7. SUMMARY OF THE DISCUSSIONS AND RECOMMENDATIONS

7.1 Present and Potential Salt Affected Areas in the Near East Region and their Impact on the Agricultural Economy

(1) The Near East Region depends largely on irrigated agriculture. Although only 36% of the arable land in the Region is irrigated, this area produces 70% of the value of all crops. According to FAO's Indicative World Plan, the irrigated area will have to be extended by 1985 to about 40.7 million ha, i.e. to about 51% of the arable area, if agriculture is not to lag behind the expected growth rate of the economy of the Region.

(2) Salinity and waterlogging are common problems in the countries of the Near East. They are closely related to inefficient water use for irrigation, lack of adequate drainage and poor water quality. The problem is expected to increase as a result of necessary expansion of irrigation to soils which are potentially saline and the use of poor quality water. The percentage of salt affected and waterlogged areas amounts to 50% of the total irrigable area in Iraq, 23% in West Pakistan, 50% in the Euphrates Valley in Syria, and 30% in the UAR. The unfavourable economic consequences of the problems of salinity and waterlogging, the danger of continuous deterioration of land, and the need for reclamation of new areas must, in the opinion of the meeting, be brought to the attention of politicians and planners. Moreover, public awareness of the problem must be created.

(3) There is a great need for more and reliable data, not only on the present extent and the danger of future spreading of salinity and waterlogging, but also on the technical feasibility, economy and social impact of land reclamation, improvement and conservation. Regional co-operation is urged for the collection of more information in this field in order to draw a complete picture of the present and future extent of the danger and possible counter measures.

(4) In this connection, the meeting noted the effort being made at present to draw a tentative regional map of present and potential salt affected soils. The map will be of importance for an overall presentation of the situation. However, to complement the picture, each country should prepare a detailed map of its present and potential salt affected soils. The maps will help planners to understand the magnitude of the problem and contribute to regional co-operation in land reclamation. The meeting urged FAO and governments to give active support to the completion and publication of national and regional maps.

(5) The meeting agreed that the basic scientific knowledge for land reclamation, improvement and conservation of present and potential salt affected areas is available or can be made available relatively easily. The problem seems to lie at the project and field level in the ability to apply scientific results and their conversion into practical value; the lack of trained personnel, shortage of funds and organizational difficulties increase this problem. The point was strongly brought out that in most of the abovementioned fields, regional international co-operation will be needed and will help considerably to overcome present difficulties.

(6) Main Recommendations

The Seminar wishes to draw the attention of government authorities, planners and public opinion to the problems of salinity and waterlogging and recommends:

(a) to FAO:

- to promote regional co-operation in all fields related to land reclamation, improvement and management;

- to continue to hold seminars and provide consultant services in the specialized fields of land reclamation;

- through its Near East Applied Research Programme, to continue to collect data on present and potential extent of salinity and waterlogging in the Region and its impact on agricultural development;

(b) to Governments:

- to pay specific attention to land reclamation, improvement and management measures as an important basis for increased agricultural production, rural employment and conservation of resources;

- to pay attention also to the need for an integrated approach to land reclamation projects;

- to control the use of irrigation water with a view to achieving a fair distribution of international water resources on the basis of optimum requirements for agricultural production;

(c) to National Land and Water Use Committees and Participants of the Seminar:

- to supply information for the completion and refinement of the map of salt affected soils in the Region.

7.2 Sampling, Analysing and Mapping of Salt Affected Soils

(7) Due to the nature of variation and heterogeneity of salt affected soils, their sampling and mapping differ from those of other soils. Generally, the accuracy of analysis considerably exceeds that of sampling. In order to improve the overall accuracy of surveys of salt affected soils, in the first instance the sampling technique has to be improved. In sampling the following points should be considered:

- the spotted nature of salt affected soils;

- the vertical distribution of salts;

- the horizontal distribution of salts;

- types of salts;

- the effect of micro-relief;

- soil stratification;

- the effect of groundwater (depth and salinity);

- seasonal variations;

- soil-moisture salt relationship;

- agro-climatological effects.

(8) The essential elements of soil sampling, i.e. site selection, obtaining representative samples, optimum number of samples and locations, methods of sampling, were discussed and the meeting agreed that guidelines for sampling of salt affected soils can be recommended. The meeting appointed a Committee to work out such guidelines which are given in the Annexe, and which are recommended for acceptance by the Near East Land and Water Use Commission. 1/

1/ The FAO Secretariat would appreciate receiving further comments and suggestions on these guidelines, also from experts outside the Near East Region, with view to establishing definite guidelines in the near future.

(9) The following maps are required for diagnosis and evaluation of soil salinity for reclamation:

- soil salinity map;
- groundwater contour map;
- groundwater salinity maps at different time intervals;
- topographic map;
- crop growth condition map.

(10) Salinity classes suggested by the U.S. Department of Agriculture might have to be revised in order to meet local conditions with regard to climate, type of salts, cropping pattern and economic factors. A tentative classification for alkalinity on the basis of ESP was presented and will have to be given further consideration under the Near East Applied Research Programme.

(11) The meeting also discussed the collection of other data needed for the diagnosis of soil salinity and for the design of reclamation projects. Agroclimatological and hydrological data are needed for both diagnosis and design. The hydraulic properties of the soil should be determined, if possible, during the soil survey. For the determination of the hydraulic properties of the subsoil, special surveys are required which are normally carried out only for groundwater development. However, sufficient knowledge of the stratification of the subsoil and its hydraulic properties should be made available for drainage projects, eventually by drilling to sufficient depths.

(12) Main Recommendations

The Seminar recommends that FAO:

- submit the tentative guidelines for sampling, analysing and mapping of salt affected soils to the Near East Land and Water Use Commission and its National Committees for consideration;
- through the Near East Applied Research Programme, revise existing salinity and alkalinity classification to meet the specific requirements of the Region.

7.3 Dynamics of Salts in the Soil-Water System

(13) Salt movement in the soil is essentially the result of water movement. Models and formulae have been developed which present and describe the complex processes of leaching and drainage of salt affected soils. The limitations of such models should be recognized; their value for design work depends on the proper establishment of their relation to actual field conditions, which can only be tested in the field. Tests under field and laboratory conditions can then complement each other. Radioactive tracer techniques could also be helpful for such tests.

(14) The meeting agreed that costly reclamation projects should not be based only on formulae which describe movements under simplified conditions, but that design criteria and expected results should be tested under actual field conditions in pilot projects.

(15) It has been suggested that a leaching efficiency factor be included in the calculation of the leaching requirement, which takes into account the extent of mixing between applied water and the soil solution. This factor is to be determined in field tests.

(16) The gross volume of irrigation water needed does not only depend on evapotranspiration and leaching requirement but also on the estimated application efficiency. The effectiveness of unavoidable deep percolation losses in the leaching of salts was discussed. Practice shows that under specified conditions, such losses may be effective to account for the extra volume of water that should be added for leaching. This led the meeting to recommend that great attention be paid to the correct determination of irrigation quantities to be applied and to irrigation practices.

(17) For design purposes, both concepts of steady state and non-steady state conditions are applicable. The selection of the appropriate concept depends on such local conditions as available manpower, experimental set up, etc.

(18) As to the permissible depth of the groundwater table, different experiences were related. It was felt that additional research in this field will be needed.

(19) A distinction was made between (i) land reclamation including measures for improvement of salt affected soils, and (ii) management of reclaimed soils including measures to prevent salinisation of soils. These two subjects will also be dealt with separately in this report, i.e. in sections 7.4 and 7.5.

(20) Main Recommendations

The Seminar wishes to draw the attention of the authorities concerned with land reclamation projects to the need:

- to complement findings on leaching requirements as estimated from empirical formulae and from models by actual field tests;

- to pay more attention to the correct determination of irrigation water requirements and its application;

and also recommends that the Near East Applied Research Programme and research institutes:

- initiate and carry out studies on the critical depth of the groundwater table under different conditions of soil, crop, climate and salinity.

7.4 Reclamation of Salt Affected Soils

(21) The leaching requirements for reclamation are ultimately determined by the level of soil salt concentration which has to be reached in order to grow crops. It was reported that special varieties of rye grass and barley have proved to be suitable pioneer crops in the early stages of reclamation. It is recommended that the search for new tolerant crops be continued.

(22) Conditions for continuous and intermittent leaching methods of reclamation were discussed. Intermittent leaching is recommended under specified conditions, such as poor soil permeability, non-saline or slightly saline groundwater and periods of low evaporation. Continuous leaching is recommended under conditions of good soil permeability, and high evaporation rate. Winter or summer leaching depends on the type of salts, soil conditions and availability of water. Preferably leaching should be done when the groundwater table and evaporation are at their lowest level. As leaching of sodium sulphate is somewhat retarded in winter, summer leaching might be more effective in this case, especially in soils of low permeability.

(23) The final depth of reclamation depends on the potential and planned land use. In this connection, it was stressed that land reclamation projects should follow a planned concept which will have to be based on an optimum use of available resources (funds, time, personnel, water equipment, etc.) for attaining the development objective or objectives (food production, economic growth, employment, etc.).

(24) The time required for reclamation is largely influenced by the above factors. Subsoiling, moledrains, addition of gypsum and other measures can help to reduce the reclamation period. The decision on the use of such measures depends on the economy of the project. If the large investments needed for reclamation are left idle for a prolonged period, the economy of the project will decrease rapidly. Project execution in stages is strongly recommended. Network analysis provides an excellent implement for sound planning of project execution.

(25) Main Recommendations

The Seminar wishes to draw the attention of government authorities concerned with land reclamation measures to the need:

- to plan reclamation projects on a long term basis;

and recommends:

- that reclamation projects be started with pilot schemes and the whole project developed in stages in order to avoid negative effects of delayed leaching;
- that the depth and degree of reclamation be decided upon in close relation to land use.

7.5 Management of Salt Affected Soils

(26) Special attention should be paid to the management of soil and water to maintain the proper salt balance. This includes irrigation, drainage, evaporation control, erosion control, suitable tillage practices, etc.

(27) The meeting agreed that irrigation and drainage networks on the farmers' fields should be included in any project design; this is considered a prerequisite for efficient water management.

(28) The layout and dimensions of fields and field roads should not only correspond to irrigation and drainage needs, but also take into consideration future requirements for mechanisation.

(29) In some areas, summer fallowing has to be practised because of water shortage. This greatly increases the danger of resalination. If summer fallow cannot altogether be avoided, irrigated and fallow areas should be arranged in large blocks to avoid unnecessary irrigation losses and rise of the groundwater level. Measures to reduce capillary rise and surface evaporation should be introduced.

(30) The meeting noted the interrelation which exists between water management, cropping pattern, leaching requirements and groundwater depth; it recommended that it be established by means of pilot projects for any new set of field conditions.

(31) The meeting also discussed the interrelation of salinity and soil fertility and concluded that information available on fertilizer use under saline conditions is insufficient. Tests on fertilizer application should be included in pilot schemes.

(32) Main Recommendations

The Seminar recommends to government authorities and other agencies concerned:

- to pay specific attention to proper soil and water management to avoid resalination;

- to complete, as part of the project, irrigation and drainage networks at the field level, including field ditches and field drains. Land grading should also be included in the project;

- to test all soil and water management aspects in pilot projects;

and recommends to FAO:

- to initiate, through the Near East Applied Research Programme, research on salinity-fertility interrelations.

7.6 Irrigation and Drainage

(33) The meeting re-emphasized that efficient field water management is indispensable. For this reason irrigation and drainage design should start from the field level and not vice versa, and should be based on correctly determined and field tested parameters.

(34) Efficient water management requires a good knowledge of water requirements of crops. The means to obtain this knowledge in research and field tests are available. Because of the effect that correct water use has on the economy of projects, planners are urged to include applied research and field tests on water requirements in land reclamation projects.

(35) It is not difficult to determine the applicability, limitations and costs of classic surface irrigation methods, but it was felt that more knowledge is needed in these fields with respect to sprinkler and drip irrigation.

(36) The system of lowering the groundwater table by exploitation of groundwater for irrigation was discussed to some extent. The meeting noted with interest that the authorities in Pakistan, where this system is used extensively, are considering the evaluation of its long term effects.

(37) The meeting also noted with interest a recently developed system for the construction of horizontal field drains using trenchless pipe-laying machines. The meeting requested FAO to initiate a study on the applicability of trenchless pipe-laying and plastic material for drains under the conditions of the Region.

(38) Main Recommendations

The Seminar wishes to draw the attention of authorities concerned with the design of irrigation and drainage systems for land reclamation projects to the need:

- to base irrigation and drainage design on correctly determined and field-tested parameters;

and recommends to FAO and the Near East Applied Research Programme:

- to initiate studies on the applicability of drip and sprinkler irrigation for salt affected soils in the Region;

- to study the applicability to the Region of trenchless drain installation machines.

7.7 Use of Saline Water for Irrigation

(39) The reports on the use of saline water for irrigation and salt tolerance of plants showed results of research work carried out in Tunisia during the past decade. The meeting noted that a direct transfer of the results obtained in Tunisia to other parts of the Region might not be possible because of the rather special conditions mentioned in the report under which these results were obtained.

(40) In discussing the report, attention was drawn to the hazards of causing sodicity by using saline water for leaching.

(41) The meeting agreed that it would be useful to study on a regional basis several problems which were raised in connection with the reports from Tunisia for which some experience in the Region already exists, and which are, in particular:

- the classification of irrigation water under different conditions of soil, cropping pattern, climate, irrigation and drainage management;
- the salt tolerance of various crops including the possibility of breeding plants adapted to saline conditions.

(42) It was noted, however, that such a programme would be rather ambitious and that only a modest start should be made in the near future under the Near East Applied Research Programme.

(43) Main Recommendations

The Seminar recommended to FAO:

- to arrange for the Final Technical Report of the Unesco/UNDP Project TUN/5 "Research and Training on Irrigation with Saline Water" to be made available to the countries of the Region;
- to promote regional teamwork in the utilization of saline water for irrigation and for support and advice in this field through the Near East Applied Research Programme;
- to initiate water quality studies under different soil, crop, environment and water management practices towards a new classification of the quality of saline water for the specific conditions of the Region;
- to initiate studies of results obtained so far on salt tolerances of plants and on the possibility of breeding plants adapted to saline conditions.

7.8 Organization of Land Reclamation

(44) The meeting wished to recall that land reclamation, irrigation and drainage have essentially agricultural objectives and should not be dealt with separately.

(45) Agriculture in its economic, technical and social aspects, however, is multi-disciplinary and, therefore, the meeting recommended that the following main disciplines should be involved in the planning, design and execution of land reclamation projects: soil science, engineering, agriculture, economy and social sciences.

(46) The meeting also recognized the central importance of water management for successful implementation of land reclamation projects and their efficient operation. It was proposed to consider the inclusion of water management in university curricula. It was noted that at the recent FAO Seminar on Water Management for the Asia and Far East Region in Manila, the same proposal was made by the delegates.

(47) In order to facilitate inter-disciplinary co-operation and a homogeneous development of land reclamation projects, it was suggested that the responsibility for surveys, investigations, planning, design, execution, operation, management and administration of land reclamation projects should be concentrated in one authority.

(48) The structural execution of projects, including land grading, can often be carried out at favourable conditions by contractors. In this case, however, the abovementioned land

reclamation authority must have the necessary technical and administrative staff for supervision. It was also recognized that where experienced contractors are not available and training of local staff is required, the project, as a whole, might favourably be executed by the project authority directly.

(49) It is strongly recommended that new land reclamation projects under the responsibility of the said authority and in co-operation with government agencies concerned, should include the whole infrastructure needed for such projects, i.e. the physical infrastructure such as housing, schools, community centres, roads, stores, etc., and organization infrastructure, such as extension services, marketing services, agricultural supplies services and farmers' associations.

(50) Special attention should be paid to the operation, administration and management and maintenance of land reclamation projects after their completion. The farmers should be involved in the operation and maintenance of "their" project to the maximum possible extent. The degree of their involvement, however, depends on their education, their understanding of the problems involved, the leadership of communities and on incentives for the farmers to form and co-operate with such communities. Farmers' organizations or associations are useful for these purposes, but they must be established with well-defined responsibilities and authority which must be based on a sound land and water legislation.

7.9 Training

(51) In all discussions on the different items of the agenda, the lack in number of qualified staff at all levels was mentioned as a serious handicap for further acceleration and expansion of land reclamation activities. However, efficient soil and water management will have to involve millions of farmers who will have to receive guidance and education in this field. Extension services for water use at the farm level will be needed in future, thus considerably increasing the training requirements, specifically for field technicians. The Seminar participants, therefore, agreed to make a strong recommendation for the establishment of intensive training programmes at all levels of education in the Region. It was noted that this recommendation is in line with the recommendations made by the Regional FAO Seminar in Manila, mentioned above, and by a Seminar on Irrigation Planning for the Near East Region in Berlin and Tunis in 1969. The meeting noted with interest the intention of the Government of Iraq to establish an international training centre, and FAO was requested to support this project.

(52) Main Recommendations (of chapters 7.8 and 7.9)

The Seminar wishes to draw the attention of governments, FAO and UNDP to the need for:

- an integrated approach to land reclamation projects and the high priority they should receive, especially with regard to their development possibilities for inter-disciplinary co-operation, institutions and training;

and recommends:

(a) to Universities:

- to include the subject of water management in their curricula;

(b) to Governments and FAO:

- to establish a regional training centre for cadres of technicians in connection with a pilot scheme;

- to reinforce the subject of water use at the field level in extension services or extension work in this field at the project level.

7.10 The Near East Regional Applied Research Programme

(53) Following the suggestions received from the Near East Land and Water Use Commission, FAO collected information on applied research work presently being carried out in the different countries of the Region in the field of saline, calcareous and sandy soils, and economic use of water. In reviewing the present status of the Programme, the meeting noted that lack of comparability of the data on applied research appears to be a serious handicap for a more efficient use on a regional and country basis of research results for project planning. In order to achieve such comparability, all necessary environmental information, such as soil, climate, water quality, etc., must be reported and standards for such recording should be worked out under the Near East Applied Research Programme.

(54) During the discussion of the individual agenda items, a number of fields were identified in which active support on regional co-operation through the Near East Applied Research Programme is recommended. These fields are, in brief, the following:

(a) The study of the applicability and usefulness of the proposed guidelines for sampling, analysing and mapping salt affected soils and of the proposed salinity and alkalinity classification.

(b) The collection of more quantitative data on the extent of present and potential salinity and waterlogging in order to understand the nature and magnitude of the problem in the Region and its economic impact. This should also provide information needed to complete and improve on the map of salt affected soils in the Region.

(c) The initiation of studies and applied research, and their co-ordination to obtain comparability, on specific technical problems, especially:

- revision of existing salinity and sodicity classifications;
- salinity-fertility interrelation;
- water quality classification;
- salt tolerances and plant adaptation;
- formulae for determination of leaching requirements;
- water and soil management practices in relation to salinisation;
- water and salt balances;
- critical depth of groundwater table;
- new drain-construction machines and materials;
- sprinkler and drip irrigation.

(55) In order for the Near East Applied Research Programme on Land and Water Use to be viable, it is imperative that the National Land and Water Use Committees in the countries of the Region be established in order to centralize the programming and follow-up services of land and water use projects in the countries concerned. The Seminar therefore urges those governments in the Region which have not as yet established their National Committees to take immediate action in this respect.

(56) Main Recommendations

The Seminar urges those governments in the Region who have not yet done so:

- to take immediate action to establish their National Land and Water Use Committees;

- to take immediate steps in actual planning, execution and implementation of some of the recommended projects and co-ordination with countries of the Region with the help and guidance of FAO and UNDP.

7.11 Summary of Recommendations

The Seminar recommends:

(a) to Governments:

- that where they do not yet exist, National Land and Water Use Committees be established immediately;

- that specific attention be paid to land reclamation, improvement and management measures as an important basis for increased agricultural production, rural employment and conservation of agricultural resources;

- that the need for an integrated approach to land reclamation projects and the high priority they should receive be recognised; special attention should be given to inter-disciplinary co-operation, institutions and training;

- that the use of irrigation water be controlled with a view to achieving a fair distribution of international water resources on the basis of optimum requirements for agricultural production;

(b) to governments and authorities concerned with land reclamation projects:

- that reclamation projects be planned on a long term basis;

- that reclamation projects commence with pilot schemes and the whole project be developed in stages, especially in order to avoid negative effects of delayed leaching;

- that irrigation and drainage networks be completed to the field level as a part of the project, including field ditches and field drains;

- that land grading should be carefully executed;

- that special attention be paid to proper soil and water management to avoid resalination;

- that more attention be paid to the correct determination of irrigation requirements and its application;

- that all soil and water management aspects be tested in pilot projects;

- that the depth and degree of reclamation be determined on a sound land use concept;

(c) to governments and FAO:

- that a regional training centre be established for cadres of technicians in association with a pilot scheme;

- that the subject of water use at the field level be reinforced in extension services or extension work in this field at the project level;

(d) to FAO and the Near East Applied Research Programme:

- that regional co-operation be promoted in all fields related to land reclamation, improvement and management;

- that they continue to hold seminars and provide consultant services in the specialized fields of land reclamation;

- that the existing salinity and alkalinity classification be adjusted to meet the specific requirements of the Region;

- that they initiate and carry out studies on the critical depth of the groundwater table under different conditions of soil, crop, climate and salinity;

- that they initiate research on salinity-fertility interrelationships;

- that they initiate studies on the applicability of drip and sprinkler irrigation for salt affected soils in the Region;

- that they study the applicability to the Region of trenchless drain installation machines;

- that they promote regional teamwork in the utilisation of saline water for irrigation and in obtaining support and advice in this field;

- that they initiate water quality studies under different soil, crop, environment and water management practices towards a new classification of the quality of saline water for the specific needs of the Region;

- that they strengthen studies on the salt tolerance of crops and on the breeding of more tolerant varieties;

(e) to National Land and Water Use Committees and Participants of the Seminar:

- that they supply information for the completion and refinement of the map of salt affected soils in the Region;

(f) to Universities:

- that they include the subject of water management in their curricula.