

## **Arendal II Workshop Report**

**UNEP and CGIAR cooperation on Data,  
Capacity Building and Networking Needs  
for the Use of Geographical Information  
Systems in Agricultural Research**

**Arendal, Norway (May 9 - 11, 1995)**

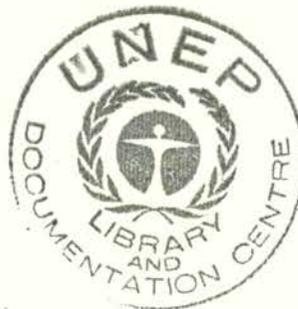
Editor: Gwynneth M. Martin



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Arendal



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CAPACITY BUILDING AND NETWORKING  
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INFORMATION SYSTEMS IN AGRICULTURAL  
RESEARCH**

*Editor: Gwynneth M. Martin*

UNEP/GRID-Arendal (1995)

**Arendal II  
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# Opening Statement

## BACKGROUND

GRID-Arendal is implementing the UNEP project "Use of GIS in Agricultural Research management", which was initiated at the CGIAR/NORAGRIC/UNEP meeting on "Digital Data Requirements for GIS Activities in the CGIAR" in Arendal in September 1992. The project aims to establish long-term cooperative links between UNEP and the CGIAR, particularly in the use of the GRID and CG networks to compile, distribute and maintain high quality natural resource and socio-economic digital data sets and to assist CG centers to ensure existing capacity to use such data sets in agricultural research activities.

The USAID/CGIAR Workshop on Use of Remote Sensing Technologies and GIS databases was held at CGIAR headquarters at the World Bank in Washington DC March 13-16 1995. The workshop came up with three generic categories of CG centers' needs related to GIS:

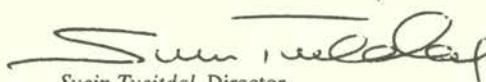
1. *Data sets and Remote Sensing products provided from outside organizations*
2. *Capacity building in GIS modelling and analysis*
3. *Networking needs (internally between CG centers, and between CG centers and other data holders like the UNEP/GRID network, CIESIN, WCMC etc.)*

The Arendal II workshop - as a follow-up to both the Arendal I workshop in 1992 and the more recent USAID/CGIAR workshop in Washington DC - aims at addressing all of these issues and translating them into concrete action.

## WORKSHOP OBJECTIVES

The primary objective of the workshop is to provide a sound basis for project planning and implementation. This will be achieved through:

- *review of the current activities and capacities of CG and UNEP/GRID centers*
- *identification of priorities and commonalities in the data and information needs of centers and their constituencies*
- *discussion of possible sources and methodologies for provision of such data sets*
- *identification of CG centers' capacity building needs to introduce GIS in agriculture research efficiently*
- *consideration of mechanisms and networking needs for data and information exchange and maintenance*
- *discussion of possible applications which might receive project support*
- *formulation of recommendations, if needed, to adapt the project document to reflect fully the CGIAR's information and data, capacity building and networking needs*



Svein Tveitdal, Director  
GRID-Arendal



## Acknowledgements

At the conclusion of the Workshop, there was general consensus that it had been of substantial benefit and provided a good basis for project activities. This is thanks to the contributions made by all attendees. We are most grateful to speakers who delivered their background papers as requested, and to chairpersons and rapporteurs (particularly those who "volunteered" for those duties in the working group sessions) for their prompt delivery of the notes upon which this report is based.

On behalf of the participants who travelled to Arendal, I would like to thank the staff of GRID-Arendal for their preparation before, and support during, the Workshop.

We are also all grateful to the Norwegian Ministry of Foreign Affairs whose support for this project made the Workshop possible.



*Gwynneth M. Martin*  
Project Advisor



# Executive Summary

## BACKGROUND

The CGIAR has long been interested in the potential application of modern information technology in agricultural research. Over time there has been a series of meetings and workshops addressing specifically Geographic Information Systems (GIS) - the first in Rome in 1986, organised by the CG and FAO; another in Nairobi in 1991, sponsored by UNEP, Rockefeller Foundation and ILRAD; a third in Arendal in 1992, arranged by UNEP/GRID with support from the Norwegian Ministry of Foreign Affairs; and a recent workshop in Washington in March of this year under USAID and CGIAR sponsorship. A project has now been funded, primarily by the Norwegian Government, to enable implementation of the recommendations emerging from the Arendal I meeting. The project aims to establish long-term co-operative links between UNEP and the CGIAR, particularly in the use of the GRID and CGIAR networks to compile, distribute and maintain high quality natural resource and socio-economic digital datasets and to assist CG Centers to ensure capacity is in place to use such datasets in agricultural research activities. The Arendal II Workshop is the first major project activity and its main objective is to provide a sound basis for detailed planning and implementation.

It is important to note that not only has the technology undergone considerable development in the years since the Rome meeting, but there have also been changes in the nature and

direction of the CGIAR research agenda. These factors make a project of this nature very timely. The project is envisaged to be system-wide, involving participation from as many Centers as possible (12 Centers were represented at the Arendal II workshop). Collaboration with other agencies is also an essential component, not only with UNEP as the title implies, but with a wide range of international and national agencies (11 such organisations were represented at the meeting). Such partnerships are needed to ensure that quality data is made available from all relevant sources and that experiences in the application of various technologies are shared in order to efficiently address the wide variety of problems dealt with by the Centers.

## SUMMARY OF THE PROGRAM

The theme of the meeting was well established by Dr. Stein Bie in his keynote address entitled Data Needs for the Food Insecure.

Workshop sessions addressed the following five primary areas, the first three of which emphasized information exchange, whereas the fourth and fifth moved towards project requirements and outputs.

1. The current activities and capacities of the 12 Centers represented were summarised. These showed a spectrum ranging from CIAT which has a large GIS unit with 20 scientists, digitising technicians and data analysts and a

well equipped laboratory, to Centers which have minimal hardware and software and no dedicated specialist staff. The UNEP/GRID system, comprising 11 Cooperating Centres was also described and the position of GRID in UNEP's Environment Assessment Program.

2. Both the CGIAR and UNEP are at an early stage of implementing new telecommunication networks. For the Centers, the network will deliver global connectivity through an Integrated Voice Data Network (IVDN), the development of which is approved and rapid implementation is planned. UNEP is in the process of establishing a satellite-based communications network, UNEPnet.

3. Three invited presentations examined new issues in use of the technology and data. Underlying all was the theme of combining database management, geographic information systems, telecommunications, etc. with various types of models to integrate into true decision-support systems.

4. Invited speakers addressed the availability and use of data in different categories, and working groups then identified priorities and commonalities in data and information needs of Centers and their constituencies, and how these needs might be met. For some needs, existing available datasets were clearly identified e.g. Digital Chart of the World (DCW) and World Vector Shoreline (WVS); in other cases possible sources of data were identified to be pursued, e.g. Defence Mapping Agency (DMA) and US Department of Agriculture (USDA); and a third group were those datasets which needed to be compiled e.g. population data.

5. Working groups also addressed the question of building capacity in Centers, particularly those currently at a minimum level. The emphasis was clearly on building human resource capability, and the requirements included increasing awareness of the potential

of such tools, at all levels. Training offerings should be application-based and use specific projects where possible, preferably cross-cutting programs and Centers.

## **RECOMMENDATIONS FOR FUTURE ACTIONS**

The recommended project activities are grouped under three headings - dataset production, institutional support and development, and networking.

### **Dataset Production**

Activities in this area should include:

- *the creation and maintenance of a catalog of existing datasets beginning with those in GRID and the Centers themselves;*
- *ensuring that existing, currently available datasets are easily accessible to Centers in a usable form;*
- *working with potential data sources to make other existing datasets also available;*
- *filling data gaps by compilation of datasets not known to be available elsewhere.*

### **Institutional Support and Development**

The project should assist Centers, especially those currently operating at a low-level, to strengthen their capacity to use GIS, Remote Sensing (RS) and related technologies. This might be done through:

- *analysis of requirements in this area;*
- *overall awareness building;*
- *formulation and implementation of institutional development programmes including seminars, workshops and demonstrations;*
- *provision of technological "tools".*

### **Networking**

The term networking is used in the broad sense of communication and is not intended to emphasize electronic communication. The project should ensure on-going exchange of data and experiences among Centres and with external agencies. This might involve regular

(electronic) newsletters and/or bulletins, cooperative undertakings, etc. Alliances with international and national agencies should be actively pursued. The project should also produce some form of brochure illustrating how GIS in decision support systems has the capability to enhance CGIAR capacity to address the problems of hunger, poverty and environmental destruction.

It is clear that current project funding is in the nature of "seed money" which can be used to take some initial steps. The products of these, with the positive interest and commitment demonstrated in this meeting, should be used in approaching donors for additional funding which will be required as project plans evolve.



# Arendal II Workshop Report

*UNEP and CGIAR Cooperation  
on Data, Capacity Building and Networking Needs  
for the Use of GIS in Agricultural Research  
Arendal, Norway (May 9-11, 1995)*

## 1. INTRODUCTION

### 1.1 Background

A key recommendation from the CGIAR/NORAGRIC/UNEP meeting on "Digital Data Requirements for GIS Activities in the CGIAR", held in Oslo and Arendal in September 1992, was that funding external to current CG allocations be sought from donors to resource implementation plans. Specifically these concerned the compilation, distribution and use of datasets identified as priority requirements for CG Centers. A UNEP project proposal document was prepared and, in late 1994, funding was secured from the Government of Norway through a UNEP Trust Fund. Matching project funds from the World Bank have now also been confirmed. GRID-Arendal is the implementing agency.

The project is aimed to establish long-term co-operative links between UNEP and the CGIAR, particularly in the use of the GRID and CG networks to compile, distribute and maintain high quality natural resource and socio-economic digital datasets and to assist CG Centers ensure capacity is in place to use such datasets in agricultural research activities.

It is over two years since the meeting in Arendal which gave the impetus for the original proposal. Over that period, individual Centers have evolved and progressed with respect to datasets in use, the technology in place and existing institutional capacity.

Therefore the intent of the workshop/meeting (referred to as Arendal II) in Arendal in early May was to initiate project activities and to ensure project plans are consistent with the current situation.

Input to the workshop was also provided from a meeting held in Washington in March of this year under USAID and CGIAR sponsorship. The topic was Use of Remote Sensing Technologies and GIS Databases and the resulting report indicated the following three generic categories of CG Centers' needs related to GIS:

- *datasets and remote sensing products provided by external organisations*
- *capacity building in GIS modelling and analysis*
- *networking needs, both internally between CG Centers and between Centers and other data holders*

Each of these was to be pursued in more detail in Arendal II.

### 1.2 Workshop Objectives and Structure

The primary objective of the workshop was to provide a sound basis for project planning and implementation. With this in mind and with the indicated directions emerging from the Washington meeting, the main thrusts of Arendal II were:

- *establishing understanding of the current situation i.e. revisiting relevant activities and existing capabilities in CG and UNEP/GRID Centers*
- *determining CG Centers' priority needs for data and information in the key subject matter areas and discussion of how these may best be met*

- *ensuring awareness of the communication facilities available and exploring possible mechanisms for net working of various types*
- *investigating the type and level of capacity required in Centers and how these might be put in place and operate effectively*
- *formulation of conclusions and discussion of project scope, approach, planning and resourcing*

Invitations were extended to all CG Centers, to GRID Centres and to external experts and Institutions both within and outside the UN system. A list of attendees is given in Appendix I.

### **1.3 Workshop Reporting**

The reporting of workshop proceedings is in two parts - this report plus a reference package. This report follows the lines of the workshop program (see Appendix II), giving a summary of each session. The reference package consists of written text of the presentations as prepared by speakers in advance and delivered to the workshop. A list of contents is included in Appendix III and the reference numbers used in this report (ref. #) refer to that list. Any of these documents can be obtained from GRID-Arendal on request.

## **2. OPENING AND INTRODUCTION**

### **2.1 Welcoming Remarks**

The Director of GRID-Arendal, also Chairman of the Project Steering Committee, Svein Tveitdal, opened the Workshop, welcomed participants and expressed his pleasure at the number of Centers and Institutions represented. He briefly reviewed the results of Arendal I and the recent workshop in Washington, and outlined the format and organisation of the sessions to come.

### **2.2 CGIAR Perspectives (ref. 1)**

Jack Doyle drew the workshop participants' attention to the changes which have taken

place regarding the nature and direction of the CGIAR research agenda. The changes have led CGIAR from being largely a food producer to now also focusing on conservation and sustainable management of soil, water and other natural resources. The future directions of the CGIAR and the purpose of this meeting correspond to the report from the Task Force on Sustainable Agriculture under the section entitled "Need for Better Information". The speaker concluded that the workshop should focus on the problems as defined in that document and that the meeting offered an opportunity to define ways in which information technology could assist in solving the problems of poverty, malnutrition and environmental conservation.

### **2.3 UNEP Perspectives**

Based on the expected approval of the coming Governing Council in May, Barry Henricksen presented the new directions for UNEP's revised strategy and its program for 1996 - 1997. He reviewed the history of UNEP's Earthwatch - its funding, mission, the shifts of emphasis, and finally the components comprising the "new" UNEP Division of Environment Assessment. These are:

- a) *assessment and reporting,*
- b) *data and information management,*
- c) *capacity building and servicing and*
- d) *UN system-wide Earthwatch coordination.*

UNEP is entering into a partnership with CGIAR. In 1996 UNEP will express its commitment by co-sponsoring CGIAR as a preliminary step towards a larger initiative.

### **2.4 Keynote address:**

#### **"Data needs of the food insecure" (ref. 2)**

Stein Bie highlighted the current global situation reflecting undernutrition and the relationship between health and access to food. Donor countries have reduced their funding both to national and international agricultural research. The challenge of this Arendal II meeting is to develop tools which will enable us to set a bet-

ter global research agenda which will contribute to greater food security and thus to better health and more welfare. Datasets for the food insecure must also include factors that relate to management - socio-economic data, relating to their general conditions of life and agricultural policies. The research agenda in the CGIAR has in the past only to a small extent been determined by the food insecure. The speaker emphasized the need for datasets to include the feedback we can expect from participatory rural appraisal and other similar methods, including the ability to focus on the needs of particular groups of people: the old, the young, the women. In this 50th UN anniversary year, we can look back on 20 years of development of research tools we need in this field. This is a normal lag time in agricultural research. The time is ripe. We must get datasets operational for the food insecure. Now is the time to harvest.

### **2.5 Project overview and status**

Otto Simonett presented the status of the CGIAR/UNEP project: "Use of Geographic Information Systems in Agricultural Research Management". He listed five project objectives and the suggested long-term and short-term outputs. The workplan for 1995 is in three "streams" - dataset production, management and networking, and capacity building. Conclusions and recommendations from this meeting will be used to define more fully the detailed activities to be undertaken, and to modify the workplan as necessary.

## **3. REVIEW OF CURRENT STATUS OF CG INSTITUTES AND THE GRID NETWORK**

### **3.1 CG Institutions**

Representatives of the 12 Centers participating in the Workshop each gave a presentation describing various aspects of their Center's GIS related activities. This included data holdings, software and hardware in place, staff

resources, institutional arrangements, specific projects, techniques in use, etc. The twelve speakers and Institutes were:

- Bill Bell - CIAT*
- Robert Hijmans - CIP (ref. 3)*
- Zaid Abdul-Hadi - ICARDA (ref. 4)*
- John Corbett - ICRAF (ref. 5)*
- S.M. Virmani - ICRISAT*
- Gamini Batuwitage - IIMI (ref. 6)*
- Christian Nolte - IITA (ref. 7)*
- Brian Perry - ILRI (ref. 8)*
- Mark Perry - IPGRI (ref. 9)*
- Kam Suan-Pheng - IRRI (ref. 10)*
- Peter Goldsworthy - ISNAR (ref. 11)*
- Nick van der Giesen - WARDA (ref. 12)*

### **The following issues arose during the discussion**

There was a wide variation in the level of hardware and software in place in Centers and this could present problems in sharing methodologies when levels are very different. This problem was emphasised further in looking to CGIAR working with external partners such as National agencies many of whom have only low levels of technology.

The lack of skilled human resources within Centers was identified as a common problem. Again this extended to Centers' work at national levels and the question of whether GIS related training was part of the Centers' role was raised. It was generally agreed that research needs were a priority for scarce Center resources. The suggestion was made that training could be undertaken by commercial organisations and at least one Center had had good results from such an approach.

Organisational positioning of GIS varied from a large, clearly identified Unit to being only used for a specific project in one section. If a "centralised unit" is established, there is a variety of ways in which it could operate e.g. core funding vs. project funding, total service providers vs. delivery of user tools, etc.

Several points were highlighted in relation to accessibility of datasets. For many purposes, available global-level datasets are not suitable; regional and national level resolution are required but not commonly available.

Accessing data held by National agencies was often difficult for legal and security reasons. When data was available, the format for delivery could be a problem for the "smaller" GIS operations. (The format provided by GRID was given as an example)

A specific question was raised concerning the availability to Centers of ARC/INFO software. This had been promised some time ago at a very preferential rate but needed further follow-up. The CGIAR/UNEP project might be an appropriate umbrella for this. It was further suggested that a positive approach would be to be prepared to establish a central CG distribution point.

### **3.2 GRID network**

Barry Henrickson took the lead in describing the current structure of the GRID network and the activities undertaken (ref. 13). These include data distribution, data cataloguing and referencing, data harmonisation, analytical support services and, increasingly, capacity building in GIS, RS and data management in support of UNEP's Environment Assessment Programme.

Norberto Fernandez added some further comments, particularly relating to the identification of institutional contacts in Latin America and the Caribbean.

## **4. EXISTING DATASETS AT GLOBAL, REGIONAL & NATIONAL LEVELS**

### **4.1 Structure of the Session**

This session was conducted in two parts, each organised with invited speakers first giving presentations on specific categories of data;

workshop participants then divided into three groups for discussion and each group reported the conclusions reached in a final plenary period. The following key areas were suggested as topics for the working groups:

- *priority data needs (strategic and operational);*
- *what is used now; shortcomings;*
- *what is missing; possible sources and possible methodologies.*

### **4.2 Expert Presentations**

Seven separate data categories were addressed by the invited speakers.

#### ***Cartographic data (ref. 14)***

Sindre Langaas reviewed three readily available cartographic databases - Digital Chart of the World, World Vector Shoreline and the 30 Arc-second Digital Elevation Model - suitable for strategic needs (1:1 million scale). He outlined their sources, discussed their strengths and weaknesses and outlined future developments likely in this area. The speaker included in his presentation three overheads addressing data quality issues.

#### ***Climate data (ref. 15)***

Trevor Booth put emphasis on the available long-term climatic normals and historic climate data as being of prime importance in agricultural research, and discussed how they might be used, describing applicable analysis tools. In his opinion, the use of high quality climatic data was needed to meet CGIAR requirements and this needed collaborative effort. He gave four recommendations for areas of work to be encouraged in this regard: the development of a moderate resolution DEM, improved interpolation methods, better documentation, and easily available "low-end" software.

#### ***Soils data (ref. 16)***

Vincent van Engelen began his presentation by commenting on the nature of what is commonly found under the title of "digital soils data-

base". These are usually digitised soil maps and do not make a comprehensive information system. He went on to outline the datasets available at the global and regional levels and described current developments, particularly in FAO (raster version of SMW in preparation) and ISRIC (linking profile data to global database). At a national level, several larger scale (1:100,000 to 1:1,000,000) SOTER-type databases are under development but it is not clear whether, and how, such data will be made freely available.

#### ***Population data (refs. 17, 18 & 19)***

Uwe Deichmann put forward a definition of the spatial and non-spatial components of a dataset to meet (some) potential uses in agricultural research, and went on to outline available datasets in that context. He suggested the following actions to facilitate the development and maintenance of population databases:

- development of a guideline database template
- investigation of options to convert from administrative unit based data to raster surfaces
- compilation of existing national level datasets to form consistent regional coverages

Ron Witt reviewed GRID's experience (with that of other groups) in assembling datasets relating to human population. Currently he is involved in planning to compile a global population density dataset and outlined three possible levels of end-product. The first is a minimum case, giving a snapshot of population at a given point in time; the second level would be two such snapshots at a distinct interval apart; and the third possibility moves to a much larger endeavour encompassing multiple demographic variables and their temporal nature. More definitive statements of user needs are required to define the required product.

Robert Fox discussed the availability of population-related data in Latin America, outlining his experiences in the area. His recommendation concerning compilation of such datasets

was to start "bottom-up" with national institutions, acquire existing data from multiple sources, and analyse and process them to make an internally consistent dataset. Bob also talked about communication of the population information, illustrating his comments with the type of graphics he felt were necessary and effective.

#### ***Crop Distribution data (ref. 20)***

Terry Taylor described the activities undertaken in the Remote Sensing Program of the Foreign Agricultural Service mission of the USDA. This involves interpretation and analysis of satellite data to give, for instance, production estimates of specific crops in given areas. Data products from the program are potentially available and it was evident that this could be a significant source of data of interest to CG Centers.

#### ***Land Use data (ref. 21)***

Ashbindu Singh presented a review of international initiatives in global land cover mapping and monitoring, and also a variety of satellites with details of their time period, resolution, etc. He described the datasets available now and in the near future from GRID-Sioux Falls, including a land cover database for the American continents.

#### ***Biodiversity data (ref. 22)***

Richard Luxmoore described the activities undertaken by WCMC in compiling and distributing datasets, pointing out some of the problems of establishing standards, ensuring accurate documentation, maintaining datasets, etc. He described available datasets which may be relevant to Centers' needs and which are, in principle freely available subject to copyright restrictions or any limitations imposed by the source. The principal GIS software used by WCMC is ARC/INFO and the Centre has developed an interface to manage and access data held. This, with the data, is known as the Biodiversity Map Library. Richard proposed

that future collaboration with the CGIAR could include provision of BML to any Center which has the facilities which the package needs.

#### **4.3 Findings of the Working Groups**

The unanimous conclusion reached by all groups was that there is a very large amount of required data currently in existence and available in varying degrees. A catalogue (meta-database) is needed, starting with those datasets immediately available. Specific follow-up is needed in some areas to investigate and arrange availability and the project (bringing together UNEP and the CGIAR) provides the mechanism for a formal, coordinated approach to potential data sources. Centre priorities need to be clearly defined with respect to filling data gaps.

Specific conclusions related to the different data categories were as follows:

##### ***Cartographic***

- these data are "essential", "a key element"
- useful at (available) global resolution; needed at other (larger) scales
- investigate Defence Mapping Agency as a data source

##### ***Climate***

- the need for daily weather data was endorsed
- large quantities of data available; collaboration with centres of expertise required to ensure the data are used to full advantage

##### ***Soils***

- limited data available
- investment in the infrastructure to support data collection is declining (this applies to climate data also)
- consideration should be given to support data collection by national institutions and to advance SOTER program
- there is a need for more than "surface" information; data on the regolith is also required

##### ***Population***

- "critical", "top priority"
- long-term needs go beyond population to other socio-economic parameters
- evolving area with considerable development on-going
- ensure Center needs are given priority in the GRID project

##### ***Land use***

- harmonisation of classification systems needed (FAO and UNEP are working on tables of equivalences; WCMC has experience in this for specific project requirements)
- high resolution satellite data required to effectively monitor change

##### ***Crop distribution***

- follow-up required with USDA especially if data for developing countries might be available

##### ***Biodiversity***

- data needed to fulfil the CGIAR's response to Agenda 21
- possibility of Centers' use of BML to be investigated

In addition it was pointed out that hydrologic data was another category of interest and the availability of datasets relating to discharge rates, groundwater, etc. should be investigated.

## **5. ELECTRONIC HIGHWAY**

### **5.1 Network Development**

Arnt Brox outlined the current plans in UNEP for implementation of a new computer and telecommunications infrastructure, UNEPnet. An important part of this is MERCURE, a satellite based network to provide for communications, including transmission of environmental information, between distributed UNEP regional offices and other data Centres. The network will be a meshed/star topology with several (A-class) regional hubs, linking to low-cost (B-class) stations. Internet standards have

been adopted. In addition to providing extensive capability (user services) for UNEP offices, the implementation plans include provision for a user interface which will allow access from governments, NGOs, funding organisations, etc. There are security provisions in the network design, allowing for secure traffic between UNEPnet centres as well as to the Internet.

It was noted that there are organisational implications and risk involved as the implementation will necessitate and stimulate change within UNEP.

In the short term (by the end of 1995), with the establishment of a station in Nairobi, Geneva and possibly Arendal, there is to be improved e-mail and fax handling, trial operation of a document management system, electronic conferencing and establishment of UNEP Web services. UNEPnet is expected to be fully operational by the end of 1997.

Paul O'Nolan outlined the current plans in the CGIAR for an Integrated Voice and Data Network (IVDN), aimed to give global connectivity to all Centers. The network will provide international direct dialing, audio conferencing, video conferencing (to some extent), electronic mail, Internet services and extensive reporting facilities. Financial justification has shown that the total cost will be in line with current voice communication costs.

Implementation will involve the establishment of a Network Operations Centre, NOC, in California, to which each Centre will be linked. The configuration in the Centers will be dependent upon factors such as the legal and regulatory environment, availability of circuits, and site size. As with UNEPnet, a security firewall is included in the network plans.

The IVDN will provide the required infrastructure, not only for internal coordination among

Centers, but also for provision of a global information service for international agricultural research.

Implementation of the IVDN will begin in July 1995 with an initial group of four Centers and the network will be extended incrementally to all Centers over the following 18 months. It is expected to be fully operational by the end of 1996.

## **5.2 Demonstrations of the World Wide Web**

Two organisations represented at the Workshop - the Consortium for International Earth Science Information Network (CIESIN) and the World Conservation Monitoring Centre (WCMC) - had prepared to give demonstrations of accessing data and information through World Wide Web (WWW). CIESIN is an NGO which is devoted to the challenge of "providing access to and enhancing the use of information world-wide, advancing understanding of human interactions in the environment and serving the needs of science and public and private decision making". A special focus is on socio-economic data and linking those with natural science information. The number of users accessing CIESIN through WWW is growing rapidly. WCMC is jointly funded by IUCN, UNEP and WWF and, as well as carrying out research and analysis activities, acts as a clearing house for their conservation related data. As in the case of CIESIN, they have increasing numbers of users accessing information through Internet.

Susan Schram of CIESIN was able to connect to her home organisation and ably demonstrated queries and showed responses. Due to technical problems on the Internet, the connection could not be made to WCMC. This made the point that these types of communication problem are not uncommon and that some patience and persistence may be required when accessing information sources, especially from developing countries.

## **6. CAPACITY BUILDING IN GIS & COMMUNICATION TECHNOLOGIES**

### **6.1 Presentations**

Bill Bell's presentation on requirements for training had to be cancelled due to illness.

Otto Simonett gave an overview of the ongoing GRID-Arendal project on GIS capacity building in Central and Eastern Europe, describing the methodology as it might apply to the CGIAR/UNEP project (ref. 23). The overall goal of the UNEP programme is to produce a global SoE report by the year 2002 based on information from the countries themselves. The approach has been to strengthen the bonds to, and the capacity of, the national ministries of environment, although efforts are made to include other relevant agencies equally. The role of UNEP/ENRIN is primarily one of coordinating and assisting. This has involved initial contacts, conducting assessments of environmental information needs and capacities, organising regional workshops and providing terms of reference for detailed needs assessments, feasibility studies and development of proposals. These are then carried out by experts in the countries and, if proposals are funded, a 3-5 year implementation is expected. It was noted that there is considerable donor interest, but that very specific targets are required to successfully attract funds.

In the discussion immediately following the presentation, it was agreed that there were some similarities with the CGIAR/UNEP project and that the general framework applies. Short term outputs relating to Centers should include some statement of requirements to be brought together to build proposals on a coordinated system-wide basis.

### **6.2 Findings of the Working Groups**

Following the single presentation, participants again moved into working groups. The groups were tasked with discussing the Centers'

capacity building needs and recommending the type of project activities which should be undertaken to meet those needs. The following summarises the conclusions presented.

Training is needed at all levels, from building management awareness to hands-on usage of specific technology. A first step would be to define these requirements in detail. However, emphasis should be given to awareness building, application based training (targeted to specific CG demands), and building expertise in Centers currently with "smaller" facilities. It was also stressed that any training activities should be undertaken in Centers themselves, not at external locations, as this would enable participation of more Centre staff. That approach may also provide opportunity for bringing staff of several Centers together, promoting interaction.

On the whole, in terms of provision of facilities, it seemed that this was the responsibility of Centers themselves. However the project should look to using a coordinated approach to obtain favourable rates, beginning with follow-up of the ARC/INFO license offer (see 3.1). The project should also ensure that analysis tools generally applicable are made available in the same way as commonly required datasets.

The idea of an "institutional model" was explored. Should there be a single Center with extensive GIS facilities? Several regional lead Centers? Each Center provided with a GIS Unit? No definite conclusion was reached and it was felt that the solution needed to be demand driven, from identification of problems, data requirements and methodologies within each Center. However it was suggested that there is a need for a "critical mass" in any Center and this is suggested to be around three people.

GRID-Arendal, as the project implementing agency, should coordinate the production of newsletters, information sheets, etc. which would strengthen and encourage links between all collaborating agencies, and also publicise the spectrum of applications in which the technology is applied across the CG system.

The importance of establishing and strengthening relations at a national level was stressed. All possible mechanisms should be used to ensure more effective exchange of information and technology.

The need for a metadatabase was reiterated (see 4.3).

## 7. NEW ISSUES

### 7.1 CGIAR's System-wide Information Network for Genetic Resources (SINGER)

Mark Perry introduced the CGIAR's System-wide Information Network for Genetic Resources, SINGER (ref. 24). SINGER is planned to operate in the framework of the CG System-Wide Genetic Resources Programme (SGRP); will enhance the genetic resources work of the CGIAR; and provide a tool that will allow collaborators greater access to the collections and related information. It is a complex endeavour involving integrating information management activities amongst multiple institutions in different geographic locations (11 Centers in 11 different countries). Each of the Centers has, over the years, developed their own information system to manage their germplasm collection. These use differing hardware and software, and the data elements differ to varying degrees. Resolution of differences whilst preserving existing Center genetic resources data management autonomy will be a challenge.

The spatial elements within SINGER are expected to include data on germplasm origin -

the site at which the germplasm was collected. This is commonly held as latitude and longitude at the degree/minute level.

Although the speaker began by expressing some hesitation concerning the direct relevance of his presentation to the workshop objectives, it was most positively agreed that many aspects were of great interest and very relevant to the UNEP/CGIAR project. The "system-wide" approach is similar and although the emphasis in other sessions might have been on spatial elements, the handling of non-spatial descriptors and harmonisation of data items is recognised as also being of prime importance.

In discussion, the importance of the information accompanying genetic resource material was stressed. It was also suggested that in cases where the georeferencing was of low quality (as had been mentioned by the speaker), there were some possible solutions for improvement.

### 7.2 Linking spatial data with models

Paul Dyke gave a presentation on the current state-of-the-art linkages between spatial data and complementary models of various kinds which may be used at all levels of decision making in the CGIAR context (ref. 25). The models can be dynamic simulation models, statistical models, socio-economic models, etc. The presentation emphasised the way in which these were linked to GIS, i.e. the latter provides input data to the model and is used as a tool for visualisation, but the model itself is not an integrated part of the GIS.

Several points were put forward for consideration. One was that metadata is becoming increasingly important, not just as an index for existing data, but as data are more and more used for analyses other than those for which they were originally collected. Another was that datasets are becoming larger and larger, and with this increasing size, there are mounting problems of transfer and handling. In rela-

tion to this, Paul put forward the proposal that the watershed unit be adopted as a common basic building block for assembly and distribution of datasets. In an agricultural-environmental-economic context, such a geographic unit is more relevant than soil-units or administrative units.

During the following discussion the idea of using watersheds, in a nested hierarchical structure, was supported by several speakers as a suitable unit for CGIAR applications, particularly given the evolving eco-regional approach to research.

### 7.3 Information needs in decision support for dairy production in Africa

Crawford Revie began his presentation (ref. 26) by pointing out that traditional database management systems, DBMS, and GIS provide capabilities to store, manipulate and analyse data which is essentially structured, and that there is considerable need to be able to better deal with less structured data such as descriptive information, fuzzy values, probabilistic estimates etc. A Hybrid Information System, HIS, was defined as an integrated package of software components which would meet this requirement. The suggested components are databases, DBMS, GIS, expert systems, mathematical models and multi-media systems. The University of Strathclyde, in collaboration with ILRI, has developed an experimental HIS for analysis of animal health issues relating to East Coast fever and trypanosomiasis.

It was acknowledged that the integration of the different components may involve considerable difficulties, particularly for example in combining rule-based expert systems with mathematical models. It was also stressed that database quality documentation was of particular importance as the quality of many answers provided by an HIS lies in the reliability of the

database containing both well-structured GIS data and fuzzy knowledge with fuzzy geographic representation.

In the discussion following, it was suggested that GIS had been oversold in the past and that there was now more realism concerning its capabilities. The last two presentations had shown that, to meet the future needs of Centers, GIS is one of several tools to be used. The approach of integrating the required components, such as in the HIS described would seem to be the path to follow in order to move towards true decision support systems.

## 8. CONCLUSIONS, PROJECT PLANNING & IMPLEMENTATION

### 8.1 Conceptual Overview

In response to a request from the meeting organisers, Henry Nix presented his perceptions of the meeting and project. He began by putting forward a problem-solving framework (Figure 1) which included databases (a primary focus of this meeting) but in the total context of development of applications to solve problems.

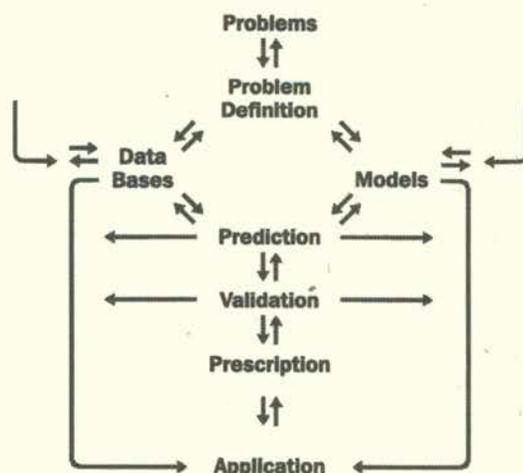


Figure 1

The following points were made in relation to the figure:

- the problem(s) must be clearly defined;
- the models often cannot be used because of lack of data;
- the model with the database enables prediction;
- the prediction must be validated;
- a prescription can then be developed and applied.

In relation to project planning and implementation, the framework would be useful in considering the roles of the various players - the CG Centers, UNEP-GRID, National Institutions and other Agencies - and the ways in which GIS technology could be used. Also Dr. Nix, with acknowledgement to SINGER, suggested the project make SINGIS, System-wide Network for GIS, an identifiable target.

Dr. Nix went on to summarise issues which had arisen during the course of the preceding sessions.

#### ***The lack of primary attribute data***

This had been extensively discussed.

#### ***The use of interpolation and extrapolation techniques***

The success of these has been so big that there is a danger that the importance of source data has been downgraded.

#### ***Institutional disfunction***

Organisations are essentially vertically structured (discipline-oriented) and problem solving needs to cut horizontally.

#### ***Housekeeping problems***

These include issues such as standards, data exchange, custodial responsibilities.

#### ***Capacity building***

Again, this had been extensively discussed.

#### ***Communication***

As presented in session 5, the electronic network developments will give new opportunities in the near future.

Finally Dr. Nix linked with some of the points made in session 7, and suggested that one of the challenges of the future was to move from what he described as sequential, or spaghetti, use of models to a "side-by-side" approach in which integration of technology allowed tools and data to be used as best suited the problem.

#### **8.2 Recommendations for CGIAR/UNEP Project Planning**

Jack Doyle summarised the conclusions and recommendations which had emerged from the preceding plenary sessions. These should act as guidelines for the detailed project planning to be undertaken in the near future.

1. A catalogue of available datasets (along the lines of the GRID metadatabase) should be built, beginning with current holdings in CG and GRID Centers.
2. With respect to data needs, there is follow-up required with identified data sources to make existing required datasets available. In areas where there are deficiencies, data gaps or the required datasets do not exist, the project may fund compilation activities. These should be driven by Center priorities and the Steering Committee is open to suggestions in this regard, especially as participants have an opportunity to reflect on this meeting and discuss needs with their colleagues. If possible, proposals should reflect System-wide needs, and results should be feasible in a relatively short time-frame.
3. With respect to capacity building, requirements have been broadly specified and these should be defined in greater detail. A project

strategy and program to meet those needs can then be developed. The recommendations from working groups (see 6.2) concerning an application-oriented approach, in Centers, should be kept in mind.

4. Several suggestions have been made in relation to how the group of CG Centers, GRID Centres and external agencies function together. These relate to Otto Simonett's "Management and Networking" stream in his project planning proposal. (Networking is meant in the general sense of communication, whether by electronic means or otherwise.) In this regard, the recommendations concerning issuance of a newsletter, a pamphlet to raise management awareness of the project, etc., should be acted upon.

There was general agreement that the summary accurately reflected the directions in which participants would like to see the project move.

There was additional discussion on project funding. It is apparent that the current level of project funding will permit a small step forward. Project planning must take into account the requirement to first produce results which can be used to demonstrate the usefulness and potential of work in this area and second, develop proposals which will attract future funding from donors. Such proposals should look towards the goal of integrating GIS and other information technologies into decision support systems which can play a role in meeting CGIAR objectives.

# Appendix I

## WORKSHOP ATTENDEES

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## **Appendix II**

### **WORKSHOP PROGRAM**

#### **MONDAY, MAY 8**

##### **Arrival**

19.30 Welcome reception and informal dinner at Tyholmen Hotel

#### **TUESDAY, MAY 9**

##### **08.00 Session 1 - Opening and Introduction**

Chair: Peter Jones, CIAT

Rapporteur: Karen Folgen, GRID-Arendal

08.00 Welcoming remarks

Svein Tveitdal, GRID-Arendal

08.15 CGIAR perspectives

Jack Doyle, ESDAR, Washington D.C.

08.30 UNEP perspectives

Barry Henricksen, UNEP, Nairobi

08.45 Keynote address:

Data needs of the food insecure

Stein Bie, FAO, Rome

09.15 Project overview and status

Otto Simonett, GRID-Arendal

09.30 Coffee Break

##### **10.00 Session 2 - Review of Current Status of CG Institutions and the GRID Network**

Chair: Svein Tveitdal, GRID-Arendal

Rapporteur: Claudia Heberlein, GRID-Arendal

- 10.00 CIAT, William Bell
- 10.15 CIP, Robert Hijmans
- 10.30 ICARDA, Zaid Abdul-Hadi
- 11.00 ICRAF, John Corbett
- 11.15 ICRISAT, S.M. Virimani
- 11.30 IIMI, Gamini Batuwitage
- 11.45 IITA, C. Nolte
- 12.00 ILRI, Brian Perry
- 12.30 Lunch
- 13.30 IPGRI, Mark Perry
- 13.45 IRRI, Kam Suan-Pheng
- 14.00 ISNAR, Peter Goldsworthy
- 14.15 WARDA, Nick Van de Giesen
- 14.30 Presentation of the GRID-Network, Barry Henricksen
- 15.00 Coffee Break
- 15.30 Session 3 - Expert Presentations on Existing Data Sets at Global, Regional and National Levels in Priority Areas:**  
 Chair: Henry Nix, CRES, ANU, Canberra, Australia  
 Rapporteur: Gwynneth Martin, Project Advisor
- 15.30 Cartographical data and data quality issues  
 Sindre Langaas, GRID-Arendal
- 15.50 Climate data  
 Trevor Booth, CSIRO, Australia
- 16.10 Soils data  
 Vincent Van Engelen, ISRIC, Netherlands

- 16.30 Working groups  
(Workshop to be divided in groups to define center requirements/  
priorities and draft follow up recommendations)
- 17.30 Plenary presentation and discussion
- 18.30 Transport from hotel to the home of Svein Tveitdal for an informal dinner
- 19.00 Dinner

### **WEDNESDAY, MAY 10**

#### **08.00 Session 3 - Expert Presentations Continue**

Chair: Henry Nix, CRES, ANU, Canberra, Australia  
Rapporteur: Gwynneth Martin, Project Advisor, Canada

- 08.00 Population Data  
Uwe Deichman, NCGIA, USA  
Ron Witt, GRID-Geneva  
Robert Fox, Consultant, USA
- 08.45 Land use (remote sensing) data  
Asbindhu Singh, GRID Sioux Falls, USA
- 09.05 Crop distribution  
Terry W. Taylor, USDA/FAS, USA
- 09.25 Biodiversity data  
Richard Luxmoore, WCMC, UK
- 09.45 Coffee Break (Travel agent present)
- 10.15 Workshop to be divided into groups to define center requirements/  
priorities and draft follow-up recommendations
- 11.30 Plenary presentation and discussion
- 12.30 Lunch
- 13.15 Transport from hotel to GRID-Arendal

**13.30 Session 4 - The Electronic Highway and its Impact on CG/GRID Strategies**

Venue: GRID-Arendal  
Chair: Svein Tveitdal, GRID-Arendal  
Rapporteur: Barry Henricksen, GRID-PAC

**Presentations/Demonstrations: UNEP, CGIAR, CIESIN, WCMC**

- 13.30 UNEP  
Christopher Smith, GRID-Arendal
- 13.45 CGIAR  
Paul O'Nolan, CGIAR Task Force
- 14.15 CIESIN  
Susan Schram, CIESIN
- 14.30 WCMC  
Richard Luxmoore, WCMC
- 14.45 Coffee Break
- 15.00 Plenary Discussion to define center requirements/priorities for communication and networking and draft follow up recommendations
- 16.00 Transport from GRID-Arendal to hotel
- 17.00 Boat Trip w/shrimps and "spekemat"

**THURSDAY, MAY 11**

**08.00 Session 5 - Capacity Building in GIS and Communication Technologies**

Chair: Sindre Langaas, GRID-Arendal  
Rapporteur: Claudia Heberlein, GRID-Arendal

- 08.00 Requirements for training in analyzing and modelling techniques and telecommunication technologies  
Bill Bell, CIAT, Colombia
- 08.30 The UNEP/ENRIN capacity building approach in Central and Eastern Europe  
Otto Simonett, GRID-Arendal

09.00 Group work to define center needs/requirements and draft recommendations

10.00 Coffee Break

10.30 Plenary discussion

**11.00 Session 6 - New Issues**

Chair: Otto Simonett, GRID-Arendal

Rapporteur: Sindre Langaas, GRID-Arendal

11.00 CGIAR's System-Wide Information Network for Genetic Resources -  
Present Status, Immediate Plans and Future Integration  
Mark Perry, IPGRI, Italy

11.40 Linkage of spatial data with models  
Paul Dyke, Blackland Research Center, Texas, USA

12.20 Information Needs in Decision Support for Dairy Production in Africa  
George Gettinby, University of Strathclyde, Glasgow, UK

13.00 Lunch

**14.00 Session 7 - Conclusions, Project Planning and Implementation**

Chair: Jack Doyle, ESDAR

Rapporteur: Otto Simonett, GRID-Arendal

14.00 Conclusions: Data requirements, capacity building, network development

15.00 Coffee Break

15.30 Recommendations on future activities

16.30 Closing Remarks

19.00 Dinner at the Tyholmen Hotel

## **APPENDIX III**

### **REFERENCE PACKAGE**

1. CGIAR Perspectives, Jack Doyle, ESDAR
2. Data Needs of the Food Insecure, Stein Bie, FAO
3. GIS Use at the International Potato Center (CIP), Robert Hijmans
4. Status of GIS Activities in ICARDA, Zaid Abdul-Hadi
5. ICRAF, John Corbett
6. Data, Capacity Building and Networking Needs for the Use of GIS in Agricultural Research: IIMI, Gamini Batuwitage
7. IITA, C. Nolte
8. GIS at the International Livestock Research Institute (ILRI), Brian Perry
9. Review of Current Status of CGIAR Institutions and the GRID Network: IPGRI, Mark Perry
10. GIS Related Activities at IRRI: Current Focus, Priorities and Needs, Kam Suan-Pheng
11. Notes for UNEP/GRID Meeting Arendal 1995: ISNAR, Peter Goldsworthy
12. WARDA, Nick Van de Giesen
13. The Environment Assessment Programme of UNEP, Barry Henricksen
14. Cartographical Data and Data Quality Issues, Sindre Langaas, GRID-Arendal
15. Climate Databases for Use in Agricultural Management and Research, Trevor Booth, CSIRO & Peter Jones, CIAT
16. Soils Data, Vincent Van Engelen, ISRIC

17. Population Data, Uwe Deichman, NCGIA
18. Concept Paper on a GIS Database for Population-related Studies:  
the Need for a Global Human Population Density Dataset, Ron Witt & Hy Dao, GRID-Geneva
19. Notes on Assembling a Population Distribution Database for African,  
Asian and Latin American Countries, Robert Fox, Consultant
20. Land Use (Remote Sensing) Data, Asbindhu Singh, GRID Sioux Falls
21. The FAS Remote Sensing Program, Terry W. Taylor, USDA/FAS
22. Georeferenced Data at the World Conservation Monitoring Centre, Richard Luxmoore, WCMC
23. The UNEP/ENRIN Capacity Building Approach in Central and Eastern Europe,  
Otto Simonett, GRID-Arendal
24. CGIAR's System-Wide Information Network for Genetic Resources - Present Status,  
Immediate Plans and Future Integration, Mark Perry, IPGRI
25. Linkage of Spatial Data with Models, Paul Dyke, Blackland Research Center
26. Information Needs in Decision Support for Dairy Production in Africa, George Gettinby et al,  
University of Strathclyde

## Arendal II: CGIAR Participation



	Arendal I, 1992	Arendal II, 1993		
CIAT			Tropical Agriculture	Colombia
CIFOR			Forestry	Indonesia
CIMMYT			Maize	Mexico
CIP			Potato	Peru
ICARDA			Dry Areas	Syria
ICLARM			Aquatic Resources	Philippines
ICRAF			Agroforestry	Kenya
ICRISAT			Semi-Arid Tropics	India
IFPRI			Food Policy	USA
IIMI			Irrigation	Sri Lanka
IITA			Tropical Agriculture	Nigeria
ILRI			Livestock	Kenya
IPGRI			Plant Genetic Resources	Italy
IRRI			Rice	Philippines
ISNAR			Service	The Netherlands
WARDA			Rice	Côte d'Ivoire

### GIS AND AGRICULTURAL RESEARCH

With the increasing importance of environmental concerns, the role of GIS in agricultural research also has become more important. Geographic analysis can provide a considerable input to research where the spatial dimension is relevant.

Applications range from service functions such as collecting and providing geo-referenced data to modelling of crop yields, identification of key areas of population pressure, biodiversity conservation and complicated impact assessment analyses.

The main objective of the UNEP/CGIAR project 'Use of Geographic Information Systems in Agricultural Research Management' is to establish long-term cooperative links between UNEP and the CGIAR to effectively integrate GIS into agricultural research activities and to generate priority and natural resource and socio-economic datasets.