Applying ICT and KM for Excellence in Science

The Consortium for Spatial Information:

Thinking spatially, acting globally - for a sustainable future

Facilitate collaboration and capacity building for geospatial data sharing, dissemination, and analysis, within the CGIAR, with national partners, and the global research and development community.

Final Work Plan

24 March, 2004

Submitted on behalf of the Consortium for Spatial Information
by:

Dr. Robert Zomer
Coordinator - Consortium for Spatial Information (CSI)
International Water Management Institute (IWMI)
PO Box 2075, Colombo, Sri Lanka
Email: r.zomer@cgiar.org

Abstract

Centers within the CGIAR work actively on issues related to sustainable development, natural resource management, environmental conservation and poverty alleviation. The spatial components of these research fields have grown exponentially in the last few years. Similarly, there has been a growing recognition of the importance of spatial information in CGIAR research and development activities. However, much CGIAR-generated geo-spatial data remains "hidden", that is inaccessible, or unavailable to the global research and development communities, NARES, other local partners, as well as to other CGIAR scientists. As a result, there has been an increasing demand for each of the CGIAR centers to work actively on data dissemination and information inter-operability.

The Consortium for Spatial Information (CSI) was formed to provide a network for CGIAR scientists to address these issues. We propose to use the existing CSI network to address specific objectives which will facilitate increased networking and collaboration, develop infrastructure for geo-spatial data sharing, common spatial data management, and provide a platform for the wide dissemination of CGIAR geo-spatial science, based on international standards and catalog initiatives. Activities and outputs of this proposal focus on three key ICT/KM issues:

1.) Strengthening of scientific and problem-focused dialogue and networking

Strengthen CSI network; improve ICT/KM mechanisms for information sharing, dialogue, and inter-center collaboration; provide training opportunities to CG scientists to improve and upgrade geospatial skills; and enable CG data sharing activities;

2.) Develop the CGIAR-CSI GeoSpatial WebPortal and Data Sharing Platform

Support to Center-based efforts to bring geospatial data into conformity with global guidelines, allowing for integration both between Centers and national partners, adding value to existing resources, and facilitating comparative analysis and use by the global geospatial data user community. Activities include development of a multi-center "GeoSpatial DataFinder"; development of the CSI web site as a central access point for all CGIAR geospatial knowledge, data, and tools; implementation of global metadata standards, multi-center and global integration of CG spatial data; wide dissemination of CGIAR global public goods.

3.) Provide and disseminate CGIAR–developed GeoSpatial Tools

Develop, share, and provide a platform to disseminate specialized knowledge generation and management tools for the GeoSpatial Data Users Community

The target audience includes scientists of the CGIAR, and a diverse set of stakeholders at local, national and international levels (NARs and NARES, government analysts, conservation and development NGOs, producer organizations, researchers). The goal of this project is to establish the CSI as a premier platform for the global sharing and dissemination of geo-spatial knowledge and information, specifically targeted to facilitate sustainable development in developing countries.

Project coordinator	Dr. Robert Zomer
Lead Administrative Center	International Water Management Institute (IWMI)
Planned Duration of Project	Three Years (April 1, 2004 – March 31, 2007)

Work Plan and Deliverables

Activity 1. Facilitate scientific and problem-focused dialogue among the CSI - GeoSpatial Community of Practice, and Promote Integration with the larger Global Community of GeoSpatial Data Users and Practitioners:

1.1 Coordination of the Consortium for Spatial Information (CSI) and Annual Meetings

In order to facilitate scientists and researchers, both within, and related to, the CGIAR to share knowledge, data and to provide a basis for inter-center collaborations, CSI activities will be coordinated and Annual Meetings held.

Timeline: Continuing through the duration of the project (however, funds are only sufficient to plan for year one and two).

1.2 Specialized Training Workshops for Data Providers and Users within the CGIAR

Two specialized Training Workshops relevant to the GeoSpatial Data User CoP will be held. The first workshop will be intended to prepare and coordinate the Metadata Inventory Activity. A second workshop will be held in conjunction with the second annual meeting.

Timeline: Year One and Two

Activity 2. Develop the CGIAR-CSI GeoSpatial Web Portal and Data Sharing Platform

2.1 Development of the CGIAR-CSI Geo-Spatial Web Portal (GeoPortal)

A CGIAR-CSI Geo-Spatial Web Portal will be developed and hosted by the CSI, with the purpose of providing a central access point and primary web presence for CGIAR developed geospatial data, analysis and tools.

Timeline: This will be on-line and functional early in Year One, but will be a continuing activity for the duration of the project

2.2 Multi-Center Map Server Capability Based on International OpenGIS Standards

This capacity allows geo-spatial data, physically housed at various CG Centers, to display and be used in the creation of on-line maps. Data from more than one center can be displayed in the same map to produce custom data products on-line by users both within the CG, and in the larger international research and development community. Additionally, by adopting OpenGIS standards, data from an enormous and growing number of sources can be easily incorporated by individual users into this facility, allowing CG data to be used with other existing datasets. Likewise, CG produced spatial products will also then be available for use with other data sources, creating a flexible and value-added Global Public Good widely accessible and easily used by a wide target audience of CG and other global GeoSpatial Data Users.

Timeline: Year Two and Three

2.3 Multi-Center Metadata Search Capability

This will provide a search capability to explore metadata records for CGIAR-held and developed geospatial data, by both users at other CG centers and the global research and

development communities. The meta-data inventory needed to provide this capability is described in Activity 2.6 below.

Timeline: Testing will start in Year One, but full implementation depends upon completion of Activity 2.6. Activity will continue through Year Two and Three.

2.4 Geo-Spatial Data Sharing Platform

The GeoPortal Data Sharing Platform will provide access to datasets developed and produced by all of the CG-Centers, either by housing them physically, or allowing access to them through hyper-links existing center-based data-sharing web sites. The data sharing platform will be integrated with the MapServer so that users can explore available data before downloading. An inter-center CGIAR Geospatial Data Sharing Policy will be produced as part of this effort, as a follow up to previous CSI IPR activities.

Timeline: Testing will start in Year One, but full implementation depends upon completion of Activity 2.2 and 2.6. Activity will continue through Year Two and Three.

2.5 GeoSpatial Toolkit

Building upon previous and existing CG Center efforts to develop and share an array of analytical, modeling and geospatial data handling tools and utilities, the GeoPortal Web Site will provide a central site to access these in the form of a GeoSpatial Toolkit. Easy on-line access, with full description and quick download of the components of the Toolkit, with documentation, will be provided on the site. Additionally, several tools within the Toolkit will be “web-enabled”, making them available for use on the web without actually downloading the tool.

Timeline: Year One.

2.6 Inter-Center Metadata Inventory

The project will facilitate and encourage the development of a full set of metadata records for geospatial data at each of the fifteen CGIAR Centers.

Timeline: Year One.

2.7 Multi-Center On-Line Analytic Capability for MapServer Function

A multi-center analytic capability will be incorporated into the on-line MapServer. This capability will be based upon a distributed database architecture and central map server approach. A selected set of geospatial datasets will be assembled and made available to demonstrate advanced ICT/KM spatial analysis capabilities. Specifically, datasets physically-housed in different centers can be displayed and joined within a Map Server application. Within this framework, a array of analytic tools will allow users to perform specific set analyses, or user programmed modeling and query functions, upon a “virtual data stack” or a series data layers (coverages) which are virtually assembled within the multi-centere MapServer framework.

Timeline: Year Two and Three

Coordination, Development, Implementation, and Dissemination of GeoSpatial Toolkit

3.1 Development and Dissemination of a GeoSpatial Toolkit of Specialized Geo-Spatial Tools Relevant to the Analysis of Sustainable Development Issues

Seven geospatial tools will be integrated into a GeoSpatial Toolkit, specifically targeted to address issues relevant to sustainable development issues. These tools will be made freely available on-line on the CSI GeoPortal as the GeoSpatial Toolkit. IWMI will take the lead in coordinating the development and integration of these tools into a coherent and well-described GeoSpatial Toolkit.

Timeline: Year One

3.2 User-Friendly and Web-Enabled Implementations of CG GeoSpatial Tools

On-line, user-friendly implementations of appropriate components of the GeoSpatial Toolkit will extend the toolkit for online use through the CSI GeoSpatial Web Portal.

Timeline: Year One

3.3 List of GeoSpatial Tools included within the GeoSpatial Toolkit

PODIUM – (IWMI):

MPdb / **DREAM** – (IFPRI)

CLIMAP / **CLIMCHART** – (ICARDA)

RSDA / **Land Use Evaluation Tool and Raster GIS Toolbox** (IRRI)

Land Systems Analysis Tool for Tropical Lowlands (CIAT)

Habitat Mapper (IPGRI)

MaizeFinder (CIMMYT)

Appendix 1: **List of CSI Member Centers, Center Representatives, and Associate Members**

IWMI	Robert Zomer	r.zomer@cgiar.org (Coordinator)
CIAT	Glenn Hyman	g.hyman@cgiar.org
CIFOR	Atie Puntodewo	a.puntodewo@cgiar.org
CIMMYT	Dave Hodson	d.hodson@cgiar.org
IRRI	Suan Pheng Kam	s.kam@cgiar.org
IITA	Christopher Legg	c.legg@cgiar.org
ICRISAT	Pierre Sibiry Traore	p.s.traore@icrisatml.org
IFPRI	Stan Wood	s.wood@cgiar.org
ICARDA	Eddy De Pauw	e.depauw@cgiar.org;
IPGRI	Andrew Jarvis	a.jarvis@cgiar.org
ILRI	Russ Kruska	r.kruska@cgiar.org
WARDA	Guy Manners	g.manners@cgiar.org
ICLARM	Marc Noordeloos	m.noordeloos@cgiar.org
CIP	Reinhard Simon	r.simon@cgiar.org
ICRAF	Horst Weyerhauser	horst@chmai.loxinfo.co.th

USGS* United States Geological Survey – Eros Data Center is a important CSI partner. It has hosted the last 2002 Annual Meeting and Workshop. Additionally, USGS has tentatively offered to physically host the CSI Web Server and GeoPortal, and provide support to its on-going maintenance and up-keep.

UNEP – GRID** The United Nations Environment Program has been an active partner of the CSI since it's inception, and currently hosts and maintains the CSI archived email list and discussion forum.

WFCP*** The CGIAR Water for Food Program will become an important member of the CSI. The WFCP is investing substantial effort into IDIS, a GeoSpatial Database which will capture GeoSpatial Data, and other GPG's being produced by the various WFCP Projects.

Appendix 2: Examples of Geo-Spatial Tools Developed by CSI Member Centers and other on-going Geo-Spatial Activities

- Forest Spatial Inventory Catalog – CIFOR
- Coral ReefBase, FishBase – World Fish Center
- Post-Hurricane disaster relief atlas for Honduras (CIAT)
- Mapping of rural poverty and natural resource constraints in dry areas (ICARDA)
- Poverty mapping in Burkina Faso (ISNAR)
- Lake Victoria Information System (ICRAF)
- Poverty mapping and spatial analysis of rural poverty in Honduras at sub-national level (CIAT)
- Mapping and analysis of rural poverty in relation to rice production (IRRI)
- Development of future human population scenarios to assess possible impact of global change and future management interventions (ILRI)
- Farm management GIS for Tel Hadya – an on-line field query system containing 21years of data related to on-farm management practices (ICARDA)
- Integration of spatial information to analyze constraints to animal agriculture (ILRI)
- Mapping of village territory and livestock migration (ICARDA)
- Study of spatial aspects of designing and targeting agricultural development strategies (IFPRI)
- GIS-based agro-climatic and water balance analyses (IRRI)
- Characterization of crop/livestock production systems in Africa, Latin America, and Asia (ILRI)
- Agro-ecosystem assessment for Latin America: agricultural extent, production systems and agro-biodiversity (CIAT)
- GIS characterization of the rice/wheat region in Asia (CIMMYT)
- Mapping and analysis of rice production at international, national, and sub-national levels (IRRI)
- Development of spatially explicit crop models, using GIS (CIMMYT)
- Spatial analysis of boron limitations to legumes; GIS analysis of water for legumes in dry areas of Sri Lanka and the Indo-Gangetic Plain (ICRISAT)
- Suitability map for potential water-harvesting schemes in central Syria (ICARDA)
- Evaluation of the conversion of forest land into agricultural land, using remote sensing (ICRISAT)
- Remote sensing and GIS applications in delineating and mapping rice areas and rice cropping systems (IRRI)
- FloraMap – a software tool for analyzing climate in relation to germplasm collections (CIAT)
- Environmental and sustainability indicators for decision-making (CIAT)
- Poverty mapping in Mexico (CIMMYT)
- Maize Research Atlas Series – Africa, Asia, & Latin America (CIMMYT)
- Targeting of resource conserving technologies in the Indo-Gangetic Plains (CIMMYT)
- Development of Climate Surfaces for Africa and Latin America (CIMMYT)
- Almanac Characterization Tool – a packaged set of geo-referenced data and query tools targeted for use in agricultural and natural resource management activities (CIMMYT)

Appendix 3.1: Descripton of GeoSpatial Toolkit Components - IWMI

PODIUM - Policy Dialogue Model

Lead Scientist: Dr. Robert Zomer

PODIUM, the Policy Dialogue Model is an interactive scenario development modeling tool, currently implemented as a spreadsheet model in Microsoft Excel. The model can be used for developing alternative scenarios of food and water demand and supply analysis and conducting sensitivity analyses of key drivers of future supply and demand. The earlier version of the model, developed in 1999 by the International Water Management Institute, handles issues at the national level. This version has details for 100 countries which comprises 86 percent of the world's population. Since then the latest version of the model is improved to handle issues at the sub-national level. Depending on the data availability, the improved version can be used for generating scenarios at the administrative level, at the river basin level, or at the agro-ecological regions level, etc.

The model at the national level has three main components, 1) Cereal demand scenario analysis, 2) Cereal production scenario analysis and 3) Water supply and demand scenario analysis.

Cereal demand component
Cereal is the dominant component of daily nutritional supply of most countries. Future cereal demand at the national level under varying assumptions of key drivers is estimated in this component. The key drivers of total demand are population growth, total calorie supply, calorie supply from cereal products, calorie supply from animal products, use of cereals in feeding animals.

Cereal Production component
Cereal production under irrigated and rain-fed conditions are estimated in this component. The area and yield determines the production. The growth of net irrigated area, irrigation intensity, irrigated cereal area, rain-fed cereal area, irrigated cereal yield, rain-fed cereal yield determines the future cereal production.

Production Surplus/Deficit:
The difference between the production and consumption determines the net imports. This includes the changes in stocks.

Water Demand and Supply component
The water demand at the national level is estimated in this component. The irrigation demand for agriculture and water demand for the domestic and industrial sector determines the total water withdrawals. The irrigation withdrawals are determined by the net irrigated area, irrigation intensity, the net evapotranspiration, and the irrigation efficiency. The growth in net irrigated area, irrigated cropping intensity and efficiencies determines future irrigation demand.

The population, per capita water withdrawals, percentage of population with access to pipe water supply determines the domestic water withdrawals. The growth in these factors determines the future domestic water demand. The population and per capita industrial withdrawals determines the total Industrial water withdrawals. The growth of population and per capita industrial demand determines future industrial water demand.

The Potentially utilizable water resources show the water that can be potentially utilizable for a country. The model estimates the primary withdrawals, i.e., the water withdrawn directly from the rivers or aquifers, show the developed water resources. Two of the major outputs in this component are the degree of development and the groundwater balance. The degree of development is the ratio of primary withdrawals to potentially utilizable water resources. The

groundwater balance is the difference between the aquifer recharge and the groundwater withdrawals.

Web Implementation

The PODIUM is currently implemented as a spreadsheet model in Excel. Visual Basic is the interface for easy navigation within the model. The model can develop scenarios for an individual country and the outputs of different modules can be seen as bar graphs or pie charts. We propose to combine Excel model structure with appropriate programming language (e.g. JAVA or Visual Basic) to implement graphical user interface and a spatially distributed graphic display capability within a GIS environment, where the outputs of different modules will be displayed in map formats. This approach will allow web-based users to explore a range of land use and water use scenarios, with spatially distributed results displayed in real-time. Components will display an array of driving factors, bio-physical parameters, and map-based scenarios, which can be easily manipulated through a easy to use graphical use interface. This will allow exploration of a variety of scenarios using intuitive based logic and comparison with historical analogies.

Appendix 3.2: Descripton of GeoSpatial Toolkit Components – IFPRI

MPdb – Market and Population Database Manager (IFPRI):
DREAM – (IFPRI) – Assessing economic benefits of R & D (IFPRI)

Lead Scientist: Dr. Stanley Wood

While spatial analysis is a relatively new activity within IFPRI, the growing recognition of its potential role in policy research has recently been acknowledged by the creation of an IFPRI Global and Regional Program (GRP) on Spatial Patterns and Processes in Development. As its contribution to the goals and objectives of this proposal, IFPRI's spatial analysis GRP will fully document and make available the following tools to CSI members and, through the CSI's WWW spatial portal, to the global spatial analysis community:

- **Market and Population Database Manager (MPdb)**. This tool manages access to and download of key agricultural development statistics from a range of "standard sources" of such data (including FAOSTAT, World Bank and UN databases), as well building and managing all such data in a single integrated database on the user's computer. Core data include national production, consumption and trade of agricultural products, economic indicators, population (total, by activity, gender, urban/rural) from 1961 onwards. MPdb checks whether specific data series have been updated at the host site and, if so, updates the users files and database documentation. MPdb also performs very flexible analyses on regression, growth rates and derived measures such as a range of partial productivity and human well-being metrics. The output of the database and analyses managed and performed by MPdb can be directly mapped in Arc/Explorer (free) or Arc/View (licensed) GIS software

- **New GIS-enabled version of DREAM:** DREAM is IFPRI's user-friendly software package for assessing the potential economic benefits of agricultural R&D. To date this package has been applied in a spatial context through a "loosely-coupled" approach requiring several manual intervention steps between performing the economic analysis and preparing maps of the spatial pattern of benefits. IFPRI would develop document and distribute a new version of DREAM that embeds the capacity to communicate directly with GIS software to obtain model inputs and to map model.

Appendix 3.3: Descripton of GeoSpatial Toolkit Components – ICARDA

CLIMCHART

Lead Scientist: Dr. Eddy De Pauw

Concept

CLIMCHART is an Excel-based educational interactive tool that allows one to gain insight into the climatic characteristics of different areas. It is targeted mainly towards NARS scientists and students. It consists of a database of climatic stations, a graph generator and data processing programs.

Current development

The database contains currently climatic stations from North Africa, West and Central Asia and the Horn of Africa. The data include monthly values of maximum and minimum temperature, precipitation and potential evapotranspiration. Graphs currently generated include climate diagram, water balance, heat units, growing period and biomass productivity indices. Data processing programs allow one to calculate numerous derived climatic variables (such as accumulated heat units, water balance and growing period parameters, climate classifications) and to generate climate summaries. Currently included climate classifications are the UNESCO drylands and the Köppen system. The user-interactive interface includes selection of station, start month for graphing, addition of irrigation amounts, and setting of various thresholds (for soil moisture storage capacity, growing period, heat unit accumulation, defining dry month).

Planned development under ICT-KM funding

- The database will be extended to cover the whole world.
- New derived variables will be added in the climate summaries (e.g. accumulated cold units, number of frost days).
- The climate classifications will be extended to include the Thornthwaite and Papadakis systems.
- The model used for assessing growing period characteristics will be upgraded by including snow as a separate sink with a temperature-controlled melt rate
- A module for estimating crop water requirements will be added.
- The interface will be redesigned to make it easier for users to insert their own databases.
- Documentation, detailing the software functionality and describing the included climatological concepts, will be prepared and integrated as an Excel-Help module.

CLIMAP

Lead Scientist: Dr. Eddy De Pauw

Concept

CLIMAP is an Excel-based GIS tool to generate climatic maps. Its main targets are GIS specialists, both at the international and national levels. CLIMAP consists of a module to generate basic climate surfaces and several application modules that generate derived climatic maps.

Current development

CLIMAP was originally designed to provide a user-friendly interface to the spatialization software ANUSPLIN 4.1, developed by M.F. Hutchinson of the Australian National University in Canberra,

and to allow generation of basic climatic surfaces in batch mode. In time application modules were added. Current capabilities include:

- Generation of basic climatic surfaces of monthly or annual variables (e.g. temperature, precipitation, radiation etc.);
- Generation of surfaces of simple derived climatic variables (e.g. heat or cold units);
- Mapping of potential evapotranspiration on basis of temperature, humidity, sunshine, wind surfaces
- Mapping of temperature and precipitation-based similarity indices
- Mapping of biomass productivity indices, including growing period characteristics
- Conversion between ArcView and Surfer (Golden Software) grids

Planned development under ICT-KM funding

- A module will be added for agroclimatic zoning (using the UNESCO Drylands and Köppen classification systems)
- A module will be added for crop water requirement calculations
- A module will be added for topography-corrected sunshine duration mapping
- A module will be added for mapping the standardized precipitation index (SPI)
- New CLIMEX-based stress indices will be incorporated and the LGP-model improvements in CLIMCHART will be ported to the CLIMAP application
- Documentation, detailing the software functionality and describing the included climatological concepts, will be prepared and integrated as an Excel Help module

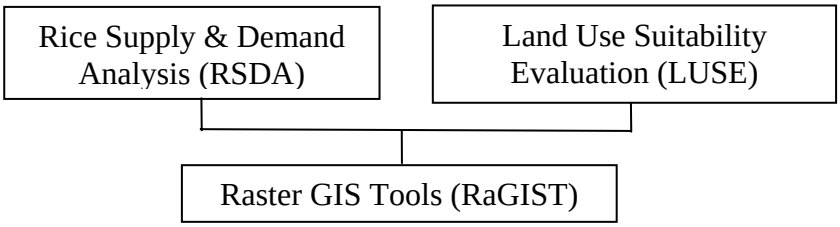
Appendix 3.4: Descripton of GeoSpatial Toolkit Components – IRRI

Rice Supply and Demand System (RSDS) and Land Use Evaluation Tool / Raster GIS Toolbox (LUSE) (IRRI)

Lead Scientist: Dr. S.P. Kam

Background and justification

Over the past years, IRRI has been developing in-house a number of GIS-based analysis and decision support tools that provide an explicit spatial dimension for addressing rice research problems, but with potential for broader application. Supplementary funding is sought for packaging these tools and data bases of selected countries/pilot areas, with proper documentation, user guides and sample applications, so that these can be more widely used by researchers from NARS and the broader agricultural research community. There are three distinct but inter-related components that we propose developing as depicted and described below:



1. **Rice supply and demand analysis (RSDA) system:** IRRI developed a GIS-based tool for analyzing the balance of rice supply and demand at the sub-national level, taking into consideration both biophysical and socioeconomic factors affecting supply and demand. The RSDA system can be used for exploring scenarios of rice supply and demand within the country based on user-defined policy objectives and assumptions about changes in production levels brought about by technological advancements. Developed within an Excel environment, the outputs of the RSDA model can be coupled with either in-house developed GIS software (the Raster GIS Tools) or exported to various commercial raster-based GIS software. The principles underlying RSDA can be applied to analyze supply and demand for other agricultural crops as well.
2. **Land use suitability evaluation (LUSE) tool:** IRRI developed a raster-based GIS approach to delineate and evaluate land suitability for diverse cropping systems that departs from the vector-based FAO approach of delineating homogeneous polygons as a basis for evaluating suitability for individual crops. Using an “evaluate first, then aggregate” strategy implemented in the raster mode, our approach can retain the spatial and temporal variability of continuous and dynamic variables such as terrain and climate. The dual representation of the raster data structure as gridded surfaces and as a tabular data matrix facilitates per cell evaluation of suitability for individual crop types as well as for season-specific cropping systems that may comprise multiple crops. Therefore this strategy provides much greater flexibility in delineating land units for complex cropping systems in highly heterogeneous environments. This approach has been implemented within an Excel environment, whereby the outputs are coupled with either in-house developed Raster GIS Tools, or can be exported to various commercial raster-based GIS software.
3. **Raster GIS tools (RaGIST):** In the process of developing spatial analysis methodology for various problem-solving situations, IRRI staff have had to develop a number of raster-based map manipulation utilities that are not available in commercial software, including (i) matching edge pixels across raster layers (solving the raster equivalent of sliver polygons), (ii) raster coarsening with options of selecting average, minimum, maximum or median pixel values, and (iii) interpolation of neighborhood pixels for gap filling of missing data. With a little more effort, this collection of specialized spatial analysis tools, together with some basic map display and

query, and data conversion algorithms, can be packaged into a user-friendly public domain GIS software, with user documentation.

Objective

To refine the packaging of the RSDA, LUSE and RaGIST software for wider dissemination and use by clients

Methodology and Activities

The RSDA methodology has already been developed and tested out for case studies in Vietnam Malaysia and the Philippines, while the LUSE methodology has been applied in northern Vietnam. The main ensuing activities include the following:

1. Solicit from NARES partners their comments and suggestions for improving the presentation and documentation of the RSDA and LUSE models and the Raster GIS tools; and
2. Further automate as necessary particular sub-components and provide detailed documentation of the modeling steps and use of the software.

Outputs

A package of three inter-linked GIS based tools (as depicted in the figure above), with methodology documentation and software (with user manual and sample data sets) comprising

1. The Rice Supply and Demand Analysis (RSDA) system
2. The Land Use Suitability Evaluation (LUSE) system
3. The Raster GIS Tools (RaGIST)

These tools will be offered on-line through the CSI website and distributed on CD-ROM.

Implementing Institutions and Participating Scientists

IRRI: Dr. S.P. Kam (GIS Specialist); IWMI: Dr. C.T. Hoanh (Senior Water Resources Specialist)

Duration: One year

Appendix 3.5: Descripton of GeoSpatial Toolkit Components – CIAT

Land Systems Analysis Tool for Tropical Lowlands

Lead Scientist - Dr. Glenn Hyman

CIAT and EMBRAPA made a very detailed study of land systems for agriculture and rural development in the lowland Amazon basin, Venezuelan and Colombian plains (the Llanos), and the Brazilian Cerrados. The study, carried out in the late 1980's and early 1990's, produced five large volumes of information on land systems in the tropical lowlands of South America. CIAT often receives requests for this information. The soil and geomorphological information remain one data set

The spatial information in this study includes a wide range of soil data such as nutrient deficiencies, physical limiting factors for production, moisture regimes and others. The database also includes land cover, geomorphological and climate information. The base map for the study was developed at 1:1,000,000 scale, making it a valuable resource for analysis of a very large area. However, the original authors envisioned this information resource to be available only in book format.

We propose to create a web-based geographic information resource for analysis of land systems in the tropical lowlands of South America. The tool will allow anyone with a standard browser to view and query the database, and to download the GIS files and documentation. Users will be able to carry out visual overlays, Boolean queries and tabular analysis for studying agriculture and conservation in the Amazon, the Llanos and the Cerrados. The application will be created with ArcIMS software and will incorporate OpenGIS protocols to permit interoperability among different software systems.

Web Site

By placing the data on the web it allows us to provide the data, as well as tools for working with the data at the same time. It overcomes the limitations of distribution which is inherent to the volumes in book format. The website will provide tools for working with the data, explanations to aid in the understanding of the complex dataset, show examples of usage of the data, and have the data and metadata available for download. The website will provide samples of more advanced programming resources for working more extensively with the data, and provide a location for users of the data to communicate with each other about their experiences, findings, and results.

Tools

The toolbox for this site will consist of basic tools for exploring geographic data. Zooming in and out, panning, returning to the full extent of the dataset, and identifying features. An advanced toolset will also be included. Tools such as making ad-hoc geographic queries and buffering will be in the advanced toolset. The inquiry tool will be the bridge to exploring the tabular data. The tabular data is very important in this dataset because it gives the most accurate explanation of what information was collected in the study. The map serves as an initial data exploration tool to give a broad view. Then, through this tabular data exploration the user will be able to see in finer detail what the map is not able to show.

How the Tools Will Help

Much of the complexity of the data is only overcome through spending time exploring what it has to offer, and understanding what the relationships are within the data and how they all work together. The tools offered will be able to provide this type of atmosphere where the user's exploration is limited more by their desire to explore than from the tools available. Where the tools available on the website reach their limit, the user will be able to download the data in an OpenGIS compatible format so that the data can be explored using a full featured GIS software of the users choosing.

Examples of Use of the Data

The area of the website showing examples of the data in use will start with a link to one of our demonstration uses, but will be able to grow by users adding links to examples of their work. This will not only provide examples of how the data is being used but also show what kind of work might be currently underway using this data.

Download of Resources

The download of the data will be available in many standard formats including OpenGIS formats for easy transition into the user's favorite GIS analysis tool. Metadata will be available for download along with the data. The metadata will be registered in FGDC clearing houses so the data will be available through metadata searches.

Web Services

This dataset will also be available via a Web Mapping Service(WMS) This web service will allow the data to be accessed in real time through OGC compliant WMS data viewers, such as Web Map Composer. This type of service allows the user to explore the data in an environment with other data of his or her choosing, not limited by those resources we have available on our website.

Mapping Framework

We will develop this site by putting together tools, scripts and programs into an experimental "Mapping Framework." All tools and functions are in a central location, allowing them to be used repeatedly. This framework will allow web mapping sites to be created with great ease, and for time to be spent more efficiently by creating and maintaining tools from a central location. We expect the framework will help us eliminate redundant tool development and increase the efficiency of future web mapping products. If the Mapping Framework is successful, we will share the tools with our CGIAR colleagues.

Appendix 3.6: Descripton of GeoSpatial Toolkit Components - IPGRI

Habitat Mapper

Lead Scientist - Dr. Andrew Jarvis

Background and justification

With the wealth of geo-referenced environmental data that is rapidly becoming available, at an increasingly higher resolution and precision, the lack of tools for their effective use and analysis is a significant constraint in agricultural research. Though the general algorithms for such analysis often exist, their use is problematic because of the lack of coupling between different software tools and because of the inability of some tools to process the very large datasets that are common in the context of GIS work. There is thus a need for increased integration between these analytical tools and GIS software and data. This project addresses the problem through the development of software for geographic data analysis and display that uses multiple data layers to produce analytical results through multivariate analysis and simulation modelling approaches.

Goals and objectives

We propose to develop tools and methodologies to tackle the following critical questions for International Agricultural Research:

1) How can we divide the earth into relatively homogeneous zones given a specific research objective (i.e. zones that are defined on the basis of the question at hand, and are not statically predefined)?

2) How well can we expect a crop or its wild relative to grow in a particular place? Given that, how sensitive will its performance be to climate change, and what might be the impact of an improved variety in the area?

Deliverables

Two software modules will be developed as follows:

A) Software to carry out multivariate analysis (classification and ordination) of data associated with points and areas, e.g. occurrence of species, characterization and evaluation data, and environmental data. The output will be maps of homogeneous zones, together with information on the relationships (distance) among the different zones. This is an enhancement over current zoning approaches, which are often “expert-driven”, qualitative, and do not explore interzone relationships.

B) Software to link crop models to global GIS databases. We will use physiology-based models of yield response for the main food crops. These models can predict yield levels. We will use a different approach for the other crops building models on top of the ECOCROP crop requirements database, which has variables for 1700 crops. We will also refine existing approaches for the prediction of the distribution of wild species (e.g. BIOCLIM or logistic regression) by making the algorithms used more appropriate for crops (where one only needs to compare the growing season, not the whole year).

C) Global 1km high-resolution monthly climate data for a number of variables will be provided and integrated to allow for these modelling activities. These datasets will be made available for download.

The new tools will be built into existing generic viewer software (DIVA-GIS) to assure ease of import and export of data and compatibility with other software (notably ArcGIS/ArcView).

Appendix 3.7: Descripton of GeoSpatial Toolkit Components - CIMMYT

MAIZEFINDER – A web-based GIS linking genotypes to environment

Lead Scientist - Dr. David Hodson

The International Center for Maize and Wheat Improvement, CIMMYT, is a center of excellence for maize and wheat breeding with a strong focus on producing improved germplasm. In addition to improved varieties, and in common with many CG centers, CIMMYT produces large volumes of research information. This wealth of information relating to germplasm performance and other characteristics is an extremely valuable global public good, but not all potential beneficiaries currently have access to these data. To try and resolve these problems, CIMMYT has started to develop a web-based GIS / database application called MaizeFinder. MaizeFinder permits the investigation and analysis of maize performance data in combination with environmental information.

Objective

The objective of the project is to provide widespread access to research information in a user-friendly and efficient manner that leverages the strengths of the Internet and GIS, thus enabling easier access to the information needed either for breeding or to make decisions on the use of existing commercial varieties.

Current Status

- A working prototype version of MaizeFinder has been developed using ArcIMS coupled to relational databases.
- A limited dataset of maize trial information for sub-Saharan Africa is available within the prototype.
- A limited number of specialized tools for data analysis, such as “head to head” analysis of varieties grown at the same localities.
- Key environmental data layers are accessible in GIS format.

Proposed Development / Outputs

- To vastly expand the amount of information accessible within the system, including expanded geographical coverage.
- To develop additional user-defined tools for improved analysis
- To develop improved export / report-generating capacity
- To develop improved on-line help functionality and tutorial material
- To move from prototype to a fully functional public domain information portal for maize information.