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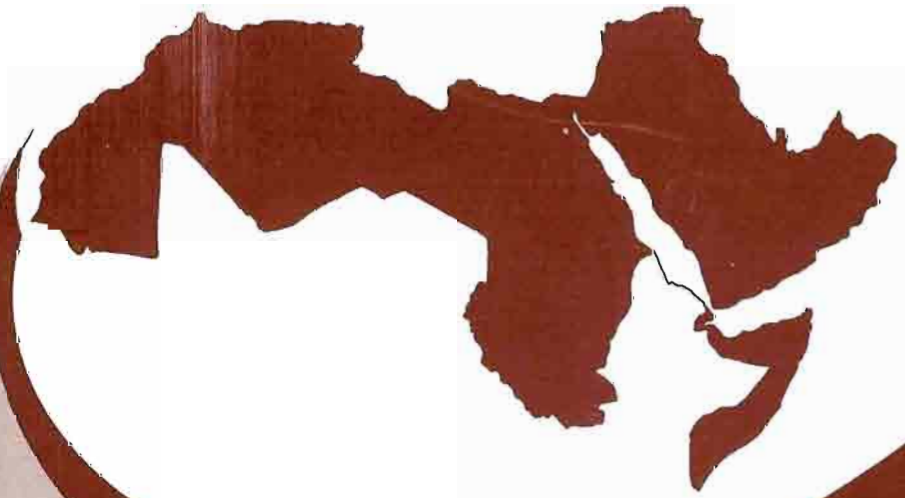

THE STATE OF BIOLOGY IN THE ARAB STATES

By Dr T. Younès

THE STATE OF BIOLOGY IN THE ARAB STATES

Report of the symposium organized by
the ICSU/UNESCO International Biosciences Network
in cooperation with
the UNESCO Regional Office for Science and Technology
in the Arab States (ROSTAS)
and the
IUBS National Committee in Iraq

5-8 December, 1983
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FOREWARD

This summary report on the "State of Biology in the Arab States" is based on the papers presented and the discussions which followed at the symposium held in Baghdad, Iraq, 5-8 December, 1983.

Undertaken within the general framework of the UNESCO/ICSU International Biosciences Network (IBN), the meeting has been organized by the IUBS National Committee in Iraq, in cooperation with the UNESCO Regional Office for Science and Technology in the Arab States (ROSTAS), and the International Union of Biological Sciences (IUBS), in collaboration with the Union of Arab Biologists.

We would like to express our gratitude to Dr. S. Al-Rawi, Director, ROSTAS/UNESCO, as well as to the National Research Council in Iraq, and to Drs. A. Khalaf and Z. Al-Doori, Chairman and Secretary respectively of the Iraqi National Committee to IUBS, for their invaluable support and contributions made in the organization of this symposium, and therefore aiding in its success.

We also wish to thank Mrs. C. Adam for her valuable contribution in the preparation of this report.

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1. INTERNATIONAL BIOSCIENCES NETWORK

(Background Information)

It is needless to point out the important role science and technology play in promoting cultural and socio-economic development; most often, available and potential scientific and technological resources constitute a valuable criterion in today's world, in determining the level of development in a country or a region; the unequal distribution of scientists and engineers active in the field of research and development provides a clear indication on the boundaries separating developed and developing worlds. Developed countries possess 88.7% of the world's available human scientific resources, whereas developing nations have only 11.3%. This disparity appears greater if the actual expenditure on science and technology for research and development is considered, where 96.9% is contributed by the industrialized countries and only 3.1% by the third world countries.

In more comparable terms, the estimate of research and development scientists and engineers (per million population) is 2214/million for the developed countries, with only 118/million in developing nations. The expenditure as percentage of the gross national product (GNP) represents 1.95% in the industrialized and 0.43% in developing countries.*

In order to bridge these differences and to enable the developing countries to benefit properly from recent advances in science and technology, tremendous efforts and large resources have been given by both inter-governmental organizations such as UNDP, UNESCO, FAO, WHO, and various national aid agencies. Unfortunately, the results of all these efforts are still far from being satisfactory, and the gap separating developed and developing worlds is widening. Many reasons lie behind the failure:

1) the approach that has been used can only have a limited value, as long as the recipients of technical aid are inadequately equipped to exploit for themselves the new knowledge and techniques made available. It has become clear that for really effective application, each community should possess its indigenous expertise;

2) experience shows that scientific development and productivity depends on the creation of a quite complex environment, i.e., research teams should exceed a certain critical size to be effective;

3) to build up the efficiency of universities and research centers, competent administration is needed to direct and coordinate the national research efforts. Policy-and decision makers cannot be expected to financially support scientific research unless they are aware that it is in the direct interest of their economy to do so. Administrators need some scientific training in order to identify national needs, problems, and priorities in the area of scientific and technological research and development.

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* Figures given in the 1982 UNESCO "Statistical Yearbook" and corresponds to 1978.

Many of the most urgent needs expressed and the most pressing problems being faced in the developing countries are either wholly or partly biological in nature, such as the provision of food and adequate nutrition for the people, ensuring better health conditions and the conquest of endemic diseases; the control of environmental pollution and nuisances; the national use of natural resources and to combat desert encroachment; as well as the control of human fertility. Moreover, these problems require research in fundamental as well as applied sciences for their solutions.

The ICSU biological unions and committees felt that the international scientific community should play its due role, and have established in partnership with UNESCO a system of "International Biosciences Networks" (IBN), covering the whole of the developing world. The principal aim of such a system is to enable developing countries to conduct biological research for themselves and help expand and strengthen existing research centers rather than building new ones. The Networks, autonomous and flexible in their operation, are organized on a regional basis. For each region, a regional coordinating committee should be established in order to fulfill the following tasks:

a) the preparation of an inventory of the region's scientists and technologists trained in the different biological disciplines, and the identification of the existing research centers which would be the best to serve as nuclei for the advancement of research in particular areas of biology;

b) the determination of priorities for research and development, taking into consideration the special problems of the region, the points where advances in technology would have the greatest economic impact, and the areas where the prospects of success are highest;

c) the organization of scientific workshops, training courses and other forms of educational activities in order to increase the supply of research workers with specially needed skills;

d) the coordination of cooperative research programmes which will benefit from the physical and scientific manpower available at the selected research centers in order to help less advanced countries in launching their own research efforts;

e) to provide a link for coordination of the activities sponsored by the IBN with those of other bodies having similar objectives on both inter-governmental and non-governmental levels.

The regional coordinating committee should include representatives of the scientific institutions and scientists working in the participating countries, as well as representatives of UNESCO and ICSU.

A small international Steering Committee has also been established for the IBN, consisting of a chairman and three other members-at-large appointed by ICSU and UNESCO, plus a representative of each of the regional networks.

Regional networks have been established using different approaches adapted to the specific contexts of the various regions: the Latin American Network (LABN) has been established in 1976 in cooperation with UNESCO and UNDP following the initiative of scientists from the region; the Asian Network has been set up by the ICSU Committee on Science and Technology for Development (COSTED), with support from UNESCO; in Africa, the Network (ABN) has been launched in 1981 at the Accra symposium on "the State of Biology in Africa", organized by ICSU and UNESCO with the support of the UN Interim Fund for Science and Technology for Development as well as the governments of France and Ghana; and the Arab region Network (ArBN) has been formally established in 1983 at the symposium on "the State of Biology in the Arab States", organized by the IUBS National Committee in Iraq, in cooperation with the UNESCO Regional Office for Science and Technology in the Arab States, ICSU/IUBS, with the Arab Biologists' Union being the backbone of the Network.

2. THE STATE OF BIOLOGY IN THE ARAB STATES

2.1. INTRODUCTION

First adopted at the Executive Committee Meeting of the Arab Biologists' Union, held in March, 1982, in Fes, Morocco, the organization of the symposium on the "State of Biology in the Arab States" was entrusted to the Iraqi IUBS National Committee, in cooperation with the UNESCO Regional Office for Science and Technology in the Arab States (ROSTAS) and the International Union of Biological Sciences (ICSU/IUBS).

The symposium was planned in order to provide basic information on the main biological issues, resources, problems and perspectives of biological sciences research and development in the Arab countries. The objective was also to launch the Arab Biosciences Network based upon the Arab Biologists' Union, with the intention of being open to all individuals and institutions (universities, research centers and institutes, regional and international organizations) concerned and active in the field of biological sciences on a regional basis.

At the meeting, 23 working papers were submitted by invited participants representing 9 Arab countries: Egypt, Iraq, Jordan, Koweit, Lebanon, Libya, Sudan, Syria, and Tunisia. In addition, the Arab League Educational, Cultural and Scientific Organization (ALECSO), ACSAD, MIRCEN in the Arab States, UNESCO, and IUBS/ICSU were also represented. These papers dealt with various topics of biological sciences, such as biological resources of the Arab region (plant, animal, and water resources); integrated ecological research and desertification; agriculture, food, nutrition and health problems, endemicdiseases, antibiotics, drugs, and medicinal plants; microbiological research and modern molecular biology techniques (single cell protein, cell and plant tissue culture). Furthermore, research needs, problems and priorities in the area of biological sciences were also discussed.

2.2. ISSUES

In discussing how biological sciences research and development can help meeting with specific needs of the Arab countries and how they may be promoted, and in order to identify the major issues to be dealt with, participants at the symposium felt the necessity to underline two important features of the region. First, the Arab world as well as other developing regions suffers from the lack of competent and well-trained specialists and technicians in the field of science and technology, particularly in the area of biology-related disciplines. Arab countries only possess 1.1% of the world scientists and engineers working in research and development; their number represents 202 per million population, while the United States have 2736/million, and Europe 1635 per million. On the other hand, expenditure on science and technology as percentage of the gross national product (GNP) does

not exceed 0.31% in the Arab region, which is lower than the average expenditure of the developing world (0.43%) and far below the average expenditure in the U.S.A. (2.15%) and Europe (1.88%).*

Second, from the biogeographical point of view, and despite the existence of a wide variety of ecosystems ranging from the tropical zone in the south of Sudan to the Mediterranean's near temperate zones, the great majority of the Arab region (90%) belongs to the arid zones of the world, consisting of marginal and fragile lands where low and variable rainfall (less than 500mm per year), low temperature and/or steep slopes severely limit natural biological productivity.

Four major bio-climatic zones in the Arab region were identified (fig. 1) according to the climatic aridity index used by UNESCO, which is the rate of Precipitation to the Potential Evapo-Transpiration, ($\frac{P}{ETP}$), these zones being:

a) the sub-humid zone where the climatic aridity index varies between 0.50 and 0.75, and the inter-annual rainfall variability is less than 25 per cent. This zone includes maquis in Mediterranean climates;

b) the semi-arid zones with a climatic aridity index between 0.20 and 0.50, which include elevated and mountain lands in Iraq, Jordan, Lebanon, Morocco, Syria and Yemen and the coastal zones in Algeria, Egypt, Libya, Morocco, Sudan and Tunisia;

c) the arid zones have a climatic aridity index of between 0.03 and 0.02. It is made of all dry lands bordering the Great Desert in Africa (Algeria, Mauritania, Morocco, Libya and Tunisia) and the arid lands of the Arabian peninsula;

d) the hyper-arid lands with a climatic aridity index lower than 0.03, and consist of the Great Desert and Al Ruba' Al Khali Desert.

The most important biological science issues concerned with the Arab region are biological resources and the low biological productivity of arid and semi-arid ecosystems; biological problems associated with agricultural and pastoral activities which constitute the main source of income and labor in the Arab world, except in the oil producing countries; perspectives of future developments concerning the establishment of a scientific basis for land use and resource management, and the development of new food sources, adequate nutrition and better health conditions.

Biological research and development activities should include both traditional disciplines such as systematics' studies (plant taxonomy and zoological nomenclature) and new biological fields such as integrated ecological research and system analysis, new molecular biology techniques, genetic engineering and biotechnology.

Conjunctively, in order to develop maximum scientific potential in the region, cooperation among Arab biologists and international biological sciences community is vitally needed. This cooperation should be promoted through the

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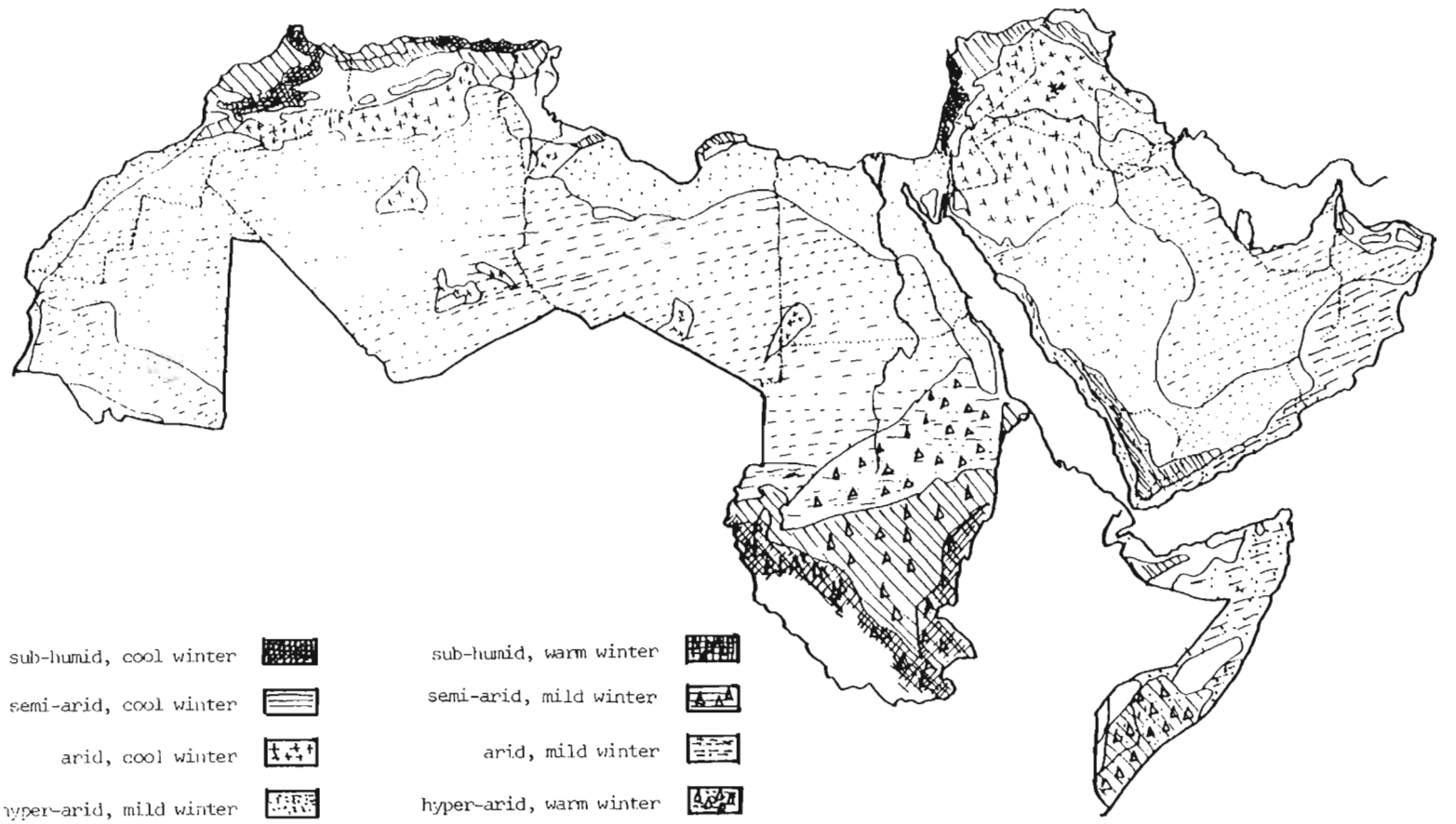
* Figures given in the 1982 UNESCO "Statistical Yearbook" and corresponds to 1978.

FIGURE 1: **Climatic Zones in the Arab Region**

*after the UNESCO map "World Distribution of Arid Regions" (1977)



organization of training courses on specific high-level topics as well as through seminars and workshops on selected fields of research, the establishment of mechanisms for the exchange of information and the development of cooperative interdisciplinary research programmes.

2.3. RESOURCES

One of the major objectives of the symposium is to review the current knowledge of biological resources in the Arab region (plant, animal and water resources), and the characteristics of agricultural, pastoral and other human activities and their impact on arid and semi-arid ecosystems.

2.3.1. Natural Vegetation & Land Use

In the arid and semi-arid zones of the Arab world, the plant cover is sparse and patchy, and consists mainly of shrubs and grass; the vegetation is dominated by species which have a thin, discontinuous and suppressed leaf canopy as a mechanism to control transpiration. Ephemeral plants germinate, grow and complete their life cycles rapidly after the rains and remain as seed throughout the long intervening dry periods (Artemisia monosperma, calligonum comosum, Ephedra alata, etc.), perennial grass sprouts from rhizomes or bulbs during rains (Tribulus, Morettia), and perennial shrubs and trees like Acacia species (Atortilis, A. raddiana, A. flava, etc.), which have woody stems and leathery leaves, are behaviorally and physiologically adapted to harsh environments and remain nutritious during dry spells.

On the other hand, Mediterranean-type vegetation occurs throughout the coasts of Morocco, Algeria, Tunisia, Lebanon, Syria, and the northern part of the Libyan coast. If the hyper-arid Sahara is excluded, forests occupy 16% of Morocco, 12.5% of Algeria, 9.5% of Tunisia, and only 0.4% in Jordan. The "Mediterranean woodland climax" includes Quercus Libani, Q. aegilops, Q. infectoria, Q. Calliprinus, Pinus brutia, P. halepensis, and P. nigra; the "semi-arid Mediterranean stage" includes wooded pseudo steppes or more or less degraded woodlands of tetraclinis articulata or juniperus phoenicea. And the "non-wooded arid Mediterranean stage", which includes the following typical steppes: woody plant steppes with Artemisia herba-alba, Ziziphus lotus, or Arthrophyton scoparium, grassy steppes with Stipa tenacissima and shrubby steppes with Argania spinosa, Pistacia atlantica, and Acacia radiana. According to Ayyad and Farid, land use in the Arab world includes mainly rangelands (270 million ha constituting 19% of the global area of the region), and arable land occupying 3.64% of the total area and used for rain-fed agriculture (of approximately 40 million ha) and irrigated agriculture (of about 10 million ha). Natural pastures are important, not only for provision of cheap renewable food resources for livestock and wild animals, but for the vital role played in preserving soils from erosion and protection of wild plants and animals.

In addition, in the papers of Drs. L. Boulos (Egypt) and A. Al-Jeboory (Iraq), toxic and medicinal plants and their importance in formal health delivery systems and in herbal medicine were considered. They agreed that very little is known on medicinal plants in the Arab world, and that an essential prerequisite for scientific work on these plants is correct identification. The

information presently available is largely insufficient and in part, unreliable, because the naming is incorrect and voucher specimens are lacking.

According to Dr. D. Al-Eisawi (Jordan), who reviewed existing plant taxonomy studies in the Arab countries, this lack of knowledge applies in general to all plant resources; he concluded that little work has been done on the flora in the region, and even though the flora of some countries has already been documented, most of the work is not updated, and monographic revisions based on the modern aspect of biosystematics of these numerous groups are needed.

2.3.2. Domestic and Wild Animals

A wide variety of animals are found in the Arab region, reflecting the various ecosystems. However, the main features of animal life lie within the physiological and behavioral adaptation of animals to unstable dry climates for survival. Many dry land animals conceive only during the good years, and several species are nocturnal, being active only when temperatures are lowest. An important feature of the behavior of dryland animals is their mobility; ungulates and their predators migrate hundreds of kilometers, making use of seasonal patterns of rainfall and the resources available in different habitats. Herbivores include grazers and browsers, many large animals are omnivorous so that they can utilize whatever food is available, even during bad periods.

Among domestic animals, sheep, donkeys, and cattle are grazers, and goats and camels are browsers. The Arab region, according to Dr. M.F.A. Farid (Egypt), possesses a large population of domestic ruminants (Table I.), estimated at approximately 66.3 million units, including cattle (42.1%), sheep (25.5%), camels (15.3%), and goats (14.0%). Five Arab countries possess 3/4 of the total domestic animal resources of the Arab region, Sudan (20.8 million units), Somalia (14.8 million units), Morocco (6.5 million units), Iraq (5.1 million units), and Egypt (4.3 million units). Camels and goats are of special interest, for they produce food for humans while existing on the scarce resources from the more arid pastoral areas.

2.3.3. Water Biological Resources

Aquatic ecosystems and their resources are increasingly used to compensate the low biological productivity of arid and semi-arid zones, in providing food for human populations and domestic animals. In this regard, the most important species are fish (90%), molluscs, and crustaceans (7 to 8%); the use of marine algae for food is still lower than 1% of the total food resources of marine ecosystems.

The Arab region possesses a high potential of water biological resources due to the very long coastline bordering the Mediterranean and Red Sea, the Atlantic and Indian Oceans, and the Arabian Gulf, and to its large inland water reservoirs (the Nile, Tigres and Euphrates Rivers).

However, water biological resources of the Arab countries are still under-exploited and not well studied; Dr. A. Khalaf (Iraq) noted that the Arab fish

production in 1982 did not exceed one million tons, representing 1.4% of the world fish production, and gave an example in that the marine fisheries in Mauritania produce only 58% of the country's fish production (36,000 tons per year), despite the proximity to the large Atlantic fish reservoir on the 470 kilometer Mauritanian coastal zone. He added that the total fish production in the Gulf countries is 312,000 tons per year, of which 63% is produced in the Sultanat of Oman. Unfortunately, only 18% of this production was used as food, as the remainder consisted of either undesirable species or lost, due to the absence of the fishing industry, therefore a lack of processing facilities. Dr. Al-Shurbagi reported that fish are used as feed for camels in Oman! Finally, Dr. Murad B.M. Mohamed underlined that rich and highly diverse marine ecosystems in the Gulf are not well known, and that interdisciplinary oceanographical research programmes should be developed as a basis for rational management, and also noted that these ecosystems are facing a dangerous problem of oil pollution.

2.4. PROBLEMS

Research needs and priorities in the Arab region are logically determined, following the situations of biological resources and the urgency of biology related needs and problems encountered in the various fields of energy, food, nutrition and health.

In dealing with these issues, participants at the meeting discussed current agricultural practices and animal production activities and their impact on ecosystems, with special emphasis on the problems of desertification, degradation of the plant cover, and erosion of soils. Consideration was given to plant protection aspects and to nurseries and afforestation methods. The need for integrated ecological research and taxonomy studies of plants and animals was stressed.

Agriculture and animal production were also discussed in relation to food and nutrition problems in the region: the development of single cell protein, microbiological research, and plant tissue culture methods were considered with the aim of providing new food sources. The meeting also dealt with health problems and diseases, and the role of antibiotics and medicinal plants in controlling them.

2.4.1. Desertification

The most important environmental problem in the Arab countries is desertification, which has been defined as "a combination of processes which result in more or less irreversible reduction of the vegetation cover, leading to the extension of new desert landscapes to areas which were not formerly desert" (Le Houerou, 1969).

The main causes of desertification which have been cited are the long term climatic change, the cyclic fluctuations in climate and periodic droughts, and

the destructive consequences of human activity. Among these factors, the increasingly destructive influence of man on the environment resulting from population growth and the uncontrolled exploitation of resources constitute the major reasons for the continuous advance of desertification.

Drs. Ayyad and Mahmoud (Egypt) underlined that 20% of the plant cover in the Arab region has now been destroyed, while 50% of the region is made up of degraded and impoverished rangelands, 20% of good pastures, and only 10% considered to have excellent ones. These protected and favored pastures are located in the mountain areas with high precipitation and in the zones that have not been exposed to excessive use by man.

Harmful human activities in the Arab region include overgrazing, marginal cultivation of annual crops, cutting of tree species for fuel wood, mechanized plowing, salinization as a result of faulty irrigation methods, and the indiscriminate use of modern agricultural techniques. These practices have resulted in the disappearance of many plant and animal species, the scarcity of many others, soil erosion, and dunal formation.

Dr. M.B. Messaudi of the Arab League Educational, Cultural and Scientific Organization reviewed the current efforts undertaken by the governments in North African countries to control desertification through sand dune fixation and afforestation projects. In each country there are several nurseries producing millions of seedlings, and tens of thousands of hectares of land have been afforested. He explained that because water is a limiting factor in these areas, attention was given to economizing water use in the nurseries and the utilization of covered root system of seedlings in the afforestation programme, as well as the importance stressed on soil preparation, proper planting techniques, and the reduction of soil moisture evaporation. Dr. Messaudi concluded that the evaluation of these experiences in North African countries will be of great importance and benefit to the Arab region.

In their paper entitled Integrated Ecological Research Toward the Development and Protection of Natural Resources in the Arid and Semi-Arid Lands of the Arab Region, Ayyad and Mahmoud addressed such questions as the need for research to respond to the priority needs of local populations, the role of system analysis, and in general, the extent of scientific responsibility in providing an ecological basis for physical planning and management of marginal areas. Such an approach should consider the following elements:

- practical observations of the models of the spatial and temporal heterogeneity of ecosystems;

- floral and faunal composition, richness, and diversity, and types of autoecological responses;

- primary and secondary productivity;

- the ecosystem's response to various natural and artificial pressures, such as reproduction, regeneration, self-regulation, "elasticity" of ecosystems, carrying capacity, and ethology of domestic and wild animals;

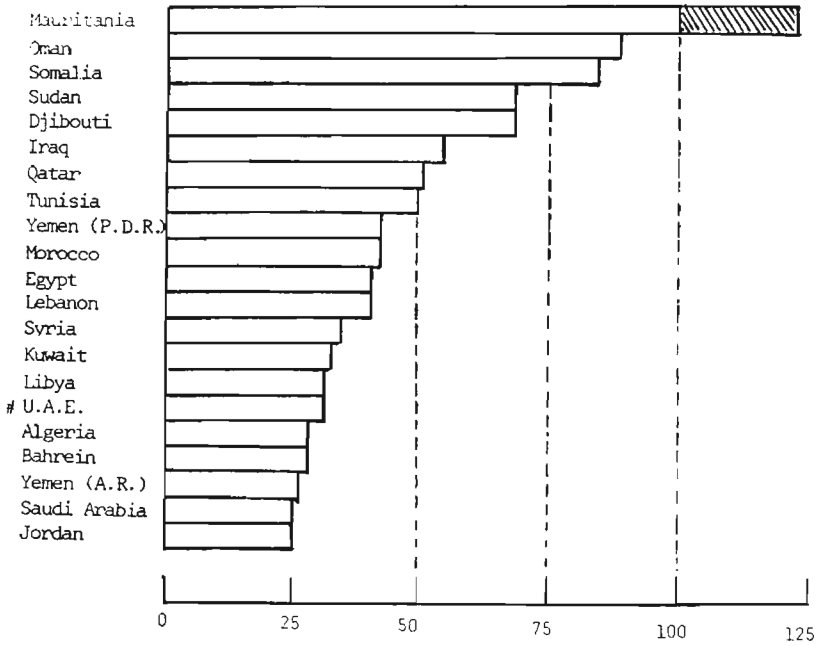
TABLE 1: DOMESTIC ANIMALS IN THE ARAB COUNTRIES
(one animal unit represents the equivalent of a cow - 450 kg weight)

Country	Number of Units (x 1000)	Percentage of Animal Species Units			
		Cattle	Sheep	Goats	Camels
Algeria	3353.9	27.8	56.5	11.3	4.4
Bahrein	7.5	53.3	6.7	26.7	13.3
Djibouti	148.0	10.3	12.0	60.1	17.6
Egypt	4314.0	85.5	7.5	4.8	2.2
Iraq	5138.5	44.7	40.2	10.6	4.5
Jordan	272.1	10.6	55.4	27.0	7.0
Kuwait	54.5	14.7	48.6	27.5	9.2
Lebanon	160.9	41.8	26.8	30.8	0.6
Libya	1392.4	11.5	60.5	12.6	5.4
Mauritania	3298.0	36.4	27.3	14.6	21.8
Morocco	6525.0	44.4	39.4	13.1	3.1
Oman	159.0	68.4	8.8	19.0	3.8
Qatar	27.0	17.8	21.5	27.4	33.3
Saudi Arabia	1067.0	25.5	40.5	23.9	10.0
Somalia	14842.0	24.9	13.9	19.2	42.0
Sudan	20781.5	63.8	13.6	8.6	14.0
Syria	2016.4	25.8	66.0	7.7	0.4
Tunisia	1630.2	39.7	38.9	18.7	12.6
United Arab Emirates	109.2	11.0	14.8	33.0	41.2
Yemen (A.R.)	2701.0	28.1	24.7	43.3	3.9
Yemen (P.D.R.)	489.5	17.5	34.9	36.4	8.2
GLOBAL	66302.0	45.5	25.2	14.0	15.3

*After the United Nations Statistical Year Book & Farid (1980) Camels in the Arab Region

FIGURE 2: **Animal Protein Self-Sufficiency Indexes in the Arab Countries** (100 = full regular population requirements met by local animal protein production)

*from Dr. Farid's working document



United Arab Emirates

- the factors and mechanisms regulating the dynamic equilibrium of ecosystems;

- organic, mineral, and water cycles, and their relationship with ecological succession and multiple resource use.

In addition, they stressed the role of systems approach, the use of mathematical and statistical modeling and simulation techniques in the application of ecology to development. This approach does not preclude traditional analytical methods, which are needed whenever autecological research is called for to provide thorough and precise information on basic mechanisms. The systems approach for the ecological study of marginal lands is the only one which can produce results that are easily transferable to the populations of these areas.

2.4.2. Food and Nutrition

The major problem facing the Arab world is how to meet the ever increasing need for food of the local populations. Ayyad and Long (1984) considered the example of cereal requirements in North African countries; the equivalent of 200 to 300 kgs of wheat grain is needed per person per year, taking into account consumption habits and nutritional standards. The average annual yield of grain cereals amounts to approximately 200 to 500 kgs of grain per hectare per year. This signifies that a rural family consisting of six adult equivalent units must cultivate on a permanent basis, a minimum of 6 ha to meet its food grain requirements. Considering that rural population density ranges at present from 10 to 90 inhabitants per km^2, vast areas of agricultural land would be needed to achieve the self-sufficiency in cereals. In the North African and undoubtedly other Arab countries, the first rural development problem to be solved is where to grow cereal food crops to obtain the highest yield in the minimum area; in this regard, it is anomalous to assume that the principles of physical planning applicable to the arid zones of developed countries should also be applied to the developing countries with a Mediterranean climate.

In Dr. Farid's paper entitled The Scientific Research Towards the Development of Animal Resources in the Arab Region (Fig. 2), it was noted that the great majority of the Arab countries are far from ensuring animal protein self-sufficiency; 15 countries produce less than 50% of the standard animal food requirements of their populations, 5 produce between 50-100%, and only one (Mauritania) produces more than 100%. The annual deficit of the commercial balance related to animal food products amounted to 1.12 billion US dollars during the period 1976-78, and estimates of global deficit by the year 2000 are of 93.3 billion US dollars. The food gap is expanding geometrically because of inferior animal productivity and the falling behind of the rates of increase in animal production in relation to the ever increasing demand for food. The Arab food problem was discussed in light of prevailing characteristics of animals and production systems, constraints on development and the present development strategies on both a national and regional level.

Traditional controversies concerning the future of animal production in the region were discussed, including the role of ruminants in the lesser developed agropastoral societies, the competition between ruminants and man for cereal grains, the role of camels and goats in the more arid pastoral areas and the future of pastoralism in relation to nomads settlement policies.

A broad outline was suggested for future research activities in the specialized fields of resources and the environment, food resources, animal nutrition, reproductive physiology, genetics and breeding and animal hygiene. The importance of goats and camels, particularly the need to upgrade their production through appropriate research programmes was also stressed.

On the other hand, Dagher and Hallab (Lebanon) noted the importance of crop storage and processing methods, and the use of advanced and appropriate food technologies, which are essential to solve the urgent problems hindering food production in the Arab countries. They also underlined the lack of adequate food policies and the need for nutrition education programmes on both school and out-of-school levels.

2.4.3. Health and Diseases Control

The role of biological research in solving health problems and controlling of diseases in the Arab region was discussed at the meeting, with emphasis on parasitic and infectious diseases, the use and misuse of antibiotics and their control, and finally, the impact of pollution on health.

Dr. I.K. Kaddou (Iraq) presented a review of the most common parasitic and infectious diseases in the region, emphasizing both their causative agents and vectors. He underlined the imporant role of insects in the propagation of diseases in acting as simple carriers of the germs (contaminators) of typhoid, trachoma, and cholera, etc., or being an intermediate host of the causative agent of the disease, as in malaria (cyclo-propagative transmission of plasmodia), elephantiasis (cyclo-developmental transmission of nematodes), and relapsing fever (propagative transmission of spirochaetes - Borellia recurrentis).

Among the most common **bacterial diseases,** Dr. Kaddou cited typhoid and parathyphoid fever (Eberthella typhosa, Salmonella paratyphis, and S. shotmulleri), dysenteria (Shigella), anthrax (Bacillus anthracis), tuberculosis (Koch's Bacillus), and cholera (Vibrio comma). **Protozoa diseases** are also very important; more than 14 species of Anopheles were identified in different Arab countries as vectors of Plasmodium spp, the agent of malaria (P. falciparum, P. vivax, and P. malariae); in addition, Leishmania tropica and L. donovani; Trypanosoma gambiense, T. castellani, and T. rhodesiense were also found, particularly in Sudan and Somalia. **Viral diseases** (polyomyelitis, trachoma, yellow fever, and dengue fever) and **Helminths diseases,** caused by Ascaris, Taenia, and Wucherria spp, were reported to be common diseases, especially in the rural areas.

Successful efforts to combat these diseases, along with the improvement of health conditions in the Arab region, cannot be obtained without the development of cooperative biological research and studies, particularly in the fields of entomology, parasitology, and microbiology.

In discussing the various aspects of antibiotic uses and misuses, Dr. Z. Al-Doori (Iraq) underlined the major factors affecting the actual efficiency of these antibiotics, which pose difficult microbial identification, the choice of antibiotics and their interference with other drugs, and the development of resistant microbial strains. She also reviewed research activities undertaken in this field in many Arab countries (Algeria, Egypt, Iraq, Jordan, Kuwait, Morocco, Sudan, and Tunisia), and pointed out an example of Salmonella spp, where various resistant strains of S. typhimurium, S. wien, and S. typhi were found in Egypt, Iraq, Jordan, and Kuwait. The most common type of resistance being the type ACTS (resistant to Ampicillin, Chloramphenicol, Tetracyclin, and Streptomycin). Other resistant strains of E. coli, Shigella, and Klebsiella were reported in Egypt, where 80% of the enteropathogenic bacteria developed multiple resistance to antibiotics.

Human settlements and biological pollution problems were reviewed by Dr. M.A. Awad El Karim (Sudan), who emphasized the important problems of water pollution, and the huge quantities of organic residues and waste which are discarded and pollute the environment, particularly in the rural areas and the crowded suburbs of Arab cities. Dr. El Karim noted that most of the research activities undertaken in this area are fragmented and not coordinated within the same country. In addition, he stressed the need for trained scientific personnel and adequate laboratory equipment, as well as the participation of both decision makers and the public to control pollution. Moreover, research programmes should be designed to deal with the use and bio-conversion of organic residues in rural communities.

2.5. BIOTECHNOLOGY AND FUTURE PERSPECTIVES

The role of biotechnology in providing new biological resources and helping to solve the various biology related problems in the Arab region was addressed at the meeting, particularly the multiple aspects of the application of microbiological processes in the provision of bio-fertilizers, food preparation and conservation, animal feed, and pharmaceuticals, in addition to the agricultural use of modern techniques of plant cell and tissue culture.

Dr. El-Nawawy (Kuwait) introduced the Microbiological Resources Center (MIRCEN) in the Arab States, located in Cairo, Egypt, whose aims are to promote the development of an effective infrastructure for applied microbiology in serving as a reference source, a training center, a depository of cultures, and a focal point for a regional newsletter (MIRCEN News). It also serves as a link with other centers in the MIRCEN International Network in Bangkok, Nairobi, Porto Allegre, and Brisbane.

The subjects of medical microbiology and the fermentation industry were brought up by Dr. Ibrahim (Iraq), who emphasized the economic importance of antibiotic production in the region, as well as the vital role applied microbiological research has for the development of this industry. He stressed the need to find alternative raw material for fermentation, the standardization of methods and products, and the identification and selection of high yielding microbial strains, and local isolates for new antibiotics.

Drs. I.Y. Hamdan and A.S. El-Nawawy (Kuwait) introduced the "Single Cell Proteins Project" undertaken by the Kuwait Institute for Scientific Research (KISR). Single cell proteins (SCP) refer to dried cells of microorganisms such as algae, actinomycetes, bacteria, yeasts, molds, and higher fungi grown in large scale fermentation systems. The substrates used for SCP production are divided into two groups: one includes industrial and agricultural by-products, and the other hydrocarbon feedstocks. The development of SCP processes to commercial scale production has been limited to very few, due to high operating costs as well as the costly extensive nutritional and toxicological tests necessary. Such financial drawbacks have made the SCP process uncompetitive with Western countries' conventional protein sources in the short term. However, the potential for commercial-scale production of SCP is still attractive for those countries with strong hydrocarbon resources and weak conventional agriculture resources.

In the Arab world, the feed and food protein market is mainly dependent on importation, as protein sources are scarce and their high cost and unavailability in times of crisis may affect the security of these countries. Further research and development in the field of biotechnology in general, and SCP technology in particular, are needed to improve on more economical processing and to solve scale-up problems. Future training programmes and joint Arab cooperation are also highly necessary in this field.

Modern techniques of plant cell, tissue, and embryo cultures were dealt with by Dr. Al-Sadek Bouzid (Tunisia). He stressed their importance not only for carrying out fundamental studies in plant genetics, physiology and biochemistry, but also for their application in the fields of plant breeding, production of seedlings free of germs, protected cultivation and hydroponic agriculture, and finally, for their utilization in the antibiotic and pharmaceutical industries.

3. *CONCLUSIONS*

Although clear assessement and identification of the present needs, problems, and priority areas in the field of biological sciences in the Arab region were identified in the meeting, more extensive studies and surveys at both the national and regional levels are necessary. The meeting stressed **major issues and problems areas** in the region:

1) problems connected with the extension of desertification and the low biological productivity in arid and semi-arid lands, and the vital need to improve and adapt agricultural methods and rangeland management practices to the particular conditions prevailing in the region;

2) protection and conservation of natural resources - natural vegetation, wild animals, and water biological resources;

3) the increasing demand for food and the need to develop animal resources and agroecosystem productivity, as well as the improvement of crop storage and processing methods, with the appropriate food technologies;

4) providing better health conditions through the improvement of a more advanced health delivery system, and the control of endemic diseases, and the control of biological pollution.

Priority scientific themes that should be developed and promoted in connection with these problems are the following:

a) integrated ecological research on arid and semi-arid ecosystems based on the systems' apprach and using mathematical modeling and simulation techniques;

b) biological resource surveys of flora, fauna, and water resources, and taxonomy studies of the flora and fauna in the Arab region, taking into consideration the modern aspects of biosystematics, and the use of modern molecular biology techniques;

c) developmental biology studies, reproductive physiology, genetics with emphasis on selected species of economic importance - goats, camels, etc.;

d) entomology and parasitology studies and the related applied fields (crop protection and biological control, vector diseases, etc.);

e) cell and molecular biology, microbiology and their importance in the field of immuno-protection and antibiotics research;

f) plant tissue cultures and their applications to agriculture.

In order to deal with these issues and problems, the **main gaps and constraints** were found being:

i) the lack of scientific research programmes and projects using the

problem-solving approach oriented to the very specific biological problems encountered in the region;

ii) the shortage in trained and qualified personnel needed for the planning and implementation of the research-action programmes;

iii) the need to develop biological education activities, particularly at the secondary school and university levels.

It is needless to mention that cooperation and coordination are the key factors which will help in maximizing the effectiveness of efforts and resources given, in addition to facilitating the success of scientific activities undertaken in this area - the cooperation among scientists working in the same country, with other countries in the region, and finally with the international scientific community of biological sciences.

The meeting recommended the establishment of the Biosciences Network in the Arab Region, which would be based and expanded upon the Union of Arab Biologists. The Network would be open to all individual biologists, institutions (research centers and universities), and organizations concerned with biological research training and education in the region. The meeting also recommended that the IIIrd Congress of Arab Biologists, 3-8 November, 1984, Amman, Jordan, provide the opportunity for the establishment of working groups concerned with the various issues and topics identified during the symposium. In conjunction, it was also suggested that the IIIrd Congress use this time to plan future activities to be undertaken in the upcoming three-year period, such as training workshops, scientific symposia, and publications.

Finally, the Biosciences Network in the Arab Region, within the framework of the IBN, would help in coordinating cooperative scientific activities with the other regional networks in Asia, Africa, and Latin America, in addition to UNESCO and the various international bio-unions.

4. *WORKING DOCUMENTS*

AWAD EL KARIM, M.A. Human Settlement and Biological Pollution
AYYAD, M.A. & MAHMOUD, R. Integrated Ecological Research for the Development and Protection of Natural Resources in Arid and Semi-Arid Lands of the Arab Region
BOULOS, L. Medicinal Plants of the Arab Region
BOUZID, Al Sadek Plant Tissue Culture
CLOR, M.A. Biology, Environment, and the Man and Biosphere (MAB) Programme
DAGHER, C. & HALLAB, A.H. Food and Nutrition Problems in the Arab Countries (communication)
AL DOORI, Z. Antibiotics and Their Effects on Public Health in the Arab Region
AL EISSAUOI, D. Plant Taxonomy in the Eastern Arab Region
FARID, M.F.A. The Role of Research in Support of Animal Production Development in the Arab Countries
HAMDAN, I.Y. & EL NAWAWY, A.S. Single Cell Protein
AL HACHEMY, W. Common Diseases in the Arab Countries
AL HAMROUNI, A.M. Forests of North Africa
IBRAHIM, M.A.K. Aspects of the Antibiotic Industry in the Arab World
AL JEBOURY, A.A. Toxic Plants in the Arab Countries
KADDOU, I.K. Insect Diseases in the Arab Region
KHALAF, A.N. Arab Cooperation for the Development of Water Resources
MESSAUDI, M.B. Nurseries and Afforestation in Arid and Semi-Arid Areas in North Africa
MOHAMMAD, M.B.N. Biological Resources of the Arabian Gulf
EL NAWAWY, M.A.R. Microbiological Research and MIRCEN Network in the Arab States
AL SAGHIR, A.R. & MAKKOUK, K. Present Situation of Plant Protection in the Arab Region (communication)
AL SHOURBAGI, M. Arab Center for Arid Land Studies
ZAHID, Z.R. State of Biological Research in the Arab Countries
YOUNES, T. Biosciences Network in the Arab States: Objectives, Resources, and Perspectives

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The International Union of Biological Sciences is a non-governmental, non-profit organization, established in 1919. Its objectives are to promote the study of biological sciences, to initiate, facilitate, and coordinate reserach and other scientific activities that require international cooperation, to ensure the discussion and dissemination of the results of cooperative research, to promote the organization of international conferences and to assist in the publication of their reports.

The membership of IUBS presently consists of **47 national members,** each country adhering through its Academy of Science, National Reserach Council, national science association sor similar organizations, and of **66 scientific members,** all of which are international scientific associations, societies or commissions in the various biological disciplines.

NATIONAL ADHERING ORGANIZATIONS

ARGENTINA - Consejo Nacional de Investigaciones Cientificas y Technicas
AUSTRALIA - Australian Academy of Science
AUSTRIA - Osterreichische Akademie der Wissenschaften
BELGIUM - Académie Royale de Belgique
BRAZIL - Conselho Nacional de Pesquisas
BULGARIA - Bulgarian Academy of Sciences
CANADA - National Research Council
CHILE - Sociedad de Biologia de Chile
COSTA RICA - Consejo Nacional de Investigaciones Cientificas y Tecnologicas
CUBA - Academia de Ciencias
CZECHOSLOVAKIA - Czechoslovak Academy of Sciences
DENMARK - Det Kongelige Danske Videnskabernes Selskab
EGYPT - Academy of Scientific Research and Technology
FINLAND - Societas Scientarum Fennica
FRANCE - Académie des Sciences
GERMAN DEMOCRATIC REPUBLIC - Deutsche Akademie der Wissenschaften
GERMANY (FEDERAL REPUBLIC) - Deutsche Forschungsgemeinschaft
GHANA - Ghana Science Association
HUNGARY - Academy of Sciences
INDIA - Indian National Science Academy
IRAQ - Scientific Research Foundation
IRELAND - Royal Irish Academy
ISRAEL - Academy of Sciences and Humanities
ITALY - Consiglio Nazionale delle Ricerche
JAPAN - Science Council of Japan
JORDAN - Yarmouk University, Amman
LEBANON - Conseil National de la Recherche Scientifique
MEXICO - Consejo Nacional de Ciencia y Technologia
MONACO - Centre Scientifique de Monaco
NETHERLANDS - Koninklijke Nederlandse Academie van Wetenschappen
NEW ZEALAND - The Royal Society of New Zealand
NORWAY - Det Norske Videnskaps-Academi
PHILIPPINES - National Research Council of the Philippines
POLAND - Academy of Sciences
ROMANIA - Academy of the Socialist Republic of Romania
SAUDI ARABIA - Saudi Biological Society
SOUTH AFRICA - Council for Scientific and Industrial Research
SPAIN - Consejo Superior de Investigaciones Cientificas
SUDAN - National Council for Research
SWEDEN - Kunglige Vetenskapsakademien
SWITZERLAND - Société Helvétique des Sciences Naturelles
TAIWAN - Academy of Sciences
THAILAND - National Research Council
UNITED KINGDOM - The Royal Society
U.S.A. - National Research Council
U.S.S.R. - Academy of Sciences
YUGOSLAVIA - Union of Biological Sciences