Roundtable on Land & Water Management

Table ronde sur la gestion de l'eau et des terres

Proceedings
Actes

Cairo/Le Caire
13-15 dec. 1993

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(Editor/Éditeur)

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FOREWORD

This document contains the ***Proceedings of the Roundtable on Land & Water Management*** organized by the Regional Office for North Africa and the Middle East (MERO) of the International Development Research Centre (IDRC). Held at the Cairo Sheraton Hotel from 13 to 15 December 1993, the roundtable counted on the participation of 11 IDRC-supported projects in North Africa and the Middle East and served to:

i) highlight the projects' commonalities, strengths and weaknesses;
ii) strengthen their execution by facilitating linkages;
iii) plan and design future activities and mechanisms for:
  a) resource sharing, technical assistance, South- South technology transfer
  b) improved communications and dissemination of results
  c) joint research
  d) coordination
iv) facilitate their contributions to the evolution of the programs of IDRC Regional Office for North Africa and the Middle East (MERO).

The invited projects all concern research activities in the areas of integrated management of natural resources, environmental studies and environmental policies, and illustrate well MERO's current program priority. They included (from West to East):

1- Développement d'un système d'information géographique pour la mise en valeur agricole (SIGMA); Maroc/IAV Hassan II, Canada/U. de Sherbrooke (completing in 1994).
2- SIG pour la gestion de l'activité pastorale dans la steppe algérienne; Algérie/CNTS (to start in 1994).
3- Système d'information à référence spatiale (SIRS) basé sur les données de télédétection pour la conservation des eaux et des sols; Tunisie/ENIT, Canada/U. Laval (completing in 1994).
4- Geographic Information System for Water Resources Management; Egypt/SRI, Canada/GIS Division-EMR (completing in 1994).
5- Water/Land Management; Egypt/U. of Alexandria, Canada/UBC/Guelph (completing in 1995).
6- Environmental Policy-Making; Egypt/AUC (completing in 1994).
7- Irrigation Efficiency; Egypt/Desert Development Centre, AUC (starting in 1994)
8- Irrigation Management; West Bank/ARIJ (completing in 1996).
9- Water Harvesting; Canada/U. of Concordia, Jordan/ U. of Jordan, ICARDA (completing in 1996).
10- Agro-Ecological Characterization; Regional/ICARDA (completing in 1994).
11- Terrace (Dryland Resource Management Project Phase II); Yemen/AREA, ICARDA (starting in 1994).

(Another initially scheduled project, Integrated Watershed Management -Syria-, could not be represented at the meeting)

The program for the meeting consisted of 2 days of presentations on project concepts (issues

covered, disciplines involved, objectives, methodologies, technical and organizational problems). Participating project leaders were requested to prepare a 30-minute presentation (jointly in the case of multi-component projects) allowing a 15-minute question period between each.

The next day was used **(1)** to present a synthesis of commonalities, strengths and weaknesses; **(2)** to propose and discuss innovative activities and mechanisms relating to objectives (ii), (iii) and (iv) above; and **(3)** to discuss potential follow-up activities by MERO staff and the projects.

These ***Proceedings*** include the speeches of the participating MERO staff members, followed by the texts made available by the invited project leaders on their projects. The compilation of commonalties, challenges and recommendations was made possible thanks to the assistance of *rapporteurs* selected among the participants. We are particularly thankful to Robert Valantin, Ferdinand Bonn, Mike Jones, John FitzSimons and Seeman Sarraf for their assistance in this matter.

AVANT-PROPOS

Ce document contient les ***Actes de la Table ronde sur la Gestion de l'eau et des terres*** organisée par le Bureau régional pour l'Afrique du Nord et le Moyen-Orient (BREMO) du Centre de recherches pour le développement international (CRDI). Tenue à l'hôtel Cairo Sheraton du 13 au 15 décembre 1993, la table ronde a compté sur la participation de 11 projets appuyés par le CRDI en Afrique du Nord et au Moyen-Orient et a servi à:

i) illustrer les points communs des projets, leur force et leurs faiblesses;
ii) renforcer leurs opérations en favorisant des liens entre eux;
iii) planifier et formuler des activités et mécanismes futurs pour:
  a) le partage des ressources, l'assistance technique, la coopération Sud-Sud en transfert de technologies
  b) une amélioration des communications et de la diffusion des résultats de la recherche
  c) la recherche conjointe
  d) la coordination;
iv) faciliter leurs contributions à l'évolution des programmes d'intervention du Bureau régional du CRDI pour l'Afrique du Nord et le Moyen-Orient (BREMO).

Les projets invités traitent d'activités de recherche dans les domaines de la gestion intégrée des ressources naturelles, des études environnementales et des politiques environnementales. Ils illustrent bien les priorités actuelles du programme du BREMO. Ils ont compris (d'Ouest en Est):

1- Développement d'un système d'information géographique pour la mise en valeur agricole (SIGMA); Maroc/IAV Hassan II, Canada/U. de Sherbrooke (terminant en 1994).
2- SIG pour la gestion de l'activité pastorale dans la steppe algérienne; Algérie/CNTS (commençant en 1994).
3- Système d'information à référence spatiale (SIRS) basé sur les données de télédétection pour la conservation des eaux et des sols; Tunisie/ENIT, Canada/U. Laval (terminant en 1994).
4- Geographic Information System for Water Resources Management; Egypt/SRI, Canada/GIS Division-EMR (terminant en 1994).
5- Water/Land Management; Egypt/U. of Alexandria, Canada/UBC/Guelph (terminant en 1995).
6- Environmental Policy-Making; Egypt/AUC (terminant en 1994).
7- Irrigation Efficiency; Egypt/Desert Development Centre, AUC (commençant en 1994)
8- Irrigation Management; West Bank/ARIJ (terminant en 1996).
9- Water Harvesting; Canada/U. of Concordia, Jordan/ U. of Jordan, ICARDA (terminant en 1996).
10- Agro-Ecological Characterization; Regional/ICARDA (terminant en 1994).
11- Terrace (Dryland Resource Management Project Phase II); Yemen/AREA, ICARDA (commençant en 1994).

(Un autre projet initiallement au programme, Integrated Watershed Management -Syrie-, n'a pas pu être présenté)

Le programme de la réunion a consisté en 2 jours de présentations sur le concept de chaque projet (ses problématiques, les disciplines concernées, ses objectifs, sa méthodologie, ses problèmes techniques et organisationnels). Les chercheurs principaux participants devaient préparer une communication de 30 minutes sur leur projet. Une période de questions de 15 minutes a suivi chaque communication.

Le jour suivant a été utilisé pour **(1)** présenter une synthèse de leurs points communs, leur force et leurs faiblesses; **(2)** proposer et discuter des activités et mécanismes innovateurs en rapport aux objectifs (ii), (iii) et (iv) ci-haut; et **(3)** élaborer sur le suivi de la réunion par le personnel du BREMO et les projets.

Ces ***Actes*** rassemblent les discours prononcés par les membres du BREMO participants, suivi par les textes offerts par les chercheurs principaux sur leurs projets. Les points communs, les défis et les recommandations ont été compilés par des rapporteurs choisis parmis les participants. Nous tenons à remercier Robert Valantin, Ferdinand Bonn, Mike Jones, John FitzSimons et Seeman Sarraf pour leur assistance à cet effet.

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Table ronde sur la gestion de l'eau et des terres
Cairo/Le Caire, 13-15 dec. 1993
Roundtable on Land & Water Management
(Salon *Nefertiti* Lounge, Hotel Cairo Sheraton)

PROGRAMME/AGENDA

Lundi/Monday 13/12/1993

9:00	Welcome address/Mot de bienvenue, **Dr. Fawzy Kishk**
9:15	Overview of IDRC's strategy in Land & Water Management in North Africa and the Middle East/Aperçu de la stratégie du CRDI pour la gestion de l'eau et des terres en Afrique du Nord et au Moyen-Orient, **Dr. Eglal Rached**
9:45	Goals, Objectives and Expected Results of the Roundtable/Buts, objectifs et résultats anticipés de la Table ronde, **Mr. Gilles Cliche**
10:30	Coffee Break/Pause café

Project Presentations/Présentation des projets

11:00	Water/Land Management, North-West Coast, Egypt **Dr. Fawzy Abdel-Kader, Dr. John FitzSimons**
11:45	Water Harvesting, Jordan, **Dr. Awni Taimeh, Dr. Seeman Sarraf**
12:30	Lunch/Déjeuner
14:00	SIG pour la gestion de l'activité pastorale dans la steppe algérienne **Mr. Said Benzineh**
14:45	Agro-Ecological Characterization **Dr. Wolfgang Goebel**
15:30	Coffee Break/Pause café
15:45	GIS for Water Resources Management, Egypt **Dr. Mona El-Kady, Dr. Mosaad Allam**
16:30	Discussion

Mardi/Tuesday 14/12/1993

Project Presentations/Présentations des projets

9:00	Irrigation Management, West Bank **Dr. Hisham Zarour**
9:45	Développement d'un système d'information géographique pour la mise en valeur agricole (SIGMA), Maroc **Dr. Abdelaziz Merzouk, Dr. Ferdinand Bonn**
10:30	Coffee Break/Pause café
11:00	Dryland Resource Management/Terrace, Yemen **Dr. Adbul Wahed Moukred**
11:45	Environmental Policy-Making, Egypt **Dr. Salwa Gomaa**
12:30	Lunch/Déjeuner
14:00	SIRS basé sur la télédétection pour la conservation des eaux et des sols, Tunisie, **Dr. M. Rached Boussema, Dr. Jean-Jacques Chevalier**
14:45	Desert Irrigation Efficiency, Egypt **Dr. Hosni El Lakany**
15:30	Coffee Break/Pause café
15:45	Integrated Watershed Management, Syria **Dr. George Soumi (**Note: Not presented/pas présenté)**
16:30	Discussion
19:15	***Dinner on the Nile/Dîner sur le Nil***

Mercredi/Wednesday 15/12/1993

Working Groups/Groupes de travail

9:00	Setting the stage/Mise en scène, **Dr. Eglal Rached/Mr. Gilles Cliche**
9:30	WG 1: Projects' commonalities, strengths and weaknesses/ GT 1: Points communs, force et faiblesse des projets WG 2: Improving linkages, coordination and project execution/GT 2: Vers l'amélioration des liens, la coordination et l'exécution des projets

Mercredi/Wednesday 15/12/93 (following.../suite...)

10:30	Coffee Break/Pause café
11:00	WGs continue/Suite des travaux en GT
12:30	Lunch/Déjeuner
14:00	Rapport of the WGs/Rapports des GT
14:30	**Open Discussions**: Mechanisms, activities and means to strengthen and expand the IDRC program in Land & Water Management in North Africa and the Middle East/**Discussions ouvertes**: Mécanismes, activités et moyens pour renforcer et accroître le programme du CRDI dans la gestion de l' eau et des terres en Afrique du Nord et au Moyen-Orient.
15:45	Coffee Break/Pause café
16:00	Recommendations and Conclusion/Recommandations et conclusion

OPENING REMARKS

Dr. Fawzy Kishk, IDRC

Ladies and Gentlemen

On behalf of IDRC, I would like to extend to all of you a very warm welcome and to thank you for accepting our invitation to participate in this regional roundtable on land and water management of the IDRC-supported projects in the Middle East and North africa region.

Your roundtable is actually the second roundtable held by the Middle East and North Africa regional office in Cairo, one of the seven offices that IDRC has around the world. It is a part of a process of consultation, where we seek input and advice from our partners in research on how to enhance our working together to produce an impact on development. This method of consultation has started more than two years ago when the Centre was developing its new program orientation.

Our first regional roundtable took place in June 1993 in Cairo, where a selected number of scientists, scholars and intellectuals were invited by IDRC to discuss the strategic choices that the Centre made in this region as well as ways for their effective implementation. This has proved to be a very useful exercise, it produced good counsel and provided many good ideas to enhance the Centre's work in the M.E. region.

I am sure that you are well familiar with IDRC and its style of operation but please allow me to tell you more about the Centre and its mission and how its programming orientation is evolving at present.

As many of you know, IDRC was established in 1970 by the Canadian Parliament. Its mission can be stated succinctly as "Empowerment Through Knowledge". This mission is predicated on the relationship between knowledge and development and the Centre's conviction that empowerment through knowledge is the key element in the development of the nations, peoples, communities and individuals. IDRC is dedicated to creating, maintaining, and enhancing research capacity in developing regions, in response to needs that are determined by the people of those regions in the interest of equity and social justice.

In the late 1980s, the growth of the Parliamentary grant has ceased and the Centre was forced to question the nature and number of its activities. So far, and since its establishment, the Centre has funded over four thousand projects in more than one hundred countries of which more than 300 projects were in the Middle East and North African Region (MENA). Of the 1200 on-going projects more than 100 projects, are in this Region.

In 1991, the time came when the Centre began to reassess its activities and sharpen it focus to use the grant in the best way to make a difference in development. So we looked at our comparative advantage as a Centre. One of the Centre's important comparative advantages is its style of operation which is based on full intellectual partnership -we do not consider our relation as a donor/recipient but rather as partners in the important process of development. Other comparative advantages that the Centre has are:

- it was the first organization in Canada to support research for development;
- it has an international Board which is a unique feature to IDRC, as a donor agency. Inspite of the fact that almost all IDRC funds come from Canadian tax payers, this does not interfere with the Board's choices and strategic decisions.
- it has a global perspective and convening powers;
- it is a mid-sized organization, not a big bureaucracy , which gives it flexibility in responding to the needs of its grant-recipients.
- it succeeded in establishing a world-wide network with researchers, policy and decision makers in the developing countries and with the scientific research community;

Now let me brief you on the evolution undergone by IDRC and why its program orientation is focused on **Sustainable and Equitable Development (SED)**

It is important to acknowledge that development must be a sustainable process as well as an equitable one. We cannot think of economic growth without thinking of equity, social justice and environmental protection. Thus in IDRC, we give high priority to research that promotes development that is both sustainable and equitable.

In June 1992, at the UNCED Rio Conference, Canada's Prime Minister declared that IDRC is chosen as one of the key implementing agencies of Agenda 21 (a follow-up on the Rio conference) and that the Centre's principle role should be to act as a catalyst for sustainable development through capacity building. He made a pledge that the parliament of Canada would provide core funding of $115M per year to the Centre for the next decade.

After the Rio announcement the Centre focused on consulting globally to determine its new role as an implementing agency of Agenda 21 and began to explore new partnerships.

This exercise has resulted in the development of a three-year Centre Corporate Framework (CPF). It lays out the priorities and broad areas of activity that will guide IDRC's programming and allocation decisions from 1993/94 to 1995/96. Its objective is to "sharpen the Centre's focus", which is a guiding principle of the Centre's strategy . All the Centre's programs are now oriented explicitly toward sustainable and equitable development, and encompass six core themes -all related to environment and development- and those six themes are to receive at least half of the Centre's program funding resources:

The six core themes are:

- Integrating Environmental, Social, and Economic Policies
- Technology and the Environment
- Food Systems Under Stress
- Information and Communication for Environment and Development
- Health and the Environment
- Biodiversity

Other programs, around 20, all oriented towards Sustainable and Equitable Development are listed under five divisions which form the operational organization of the Centre; these divisions are:

- Environment and Natural Resources Division
- Social Sciences Division
- Health Sciences Division
- Information Sciences and Systems Division
- Corporate Affairs and Initiatives Division

This should give you an idea on the new Centre orientation and its structure for the next three years. This, we feel, will allow the Centre to sharpen its focus, i.e. to allocate its limited funds to smaller number of research areas and in smaller number of institutions which will increase its chances for making a tangible difference in the development efforts of the developing regions of the world.

In the Middle East and North Africa Region, the Centre developed its regional strategy on the basis of its past experience and with the help of a number of development experts from the region. Two strategic research areas were identified for this region, these being:

1) Sustainable utilization of natural resources, particularly land and water in the region's threatened ecosystems; and

2) Technology development and utilization, particularly for the region's small and medium-scale industries.

More elaboration on the regional program will be presented by my two colleagues in the regional office (E. Rached & G. Cliche).

Closing note

In conclusion, I am very hopeful that your deliberations during this three-days roundtable will make valuable contribution to the on-going discussions within the Centre on questions such as: how could the Centre best use its expertise and experience in developing research in ways that will make appreciable difference without duplicating other existing efforts. We welcome your views on how we -as partners in research for development- may work together more effectively and efficiently. I promise that we will take serious note of your advice and assure you that the results of this consultation will be reflected on our future collaboration.

We are most honoured to have this gathering of distinguished colleagues and scientists from the Middle East and North Africa region and their Canadian research partners. Let me extend to you again, on behalf of the Centre, a warm welcome and best wishes for a fruitful meeting and a pleasant stay in Cairo.

OVERVIEW OF IDRC's STRATEGY IN LAND & WATER MANAGEMENT IN NORTH AFRICA AND THE MIDDLE EAST

Dr. Eglal Rached, IDRC

It is a great pleasure to welcome you, on behalf of IDRC, to this important gathering on the very vital issue of sustainable water and land management in the Middle East and North Africa Region. I have been working with many of you individually in developing some of the projects that will be discussed here, and it has always been disappointing for me not to be able to tell you more about what the others were doing. This is our chance now, and I am sure you will find it as interesting as I will to hear and exchange about what others are doing in related fields.

The objective of this short presentation is to provide an overall explanation of IDRC's program strategy in the Middle East and North Africa Region, as related to Land & Water Management.

Some two years ago, IDRC has been very active in redefining its program priorities and strategies for research support. This was due to a number of factors: the changing global perspectives for research & development; a recognition of the specific development issues and needs of the different regions of the world which brought about the formulation of specific IDRC strategies for each of its regional offices, including our for the Middle East and North Africa region; a greater decentralization of IDRC's operations which translated in increased program responsibilities to its regional offices; a relative downsizing of IDRC which forced us to concentrate on fewer research issues while aiming at increasing our development impact; and more recently, the designation of IDRC by the Government of Canada to be one of the key implementing agencies for Agenda 21.

After intensive discussions and consultations with our regional partners, other Centre staff and like-minded donors, the Centre's strategy for MENA was developed and focusses on two programmatic areas: these are economic participation with special emphasis on small and medium size enterprises, and the sustainable utilization of natural resources with emphasis on water and land resources in the fragile ecosystems of the region. An essential part of this strategy is the link between the two program areas: land and water resource management in the fragile ecosystems are, by definition, faced with formidable limitations and constraints. The development of alternative livelihood systems in these regions is an essential element not only for relieving direct pressures on the resources, but also for improving the living conditions of the local populations.

A number of strategic choices were made here: first the focus on fragile eco-systems (arid and semi arid areas and highlands), second the selection of land and water as target natural resources and third, the integration of land and water dimensions.

Why fragile eco-systems: essentially because they are the ecosystems most threatened by degradation, and because little has been done in these areas in terms of research and

development in these regions, while relatively much attention was concentrated more on the wetter zones, where projects are expected to yield higher economic rates of return than projects located in disadvantaged ecosystems.

The importance of water resources in this region is no news to you: Most of the region is characterized by severe WATER SCARCITY. In addition to the natural climatic factors, the water scarcity has been exacerbated by several other factors such as rapid population growth, urbanization, industrialisation and increased irrigation needed to satisfy the additional demand for food. The increased demand for water is being exacerbated by the excessive pumping of groundwater aquifers, some of them holding fossil water, and by the deteriorating quality of both surface and groundwater supplies.

I will not dwell here on the political issues related to water scarcity. Again these are well known. Suffice it to say that it is expected that increasing water shortages, combined with the deterioration in water quality, will leave insufficient water to satisfy the growing human, developmental and security needs among nations of the Middle East and could lead to desperate competition and major confrontations between countries of the region.

On the technical side, conventionally, water resources research has been focused on water supply management, looking at options to increase or adjust supply, in terms of dams, streams, conveyance systems. Very little work has been done at demand management, i.e. looking at conservation options or redirecting demand. It is increasingly being argued that we are likely to find that gaps between supply and demand can be more easily, more cheaply and more safely resolved by conservation measures than by increasing supply. Similarly the significance and vulnerability of the "invisible water" such as soil moisture and groundwater has largely been overlooked. Finally, seldom has the demand/supply/quality dimensions of water been looked at concurrently. The program we are developing in this region attempts to tackle some of the above gaps, with a central attention to the human and social dimensions. Examples of research activities in this field will be provided in projects such as Water (West Bank), Water Harvesting (Jordan) and Irrigation Efficiency (Egypt).

The second component of this program is land. Obviously, in those areas, the problems of degradation are immense and are related both to environmental factors (fragile soils, rainfall distribution) and to human factor such as mis-management, policies, economic factors, etc. The program developed in the area addresses a number of key factors, such as the monitoring and evaluation of degradation in dry rangelands areas (Steppes, Algerie), the planning for integrated management of land and water resources (eg. Land/Water Management, Egypt, Badia - Syria, Water Harvesting Jordan), and the identification of sustainable systems to combat degradation (eg. Terraces, Yemen; GIS for Soil & Water Conservation, Tunisia).

An important common factor in several of the projects being implemented is the development and use of modern information technologies which can assist in the analysis of the complex issues under studies. A majority of projects in the program make use of remote sensing and geomatics tools and indeed, some are pioneering in these disciplines: GIS for Water Resources Management, Egypt; SIG pour la mise en valeur agricole, Maroc; to name a few.

Finally, and as relates to the development of sustainable alternative livelihood systems in fragile eco-systems, we are also developing projects aiming at provided extra value to the resources, while contributing to their protection and to the welfare of the populations

depending on them (eg. plantes aromatiques - Maroc and Palm mid-ribs Egypt).

Many of these projects will be presented during this roundtable, the idea being to identify their common points and their complementarities. Gilles Cliche will be describing in more details the objectives and organization of the workshop. Before leaving the floor let me indicate that we are eagerly looking forward to the outcome of the presentations and discussions which will take place during this roundtable. Again, thank you for having positively responded to our invitation, and welcome to Cairo.

GOALS, OBJECTIVES AND EXPECTED RESULTS OF THE ROUNDTABLE

BUTS, OBJECTIFS ET RÉSULTATS ANTICIPÉS DE LA TABLE RONDE

Gilles Cliche, IDRC/CRDI

Permettez-moi d'abord de vous souhaiter, à mon tour, la bienvenue au Caire et vous remercier pour votre présence à cette table ronde sur la gestion de l'eau et des terres. En faisant appel aux chefs de projets qu'il appuie, le bureau régional du CRDI au Caire tenait à démontrer l'importance qu'il accorde aux institutions récipiendaires de son aide dans la formulation, et plus précisément l'évolution, de son programme d'appui à la recherche pour le développement. Vous êtes pour ainsi dire l'épine dorsale de notre programme, ce qui le fait tenir debout, et tous et chacun d'entre vous, par les projets que vous représentez, illustrés les éléments fondamentaux de notre approche: une vision précise de l'importance de la recherche appliquée dans et par les pays en développement; un besoin d'axer les efforts sur des problématiques visées et prioritaires aux niveaux local, régional et mondial; une reconnaissance de l'apport d'une approche pluri et interdisciplinaire dans la quête de solutions viables à ces problématiques; et un intérêt à promouvoir le respect de l'environnement et un développement durable et équitable.

We are very please to have you with us in Cairo and we thank you for your acceptance of our invitation to spend the next 3 days looking at the IDRC program on Land & Water Management in the region, and at discussing ways to improve it. In concrete and practical terms, the IDRC-supported projects you are representing are the best examples to illustrate our current program priorities in the region, and we want to build on them. Initially, our intention was to organize a meeting to follow up on the Geomatics project leaders meeting that took place at IDRC Head Office in Ottawa in March 1992, and to which several of you participated. In fact, such as follow up meeting had been programmed for the North African geomatics projects and built in the GIS project on Soil and Water Conservation in Tunisia. D'un commun accord avec Dr. Rached Boussema, nous avons décidé d'organiser cette réunion ici au Caire, et de l'étendre à l'ensemble des projets appuyés par le programme du Bureau régional du CRDI au Caire sur la gestion de l'eau et des terres.

One of our principal goals for this roundtable is to promote exchange and further the linkages between and among similar projects supported by IDRC in North Africa and the Middle East. Through the series of project presentations, you will no doubt discover that common issues and problems are being addressed. This should not be too much of a surprise since we deliberately selected and invited projects in the areas of natural resource management in fragile ecosystems, of environmental studies and policies, always aiming at generating new information and representing knowledge for efficient decision-making. We hope that you will enjoy learning what others supported by IDRC are doing or planning to do, and that through this process you will discover the Gold Mine of talent and expertise from which your own individual project could benefit.

While in most cases the projects were designed as stand alone entities with most if not all of the ingredients to bring them to fruition, it is our strong belief that furthering the linkages among them will bring additional benefits. En comptant sur l'expertise des uns là où elle est déficiente pour les autres, en accédant à un bassin plus large de compétences que celui du propre projet, on ne peut qu'accroître les chances de succès et les retombées des projets tout en évitant les erreurs. We believe that the execution of the projects can be improved by facilitating their linkages which would increase the sharing of existing expertise, and would enable a better transfer of technology and methodology (particularly South-South and Canada-South), and a better dissemination of the research results.

Lors des présentations des projets, nous chercherons donc à identifier et préciser leurs points communs, à cerner les faiblesses et les forces qu'ils présentent. Au programme, nous avons une douzaine de présentations de projets. On a prévu 30 minutes pour chacun avec une période de questions de 15 minutes. On suggère, qu'en pléniaire à la fin de chacune des 2 journées prévues, de procéder par un tour de table pour ensuite tirer une synthèse des observations soulevées sur ces points. C'est cette synthèse qui servira de point de départ pour notre travail en groupe du mercredi matin.

To facilitate the identification of common issues for our subsequent debates, we kindly request each project presentation to follow the guidelines which were provided to you earlier. In particular, in describing your project, we wish you could emphasize the following elements:

1. the project's issues, challenges and objectives, and their regional relevance;
2. the disciplines involved;
3. the project expertise (or lack of) in each one; in the case of lack of expertise, how is this being filled?;
4. the research capacity building component;
5. the innovative methodological aspects of the project;
6. actual or planned activities to disseminate project results to target user groups;
7. technical and/or project management issues which could be of common interest; and
8. anticipated/required follow-up to the project.

Each presentation is programmed for 30 minutes, followed by a 15-minute question period. At the end of each day, on Monday and Tuesday, we will wrap-up the day by producing a synthesis of your observations. These will in turn serve as starting points for our group discussions on Wednesday morning.

Nos défis seront d'identifier et d'articuler des activités et mécanismes pour mettre en place des liens efficaces et productifs entre les projets. On se doit d'innover et de cerner ce qui est possible en tenant compte des réalités propres à tous et chacun. En reconnaissant le besoin d'échanges accrues d'information, on se devra d'explorer les possibilités que nous offrent les nouvelles technologies d'information et de communication, là où elles sont offertes et abordables. Nous devons également regarder du côté des autres acteurs et réseaux existants, à l'extérieur du CRDI. Et bien sûr, pour toutes propositions d'activités futures dans le domaine, nous devons voir les implications pour les institutions concernées, tant chez le CRDI que chez les vôtres.

One of the challenges of the meeting will be to identify ways, mechanisms and activities to

enable efficient and cost-effective linkages among projects. I am stressing the need to innovate and to look at affordable but yet effective means for these linkages to materialize. We must emphasize the need for better information sharing and explore what the new information and communications technologies could offer for our purpose, where and how they could be available to us. We must take into account the cultural, linguistic and country-specific and institutional factors which may adversely affect our networking intentions. We must also pay attention to the opportunities that could be offered by other agencies and networks, outside of the IDRC "family". And of course, for any future activities that could be proposed, we must look at the type of institutional arrangements and responsibilities that would be entailed both for IDRC and your institutions, and at their requirements (financial, human and infrastructure).

Un autre objectif de la table ronde, aussi important que le premier, est celui de favoriser une contribution plus directe des projets à l'évolution du programme du CRDI en Afrique du Nord et au Moyen-Orient. Cet objectif touche aussi bien votre participation à la définition et au raffinement de nos priorités de programme, qu'à notre soucis d'améliorer nos mécanismes et procédures, et d'accroître nos moyens pour sa conduite efficace. Dans le premier cas, nous croyons qu'à la lumière de vos propres expériences dans le cadre de vos interventions sur le thème de la gestion de l'eau et des terres et ses disciplines connexes, il serait possible d'identifier de nouvelles initiatives, de nouveaux axes de recherche sur lesquels le CRDI pourrait se pencher. Nous sommes intéressés par vos commentaires et vos idées sur ce sujet, particulièrement en ce qui a trait aux lacunes que vous pourriez percevoir et aux opportunités de programme d'actions, de projets de recherche que vous pourriez entrevoir pour les combler. L'autre facette de cet objectif concerne nos modalités d'interventions en tenant compte d'une part de nos contraintes institutionelles (l'argent bien sûr, notre mandat, nos ressources humaines, notre avantage comparatif, notre philosophie, etc.) et d'autre part, notre quête pour améliorer, voire maximiser, notre efficacité, la visibilité et l'impact de nos interventions. Sur ce sujet, nous sommes particulièrement ouverts à toutes recommendations qui pourraient nous permettre d'explorer des possibilités de partenariat avec d'autres agences de développement, donateurs ou autres, tout en conservant notre leadership pour la mise sur pied de notre programme. Nous sommes aussi sensibles à la situation économique au Canada qui nous demande des efforts spéciaux pour maintenir l'appui à nos programmes. Tous nos bénéficiaires ont un rôle à jouer dans ces efforts. En fin, notre devoir concerne également la révision de nos modalités. Outre notre travail sur une base de projet, nous aimerions explorer avec vous d'autres options tels que l'appui institutionnel à des Centres d'excellence, la mise en réseau, une plus grande responsabilité aux institutions récipiendaires pour l'exécution et l'administration des projets, qui permettraient de réduire nos coûts d'opération et libéreraient des fonds pour les projets de recherche. Nous proposons d'axer la pléniaire de mercredi après-midi sur ces sujets.

We wish the roundtable could serve the purpose of helping IDRC to improve its program definition and delivery in North Africa and the Middle East. For this objective, a special attention must be paid to both the identification of gaps in our research program priorities and activities, and to the initiatives that could be suggested to tackle them. This meeting provides a great opportunity to survey these issues in our program on Land and Water Management and in its related research components, disciplines and methods. IDRC is also interested in its own growth for your benefit, and is in a constant search for better program delivery mechanisms to increase its efficiency, visibility and impact. We have to explore opportunities for partnership with other development and donor agencies and promote our

approach in their agenda. Special efforts must be made as well to communicate our role and impact in development issues to the Canadian public, particularly in light of the economic situation in Canada. All those involved with IDRC have a role to play in this endeavor. The roundtable can also serve to explore alternative program delivery modalities which could reduce our cost of operation and secure more funds to research initiatives. These could include institutional support to Centres of Excellence, greater responsibility to recipient institutions in the execution and administration of projects, networks of projects, etc. We are suggesting to concentrate on these topics during the plenary on Wednesday afternoon.

The roundtable should aim at producing a series of recommendations that would provide guidance to the IDRC Regional Office for North Africa and the Middle East in the area of Land & Water Management and related subjects. They should also enable the identification of some concrete activities that could be pursued and implemented in the short to medium term, particularly those relating to networking of projects, activities to fill any identified gaps in our research agenda, and any relevant required follow-up to completing projects. We should identify entry points to tackle the issues of communicating more effectively our activities to beneficiaries, including the Canadian public, and of insuring a continued and expanded impact of our project results through improved collaboration with development partners.

Thank you for your attention et bonne table ronde!

WATER/LAND MANAGEMENT : NORTH-WEST COAST -Egypt-

Dr. Fawzi Abdel-Kader, UoA
(University of Alexandria)

Dr. Hans Schreier, UBC
(University of British Columbia)

Dr. John FitzSimons, UoG
(University of Guelph)

Background:

The general development issues facing the north-west coast of Egypt are common to many areas in the middle east and north Africa; the improvement of agricultural production and the well-being of its inhabitants without the degradation of a fragile environment.

As a result of increasing restriction on movement during the past thirty years, the Bedouin population along the NW-Coast of Egypt has been encouraged to evolve from a semi-nomadic agro-pastoral system to a more sedentary agro-pastoral system. Given the population increase, the uncertainty of rainfall and increasing external influences such as tourism development, the transformation has been challenging. Over the past 20 years, the system of water harvesting, storage and redistribution has been greatly expanded and food supplies for both animals and people have been improved through mechanisms such as subsidies, favourable export quotas and direct external aid. However, these changes have been accompanied by increasing degradation of an already fragile environment.

The main questions to be asked are how water use can be further improved, by how much can the biomass production be enhanced, and what are the environmental consequences and sustainability questions in this coastal zone given current inputs and pressures on resources in the region.

Goals:

The overall goal of the project is to examine the bio-physical and socio-economic dynamics of the East Matrouh area of the NW-Coast of Egypt in an integrated and interdisciplinary manner and to evaluate the potential production and carrying capacity of the current system given environmental constraints and the pressures of population growth.

A micro-computer based information system is to be used to integrate biophysical and socio-economic information and to facilitate the evaluation of the resources, generate management options and identify potential environmental consequences if the demand for biomass production continues to increase.

The specific aims of the project are:

1. Evaluate the efficiency of the water collection systems in relation to annual variation in aridity.

2. Examine the changes in land use and production systems in terms of efficiency and sustainability.

3. Determine the animal population dynamics in relation to external demands, inherent social values, and economic pressures.

4. Document population growth in relation to resource availability, production potential and constraints.

5. Evaluate extent of land degradation due to crop intensification, mono-cropping and nutrient depletion.

6. Illustrate the effect of external pressures such as tourism and technological change, and

7. Examine the problems, options and consequences of shifting from subsistence pastoralism to a market production system.

A comprehensive resource and socio-economic database is to be developed in a spatially referenced manner for the Wadi Naghamish and this test area will be used to develop modelling and evaluation capabilities for simulating future development scenarios. This is to be accomplished in a way that enables us to compare the production potential and constraints in a rapid and interactive manner in the test area and to use the techniques for spatial extrapolation to the region.

Methodology:

The project has both a research and a training component. The Canadian collaborating institutions will assist in computer training (Geographic Information Systems (GIS) and database management), the use of new techniques for automated monitoring of bio-physical resources and for evaluating production system dynamics and socio-economic conditions at the community, sub-tribal and extended household level.

The following four components of the project are under way:

1. Development of an integrated, geo-referenced database:

   The first step was to set up a GIS system (Terrasoft) at the University of Alexandria which will form the integrated platform for all data collection, data management and modelling. A three week training course was successfully completed in June 1993 and the development of a geo-referenced integrated resource database is well on its way. It will consist of climatic, topographic, soil, land use, production systems and socio-economic information. Once completed, this database and platform will be

used for modelling resource options and documenting environmental constraints.

2. Biophysical mapping and monitoring:

A climatic network is being set up that consists of one fully automated weather station, five automated rain gauges that monitor rainfall and intensity, and 30 manual 24 hr. rain gauges. Five cisterns have been selected in the Wadi Naghamish test area and the rainfall input (amount and intensity) and the water accumulation in these underground cisterns is monitored using pressure transducers and dataloggers. Knowing the surface area from which rainwater is directed into the cistern, the amount and duration of rainfall and the amount accumulated in the cisterns will enable us to determine how efficient the collection systems are. We will also be able to monitor how much water is used during the rest of the year once the winter rains are over.

Mapping of soils, vegetation and land use will be completed and attempts will be made to document historic land use changes. Soil fertility and erosion conditions will be examined in the rangeland and cultivated areas and production data will be collected from interviews.

3. Farming Systems/ Socio-Economic Data Collection and Modelling

Surveys, using a variety of both formal and participatory techniques are underway to generate geo-referenced data for a series of extended household level farming systems models comprising interacting crop, animal, off-farm and household components reflecting various household wealth levels and the main agro-ecological zones of the study area. The data cover inputs and outputs
from the household systems under "good", "average", and "poor" climatic years, together with the main resource allocation/ production systems decisions expressed in local knowledge/ management systems terms to permit dynamic analysis of system behaviour. On-going training is provided in variety of formal and participatory research techniques and farming systems analysis and modelling.

4. Integration and modelling:

A flowchart (Figure 1) is provided to document the main components of the project and their integration. The key topics to be evaluated are water efficiency, environmental sustainability, carrying and production capacity under various conditions, options for increasing market based activities. We also anticipate developing an annual water management forecasting model for the cistern.

We plan to design a computer based information system for the test area that allows decision-makers and researchers to access the basic data, to evaluate variable interactions, to develop evaluation schemes and to get involved in scenario development.

How can the Water/Land Management Project on the NW Coast of Egypt assist in sharing information and experiences?

Commonalties, Strength and Challenges:

Commonalties:
The resource issues are similar: Water quantity and quality problems, population growth, deterioration of resources and environment. Need to increase biomass production. Need to retain cultural integrity.

Strengths:
Integration of bio-physical and socio-economic evaluation - a holistic approach.
Field monitoring is semi-automated to provide more reliable data on bio-physical processes.
All data is geo-referenced - GIS used as a database and analytic tool.
Computerized database and system will lend itself for innovative modelling approaches.

Challenges:
Difficulty of gathering reliable historic information.
Obtaining reliable production system and socio-economic information from field interviews with Bedouin. Requires innovative participatory approaches and triangulation.

Linkages:
Specific Activities: NW-Coast Project.

Demonstration projects; Once our monitoring program is functioning well (within 6 months) other groups could visit the field installation and get a demonstration of how dataloggers and computers can help in data collection and data integration.

Share experiences and provide information on what kind of field equipment and what kind of techniques work and what does not (GIS, GPS, dataloggers, etc).

Also, within 8-10 months the Alexandria team will be able to
provide a short course in the development of an integrated regional GIS resource database.

Regional Level:
Strong potential for coordination of technical cooperation and training activities between projects.

Hold a regional workshop every 18 months. The host should be a group that has completed a project and can show what was done, what worked and what failed. All participants will present an overview of their projects.

DEVELOPMENT OF OPTIMAL STRATEGIES FOR WATER HARVESTING AND UTILIZATION IN ARID LANDS -Jordan-

(University of Jordan/ICARDA/Concordia University/Université de Moncton)

Dr. Seeman Sarraf, Concordia University

Dr. Awni Taimeh, University of Jordan

BACKGROUND

- Jordan, like most Middle East countries, suffers from shortage of water
- Over 85% of Jordanian land has an average annual rainfall of less than 200 mm
- The only potential left for agriculture development is that of these arid and semi-arid lands
- Nearly all of the rainfall over these lands is presently lost by evaporation
- A vitally important development is to convert this wasteful evaporation into productive evapo-transpiration in plant production
- Harvesting this water for agriculture development is a priority for Jordan as well as many Middle East countries
- Before establishing water harvesting schemes it is of utmost importance to ensure optimal and sustainable storage and use of this water
- An integrated hydrological - water storage and utilization optimization model is required
- Muwaggar watershed was chosen as project site since FAUJ has already built three earth dams and collected field data needed for the evaluation and verification of the model

GENERAL OBJECTIVE

To develop an integrated model, adapted to arid and semiarid regions, capable of devising optimal and sustainable strategies for the planning, design, layout, and operation of water harvesting schemes in watersheds, and for the sustainable use of harvested water to increase crop production and reduce soil erosion.

Specific Objectives

- To collect assemble, organize and analyze soil, water, and socio-economic data from the Muwaggar watershed for input into the different model components;

- To organize the collected information into a Geographic Information System (GIS); and to interface the model with the GIS;

- To develop the three major components:
  a) Runoff prediction component,;
  b) Water storage optimization component;
  c) Water use optimization component, in a micro-computer based

software and integrate them into one model;

- To disseminate project results as related to model capability, limitations, application and utilization.

WATER HARVESTING DESIGN AND OPERATING MODEL (WHDOM)

LIST OF MODULES

1. User interface module **WHDOM**
2. Manager Module*
3. Database Module
4. Data Acquisition Module*
5. Geographical Information System (GIS) Module
6. Watershed Module
7. Environment and Socio-Economics Module
8. Optimal Water Storage Design Module
9. Optimal Water Utilization (Operation) Module

(*Transparent to user)

"WHDOM" DESIGN SPECIFICATIONS

* Multitasking (preemptive through OS/2 2.1)
* Use of all Presentation Manager (PM) graphical user interface features.
* Extensive use of Dynamic Link Libraries (DLL) for functions and programs
* Help facilities.
* Interprocess communications.

Benefits:

* User friendly
* Printing report, calculating and data input/output at the same time
* Reduced memory requirements
* Easy maintainability
* Code sharing
* Upgradability
* Very high integration (Limited only by present version of SPANS GIS)

1. USER INTERFACE MODULE

Features:

* Use of all Presentation Manager Interface features
* User friendly
* Access to any component of WHDOM for:

a. Data manipulation
b. Module selection
c. Module run

* Graphical data display
* Report generation capability

2. MANAGER MODULE

Functions:

* Interprocess communication
* Interprocess schedule
* Management of hardware resources

Features

* Expendability for additional modules
* Configurable for specific needs

3. DATA BASE MODULE

Functions

* Organization, storage, retrieval, report generation and backup of any data needed by WHDOM components;
* Data pre-screening for error, missing values or inconsistencies;
* Generate statistics from database including, mean, standard deviation, skewness; etc.

Features

* Real-time database update from data processed by the Data Acquisition Module
* Full transparent access of data by any module or directly by user
* Possible division between static database and dynamic database.

A. Static (Physical Characteristics of The System)

* Topography Data
* Physiographical Data
  - Drainage channels (location)
  - channels cross - section; slope; roughness
  - basin area; perimeter, average slope
  - infiltration parameters
* Soil Physical Characteristics
  - soil erodability
  - soil texture
  - soil water - holding capacity
  - unsaturated infiltration rates
  - soil depth
  - soil classification

* Hydraulic Data
    - reservoirs site, location
    - reservoirs size, area- volume curves
    - reservoir construction costs
    - conveyance and control system costs
* Meteorological Data Collection
    - type, location of gauging station, weather station

Socio-Economic Data

- cadastral data including land ownership, area location and suitability for agricultural production
- land costs
- Population data including number of people; location, group age; economic and educational level etc.
- Government policies affecting selection of WHDOM module parameters such as farm sizes; internal rate of return or benefit/cost rates of federal projects, data required by economic and financial analysis including number of years to pay back, investment costs, subsides on operation and maintenance costs.
- Farmers' level of cooperation and organization.

B. Dynamic

* Hydrological/Meteorological
    - Wind direction and speed at several heights
    - Solar radiation
    - Temperature daily; maximum, minimum
    - Humidity
    - Vapor pressure data
    - Runoff data
    - Water quality data
    - Soil moisture content
    - Cloudiness data
    - Number of sunshine hours
* Agricultural Data
    - Crop water requirement
    - Animal (cattle, etc.) water requirement
    - Cropping pattern
    - Cultivated area
* Cost Data
    - Crop market values
    - Energy costs {Power & Consumption}
    - Water tariffs
    - Structures operation and maintenance costs
    - Crop production costs including:
        Soil preparation
        Agricultural inputs
        Machinery/labor costs
        Harvesting

Transportation and storage costs

* System Feedback Data
  - Actual demanded water/delivered water
  - Actual reservoir levels
  - Actual structures settings

4. DATA ACQUISITION MODULE

Functions:

* Receive and send data from points on the telemetry system
* Check for errors on receiving data
* Send information, controls to the system

Requirements:

* Requires the installation of a telemetry system (hardware) including:
  -- Analog/digital and Digital/Analog converters
  -Telemetry system which can be: leased telephone lines; VHF radio; UHF; Coaxial/twisted; dedicated cables; microwave, etc.
  -Electronic measuring devices such as: flow meters; level gauges; Rain gages; etc.
  -Electronic control devices: Programmable Logical Controls (PLC); Regulators; Gates;); Regulators; Gates; Valves; Pumps, etc.

5. GIS MODULE

Functions:

* Should be able to access all information contained in the Database module
* Generate thematic maps from Database
* Respond to specific queries of the WHDOM
* Make use of command files to automate WHDOM queries
* Should be able to receive satellite image data
* Should be able to interact as an input/output front end for other modules of WHDOM. As an example:
  - Provide most favorable locations for irrigation development based on soil types, water availability, climatic conditions, etc.
  - Provide most favorable reservoir sites (most favorable location for water accumulation) in the watershed.
  - Should be able to display all watershed features as reservoir locations; irrigation areas; etc.
  - Should be able to provide information from a user select location required by the design module as: reservoir flooded area as a function of reservoir height, drainage channels (wadis) cross-section data and slope.
* Should be able to provide physiographical characteristics of watershed for watershed module including: area; perimeter, length, slope infiltration rates, etc.

6. WATERSHED MODULE

Functions:

* Should provide user with option to select model
* Should provide user option to select type of function: as an example the type of evaporation equation to use.
* Should make use of distributed data from GIS: preferable a distributed model.
* Possibility to calibrate model parameters automatically through optimization or user input.
* Should be able to accept changes in the watershed such as inclusion of new reservoirs, change in land use/cover, etc.
* Give runoff prediction in any required point of watershed
* Runoff given in any time frame required such as: hourly, daily, weekly or monthly

Possible Candidates: CEQUAU, SLURP, SSARR, RUNOFF, and ANSWER

7. ENVIRONMENT / SOCIO-ECONOMICS MODULE

Functions:

* Should be able to supply crop water demands
* Should be able to provide irrigation water requirements
* Should be able to supply livestock water demands
* Drinking water demands
* Environmental demands
    - minimum downstream release
    - maximum allowable flooded area on reservoirs
    - minimum reservoir storages for wildlife and fish
    - operational requirements for recreation, navigation etc.
* Water demand data should be given in any time frame required

8. OPTIMAL WATER STORAGE DESIGN MODULE

Functions:

* Determine optimum location for reservoir sites
* Determine for each site the optimum size
* Determine the optimum implementation schedule for the proposed reservoir sites
* It should consider the stochastic component of problem
* It should be based on at least on the following criteria
    - Foundation costs
    - Dam costs (cross section construction costs)
    - Hydraulic structures costs
    - Distance to supply area (conveyance costs)
    - Environment costs including flooded area, etc.
* As featured on GIS module it should be able to receive data from GIS on most favorable location to process and should be able to output the new reservoir location for the GIS and

WATERSHED modules.
* It should be able to consider routing in the channel and reservoir.

9. OPTIMAL WATER OPERATION MODULE

Function:

* Provide operation guidelines for all reservoirs on the system
* Provide monthly or seasonal operation policies
* Should be able to provide daily operation policies
* Should be able to operate in real - time (requires telemetry system and the Data acquisition module);
* All operation policies should be optimized;
* Provide optimum conjunctive use of surface and ground water use if available;
* Should consider stochasticity of available inflows and demands (fully demand responsive system);
* Should be able to provide Proportional Integral Differential (PID) control for control points
* Should make use of short-term forecast for inflows and demands.
* Integrated with GIS module

SIG POUR LA GESTION DE L'ACTIVITÉ PASTORALE DE LA STEPPE ALGÉRIENNE

Said Benzineh, CNTS
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INTRODUCTION ET PROBLEMATIQUE

1. En Algérie, le phénomène de dégradation du milieu steppique s'est amplifié avec le temps et s'est accompagné d'un processus de dégradation socio-économique:

- **dégradation du niveau de vie**
- **concentration des populations autour des agglomérations** qui n'offrent pas d'activités de substitution induisant ainsi un déséquilibre entre l'infrastructure existante et les besoins de la population. L'Algérie s'est préoccupée depuis longtemps de la dégradation de l'écosystème steppique. En effet, plusieurs structures ont été engagées dans la réalisation de divers programmes de la préservation du patrimoine végétale et la lutte contre le phénomène de désertification. Ces programmes s'articulent autour des axes suivants:

- **la recherche**
- **la vulgarisation**
- **l'aménagement.**

2. Certains départements ministériels ont été amenés à créer des structures spécifiques aux zones arides, tel le Haut Commissariat au Développement de la steppe (H.C.D.S) sous tutelle du Ministère de l'Agriculture. Toutefois, le préalable à l'élaboration et la mise en place de leurs programmes de développement en zones arides est la connaissance:

- **des potentialités naturelles,**
- **du phénomène de dégradation de ces milieux,**
- **des relations homme/milieu.**

3. Le système agro-pastoral traditionnel a permis pendant des siècles à la population de tirer ses moyens d'existence du milieu aride sans encourir les risques de dégradation. La dispersion de la population normale a permis d'alléger les pressions humaines sur le milieu grâce à un éparpillement sur de vastes étendues et à une complémentarité de l'activité pastorale avec l'activité agricole du nord.

4. Les paramètres historiques et le "développement" d'une façon générale ont entrainé une rupture de cet équilibre. Le passage d'une économie traditionnelle de subsistance à une économie monétaire ainsi que la modification du modèle de consommation induite par l'amélioration du niveau de vie ont entrainé:

- **une tendance à la sédentarisation,**
- **la détention du cheptel plus nombreux pour des motifs commerciaux.**

5. Ces deux modifications déterminantes sur les pressions exercées par l'homme sur le milieu sont aggravées par:

- **la croissance démographique,**
- **la modernisation des moyens de transport et des techniques,**
- **la multiplication des points d'eau.**

6. L'équilibre écologique de cette région a donc été compromis sous l'action combinée des facteurs anthropiques (le surpaturage, l'éradication des espèces ligneuses, le défrichement

pour la mise en place de culture aléatoire...) et des aléas climatiques (variabilité des précipitations et autres causes dites "naturelles"). Cette dégradation a eu des conséquences très néfastes sur cet écosystème fragile:

- une réduction globale du couvert végétal,
- la prolifération dans les terres de parcours d'espèces végétales peu palatables (refusées par le cheptel),
- la dégradation du sol par le piétinement et le tassement provoqués par le troupeau rendant les processus de remontée biologique difficile,
- la baisse de fertilité notamment par diminution du taux de matière organique et la perte d'éléments fertilisants.

OBJECTIFS

Objectif Général

7. L'objectif général de ce projet est de contribuer au développement durable et intégré de la steppe par l'introduction d'une approche multidisciplinaire et la recherche de nouvelles méthodes et outils informatiques pour la gestion harmonieuse de ce milieu algérien. Il a pour but ultime le développement de ces zones et d'atteindre de nouveaux équilibres socio-écologiques fondés sur les principaux soucis:
   - D'assurer un développement durable du milieu,
   - De permettre l'autosuffisance alimentaire, voire l'élévation du niveau de vie des populations concernées,
   - D'améliorer la gestion pastorale.

Objectifs spécifiques:

8. En partant d'études de cas sur deux zones test "Brida et Aflou" faisant partie de la région de Laghouat et Djelfa, ses objectifs spécifiques sont:

   a) D'effectuer une étude cartographique multitemporelle (1976-1992) pour quantifier les changements du paysage de la zone par l'utilisation de l'imagerie satellitaire soutenue par une étude socio-économique détaillée;
   b) de déterminer les causes de la dégradation des parcours dûe à l'activité anthropique ou aux changements climatiques (variations des précipitations et températures);
   c) de stimuler une approche interdisciplinaire dans l'étude du milieu steppique algérien par l'intervention de thématiciens et organismes variés et l'introduction de procédés géomatiques;
   d) de renforcer la capacité du CNTS et les opérateurs nationaux dans la maitrise de l'outil SIG et ses applications en gestion pastorale; et
   e) d'organiser des activités de participation des populations au processus de formulation de plans d'aménagement et diffuser les résultats de la recherche au niveau national et international.

RESULTATS ANTICIPES

9. La maitrise de l'outil S.I.G dans la conception générale et particulièrement l'étude du pastoralisme, à un niveau local et régional. Ce résultat est visé tant par le CNTS comme institution de recherche et enseignement, que par les organismes impliqués dans la planification des milieux semi-arides et l'aménagement du territoire.

10. Une connaissance approfondie des éléments physiques et humains affectant la steppe par: une compilation de données thématiques variées; leur constitution en bases de données géographiques facilement mises à jour et extensibles; la formulation de modèles dynamiques

d'analyse de données; et la génération d'informations dérivées et utiles pour la gestion de la steppe.

11. La publication des résultats de la recherche sous forme de rapports et d'articles scientifiques et leur diffusion au niveau national et international.

12. La promotion d'une approche interdisciplinaire pour la recherche de solutions aux problèmes environnementaux d'écosytèmes fragiles.

DESCRIPTION DE LA ZONE D'ETUDE

13. La région d'Aflou se situe dans la partie sud de l'Atlas Saharien central, dans la wilaya de Laghouat. C'est une région steppique, elle est distante d'Alger de 300 KM environs. La région se caractérise par un climat de type méditerranéen. Les précipitations annuelles sont comprises entre 100 et 400 mm et présentent une grande variabilité intermensuelle et interannuelle et aussi une variabilité spatiale. Les températures sont relativement homogènes mais très contrastées. Cette aridité croissante, du nord au sud, est marquée par des températures qui augmentent engendrant une sécheresse estivale plus longue. La synthèse de ces 2 paramètres, précipitation et température, caractérise la région d'étude par un bioclimat méditerranéen aride et semi-aride à variantes fraiches et froides (sens EMBERGER) et une saison sèche assez prolongée (plus de 5 mois). La distribution des sols qui se fait en étroite relation avec la situation géomorphologique et la végétation en place. Ce sont en général des sols sqelettiques. Toutefois les conditions pédologiques les plus favorables pour la mise en valeur se situent dans les lits d'oued, les piémonts et les dayas. La couverture végétale est basse, clairsemée, constituée de parcours très dégradés. La couverture forestière de la région d'étude constituée de forêts dégradées et clairsemées. Il faut souligner que compte tenu du déficit fourrager dans la steppe, ces formations forestières subissent une forte pression pastorale. Les principales cultures sont annuelles en sec (céréales) avec des jachères paturées plus au moins anciennes. Les ressources hydriques sont importantes mais restent à évaluer en fonction des objectifs du développement. Les équipements sont détériorés pour certains et inexistants pour d'autres. L'effectif du cheptel ovin dans l'ensemble du territoire steppique a été estimé à 12 millions de têtes dont 60 % de brebis. La répartition géographique de ce cheptel est très inégale. Les races les plus répandues dans ce cheptel sont: l'Ouled Djellal, la rembi. La part du cheptel pour la région d'Aflou est l'une des plus importantes.

METHODOLOGIE

14. Le CNTS effectuera une comparaison de deux cartes d'occupation du sol réalisées par télédétection (1976, en utilisant des données MSS et TM de 1992) à partir d'un échantillonnage minutieux sur terrain (incluant radiométrie spectrale) et sur images (utilisant le système d'analyse d'images disponible au CNTS), et une évaluation de la variation du taux de recouvrement des parcours à ces deux dates. Cette comparaison fera apparaitre les zones affectées par la dégradation, leur vitesse de dégradation, et les zones potentielles de dégradation. Elle sera renforcée respectivement pour les deux dates par une enquête socio-économique (activité humaine, mutations...) à laquelle le CREAD apportera son expertise et une étude climatique (évolution des températures , précipitations, et indices climatiques...) pour mettre en évidence les causes de la dégradation et pour discriminer les facteurs qui concourent à la mettre en place.

Base de données et ses applications

15. Cette phase intervient après l'étude d'inventaire. Elle consistera à la mise au point d'une base de données d'inventaire du milieu naturel et artificiel qui seront intégrées dans un système d'information géographique (SIG). Les informations concerneront principalement les données du milieu physique collectées ou dérivées de données secondaires (pentes, climat, géologie, points d'eau, occupation du sol...).

16. Les données socio-économiques prises en compte seront principalement les routes, agglomération, estimation du cheptel, populations... A travers cette recherche, le projet tentera de répondre à différents points: Comment les populations utilisent-elles les végétaux et les sols et, sous quelles contraintes? Comment relacher ces contraintes pour permettre une utilisation non abusive (non désertifiante) des sols et des végétaux? Ces préoccupations seront mises en pratique sur deux dairates Brida et Aflou relevant de la région d'étude.

Classification des parcours et évaluation de leurs potentialités pastorales:

17. Dans une perspective de développement des parcours, il sera étudié avec détails les différents parcours selon leur quantité (type de faciès végétal, et niveau de dégradation...), et qualité (unité fourragère). Un échantillonnage méthodique et minutieux sera élaboré sur terrain (mesures de la biomasse et mesures spectrales à l'aide de radiomètre...) et sur images. Plusieurs études ont démontré l'existence de différents faciès végétaux dans le domaine semi-aride en général. Elles seront comparées aux résultats de l'échantillonnage.

Propositions d'aménagement visant à une meilleure gestion de l'espace steppique, et une répartition du cheptel en fonction des potentialités fourragères

18. Après la mise au point d'un système d'information géographique "vivant" faisant intervenir les données du milieu, les données socio-économiques et les analyses "modélisées" suite aux discussions avec les agropasteurs et les autorités locales, des lignes directrices d'aménagement seront établies en commun accord avec eux. Ces résultats feront l'objet de journées d'étude et d'information où seront présents en plus des gens concernés par le projet, les opérateurs nationaux d'autres régions de la steppe.

19. Le cheminement méthodologique prévu vise à:

a. Voir la possibilité de générer une carte de perception des contraintes et des attentes des agro-pasteurs sur leur environnement. L'équipe élaborera une sélection de variables significatives à considérer particulièrement en ce qui concerne le rôle joué par les membres de la cellule familiale, l'âge, le niveau d'instruction...

b. Comparer l'étude climatique d'une part, et l'étude socio-économique d'autre part, à la cartographie multitemporelle des changements du paysage steppique. Cette phase se fera autour de sessions de travail entre chercheurs pour l'analyse des causes et effets des changements évalués. Cette composante est d'autant plus importante compte tenu du débat international concernant les causes de la dégradation du milieu et la désertification.

c. Situer le SIG comme centre de l'interdisciplinarité dans le sens où il permettra d'assembler et d'analyser des données pertinentes à plusieurs disciplines. Sa promotion dans le cadre du projet et la participation d'opérateurs et de chercheurs de disciplines différentes favoriseront le recours à une approche interdisciplinaire pour traiter toutes questions d'option d'aménagement du territoire. Le SIG offre à la fois des outils: de saisie, de stockage et de mise à jour des données à référence spatiale; de traitements, d'analyse et de restitution de données; et de cartographie et d'édition de tableaux chiffrés. A partir de la base de données géographiques constituées par les apports des différentes disciplines participantes (et incluant dans la mesure du possible des données spatialisées de contraintes et attentes des populations locales), le SIG sera conçu de manière à pouvoir modifier le poids de toutes variables disciplinaires ou sectorielles par la construction d'algorithmes d'analyse dynamiques. Ce principle permettra de générer quasi-automatiquement différentes cartes d'option d'aménagement ou de représentation des connaissances à partir des priorités des différents intervenants (populations locales, chercheurs, opérateurs). Il facilitera la recherche de compromis et le choix d'actions à mettre en place sur le milieu et ses activités humaines.

d. Fournir une formation complémentaire à l'équipe de chercheurs, pour maximiser l'utilité du matériel informatique SIG et TD qui sera fourni au CNTS. Le CNTS s'engage également à

transférer son savoir-faire en géomatique à ses partenaires chercheurs dans le cadre du projet et aux institutions intervenants dans la gestion et la planification de la steppe en Algérie (HCDS, DSA, CREAD). Pour ce faire, des activités, journées scientifiques, ateliers et tables rondes seront programmés pour cerner le sujet.

e. Favoriser l'intervention de la population locale dans tout le processus du projet de par la nature de ses objectifs. Particulièrement pour la formulation d'option d'aménagement, des tables rondes/audiences seront organisées autour de groupes représentatifs d'agro-pasteurs durant lesquelles les agro-pasteurs seront stimulés et invités à présenter leurs points de vue. Ceux-ci seront integrés à la confection des algorithmes/modèles du SIG, permettant de génerer de façon interactive des options d'aménagements dérivées de ces propositions. Cette méthode novatrice permettra ainsi aux agro-pasteurs comme aux opérateurs de mesurer l'impact de leurs propositions sur une base spatiale.

DISSEMINATION DES RESULTATS

20. A un niveau local, les résultats tant partiels que finaux se feront connaitre par les différents intervenants dans le projet par le biais des réunions scientifiques. Tous les intervenants du projet seront exposés et introduits aux outils performants et modernes tels que la télédétection et les SIG.

21. Au niveau national, il y a lieu de souligner que les organismes nationaux seront sensibilisés quant à l'utilisation de nouveaux outils pour leurs études par la participation de leurs membres aux différents séminaires nationaux prévus traitant des problèmes de l'environnement steppique (banque de données à référence spatiale, manipulation de données, intégration de données multisources...).

22. Les résultats finaux de ce projet feront l'objet d'un atelier international où seront invités des scientifiques et des décideurs d'autres pays d'Afrique à manipuler le SIG orienté vers la planification et le dévéloppement des zones arides et semi arides. Le projet prévoit également la préparation d'articles scientifiques pour soumission à des revues spécialisées et à des événements régionaux et internationaux (séminaires, colloques).

AGRO-ECOLOGICAL CHARACTERIZATION

(ICARDA/INRA[Morocco]/DMN[Morocco]/METEOROLOJI[Turkey])

Wolfgang Göbel, ICARDA

Introduction

The natural environment in North Africa and West Asia is characterized by high variability both in time and across space. The consequence is a high degree of uncertainty and risk for agricultural production. In such an environment it is difficult and time-consuming to conduct agricultural research, difficult to target research, difficult to provide sound advice to farmers how they can minimize their risk while at the same time maximizing their income, difficult to plan and allocate resources optimally, both at the farm and at the national level. There is a need to complement research on the ground by modelling and simulation, there is a need for effective tools to characterize quantitatively the environment and its variability.

Building partly on already existing applications and experience, ICARDA developed a set of tools to address this task. They are:

- **SIMTAG** (M. Stapper / H. Harris),
  a wheat model which simulates wheat growth based on daily data of rainfall, air temperature and solar radiation, soil profile data, genetic coefficients, and management information,

- **SWG** (W. Göbel),
  a spatial weather generator which permits the stochastic generation of daily climatic series for all cells of a spatial grid; the synthetic series can be used to map the frequencies of climatic events or to drive crop or other models,

- **MULTISIM** (U. März / T. Nordblom),
  a multivariate crop yield generator which maintains the correlations between the yields of different crops; its coefficients are derived from data obtained in farmer interviews or from historical yield statistics.

None of the modules itself represents an entirely novel approach. Innovative aspects are the addition of the spatial dimension which the SWG brings to weather generation and crop modelling or, from a different angle of view, the stochasticity dynamism which SWG and MULTISIM are able to add to otherwise static GIS approaches.

The Project

In order to validate these tools, ICARDA required the assistance and collaboration of national programmes, since the centre had neither the data nor the manpower to undertake this task entirely on its own. Therefore the current project was initiated with the following objectives:

- to validate and test the set of tools,
- to demonstrate their potential for solving problems identified by collaborating national

programmes by executing a number of case studies,
- to train staff from national programmes in the use of the tools,
- to document and publish the tools and the results of the case studies.

The activities to be executed by the project were to follow a logical sequence. After the selection of a project area and the training of the counterparts from the national programmes, the necessary data were to be collected (daily climatic data from all stations in the area for the compilation of the weather generator coefficient maps and the validation of the SWG, topographic data for the construction of a DEM, soils data to compile a digital soil map together with profile data, crop data to compute genetic coefficients and for crop model validation, yield and production statistics for validating MULTISIM). Only then, after the validation and, if necessary modification of the software, the case studies were to be undertaken and the results published.

The expertise required by the project is in the areas of agronomy/physiology/crop modelling, soil science and agricultural economics on one side as well as agroclimatology/climatology and GIS. Logical counterparts are therefore the national agricultural research services and the meteorological services. Between them, these two services also usually are the owners of most of the data required by the project.

Mainly because of their contrasting climates, Morocco and Turkey were the two countries from where national programs were invited to join ICARDA in the project.

The Turkish Experience

ICARDA approached the Ministry of Agriculture, Forestry and Rural Affairs which designated the national project coordinator. He in turn assigned scientists from two agricultural research institutes to the project and, together with ICARDA, approached the State Meteorological Service. ICARDA had no influence on the selection of the counterparts. Except in the collaboration with the meteorological service, the project made very little progress in more than three years and collaboration with the agricultural research institutes had to be abandoned eventually. Together with the meteorological service alone, it will only be possible to attempt a fraction of the envisaged objectives, in particular those relating to the validation of the SWG.

The likely reason for the partial failure of the project in Turkey is the top-down way in which collaboration was set up. Counterparts did not identify themselves with the project, they rather perceived it as an additional burden. The lesson to be drawn is not to start any collaborative project unless it is absolutely certain that there is a clearly positive attitude and an eagerness to work together at all levels, from the research scientists up to the decision makers. Projects need to be initiated in a bottom-up manner; collaborating institutions and their staff need to be convinced that it is in their own interest to execute the project, that indeed it is their own project. For that they need to be involved as equal partners in all stages of project formulation right from the beginning.

The Moroccan Experience

Although collaboration in Morocco was initiated in a similar top-down manner, it was fortunate that in the person of Dr El Mourid a very capable national project coordinator was designated who succeeded to bring together an enthusiastic team of collaborators in the Institut National de la Recherche Agronomique (Centre Aridoculture in Settat and Departement du Milieu Physique in Rabat) and the Direction de la Meteorologie Nationale (Centre National du Climat et de la Recherche Meteorologique in Casablanca).

A sign of the keen interest of the Moroccan counterparts in the project is the large number of case studies which they are currently undertaking (the project area stretches approximately from the Atlantic coast to Fes in the North and Marrakech in the South):
- Climatic atlas,
- Soil map (compiled from all available published and unpublished sources),
- Drought risk during different development stages of wheat,
- Optimal planting time for wheat,
- Optimally adapted wheat varieties,
- Optimal strategy for supplemental irrigation in wheat,
- Analysis of the gap between yields achieved by farmers and potential yields,
- Land suitability for various crops (following the FAO methodology),
- Effect of increased precipitation through cloud seed seeding on rainfed crop production,
- Forest fire risk index map,
- Analysis of the applicability of the tools promoted by the project for national planning.

It is expected that all these case studies will be presented at a workshop planned for the last week of March 1994 at ICARDA headquarters in Aleppo. The workshop proceedings will later be published. Other ways in which the project is disseminating results and experience are:
- in-country training workshops in Morocco,
- the participation of staff from other Moroccan government agencies (from extension services, national planning and others) in some of the case studies listed above,
- a project demonstration day to be held in Morocco following the workshop in Aleppo,
- the publication of manuals and workshop proceedings.

In spite of all good will, there were also a few difficulties which the project had to overcome in Morocco. The most serious one being the slowness with which data became available. It took four years instead of two as had been planned until all climatic data from the project area was ready for use. As consequence, it was not possible to adhere to the project timetable. The project had to be extended twice for one year and the different activities could not be executed in an orderly sequential fashion as had been planned; model validation, execution of case studies and model documentation have to be done simultaneously as far as this is possible. Other data also were slow arriving, but this was of no consequence as not much could be done without the climatic data in any case.

It is quite clear that the size of the task of digitizing and quality-controlling the climatic data from several hundred meteorological stations has been greatly underestimated by all involved. There is a clear need for future projects to pay more attention to the question of data acquisition and preparation, for more realistic planning and resource allocation for this task.

It also turned out that the data quality of a substantial fraction of those stations which are not operated by the meteorological service itself is so poor or their series are so short that they are unusable. This makes it impossible to undertake the validation of the SWG with the Moroccan data set alone, since the remaining stations are not enough to examine the effect of different densities of the station network on the quality of the synthetic data produced by the generator. Fortunately the German meteorological service helped by supplying a very large test data set from Germany which is used to address this question.

In spite of these problems and the delays which they caused, it can be said that usage of the advanced techniques for agro-ecological characterization introduced by the project is firmly established within INRA and DMN and is spreading within Morocco as a consequence of the involvement of staff from other offices in the in-country training workshops and in some of the case studies. Usage of the methods will continue whether or not there will be a follow-up project. The project has also been a catalyst to intensifying the collaboration between INRA and DMN in agrometeorology and agroclimatology.

Outlook

The Moroccan counterparts and ICARDA would like to build and expand on the experience gained in the present project and follow it up with a second phase project with a country-wide scope. This project would have three major components:

- Database construction (weather generator coefficient maps, DEM, soil map, land use map, map layers showing hydrography, road network, administrative units and population distribution, genetic coefficients for various crops),
- Database usage (expanding case studies of the present project to cover the entire country, using yield gap analysis to help prioritize INRA's research, deriving practicable guidelines for agricultural extension from the case studies, e.g. on supplemental irrigation strategies or on recommended varieties),
- Research / tool refinement (development of a predictive model for crop yield forecasting based on SWG, crop models and medium-term weather forecast maps, linking the set of IBSNAT crop models to the SWG).

A proposal for a similar project with Ethiopia involving the Institute of Agricultural Research, the National Meteorological Services Agency and the Land Use Planning and Regulatory Department is under preparation. Great care is being taken in developing this proposal not to repeat the mistakes committed before. All three collaborating national institutes have been fully involved in the project planning and formulation right from the start. It is expected that the Moroccan counterparts will be able to bring in their experience into this project as partners.

ICARDA would be interested to undertake similar projects with national programmes in other countries which perceive a need this type of agro-ecological characterization. Due to the shortage of manpower at ICARDA, this would, however, require that additional staff can be funded through such projects. It also seems desirable, also in the interest of continuity, to enlist additional expert support from outside. Relevant expertise exists and interest has been expressed by the universities of Guelph and Hohenheim (crop modelling), Florence (geomatics) and others.

GEOGRAPHIC INFORMATION SYSTEM FOR WATER RESOURCE MANAGEMENT -Egypt-

Dr. Mosaad Allam, GISD/NRC
(GIS Division, Natural Resources Canada)

Dr. Mona El-Kady, SRI/WRC
(Survey Research Institute, Water Research Center, Egypt)

Introduction

There is nothing in the makeup of our earth's system that is more basic than water in its various states. In addition to our bodily demands of water, there are other compelling needs for adequate supplies of water. Plants, for example, require a number of elements for their growth including water and minerals from the soil. Water is essential to bring the soil's minerals into a solution before they can be used by plant life for their growth and to add nutritional value to the food.

The management of water resources is an important issue in Egypt particularly for irrigation. There are many problems associated with irrigation and to utilize water resources in the most efficient and cost-effective manner, new technologies are needed. One of these new technologies is the Geographic Information System (GIS).

In order to find ways to apply this new technology, a joint project was initiated in Egypt with participation from the Water Research Center (WRC) of the Ministry of Public works in Egypt, the GIS Division of the Surveys, Mapping and Remote Sensing Sector of Natural Resources Canada (formerly EMR) and the International Development Research Centre, Canada. The overall objective of the project was to develop a prototype GIS for the storage, manipulation and analysis of data related to irrigation, agriculture and land information that will be applied for short-term and long-term management of the water resources in Egypt. Specifically, the objectives were:

1. Conduct a user needs study
2. Establish a project definition
3. Conduct a literature search
4. Select a suitable GIS software package and hardware systems
5. Define the themes for the project's GIS coverage
6. Design the spatial and non-spatial databases for the project
7. Identify the data required and their sources
8. Design simple database queries
9. Identify a key water management issue and select a predictive modelling software that addresses this issue
10. Establish a procedure for data exchange between the modelling software package and the GIS
11. Design complex GIS queries that utilize information supplied by the modelling software package

Methodology

This project was completed in four stages. These stages were:

1. Development of the GIS databases
2. Preparation of non-spatial (attribute) data
3. Preparation of spatial data
4. Performing geographic analysis

1. Development of the GIS databases

During this stage, GIS Division established the following project components:

- The theme for each GIS coverage, i.e., lots, irrigation features, soil texture, etc.
- The feature codes for each GIS coverage
- The structure for the non-spatial data tables
- The structure for the spatial data tables

The structure of each table in the database has a field containing a unique identifier. This unique identifier was used to link various tables during geographic analysis (queries). Table I shows a list of database tables created during this a step.

2. Preparation of non-spatial data

In this stage the project databases were populated using digital data supplied by the Survey Research Institute. The data supplied by SRI was restructured using EXCEL 4.0 (Windows version 3.1) and exported into dBASE files. The respective fields of unavailable data were left empty until they can be obtained from other sources.

Table I. List of GIS databases created for this project

	Database	Examples	Source
1	Parcels	Owners, renters, areas, etc.	SRI
2	Lots	Owners, renters, areas, crops,	SRI
3	Irrigation	Canals, drains, etc.	SRI
4	Cultural	Homes, mosques, etc.	SRI
5	Soil texture	Three classes of texture	Report*
6	Soil salinity	Three classes of salinity	Report
7	Soil sodicity	Three classes of sodicity	Report
8	Ground water level	Three classes of water level	Report
9	Lots crop info.	Crop planted in each lot	SRI
10	Crop suitability	Produced using 5 to 8	Developed
11	Crop requirements	Preferred growing conditions	Literature

(* Egypt's Water Use and Management Project, Mid-Project Report, Appendix A, September 1980)

3. Preparation of spatial data

Spatial data for this project was based on four topographic map sheets (scale 1:2,500) that were supplied by SRI. Each map sheet covered an area equal 1.5 km2. Therefore, the total project area is 6.0 km2 (1428 Feddans). Each map sheet was digitized using ARC/INFO's ADS module and cleaned using ARCEdit. Finally, the four map sheets were joined. Soil properties' maps, e.g., soil texture, salinity, etc., were obtained from a previous report and their coordinates were transformed to UTM coordinates using GPS data supplied by SRI.

4. Performing Geographic Analysis

The needed geographic analysis was divided into two groups: simple and complex analysis. A simple geographic analysis is performed using GIS and any linked databases. On the other hand, a complex geographic analysis will require a predictive model. The modelling software receives an input from the user and produces an output that is communicated to the GIS. Subsequently, the GIS manipulates the received information and produces a suitable output.

Also, during this step, several simple geographic analysis procedures were designed and tested. Since these procedures were designed for decision makers, SML macros were written to do the analysis. These macros allow the user to input needed data via menu selection. These macros were written to show SRI's engineers the potential and usefulness of this approach.

SUMMARY AND CONCLUSIONS

The main goal of this project was to transfer the Canadian GIS Technology to Egypt and to provide an opportunity to SRI staff to develop their skills in this field. The GIS Division (EMR) was successful in achieving these objectives.

Two Egyptian Engineers were given training in Canada for two weeks and another was provided with support material for research work in Canada towards a Masters Degree in GIS. Also, three engineers at SRI were given ARC/INFO training in Egypt.

In Canada, spatial data for the project was generated by digitizing the four map sheets in the study area and the design of the databases was completed for spatial and non-spatial data. The databases were loaded and where no non-spatial data was available, fictitious data such as soil types, salinity, soil conditions, microclimate and temporal and historical data were added to test the methodology. When the actual data becomes available, these can be entered in the created databases.

Two engineers from GIS Division went to Egypt and installed the databases and trained SRI engineers on data conversion, populating the databases and using ARC/INFO for GIS analysis.

Since then, GIS Division has completed several SML macros for the analysis and has tested queries. The project is nearly complete. The final installation of the additional databases and the SML macros, demonstration of GIS capabilities in answering water resources

management queries and the international seminar in Egypt are the remaining activities to be completed.

The technical expertise available in the GIS Division, in geomatics, database design and computer science, has been the strength behind the success of this very important project.

IRRIGATION MANAGEMENT PROJECT -West Bank-

Hisham Zarour, ARIJ

Introduction:

Irrigated agriculture in the West Bank is largely underdeveloped, with irrigated Palestinian lands presently being estimated to be one-fourth of the potentially irrigable land. Data relating to land and water uses in the West Bank are scarce and unreliable. The basic objective of ARIJ's IDRC-supported irrigation project in the West Bank is to evaluate the extent of water and related land problems as well as the needs of the irrigated sector, and to identify potentials for sustainable and equitable development of the sector in the West Bank.

During the last two decades, agriculture and irrigation underwent drastic changes in the West Bank. In 1972, drip irrigation were first introduced to the area with funds from the Mennonite Central Committee (MCC) and some other voluntarily organizations. Israeli private commercial companies provided the technology. During the same period, green houses, covered agriculture, sprinkler irrigation and improved varieties were also introduced in the area.

Despite these recent advancements in Palestinian agriculture in the West Bank, the general situation is still far from being well developed. Israeli control over fertile lands, water resources, and even markets is most probably the main obstacle hindering development agriculture in the area. Other factors such as land ownership and inheriting complexities, socio-economic relations, lack of long-term planning, and the absence of an organized national infrastructure are other factors that restrain the potentials for developing the Palestinian agricultural sector. The need 'for well-thought out research targeting the development of irrigated agriculture in the West Bank is self evident. Promising options as well as various constraints have to be evaluated and a comprehensive formula for sustainable and equitable agricultural development and efficient management of available resources urgently required, especially with the latest developments in the region.

Although the situation in the West Bank may seem to be unique, many of the issues which the project addresses is highly relevant to other countries in the MERO region.

Beneficiaries and Target Users:

The ultimate beneficiaries of the project would most certainly be the farmers as well as the whole community in the West Bank. However, These do not represent the direct users of the results of the project. Local authorities, agriculture and water departments as well as active NGOs were initially meant to be the prime users of the project findings. However, and with the recent political developments, it is not unrealistic to include the forthcoming national authority in the list of the prime beneficiaries of the project.

As for the implementing party, ARIJ, the institute will directly benefit from the project as it will strengthen its capability in the field of collection and analysis of environmental and resource information. The data that is to be collected under the project will complete

information obtained from other projects, such as the rain fed farming and water resources studies, which ARIJ undertook. Cross-interpretation of accumulated knowledge will enable development of a comprehensive understanding of constraints and areas of gratification. Based on such an understanding, competent plans for developing agriculture can be devised.

The findings of the project will be disseminated to the target users through providing raw and processed information through ARIJ's Agricultural Resource Centre (ARC), the technical papers that will be produced and the final comprehensive report which will describe in detail the methodologies used and the findings of the work.

Research Methodology:

Since the overall objective of the project is to come out with a comprehensive analysis of the potentials for developing the irrigated agriculture sector in the West Bank in a sustainable and equitable manner, various disciplines should be encountered. These range between pure technical subjects to complex socio-economic aspects, with environmental considerations being continuously watched.

As much as physical data is concerned, the project utilizes novel information technologies such as remote sensing and GIS for the purposes of inventorying, mapping and representing land uses, water availability and quality, climatic variables, cropping cycles and the like in addition to present and potential areas for irrigation. In addition to remote sensing, information will be gathered from held measurements, laboratory analysis of samples, and existing soil and topographic maps which will be digitized. A regular system of ground truthing will assure the accuracy and continuous updating of secondary information. As for socio-economic, institutional, legal and technical information, questionnaires had been prepared to obtain information from various parties including farmers, suppliers of equipments and irrigation systems, extension workers and active institutions.

Anticipated Effecting Difficulties:

Lack of basic reliable information from secondary sources is expected to be the main obstacle in undertaking the project. Other obstacles are expected to be the lack of coordination and exchange of data between local institutions, the cloak of secrecy thrown by Israeli authorities over data on water and land and their uses, the inadequacy of expertise in specific field such as remote sensing and GIS technologies and the constraints on free movement of people and equipment in the area.

The capacity building component of the project is herein seen as a very important step towards compensating for the lack of experience on a national level in some areas of knowledge. As for the remarkable dearth of information, the databasing component in the project will help bridging this gap.

Regarding the lack of coordination among local institutions, ARIJ intention is to use this project to set an example on coordination. Attempts are currently being made to reach agreements with key institutions in the West Bank and Gaza Strip regarding resource sharing and dissemination of knowledge. It is hoped that the recent political developments would enhance information and expertise exchange with Israeli organizations.

UN SYSTEME D'INFORMATION GÉOGRAPHIQUE POUR LA MISE EN VALEUR AGRICOLE DES TERRES ARIDES ET SEMI-ARIDES NON-IRRIGUÉES (SIGMA) -Maroc-

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Problématique

Dans les régions arides et semi-arides, la mise en valeur des terres agricoles se fait habituellement de deux manières: d'une part par l'irrigation quand les ressources en eau sont disponibles et suffisamment proches pour pouvoir être accessibles et d'autre part par la mise en valeur des secteurs d'agriculture pluviale. Dans le cas du Maroc, 90% de la SAU (surface agricole utile) est constituée de terres non irriguées, appelées "bour". Ces terres fournissent 50% de la production vivrière du pays, qui représente 70% de sa valeur marchande, alors que les régions irriguées sont plus tournées vers les cultures d'exportation. La mise en valeur de ces terres "bour" est devenue une priorité nationale, exprimée clairement dans le document intitulé "Stratégie de développement rural au Maroc" en mai 1993.

Compte tenu de la distribution saisonnière des pluies de la zone semi-aride du Maroc, concentrée de novembre à mars, l'essentiel du cycle végétatif des cultures doit être accompli à partir des réserves accumulées dans les sols. Les propriétés physiques des sols, leur capacité de rétention pour l'eau, leur capacité d'échange pour les éléments nutritifs et leur position topographique jouent donc un rôle majeur dans l'accomplissement de la production alimentaire. Les travaux d'aménagement des sols comme l'épierrement, les amendements majeurs et la lutte contre l'érosion ont donc une importance de premier plan dans le maintien du capital-sols des régions "bour" et dans le développement de l'autosuffisance alimentaire à l'échelle nationale. Compte tenu des moyens importants requis pour certains de ces aménagements, comme la machinerie d'épierrage par exemple, ceux-ci doivent être coordonnés et gérés à l'échelle des directions provinciales de l'agriculture (les DPA), qui offrent ces services aux exploitants agricoles.

Suite à cette problématique de mise en valeur du territoire agricole, il est donc important que les DPA disposent de la meilleure information possible pour pouvoir accomplir leur rôle de gestionnaires du territoire agricole. Le projet SIGMA (Système d'information géographique pour la mise en valeur agricole), développé par le Département des sciences du sol de l'Institut agronomique et vétérinaire Hassan II de Rabat en association avec la DPA de Settat, avec le support technique du Centre d'applications et de recherches en télédétection (CARTEL) de l'Université de Sherbrooke (Canada) et le support financier du CRDI, vise à développer des solutions et à mettre au point des outils d'aide à la décision pour la mise en valeur agricole de la province de Settat. Cette province, située dans une zone de transition

climatique (de 700 à 300 mm de pluie par an) et géologique (Haute et Basse Chaouia) représente un bon échantillonnage des diverses conditions qui prévalent dans les régions d'agriculture pluviale au Maroc. Les résultats seront donc adaptables à d'autres régions présentant des conditions similaires. Un projet antérieur, réalisé dans la même province, avait permis de montrer la faisabilité de la cartographie des sols au 1:125 000 à l'aide des images Thematic Mapper du satellite LANDSAT 5.

Le projet SIGMA s'est donc appuyé sur l'expérience antérieure à l'IAV et à la DPA de Settat pour constituer une base de données des informations nécessaires à la gestion du territoire agricole. L'équipe de l'IAV avait une longue expérience en cartographie des sols et a acquis au cours du projet précédent une expertise en télédétection. Une formation complémentaire en SIG a été donnée aux chercheurs de l'IAV et les ressources matérielles requises (un SIG de la société PAMAP) y ont été installées, accompagnées d'une mise à jour des ressources informatiques de traitement des images (système Easy-Pace de PCI). L'installation des outils informatiques n'est cependant pas une fin en soi, il faut aussi les utiliser au mieux de leur potentiel. C'est pourquoi les objectifs du projet sont:

a) La collecte de l'information pour l'établissement d'une base de données à références spatiales de la région de Settat. Cette base comporte des données de nature physique (relief, géologie, hydrologie, pédologie, hydrologie, aptitude des terres à la culture) et des données de nature socio-économique y compris les infrastructures anthropiques (routes, villes, villages).

b) La réalisation de documents cartographiques thématiques relatifs aux pentes, à l'utilisation du sol, à la pierrosité, à la capacité de rétention, aux précipitations, à l'évapotranspiration, au déficit hydrique, etc, pour une période de temps donnée.

c) La production, à partir de la base de données et au moyen des capacités de modélisation incluses dans le SIG, de cartes des potentiels des terres en fonction du type de culture, du niveau de production, des rendements, du déficit hydrique, des zones prioritaires pour les interventions d'épierrage et les actions antiérosives.

d) Le développement d'une méthode d'intégration des données de télédétection au SIGMA pour la mise à jour de l'information sur la couverture du sol et la dynamique de son occupation en fonction des différentes opérations de mise en valeur.

e) Au travers de ce projet pilote, démontrer aux responsables de la DPA l'efficacité de la technologie des SIG et de la télédétection comme outil d'information sur le territoire agricole et d'aide à la décision pour les opérations de mise en valeur des terres.

f) La formation des enseignants-chercheurs et des étudiants gradués du DSS à l'utilisation des SIG et la mise en contact de ces enseignants avec les préoccupations pratiques de la DPA de Settat et, par voie de conséquence, donner aux ingénieurs de la DPA un complément de formation professionnelle.

g) Parallèlement à ces objectifs de formation, le développement des liens et la multiplication des rapports entre les enseignants-chercheurs de l'IAV Hassan II et les professionnels, planificateurs et décideurs du développement régional. Ceci aura pour effet de centrer les problématiques de recherche de l'IAV sur une orientation pratique inspirée de la réalité marocaine.

h) La diffusion des résultats aux autres DPA marocaines situées dans les régions d'agriculture pluviale et vers les régions d'Afrique du Nord et du Sahel vivant une problématique similaire.

Innovation, expertises et renforcement des capacités de recherche

Ce projet s'est appuyé sur une expertise qui existait déjà à l'IAV dans le domaine de la télédétection, mais est venu la renforcer sur le plan des SIG et de la modélisation du milieu agricole. Pour les responsables de la DPA de Settat, le projet a permis de découvrir le potentiel et les limites d'une approche géomatique de la gestion du territoire, c'est à dire d'une approche qui, en plus de répondre aux questions pourquoi?, comment? et combien? que posent habituellement les autres sciences de la nature, répond aussi à la question où?, c'est à dire qu'elle introduit la dimension spatiale de la localisation géographique des phénomènes étudiés et des interventions humaines sur le milieu.

Pour ce faire, le projet a permis de mettre en place à l'IAV des outils, matériels, logiciels et humains qui renforcent l'aptitude institutionnelle à se positionner dans le domaine. Cela s'est traduit par des demandes fréquentes adressées à l'équipe de l'IAV pour des expertises internationales, que ce soit à la FAO ou dans des pays voisins, par une reconnaissance de l'équipe de l'IAV au niveau du Comité national de télédétection et de SIG et par sa sélection comme partenaire marocain principal dans le cadre de l'opération GLOBESAR, un projet pilote canadien d'acquisition d'images radar aéroportées pour simuler les données du futur satellite RADARSAT dans divers pays àtravers le monde. Nous avons donc maintenant en place à l'IAV une équipe de gabarit international dans le domaine de la télédétection et des SIG appliqués à l'agriculture, en particulier dans le domaine des sols, qui, par son rôle constant de formation avec une demi-douzaine de thèses réalisées dans le cadre du projet, essaime vers d'autres secteurs de l'économie marocaine.

Les problèmes rencontrés

Il serait faux de dire que tout s'est déroulé sans problème dans ce projet. Un des principaux problèmes se situe au niveau de la communication entre le partenaire marocain et le partenaire canadien. En effet, pour des raisons extérieures et de nature surtout économique, il y a eu un manque de continuité au niveau du personnel affecté au projet du côté canadien, où pas moins de cinq assistants de recherche se sont succédés dans le projet en moins de trois ans. A chaque fois, il a fallu reprendre le dossier à zéro, avec tout ce que cela peut impliquer comme perte d'information. De plus, les responsables du projet de chaque côté sont aussi des directeurs de laboratoires ou de centres engagés en permanence dans un dur combat pour la consolidation et la survie de leurs laboratoires dans un contexte économique qui n'est pas toujours très facile, au Maroc comme au Canada, et de ce fait ils manquent chroniquement de temps. Mais malgré cela, l'équipe marocaine a su mettre en place un groupe d'assistants de recherche et d'étudiants de 3ième cycle qui ont pu assurer le fonctionnement, la collecte des données et les contacts avec al DPA de Settat.

Il y a eu des problèmes de compatibilité matérielle et logicielle entre les équipements acquis dans le projet SIGMA et ceux qui étaient sur place suite au premier projet. Le budget initial du projet SIGMA ne prévoyait en effet pas de mise à jour du système de traitement d'images, qui du coup se trouvait être d'une version plus ancienne que le SIG avec lequel il a été interfacé. Cette ancienne version ne pouvait pas non plus lire les nouveaux formats d'images

satellitaires, ce qui a fait que la mise à jour des cartes d'utilisation du sol dans le cadre du projet s'est trouvée compromise pendant un certain temps. Cette situation est maintenant corrigée.

Au niveau de la communication entre les deux équipes, le manque de continuité du côté canadien n'a pas aidé. Idéalement, il aurait fallu greffer une thèse d'un étudiant canadien sur le projet, mais cela n'a pas été possible pour des raisons humaines et matérielles (manque de candidatures d'étudiants canadiens et manque de ressources pour encourager ces candidatures). Quand à la thèse d'un étudiant marocain qui devait initialement porter sur le projet, elle a changé d'orientation car il était plus difficile pour lui de garder le contact avec le terrain et avec la base de données à distance. Par contre, les divers intervenants canadiens qui ont eu l'occasion de travailler dans le projet ont tous gardé une excellente image de leur séjour au Maroc et ont tissé des liens d'amitié avec les collègues marocains. Et c'est cette dimension humaine qui, au delà de tous les problèmes techniques ou administratifs, est sans doute la plus importante, car elle est la porte ouverte à la compréhension, à la tolérance et au respect mutuel de civilisations qui sont au départ très différentes.

Actions de suivi envisagées

Les actions de suivi envisagées se situent au niveau de la poursuite de l'assistance scientifique du DSS vis à vis de la DPA de Settat puisque celle-ci a été suffisamment convaincue de l'efficacité de la démarche qu'elle a décidé d'investir pour géomatiser ses opérations. Mais il est évident qu'elle aura encore besoin de l'assistance du DSS pendant sa phase de transition, car ce n'est pas si simple que cela de passer d'un système de recherche à un système opérationnel au sein d'un service chargé de la gestion du territoire.

D'autre part, un système relativement simple comme celui qui a été installé à l'IAV permet de travailler sur d'autres secteurs et d'assurer la formation des utilisateurs. Il est donc important de tirer les leçons des réussites et des difficultés du projet SIGMA pour pouvoir aider d'autres provinces ou des institutions similaires d'autres pays à améliorer leurs méthodes de gestion du territoire par la géomatique. Cette phase est déjà commencée puisque l'équipe du DSS a été retenue pour assurer un cours intensif de formation, patronné par le Centre royal de télédétection spatiale, sur les systèmes d'information géographique appliqués à la gestion de l'environnement, en septembre 1993. Une diffusion des résultats du projet SIGMA par le biais de la littérature scientifique, en s'appuyant sur les thèses réalisées dans le projet, est un aspect qui reste encore à développer davantage.

DRYLAND RESOURCE MANAGEMENT IN NORTHERN HIGHLANDS OF YEMEN

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CONCLUSIONS AND RECOMMENDATIONS

1.1. Conclusions:

1.1.1. General:

The total surveyed area was 3452.2 ha (34.5 km2), for which land resources were studied and resulted in the preparation of a geological map, a physiographic map, and a soils map for the study area. Also, suitability classes and resources deterioration extent were identified. The identified main physiographic zones are the wadi terraces (243.3 ha) and lower mountain (526.6 ha) zone (I), the middle mountain zone (II) (774.6 ha), and the upper mountain zone (III) (1907.7 ha). The highland plateau area was not determined. Farmland terrace deterioration was determined. Uneroded terraces occupy 47 %, but need better soil management. Remaining terraces are either moderately to severely eroded (28 %), and uncultivated completely eroded lands (25%). The topography of the study area, is probably one of the major constraint for agricultural development. Present real problems encountered by farmers are probably drought and soil erosion .

Essentially, the intermountainous-wadi systems of the study area share numerous common features which not only have a profound impact on their hydrology but also make these systems extremely fragile, sensitive and quickly responsive to any changes in land and/or water use. These features, to name a few, include: the un-reliable rainfall; the erratic nature of flood events; the intermittent and un-reliable baseflow; the limited groundwater potential and the quick impact of its development on surface water availability (baseflow and spring discharge); the extensive terracing of the mountain slopes; the wide-spread practice of spate irrigation along wadi channels;... etc.

Since no hydrologic monitoring stations exist within the area, assessment of the various surface and groundwater components of the area's water system was largely based on data available from nearby areas. Therefore, the derived estimates should be considered of preliminary nature and only indicative of the general magnitudes. It was concluded that significant quantities of water leave the area as surface as well as subsurface discharges (mainly as floodwater and subsurface outlfow). Hence, various development options (recharge basines, underground dams, etc.) were proposed to salvage these quantities. However, these options remain to be assessed particularly with regard to their impact on downstream users.

Since the dominant farming system is rainfed, terraces remain to be the most efficient water management technique that need special attention. On-farm water management for high productivity requires farmers to have interest in how: to increase effective rainfall, to conserve soil moisture, to increase soil water holding capacity and to practice supplemental irrigation whenever water resources allows.

1.1.2. Discipline-wise Conclusions:

1) Land Resources:

1. The lithology of the study area is very complex due to tectonic movements, and characterized by sandstones, rock outcrop, green silty shales at faces of the lower part over the basement rock. Calcareous parent material dominates the highland plateau.

2. The soils of terraced land in all zones have recent fluvial deposits, and one classified as Usitfluvents and Torrifluvents (according to soil condition). The soils of terraces at base of steep slopes have been developed on recent colluvial materials and classified as Ustiorthents and Torriorthents.

3. Soils of the eroded terraces on steep slopes of the upper and middle mountain zones are classified as Torriorthents. The soils are shallow to lithic and stony phase of the Torriorthents.

4. Cultivated soils, which are derived or developed on calcareous and limestone, are classified as Haplustools and Calciustolls. They have a mollic epipedon and calcic or petrocalcic horizons. Soils of the rangelands (pastures) are shallow with dark colored mollic epipedon.

5. Permanently not suitable lands for crops (N2) occupy about 51% of the study area; whereas, currently not suitable lands for crops (N1) occupy only 22%. Farmlands are moderately and marginally suitable for crops (S2, S3) and occupy about 27%. These lands need proper soil management and conservation.

6. At present land use classes were identified as: farmland (27%), rangelands (22%) and others (51 %). About 75% of farmland is presently under cultivation. Sub-divisions of the rangelands and class are: forest trees (10%) grass land and shrubs (19%), shrubs and grass land (58%), and pastures and scattered trees (13%).

2) Water Resources:

1. In terms of rainfall, the average annual depth was estimated at 550 mm while the dry and wet year depths (10% probability) were estimated at 100 and 650 mm, respectively.

2. Total runoff from the mountainous part of the study area (about 46 /cm2) was estimated at 2.7% of the annual rainfall which amounts to about 0.68 MCM in an average year. Of this quantity, about 0.37-0.49 MCM reaches the main-channel of W. Sharis as direct runoff and 0.19-0.31 MCM is discharged as spring flow along the slopes of Jabal Kuhlan.

3. Additional runoff which is generated by rainstorms on the upstream area of W. Sharis (184 km2), and which enters the study area via the main wadi-channel, was estimated at 6.49 MCM in an average year. About 2.07-3.60 MCM of this quantity flows into the area as floodffow and some 2.89-4.42 MCM enters as combined baseflow plus groundwater underflow (sub-surface inflow) through the wadi-bed section.

4. In terms of groundwater availability, only the shallow alluvium aquifer is of proven productivity. Moreover, since the area is underlived by basement rocks, it is not expected that deep aquifers exist in the area. However, the groundwater potential of the fracture zones along the J. Kuhlan contact with the wadi-channel as well as the hillslopes of J. Kuhlan remain to be investigated.

5. Domestic water supply depends greatly upon unsafe surface water sources, with inadequate supply services in terms of coverage (< 50% of the population) and water shortage. Unfortunately, no significant change in the service is anticipated within the present and next decade.

6. The average per capita water consumption is very low compared to national and international standard, and large differences do exist among household's consumption. The present domestic water demand was estimated at 0.115 MCM, to be doubled in the year 2000 and will exceed six folds in the year 2010.

7. Estimated present and future per unit area crop water requirements indicate an expected increase in consumption by 30 to 45%, which requires careful consideration to be given to efficient water use especially when irrigation agriculture would dominate.

3) Natural Vegetation and Rangelands:

1. The vegetation map and report provide basic information on natural vegetation and its natural environment in different physiographic zones of the western escarpment, and can be used for teaching purposes.

2. Longer time and protected plots are needed for range productivity investigations.

3. Grazing is practised in three types of land, i.e., rangelands, cropland and uncultivated lands. Most farmers tend to send their sheep and goats for grazing in rangelands all year round.

4. Despite the increasing utilization of alternative fuel sources (e.g., butane gas and kerosine), farmers do utilize higher amounts of firewood. Wood cutting have caused serious damages to rangelands and resulted beside other reasons in over utilization, increasing runoff and accelerated erosion.

4) Crop Production

1. About 84% of the land is rainfed cultivated land and about 16% is irrigated land. The water shortages which leave about 50% of the agricultural land unused is probably the major limiting factor for increasing agricultural production.

2. Analyzing the dynamics of farmland illustrated a net loss of land in most farms due to deterioration (erosion, drought); an indication of the physical incapability of land resources to allow significant expansion, unless deterioration is controlled. However, farmers' perception of future trends in cropping pattern and intensity may indicate possible increase in resource demand.

3. Crop yields have been found to be low, due mainly to low productive crop cultivars and to low levels of inputs use.

5) Livestock Production:

1. There is only one breed of cattle, two breeds of sheep and two breeds of goats in the study area. The productive performance of cattle, sheep and goats is very poor. Cattle produce small quantity of milk (1.2-1.8 l/d) in a short duration (2.7-3.8 months).

2. Farmers have tendency toward increasing their livestock holding by purchasing cattle, sheep and goats from the market. During the period 1991- 1992, the area was severely striked by drought and feed was scarced. Accordingly, mortality rate was increased and production was highly affected.

3. Rinderpest is the most important disease affecting cattle and vaccination was done in the past. Sheep and goats suffer from ploat, skin decease and sheep pox where drugs and threaputics are very scarced.

4. Feed supply is of low quality nutritive value and in a short supply. Season of short supply is winter at first then spring.

6) Socio-economic:

1. Production costs have been increasing due to irregular supply/provision of agricultural inputs with reasonable prices to farmers.

2. Low productivity and profitability of cereal production caused farmers to be stagnant on subsistence farming, and to switch to producing other agricultural products such as qat and vegetables which are relatively higher profitable.

3. The extension agents' role is limited and hampered by many obstacles i.e., transportation facilities, which resulted in irregular information flow. Furthermore, interpersonal communications with the extension agents is also limited, however, fellow farmers communication is the major information source for most of the farmers.

4. Mass media facilities such as radio and TV were relatively highly used by farmer and are considered the major information sources for many farmers. Further, afternoon extension meetings were widely preferred by most farmers.

5. Agricultural research services on field crops, vegetables, and fruits to increase yield and farm income (under rainfed cultivation) are scarce.

6. Drinking water shortage and poor supply services are major problems encountered by the population in the area; consequently, prices of drinking water have been increasing.

1.2 Recommendations:

1.2.1. General

Whether or not the proposed development options are considered, proper management of the existing land and water system requires more data. Therefore, it is recommended that the following data collection measures be undertaken:

(i) establish an adequate network of rainfall stations within the basin of W. Sahris,
(ii) establish at least one meterological station,
(iii) establish at least two stream gauging stations to monitor the baseflow and floodflow discharges. One station should be located at the outlet of W. Sharis where it meets W. Mawr. The other station should be located near the study area,
(iv) carryout a spring inventory and establish a regular monitoring program,
(v) collect and monitor water quality data; and
(vi) compile information on soils, water and vegetation of the area in an effort to establish a national "Resource Information Service"

As is the case in other wadis in the country, the rapid degradation of the mountain terraces causes the floodwater flow to become more destructive. In response to the destruction of terraces and the loss of cultivated land there appears a need to develop and diffuse a most economic and replicable methods for reconstruction of abandoned and degraded terraces farmlands and water control structures (e.g., gabion enforcement of stream-banks, reafforestation, terrace rehabilitation...etc.).

1.2.2. Resource Management:

I. Land:

1. Provide technical assistance to farmers with regard to proper rangelands management and natural vegetation conservation.

2. Select suitable crops for highly calcareous soils and promote soil fertility improvement (e.g., addition of phosphatic and organic fertilizers).

3. Initiate studies on crop and soil management improvement in this area and similar dryland farming systems.

II. Water:

1. Since water competition is bound to increase in the future, it is recommended that the National Water and Sewerage Authority (NWSA) be encouraged to search for other water sources (for the town of Hajja) to either replace or supplement the existing wells drilled in W. Sharis.

2. The concept of conjunctive use of surface and groundwater sources should be adopted

as a guide for any future development activities.

3. Promote the notion of efficient and equitable water use, and provide for easing the availability of water-efficient techniques.

III. Rangelands:

1. Few plant species are still not identified, for which a technical assistance is needed.

2. Extensive vegetation studies are needed in order to have better understanding of eco-systems in other areas of the country.

3. Promote the use of alternative fuel sources especially butane gas, which has advantages over the use of fire-wood.

4. In-depth understanding of local grazing systems especially socio-economical as well as natural issues of these systems in various areas of Yemen.

5. Watershed protection efforts should be promoted at the national and regional levels to secure more water quantities in these runoff producing areas.

1.2.3. Agricultural Production:

I. Crop Production:

1. Low productivity of crops necessitates the introduction of new cultivars that will efficiently use the limited resources.

2. Drought seems to be an important problem in this rainfed system; therefore, studies on the interaction of different crops, cultivation techniques and cropping systems appear to be of a major priority.

3. Agricultural inputs present important means for yield improvement, therefore, there appears a need for providing suitable agricultural inputs at reasonable prices and to encourage farmers of using them.

II. Livestock Production:

For improving the production potential of farm livestock, the following recommendations should be considered:
1. maintain a balance between resources and livestock population in the area.
2. improve management practices of the traditional system.
3. provide for high quality supplementary feed for productive animals.
4. improve the nutritive value of low quality crop by products.
5. improve housing and sanitation in animal stables.

1.2.4. Socio-economic Development

1. Provide for technical and financial support to farmers in order to carry-out the required maintenance and reconstruction of destroyed cultivable terrace land. In this matter, an easy credit facilities is required and policies should be directed towards encouraging farmers response.

2. Initiate studies to identify problems hindering the market of farm products.

1.2.5. Required Operational Programs:

A. Priority Programs

Both the general and the discipline-wise recommendations have generalized on the study area's need for various environmental and socio-economical development programs. For convenience of implementation, these programs could be prioritized and reorganized into three categories within which several operational programs are outlined.

I. Basic Rural Development:

1. Improvement of rural water supply systems and services.

2. Development of health-care center; basically mother and childhood care.

3. Rural women development.

4. Upgrading (and extending) the agricultural extension services.

II. Resource Conservation:

1. Technical assistance and incentives to encourage terrace rehabilitation.

2. Promotion of water harvesting practices both existing (historic techniques) and modern cost-effective technology.

3. Introducing cost-effective water-efficient techniques.

4. Development of soil fertility through proper soil management.

5. Range vegetation conservation and diversification maintenance.

III. Agricultural Production:

1. Development of appropriate technological packages.

2. Encouragement of farmer's interest in technology dissemination by establishing a two-way linkages.

B. Coordination of Technical Cooperation:

Because of coordinated technical cooperation between AREA, FOA (Sana'a Univ.) and ICARDA, with the kind support of IDRC, this study was made possible. At the very beginning, it was intended to confirm the coordination capacity of the two national institutions, to carry-out this pilot study. The output proves the successful achievement. In future programs, particularly those related to technology transfer, the participation of the rural development agencies (RDA's) may even prove much successful. For instance, in the case of the northern highlands, the Sana'a, Saa'da and Hajja Agricultural and Rural Development Authority (SSHARDA), and in other regions the respective RDA's, could be involved.

Doubtless, international cooperation, in terms of both technical assistance and financial support, is still needed to support future resource development programs in the highlands and other regions of the country. Through-out the preparation of this study, the technical back-stopping of ICARDA was invaluable and very much appreciated. A potential role of this international Center is anticipated as regards technical assistance, regional networking and aid coordination. However, bilateral cooperation could be established directly between Yemeni institutions and donor governments' development agencies (e.g. IDRC). In the case of environmental resources management differences between countries of the WANA region may not be in favor of networking. Therefore a direct, rather than indirect, involvement of donor agencies could alternatively be much attractive and successful.

At present, cooperation environment in the Republic of Yemen is so much in favor of strengthening linkages with overseas development agencies. There are several aid agencies repositioning and negotiating possible aspects of cooperation. Because of the rapid change in the country's economy towards open-market, resources are unsustainably utilized, due mainly to mismanagement and poor resource information systems. Cosequently, the national government intervention is required, and thus international technical cooperation becomes indeed imperative.

ENVIRONMENTAL POLICY-MAKING IN EGYPT

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(Social Research Center, The American University in Cairo)

The nurturing of the world we live in has become one of mankind's foremost concerns. The environment has thus become an increasingly important policy issue throughout the world. Robert Nisbet's prediction that the history of the twentieth century might possibly be the history of environmentalism seems well on the way to being fulfilled.

Egypt is a country with a huge population of 58 million residing in a narrow strip of valley and delta flanked by the Sahara Desert on both sides. It suffers from environmental hazards associated with high population densities, scarce resources, and an ever-larger urban sprawl. Notwithstanding this, environmental concern has only recently developed into an "issue area" encompassing several legislative measures and a complex and diverse network of political activities, both within and outside the government.

The purpose of this study is to analyze and explain the nature, development, and possible implications of environmental concern as a political issue in Egypt. The study is premised on the contention that unlike most countries where environmental issues evolved mainly as an outgrowth of grass-roots activities, the state - prodded to a large extent by foreign encouragement and/or pressures - was the prime initiator of such policies in Egypt.

The study will therefore explore the interactions between the government, social groups, political parties and foreign donors and analyze the leveraging powers of each with respect to policy-making. Specific questions to be addressed are the following: Who are the actors involved? How effective are they? What might the development of environmental concerns imply for Egypt's political system? These questions will be answered with reference to two major environmental policies: the National Environmental Action Plan and the Environmental Integrated Law.

Despite the magnitude of environmental problems in Egypt, environmental policy-making has come late to the political system and is a virgin field of study. To date, most environmental studies are confined to the technical aspects of the issue and rarely touch upon its political and social implications. The importance of this study, therefore, lies in the insights it will provide into the performance of Egyptian public policy in this hitherto unstudied area. It will also help Egyptian policy-makers to improve the management of the country's natural environment and enable the development of more effective policy formulations and socio-economic development plans. In addition, the study will provide research that can be relevant to other developing countries facing the same resource constraints and environmental conditions. The results will be equally important to the industrialized nations in their efforts to assist developing countries in addressing environmental issues that affect the entire globe.

The research will focus on two examples of Egyptian policy making in the field of environment.

a) The National Environmental Action Plan (NEAP)

NEAP is the only comprehensive document that reflects the government's perception and position on how to manage Egypt's environment. NEAP was created with the help of the World Bank as part of the Bank's policy to encourage Third World countries to formulate their own national environmental plans.

In Egypt, ten national working groups of experts from different ministries, agencies and non-governmental organizations (NGOs) worked together with World Bank representatives to create Egypt's NEAP. The NEAP is divided into five sections: pollution and degradation of natural resources, air pollution, solid waste management, protection of Egypt's heritage, and strengthening environmental institutions. Problems were explained and policies were stated in every section.

The NEAP was presented by the Egyptian Environmental Affairs Agency (EEAA) to international donors in a conference held in Cairo on May 24, 1992. Donors were asked to invest in Egypt's NEAP. A number of external donors have thus had the chance to comment on the plan. By focusing on the NEAP, the research will examine the role of external organization in the formulation of Egypt's environmental policy.

The NEAP, being jointly designed by government units and NGOs, also offers the best example in Egypt of state-society relationships as far as environmental issues are concerned. A comparison of the input from each party to the end product should show the extent of the impact of society on the government's agenda. Furthermore, an analysis of the plan's content and a comparison of its goals with that of the Third Five Year Plan of the government will help to identify the relationship of environmental policy to broader national development plans.

b) The Environmental Integrated Law (EIL)

The draft law contains 94 articles and is composed of four chapters. The first chapter deals with the transformation of the Egyptian Environmental Affairs Agency into a Central Environmental Agency (CEA). The second chapter addresses air quality control, the third focuses on protection of the marine environment, and the fourth chapter specifies fines and penalties. Other environmental aspects such as fresh water, land use and natural resources are not included because they are covered by existing legislation.

The draft law was debated in the Peoples' Assembly, rejected, revised and still awaits approval. The draft law raised conflict between the EEAA and such development groups as the Ministry of Petroleum, the Ministry of Tourism and the Ministry of Industry. An analysis of the draft law, the debate surrounding it, and the positions of the Peoples' Assembly members will help in drawing a picture of the general political and economic context of environmental policy making. The final draft law will reflect the various interests and their impact on environmental policy making in Egypt.

Therefore, the EEAP and the EIL represent documents which have arisen

through a fairly comprehensive debate among most of the principal actors on the environmental stage in Egypt. Their implementation, which can only be measured at a later date in a much more extensive study, is not the point of this research. It is an understanding of the participants and their positions that is being sought and a thorough analysis of the process which generated these two documents should lead to that understanding.

CONCEPTUAL FRAMEWORK

A modified policy cycle approach will be used to examine the policy making process in Egypt. This model includes the following: Policy Initiation, Agenda Setting, Decision Making and Policy Impacts or Assessment. No attempt will be made to deal with the implementation process because the NEAP will not have been implemented fully by the end of this research.

a) Policy Initiation

In this stage, the research will identify the actors who initiated the issues. This includes the state, external donor agencies, and non-governmental organizations. An analysis of the EEAP and the EIL will provide this information in the form of a list of important personnel and the agencies they represent. Non-participants can be identified by elimination.

b) Agenda Setting

Before a policy choice can be made, a problem must be accepted as part of the agenda by the policy making system, i.e., it must be deemed amenable to public action and worthy of the attention of policy makers. Setting the agenda is a political activity which illustrates the amount of control various parties have over ultimate policy choices. therefore, an understanding of how the existing environmental agenda was set will help to explain how political power in Egypt is exercised and by whom. The NEAP and EIL reflect the issues that have been sanctioned and thus the sources, proponents, content and variation of environmental policy making in Egypt.

c) Policy Formulation

After a political system accepts a problem as part of its agenda, it must develop a mechanism for solving the problem. Policy formulation involves setting of for policy, creating specific plans and proposals for these goals, and selecting the means whereby such plans can be implemented. NEAP and EIL are the government's attempts to respond to environmental problems in Egypt in a comprehensive. The analysis of NEAP will shed some light on the government's environmental priorities, goals, plans and means to achieve these plans. The analysis of EIL will provide the legislation and institutional frame that will supervise the implementation and enforcement of environmental policy in Egypt. Consequently, the understanding of both NEAP and EIL will improve our knowledge of the extent of environmental concern in Egypt. A better understanding of the policy can help identify areas that need to be reformulated and consequently helps in improving the quality of

environmental policy in Egypt. The resultant policy in Egypt may become a model for other developing countries to follow.

d) Decision Making

The main objective at this stage is to study the decision making process to understand how policy choices are made. Does the decision making process in environmental policy differ from decisions made in other policy areas? Does the structure of the Egyptian government and its characteristics (a semi-presidential/semi-parliamental system, strong executive authority, weak legislative authority, weak political participation) affect the decision making process in the field of environment?

Environmental problems in Egypt have all the elements needed for a crisis situation, i.e. threat to core value, short time duration and the need for quick decisions. Environmental degradation is a threat to core value (development and well being of the Egyptian people) and it increases rapidly unless fast decisions are made. The fundamental question then is whether the decision making process is truly compatible with the urgency of the problem or whether it is just a reflection of bureaucratic and organizational conflicts.

e) Policy Assessments (or Policy Impacts)

All the procedures involved in evaluating the social impact of government policies, in judging he desirability of these impacts and in communicating these judgements to government and public can be called "policy assessments". The researcher's main concern is to assess the effects of the governmental environmental policy on its citizens. Because environmental policy involves trade-offs between environmental values, technical feasibility and economic growth, it is very important to analyze its impacts within a broader context, i.e. in relation to the National Development Plan and the government's limited resources.

METHODOLOGY AND OPERATIONAL PLAN

Examination of primary data collected from the government, the EEAA, and from the Egyptian Green Party, as well as interviews with government and party officials, will constitute the main part of this research. Research will also be conducted into the identification of non-Egyptian (donor) government agencies whose foci include Egyptian environmental issues. These include the World Bank, the Canadian International Development Agency (CIDA) and USAID. These sources will be investigated for documentary evidence and direct interviews with relevant personnel will be conducted. Private Egyptian environmental activists will be consulted concerning major ongoing or planned development projects deemed either officially or privately by concerned Egyptian activists as environmentally significant.

DISSEMINATION OF FINDINGS

In addition to a book manuscript, the findings of this research would also be available to decision-makers through a final report.

A one-day symposium is planned for the end of the project where the findings would be presented and discussed by experts, policy makers and members of NGOs.

During the course of the study, the researcher has been called upon to partake in conferences and disseminate research findings to officials from the EEAA, environmental NGOs and foreign donors such as CIDA.

SIRS POUR LA CONSERVATION DES EAUX ET DES SOLS -Tunisie-

Dr. M. Rached Boussema, ENIT

Dr. Jean-Jacques Chevallier, U. Laval

1. Introduction

En Tunisie, l'agriculture constitue l'une des principales ressources de l'économie nationale et représente plus de la moitié du PNB et emploie plus de 60% de la population. Or, dans les régions arides et semi-arides, l'érosion des sols constitue un fléau pouvant hypothéqué l'avenir du pays car un sol érodé est définitivement perdu. Ce phénomène dépend de plusieurs facteurs fort complexes. La gestion des sols et des ressources en eau est un processus complexe, aux composantes et incidences multiples, de même, les interventions envisageables peuvent être très variées, et doivent être soigneusement intégrées dans l'environnement physique et socio-économique (Chevalier et al., 1993).

Une politique de conservation des eaux et du sol est mise en place depuis quelques années. Un organe de mise en oeuvre de cette politique est crée au sein du Ministère de l'agriculture en la DCES. Cette politique a reçu l'appui de certaines instances internationales. Les résultats parfois spectaculaires présentent néanmoins des insuffisances voire même des échecs compte tenu des moyens financiers investis.

La présente contribution présente le projet, mené depuis janvier 1992, en collaboration entre l'ENIT, la DCES et l'UL, avec le concours financier du CRDI. Il a pour objectif la création d'un SIRS en vue d'aider la DCES dans la réalisation de sa politique. Le SIRS concerne le bassin versant de l'oued Merguellil en Tunisie centrale, de 154 00 ha environ. Les apports solides du Merguellil sont estimés à 5,5 million de m3/an. La pluviométrie annuelle varie entre 200 et 400 mm répartie entre 40 et 70 jours.

2. Problématique, défis, importance en Afrique du Nord

En Afrique du Nord, le phénomène érosion est dû à de multiples facteurs. D'abord, des facteurs climatiques illustrés par l'agressivité et l'irrégularité des pluies entraînant des crues brutales et épisodiques. Ensuite, des facteurs édaphiques font que les sols sont souvent jeunes correspondant à des alluviaux ou colluviaux. Il y a très peu de sols évolués et riches en humus. Viennent ensuite les facteurs topographiques marqués par des terrains à pentes raides qui accélèrent l'érosion. Les facteurs socio-économiques ne sont pas moins importants. L'érosion est largement aidée par le défrichement de la végétation naturelle, par la mise en culture de terrains de parcours et par la pratique de procédés culturaux inadéquats.

En plus de l'érosion, d'autres problèmes majeurs affectent la région tels que l'envasement des barrages réduisant ainsi leurs durées de vie et la diminution des nappes souterraines.

Une politique de CES a pour objectif la protection de ces sols visant à améliorer leurs rendements. Elle se base sur des travaux sous forme d'aménagements ou d'ouvrages CES. Certains de ces ouvrages telles que les retenues collinaires permettent d'atténuer les conséquences de l'érosion, d'améliorer le bilan hydrique des terres et de favoriser le couvert

végétal. Seulement, cette politique doit être bien définie, concrétisée de manière efficace et assurant un suivi continu. Elle s'appuie sur une bonne connaissance des conditions à la fois naturelles et sociales du milieu afin que les aménagements intégrés soient techniquement réalisables, socialement acceptables et économiquement rentables. Ainsi, plusieurs programmes sont mis sur pied par la DCES visant à diminuer et contrôler ces fléaux touchant outre à l'érosion, à la désertification et à la salinisation.

Ces aménagements constituent un processus comprenant quatre phases essentielles: la planification permettant de déterminer les zones prioritaires, la programmation des aménagements appropriés, leur exécution et le contrôle et le suivi incluant des études d'impact et des évaluations agro-socio-économiques. Pour ce faire, un besoin énorme en information se fait ressentir à la fois en quantité, en diversité, de point de vue acquisition et de gestion Leur analyse permet de prendre des décisions.

Le projet présentait à la fois un haut degré d'incertitude (quel sont les besoins réel, et ceux qui pourraient être satisfaits ?) et une grande complexité (de par les multiples intervenants, la diversité des aspects à considérer, les problèmes aussi bien de captage et de traitement que de gestion ou d'exploitation des données) (Chevallier et al., 1993). Par conséquent, les défis sont nombreux. Outre la nécessité de réaliser un SIRS qui permet de sélectionner les zones critiques, de concevoir des ouvrages de protection anti-érosive, d'étudier le comportement hydrographique du bassin versant, etc., le projet doit moderniser les outils d'acquisition et de gestion des données, et de les intégrer aux activités des ingénieurs et décideurs CES.

3. Objectifs

Le projet a pour objectif général le développement du potentiel des SIG et de la télédétection pour l'étude des problèmes liés à la dégradation des ressources naturelles en Tunisie. Comme objectifs plus spécifiques, le projet cherche à développer une méthodologie adéquate d'utilisation de ces données et techniques en vue de préserver ces ressources. En particulier, les mécanismes pour acquérir, gérer et tenir à jour les informations descriptives du territoire, l'utilisation conjointe des techniques des SIRS et de télédétection pour améliorer l'identification des sites potentiels d'érosion hydrique, l'obtention de meilleures connaissances sur les contraintes et les possibilités de l'intégration multisources. On aurait ainsi répondu aux besoins de la DCES, facilité l'accès aux données par les opérationnels, optimisé les temps de collecte des données et mis à disposition d'un outil évolutif pouvant appuyer la prise de décisions judicieuse à tous niveaux.

4. Méthodologie et aspects innovateurs

La méthode s'appuie sur la technique du double prototypage consistant en:

- un premier prototype rapide permettant de lever les plus grands facteurs d'incertitudes relatifs au projet
- un prototype évolutif permettant de réaliser le futur système par modules successifs

Le prototype rapide touche deux niveaux de décision:

- l'identification des zones prioritaires affectées par l'érosion
- l'étude de l'aménagement intégré

Cette étape permet de se faire une idée de l'état du territoire, d'évaluer les besoins en interventions, de proposer des variantes d'aménagement et de simuler leurs impacts. Elle a démarré par l'inventaire de la documentation disponible qui a abouti à la mise au point d'un modèle de données (MCD et dictionnaires) ayant servi de base au développement du prototype rapide.

5. Disciplines concernées, expertise, retombées en matière de recherche

Le projet global est un projet de géomatique au sens large, puisqu'il exploite les technologies des SIG, de la télédétection, de la photogrammétrie, des GPS et de la cartographie.

La problématique met en contribution des disciplines liées à la conservation des eaux et du sol en matière de génie rural, eau, agriculture, géomorphologie, pédologie, géologie, etc.

La réalisation du projet a soulevé des aspects forts intéressants de la recherche: intégration de données multisources, prise en compte et modélisation des facteurs socio-économiques, recherche de nouvelles techniques de classification d'images satellitaires, développement de fonctionnalités et de structures de données adéquates, interfaçage avec les modèles hydrologiques, etc.

6. Problèmes techniques et organisationnels de gestion d'un projet d'intérêt commun

Les problèmes techniques sont surtout au niveau des données: problèmes de spécifications (exigence de précision, de disponibilité, de mise à jour de cohérence) et d'accès (difficilement accessible ou éparpillées). Ils sont aussi au niveau des méthodes et outils: méthode approchées souvent non validées, outils traditionnels, utilisation abusive de l'extrapolation, etc.

Les problèmes organisationnels sont liés aux moyens humain (disponibilité, compétence et formation), aux moyens matériels et financiers (disponibilité qualité) mais surtout à des besoins d'une politique à long terme (choix de solutions informatiques, développement d'applications, formation, etc.).

7. Activités passées ou prévues de diffusion des résultats de la recherche

Trois actions principale sont prévues par le projet pour diffuser les résultats de la recherche:

- la journée d'information et l'atelier de Sidi Thabet (4-5 novembre 1992)
- le colloque tuniso-canadien prévu pour septembre 1994
- les publications

La réunion de Sidi Thabet a permis d'informer l'ensemble des personnes et organismes concernés de l'existence, des objectifs et de l'état d'avancement du projet. On y a présenté le prototype rapide ce qui a permis de valider les objectifs du projet, de définir le contenu et les

étapes de développement du prototype évolutif.

Le colloque tuniso-canadien présentera les résultats auxquels le projet a abouti dans les divers aspects de la recherche.

Jusqu'à aujourd'hui, le projet a déjà donné lieu à 8 publications dont 5 communications.

D'autre actions sont également envisagées. On peut citer deux actions importantes:

- une démonstration du prototype évolutif à la DCES le 17 décembre 1993
- l'installation du logiciel ARC/INFO sur le matériel de la DCES afin que les technicien puissent effectuer des manipulations sur le prototype.

8. Conclusion

Le projet présente plusieurs points forts. D'abord, il s'insère dans le cadre de la politique nationale actuelle visant àprotéger les sols tunisien. Ensuite, il permet de rapprocher la recherche scientifique des cadre et techniciens de la DCES en leur assurant une formation nouvelle et en utilisant des outils et méthodes modernes leur permettant d'étudier des variantes, d'évaluer les efficacités, impacts et contraintes et décider avec une meilleure connaissance des problèmes.

L'approche adoptée est nouvelle et innovatrice dans l'étude des bassins versants et la lutte contre l'érosion. Elle est systématique, intégrant de nombreux facteurs et concerne le domaine de l'aménagement rural en milieu semi-aride. De ce fait, elle semble facilement transposable à d'autres bassins versants dans des conditions similaires.

L'intégration des données socio-économiques en amont des phases du processus de modélisation du SIRS fera que les résultats soient proches de la réalité et non des modèles physiques figés.

Certes, plusieurs questions risquent de ne pas trouver de réponse. Par exemple, la manière de rendre opérationnelle certains résultats, l'évaluation des coûts récurrents à certaines réalisations, une évaluation rigoureuse de la perte des sols etc.

Synthèse des facteurs dynamisants (+) et pénalisants (-)

Ces facteurs ne constituent pas une critique du projet, mais veulent simplement tirer profit de ce projet - par ailleurs réussi - en dégageant les facteurs positifs et négatifs les plus utiles à la préparation de projets ultérieurs.

+	-
Modalités de la collaboration	
Visite de prise de contact en Tunisie	Moyens de communication plus efficaces (fax, e-mail)
Couplage avec d'autres projets, permettant d'augmenter le nombre de voyages et d'optimiser leur efficacité	
Stage initial de 5 semaines de 3 spécialistes Tunisiens au Canada (formation et démarrage du projet)	Amélioration des modalités de transfert de savoir-faire (p.ex: séjour prolongé en fin de projet d'un(e) Tunisien(ne) au Canada)
Degré d'engagement des partenaires	
Haut niveau d'intérêt pour le projet aussi bien dans le Ministère que chez les chercheurs tunisiens et canadien	Difficultés pour les chercheurs de se dégager d'autres tâches pour que le Projet puisse réellement passer au premier rang
Participation de deux professeurs canadiens et de deux professeurs tunisiens (soutien réciproque, remplacement)	
Bonne intégration du projet dans les axes de recherche principaux des partenaires	Trop de soucis annexes, dispersion des effort et perte d'énergie
Questions de personnel	
	Difficulté de faire déléguer par le Ministère des personnes ressources (1) compétentes, (2) intéressées et (3) stables pour la durée du projet
Haut niveau de compétence de collaborateurs canadiens	Changement de collaborateur tunisien en cours de projet
Thème du projet et résultats	
Problématique très concrète	Difficulté de collaborateurs tunisien en cours de projet
	Résultats inévitablement partiels
Résultats sous la forme d'une méthode de travail et d'une solution évolutive	

INTEGRATED MANAGEMENT OF WATER RESOURCES IN IRRIGATED DESERT FARMS -Egypt-

(DESERT IRRIGATED EFFICIENCY)

Dr. Hosni El Lakany, DDC/AUC
(Desert Development Center, American University in Cairo)

SUMMARY PAPER:

"The overarching objective of the agricultural strategy for the 1990s is to complete the policy reform program which has already been initiated for the sector, to increase agricultural production and incomes, taking into consideration the overall changes taking place within both the Egyptian and international economy and the linkages between the agricultural sector and the other sectors of the economy. *Within this context the objectives are to increase agricultural productivity per unit of land and water through more efficient use of these limited resources, reduce unit costs of production, and thereby increase national output and farmers' incomes.* (A.R. of Egypt, An Agricultural Strategy for the 1990's, 1992)

1. INTRODUCTION / BACKGROUND

1.1. WATER RESOURCES:

One of the most important current concerns and potential sources of conflicts in the Middle East is the availability of water at the national level. The water resources in the region are limited while water needs are augmented by the aridity of the climate, ever-increasing demands for food and water requirements for non-agricultural uses. Many countries in the region, including Egypt, are classified among the countries close to, or already facing water-stress conditions.

With limited quantities of water, the agriculture sector will have to adjust to a lower percentage of available water than before. Even with increased use of ground water and the reuse of drainage water, it is most likely that, in percentage terms, the agriculture sector will have less water available to it than at present. The implication of this for sustainable agricultural development is that measures should be introduced to induce a more economic use of water. These measures would span the whole spectrum of alternatives.

A related aspect is that of water quality, and in this context the impact of pollution on water availability cannot be over-emphasized. This is important particularly in the context of ongoing and future reuse of drainage water. Agricultural activities affect water quality through fertilizers, pesticides and other agricultural chemicals. Other major sources of pollution are the industrial and urban sectors. It is clear that the extent to which polluted drainage water can be reused through the present mechanism of mixing with canal water will have to be carefully monilored to avoid health hazards and environmental degradation.

The problems associated with water use in the new land can be grouped into four categories:

infrastructural, training, extension and equipment-related. Infrastructural-related problems, including malfunctioning of power stations and power cuts should be dealt with by the concerned governmental authorities. Training settlers regarding on-farm water management, especially geared to the operation and maintenance of pressurized irrigation techniques, requires the presence of effective extension service, but such services are particularly weak in the new land. On-farm water management units, comprising subject-matter specialists, should be incorporated into the governmental agricultural extension system. While the new policy promoting privatization and free market economy would lead to the availability of the proper equipment and spare parts, credit should be made available for new settlers to enable them to carry out the necessary maintenance and/or replacement of irrigation equipment.

Sustainable agriculture in Egypt is almost synonymous with sustainable water resources utilization. Since water resources are very unlikely to increase to satisfy needs in the near future strategies aimed at improving the efficiency of water use should be adopted.

DDC, in coordination with other national institutes, intends to promote sustainable, environmentally-sound practices aiming at improving water use efficiency, especially with the owners of small desert farms. While this proposed project cannot resolve major water policy issues on the national level directly, it will address some of the technical problems which reduce WUE on the farm level. Substantial improvements in WUE can be realized through the use of proper irrigation systems, reducing water losses (either directly through leakage from the system or high evapotranspiration rates) andlor modification of irrigation systems to cope with water or soil salinity.

Based on the results of the experiments to be carried out in the research station and after exploring the farmers' perception of the problems related to water delivery and use, the project will provide background information for governmental institutions which endeavor to draw policies for pricing irrigation water and other national agro-economic policies.

CONCLUSIONS

The 2 working group sessions and the final plenary served to highlight the common features of the MERO program on Land & Water Management and the challenges facing its supported projects:

COMMONALITIES:

- understanding causes of degradation processes
- fragile ecosystems
- degradation of land & water resources
- collect data --> represent it spatially --> GIS --> modelling
- outputs for planning, decision support
- integrate different types of data (geophysical, biophysical, socio-economic)
- multidisciplinary
- (supported by IDRC)
- working with multiple agencies
- target users: planners, decision makers
- strong socio-economic interests
- technology overwhelms socio-economic aspects
- difficulty of capturing indigenous knowledge (I.K.)
- disciplines
  GIS, hydrology, soil science, socio-economy, information science, agro-meteo, remote sensing, environment, maths/modelling, geomorphology, civil engineering
- land use issues
- land tenure issues
- agricultural systems

CHALLENGES:

a) - building into traditional research program of national/academic institution
   - multidisciplinary
   - tools/techniques
   - time frame

b) - implementation/transfer of results/institutionalization

c) - management of interdisciplinary/interinstitutional teams

d) - data quality, format, physical accessibility, historic data, cost

e) - sustainability of resulting system (data updating, finance)

f) - maximize/broaden base of local participation
   - modelling

g) - importing/adapting

h) - understanding/explaining model limits

i) - difference between use of models for understanding system (simulation) and predictive models

j) - match between data and models
   - integration of physical & socio-economic models

k) - availability/access to equipment, human resources
   - continuity of Project staffing

l) - moving targets/dynamic systems - how to keep up
m) - addressing transnational problems with national level projects
n) - technical/top down
o) - application of output to answer needs of end users/beneficiaries
p) - socio-economic is often add-on/outnumbered
q) - narrowness of training for this type of work
r) - communication needs: partner, inter-regional
s) - access to info./literature, who is doing what, models

The participants expressed the desire to institute a series of mechanisms and activities to strengthen the MERO program. The main points of their recommendations can be expressed as follows:

RECOMMENDATIONS:

*1. Share data models among projects, for info.
*2. Share tools for describing data quality
*3. Share data collection techniques/tools, access to data
*4. Use IDRC in raising issue of access to data/information in policy fora/at policy level
*5. Share (annual) project updates
*6. Establish email connectivity & mailing list/LISTSERV
*7. Coordinate between project scientific workshops (& share info. about local workshops)
*8. Share info. on techniques for local-level needs assessment (& local involvement, local dissemination)
*9. Consider a rotating project network secretariat
(Dr. Allam, GIS Division, EMR, volunteered for 1st year)
*10. Address the need for training in socio-economic aspects, esp. methodological
*11. Strengthen research on methodologies to integrate socio-economic aspects into research designs, & facilitate training thereof
*12. Incorporate appropriate social science expertise in project design
*13. Share info. about project management procedures, courses, methods, etc.
*14. Share info. about project expertise (inside and outside), services, etc. to maximize resources available to each
*15. Identify impact indicators at project design stage
*16. Insure institutional continuity with professional training/education and curriculum development in participating universities
*17. Promote S - S collaboration and mutual support - support joint projects (S-S and within a country)
*18 Establish peer-review procedures for new projects and proposals

In the short term, it was recommended and agreed upon to start looking at the availability and requirements to establish electronic communications between the projects. The projects/institutions/individuals not currently using email will investigate the current status of this matter with the assistance of IDRC. A number of "information-sharing" issues will be efficiently tackled when the email connections are implemented. These will be given a high priority. The design, building and sharing of a database on experts and expertise will also be pursued (point 14) by IDRC with the contributions of all the projects. Networking procedures

will also be designed and implemented in 94/95. A special attention will be paid to ensuring effective socio-economic contributions in the projects' research agendas. We will explore ways to bring and/or develop the required expertise in the program.

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