for a few minor trials with introduced crops and new varieties. In two countries, research was initiated by private or semi-independent agricultural societies. In Egypt, the erstwhile Royal Agricultural Society commenced its first research work in 1897 at Giza in cotton pest problems. Research in Sudan began in 1902 almost exclusively on cotton in the Gezira Scheme.

That a thriving agricultural industry was of paramount importance for economic expansion became increasingly clear to the countries of the region, and it was not, therefore, long before the department of agriculture was upgraded to a ministry, enjoying fully independent

Table 2 : Number and Type of Agricultural Research Institutions in the Country

Country	Government and Nonprofit Institutions		Commercial Institutions	Development Projects with Research Comp.	Regional/ International Institutions
	Noneducational	Educational			
Algeria	INRA, INRF, IT*, IN*	INA, ENV, INES, ITA, ITAS, INFS	++	++	AOAD office
Libya	ARC, ACDRDCD	FAFU, FAGYU, FVMFU, OMUAS	++	++	AOAD office
Mauritania	CNRADA, CNERV, CNROP	ENFVA	+	++	AOAD office
Morocco	INRA	IAV, ENSA, EGRT, ENFI	+++	++	AFFA, CAFRAD, AOAD office
Tunisia	INRAT, CRGR, INRF, IO, IRA, DRS, BIRH, IRVT, INSTOP	INAT, ENMV, FS	++	++	ALECSO, ICARDA office, CIP office
Djibouti	DA, ISERST		+	+	
Egypt	ARC, WRC, DRI, NRC (ASRT), IOF (ASRT)	FAASU, FAFU, FAAISU, FAALU, FAMU, FACU, FASCU, FAAZU, FAMAU, FAMOU, FAQU, FATU, FAZU, FCSHU, FVMALU, FVMASU, FVMCU, FVMZU, AUC	+++	++	ICRD, IDRC office, ICARDA office, IRRI office, AOAD office
Somalia	DAR, LR	FAUS, FVMASUS	+	++	
Sudan	ARC, APRA, VRLA, NCR	FAKU, FVMKU, FASUG, IAHKU, FNRESJU	+++	+++	AAAIID, AOAD
Iraq	SBAAWRR, CSR** (AWRRC, BSRC, SERC, GEBTRC)	FABU, FAFMU, FAFARMU, FVMBU, FVMU	++		AUFI, FASRC, ESCWA, AIDO, AOAD office
Jordan	NCARTT	FAUJ, FAJUST	+++	+++	CAEU, AOAS, UAU, ICARDA office, AOAD office
Lebanon	ARI	FALU, FAFSAUB, ASMAE	+++		ICARDA office, UCCIAAC
Syria	DASR, DS, DIWU, DCB, TRI	FADU, FAAU, FAAUD, FATU, FVMBU	++	++	ACSAD, ICARDA, AOAD office, ACOLID, AAU
Bahrain	DAR, BCSR	FASAGU	++		
Kuwait	KISR, AAFRA	FSKU	++		AFESD, AFCFP, API, CAAR
Oman	DAR	FASQU	++	+	
Qatar	DAWR	SARCQU	++		
Saudi Arabia	RAWRC, DAR, KACST	FAKSU, FAVMKSU, FASFKFU, FVMKFU	+++	++	GCC, AGFUND, IDB
U.A. Emirates	ARC	FAUAEU	+++		
Yemen AR	ARA	FASU	++	+++	AOAD office
Yemen PDR	DRE, MSARC	FAAU	+	++	

Intensity and type of NARS involvement: + Insignificant, ++ Significant, +++ Highly significant.

* ITAFV, INPV, INSA, ITGC, ITCMCI, ITEBO, ITPE, ITDAS, INSID.

** Cancelled in late 1989.

status. For example, the Department of Agriculture in Egypt was established in 1910 as part of the Ministry of Public Works to conduct research, produce seeds, and extend agricultural information on field crops, especially cotton, to Egyptian farmers. The Ministry of Agriculture in Egypt was established in 1913. Similarly, in Syria the Department of Agriculture was part of the Ministry of Economics until the forties when the new Ministry of Agriculture was established. At the present time, with the exception of Bahrain, Kuwait, and Qatar, where agricultural land resources are limited, all Arab countries possess a ministry of agriculture.

- b. In the second stage of advance, most countries established a separate department (or sections within departments) for agricultural research within the existing organizational structure of the ministry. It was at this stage that an expansion in the number of research stations took place, and institutions commenced to formulate their own research programs, based on what they believed to be the most urgent problems requiring solutions. This stage of research development frequently lacked reliable data on climate, vegetation, and soils, and it was not integrated with any national research policy designed to meet the overall requirements of agricultural development. In general, it was directed towards tackling the emergency situations that are bound to a rise in the production of valuable export crops.
- c. The third stage of research organization was achieved when some form of organizational arrangements were introduced to promote research and gear it to government policy and an agricultural development plan. Most Arab countries have now reached this stage. In this stage, there is a tendency for small systems to include agricultural research as a separate department (or sections within departments) within the ministry of agriculture while large systems tend to have a large number of institutions involved in research.

Despite recent efforts to improve the efficiency and effectiveness of agricultural research in the region, Arab NARS are highly fragmented and difficulty in coordination among them is a common problem. While there is a tendency to see structural change as the solution to problems of coordination, or as a means of stimulating new activities, there is often a failure to understand how complicated organizational change can be and to recognize the usefulness of improved management tools in achieving the same ends. In many cases, the desired objective may be obtained through better approaches to strategic planning, program formulation, and program budgeting rather than through the restructuring of organizations.

3.3 National Investments and Human Resources for Agricultural Research

The share of agricultural research investment in total agricultural investment in many Arab countries for which data are available has been around two percent or less (Oram, 1988). According to FAO/UNDP (1984), there is likely to be an insufficient flow of new technology if this figure is under 10 percent.

There are inconsistencies among Arab countries in how much of their agricultural GDP is spent on research. The ratio of research expenditure to agricultural GDP is low (excluding Qatar) -- between 0.06 percent and 0.72 percent with an average of 0.36 percent (Table 3).

NARS Indicators

Table 3: National Agricultural Research Resources: expressed as 1980-1985 average

COUNTRY	(1) Personnel	(2) Ag.Res. Expd.	(3) Ag.Res.Expd. per capita	(4) ARI	(5) Qualification Index
North Africa					
ALGERIA	305	NA	NA	NA	0.45
LIBYAN ARAB REPUBLIC	NA	NA	NA	NA	NA
MAURITANIA	12	0.50	NA	0.26	0.92
MOROCCO	225	25.21	112	0.72	0.26
TUNISIA	116	14.43	102	0.68	0.06
Nile valley and East Africa					
DJIBOUTI	NA	NA	NA	NA	NA
EGYPT	4246	36.52	10	0.44	0.50
SOMALIA	26	0.32	9	0.06	0.10
SUDAN	198	13.68	75	0.33	0.83
Fertile Crescent					
IRAQ	542	NA	NA	NA	0.31
JORDAN	62	1.58	26	0.40	0.55
LEBANON	NA	NA	NA	NA	NA
SYRIAN ARAB REPUBLIC	217	6.59	26	0.10	0.13
Arabian Peninsula					
BAHRAIN	NA	NA	NA	NA	NA
KUWAIT	8	NA	NA	NA	1.00
OMAN	42	NA	NA	NA	0.83
QATAR	7	1.54	220	4.54	0.14
SAUDI ARABIA	171	NA	NA	NA	0.53
UNITED ARAB EMIRATES	12	1.24	104	0.49	0.83
YEMEN, ARAB REPUBLIC	58	9.77	145	0.17	0.52
YEMEN, P.D.R.	66	2.36	34	NA	0.51

SOURCES:

1) Personnel and Agricultural Research Expenditures:

Pardey, P.G. and J. Roseboom. "Agricultural Research Indicator Series: A global data base on national agricultural research systems". International Service for National Agricultural Research, The Hague (unpublished draft version, 1988)

2) Agricultural Gross Domestic Product (AgGDP):

UN. "Gross Domestic Product by Broad Economic Sector." Office for Development Research and Policy Analysis of the United Nations Secretariat Mimeo, 1988.

DEFINITIONS:

NARS Indicators

- (2) **Agricultural Research Expenditures (in millions of 1980 US\$)**
Agricultural research expenditures were first deflated into constant 1980 local currency units using an implicit GDP deflator (UN, 1988) and then converted into 1980 US \$ using PPP over GDP indices from Summers & Heston (1988)
- (3) **Agric. Res. Expds. per scientist = Ag.Res.Expds/Personnel (in 1000's 1980 US\$)**
- (4) **ARI (Agricultural Research Intensity Ratio) = Ag.Res.Expenditures/AgGDP (in percent)**
- (5) **Qualification Index: PhD+MSc/Total Scientists**
inclusive of expatriate personnel - assumed to hold a higher degree

By comparison, the average spending for agricultural research for the period 1980-85 in 52 developing countries was 0.94 percent, and in 18 industrial market countries it was 2.17 percent of agricultural GDP (ISNAR, 1988). The FAO/UNDP (1984) recommends a level of at least 1.0 percent; and the World Bank (1981) has suggested a target of 2.0 percent of Agricultural GDP for all developing countries by 1990. Thus, Arab countries, excluding Qatar, are investing an average of 0.36 percent, which is about half of the recommended FAO/UNDP ratio.

The average expenditure per scientist in Arab countries is about US\$ 19.5 thousand. This figure drops to about US\$ 12.2 thousand in large systems: Egypt, Sudan, and Syria, where perhaps there is a need to increase expenditures per scientist rather than simply adding more staff to a system, which is probably significantly underfinanced (Table 3). Countries having small to medium-sized systems -- as in the North Africa Subregion -- are spending more per scientist. In this case, raising their staff numbers at existing levels of expenditure per scientist might be what is needed. In other countries, such as Somalia, data show that it should increase spending on agricultural research in general as well as per scientist, and that it could probably increase the number of its national staff over time.

Despite the existence of universities with faculties of agriculture and veterinary medicine (Table 2), there are still shortages of scientists as well as inadequate training. In a few countries, such as Jordan, Sudan, and Egypt, over half of the scientific staff at research institutions have M.Sc. and Ph.D. degrees (Table 3). The high qualification index in Mauritania, Kuwait, Oman, Saudi Arabia, U. A. Emirates, and Yemen is attributed to the presence of expatriates.

Countries such as Egypt, Sudan, Jordan, and Iraq, where there is no shortage of Ph. D.-holders have become exporters of scientists to the Arabian Peninsula. The latter countries are heavily dependent on expatriate researchers, mainly from Egypt and Sudan, and during the last decade they have established their own faculties of agriculture to train national scientists. However, Bahrain, Kuwait, and Qatar, where agricultural land resources are limited, depend on foreign training for their national scientists.

Chapter 4.

ANALYTICAL APPROACH OF ORGANIZATION AND STRUCTURE
OF NATIONAL AGRICULTURAL RESEARCH SYSTEMS (NARS)

Organizations provide a context for the managerial functions needed to transform research inputs into the desired outputs. These managerial functions are interrelated, as are the organizational mechanisms used at different hierarchical levels of the research system and/or institutions.

Therefore, in analyzing organizational options, the various interactions and possible trade-offs between different organizational characteristics will be examined. Because such trade-offs differ from country to country -- and even change within one country with the evolution of research policy and strategy, functional needs, and country circumstances -- attention will also be given to environmental conditions that facilitate or hinder organizational performance.

In doing this, and in undertaking cross-country comparisons, the analysis will seek to explain the diversity of experience in the Arab NARS in terms of underlying generic analytical procedures. It might then be possible to understand which organizational options work well, which do not, under what conditions, and why.

The Arab NARS reviewed represent a wide range of organizational arrangements -- size, complexity, type of structures and mechanisms used, etc. The analysis is intended to help explain why certain structures facilitate or hinder the performance of such managerial and linkage functions as research institution governance, policy formulation and strategic planning, program planning, programming, implementation, monitoring, and evaluation. The purpose is not to explain the diversity of Arab NARS, but to synthesize lessons of experience for future use by Arab NARS leaders.

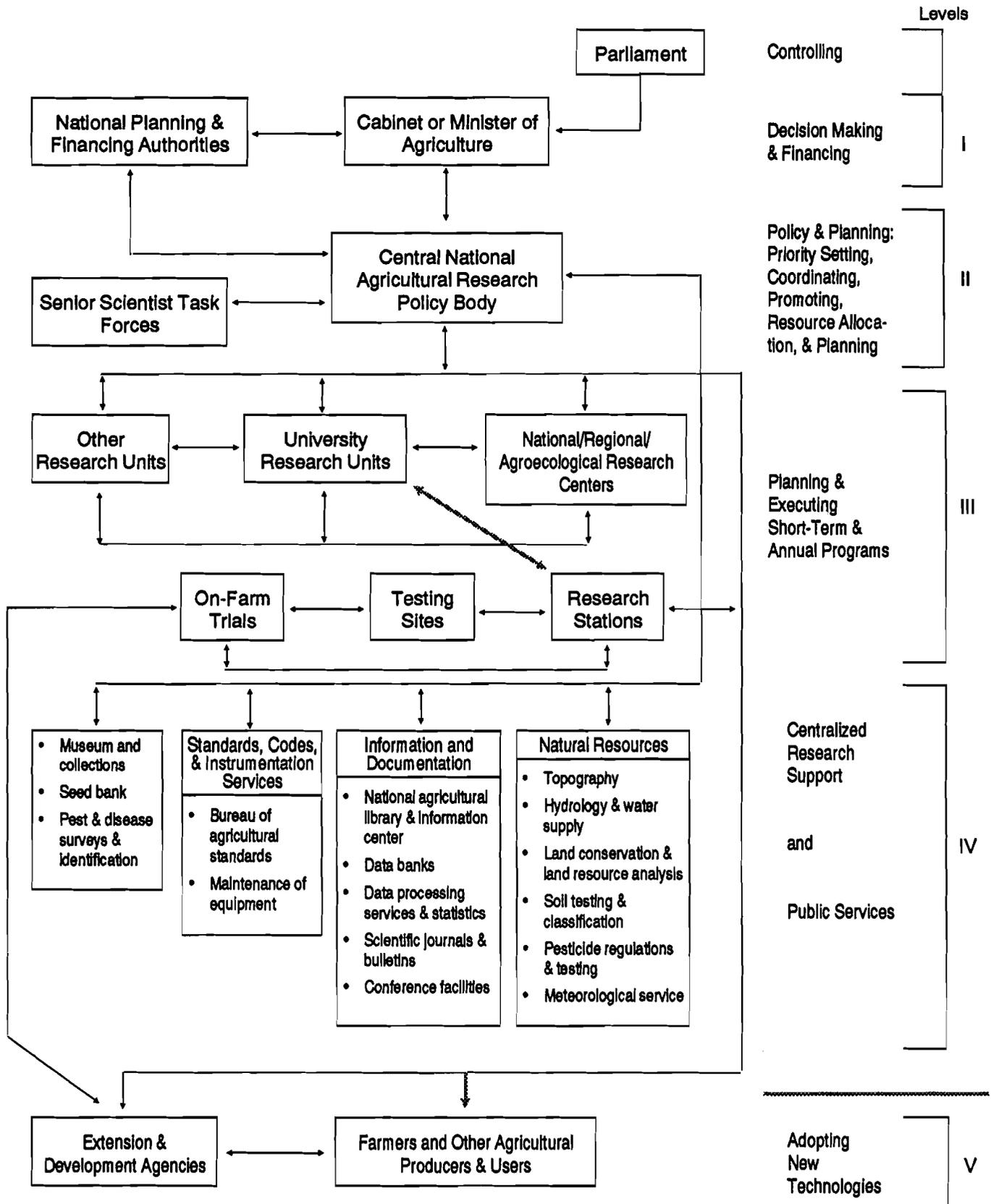
A number of key managerial functions have been identified as study areas. The study will try to answer questions such as where the managerial functions are carried out at national, institutional, and implementation unit levels. What are the specific management functions? How are they implemented (methodological means) and by whom (organizational devices)? Various alternatives to answer these questions are listed in Table 4. For implementing these various alternatives, Figure 1 provides structural responsibilities for formulating research policies, plans and programs; for providing centralized support and public services, and for adopting new technologies. Both Table 4 and Figure 1 will be utilized as the framework for this study.

Table 4: Undertaking Research Management Functions at National, Institutional and Implementation-Unit Levels

<u>Where</u>	<u>What</u>	<u>How</u>	<u>By Whom</u>
Level	Management Functions	Methodological Means	Organizational Devices
National	Securing political, financial, and human resources	<ul style="list-style-type: none"> . Information exchange . Coalition building . Ensuring external accountability for use of funds 	<ul style="list-style-type: none"> . Apex body: Board/Council, National Committee . Ministry . Semi-autonomous institution . Some combination of above . Each institution independently
	Determining policy and strategy, approving long-term research plan	<ul style="list-style-type: none"> . Political processes . Socioeconomic studies . Analysis of technical potential . Assessment of availability of research resources 	<ul style="list-style-type: none"> . Apex body . Technical committees(s) . Ad hoc task forces
	Organizing for implementing policy, strategy, and long-term research plan	<ul style="list-style-type: none"> . Assigning responsibility . Interinstitutional coordination . Ensuring accountability of research institutions 	<ul style="list-style-type: none"> . Apex body . Committee . Task force
	Supervising implementation	<ul style="list-style-type: none"> . Reporting mechanisms for monitoring and evaluation, and annual programming . Periodic review of organizational performance 	<ul style="list-style-type: none"> . Ministry dept. . Secretariat to apex body . Standing committees . Planning unit

Level	Management Functions	Methodological Means	Organizational Devices
Institution	Research programming	<ul style="list-style-type: none"> . Identification of production problems . Setting objectives . Assessing scientific potential, resource availability, and researchability . Setting priorities . Approving annual programs 	<ul style="list-style-type: none"> . Institution management . Research managers . Research committee
	Organizing research and supervising implementation	<ul style="list-style-type: none"> . Assigning responsibilities to implementing units . Coordinating between implementing units . Reporting mechanisms for monitoring and evaluation, and annual programming 	<ul style="list-style-type: none"> . Institution management . Research managers . Program leaders . Multidisciplinary teams
Implementation units	Formulation of annual programs	<ul style="list-style-type: none"> . Assessment of scientific potential, resource availability and researchability . Setting priorities . Preparing study proposals and experiments 	<ul style="list-style-type: none"> . Unit management . Researchers . Multidisciplinary teams
	Implementation of studies and proposed experiments	<ul style="list-style-type: none"> . Experimental design . Conducting research . Data collection . Analysis . Interpretation of results . Dissemination of results . Reporting to higher management 	<ul style="list-style-type: none"> . Researchers . Technical and support staff . Extension staff

Figure 1. NARS Structural Responsibilities for Formulating Research Policy, Plan, and Program; Providing Centralized Research Support and Public Services; and Adopting New Technologies



Chapter 5.

ANALYSIS AND DISCUSSIONS OF ORGANIZATIONS AND
STRUCTURE OF NARS IN ARAB COUNTRIES

5.1 NARS Structural Diversity

In terms of diversity at the national level, the focus is on what researchers and managers of agricultural research institutions are trying to achieve. Therefore, one of the main criteria for analyzing the structural diversity of Arab NARS has been the coordination of planning and programming of research efforts to support national agricultural development.

Three different types of coordination between agricultural research institutions can be distinguished: atomistic behavior, low coordination, and high coordination.

Atomistic behavior is characterized by the absence of any explicit framework for coordination between research institutions. Any interaction is of the incremental type achieved through partisan mutual adjustments.

Low coordination is characterized by the attempt to apply rational-technical criteria to agricultural research policies. Coordinated policies are arrived at by induction from the initiatives of individual research institutions. These institutions set their plans in motion and only then discuss with each other the rationality of pursuing all their plans independently of one another.

High coordination is characterized by the attempt to ensure not only that resources are used according to rational-technical criteria, but that they are used to optimum effect in terms of overall national agricultural development objectives. This approach involves setting systemwide goals for agricultural research by inference from these national agricultural development objectives. Lower-level agricultural research objectives are in turn inferred from those agricultural research systemwide goals.

In conclusion, low coordination is a "bottom-up" process, while high coordination is "top-down".

By applying these coordination types to agricultural research institutions in the Arab countries, five structural models can be identified: pluralist, financing, coordination, financing and coordination, and centralized administrative.

In the pluralist model, resources are made available directly to the various research institutions of various ministries and universities. The overall national agricultural research budget becomes the sum of the research institution budgets. In this model, formal coordination between various research institutions is low or absent. It is characterized by the tendency to ignore long-term research planning. Therefore, research budgets are easily sacrificed in times of budgetary stringency.

The financing model is similar to the pluralist model except that various research institutions belong to one ministry where a centralized research budget is allocated, but determination and implementation of research programs are carried out independently by each research institution. In both the pluralist and financial models, research efforts are highly fragmented and difficulty in coordination among the entities is a common problem.

In the coordination model, the various research institutions determine and implement their research programs independently but there is an emphasis upon national scientific research policies, including agricultural research. For this reason, there are central advisory bodies that form links both between ministries and between the ministries and institutions. The greatest limitation is that their role is strictly advisory.

The financing and coordination model aims at achieving a consensus among the various ministries, and a coordinating body may prepare the decisions to be finalized by a ministerial committee. There is a science budget under which the various ministerial research programs can be assessed and decisions on expenditure, both short-term and long-term, taken.

In the centralized administrative model, the budgetary resources for national agricultural research are provided as a single package through a central authority. This approach calls for central resource allocation and decision making and detailed planning, but for research planning and implementation to be decentralized. It has the advantage of facilitating a total policy for national agricultural research activities, which 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 has the disadvantage that resource availability in a particular field is determined by bargaining and compromising between claimants at a high political level. Nevertheless, the centralized administrative model ensures high coordination in the determination and implementation of national agricultural research policies.

Table 5 summarizes the main conclusions that can be drawn to fit this theoretical approach. Most Arab NARS fall into the pluralist model, where independent determination of research programs by each research institution in the country is practiced. This model, as mentioned earlier, is characterized by the tendency to ignore long-term research planning. On the other hand, the central administrative model, which is characterized by central resource allocation and decision making and detailed planning, has been adopted by either small systems (such as Yemen AR and Yemen PDR) or by large systems (as is the case in Morocco for INRA research).

In Libya, steps to centralize resource allocation and planning at the national level for both ARC and faculties of agriculture were recently adopted. These steps have led to an integration of ARC's programs and staff with those of the faculties of agriculture.

Table 5 : NARS Structural Diversity

Country	Pluralist Model	Financing Model	Coordination Model	Financing and Coordination Model	Centralized Administrative Model
Algeria Libya Mauritania Morocco Tunisia		MA		HCR*	ARC CNCRAV INRA-EB, INRA-TC
Djibouti Egypt	ARC, WRC, DRI, ASRT, Universities	MARD			
Somalia Sudan	ARC, MAR, NCR, Universities	MA, MLFR MAR**			
Iraq	SBAAWRR, AWRRC, Universities		CSR*		
Jordan	NCARTT, Univerities		SCST		
Lebanon Syria	ARI, Universities	MAAR			
Bahrain	DAR, University, BCSR				
Kuwait Oman Qatar	DAR, Univeristy DAWR, University				KISR*
Saudi Arabia U.A. Emirates	RAWRC, DAR, Universities ARC, Univeristy			KACST*	
Yemen AR Yemen PDR					ARA DRE

Pluralist Model: Independant determination of research program by each research institution.

Financing Model (no coordination): A centralized research budget for the ministry research institutions, without coordination in the determination and implementation of research programs.

Coordination Model (low coordination): Independent determination of research program by each research institution, with a central advisory body to link and advise on national research policies.

Financing and Coordination Model (low coordination): Achievement of consensus of the wishes of various research institutions, with a coordinating body and a centralized research budget.

Centralized Administrative Model (high coordination): Central resource allocation and decision making and detailed planning, but decentralized implementation of research activities.

* Various fields of scientific research.

** For APRA and VRLA.

KISR, in Kuwait, is undertaking applied research in various fields, including agriculture. It is an autonomous public research institute. The responsibilities of the board of trustees were expanded in 1981 to include the coordination of science and technology policy.

In Iraq, where fairly radical organizational changes in the agricultural research establishment have taken place in recent years, the State Board for Applied Agricultural Research of the Ministry of Agriculture was the main body responsible for agricultural research. The Board was formed in 1979 from an amalgamation of other institutes. However, it seems that the government was already dissatisfied with the performance of research as part of the Ministry of Agriculture and therefore implemented further changes. In 1987 it transferred responsibility for leadership of agricultural research to the Council of Scientific Research (CSR). Nevertheless, independent determination of research programs by each research institution is still the main approach.

In Jordan, where SCST was established in 1988 to direct, coordinate, and finance scientific research, the NCARTT is in the process of preparing a national agricultural research strategy to be submitted to SCST for approval. It is intended that the strategy will improve research coordination in the country.

5.2 NARS Structural Responsibilities for Research Policy Formulation and Implementation

Formulating research policy is a key step in translating the objectives of national agricultural development into research programs. Effective mechanisms are needed for making difficult decisions regarding research strategies and priorities. The lack of clearly formulated research policies and plans often results in fragmented research programs that are only superficially linked to agricultural development objectives.

In Table 4, five management functions concerning policy formulation and implementation are identified. In considering these functions as processes to translate national agricultural development objectives to research programs in Arab NARS, various organizational devices are identified and listed in Table 6.

5.2.1 Securing political, financial, and human resources

In most Arab countries, the ministry of agriculture and other relevant ministries are the main sources of government support for agricultural research (Table 6). However, in countries where the apex bodies -- board or council of agricultural or scientific research -- are at ministerial or cabinet levels, support for research is associated with the activities and mandates of these bodies.

These bodies vary from boards of autonomous/semi-autonomous research institutions to councils of scientific research at the national level (Table 7).

5.2.2 Determination of research policy and long-term plan

In general, there are no long-term research strategies and plans in Arab countries. National research strategies and plans are formulated to

Table 6 : NARS Structural Responsibilities for Research Policy Formulation and Implementation

Country	Securing political, financial, and human resources at national level by	Determining policy and strategy at national level by	Determining long-term research plan at national level by	Organizing and supervising implementation at national level by	Implementing institution	Plan horizons (Years)
Algeria	HCR, CSRDA, MAP	HCR, CSRDA, MAP	INRA, DRFV	INRA, DRFV	INRA, NI, TI University Units	5
Libya	ARC Board, PCSSR	ARC Board	ARC Board	ARC Board	ARC, Universities	
Mauritania	MRD, CNCRAV			CNCRAV	CNRADA, CNERV	
Morocco	INRA-EB, MAAR	INRA-EB, INRA-TC	INRA-TC	INRA, IAV	INRA, IAV, others	5
Tunisia	MA			DRES, DERV, CGP	Various Institutions	5
Djibouti	MARD				DA	
Egypt	MA, ASRT	ARC Board, ASRT Board	ARC Board, ASRT Board	ARC, NRC	Various Institutions	5
Somalia	MA, MLFR				Research Stations	
Sudan	MANR, MAR, MFEP, NCR			ARC, APRA, VRLA	ARC, APRA, VRLA, Univers.	
Iraq	MAI, CSR	CSR		SBAAWRR, AWRCC	SBAAWRR, AWRCC, Universities	5
Jordan	MA, SCST	NCARTT Board, SCST	NCARTT Board	NCARTT	NCARTT, Universities	5
Lebanon	MA, NCSR	ARI Board	ARI Board	ARI	ARI, Universities	5
Syria	MAAR, SCS				DASR, DS, DCB	5
Bahrain	MTA			DAR	DAR, BCSR, University	
Kuwait	KISR Board, KFAS, MPW	KISR Board	KISR Board	KISR	KISR, AAFRA, University	5
Oman	MAF			DAR	DAR, University	5
Qatar	MIA				DAWR, University	
Saudi Arabia	MAW, KACST	MAW, KACST	DAR, RAWRC	DAR, RAWRC	DAR, Universities KACST, RAWRC	5
U.A. Emirates	MAF			ARC	ARC, University, DMERC	
Yemen AR	MAF	ARA Board	ARA Board	ARA Board	ARA	5
Yemen PDR	MAAR, CCSR	AREC, CCSR	DRE	DRE	DRE Centers, University	5

match the country's five-year development plan, and are the sum of research proposals by scientists.

In some countries, five-year strategies and plans are published to guide research studies and experiments, e.g., Egypt (ARC and ASRT five-year plans), Yemen AR (ARA five-year plan), etc. However, in 1987 Tunisia, with ISNAR's assistance, developed a long-term research plan (10-15 years' perspective). Discussions, approval, and implementation of this plan are underway.

In Morocco, while INRA-EB determines the broad lines of INRA's research strategy, the INRA-TC determines the detailed policy and formulates the five-year research plan (Table 6).

5.2.3 Organizing and implementing research policies and plans

Organization and implementation of research policies are conducted by research institutions. However, organization of research policies in Algeria, Tunisia, and Yemen PDR is the responsibility of the concerned directorates at the ministry level, while in Libya and Yemen AR it is the responsibility of the boards (Table 6).

5.2.4 Structure of policy boards

It is very well known that effective boards make effective institutions. The effectiveness with which the board's trust is fulfilled depends on the standing and credibility of the board vis-a-vis the professional research managers and the confidence placed in it by the government. Regarding the structure and composition of boards, there are five possible options (see Fernandes, 1986):

- * No board: the top management of the institution is entrusted to a single individual. This option may appear attractive because it allows speedy decisions, unhindered by the laborious discussions and delays involved in board meetings, and it pinpoints responsibility. But it has the danger of placing far too much authority and responsibility on one person. It does not allow for the participation of top management. It makes the sole controller vulnerable to illegitimate pressure. This option can at best be employed in a transitional stage.

- * A wholly external board: all members of the board, except the managing director of the research institution (ex-officio), are outsiders. They are not employed by the institution and are not responsible for specific management functions of the institutions. This option provides for the nomination of external professionals with mature experience who can provide a second opinion and guide the professional managers within the institution. It allows for the inclusion of interest groups such as farmers' unions, government agencies (extension, planning, finance, etc), environmental groups, academics, private business, etc. Such an external group, unbiased by day-to-day management problems, can objectively assess performance. The major drawback of this option is that the board members bear no direct responsibility for management, and it is possible that they can be manipulated by an aggressive and skillful managing director.

Table 7 : Structure of NARS/Institute Policy Boards

Country	Board		No Board	Wholly External Board	Wholly Internal Board	Two-tiered Board	Composite Board
	NARS Level	Institute Level					
Algeria	SCR***						
Libya	ARC						ARC
Mauritania	CNRADA, CNERV			CNCRAV			
Morocco	INRA			INRA*			
Tunisia	CSRDA						CSRDA
Djibouti			DA				
Egypt		ARC					ARC
Somalia							
Sudan		ARC		ARC**			
Iraq		AWRRC, SBAAWR		AWRRC, SBAAWR			
Jordan	NCARTT			NCARTT			
Lebanon	ARI			ARI			
Syria			DASR, DS, DCB, DIWU				
Bahrain			DAR				
Kuwait	KISR***			KISR			
Oman			DAR				
Qatar			DAWR				
Saudi Arabia			DAR				
U.A. Emirates			ARC				
Yemen AR	ARA			ARA			
Yemen PDR	AREC						AREC

No Board: Single individual is top manager.

Wholly External Board: Outsider members and managing director (ex-officio).

Wholly Internal Board: Full-time directors of senior staff positions.

Two-tiered Board: A supervisory board of outsiders, and operational board of insiders.

Composite Board: A blend of outsiders and insiders.

* Director of INRA attends meetings with a consultative status.

** Outside members; director general is the chairman; his deputies are members.

*** Scientific research fields including food and agriculture.

- * A wholly internal board: the board is composed entirely of full-time directors (insiders) who hold senior staff positions in the research institution. The managing director of the institution is the chairman. This option ensures professional competence, establishes a direct link between authority and responsibility, provides for participative management, and provides an atmosphere of incentive, involvement, and motivation. The main problem of this option is that it is too inbred. It does not provide exposure to a second opinion; it makes no room for representation of relevant interests and concerned government institutions.

- * A two-tiered board: this is an attempt to combine the wholly external and the wholly internal options.
 - At the higher policy-making level, a supervisory board composed of outsiders, structured on the lines of the wholly external board option.
 - At the operational level, a management board composed of the institution's managers, structured on the lines of the wholly internal board option.The managing director presides over the management board and is a member of the supervisory board, thus providing a link between the two bodies.

This option provides a balance between participative management and the rigours of external control. Problems, however, arise when this option is put into operation, principally in the demarcation of the authority and responsibility between the two boards. The filtering of decisions through two levels may also create bureaucratic delays. In practice, it is likely that one of the boards will usurp power, making the other only a nominal body.

- * A composite board: this board is composed of a judicious blend of insiders and outsiders. From within the institution, the board includes the managing director and the senior managers. From outside, the board includes experts chosen for their professional experience and familiarity with research problems, as well as selected representatives of interest groups and concerned government ministries. This option would appear to provide most of the answers. It has the advantage of a two-tiered board with the additional merit that it secures cohesion and unity of command.

The composition of the boards of research institutions in Arab NARS is shown in Table 7.

5.3 Research Program Implementation Units

5.3.1 Organizational structure of implementation units

Although the agricultural research organizations in the region have evolved in similar ways, their final form now differs widely from country to country.

They may be classified into three major categories:

- * Model I, The Ministry Department Model: research is conducted by one or more specialized departments under one or more ministries.
- * Model II, The Research Institute, Center, Corporation, or Authority Model: research is conducted by one or more semi-autonomous research institutions.
- * Model III, A combination of the first two: research is conducted simultaneously by a ministry or ministries and semi-autonomous research institutions.

According to the presence of research divisions within or outside the research department or semi-autonomous institutions, models I and II may be again each classified into three sub categories:

- a) research divisions within the department/institution headquarters;
- b) research divisions within each of the main research stations;
- c) research divisions within a specialized center of the department or a main research station.

Table 8 summarizes these categories and the affiliations of the research divisions.

Research organizations become ponderous when they are fragmented among various departments in such a way that effective coordination is prevented. The complicated network of many research departments, the multiplicity of regulations, and the top-heavy administrative hierarchies can only result in the frustration of the researchers and the stagnation of research.

Agricultural research achievements are normally the result of teamwork, where workers of 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 (that is, a combination of soil, climate, and plant life) forms a complex whole of which none of the components can be considered as an entirely separate entity. Thus, to improve animal production, there is need for the animal breeder, agronomist, biochemist, pedologist, soil scientist, and socioeconomist to work together as a team to solve animal production problems.

To ensure harmonious cooperation among the various specialists involved and to ensure the most favorable organizational and management circumstances is a crucial task. But when they are operating in different ministries or different departments within a ministry, each with its own hierarchy, its own set of regulations and its own budget, then any attempts to promote and coordinate research will be inefficient. The difficulties involved in managing a research institution or implementing a research program seem to increase in proportion to the number of different institutional hierarchies which are concerned in the organizational structure.

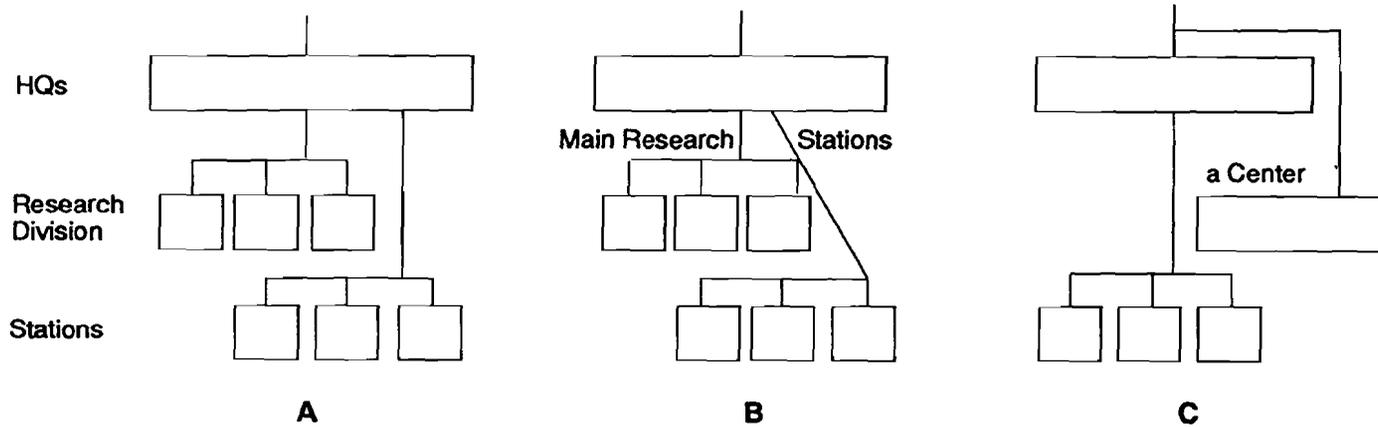
In both models I and II, where agricultural research is conducted by one specialized department or semi-autonomous institution within the ministry of agriculture, research institutions are identified and grouped for the most effective achievement of the policy of the ministry. A number of

Table 8 : Organizational Structure of the Network of Implementation Units

Country	Model I			Model II		
	A	B	C	A	B	C
Algeria				INRA, TI, NI		
Libya				ARC		
Mauritania				CNRADA		
Morocco				INRA		
Tunisia				INRAT, CRGR, INRF, IO, IRA		
Djibouti	DA					
Egypt				ARC, NRC WRC, DRI		
Somalia		DAR				
Sudan	APRA, VRLA					ARC
Iraq				SBAAWRR		
Jordan	NCARTT					
Lebanon					ARI	
Syria	DASR, DCB, DS, TRI, DIWU					
Bahrain	DAR					
Kuwait	AAFRA			KISR		
Oman		DAR				
Qatar	DAWR					
Saudi Arabia			DAR, RAWRC			
U.A. Emirates	ARC					
Yemen AR				ARA		
Yemen PDR		DRE				

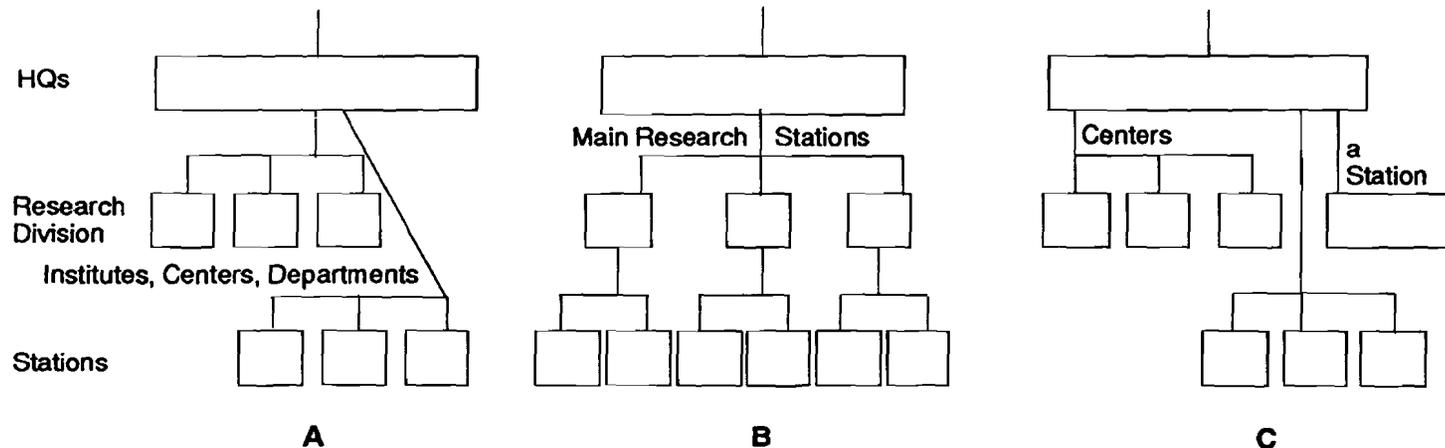
I. The Ministry Department Model

- A. Central research divisions within department headquarters + main and provincial stations
- B. Department headquarters + main research stations with research divisions + provincial stations
- C. A central research center with research divisions + department headquarters + main and provincial stations



II. The Agricultural Research Institute, Center, Corporation, or Authority Model

- A. Central research institutes, centers or departments, and laboratories within the headquarters + main and provincial stations
- B. Headquarters + main research stations with research divisions + provincial stations
- C. Headquarters + a main station with research divisions + specialized national research centers + main and provincial stations



countries (particularly those that have only during the last two decades started building up their research institutions from small beginnings) have adopted this set-up. It ensures effective coordination at planning and execution, permits efficient use of resources, ensures good opportunities for communication and collaboration between researchers, and provides the most suitable climate for the formation of teams.

5.3.2 Implementation-unit networks

Research stations in a country, whether multipurpose, commodity or for a group of commodities, are located at national, agro-ecological, and provincial levels.

Research priorities at the national level may need stations where problems are dealt with on a national basis to integrate research efforts to solve these problems: whereas establishing stations for homogenous agro-ecological zones would make it easier to grasp the agricultural constraints and potentials and to implement research findings, establishing stations at provincial levels would help in improving interactions with policymakers, extension services, development organizations, and farmers in the concerned provinces.

For a research station to function efficiently, the research system must ensure that the country's financial resources are available, sufficient, adequate, and available on time to maintain implementation of the research program. The system must also ensure availability of the required professional staff for conducting research activities, and of physical facilities for carrying out the research programs.

The availability and adequacy of financial, human, and physical resources for implementing research programs varies very considerably from one Arab country to another, and within a country from station to station.

The general picture of station networks in the region appears as follows:

- a. There are main stations at national as well as at regional levels located in various provinces and/or ecological regions in most countries.
- b. There is a tendency to allocate more resources to main stations, especially to those located within or close to the headquarters of the research institutions. There is also a tendency to spread a large number of stations across the country without providing adequate resources for them.
- c. There are a number of well-established main research stations where resources are inadequately allocated.
- d. Despite the fact that about three-quarters of the arable land in the region is rainfed, there is a tendency to establish more stations in irrigated areas and to allocate more resources to them.

Annex 1 summarizes available information on networks of research station in the Arab countries. Information available on stations deals with geographic mandate, research activity structure (areas and disciplinary structure, commodity structure, or a mixture of all three), type of cropping (rainfed, irrigated, or both rainfed and irrigated), number of scientists in the station, and coordinated programs.

It is obvious the number of scientists in each station is not available for all stations.

Multidisciplinary research is done by a group of scientists from several disciplines and is usually planned and executed in a coordinated way whether the scientists belong to the same or different departments. It is best done when organized, wherever possible, according to commodities or groupings of similar commodities rather than by disciplines. Thus, a coordinated wheat research program, for example, would be composed of scientists from such disciplines as breeding, plant pathology, agronomy, physiology, entomology, and socioeconomics.

In most Arab countries, the most common structure is for the scientist to be placed in disciplinary departments. Therefore, when an attempt is made to assign scientists to work as members of multidisciplinary teams in commodity programs or projects, they end up being responsible to more than two boss.

However, having strong multidisciplinary teams in well-led commodity programs as the basic organizational unit for implementing research activities has the advantage of intensifying team cooperation and clarifying research purposes.

Examples of coordinated programs from Arab countries are shown in Annex 1.

5.3.3 Autonomy and control of implementation units

As discussed above, there are two basic types of research organizations in Arab countries: the ministry department model and the autonomous or semi-autonomous research institution model. The most important difference between the two models is the degree of autonomy under which each model performs.

At the system level, there must be enough institutional and administrative autonomy for policies and procedures to correspond with the specific characteristics and requirements of the research process. To solve the problems and limitations of human resource development, financial management, and monitoring and evaluation as they relate to planning and programming of research, the autonomous or semi-autonomous institutions must be able to establish policies and procedures that reflect the needs of research.

On the other hand, while some degree of hierarchy is essential to a research institution, there is a need for a division of labor within the implementation units. This can be accomplished by delegating responsibility and authority.

In Arab NARS, it has been noticed that while many research institutions enjoy a fair degree of autonomy, the management of these institutions resists delegating authority and responsibility to various levels of program leaders and researchers.

This issue of delegation of authority could be dealt with within the concept of centralization versus decentralization. Centralization-decentralization can be applied at the level of the research system, the research institution, and the implementation unit.

To direct activities effectively toward national research priorities, to coordinate research programs, to maintain a stable and continuous flow of financial resources, and to communicate effectively with various policy and decision makers, some degree of centralization is needed at a high level. However, since agricultural research is highly location-specific, research activities must be developed at problem sites. This requires a high degree of operational and decision-making decentralization. In some cases, other factors imply the need to centralize those same aspects. As discussed below, some research support services are performed more effectively and with a more efficient use of resources when they are centralized. Thus, the organizational structure must respond to the research needs and balance opposing forces, allowing implementation units to maintain enough initiative to effectively influence program development and implementation.

Increasingly, the adoption of the multidisciplinary approach (where decisions are made chiefly by mutual consultation among members of research teams and allocation of resources is to programs rather than to administrative units) will allow the required balance between centralization and decentralization to be maintained and will improve the participatory management of research institutions where research staff become more involved in the process of making decisions.

5.3.4 Organizational linkages of implementation units.

One of the basic functional duties of the research institutions is to communicate with a wide range of research partners. Obviously, those partners are not all playing equally important roles. In this context, a distinction could be made between linkages with the world of knowledge within and among NARS institutions and within and outside the country, and linkages of NARS institutions with their major clients -- policymakers and the technology-using and -transfer system. Another distinction could be made between the characteristics and channels of linkages (informal versus formal, downstream versus upstream, top-down versus bottom-up, horizontal versus vertical).

In addition to the presence of various types, characteristics, and channels of linkages, partners in the linkage process generally vary greatly in their competence and commitment to collaboration. Therefore, the nature of the linkages varies from simple to quite complex, and from country to country. However, certain major types of linkages and their problems in Arab countries can be recognized. For research implementation units, linkages of importance have been identified with extension and farmers, and with sources of knowledge -- national academy research, university research, and regional and international research (Table 9).

Linkages with extension and farmers. Almost all Arab countries have organized, in one way or another, their research and extension services. In most countries, there is a functional gap between research and extension, where both actually operate with more independence than complementarity. This weakness has both structural and managerial aspects to it.

- a) On the structural level, research and extension are usually found in separate entities, making effective contact between research and extension workers an informal matter at the implementation unit level.

Some countries have established separate research and extension services, others have placed extension under a larger department of crop production, animal production, or plant protection. In a few countries, research and extension are joined under one national organization (Table 9). Furthermore, while in some countries research and extension are unified at the national level (e.g., Egypt and Syria), others have kept the extension function at the regional or even at the production scheme or project level (e.g., Sudan and Yemen) at the same time their research has been unified at the national level (e.g., Sudan's ARC and Yemen's ARA).

- b) The majority of countries have kept collaboration between research and extension at the coordination level, which is informal and weak to moderate in most cases (Table 9).
- c) The predominance of on-station research makes the contact between research and extension workers less important in the work of each of them.

In very few countries, those where on-farm verification trials have been adopted, a strong and formal linkage exists between research and extension, e.g., Egypt, Yemen PDR, and Sudan (wheat and fababeen programs). Recently, Yemen, Syria, Jordan, and others have adopted this approach for specific research programs. The subject-matter specialist exists in Egypt, Yemen PDR, and Oman. Recently, Syria has been considering the adoption of this function.

- d) Procedures to ensure that research programs reflect the needs of farmers and the country have not been readily accepted. Thus, researchers have not related their research programs, in most cases, to the needs of farmers and the country. This explains why research activities in many countries are not relevant.
- e) Differences in availability and adequacy of resources between research and extension result in inefficient linkages between the two systems.

The result of all this is the coexistence of different models of research and extension linkages in many countries. Even where there is a basic attempt to have a national research organization and a unified extension system, one finds specialized crop institutes operating on a semi-autonomous basis. The most obvious examples of a semi-autonomous institute, integrating research, extension, and other services, are cotton research in Syria, Egypt, and Sudan; tobacco research in Syria; olive research in Tunisia; and citrus research in Syria.

Table 9 : Important Linkages of National Agricultural Research

Country	Research/Extension		Research/Extension Collaboration			Links with National Academy research	Agriculture, Veterinary, & other colleges		Links with Regional and International Research
	Separate	Joined	Coordination Level	On-farm Trials	SMS		Conduct Research	Links with NAR	
Algeria		+	(a)			1	2	2	1
Libya	+		2	+		1	3	3	1
Mauritania	+		1			-	-	-	1
Morocco	+		2	+		-	2	2	2
Tunisia	+		2			-	2	1	3
Djibouti		+				1	-	-	
Egypt	+		3	+	+	2	3	1	3
Somalia	+		1			1	1	1	1
Sudan	+		1	+	(b)	2	3	1	3
Iraq	+		2	+		2	3	1	1
Jordan		+	2	+		1	3	2	3
Lebanon	+		1			3	3	2	2
Syria	+		2	+		-	1	1	3
Bahrain		+	1			-	1	-	-
Kuwait			1			3	2	2	-
Oman	+		2	+	+	-	1	1	1
Qatar		+	1			-	1	1	-
Saudi Arabia	+		2	+		2	2	1	1
U.A. Emirates	+		1			-	1	1	1
Yemen AR	+		2	+		-	1	1	2
Yemen PDR		+	3	+	+	-	1	1	1

(a) Technical Institutes (R/D)
(b) Wheat and fababean programs

1 = Weak
2 = Moderate
3 = Strong

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 adopt appropriate technology. Thus, every effort should be made to continuously improve the institutional arrangements between research and extension by establishing coordinating mechanisms for joint planning and follow-up; for identification of farmers' problems; for joint validation, verification, and on-farm trials; for mobility of research and extension staff; and for funds 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 the academic and basic research centers at a global level to the 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 entities, in particular to maintain linkages with other national sources of knowledge (e.g., national academy and university research) and external sources of knowledge (e.g., regional and international research organizations).

Table 9 is an attempt to summarize the perceived nature of the linkages which exist between principal national agricultural research organizations and other sources of knowledge. In combination with Table 2, which identifies individual research, academic, regional, and international institutions with which they can collaborate, this table provides a picture of the strength of linkages in the research system. From these tables, we can note the following:

- a) Most countries of the region have national faculties of agriculture and veterinary medicine with which the research institutions could potentially collaborate.
- b) Small countries often have no agricultural faculty, and where such a faculty exists, it is engaged primarily in research of a didactic nature.
- c. In countries where other research, including agricultural research, is carried out by the academies, the research institutions could potentially collaborate. In some cases, most or part of the national agricultural research is carried out by these academies, e.g., Kuwait; Iraq, and Egypt. In other cases, however, national academies finance national agricultural research, e.g., Lebanon, Saudi Arabia, and Egypt.
- d) Collaboration between the research institutions and universities is usually on a scientist-to-scientist basis and is informal in nature.

Leaders of both national universities and agricultural research institutions are aware of the schism between them and have been willing to seek greater collaboration. However, separation of higher education and agricultural research in different ministries, different criteria for hiring and promoting staff, and different conditions of service have made it difficult to have a movement of research staff between institutions or joint appointments in any meaningful sense.

The need to establish effective linkages is particularly important in the smaller systems where there is no critical mass for research either in the university or in the research institutes. Together they could create a critical mass for major research efforts, or their joint action could be aimed at gathering the knowledge needed to become effective importers of technology from outside.

Much agricultural research in Arab countries is carried out in isolation from, and often in replication of, the same activities in neighboring countries with similar agro-ecological conditions. Networks are an efficient interinstitutional arrangement 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 such as the following:

- * FAO Near East Regional Projects, e.g., field crops, rangeland management, land and water use, palms and dates, animal production and health;
- * international agricultural research centers' research networks, particularly international nurseries for the evaluation of the genetic potential of cereals, food legumes, root crops, and forage crops;
- * European networks for olives, grapes, etc., where Arab members have collaborated on and benefited from the efforts of the networks;
- * international networks in specific commodities, disciplines, production factors, and natural resources.

Establishing intercountry networks in the region has been a subject of regional meetings during the last few years. For example, FAO/ICARDA/ISNAR collaboration was instrumental in the establishment of the Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA), a network to improve research management and information exchange, and to support cooperative research by developing and implementing common research methodologies, research plans, and data collection and interpretation.

Various regional meetings, dealing with rainfed and irrigated agriculture, have identified priority problems that are shared in the region: wheat and barley, food legumes, oil-seed crops, sugar crops, animal feeds, ruminant livestock, soil and water management, palms and dates, cotton, horticultural crops (potatoes and tomatoes), and socio-economics.

5.4 Centralized Research-Supporting Services

Research-supporting services exist to support researchers in their work. The way in which these services are organized within a research system/institution is of great importance for research outputs. They can help generate a favorable ambiance, which is so important to successful research.

From among the many centralized research-supporting services listed in Figure 1, eight were selected for this study. These include statistics, data processing and socioeconomics; soil testing and classification; routine chemical analysis of food, feed, fertilizers, pesticides, etc.; plant protection -- museums and collections, pest and disease surveys and identification; maintenance of a central agricultural library, an agricultural documentation center, and a seed bank; and maintenance of scientific equipment.

Central administrative services such as accounting, personnel services, purchasing, communications, and physical plant services are excluded from this study. Maintenance of scientific instruments was selected because of its importance to NARS in developing countries.

5.4.1 Statistics, data processing, and socioeconomic service units

The agricultural economics and statistics section, department, or institute in most Arab NARS carries out research in various fields of agricultural production economics, land economics, marketing, statistics, etc. The role of the unit in providing services to research is very limited. Furthermore, in some research institutions, there is no research in statistics and economics, e.g., DASR in Syria and DRE in Yemen PDR (Table 10).

The data processing services are needed to meet the major research program requirements. Thus, these services should be made available by developing capacities in statistical analysis and experiment aids to help scientists carry out their research activities.

5.4.2 Soil testing and classification units

Soil testing and classification is conducted by units either outside or within the research institution. Examples of soil units working independently are INSID (Algeria), DRS (Tunisia), DS (Syria), and SWL (Oman). Soil testing services to research are generally centralized and within research institutions in the remaining countries (Table 10).

5.4.3 Plant protection research units

In general, plant protection services are carried out within research institutions (Table 10). Exceptions are INPV (Algeria), AAFRA (Kuwait), and PPL (Oman), where plant protection is a combination of research and public service.

Table 10 : Centralized Research-Supporting Services for Noneducational Research Institutions at the National Level.

Centralized Service Country	Statistics, Data Processing, & Socio-economics	Soil Testing and Classification	Plant Protection	Chemical Analysis *	Central Agricultural Library	Agricultural Documentation Center	Seed Bank	Maintenance of Scientific Instruments
Algeria	INRA	INSID	INPV	n.a.		CNDA	INRA	n.a.
Libya	ARC	ARC	ARC	ARC	ARC	ARC	ARC	ARC
Mauritania	CNRADA	CNRADA	CNRADA	CNRADA	CNRADA	CNRADA	CNRADA	n.a.
Morocco	INRA	INRA	INRA	INRA	INRA	CND	INRA	n.a.
Tunisia	n.a.	DRS	INRAT	INRAT	n.a.	CNDA	INRAT	n.a.
Djibouti	DA	DA	DA	n.a.	n.a.	COA	-	-
Egypt	AERI	SWRI	PPRI, PDRI	ARC HQ	ENAL	EDICA	ARC	ARC, NRC
Somalia	n.a.	CARS	CARS	CARS	CARS	DAR	CARS	n.a.
Sudan	ARC	GARS	GARS	GARS, FRC	ARC	ARC	GARS	n.a.
Iraq	SBAAWRR	SBAAWRR, AWRRC	SBAAWRR, AWRRC	SBAAWRR, AWRRC	n.a.	SDC	SBAAWRR	AWRRC
Jordan	n.a.	NCARTT	NCARTT	NCARTT	NCARTT	NCAD	NCARTT	n.a.
Lebanon	n.a.	ARI	ARI	ARI	ARI	CDIS	ARI	n.a.
Syria	n.a.	DS	DASR	DASR, DS	DASR	NADC	DASR	n.a.
Bahrain	DA	DA	DA	DA	DA	DA	-	-
Kuwait	KISR	KISR	AAFRA	KISR	KISR	AAFRA	KISR	KISR
Oman	n.a.	SWL	PPL	n.a.	n.a.	none	MAF	n.a.
Qatar	DAWR	DAWR	DAWR	DAWR	DAWR	none	n.a.	n.a.
Saudi Arabia	n.a.	RAWRC	RAWRC	RAWRC	RAWRC	DAR	RAWRC	RAWRC
U.A. Emirates	n.a.	ARC	ARC	CL	none	MAF	ARC	n.a.
Yemen AR	ARA	ARA	ARA	ARA	ARA	ARA	ARA	n.a.
Yemen PDR	n.a.	El-Kod, Seiyun	El-Kod, Seiyun	El-Kod, Seiyun	none	DYDCA	n.a.	n.a.

* food, feed, pesticides, fertilizers, etc.

5.4.4 Routine chemical analysis of food, feed, pesticide and fertilizer units

Chemical analysis units are within research institutions in most Arab countries (Table 10). However, fertilizer analysis in Syria is carried out by DS. Routine chemical analysis in U.A. Emirates is conducted by the central laboratories of the MAF.

5.4.5 Central agricultural library

Agricultural libraries have to keep pace with the onrush of new information. Faced with a flood of material and continuing limitations of space, time, and money, agricultural research managers are challenged as never before to discriminate between valuable and less-valuable publications for their research programs, since much scientific literature is not read, not cited, not sought, and not useful. However, managers and librarians are overwhelmed not only with more information than ever before, but also with more choices of systems and machines for receiving, processing, and disseminating that information. Deciding which technologies best serve a particular library is a difficult task, compounded by improved systems regularly entering the market and often at a lower price.

For these reasons, i.e., the flood of information and choices of systems and machines, the Arab NARS are being forced to centralize and strengthen central agricultural libraries.

In Egypt, architects have drafted sketches for a modern library-information center (ENAL) within ARC, which will house collections and reading areas for researchers and other users of agricultural information (Momtaz, 1988). The ENAL will be the center of an information network, feeding ARC's research institutes and stations. It will receive and provide various services, including on-line services from outside and inside the country.

Similarly, the central library in a few other Arab NARS receives and provides library services, e.g., KISR (Kuwait) and RAWRC (Saudi Arabia). In other countries, more efforts are needed to improve the central library collections and services.

5.4.6 Agricultural documentation center

There is an agricultural documentation center in each Arab country (Table 10). This center is either affiliated with research, the department of agriculture, the scientific research institution, or the university. Cases of affiliation of the documentation center with research are in Libya, Mauritania, Somalia, Sudan, Syria, Saudi Arabia, and Yemen AR.

Most Arab countries have AGRIS and CARIS centers through FAO assistance, and representatives of the centers meet every two years to collaborate and coordinate their work.

5.4.7 Seed banks

There has been little collection of plant genetic resources in most Arab countries. In general, Arab countries are 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 Arab countries should be singled out as high-priority targets.

Information on the organization of conserving and documenting plant genetic resources in Arab countries is very limited. However, Table 10 lists research institutions involved in collecting and conserving plant genetic resources.

5.4.8 Maintenance of scientific instruments

Excluding buildings and land, a research institution's largest capital investment is usually in the equipment required to conduct and support research. This includes scientific instruments, office machinery, vehicles, farm machinery, etc.

Researchers and managers frequently experience difficulties in identifying correct scientific instruments to conduct agricultural research. Often, when an instrument is identified, it is purchased with little more evidence than hearsay as to its suitability and reliability. Frustration for both researchers and maintenance personnel occurs when a scientific instrument cannot be maintained. Thus, maintenance of sophisticated and expensive scientific instruments should be consolidated and centralized whenever possible. In most Arab countries, a central maintenance unit for scientific instruments is lacking (Table 10).

Chapter 6.

ORGANIZATIONAL DESIGN ISSUES

As stated earlier, while there is a tendency to see structural change as the solution to problems of research coordination, or as a means of stimulating new activities, there is often a failure to understand how complicated organizational change can be.

A basic conclusion to be drawn from this study is that there is no single, most appropriate structural model, and each country will develop structures that reflect different historical and economical events. The result is that at any one time, the structure and organization may not be the most appropriate to achieve the research goals of the society. Managing structural change in research institutions is a very difficult process, but it may be possible to develop improved management processes which can lead to the same goals without the risks of major structural reorganization.

6.1 The Organization as a System of Flows

In order for organizations to work properly, they must be appropriately designed and structured, and provided with various types of resources. Designing organizations involves bringing coherence to the goals and purposes for which the organization exists, the patterns of division of labor and interunit coordination, and the people who do the work (Javier, 1988).

In the design and management of organizations, there are key considerations representing the variables that managers continually adjust and manipulate to make organizations work. Structure is a key variable common to all organizations. It is the established pattern of relationships among the components of the organization (Kast and Rosenzweig, 1985).

The organization as a system of flows has been discussed by Mintzberg (1979). The parts of the organization are joined together by different flows of authority, of work material, of information, and of decision processes.

6.1.1 The organization as a system of formal authority.

Traditionally, the organization has been described in terms of an "organizational chart" which represents an accurate picture of the division of labor (what positions exist in the organization, how these are grouped into units, and how formal authority flows among them), in effect, describing the use of direct supervision.

6.1.2 The organization as a system of regulated flows.

The organization is described as a network of regulated flows of work materials, information, and decision processes, but only those aspects that are regulated are included, in other words, those that are systematically and explicitly controlled. Thus, whereas the first view of the organization described the use of direct supervision -- formal authority -- as a coordinating mechanism,

this one describes the use of standardization. Three distinct flows can be identified in the regulated system, the operational work flow, the flow of control information and decisions, and the flow of staff information.

6.1.3 The organization as a system of informal communication.

Considerable activity outside the systems of formal authority and regulated flow processes are flows of informal communication. There are two prime reasons for informal communication in organizations. One is directly work-related, the other is social.

6.1.4 The organization as a system of work constellations.

The organization of informal communication in the system has been reviewed as a rather random set of communication channels connected by nerve centers. Now, the organization takes on the form of a set of work constellations, quasi-independent cliques of individuals who work on decisions appropriate to their own level in the hierarchy. Work constellations can range from the formal to the informal, from work groups shown as distinct units on the organigram of the organization to those in which individuals from different units converse informally to deal with certain kinds of decisions. In fact, most work constellations correspond to the work flow.

6.1.5 The organization as a system of ad hoc decision process.

Authority and communication in organizations are not ends in themselves, but they facilitate the other two basic flow processes -- the making of decisions and the production of products and services. Here, the informal and formal aspects of organizations -- the formal authority, the regulated flow of information, and the flow of informal communication -- all blend together to determine organizational behavior.

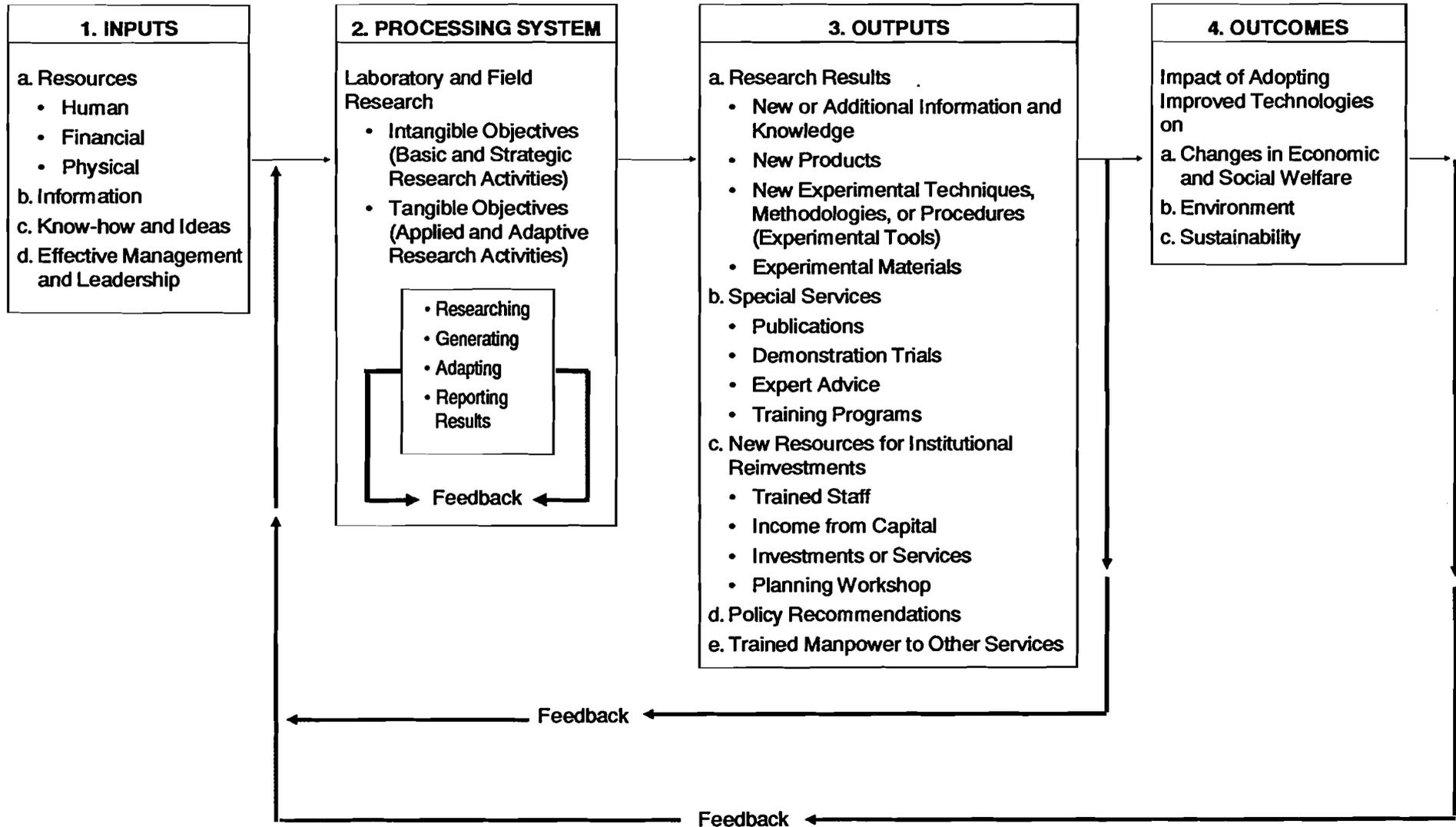
This modern view of structure and organization is very relevant to determining how with identical formal structures can behave and perform so differently. On the other hand, it also suggests how organizations can be made to work, even with very complex formal structures.

6.2 An Integral System Approach for Organizing Agricultural Research

All organizations are composed of systems working together to produce information, materials, and services. They are considered in terms of a general open-system model to ensure their continual interaction with their environment. The survival of the system depends on continuous inflow, transformation, and outflow. Thus, the system must receive sufficient resources to maintain its operations and also to disseminate the output in acceptable form to the environment to continue the cycle.

An agricultural research organization is a system itself, with its own inputs, processes, and outputs. Figure 2 shows a typical agricultural research organization working as a system.

Figure 2. The Agricultural Research Organization as a System



6.2.1 Inputs

Inputs of an agricultural research organization are resources -- human, financial, and physical -- information, know-how and ideas, and effective management and leadership.

6.2.2 The processing system

The processing system is the research organization itself, which turns the inputs into outputs by proposing and conducting research, researching activities, generating and adapting technologies, and reporting results.

6.2.3 Outputs

Outputs include (a) research results -- new or additional information and knowledge, new products, new experimental tools (techniques, methodologies, or procedures), and experimental materials; (b) special services such as publications, demonstration trials, expert advice, and training programs; (c) new resources for institutional reinvestment such as trained staff, income from capital investments or services, and planning workshops; (d) policy recommendations; and (e) trained manpower to other services.

6.2.4 Outcomes

Outcomes are the accomplishments that have value for the agricultural research organization. They are produced when the receiving system (producers, consumers, decision- and policy-making bodies, development organizations, extension, other research organizations, academic community, and others) accomplishes something with the outputs of the processing system -- considering that the impact of adopting improved technologies on changes in economic and social welfare, environment, and production sustainability is the main outcome of an agricultural research organization.

Finally, if research institutions are to be efficient and effective, they must be in a position to transform the available and adequate research inputs into outputs that are acceptable to major clients of the NARS. Therefore, the NARS must provide the framework -- broad research priorities, long-term research plans -- allocate resources, and ensure that adequate inputs are available so that the research institutions can transform them into acceptable outputs. Consequently, only valuable outputs and outcomes of research will be the criteria for measuring the success of research institutions, whatever structural models they are adopting.

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Annex 1. Research Program Implementation Units Networks and Structure

Country	Institution	Headquarters	Main Station/ Center Location	Natio nal	Regio nal	Res.Areas & Discipl Structure (1)	Commodity Structure (2)	Mix of (1) & (2)	Rainfed (R)/ Irrigated (I)	No. of Scien- tists *	Coordinated Programs
Algeria	INRA	El-Harrach	A) HQ and 2 Labs CNRA; CNRZ	+		+					<u>National:</u> 1. Cereals, dry legumes and forage crops (product) 2. Cereals/sheep (system) 3. Cattle, meat and milk production (products) 4. Cattle/upland pasture (system) 5. Tree, crops & viticulture (product & system) 6. Date palms (product) 7. Saharan agric. (system)
			B) 5 stations								
	TIs & NIs	Algiers	A) 6 TIs: HQ+Labs			+					
			- Field crops	+			+				
			- Vegetables & industrial crops	+			+				
			- Fruits & vines	+			+				
			- Saharan agric	+							
			- Cattle & sheep	+			+				
			- Poultry	+			+				
			B) 3 NIs:HQ+Labs								
			- Animal health	+		+					
			- Plant protection	+		+					
			- Soils, water & drainage	+		+					
			C) 38 Res/Dev sta. Network								
	INRF	Algiers		+			+				
Libya	ARC		A) HQ & 7 Depts.	+		+					
			B) 4 Region. Centers								
			1. Tripoli RC		+			+			
			at Tajoura								
			- Al Zahraa		+			+	I		
			- Tarhouna		+			+	R		
			- Agilia		+						
- Sfeit											
			- Al Marqab								

National Science Foundation

II

Country	Institution	Headquarters	Main Station/ Center Location	Natio nal	Regio nal	Res.Areas & Discipl Structure (1)	Commodity Structure (2)	Mix of (1) & (2)	Rainfed (R)/ & Irrigated (I)	No. of Scien- tists *	Coordinated Programs
			2. AlJabal AlAkhdar RC at Al Marj - Al Fateh - Darnah - Alsafsaf - Benghazi								
			3. Fazzan RC at Sebha - Al Raqiba								
			4. Middle RC at Masrata - Masrata								
Mauritania	CNRADA	Kaedi	- Barkéol	+				+	I		
			- Sélibaby		+		+		R		
	CNERV	Nouakchott		+				+			
Morroco	INRA	Rabat	A) INRA HQ	+						228	
			B) Central Labs, Rabat	+		+				10	
			C) 8 CRRA							112	
			D) 23 stations								
			- Tangier(CRRA, Rif)		+					9	
			- Kenitra(CRAA,Gharb)		+					16	
			- Sais		+					4	
			- Meknes		+					12	
			- Khemisset		+					4	
			- Oujda		+					3	
			- Rabat		+					6	
			- El Jadida		+					7	
			- Tadla (CRAA)		+					9	
			- Settat(CRAA,Doukhla)		+					11	

Country	Institution	Headquarters	Main Station/ Center Location	Natio nal	Regio nal	Res.Areas & Discipl Structure (1)	Commodity Structure (2)	Mix of (1) & (2)	Rainfed (R)/ Irrigated (I)	No. of Scien- tists *	Coordinated Programs
			- Marrakech (CRAA)		+				R	14	
			- Errachidia		+					3	
			- Sousse		+					11	
			- Laayonne (CRRRA, Agadir)		+					1	
Tunisia	INRAT	Ariana, Tunis		+				+		72	Cereals (wheat & barley) coordinated program
			A) 25 Labs:								
			- Field crops (3)	+			F				
			- Horticultural crops (10)	+			H				
			- Animal production & forage (2)	+		+					
			- Crop protect. (4)	+		+					
			- Agronomy (4)	+		+					
			- Rural Economy (2)	+		+					
			B) 22 Stations								
			- Ariana-Soukra				F; H		I		
			- Beni Khallad				F; H		I		
			- Bou Rebio				F		R		
			- Elafareg				F; H		I		
			- Lekef				H		R		
			- Mornag				F; H		R		
			- Qued Beja				F		R		
			- Ouedliz				F		R		
			- Ousseltia				F; H		R		
			- Sedjenane				F; H		R		
			- Sfax				H		R		
			- Tabarka				F; H		R		
			- Teboulba				F		R		
			- Tozeur				D				
			- Sbiba								

IV

Country	Institution	Headquarters	Main Station/ Center Location	Natio nal	Regio nal	Res.Areas & Discipl Structure (1)	Commodity Structure (2)	Mix of (1) & (2)	Rainfed (R)/ Irrigated (I)	No. of Scien- tists *	Coordinated Programs
	CRGR	Ariana, Tunis	A) 6 Labs - Agronomy - Pl. phys. - Soil & water chemistry - Soil and water physics - Fertilization - Ag. mechanics B) 6 Stations - Soukra - Chott Mariem - Cherchef - Nabeul - Hendi Zitoun - Ksar Gheriss	+		+				15	
	INRF	Ariana, Tunis	- 4 Substations and 45 arbor- atums	+			+			17	
	IO	Sfax	<u>Labs:</u> - Sousse - Tunis	+			0		R	15	
	BIRH	Tunis		+		+				31	
	DRS	Tunis		+		+				20	
	IRUT	LaRabta		+		+				27	
	INSTOP	Salammba		+			+			20	
	IRA	El Fjé	- Gabes - Chenchon	+		+				21	

V

Country	Institution	Headquarters	Main Station/ Center Location	Natio nal	Regio nal	Res.Areas & Discipl Structure (1)	Commodity Structure (2)	Mix of (1) & (2)	Rainfed (R)/ Irrigated (I)	No. of Scien- tists *	Coordinated Programs
			- Ben Gardane - Dar Dhaouni - Kebili								
Djibouti	DA	Djibouti		+							
Egypt	ARC	Cairo; Giza	A) 14 Res. Institutions	+						2307	<u>18 National interdisciplinary integrated programs:</u>
			1. Cotton	+			C			140	1. Cotton
			2. Soils & water	+		+				344	2. Maize and sorghum
			3. Field crops	+			F			287	3. Wheat & barley
			4. Sugar crops	+			S			35	4. Rice
			5. Horticulture	+			H			301	5. Oil seeds
			6. Plant pathology	+		+				199	6. Sugar crops
			7. Pl. protection	+		+				318	7. Legumes
			8. Ag. mechanics	+		+				4	8. Forage
			9. Ag. Economy	+		+				114	9. Fruit trees & ornamental
			10. Animal prod.	+			L			166	10. Vegetable & med. plants
			11. Animal health	+		+				160	11. Soils, water & fertility management
			12. Animal repro- duction	+		+				23	
			13. Serum & vaccine	+		+				67	12. Crop intensification & Ag. systems
			14. Extension	+		+					
			B) Central labs							38	13. Adaptive mechanization
			1. Pesticides	+		+				79	14. Milk & meat
			2. Experimental design	+		+				13	15. Small ruminant
			3. Food & feed analysis	+		+				2	16. Poultry
			4. Integrated plant protection								17. New lands technology
			C) Regional stations and others								18. IPM

Country	Institution	Headquarters	Main Station/ Center Location	Natio nal	Regio nal	Res.Areas & Discipl Structure (1)	Commodity Structure (2)	Mix of (1) & (2)	Rainfed (R)/ Irrigated (I)	No. of Scien- tists *	Coordinated Programs
			1. Alexandria & North Coast								
			- Sabahia (HQ)		+		F; H		I	60	
			- Montazeh				P		I	15	
			- Burj Al Arab				L		R	5	
			2. New Lands								
			- Nubaria (HQ)		+		F; H		I	12	
			- Tahrir				H		I	8	
			3. North Delta								
			- Sakha (HQ)		+		F; L		I	222	
			- Sirw				F; L; P		I	17	
			- Mahlat Musa				L		I	5	
			4. Middle Delta								
			- Gemiza (HQ)		+		F; L; P		I	87	
			- Sers				F		I	4	
			5. Eastern Delta								
			- Ismailia (HQ)		+		F; H		I	17	
			- Kanater				H; P		I	29	
			6. South Delta (Greater Cairo)								
			- Bahteem (HQ)		+		F		I	40	
			7. Al Fayoum								
			- Fayoum (HQ)		+		F; P		I		
			- Tamiah				L		I	2	
			8. Middle Egypt								
			- Sids (HQ)		+		F; H; L		I	13	
			- Giza				F; H; L		I		
			- Mallawy				F; L		I	33	
			9. Upper Egypt								
			- Shandweel (HQ)		+		F		I		
			- Maatana				F; L		I	9	
			10. New Valley								
			- Kharja (HQ)		+		F		I		

VII

Country	Institution	Headquarters	Main Station/ Center Location	Natio nal	Regio nal	Res.Areas & Discipl Structure (1)	Commodity Structure (2)	Mix of (1) & (2)	Rainfed (R)/ Irrigated (I)	No. of Scien- tists *	Coordinated Programs	
	NRC	Cairo	A) 7 Laboratories (Cairo)	+							With ARC:	
			- Botany	+		+				87	- Micronutrient project	
			- Soils & use of water	+		+				63	- National maize program	
			- Pests & pl. prot.	+		+				70	- Regional tomatoes project	
			- An. reproduction	+		+				24	- Citrus project	
			- An. parasites & diseases	+		+				12		
			- Animal Feeding & poultry	+		+				23		
			- Ag. Economics	+		+				7		
			B) 2 Res. Farms									
			- Kanater				F; H		I			
			- Abon Redash				L		I			
	IOF	Alexandria	- Red Sea Sta.				Fish					
			- Medit. Sea Sta.									
			- In land sta.									
	WRC	Cairo	- Irrigation Inst.			+						
			- Drainage Inst.			+						
	DRI	Cairo	- Mariut					+	R		100	
			- Ras Sidr					+	R			
Somalia	DAR	Mogadishu	- Afgoi (CARS)	+				+			40	At Afgoi
			- Bonka		+		F		R		6	- Sorghum/millet team
			- Jilib (Gelib)		+		F		I		1	- Maize team
			- Aburein		+		F		R		1	- Rice/wheat team
												- Grain Legumes team
												- Oil seeds team

VIII

Country	Institution	Headquarters	Main Station/ Center Location	Natio nal	Regio nal	Res.Areas & Discipl Structure (1)	Commodity Structure (2)	Mix of (1) & (2)	Rainfed (R)/ Irrigated (I)	No. of Scien- tists *	Coordinated Programs
	LR	Mogadishu	- SVI	+							- Fruit crops team - Vegetable crops team
Sudan	ARC	Wad Medani	A) HQ B) Stations/Centers	+		+				20	A) <u>National coordinators for:</u> - Groundnuts - Plant pathology - Entomology - Soil science - Cotton - Wheat - Sugarcane - Sorghum & millet - Horticulture
			- Gezira	+	+			+	I	65	- Fababean coordinated Program
			- Yambio		+		F; H		R	8	
			- Hudeiba		+		H; F		I	14	
			- Kenana		+		F		R; I	9	
			- Kadugli		+		F; L		R	5	
			- Rahad		prov.		F; H		I	6	
			- Sennar		prov.		F; H		I	6	
			- New Haffa		prov.		H; F		I	9	
			- Shendi		prov.		Cs		I	2	B) Fababean coordinated Program
			- Obeid		prov.		F; H		R	10	
			- Fasher		prov.				R		
			- G. Gawzat		prov.		F		R	5	C) Wheat coordinated Program
			- Shambat		prov.		H		I	9	
			- Guneid	+			S		I	4	
			- Kassala		prov.		F; H		I; R		
			- Food (Khartoum)	+		+				34	
			- Fisheries (")	+			+			14	
			- Wildlife (")	+		+				6	
			- Forestry (")	+			+		R	12	
	APRA	Khartoum/ Kuku	A) HQ + Labs B) Stations	+			L			35	
			- Shukkaba		+		L dairy			4	
			- Umbenin		+		L cattle			2	
			- Huda		+		L sheep			2	
			- G. Gawzat		+		L cattle			1	
			- Atbra		+		L cattle			6	
	VRLA	Khartoum	A) HQ + Labs	+		+				127	

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			B) Stations								
			- Nyala		+	+				}	
			- Obeid		+	+				}24	
			- Sennar		+	+				}	
			- Kassala		+	+				}	
Iraq	SBAAWRR	Baghdad		+						303	
			A) HQ + 9 Central Centers	+				+		+	
			- Field crops								
			- Horticulture								
			- Breeding								
			- Plant protection								
			- Animal wealth & health								
			- Ag. mechanization								
			- Range management								
			- Ag. Economy								
			- Botany & seed certification								
			B) Centers (a)								
			- Ninevah		+			+	I; R		
			- Tameem		+			+			
			- Wasit				F	+	I		
			- Mesan					+			
			- Basrah					+	I		
			- Arbil					+			
			- Dhook					+			
			- Sulimaniah					+	R		
			- Diala					+	I		
			C) Stations (5)								
	AWRRC	Baghdad		+						239	
			A) 5 Central Depts	+				+			Collaboration programs at

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			B) Stations								national level
			- Dulmuj		+				I		
			- Babel		+		D		I		
			- Basrah		+		D		I		
	BSRC	Baghdad		+		+					
	SERC	Baghdad		+		+					
Jordan	NCARTT	Amman/Bakaa		+						95	
			A) HQ & Central Depts							48	
			B) Stations & Reg. Centers								ICARDA/NARS wheat coordinated programs
			1. Dier Alla Center		+						
			- Dier Alla				H; F		I	25	
			- Karamah				H		I		
			- Yabis				H		I		
			- Abu Habee1								
			2. Ramtha Center		+						
			- Ramtha				F; L		R	7	
			- Maru				F; H		R	5	
			3. Mushagger Center		+						
			- Mushaggar				F; H; L		R	2	
			4. Khalidiah Center		+						
			- Khalida				H		I	5	
			5. Rabba Center		+						
			- Rabba				F		R	2	
			- Ghor el Safi				H				
			- Ghuair				F; L				
			6. Shubak Center		+						
			- Shubak				H		R; I	1	

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Lebanon	ARI	Tel Amara		+						25			
			- Tel Amara	+					R; I				
			- Fanar	+			L		+	R; I		Cereal coordinated programs (wheat)	
			- Terbol	+			L		+	R; I			
			- Abde			+	CS			I; R			
			- Tyre (Sure)			+	H			I; R			
			- Kafr Shakkhna			+	O			I; R			
			- Kafr Dan			+							
Syria	DASR	Douma, Damascus		+						335			
			A) HQ, Depts & 7 Sta.	+					+		152		
			B) 14 Centers + 7 Stations							+		203	
			1. Ain AlArab - ARA		prov.		H			R		8	DASR/ICARDA wheat & barley
												2	
			2. Izraa - Jilleeen		prov.		F; H			R		11	Improved program
							F; H			R; I		3	DASR/ICARDA fababean, lentil, and chickpea improvement programs
			3. Homs		prov.		F; H			I		23	
			4. Hama		prov.		F			I		21	
			5. Idlib		prov.		F			R		4	
			6. Tartous		prov.		H			R; I		6	
			7. Jableh		prov.		H			R; I		26	
			8. Ghab		prov.		F			R; I		8	
			9. Aleppo		prov.		F; H			R; I		38	
			10. Rakka		prov.		F; H			I		7	
11. Dier Ez Zor		prov.		F; H			I		21				
12. Hemo		prov.		F			R		19				
13. Hasakeh		prov.		F			R; I		5				
14. Quneitra		prov.		H			R		1				

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	DAB	Aleppo	A) HQ + Central Lab B) 8 Field Stations: - Aleppo - Dier Ez Zur (2) - Rakka - Hasakeh - Ghab - Homs - Hama	+			CN			34 26	Coordinated cotton breeding program
	DS	Douma, Damascus	A) HQ + Central Labs B) Other Labs - Deraa - Idleb - Aleppo - Latakia - Rakka - Dier Ez Zur - Hasakeh	+		+				169 94	ICARDA/DS Joint program on barley response to phosphorus
	DIWU	Douma		+					R R R; I R; I I I I; R	2 4 22 5 16 4	
	TRI	Latakia	A) HQ + Central Sec B) 3 Stations	+			T				
Bahrain	DAR	Manama	Budaya	+				+	I		
Kuwait	AAFRA KISR	Kuwait Kuwait	Omariya	+		+		+	I		

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Oman	DAR	Muscat	A) Main Station - Rumaïs - W. Quriyat - Salalah B) Substation - Rustaq - G. Mountain - Giroune	+			L		I I I		
Qatar	DAWR	Doha	- Doha	+				+	I		
Saudi Arabia	RAWRC	Riyadh	- Riyadh - Al-Kharj - Dirab	+		+	F; H Horse		I I		
	DAR	Riyadh	- Hofuf - Oneiza - Al Qassim - Najran - Kateif - Jizan - Western Region - Jawf - Medina - Beljorshi - DPRC		+		L H F H Fish		R; I I I I I I R I		
	FASFKFU		- DPRC	+			D		I		
U.A.Emirates	ARC	Ras Al Khaimeh	- Dibba - Dhaid - Hamranryah	+			H H H	+	I I I		

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Yemen AR	ARA	Dhamar	A) HQ + Central Depts. B) Regional Stations	+		+				91	<u>National programs:</u>
			- Taiz		+		F; H		R; I	15	- Cereals
			- Dhamar		+		F; H		R; I	15	- Legumes
			- Zabid/Surdad		+		F; H		R; I	14	- Fruits & coffee
											- Vegetables
											- Industrial crops
											- Livestock & Feed
Yemen PDR	DRE	Aden	- El Kod - Seiyun	+							<u>Regional programs:</u>
					+	+			I	70	- Vegetables
					+	+			I	26	- Fruits
											- Cereals
											- Industrial crops (El Kod only)
											- Legumes

D = Date Palm L = Livestock P = Poultry CN= Cotton
 F = Field crops O = Olives S = Sugar crops CS= Citrus
 H = Horticultural crops M = Maize T = Tobacco

Note: Scientist numbers are the latest available.

* B.Sc. included.