

Strategies for Improved Management of Latin American Drylands

**Edited by J.A. Mabbutt,
H.J. Schneider, and R. Nava**



THE UNITED NATIONS UNIVERSITY

STRATEGIES FOR IMPROVED MANAGEMENT OF LATIN AMERICAN DRYLANDS

**Report of a Workshop held in the Department of Renewable
Natural Resources, "Antonio Narro" Autonomous
Agricultural University, Saltillo, Coahuila, Mexico**

25–29 February 1980

**Edited by J.A. Mabbutt,
H.J. Schneider, and R. Nava**

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From the CHARTER OF THE UNITED NATIONS UNIVERSITY

ARTICLE I

Purposes and structure

1. The United Nations University shall be an international community of scholars, engaged in research, post-graduate training and dissemination of knowledge in furtherance of the purposes and principles of the Charter of the United Nations. In achieving its stated objectives, it shall function under the joint sponsorship of the United Nations and the United Nations Educational, Scientific and Cultural Organization (hereinafter referred to as UNESCO), through a central programming and co-ordinating body and a network of research and post-graduate training centres and programmes located in the developed and developing countries.

2. The University shall devote its work to research into the pressing global problems of human survival, development and welfare that are the concern of the United Nations and its agencies, with due attention to the social sciences and the humanities as well as natural sciences, pure and applied.

3. The research programmes of the institutions of the University shall include, among other subjects, coexistence between peoples having different cultures, languages and social systems; peaceful relations between States and the maintenance of peace and security; human rights; economic and social change and development; the environment and the proper use of resources; basic scientific research and the application of the results of science and technology in the interests of development; and universal human values related to the improvement of the quality of life.

4. The University shall disseminate the knowledge gained in its activities to the United Nations and its agencies, to scholars and to the public, in order to increase dynamic interaction in the world-wide community of learning and research.

5. The University and all those who work in it shall act in

accordance with the spirit of the provisions of the Charter of the United Nations and the Constitution of UNESCO and with the fundamental principles of contemporary international law.

6. The University shall have as a central objective of its research and training centres and programmes the continuing growth of vigorous academic and scientific communities everywhere and particularly in the developing countries, devoted to their vital needs in the fields of learning and research within the framework of the aims assigned to those centres and programmes in the present Charter. It shall endeavour to alleviate the intellectual isolation of persons in such communities in the developing countries which might otherwise become a reason for their moving to developed countries.

7. In its post-graduate training the University shall assist scholars, especially young scholars, to participate in research in order to increase their capability to contribute to the extension, application and diffusion of knowledge. The University may also undertake the training of persons who will serve in international or national technical assistance programmes, particularly in regard to an interdisciplinary approach to the problems with which they will be called upon to deal.

ARTICLE II

Academic freedom and autonomy

1. The University shall enjoy autonomy within the framework of the United Nations. It shall also enjoy the academic freedom required for the achievement of its objectives, with particular reference to the choice of subjects and methods of research and training, the selection of persons and institutions to share in its tasks, and freedom of expression. The University shall decide freely on the use of the financial resources allocated for the execution of its functions

INTRODUCTION

The Workshop was held in the Department of Renewable Natural Resources of the "Antonio Narro" Autonomous Agricultural University (UAAAN) at Saltillo, Coahuila Province, in semi-arid northern Mexico. On behalf of the participants and the United Nations University we express deep appreciation to the head of the department, Dr Roberto Nava, and to his colleagues, for the arrangements for the meeting and for administrative support. The co-operative assistance of the secretarial and administrative staff of the department is warmly acknowledged. The success of the Workshop owed much to the friendly spirit engendered by our Mexican hosts, and we express our thanks, on behalf of all who attended, to Roberto Nava and his colleagues for their warm hospitality and never-failing kindness.

The Workshop was opened by the Vice-Chancellor of UAAAN, Dr Humberto Alvarado-Sánchez, who welcomed the delegates on behalf of his university. The support of UAAAN in hosting the Workshop and in providing facilities and transport is gratefully acknowledged.

The 37 participants included specialists in arid lands problems from five countries in Latin America with extensive dry areas: Mexico, Argentina, Brazil, Chile, and Peru. In addition there were consultants from Australia, Israel, and the United States, and a representative of the UN University from its headquarters in Tokyo. A list of participants is given in Appendix III of this report.

The objectives of the Workshop were:

- to identify environmental, social, economic, technological, and organizational obstacles to the development and conservational management of the drylands of Latin America;
- to review existing training programmes and research strategies for the improved management of Latin American drylands;
- to consider the scope for research and training activities in Latin America under the Arid Lands Sub-programme of the United Nations University, with its theme "Assessment of

Obstacles to the Application of Existing Knowledge to Arid Lands Problems."

The activities of the Workshop consisted of two days of concurrent working commission sessions and plenaries, followed by a one-day field visit to the UAAAN Experimental Station at Noria de Guadalupe, Zacatecas, and concluded with two more days of plenary sessions. The programme is given in Appendix II.

In his opening address Dr Alvarado-Sánchez stressed the impact of population pressure and associated social and technological changes which were causing serious problems for management of drylands in Latin American countries. In Mexico, improvements in this area were of particular importance because of the rapidly growing need to produce greater quantities of basic foodstuffs in the areas of rain-fed agriculture. As a major academic institution concerned with these problems, UAAAN was involved in research, training, and extension aimed at improved management of drylands. Dr Alvarado-Sánchez expressed his hopes that the Workshop would contribute to furthering these activities, and that in turn it would benefit from the experience of UAAAN.

Replying on behalf of the United Nations University, Dr Richard Odingo, Senior Programme Officer, Natural Resources Programme, thanked the Vice-Rector for his support. Dr Odingo briefly explained the philosophy, aims, and operation of the UN University, and described some of its activities, particularly within the Natural Resources Programme.

In an introductory account of teaching and research at UAAAN, Dr F. Rodríguez Cano traced the history of the institution from its foundation as a regional school of agriculture in 1923 to its separation from the University of Coahuila as an autonomous university in 1975. Arid lands studies had a long history in the university, and were strengthened with the establishment in 1971 of a National Centre for Research for the Development of Arid Zones.

The university has four divisions—Agronomy, Agricultural Engineering, Socio-economics, and Animal Science—within which the Department of Renewable Natural Resources is situated. At the graduate level of teaching there are Master's programmes in plant improvement, animal science, irrigation, and soils, and there is also a Doctoral programme in plant improvement. The main lines of research have been into improved technology for food production in arid zones, and into the utilization of natural resources in the arid zone. These investigations are carried out at a number of field stations in arid and semi-arid environments (see Appendix I).

Professor Jack A. Mabbutt, Co-ordinator of the Arid Lands Sub-programme, concluded the Introductory Session by explaining the aims and operations of the Workshop to the participants. Its main object was to provide guidance to the UN University in its decisions as to what activities it should sponsor in Latin America under the Arid Lands Sub-programme. It was not expected that

formal resolutions would be passed, but in their presentations and discussions participants should strive towards consensus on major problems, principles, and needs relevant to the theme of the sub-programme. Chairmen were asked to guide the discussions of their commissions towards the formulation of a few important points which could be carried to the plenary sessions for more general discussion. Rapporteurs were asked to hand in their summaries promptly, so that a record of the Workshop proceedings could be built up.

In this and in the following sessions of the Workshop, proceedings were in Spanish or in English, with interspersed translation into the other language by various helpers. The assistance of Dr Hans Schneider in providing these translations was warmly appreciated by all participants. The organizers are grateful to those who helped overcome the barrier of language, and to all participants for their tolerance in light of the problems involved.

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I. PROBLEMS OF MANAGEMENT AND DEVELOPMENT OF LATIN AMERICAN DRYLANDS

In the working sessions of the first two days, management and development were listed separately, but in fact treatment of these two closely related topics was inevitably overlapping. For this reason the proceedings have been reviewed under a single heading.

In Session I, Commission A discussed environmental factors affecting the present management of Latin American drylands. Papers were presented by Harold E. Dregne on *Environmental Factors in the Agriculture of Arid Zones of Latin America*, and by Juan Gastó on *Environmental Factors in the Management of Arid Rangelands in South America*.

Dregne noted that significant soil degradation had occurred in all agricultural regions of Latin America, in the form of accelerated wind and water erosion, excessive leaching of nutrients, salinization and waterlogging of irrigated lands, soil crusting, and soil compaction by heavy machinery.

Winds are strong at some times of the year throughout the arid regions, particularly in the extreme south of South America, and wind erosion is a natural consequence of overgrazing or unwise cultivation of sandy soils. Fortunately these are extensive only in central Argentina, but wind erosion is locally important in other parts of Argentina and in northern Mexico. Water erosion is severe on steep slopes, as in the Andean *altiplano* of South America and in the Mexican highlands, but is also significant on moderately sloping lands. An environmental factor is the high intensity of summer rainfalls, as in northeastern Brazil (where the tropical soils are also highly erodible) and in Mexico. Another general factor is the sparsity of protective vegetation at the end of the dry season. Drought is a recurring feature of all arid regions, but its impact on the livelihood systems of Latin America is probably greatest in northeastern Brazil, where a quite appreciable rainfall may be concentrated in a few summer months and where droughts frequently continue for three or more years.

One example of soil-nutrient loss is the Guajira region of northern Columbia, where overgrazing and soil impoverishment have led to the replacement of the climax vegetation by thorny species of more xeric character. The porous soils of low water-holding capacity have contributed to loss of fertility. Generally, however, reduction in soil fertility is due to erosion rather than to leaching.

Problems of drainage and salinity generally occur together. They affect all irrigated lands in Latin America to some degree, but are major concerns in the Mexicali Valley of Mexico, in Santiago del Estero in Argentina, and in the many alluvial valleys that cross the coastal plain of Peru. Most of the damage is the result of poor management, but salinity of irrigation water contributes significantly in northern Mexico and Argentina, where saline geological strata provide a salt source. Cyclic salts affect coastal soils of western South America, but are economically unimportant. Large saline depressions (*salinas, salares*) occur with enclosed drainage and impermeable sediments in Argentina and on the Andean *altiplano*.

Gastó agreed with Dregne that the environmental problems of the dry rangelands of South America were not unique to that continent, save for the dominance of the N-S Andean chain, which restricted the latitudinal transfer of water, sediment, and nutrients. Most of the rangelands were shrublands rather than grasslands, and common environmental problems were infertile soils, seasonal aridity, and highly variable rainfall. A combination of edaphic and climatic stress and human pressure—overgrazing, clearing of watersheds, and removal of vegetation for fuel—had generally given rise to a more xeric vegetation sub-climax than was warranted by the climate. This was the result of deterioration of soil structure and soil-water relations, with consequent hydrological deterioration. Reduction in phytomass had generally led to the opening up of the biogeochemical cycles, and loss of fertility. There had commonly been a reduction in the cover of useful perennial pasture plants and an increase in less durable annuals, or invasion by

shrubs of little value. Dr Gastó illustrated these points in a broad survey of the main rangeland types.

So far little study had been made of the rangelands and of plant successions under grazing in the interests of management, but experience in the Chihuahua Desert, where rangelands had been enclosed for three years, had indicated that improvements could be achieved comparable with those in the United States. The fact that most of the grazing systems had been in operation little more than 150 years in South America meant that the situation was generally not irremediable.

In discussion it was stated that there was evidence that the deterioration or desertification described in these two papers was the result not of climatic change but rather of a combination of land-use pressure and environmental stress. Dr X.E. Hernández claimed that in Mexico the interaction of man with vegetation went back much longer than claimed by Gastó, probably for several thousands of years. This was suggested by survival patterns of grasses in the arid zone. These remained important resources which we should learn to develop; there should perhaps be less emphasis on the problems of the arid zones and more on their endemic resources. This potential called for regional studies in support of development.

One notable feature of the Latin American environment was marked seasonal aridity, such that regions with more than 800 mm annual rainfall, as on the southern margins of the Amazon Basin, could suffer marked deficit. These regimes were not well-suited by existing climatic classifications and called for a new conceptualization of drought.

In Commission B social and economic problems were represented in papers by Manuel Correia on *Economic and Social Problems in the Irrigated Areas of the San Francisco Valley, Northeast Brazil*, and D.J. Trueba on *Economic and Social Problems in the Mexican Arid Zones*.

The San Francisco basin is the major catchment of northeast Brazil and the only permanent water course. A large number of seasonal tributaries account for an extremely variable discharge, from a low-season 900 cumecs to over 13,000 cumecs during the wet season. The seasonally inundated floodplains have traditionally been used by peasants for crops after the waters receded. However, the damming of large reservoirs for electricity-generation and irrigation schemes has put these fields

permanently under water. In the face of these problems the government set up an agency for the planning of modern irrigation schemes, but these have been oriented towards commercial agriculture, with capital-intensive, labour-saving enterprises such as sugar plantations, distilleries, vineyards, and improved pastures. An attempt at co-operative farming based on family-size properties appears to have failed.

These measures not only have failed to resolve socio-economic problems within the region but are creating even more serious problems of inter-regional imbalance. They are resulting in the expulsion of the poorer sector of the rural population, mainly the peasants and fishermen who used to live on the river margins. These people are being forced to migrate to the cities, where, because of lack of education and training, they tend to swell the ranks of urban unemployed. In destroying the family-size holdings, development policies have increased the landless, wage-earning component of the rural population, which is able to find work on the large estates only during planting and harvesting times, and on the hydro-electricity and irrigation projects only during construction.

Dr Trueba stated that serious desertification of the Mexican drylands had in the past resulted from neglect or misuse of the land, and from conditions of land tenure. Mining, forestry, and the operations of large estates had all contributed. In more recent times, population growth, urbanization, and industrialization had been responsible. In formerly densely wooded areas of southeastern Mexico, forests had been destroyed for the establishment of pastures for beef cattle. The peasants had been forced out of this system of commercial livestock farming because of their lack of capital and know-how, and had ended up by having to lease out their land to entrepreneurs who exploited their labour. Because they cannot obtain their living from the cattle, the peasants are being reduced to depending on government assistance, and finally to being driven from their lands.

Trueba went on to discuss recent problems for arid lands management. First, there had been inadequate analysis of the production systems and of the role played by different groups of producers under changing conditions of Mexican agriculture. Second, there had been a failure, by government and by private institutions, to identify the real problems of the rural population, and to study them. These failings become important when it is considered that, in the new international division

of labour, Mexico has been assigned the role of producer of raw materials, and that the new technology introduced to increase the production of export crops often causes additional and greater damage to the environment than did traditional subsistence farming. He stressed the need for the education and organization of the peasants in order to obtain their support and involvement in the campaign against desertification.

Commission C received presentations from G.M. Anaya on *Technology and the Present Management of the Arid Zones of Latin America*, and from Freeman M. Smith on *Management of Natural Resources in the Arid North of Mexico*.

Anaya stressed the great extent of arid and semi-arid lands in Latin America, covering 60 per cent of Mexico and Argentina and 25 per cent of Peru. Whilst this represents a great potential for food production, these areas are undergoing accelerating degradation, or desertification, relative to their natural powers of recovery. Hence the important need to generate and apply technology that is in harmony with the essential production systems of agriculture, livestock, and forestry, with the object of sustained and increased productivity and the raising of living standards in the areas.

But technology must be seen as part of a complete system which embraces economic and social conditions as well as ecological considerations, for technology is the essential link between the natural and social system. Whilst technology is the essential instrument of development, its misapplication can have harmful environmental consequences, as are evident in deforestation, overgrazing, over-withdrawal from aquifers, and defective drainage of irrigated lands. Whilst we have a large store of technology, it needs to be evaluated in order that we may select what is appropriate for a particular region. This places considerable responsibility on institutions that are developing technologies, namely to consider their relationship with the wise management and conservation of natural resources.

Anaya stressed the need to evaluate the current desertification of Latin America in order to assist the diffusion of technology suited to combating it. Interchange of experience in training, research, and development was essential. This would help in establishing pilot areas for training, research, and local production that were ecologically representative, with the aims of diffusing this experience into adjacent regions. Plans to combat desertification

were being drawn up by national committees in several Latin American countries, and these organizations could assist the exchange of experience with the object of establishing integrated systems of production for the better use of natural resources in the various dryland environments.

Freeman Smith approached the problem of resource management as exemplified in arid northern Mexico through an analysis of ecosystem characteristics. He noted the basic problem of rainfall variation from year to year. He stressed the importance of conservational management to improve the physical and chemical properties of the soil, which he considered to be the fundamental manageable resource. On the other hand, vegetation resources were capable of more flexible management, for direct use in cropping systems or indirect use in the case of livestock-based production. He introduced the concept of time and space as resources which underlie alternatives for management. The first is evident in the choice between management for sustained production and opportunistic management which attempts to harvest the surplus of occasional good climatic years; the second is fundamental to the choice between smaller-scale and larger-scale production systems.

Plenary discussions following the presentation of commission proceedings centred on relations between management or development programmes and the resource-user. It was claimed that these programmes are generally formulated from the cities, and that they tend to reinforce the interests of capitalist rural and urban groups to the disadvantage of the peasant sector. There was need for the design of programmes to work with the people, and one consequence of this was a study of the question of migration; to find out why people stay, or leave, or return to the land. The development of conservational systems of resource use required linkages between researchers and land-users. Indeed, there was a need for integration of all the sectors involved, in research, training, and development, and for programmes to be designed to remove the time-constraints imposed by bureaucracy so that development could be re-defined in appropriate time-frames.

Concerning the many concurrent programmes dealing with desertification, it was considered important that support should be given to activities with different perspectives of desertification, in order to answer the question "How do aims between these groups conflict or agree?" It was necessary to analyse the ways in which different

agencies focus on action in arid lands, and to look at illustrative case studies.

In Session II, Dr Rolando Braun spoke to Commission A on *Technological Obstacles to Development in West-Central Argentina*.

Dr Braun, Director of the Instituto Argentino de Investigaciones de las Zonas Aridas (IADIZA) at Mendoza, summarized briefly some of the major technical problems which faced the development of natural resources in his region. These included:

- export of natural wealth from the region, such as timber and firewood;
- inefficient use of surface and underground water resources, leading locally to secondary salinization of soils;
- bad management of livestock, and particularly overstocking;
- the need for improvement of local livestock breeds;
- problems of animal health;
- misuse or non-use of pasture resources;
- the problem of maintaining a balance in the local fauna in combination with its economic harvesting;
- improvement in the availability of energy, particularly non-conventional energy.

Dr Braun stressed that this enumeration of technical problems opposing regional development did not mean that it was not recognized that many important obstacles were linked with economic and social conditions in the region.

Two papers on social and economic obstacles to development were presented to Commission B, namely *Social and Economic Problems in the Management of Arid Lands on the Altiplano of Peru and Bolivia* by David L. Browman and *Socio-cultural Obstacles to Agricultural Innovation* by Susan H. Lees.

Dr Browman used his case study from the *altiplano* of Bolivia and Peru to illustrate the principle that development programmes must consider the social relationships of production. In this area an ecologically successful agro-pastoral economy had developed by 3000 B.P., combining cropping of tubers, grains, and legumes such as native beans at lower levels with the nomadic herding of camelids at higher elevations. The system was well-adjusted to the two main environmental problems of seasonal aridity and salinization of soils. With European impact, wheat and barley replaced native grains, whilst sheep replaced the camelids,

on the basis of the hacienda system, but on the Indian lands the social relationships of production remained little changed.

Agricultural reform movements in Bolivia from 1953 and in Peru from 1969 attempted to change these relationships, with the breakdown and transfer of haciendas to syndicates or co-operatives, and pressure was brought to bring subsistence agriculture into the wider national economy. These moves have not succeeded, partly because they failed to appreciate the strength of tradition of individual land-ownership and partly because they emphasized capital-intensive rather than labour-intensive production in areas of high rural unemployment. Political policies of low prices for farm commodities were another problem.

Browman proposed some lines of agricultural development which he considered might be socio-economically and ecologically appropriate. These included the re-introduction of camelid herding, as being ecologically more efficient than that of sheep, supported by improved animal and range management; development of aquaculture in natural and artificial ponds, which would include some saline lands, for production of fish, water plants, and algae dried for sale as a foodstuff; and the resuscitation of old, appropriately labour-intensive, field-cropping methods such as ridge-and-furrow to control salinization.

In her review, Dr Lees commented that concurrent evaluations of development schemes were few, but on the evidence she doubted the reality of "cultural opposition" to agricultural innovation among traditional societies in Latin America. Rejection or misuse seem to have resulted from such factors as risk aversion, lack of correct information, lack of access to essential resources, or inappropriateness of the innovations to local conditions. Other quoted obstacles, such as the gap between educated and uneducated or the reluctance of administrators and technical advisers to stay in the "hinterland," were neither peculiar to nor universal in Latin America.

Dr Lees claimed that the fundamental obstacles to development were the natural hazards such as drought, and noted that development schemes tend to increase the vulnerability of communities to such hazards, either through the increased specialization involved in the new technology or through increased poverty and dependence among the weaker sectors of the communities affected. This was demonstrated in studies of the effects of

irrigation schemes in northeastern Brazil.

Such experience suggested that planning for development should first involve study of traditional strategies for coping with environmental hazard, and then design its measures and staff-training on the basis of that understanding. These measures should foster existing adjustments to hazard and if possible increase their effectiveness, as through extension services, and complement the adjustments with new inputs, for example with drought-resistant crop varieties. The next step should be to consider the impact of modernization on the ability of the local population to cope with the severe impact of environmental hazard and to design appropriate options. Lastly, technicians and social workers should be prepared to detect and report on changes which affected the ability of the community to respond to natural and economic pressures. Since that response diminishes with dependence, there is a paramount need for participation by the local community in the development process, suggesting that the gap between farmer and technician is the most important of the many communication gaps that have been identified as obstacles to development.

In the ensuing discussions in Commission B it was pointed out that models of exploitation from without commonly stand opposed to indigenous models of subsistence production. Where active resistance is repressed, indigenous groups may use passive resistance in the form of rejection of aid. Sometimes there is an initial acceptance of innovation as a means of obtaining access to land, but deeper or continuing integration is refused, either because of ingrained cultural problems, such as those between Indian and white-mestizo elements in some parts of Latin America, or because the advantages of co-operation are seen as having been exhausted. Research itself may suffer from its "external" character, tending to respond to the interests of the researchers rather than of the land-users.

Dr Lees reaffirmed that social and cultural obstacles are often related to vulnerability to natural hazards, which increases with poverty and social backwardness. This suggests target areas for research and planning: studying the risks involved in human activities; learning how people confront these problems; and planning operations and remedial measures in light of the findings.

In his paper to Commission C on *Economic Obstacles to Development of the Arid Zones of*

Latin America, Victor M. Piña noted that, despite the long involvement of international organizations in strategies for development, there remained basic problems in the agricultural economy. In 1978 agricultural production in Latin America increased by only 1.8 per cent, when the overall growth rate was 4.8 per cent, and had remained below the rate of population increase. Whilst agricultural labour comprised 40 per cent of the work force, its share of total income was 15 per cent. Rural poverty was associated with lack of education and unsatisfactory nutrition, housing, and health. At the same time agricultural lands were not being fully utilized, and were being abandoned in many arid regions.

There was inadequate expenditure on agricultural research to maintain the necessary inflow of technology, despite the activities of the United Nations International Development Organization (UNIDO), etc. Whilst all countries in Latin America were seeking investment finance, the level of technological and financial assistance from the developed world had fallen, such that further growth in Latin America was seriously threatened.

At the regional level, development of natural resources was needed to maintain the balance between regions and between the city and the country. Rural migration to the cities creates unemployment and overcrowding there, whilst it depletes the rural areas—particularly the arid zones—of people with the will and knowledge for the application of technology. There was a need for integrated and democratic planning to provide technical and marketing assistance and for an evaluation of projects in terms of their social as well as their purely economic benefits. It will not help to consolidate existing agrarian structures which thereby add to inequality and social injustice.

Among the needs Dr Piña listed were:

- increased public expenditure on basic rural needs;
- more equitable distribution of the benefits of development;
- rehabilitation of arid lands, including reforestation, to combat the combined impact of man and nature;
- settlement policies which restored the balance between rural and urban sectors;
- extension of the area of productive land and promotion of new commercial crops (jojoba, etc.);
- increased flow of international capital;
- incorporation of the inflation factor in development programmes.

Two contributions to Session II dealt with organizational problems of development and technology transfer. Donald J. Percious presented a paper on behalf of Michael E. Norvelle and himself on *University Technical Assistance and Drylands Development*, and in Commission A Joel Schechter spoke on *Organizational Problems in Management of Latin American Drylands*.

Dr Percious described the experience of the Laboratory of Native Development, System Analysis and Applied Technology (NADSAT) at the University of Arizona, and suggested that principles and methods used to assist the economic development of tribal American Indians in the arid southwestern United States might be applicable elsewhere. NADSAT was established in 1976, with support from the US Department of Commerce, with two primary objectives:

- to provide technical assistance to American Indian tribes for the more effective use and economic development of natural resources on their reservations;
- to transfer current technology to the tribes to assist them towards their expressed goal of self-determination.

The programme has since been broadened to include assistance with administrative management.

NADSAT has a small core of staff, experienced in natural resources development, which knows how to tap the wide range of skills within the university community, or which may sub-contract with outside help. Temporary staff are employed for specific projects. NADSAT operates only in response to expressed community needs, and on the principle that it will continue to serve in helping to solve problems that inevitably crop up in any undertaking after the formal conclusion of the project.

The bases of technology transfer during project operations are:

- direct involvement of tribal personnel throughout;
- attention to appropriate methods of presentation of information;
- specific technical training as required by the project.

A university is well placed to fill the gap between science and technology and the user in developing communities, for its knowledge of the regional environment will guide it in the application of systems best suited to local conditions, and in the

necessary adaptation of imported technology.

Schechter stressed that organizational schemes for development and management should be complete packages of interactive, mutually reinforcing components, which contain the incentives to achieve their goals. They should include extension services, marketing support, etc. Lack of reinforcing elements can lead to failure of the entire scheme, for example where credit incentives to farmers are not associated with risk-sharing components.

Agrarian reform measures tend towards land fragmentation unless linked with forms of co-operative enterprise. Schemes for new land settlement which do not include sufficient possibilities for non-agricultural employment will result in wastage of manpower and social instability. Planning and management are commonly scattered among separate and uncoordinated agencies, rather than forming part of an integrated whole.

Adaptation of technology to local conditions calls for locally based research and experimentation centres linked with extension systems. This allows the stations to act as centres of diffusion of management techniques.

To overcome problems of social and cultural acceptability, schemes should have long-term objectives supported by suitable educational programmes.

In the concluding plenary session Dr Schechter affirmed that commonly little was known about available technology and that the processes of diffusion and adaptation tended to be ineffectual, with the result that there were few examples of the successful adaptation and application of new technologies. For this reason there was need to examine the relationships between research, technology, and development, for example the role of research and experiment stations in relation to development.

It was agreed that action programmes should be initiated in regions with potential for rehabilitation, and that they should be sufficiently integrated to provide incentives for all sectors of the community, including the administering authorities as well as different strata of producers.

It was suggested that the UN University might sponsor case studies of areas where development had occurred or had been attempted, to evaluate

that experience and to establish guidelines for overcoming obstacles in the future. Because of the importance of maintaining flexibility in strategies for development of the drylands, comparative studies should be encouraged, for instance between small-scale, labour-intensive farming systems and large-scale exploitation of the hacienda type, to determine their applicability. It was important to discover development alternatives, not only for different ecosystems but for contrasting economic, social, and political systems.

Other topics recommended for study were:

- traditional strategies for confronting major hazards of arid lands, such as drought;
- the problem of migration in its broadest

context, including why some people resist outmigration and others leave; why some return; and the impact of migration on the rural source areas and on receiving areas in the cities;

- problems of integration of the poorest social elements into society, in the framework of the development process;
- the creation of systems of education which reflect the aspirations of rural communities and their perceptions of priorities.

In all this work, preference should be given to regionally oriented, multidisciplinary teams based on local universities.

II. PROGRAMMES OF TRAINING AND RESEARCH FOR MANAGEMENT AND DEVELOPMENT OF DRYLANDS IN MEXICO

Session III received reports on research and training from universities and research institutes in Mexico.

Sr Jorge G. Medina spoke on behalf of his colleagues on the role of the "Antonio Narro" Autonomous Agricultural University at Saltillo, with emphasis on the work of the Department of Renewable Natural Resources. Dr Rodriguez had already given an account of the history and organization of the university in the introductory session of the Workshop. Sr Medina stated that the basic objective of the educational programmes and of research into natural resources was to bring benefit for man and his environment. The training programmes aimed at producing highly qualified professionals; training technical personnel for the field; and improving methodology and productivity in the agricultural, livestock, and forestry industries. There was need for a dynamic and flexible educational structure to adjust to the needs of a changing society. There was also a need to sustain criteria of ecological viability, economic rentability, and socio-cultural awareness to guide decisions about the implementation of technology and the provision of technical assistance. An education system aimed at an integrated and objective perspective would be a major factor in improving management practices for the better development of the arid zone. Sr Medina then summarized the activities of UAAAN from the viewpoint of educational programmes directed at the improvement of the arid zone.

Dr Fernando Medellín discussed the operations of the Instituto de Investigación de Zonas Desérticas at the University of San Luis Potosí, which is situated about 400 km south of Saltillo. The institute was founded in 1954 and now has the following organization:

- Department of Biology
(sections of Botany, Zoology, and Apiculture, and Herbarium)
- Department of Soils
- Department of Water
(sections of Hydrogeochemistry and

Microbiology)

- Department of Phytochemistry
- Department of Desertification Studies
(under sponsorship of the Ministry of Public Education)
- Library

The herbarium has 15,000 plant specimens, not only from the State of San Luis Potosí but from the arid zone of Mexico generally, and from the deserts of the United States. The library has 4,000 volumes and subscribes to more than 450 periodicals. In 25 years the institute has produced about 230 research publications.

The institute provides a public service in undertaking analyses and assessment studies, and collaborates closely with other branches of the University of San Luis Potosí. It does not offer formal programmes of teaching, although in 1979 it organized a two-month course on The Ecology of Arid Zones, sponsored by the Ministry of Public Education, which was attended by students from nine Mexican universities. On the other hand, 42 of its publications consist of Honours theses carried out under the general research programme for students of the university, and representing all the branches of study listed above.

Sr F. Castro referred to research by the Instituto Nacional de Investigaciones Agrícolas (INIA) in support of the generation of technology to increase agricultural production in regions receiving more than 350 mm annual precipitation.

Sr S. Olivieri of the Instituto de Investigaciones sobre Recursos Bióticos (INIREB) described research being carried out at stations in Durango, Mapimi, Michila, and Puebla/Veracruz, mainly into tropical agriculture.

Dr G.M. Anaya of the Postgraduate College of the University of Chapingo gave details of recent decisions under the Mexican Plan to Combat Desertification. He stated that Mexico had been carrying out studies of desertification since the

United Nations Conference on Desertification in Nairobi in 1977. The latest approach was based on a comprehensive review of the problem, and of possible solutions at the national level. The Plan would be carried out mainly through the ministries for Planning and Budgetary Affairs and of Agriculture and Water Resources, with support from the Postgraduate College at the University of Chapingo, the Mexican Arid Zone Commission, and others.

Seven experimental areas had been selected for research and demonstration, in the states of Sonora, Coahuila, Guanajuato, Zacatecas, Cuenca de Mexico, Oaxaca, and Tabasco, which include regions with differing degrees of desertification. Special emphasis was being given to central Mexico, however, where there was a combination of population concentration (60 per cent of the total) and serious degradation. Basic studies carried out in 1980 would lead to the formulation of plans for both long-term and short-term action. Proposals for expenditure are being drawn up, to be applied within pilot areas of 10,000 hectares, although concentrated in smaller cores within those areas.

The Plan aims to explore possibilities of alternative land uses, for example crops, improved pastures, or reforestation, supported by experimentation and demonstration projects. Its object is to achieve a degree of integrated regional development, halt deterioration of croplands and rangelands, and improve environmental and living conditions. One serious problem to be overcome was that of co-ordination of activities, since there are more than 60 organizations dealing with the problem in central Mexico alone.

In the discussion that followed Dr Nava reviewed attempts at UAAAN to improve the decision-making processes, both at the level of the technology-generating institutions such as universities and at the level of the implementing agencies, by involving peasants and their organizations in the processes. There remained the question as to how far *ejido* members are real participants in decision-making. Other problems were how to close the economic gaps in rural society and how to determine priorities for inputs. An integrated strategy of development needed to be based on participation by the community involved, anticipation of the necessary inputs for improved management of natural resources, and an ability to assess the needs and the capacities of all the participants. One also needs to have information about the

minimum size of holdings for economic viability, the ways in which the various rural institutions can contribute to development, and on appropriate marketing policies for rural and urban needs. There is also a need for more socio-economic information relevant to the development process, and one needs to establish economic, social, and psychological indicators in order to monitor change.

An objective of research by the Department of Renewable Resources was the design and testing of a technology package suited to regions with less than 500 mm annual rainfall which would be acceptable to rural communities and compatible with prevailing principles of ecosystem management, and which would have the object of increasing production and raising peasant incomes. A second aim was the design of an organizational structure to implement this technology, extending to the level of the small farmer and with specific concern for inter-agency co-ordination. Lastly, there should be active participation of the peasants at all stages, from design to implementation. Important components would include research on rural institutions and on credit facilities for peasant communities. The approach would be multi-disciplinary, and the study would be based on one or two communities, but hopefully the results would be applicable to other regions.

Experience in experimentation had shown the need to incorporate the three dependent variables: the participating peasants, the rural institutions, and the natural resources. Peasant knowledge of natural resources was particularly important where programmes for improved management of drylands were based on native species. Continuity and consistency are critical to experimental programmes, which should be institutionalized to preserve their overall structure even where components are changed.

Dr Lees asked how peasant participation was supposed to operate. One needs first to know something of their aspirations and expectations, and decisions about inputs for development should be guided by that knowledge. She suggested a project involving collaboration between academics, government employees, and peasants based on a local area such as San Tiburcio.

Sr Trueba commented on his experience of peasant participation in the Tierra Blanca district, saying that where peasant organizations had access to outsiders for consultation and support the results had been positive. However, the data on results of

this kind are so uncertain as to render their assessment problematical.

Dr Nava mentioned that work at UAAAN had been criticized as too theoretical, on the grounds that recommendations for increased productivity had not taken sufficient account of social and economic factors. Increasing poverty among peasants, environmental deterioration, and diminishing natural resources all have to be taken into account, together with the purely technical aspects. The main limiting factors in research to support the application of technology to arid lands problems appear to be lack of trained people and insufficient exchange of scientific information, and the present Workshop might attempt to identify ways in which research could be strengthened. The peasant sector remains the most important in a system which is not well understood, and, again, the Workshop could perhaps offer guidance on research directions.

Sr Flores discussed his experience with peasants employed in collecting candelilla (*Euphorbia antisyphilitica*) who were among the very poorest. He had been involved with them for more than 20 years and had heard much talk of development, but had seen few results. The main problems

appeared to him to be illiteracy and lack of training; however, a few teachers who were living and working with the peasants were making progress, suggesting that we need to have greater contact and involvement with the peasant population in order to overcome arid lands problems.

Sr Laborde described his experience in a development project for rural communities in the San Tiburcio basin. The peasants had participated actively in their seminar, and this had helped to a better understanding of the rural situation. There was, in his view, a general lack of co-ordination between universities and government agencies in social work in rural areas. There was also a problem of insufficient data, but they had first to determine what type of data was needed.

Dr Odingo invited suggestions on interdisciplinary programmes centred on the problem "Why does existing knowledge not reach the peasant sector?", with support from several institutions. He asked what contributions could be expected from the institutions represented at the Workshop if the UN University were to support a training programme, and what types of agricultural and livestock research should be supported.