

## THE NATIONAL AGRICULTURAL RESEARCH SYSTEM OF YEMEN<sup>1</sup>

### 1. HISTORICAL BACKGROUND

Agricultural research (AR) activities in Yemen date back to the forties when the British Colonial Government (which ruled South Yemen until 1967) introduced the "Lambert type" of cotton from Sudan in the Abyan coastal area. El-Kod Research Station was established in 1955 in this region (50 km from Aden), and research activities were expanded to other field crops. Seiyun Research Center was established in Wadi Hadramout in 1972 to cover the mid-altitude region of South Yemen.

Research activities were later developed in most parts of the country, especially through numerous projects supported by UNDP/FAO and IDA. They were introduced in North Yemen starting in 1970, later developing into a central AR station in Taiz in 1978. In 1980, the Ministry of Agriculture and Agrarian Reform of South Yemen created the Department of Research and Extension (DRE), based at Aden, which was transformed in 1986 to the Directorate of Research and Extension. This Directorate was responsible for research and executed only technical control of extension units. At the same time, the Agricultural Research Authority (ARA) was established in Dhamar in North Yemen for conducting research and applied studies to improve agricultural production.

In 1990, after the unification of North and South Yemen, the Agricultural Research and Extension Authority (AREA) was formed by merging DRE and ARA and their respective research centers and stations. The Extension Department of the General Directorate of Extension and Training (GDET) was transferred to AREA in 1990 and was mandated with the tasks of technical backstopping and strengthening linkages between research and extension. Extension systems, however, are still under different authorities within the Ministry of Agriculture.

Agricultural higher education (AHE), with some related AR activities, started with the foundation of an agriculture institute at Aden in 1975, which became in 1978 the Faculty of Agriculture of Aden University. In 1984, the Faculty of Agriculture of Sana'a University was opened. The Faculty of Agriculture of the University of Ibb and the Faculty of Agriculture and Veterinary Science of the University of Dhamar were established in 1996.

Research on fisheries started with the inception of the Marine Sciences and Resources Research Center at Aden in 1986.

### 2. THE CURRENT NARS<sup>2</sup>

#### 2.1 Overview

The NARS of Yemen is currently made up of three main sets of institutions:

- The scientific institutions which have AR as their central mandate: the Agricultural Research and Extension Authority (AREA), affiliated with the Ministry of Agriculture and Irrigation (MAI), and the Marine Sciences and Resources Research Center (MSRC), affiliated with the Ministry of Fisheries, which account together for 76% of the total potential research years (pRYs: equivalent full-time researchers) and 70% of the total financial resources of all the NARS; these two institutions are presented in Section 2.2.
- The four faculties of agricultural sciences, which are more or less involved in AR, account for 16% of the pRYs and 4% of the total financial resources of the NARS (see Section 2.3).
- Other institutions partly involved in AR activities, mainly temporary agricultural development projects (around 8% of the pRYs and 26% of the total financial resources of the NARS) (see Section 2.4).

Limited private-sector research is carried out in collaboration with the public sector, e.g., research on the introduction of hybrid seeds, pesticides, agricultural machinery, and fertilizers.

Since its reorganization in 1996, AREA has been mandated with the supervision and coordination of national AR activities, technical supervision of extension activities, and evaluation and certification of research results in the country. In fact, this mandate overlaps with some activities within MAI, and AREA has actually some difficulty in insuring its

<sup>1</sup> By **Dr I. Muharram**, Chairman, AREA; **Dr Saleha Nahdi**, Professor, FAUS; and **Dr A.M. Bamatraf**, Vice Minister, MAI; with the support of Dr. S.V.R. Shetty, Team Leader, ICARDA-Yemen.

<sup>2</sup> Unless otherwise indicated, most of the data in this monograph relate to 1996.

role. However, a National AR and Extension Council and an AR Scientific Technical Working Committee set up by AREA in 1991 and 1995, respectively, are still supposed to determine the national AR policy and coordinate the NARS institutions.

## **2.2 The Agricultural Research and Extension Authority (AREA)**

### **Mandate and Organization**

AREA is by far the largest NARS institution with 67% of the pRY and 68% of the financial resources of the NARS. It is a semi-autonomous institution governed by a Board of Directors, with the membership of representatives from various ministries<sup>1</sup>. The Chairman of the Board, who is the principal executive of the Authority, is assisted by a Vice Chairman for Research and Extension and one for Finance and Administration, and a Director General of Research and Extension. Together, they ensure the overall planning and management of the research and extension programs and their full coordination.

AREA carries out applied and adaptive activities in all fields; these activities mobilize around 60% of the time of the senior staff. Its other activities cover extension (technical expertise and backstopping of extension institutions or projects, technical support and publications, recommendations, training for extension personnel, on-farm trials and demonstrations, etc.), services (soil analysis, seed production), and consultancies.

### **Human, Physical and Financial Resources**

AREA currently has 274 scientific and technical graduate staff members, including 255 nationals<sup>2</sup> and 19 expatriates, who represent around 164 pRYs<sup>3</sup>. The rather low qualifications of the graduate national staff (45 PhD, 68 MS, 142 BS) can be explained by the past loss of many trained researchers to the universities because of the better salaries observed there until 1996 when the salaries of AREA staff increased to be equivalent to those of academic staff<sup>4</sup>. The distribution of researchers with respect to the different regions based on the needs of the regions is unbalanced: for example, 32.5% of AREA research staff and about two-thirds of the PhD and MS holders are located in El-Kod and Seiyun Research Stations, and only 2% in the Eastern Region (Marib).

AREA employs also 242 junior technicians and other support staff (clerks, accountants, laborers, etc.). The ratio of technicians and other support staff to graduate staff member (1 and 2, respectively) is half the general agreed upon standard (2 and 3–4).

Besides the headquarters located in Dhamar, AREA has five specialized centers: the Livestock Center in Lahaj, the National Resources Management Center, the Food and Post-Harvesting Technology Center, the National Agricultural Training Center (all three in Dhamar), and the Mass Media Center in Sana'a. Eight regional stations cover research in field and horticultural crops, plant protection, soil and water, farming systems, livestock, and forestry in the different agroecological zones.

The area of all these units sums up to around 392 ha. In general, research facilities (offices, labs, farms, equipment, vehicles, etc.) and information services are poor and need repair and spare parts. There is a need for computers for conducting statistical analysis and data processing. A database center has recently been established in Dhamar, but lacks skilled staff and appropriate facilities. The central library has poor stocks of journals.

In 1997, the total AREA financial resources amounted to around Yemeni riyals (YR) 755 million (\$US 6 million), of which:

- YR 180 million came from national sources, mainly through local recurrent budget and, to a limited extent, through income generated from production ;
- YR 125 million (US\$ 1 million) (from a World Bank loan) received through the research component of the Agricultural Sector Management Support Project (ASMSP) since 1995;
- YR 450 million (US\$ 2.9 million) from foreign grants, the major donors being the Netherlands and Germany.

<sup>1</sup> AREA's legal status was defined by a presidential decree in 1998.

<sup>2</sup> In 1989, AREA had 207 professional graduate staff, consisting of 173 nationals (23 PhD, 67 MS, 83 BS) and 34 expatriates. In 1992, this national staff was 235 (27 PhD, 82 MS, 126 BS) (Source: Hariri, 1994).

<sup>3</sup> pRYs = Number of researchers on duty x 60% (percentage of the senior staff's time devoted to AR).

<sup>4</sup> The current average monthly salaries of AR and academic staff is YR 48,000 (US\$ 380), 31,000 (US\$ 250) and 28,000 (US\$ 220) for PhD, MS and BS holders, respectively, and YR 12,000 and 8,000 for technicians and laborers.

Since 1980, the national resources have remained stable or slightly decreasing in US\$ equivalent (2 million in 1980, 5 million in 1987, 1.7 million in 1996). But with the increase of staff number, the part allocated to salaries has been growing over the years, reaching 91% of the national budget in 1995 and 1996 and 92% in 1997. Now, the operational and capital costs (OCC) are mainly funded by the loan and the foreign grants. Assuming that two-thirds of these external funds are allocated to the expatriates' salaries and to OCC, the total OCC may amount to around US\$ 9,500 per graduate staff member, which is very insufficient for providing satisfactory conditions of work (see Section 3.3).

Financial management of AREA headquarters is weak and audit accounts are delayed.

### Research Activities and Linkages

Research planning is done according to the five-year plan and annual planning exercises (see Section 4.1). However shortages of researchers and financial resources are crippling the implementation of the planned activities.

Currently, 32% of the AR senior staff are allocated to field crops; 10% to horticulture, forestry and animal production; 15% to natural resources; 2% to food technology; and the numbers of socioeconomists are almost negligible. Only the research programs/activities which benefit from external financial support are actually implemented, mainly resource characterization (with FAO), networking on crops, and farming systems and on-farm trials (with ASMSP). Except in these externally supported programs, research outputs are inadequate due to financial difficulties and the lack of resources, incentives and accommodation facilities in remote rural areas.

The current organization of research activities is poorly defined, with some sections and units existing only on paper. Lines of authority and communication are not clear.

Cooperative relations exist with international organizations and international agricultural research centers (IARCs) such as ICARDA, CIMMYT, ICRISAT, IBPGR and ACSAD, mainly in exchange of genetic resources and information, and training of AREA staff. Yemen receives both technical and financial support from different donors, e.g., Germany, the Netherlands, the UK, the World Bank, UNDP, ICARDA and FAO.

AREA is a member of some research networks and projects like the Sorghum and Millet Network with Asian countries (coordinated by ICRISAT); Oil Seed Crops Development Network with Somalia and Sudan; Irrigation and Water Management Network with several Arab countries; the ICARDA Nile Valley and Red Sea Regional Program (with Egypt, Eritrea, Ethiopia and Sudan) and the Arabian Peninsula Regional Program (with the Gulf countries and Saudi Arabia).

Through these activities, AREA benefited by providing on-the-job training for its permanent staff, obtaining equipment, exchanging information, joint planning and implementation of research activities.

### **The Marine Sciences and Resources Research Center (MSRC)**

MSRC is a semi-autonomous institute within the Ministry of Fisheries. It carries out applied and adaptive research activities on fisheries and oceanography, which mobilize around 50% of the time of its senior staff (other activities cover survey of national fisheries resources, extension).

MSRC has 46 graduate staff members, all nationals (5 PhD, 25 MS, 16 BS). Apart from the headquarters located in Aden, MSRC has two branches: one in Hodeida and another in Mukhala.

Its total financial resources amount to around YR 23 million (\$US 0.18 million), mainly from national sources, i.e., about US\$ 3,900 per graduate staff members. OCC is extremely low; accordingly, no significant research program is under way, and the graduate staff is currently largely underemployed.

MSRC has poor external relations, limited to the membership of an international aquaculture network funded by the Netherlands and UNDP.

## **2.3 The Four Faculties of Agricultural Sciences**

**Overview** - These are:

- The Faculty of Agriculture of Sana'a University (FAUS), with 77 academic staff (all nationals: 45 PhD, 8 MS, 24 BS), supported by 11 technicians and other support staff (clerks, laborers);
- The Faculty of Agriculture of Aden University (FAUA), with 72 academic staff (including 60 nationals: 42 PhD, 15 MS, 3 BS; and 12 expatriates, all PhD holders);

- The Faculty of Agriculture of the University of Ibb (FAUI) and the Faculty of Agriculture and Veterinary Science of the University of Dhamar (FAVUD), both established in 1996, which do not have permanent academic staff (education provided by scientific staff coming from FAUA and FAUS).

The four FASs are semi-autonomous, public institutions within their respective universities, affiliated to the Ministry of Education (MOE). They provide BS degree education. FAUS and FAUA have started recently a postgraduate program.

The 149 academic staff members of the FASs represent 38 potential RYs<sup>1</sup>. Physical resources are limited, except at FAUS which has good laboratory facilities (infrastructure and equipment renovated in 1993/94 through the assistance of USAID and the Islamic Bank).

The total national budget of the four FASs amounts to around YR 60 million (US\$ 0.48 million), of which 30 and 15 are for FAUA and FAUS, respectively, which means about US\$ 3,200 per academic staff member for all the academic and research activities and all costs (salaries and OCC). External resources are mainly allocated to the cost of the expatriates; they may roughly amount to US\$ 1 million (YR 120 million), but such amount may not exceed US\$ 250,000 (about YR 30 million) at the “national cost” (when estimating the salary costs of the expatriates on the basis of the average salary cost of national graduate staff).

**Research Activities** - The availability of highly qualified staff and of students who could be associated with research offers a large comparative advantage for the FASs to implement AR programs; however, AR is constrained by several factors:

- Academic staff members have little time available for research because of the excessive teaching loads dictated by the large numbers of students.
- Research resources are rather limited: technicians are scarce and mainly mobilized by the education activities, physical resources are limited, and financial resources are meager and spent mostly on salaries; there are no funds for research.
- The links with AREA, development/extension organizations and external educational and/or research institutions are very limited.

So far, AR activities have been very modest at FAUS and FAUA and have not yet been developed at FAUI and FAVUD. As a consequence, the time allocated for research by the academic staff members does not actually exceed 10%, which gives less than 15 actual RYs for the four FASs.

## **2.4 The Other NARS Institutions**

### **The Other Scientific Institutions**

Apart from the FASs, the Yemeni universities have some faculties (sciences, economics, etc.) with units/departments specialized in agriculture-related sciences, such as those of plant/animal biology, food technology, rural geography, socioeconomics, etc. A recent, complete inventory of these units is not available; it is even difficult to have a rough estimate of the total number of scientists concerned.

### **The Development Projects Involved in AR Activities**

Numerous agricultural/rural development projects funded by bilateral and multilateral agencies have an AR component, some with a proper research–development unit. Since an up-dated precise inventory of these units is not available<sup>2</sup>, it is difficult to have a precise idea of the AR activities and resources of these projects.

However, it is worth mentioning that in 1997, 11 development projects funded by the World Bank, UNDP, Germany, and IFAD represented an external amount of US\$ 142 million (including US\$ 135 million as loans and 7 as grants<sup>3</sup> for

<sup>1</sup> Taking into account the normative rate of 25% of the academic staff members' time allocated to AR activities, adopted for the analysis of all the WANA NARS (see methodology of the study).

<sup>2</sup> Recently, it was decided to make an inventory of research activities within the projects for developing the National Agricultural Research Program (NARP). This will be ready in September 1999.

<sup>3</sup> Among the eight projects funded by the World Bank (total loan around US\$ 115 million) there were 6 regional projects (Tihama/coastal region; southern and northern mountain regions; eastern region; Wadi Hadramout/eastern desert; south) focusing on natural-resource management, and 2 national projects (land and water conservation; seeds and agricultural services). The two national projects funded by UNDP and Germany (US\$ 7.5 million as grants) were the Sustainable Water Resources Management Project and the Sustainable Environment Project, implemented by the National Water Resources Authority and the Environmental Protection Council, respectively. IFAD supported the Tihama Environmental Protection Project through a loan of US\$ 20 million.

the time of their duration (between 3 and 8 years, with an average of five years), with 5 to 10% of their total funding allocated to AR (very rough estimate through a quick survey). This would mean that at least about US\$ 1.5 million per year (YR 190 million) were allocated to AR activities in these projects (mostly funded by loans), carried out by proper research units and staff (at least 10 expatriates and their national counterparts), often in collaboration with AREA<sup>1</sup>.

It also seems that AR activities in development projects concern mostly regions and scientific fields (mainly natural resources) poorly covered by AREA and the FASs.

### 3. AR RESOURCES

#### 3.1 **Human Resources** (see [Table 1](#))

In 1997, the Yemeni NARS involved less than 500 scientific and technical senior graduate staff, who account for about 245 potential RYs (220 national, 25 foreign), most of this staff being from AREA and the FASs.

The level of academic training is quite good at the FASs (63 and 17% PhD and MS holders, respectively) but insufficient at AREA (only 18% with a PhD degree). The recent improvement of the status and salaries of AREA researchers opens possibilities for better equilibrium in the future. Staff of these agricultural scientific institutions remains highly concentrated in a few places; some agroecological regions (eastern region) are far from being covered according to their agricultural importance.

In general, the number and quality of technicians and other support staff (laborers, clerks) are insufficient due to the very low salaries offered by the public institutions. This situation is strongly affecting the scientists' research efficiency.

#### 3.2 **Physical Resources**

The most important physical research resources of the NARS are within AREA units (headquarters, centers, stations), which are rather well distributed in the country. Most of the FASs have very modest research facilities, with the exception of FAUS.

Until recently, land was sufficient; however, large areas have now been taken by the Government. The other physical resources (offices; farm buildings; laboratories; libraries/documentation services; scientific, computer, transport and communication equipment) are inadequate and/or need efforts for maintenance and/or modernization. The common problem at present in all institutions is the absence of a central workshop for maintenance of equipment. Often costly equipment remains unused because the staff does not know how to operate it or because of some minor problem such as replacing the spare parts.

#### 3.3 **Financial Resources** (see [Table 1](#))

In 1997, the total (national and external) AR financial resources amounted to around YR 760 million (US\$ 6.1 million), of which YR 180 million (US\$ 1.4 million) came from national sources (mainly the government budget), YR 260 million from loans (from the World Bank to AREA and from diverse donors to AR activities within the development projects), and YR 320 million (US\$ 2.6 million) from external grants secured through bilateral or multilateral donors. This breakdown clearly shows that the NARS relies mainly on external funds, especially for OCC.

The AR total resources of the NARS amount to around 0.68% of the Agricultural Gross Domestic Product (AGDP estimated at US\$ 0.9 billion in 1996). The national contribution represents only 0.16% of the AGDP, but reaches 0.39% when adding the loan which will be finally paid by the country. Such ratios are much under the 1% recommended ratio by some international organizations (World Bank, European Union, etc.). This statement pledges for an increase of the national financial resources to take into account the needs of the national scientists, and to keep an acceptable balance with external funds, especially with the loans.

Areas of expenditure vary between the NARS institutions; however, in the scientific institutions, the available OCC per graduate staff member is relatively low and inadequate for allowing satisfactory work conditions. The corresponding OCC

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<sup>1</sup> These conservative estimates do not take into account other projects that may also be involved in AR and funded by other donors, such as the Environmental Resources Assessment for Rural Land Use Project (FAO and the Netherlands); the Innovation Development in the Agricultural Sector Project (GTZ); the Mountain Terrace Project (IDRC); the Nile Valley and Red Sea Regional Program, coordinated by ICARDA; etc.

per pRY (around US\$ 13,000<sup>1</sup> at AREA, less than US\$ 3,000 at MSRC and the FASs) is much under the "optimal" amount of US\$ 25,000–30,000 per RY used in the long-term plans designed by many developing countries, which means that the AR scientific potential is currently far from being fully mobilized. According to this reference, the actual scientific potential of the NARS amounts to approximately 105 actual RYs (of which around 65 are at AREA, 5 at MSRC, 15 at the FASs, and 20 in the development projects) as opposed to the 245 pRYs estimated above, which means that the human potential of the NARS is much underemployed.

## 4. RESEARCH ACTIVITIES

### 4.1 Research Orientation

Research planning is officially done according to the agricultural component of the national development plans. For instance, the 1996–2000 development plan emphasizes a number of areas such as:

- Adopting the farming systems approach to research and extension, in particular to rainfed agriculture. At present, research is commodity oriented.
- Natural resource management research to conserve the overexploited water resources, and to prevent land deterioration due to soil erosion, terrace deterioration, and degradation of crop cover leading to desertification, as well as to conserve genetic resources.
- Integrated pest management and biological control of virus and virus-like diseases of citrus, dates, sub-tropical fruits, vegetables, cereals and industrial crops; control of pests, vectors and pathogens; improving lines through breeding for resistance; control of losses at the field and post harvest levels; and forecasting epidemic outbreaks.
- Crop improvement for wide adaptability and tolerance to stresses (drought, salinity and pests), introduction of high-yielding varieties, improvement of cultural practices, encouraging breeding for multiple resistance using traditional plant breeding and new biotechnology approaches.
- Rangeland and livestock production, especially sheep and goats, and control of rangeland degradation by introduction of rangeland practices and production of green forage.

Until 1997, AREA was not able to follow this orientation; its resource allocation is still rather unbalanced between research fields and regions, and this weakness is partly compensated for by the temporary projects/programs.

The national AR strategy recently prepared with the assistance of ICARDA and ISNAR will help in strengthening priority scientific and regional areas and the development of medium- and long-term plans according to a time schedule.

### 4.2 National and International Linkages

Relations of AREA with development and extension organizations suffer from the poor distribution of its researchers and its focus on commodity-oriented research; however, the process of research decentralization and the higher attention given to farming-systems-oriented research are promising for the future. In general, the FASs are not serving agricultural development, and AR activities in the development projects are suitably related with farmers' issues.

In spite of the many constraints and weaknesses, AR activities seem to have met some of the development objectives of the country; for example, self-sufficiency in vegetables and fruits has been achieved.

At the national level, linkages (which remain very weak at present) between AREA and each of MAI, Ministry of Planning and Development (MPD), Ministry of Finance (MOF), Ministry of Education (MOE), and the universities are mainly through its Board of Directors, where representatives from these organization are members. Linkages with the universities are weak and are at the individual level, even though the deans of FAUA and FAUS are members of AREA Board of Directors. There is no representative from AREA at the faculty councils.

As seen above, international scientific linkages are relatively important for AREA, and have been highly profitable (joint planning and implementation of research activities, on-the-job and foreign academic training for its permanent staff, exchange of information, procurement of equipment, etc.). These linkages are rather poor for MSRC and the FASs.

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<sup>1</sup> As the numbers of pRYs are lower than those of graduate staff members, but part of the OCCs are allocated to other activities than research (see Table 1, note related to AREA).

## 5. CONCLUSION

The Yemeni NARS is young. Its permanent scientific institutions have been established recently and have grown quickly. Although there has been an annual increase in their staff numbers, funds have not increased accordingly and national resources per scientist have become more and more limited.

AREA is the unique AR institution officially responsible for all AR activities in the country (except the fisheries research sector for which MSRC is responsible). However, it currently has limited relations with the two other main components of the NARS (FASs, development projects). Coordination and communication within the NARS are weak at all levels, and it has been difficult so far to take advantage of the comparative advantages of its institutions: large number of human resources and important physical resources at AREA; highly qualified and stable staff at the FASs; and good finding and external relations in the projects.

Through the implementation of the medium-term plan, AREA should improve its efficiency (higher qualification and stability of its researchers; better balance among the research fields and regions; larger number of technicians; higher national funds; etc.) and be able to progressively meet the research needs currently covered by the development projects.

### Main Acronyms

**MAI:** Ministry of Agriculture and Irrigation. **MOE:** Ministry of Education.

**AREA:** Agricultural Research and Extension Authority. **MSRC:** Marine Sciences and Resources Research Center. **FAUA:** Faculty of Agriculture, University of Aden. **FAUI:** Faculty of Agriculture, University of Ibb. **FAUS:** Faculty of Agriculture, University of Sana'a. **FAVUD:** Faculty of Agriculture and Veterinary Science of the University of Dhamar.

**YR:** Yemeni riyal.

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**Table 1 - The National Agricultural Research System (1996/97)**

*Italics: Approximate data. °: Rounded numbers. ...: Data not available. \*: See footnotes.*

NARS Institutions				AR Graduate Scientific & Technical Staff (Units)			Potential Res. Years (pRY)		Total Budget (million YR)		AR Expenditures/Resources (E) (million YR)			
No.	Name - Acronym (Head Office - Year Establishment)	Mandates AR Fields	Govern. Ministry	Nationals Total - (PhD , MS)		Exp.	Nat.	Exp.	Nat.	Ext.	Nat. E NE	Loan LE	For. E FE	Total E TE
a	B	c	d	e	f	g	h	i	j	k	l	m	n	o
1.1	Agricultural Research and Extension Authority AREA Dhamar 1955,90	AR (60%) - (AD) All exc. fisheries	MAI	255	45 , 68	19	153	11	180	575	140*	80*	300*	520
2.1	Marine Sciences and Resources Research Center - Aden MSRC 1983	AR (50%) - (AD) Fisheries, aquacult.	MOF	46	5 , 25		23		23	...	20°		...	20°
<b>1-2</b>	<b>Total Agricultural Research Institutes</b>			<b>301</b>	<b>50 , 93</b>	<b>19</b>	<b>176</b>	<b>11</b>	<b>245</b>	<b>560</b>	<b>160</b>	<b>80</b>	<b>300</b>	<b>540</b>
3.1	Faculty of Agriculture, Sana'a University - Sana'a FAUS, 1984	AHE - (AR%) All*	MOE	77	45 , 8	0	19		15		3			3
3.2	Faculty of Agriculture, Aden Un., Aden FAUA, 1975	AHE - (AR%) All*	MOE	60	42 , 15	12	15	4	30	120	6		10*	16
3.3	Faculty of Agric. & Vet. Scienc., Ibb Univ. - Ibb* FAUI, 1996	AHE - All*	MOE	0*		0*	0	0	15		0			0
3.4	Fac. of Vet. Scienc., Univ. Dhamar - Dhamar* FAVUD, 96	AHE – An. prod./health	MOE	0*		0*	0	0			0		0	0
<b>3</b>	<b>Total 4 Faculties of Agricultural Sciences</b>			<b>137</b>	<b>87 , 23</b>	<b>12</b>	<b>34</b>	<b>4</b>	<b>60</b>	<b>120</b>	<b>10°</b>		<b>10</b>	<b>20°</b>
<b>4</b>	<b>Other Scientific Institutions (see Section 2.4)</b>			...	...	...	...	...	...	...	...		...	...
<b>5</b>	<b>Development Projects Involved in AR (see Section 2.4)</b>			...	...	...	10	10	...	...	10	180*	10*	200
<b>6</b>	<b>Total NARS</b>			<b>438</b>	<b>137 , 116</b>	<b>31</b>	<b>220</b>	<b>25</b>			<b>180</b>	<b>260</b>	<b>320</b>	<b>760</b>
<b>Exchange Rate: Yemeni riyals (YR) 1000 = US\$ 8 or US\$ 1 = YR 125 (1997 average official rate)</b>				<b>Actual Research Years (aRYs) (rough estimate)</b>			<b>105</b>		<b>AR Expenditures (US\$ million) →</b>		<b>1.4°</b>	<b>2.1°</b>	<b>2.6°</b>	<b>6.1°</b>

**MAI:** Ministry of Agriculture and Irrigation. **MOE:** Ministry of Education. **MOF:** Ministry of Fisheries.

**c: Mandates:** AR (.. %): Approximate average % of human resources devoted to ag. research (AR); **R:** Research; **AHE:** Ag. higher education; **AD:** Ag. development/services (for AR and AHE institutes: seed production, soil and water analysis, extension, studies, etc.). **h, i:** Potential research-year (pRY) = equivalent full-time researcher; for the FASs, the pRYs have been estimated by multiplying the number of academic staff by 0.25. **I:** For the AR institutes, AR financial resources have been roughly estimated through the following formula: Total budget × [(ω + 0.5(100% - ω)), ω being the % of time devoted to AR by the graduate staff.

\* **Notes:** **1.1/m:** Assuming that 60% of the World Bank loan (through the Agricultural Sector Management Support Project) is allocated to AR activities and 40% to extension. **1.1/n:** Grants estimated at national cost: Estimated by evaluating the salary costs of the expatriates on the basis of the average salary costs of a national graduate staff (estimates made assuming that around one-third of the grants is allocated to the salary costs of the expatriates). **3.3 and 3.4/e, g:** FAUI and FAVUD has no permanent academic staff; lectures are provided by academic staff of FAUA and FAUS (see monograph).

National AR expenditures (NE): **0.16%** of the Agricultural Gross Domestic Product (AGDP: US\$ 0.9 billion in 1996). National expenditure + loans: **0.39%** of the AGDP. Total AR expenditures (TE): **0.68%** of the AGDP.