Development and Evaluation of Models and Methods to Improve the Assessment of Status and Estimate the Economic and Environmental Impact of Options to Enhance Food Security

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WORKSHOP REPORT
Volume II
Proceedings

Institute of Rural Economy
Institute of Sahel
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Volume II

Proceedings of the Workshop

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Introduction

The workshop report is provided in two volumes. Volume one deals with the Findings and Recommendations and this second volume is a Proceedings of the Workshop. It contains summaries and illustrations of the presentations made during the workshop.

Twenty-five presentations from International, Regional and National institutions were presented. The workshop produced very intensive discussions and effective recommendations. In addition to the summaries, this volume summarizes conclusions reached at the end of each session. For details on the workshop results and recommendations, refer to Volume I – *Workshop Findings and Recommendations*.

The Planning workshop on "Development and Evaluation of Models and Methods to Improve the Assessment of Status and Estimate the Economic and Environmental Impact of Options to Enhance Food Security " was held at the Palais des Congres in Bamako, Mali from 7 to 9 December 1999.

The overall purpose of the workshop was to plan for further development and evaluation of the Texas A&M models and methods to improve the assessment of status and estimate the economic and environmental impact of options to enhance food security. Its product will be a refinement of the plan of action for a pilot study in Mali to develop methods and their practical use in assessing the status of food security now and in the future and the impact of new technology or policy options on food security.

During these three days, the workshop was organized in two major sessions (i.e. Planning Agenda, *appendix 1)*. The first two and a half days were targeted toward key operators and managers that will use the methodology being developed and evaluated in the pilot study, a session called technical session. The last half-day was directed toward policy makers in the government, national research institute leadership, regional institutions, and potential donors, a session called Decision-Makers session. It provided an overview of the workshop and the conclusions reached in the first two days.

The workshop began with general comments by senior government officials noting the relevance and importance of the subject. Dr. Idriss Alfarouk, Director General of INSAH, opened the workshop by a welcome address while Dr. Mamadou Goita, General Secretary of MDRE, made

the opening comments. Than, the technical session began. There was further discussion by representatives of research and government agencies and tentative conclusions were drawn for subsequent presentation in summary form to GOM decision-makers. After discussion at this level, general conclusions and plans for follow on action were developed by the policy group.
In the first two and a half days of the technical session, about 70% of the time was used for more or less formal presentations; 30% for discussion and feedback.

For both session, there were approximately 40 participants, including key government decision makers, national researchers and staff of government agencies that will use the methods, donors, FAO, and Texas A&M University under the USAID SANREM CRSP. Workshop participants included also a small cadre of advisors enlisted to participate in the evaluation of results and design of modification of products as the pilot study proceeds.

More specifically, some of the discussions were to enhance understanding and to identify potential applications of the assessment methodology provide. This was to plan for further development and enrichment of the design of the pilot studies and agreement on the roles and contributions of national and regional collaborators.

Each session had specific objectives as summarized in the following table.

Sessions	Purpose

Technical session	
Needs of national and regional research institutes and parts of the Government of Mali (GOM) for improved methods of assessment	Increased understanding and insight into the needs of several agencies for analysis of the impact of alternative policy options and use of technology to enhance food security and ensure protection of natural resources and environment; Provide current activities and discussion to refine the targets and scope of proposed studies and implement plan of actions
Presentation of Texas A&M Global Decision Support System	Presentation of the INTSORMIL CRSP case study as a "proof of concept" for the methods; Presentation of the suite of models and results; Illustration of how these models might be used in assessing the results of several intervention scenarios to improve the status of food security at the year 2015; Discussion of their use and utility by national and regional partners; Recommendations for further development and on ways in which their utility can be enhanced.
Presentation of FIVIMS and WAICENT - FAO	Presentation of FIVIMS and how to implement and improve the national capacity to monitor and assess the impact of options to improve progress towards achieving the goals of the World Food Summit and CCD; Relationship with the integrated food security system for Mali and the National Environmental Action Plan for Environment; Presentation of FAO databases and Information Systems with a demonstration of WAICENT data bases and the Knowledge Management Information System (KIMS)

Decision-Makers session	
Presentations and discussion by national and regional institutions, Texas A&M University and FAO	Summary and Consensus Statement from Technical Workshop; Contributions and collaboration by Malian and Regional institutions; Announcement of recommendations to be included in the plan of action to improve utility by the GOM

SECTION 1

NEEDS FOR ANALYSIS AND ASSESSMENT BY NATIONAL PARTNERS

Welcome addresses

Dr. Idriss Alpharouk

Director General, INSAH

Director General Idriss Alpharouk welcomed the participants to the workshop and wished them success in their deliberations. He noted the importance of the workshop, not only for Mali but for the other member countries in CILSS. He recognized the critical need to develop improved methods to plan for and achieve improved food security in West Africa. Dr. Alpharouk acknowledged the expertise of the technical participants and expressed his very positive expectations for the success of the workshop. He thanked Texas A&M for their work and for organizing the workshop. He assured members of the workshop of the full support of INSAH during the meetings and afterwards. He expressed pleasure in having INSAH serve as host for the workshop.

Opening Comments

Dr. Mamadou Goita,

General SecretaryMinistry of Rural Development and Water (MDRE)

Secretary Goita extended greetings to members of the workshop and wished them success in their deliberations. He noted the importance of the outcomes of the workshop for the Sahel in general and for Mali. He recognized the importance of having the capability of making quantitative assessments of the impact of technology and policy options as critical decisions about sustainable development are considered by policy makers at all levels of government. He recognized the involvement of specialized interests and capabilities represented by the FAO and other international participants. He also acknowledged the expertise represented by research scientists of IER and analysts working in other parts of the government and stated his expectation that this would contribute to the success of the deliberations. Secretary Goita stressed the importance of developing and using an assessment approach that concurrently deals with food security, natural resource management, and desertification. He noted that Mali is committed to the goals of the World Food Summit, including the reduction of hunger by 50% in the year 2015. He recognized that the task of achieving these goals was daunting and required a concerted cooperative effort within the Government of Mali. He stressed the importance of making the best use of limited resources through enlightened planning and evaluation. He expressed the belief that the planning for development and evaluation of models to facilitate decision making being undertaken in this workshop would be an important step in providing the analytic capacity needed to help achieve the goals in improving food security through sustainable use of natural resources.

Agriculture and Natural Resources as a National Planning Initiative

Dr. Lamine Keita

CAFPD, Secretariat General de la Presidence de la Republique

Rural Sector is essential in Mali for which it represent 80 % of Mali' population, 40 % of the GDP, 84.5% of the employment. In 95/96, cultivated land represented 3.5 million ha for 2.4 million tons in good season. Refer to the Politic and strategy for Mali Development, Mali 's agriculture development strategy is putting emphasis on food security and export increase for 2010. To meet these objectives, recommendations are made to increase irrigated cultivated land by 150 000 ha for a production of 900 000 tons/year, to increase by 40 % millet-sorghum production and to produce 500 000 tons of maize and 900 000 tons of cotton. Government policy and strategy is based on land development and increased use of natural resources.
To meet these objectives and to succeed in the combat against poverty and food insecurity, in the integration of Mali into the international and regional economy and to respond to the stated objectives of the several international conventions on Environment, Government policies and strategies have to consider the environmental-cost and take into account several factors affecting the sustainable use of natural resources:

- Major factor is climate variability that imposes perpetual change in human occupation for access to the natural resource available in space and time. 84 % of the population is located on 36% of the national territory. This lead to increase competition for the scarce natural resource available.
- Trade policies are another factor that affects the rural-urban relations and the integration of Malian economy in regional and international economy. For example, commodity prices' decrease during the harvest is following by commodity storage in urban areas that reduce farmers' revenues.
- Population growth leads to increase cultivated land with fertilizers fallow duration decrease and major side effects on soils fertility, pollution and deforestation. 90% energy needs comes from firewood with tremendous effects on forest resources.
- Mining industry expansion is associated with urban growth and its side effects like increase waste and pollution.

For better environmental-cost assessment, decision-makers need to have a better understanding of the diversity and the complexity of the social component in an integrated approach and develop an efficient natural resource management at national, regional and international level.

To address this main objective, recommendation is made to improve the capacity of policy formulation and to assess the environmental impact of policy options. Data availability and reliability for research and development, national capacity building for data analysis and appropriate methods and tools like integrated suite of models proposed by Texas A&M are the key elements to develop in order to reach the objectives of food security, combat against poverty, environment conservation and international economy integration.

Perspectives on Need for Enhanced Assessment Capabilities by Senior Representative of Government of Mali 1) Food security and vulnerability 2) Environment and natural resources

Dr. Bino Teme

Director Scientific, IER

Malian economy handicaps are diverse with unrecognized mining resources potentiality, agriculture high dependence to climatic conditions, low level of industrialization and natural resource management. Mali is also a West Africa enclave, which leads to high import costs.
On the other hand, Mali represents a country with diverse natural resources, with over 1 million irrigated land available, 5 million cattle and 10 million small ruminants, a substantive fish production, cultural population attachment to land and dry farming land availability.

But given this, Mali economic welfare needs improvements in rural production by irrigated farming development, intensification in suitable climatic zones and production support system in marginal lands under low rainfall conditions and pastoral system productivity improvement. These options should be driven by a natural resource conservation management to avoid space consuming production systems. Economic development must be done in an integrated way from producers to consumers, with focus on value-added commodities improvements (agri-business, marketing…) with support from policy makers (credit access, income tax…).

Food security issue is strongly linked to Mali rural development and models are efficient tools to apply for both researchers and decision-makers.

The National System for Integration of Agricultural and Food Security Statistics – SNISA

Abou Doumbia

CPS, MDRE **Error! Reference source not found.**

Mali Rural Sector National Action Plan 1997-2001 states the general objectives for the country rural development which are:

- Food security
- Revenues and living conditions improvement (nutrition, surplus, production diversity)
- Natural resources conservation to assure sustainable development
- Capacity building improvement to enhance development management capability

To reach these objectives, there is a fundamental need to have reliable and updated agricultural databases at national and sub national levels. However, in Mali, data collection, analysis and dissemination belong to different administrative services without any integrated network to better coordinate and validate the databases and enhance decision-making process. In order to create a more cohesive structure, the government created in 1992 the Statistics and Planning Unit (CPS). Through its Documentation and Statistic Division (DSD), CPS was created to provide an integrated environment for consultation and collaboration development between administrative structures, information needs identification, methodologies development, surveys supervision, formation, databases coordination and centralization, and information dissemination. CPS has no vocation to collect databases, which belong to the National Directions. Its intent is to rely on the existing structures for better coordination. For example, for the MDRE, DSD-CPS relies on the different statistical bureau of the DNAMR, DNAER and DGRC at the national and sub-national levels.

To satisfy the data need and update the agricultural knowledge of the country, an agricultural census is launched in accordance with the Agricultural Census 2000 World Program recommended by FAO. This census will be accompanied by the implementation of the Agricultural and Food Statistics National Integrated System (SNISA) which will provide updated agricultural data on an annual basis.

RGA and SNISA's objectives have been defined in accordance with the Agricultural Sector

Development National Action Plan (Ministry of Plan, 1992) which stated the need of:

- Updated information on agricultural production (quantity, prices, costs, harvest forecats), agricultural sector structures knowledge (farm, employment) and cereal balance sheet ' reliability improvements
- Livestock, fish production, stand treatment and gathering databases,
- Annual status on the environment and the natural resources.

As a result, RGA and SNISA will provide:

- Fundamental data on the rural sector and aggregates that will serve as benchmarks for future estimate,
- Detailed data on farms structures,
- Detailed information on producers and factors of production,
- Information on Woman participation in the rural economy development,
- Agricultural surveys improvement,
- Data collection and dissemination development to others administrative structures, public, parapublic and private organizations and development projects,
- Vegetal and animal productions on markets monitoring coordination,
- Specific surveys implementation
- Information database on the Rural sector implementation.

SNISA will develop an agricultural and food data collection, analysis and dissemination's action plan on the following activities:

- Improvement of the existing Agricultural Situation Survey (EAC) operated conjointly by the DNAMR and the DNSI,
- specific surveys and studies development on gathering products, agricultural products' external trade, rainfall and hydrology monitoring, water resources assessment for agricultural use, livestock zootechnical parameters monitoring…
- administrative and others qualitative data sources running
- agricultural sector database implementation
- agricultural statistics directory development and dissemination

SNISA activities will be coordinated by the CPS/MDRE in collaboration with several partners like PNUD, Europe Union, USAID and the Dutch Cooperation. Because of upcoming delays, activity calendar has been revised. Methodologies, surveys and scaling development for the agricultural census have been defined with the FAO collaboration at the same time that the demographic census was made in 1998. Data collection should start in 2 000 with results to come in 2 001 at the same time that SNISA will be created. SNISA activities to continue in 2002 and 2003.

The CPS, in accordance with its agricultural development strategy and policy assessment role, will use SNISA information for modeling activities. CPS has currently developed two models, which need very diverse and detailed information to be available at the SNISA:

- Policy Analysis Matrix
- West Africa Agricultural Policy Regional Simulation Model.

SNISA would be part of a national and international network and should be able to provide the information needed by different users like model developer, decision-makers, private operators…

The National Action Plan Responding to the Convention to Combat Desertification,

Dr. Salif Kanoute

Coordinator National Environmental Action Plan, ME

Different events[1], since the early seventies, has worked toward the development of the Mali National Action Plan and Environmental National Action Plan.
To respond to the CCD convention, a Rural Environmental Assessment was developed to better address the objective of natural resource management improvement. Results showed that the current use of natural resources is high leading to degradation. To meet the consumption needs, it would require increased production, which interfere with resource conservation. But the question lays to know if population has the capability for intensification?
Different programs has been defined in the National Action Plan:

- Territory Management Program
- Natural Resource Management Program
- Water Resource Management Program
- Urban environmental improvement Program
- New and Renewal Energy Resources Development Program (92 % energy needs are coming from forestry resources. To fill the needs, population are using cattle excrements, a practice that effect soils fertility)
- Environmental Information System Program, in which the present workshop is interested, in regard to the lack of reliable information on status and evolution of natural resource
- Environmental Dissemination, Education, Information Program
- Coordination Program
- Natural Resource and Desertification Research Program

[1]The 68-73 drought, the creation of the CILSS, the conference of Mexico in 1974, the conference of Nairobi in 1977, the conference of Rio in 1992, the Convention on Climatic Change and Biodiversity, the CCD and the Agenda 21.

Taking example on the Environmental Information System Program, a National network for environmental monitoring has been developed to enhance decision-making by data collection and analysis improvement.
At these 9 national programs, you can add 8 sub-regional and others local (village/county) programs that have been established to take into account the decentralization and the diversity of the country. These regional programs put emphasis on water control, soil-rangeland-vegetation degradation according to the specificity of each region.

The general objective is to improve the natural resources management by the development of an integrated vision of the space, the resources and the needs by international, regional, national and local partners.

The Mali Famine Early Warning System

Mr. Salif Sow **Error! Reference source not found.**

National Representative FEWS USAID

Funded by USAID, FEWS/Mali is a project with multiple national partners like SAP (Early Warning System), GTPA (DNM), BSES / MDRE, OMA (ex-SIM), GIS Users Group, CPS / MDRE, DIAPER and CILSS/FAO.

FEWS objectives are to assess at the national and sub-national levels the food availability and accessibility, to identify vulnerability zones and the level of insecurity on an annual basis. The overall goal is to provide a basis for future assessment and give recommendations to enhance decision-making. FEWS output is the Current Vulnerability Analysis (CVA).

The model used for the Current Vulnerability Analysis is based on the physical availability (production and stock), the access/purchasing power (income, prices) and the use of food. 4 categories have been defined to characterize food security from secure, moderate, high and extreme (emergency) vulnerable.

CVA is made at the end of the agricultural season (February) at the beginning of each year to allow time for national and international decision-makers to take actions and dispatch food before June (period of soudure). Analysis follows 3 steps 1) national and sub-national availability assessment 2) households access to food assessment through surveys and participatory evaluations in rural areas, data analysis on household income and prices 3) food security level designation for different socio-economic group.

FEWS is using satellite imagery for rangeland and cropland assessment. Biomass is estimate with NDVI and rainfall with METEOSAT. FEWS has developed a model since 2 years that allows the identification of the beginning of the agricultural season with NDVI and METEOSAT that makes the correlation with current and future status. Index of greenness areas at the beginning of the season, at the middle and the end in order are used to assess food access. Satellite imagery provide a efficient and complementary tool for validation but it must be used with ground surveys and others indicators like prices of cereals, terms of trade goat / millet…

For example, 2.951.700 tons of cereal was produced in Mali in 1999/2000, +16% than 1998/1998 and + 28 % than the average 1994-1998 period. Accessibility was better than 1998 because of lower cereal prices. But, Mali provides cereals to the neighboring countries that make the availability for the locals difficult despite good crop yields.

Crop Modelling at LaboSEP (IER): Overview of ongoing and forthcoming activities

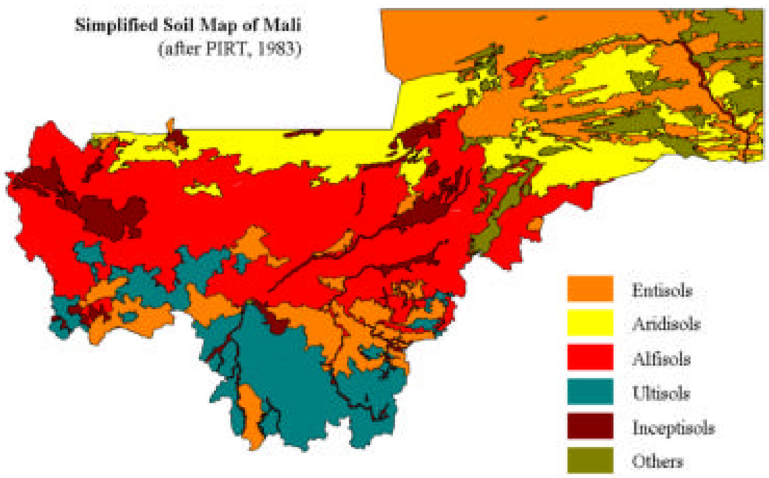
Sibiri Traore

Laboratory SEP - IER

IER, the Institute for Rural Economy, conducts research and development activities in the fields of GIS, remote sensing and crop modeling through its GIS and Remote Sensing Unit, hosted by IER Soil-Water-Plant Laboratory (LaboSEP). Currently, ongoing and forthcoming projects in the GIS & Remote Sensing Unit are targeted towards i/ standardized database development for ii/ modeling purposes (soil, crop and climate interactions), and iii/ capacity building, especially through the establishment in January 2000 of the joint IER-ICRISAT Modeling and GIS Laboratory, with regional scope (West Africa).

i/ Datasets development is conducted within the framework of the ARISE digital database (Agricultural Resource Information for a Sustainable Environment). This database features static and dynamic layers at a range of temporal and spatial scales, including:

- Information on soils: FAO soil map of the world (1974), Mali land and water resource soil units (1983), 33 ;morpho-pedological studies at the regional level, several tens of typical toposequences at the basin scale, and numerous soil pedons with associated physical and chemical properties;
- Information on vegetation: AVHRR normalized difference vegetation index time series (weekly), Mali land use and land cover inventory (1990), several map products established at the regional and local scales, and extensive collection of plant samples with associated physical and chemical properties;
- Information on climate: AVHRR land surface temperature time series (weekly), ERS radar derived upper soil moisture time series (weekly), comprehensive historical archive of met data from the national weather service (daily time step);
- Political information: up-to-date 4-level administrative boundaries (national – regions – cercles – communes) derived from data issued by the Decentralization Mission;
- Other information on: cultural calendars (CMDT statistical directories), topography, etc…



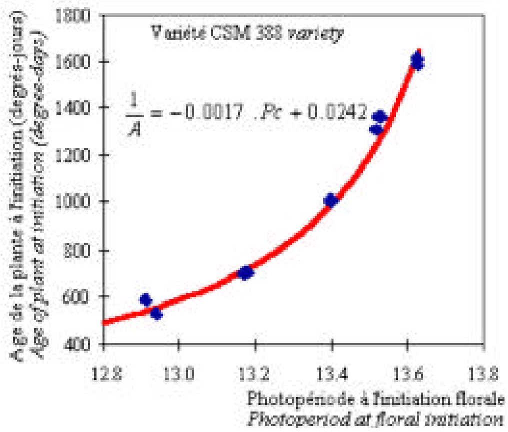
Spatialized database development: simplified soil map of Mali (after Projet Inventaire des Ressources Terrestres, 1983)

The GIS & Remote Sensing team is working at merging datasets into a standardized GIS environment, for example at the integration of soil analysis surveys with cultural calendar maps. Effects of scale integration are investigated to address the issue of surface heterogeneity.

ii/ Among the main uses of the ARISE digital database is the feeding of crop and agro-meteorological models. Modeling activities have been extensively conducted at LaboSEP for several years already but have focused renewed interest for the past 2 years or so. In the present stage LaboSEP's GIS and Remote Sensing Unit is principally involved in the validation and development of 3 models:

- Bipode, an ETP-driven water balance model fed with in-situ meteorological observations; this project aims at detecting the onset and termination dates of the rainy season, to monitor crop growth in west african sorghum cropping systems (in collaboration with LaboSEP's agro-climatology unit and in partnership with CIRAD);
- NuMaSS, a Nutrient Management Support System designed by a consortium of 4 US universities within the framework of the Soil Management CRSP of USAID; in collaboration with LaboSEP's soil science unit, local scientists work at incorporating Malian pedons into the model and parameterizing phosphorus buffer coefficients along with other validation tasks;
- ScatYield, a comprehensive drought early warning system based on microwave remote sensing (scatterometer payload of the ERS satellites); here, LaboSEP's GIS and Remote Sensing Unit participates in the validation and development of the system, including the extraction of upper soil moisture, simulation of planting dates and yield prediction (in partnership with a consortium of European institutions).

Modeling activities: determining the optimal cultivation zone for photosensitive sorghum CSM388 based on Bipode water balance modeling and crop specific cycle information

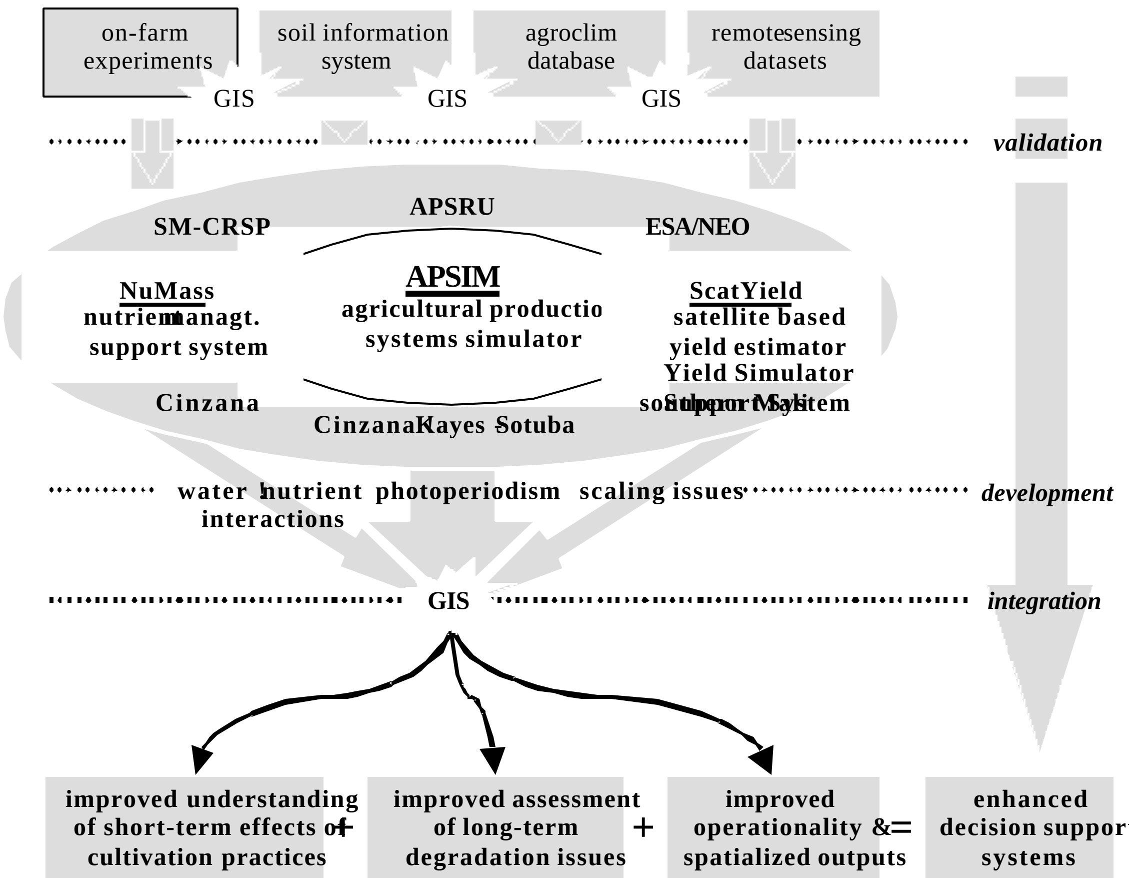


iii/ The third objective relates to capacity building in an effort to:

- strengthen networking among national institutions to capitalize information,
- train users to optimize agricultural data collection, processing and diffusion throughout the region,
- develop, adapt, validate and integrate crop and agro-meteorological models for better research guidance and enhanced early warning systems,
- develop decision support tools for national and regional institutions to help planify and integrate agricultural policies.

These activities are developed in partnership with ICRISAT, with expected involvement of INSAH, CIRAD and others. In 1998, a natural resource management committee was set up jointly by IER and ICRISAT and today's challenge is to develop spatialized interfaces for models, with special emphasis on scaling tools. These capacity building efforts are conducted within the context of specific strategic research projects, such as the parameterization of the APSIM model (ICRISAT-APSRU partnership) or the recently launched CLIMAG-AFRICA pilot project (coupling climate prediction and crop modeling, with multilateral partners). The following flowchart presents the tentative research framework for the joint IER-ICRISAT laboratory for year 2000.

IER/ICRISAT Joint Regional Modeling & GIS Laboratory: model validation, development and integration for enhanced decision support systems



SECTION 2

NEEDS FOR ANALYSIS AND ASSESSMENT BY REGIONAL PARTNERS

Regional Perspective

Dr. Gaoussou Traore

Director AGROSOC/PRISAS[1], INSAH

CILSS is an regional institution that has been created for the combat of desertification. The institution is divided in two major components :

- INSAH to address food security issues,
- AGRHYMET for Natural Resource Management / Desertification issues. Each 9 CILSS countries have a national representative through the Natural Resource Management Pole.

INSAH is also subdivided in two major programs with AGROSOC (agro-socio-econmoy) and CERPOD (population-Development).

AGROSOC overall objective is to contribute to creating conditions for a sustainable developemnt in the Sahel in the perspective of a regional integration through the seeking of food security and the sustainable management of natural resources.

Strategic options for removing agro-socio-economic constraints to sustainable development are promoted at national and sub-regional levels by[2] :

- furthering the knowledge of agro-socio-economic constraints and proposed strategic options with studies and researches on the intensification of agriculture in the Sahel (water control, production system adaptation…),
- developing and strengthening the institutional capacities of States and actors of civil society by impact assessment improvement, especially in nutrition and poverty (with capacity building development at national and regional levels for Ministries and technicians in collaboration with different partners like CIRAD, Purdue),
- developing the synergy between the National Agricultural Research Systems (NARS) that have been created to generate and promote appropriate technologies,
- providing strategies and methodological for education and communication for the perpetuation of environmental education,

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[2]CILSS/INSAH - *Major program on agro-socio-economic research, 1999-2001 three year plan draft.* Third session of the technical and Management Committee, 5-7 October 1998, 5p.

- valorizing and disseminating research results at national and regional levels.

Data collection and analysis should integrate the dynamic and the variability of the systems in order to be useful for decision makers in policy options assessment. One of the challenge is to be able to propose options for strategies and policies for helping in decision-making at all levels. This justify the importance of models which provide a powerful and efficient tool.

This should be done in taking account of priorities stemming from the « Sahel 21 » process. Sahel 21 is a participative processus, consensus and partnership based organisation to reflect the 21 century Vision of the future of the Sahel by Sahelian men and woman. Participants included CILSS and others actors like woman, young adults, traditional chief, cooperatives…Sahel 21 Vision is a federated, democratic, peaceful, Sahel in good physical and moral health, productive, competitive and respecting values, health being a strong component of the vision.

To reach these objectives, CILSS countries will need capacity building development, national and local institutions capability improvement, production diversification, economic growth and a Sahelian space establishment open toward Africa and the World.

The use of Natural Resource Data in Assessment of Food Security

Djaby Bakary

AGRHYMET

AGRHYMET models and tools have been developed in the 9 CILSS countries for different national institutions like DNM, EWS, Livestock and agricultural divisions…AGRHYMET overall objective is the production, the dissemination and the management of information concerning food security, desertification and natural resource management. AGRHYMET main activities consist in the collection, the analysis and the dissemination of meteorological, livestock, plant health and natural resource data, and in providing results through DIAPER, water balance…. with methodologies development on food security and natural resource management.
Since 3 years, AGRHYMET has developed a Early Warning Integrated System for the Sahel (SIAP) for:

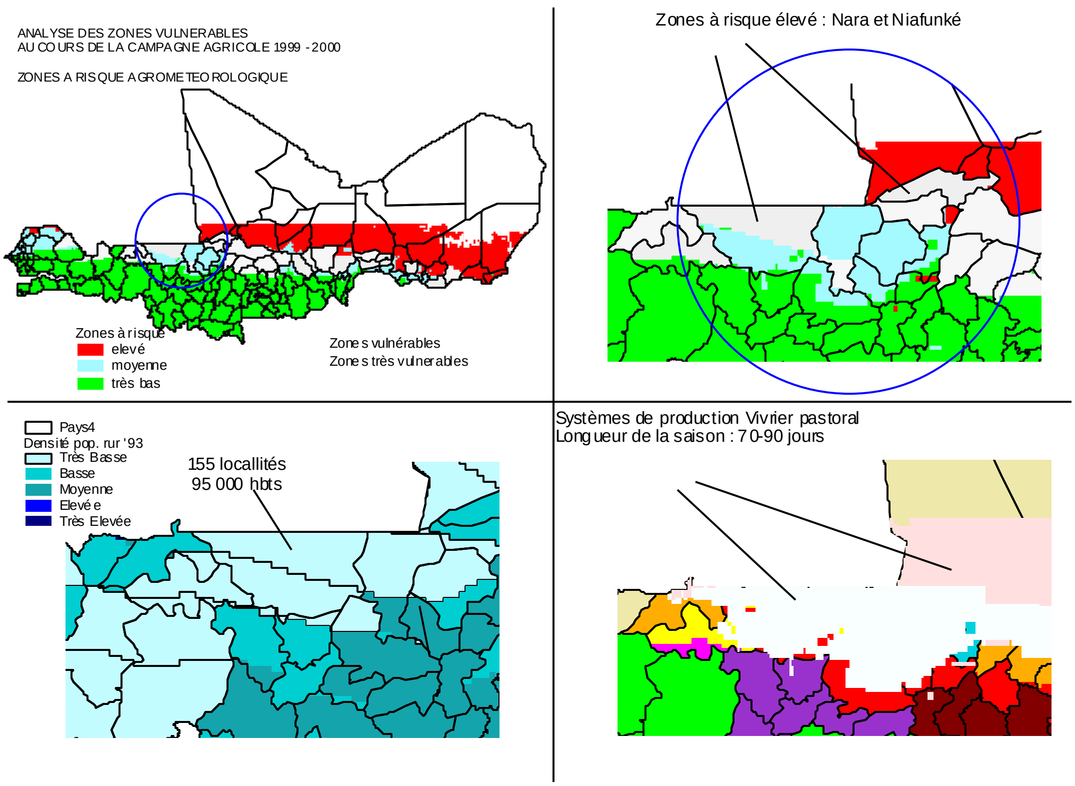
- Identify risk areas for crop-forage production,
- Identify structural and conjectural factors having an impact on Sahelian populations vulnerability,
- Provide warning products useful for both technical and policy decision makers,
- Develop GIS and Internet capabilitity

SIAP is organized into 4 components: the SGBD, the Territory Analysis System (SAT), the Proceeding in Structural Vulnerability Assessment (PRVS) and the Conjectural Analysis System (SAC).

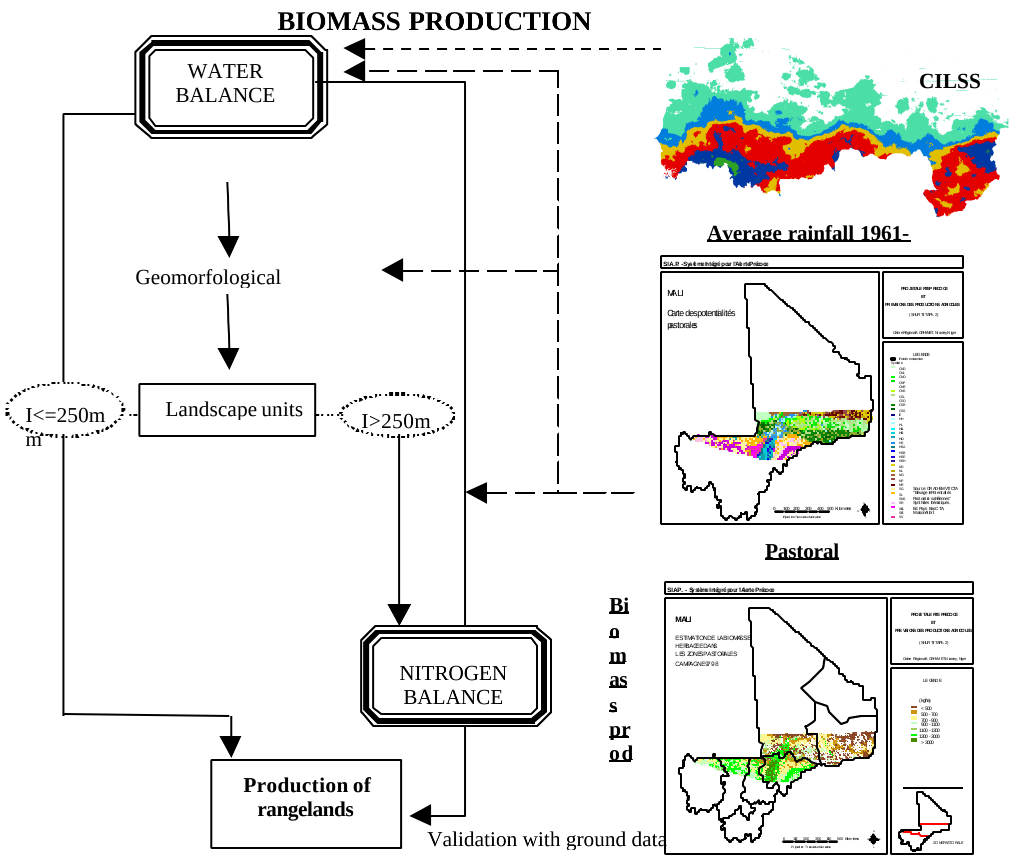
The SGBD consist in demographic (RGP at village level), agricultural (DIAPER, FEWS), livestock and meteorological data collection at meteorological stations, villages and sub-national (administrative boundaries) levels. Time scale varies from a specific date like a demographic census to period of time like 1985-1998 for agricultural data or 1961-1997 for meteorological data. The SGBD has been developed for easy use. Update is made by the national institutions. This system allows easy information dissemination and access for the CILSS countries.
The Territory Analysis System (SAT) is a GIS that provide a cartographic (administrative boundaries), thematic (population, density, crop yields, cattle…) and biophysical (soils, vegetation, climate and satellite imagery using METEOSAT, NOAA, AVHRR for rainfall

estimate every 10 days since 1993, 5km pixel or NDVI for land cover) homogeneous and coherent databases available for the CILSS countries. These databases are used to run models on vulnerability and primary production.

The Proceeding in Structural Vulnerability Assessment (PRVS) and the Conjectural Analysis System (SAC) has been developed to identify risk and vulnerable zones.



Vulnerability assessment is using agro-meteorology (rainy season duration), agricultural production, population density and cultural systems variables. Another application assesses the Sahelian forage productivity. This assessment is using a biomass production model. This model has been developed for livestock farming issues.



SIAP future is limited by several constraints like spatial resolution, aging cartographic databases, scale integration issues and the interpolation-extrapolation toward primary production units. To address these issues, AGRHYMET is working on the development of natural resource inventory using high resolution aerial videography and remote sensing with spatial interpolation. And, research will focused on methodology improvement for multi-source and multi-format data integration.

SECTION 3

NEEDS BY INTERNATIONAL PARTNERS : RELATIONS WITH FAO FIVIMS

Information Systems and Key Indicators Mapping System

Dr. Cristina Petracchi

WAICENT-FAO

The World Food Summit Plan of Action (FAO, November 1996, Rome) highlighted information as one of the priority areas in achieving food security.

Therefore, FAO established the World Agricultural Information Center (WAICENT) as its strategic program for the management and dissemination of its information. WAICENT aims at bringing together the multiple information systems, databases and publishing tasks of this large, multidisciplinary, international organization, and to reorient these activities taking advantage of the latest developments in information technology. It provides the information systems platform for accessing FAO's information resources and makes the accumulated knowledge of the Organization, in all fields of food security and agricultural development, available to millions of users around the world.

As previously stated, the WFS recognized that better information at all levels is needed to identify the food insecure and vulnerable groups, assess the extent of low food intake and under nutrition, and ascertain the main causes and elements contributing to their food insecurity and vulnerability. Better quality and more timely information is expected to contribute to the identification of appropriate policy and program responses and the targeting of interventions to improve food security and nutrition.

With this objective in mind, governments, in partnership with civil society and international institutions as necessary, committed themselves to further define, develop and periodically update a system to meet those requirements. This system is referred to as Food Insecurity and Vulnerability Information and Mapping System (FIVIMS).In establishing effective mechanisms for developing this system, the WFS encouraged all relevant UN agencies and institutions to collaborate in the further development, operation and use of national and local level FIVIMS and specifically requested FAO, to play a lead role in coordinating this effort. WAICENT contributes to the establishment of FIVIMS and will allow to expand the ability to gather, analyze and share knowledge that can guide future initiatives to increase access to food for all.

WAICENT also provides specialized information systems on topics of global relevance, such as Desertification, Gender and Sustainable Development, Food Standards, Animal Genetic Resources, Post-Harvest Operations, Agro-Biodiversity and Food Systems in Urban Centers.

Several information systems has been developed under WAICENT program as such as FAO' statistics databases like FAOSTAT, the FAO agenda, the virtual library catalogue and the WAICENT information finder.

WAICENT serves also as a plat-form for specialized information systems such as the Domestic Animal Diversity Information System (DAD-IS), EMPRES for animal and plant pests and diseases and the Global Information and Early Warning System (GIEWS).

WAICENT is also developing a new information system named the Key Indicators Mapping System (KIMS). KIMS has been specifically tailored for FIVIMS requirements and may be modified as those requirements change or expand. It is a user-friendly mapping system that displays and disseminates maps, graphs, spreadsheets, metadata and links of Food Insecurity and Vulnerability indicators and related data. The system is 100% Java based and portable across Windows, MacIntosh, Linux and other Unix platforms.

KIMS is not a Geographic Information System. It relies on GIS systems to provide its mapping layers and data providers for its data content. The software will allow the import and export of the major five GIS map formats BNA, ARC/INFO, Shapefile, IDRISI and Map Info). KIMS is specifically designed to be a tool that combines GIS maps with related data sets and displays and disseminates the information in any easy and efficient manner in stand-alone mode and over the Internet.

KIMS has been customized as a tool for national and international FIVIMS partners to help in collecting, presenting and mapping the key indicators of food insecurity and vulnerability.

The Food Insecurity and Vulnerability Information and Mapping System (FIVIMS)

Dr. David Wilcock

FAO-FIVIMS

The Food Insecurity and Vulnerability Information Mapping Systems (FIVIMS) Program consists of national and global systems for tracking progress towards meeting the goals of the World Food Summit and other international conferences. During the summit in 1996, South America countries asked for a " hunger map" program, which later on became FIVIMS. The goal was to reduce food insecurity from 830 billions in 1996 to 415 billions in 2015. Specific objectives were to:

- increase awareness of food security issues,
- improve data quality and food security analysis at local and national levels,
- develop a better knowledge of information needs of the different action plans,
- enhance the collaboration between donors, technical agencies and national institutions to ensure sustainability of national systems,
- Improve users information access through network development and information access.

To address these objectives, FIVIMS was created and is defined as "*any system or system network that assembles, analyzes and disseminates information about people who are food insecure or at risk*".

FIVIMS is a framework within which a wide range of activities may be carried out at both national and international levels in support of improved information to achieve World Food Summit goals.

- At the national level, it is implemented through a network of information systems that gather and analyse data relevant for measuring and monitoring food insecurity and vulnerability. This network is referred to as a *national FIVIMS*.
- At the international level it is implemented through a diverse program of activities that aim to support national FIVIMS and establish a common database and information exchange network, referred to as *global FIVIMS*.

At the international level, different organizations formed an *Inter-Agency Working Group on*

Food Insecurity Vulnerability Information Mapping Systems (IAWG-FIVIMS) to oversee the development of FIVIMS internationally and coordinate related efforts addressing the problem of food insecurity and vulnerability. The IAWG-FIVIMS UN agencies currently include representatives from over 20 agencies and organizations, including bilateral donor agencies, NGOs. Four international meetings have been organized since 1997 and since February 1999, a permanent secretariat has been established at the FAO headquarters. Four FIVIMS sub- working groups are operational (country applications, indicators-assessment-mapping, technical materials and Common International Database).

International activities support the establishment and strengthening of national FIVIMS. The national FIVIMS are the driving force behind the entire FIVIMS initiative. It is at the national level that progress will be made towards the goal of halving the number of food insecure by 2015.

At national level, FIVIMS is based on existing national and sub-national information systems related to food security. It responds to the information needs of different user groups within the country itself. FIVIMS is operated and controlled by the country involved, designed in response to the needs of national decision-makers. The goal is to contribute to the reduction of food insecurity and vulnerability by better access to more comprehensive, up-to-date information, enhancement of food security policy formulation, improvement of the design and targeting of interventions and by monitoring of progress.

To this end, it was agreed that the development of FIVIMS at country level should be promoted by UN Administrative Committee for Coordination (ACC) Thematic Groups on Rural Development and Food Security, a mechanism established to ensure appropriate inter-Agency coordination for World Food Summit follow-up at the field level. The principal orientations are to develop a consensus on standards for the information systems, to define short-term (transitory) and long-term (chronic) Food Security problems, to promote systems like FIVIMS type at the national level and to stress the uses and the improvement of the existing systems for sustainability.

To address these objectives at both level, the Key Indicator Mapping System (KIMS) has been developed. KIMS is a user-friendly mapping system especially developed by the World Agriculture Information Centre (WAICENT) of the Food and Agriculture Organization of the United Nations. KIMS was designed for data-sharing, mapping key indicators and information retrieval purposes. KIMS is a tool for national and international FIVIMS partners to support the presentation and mapping of key indicators of food insecurity and vulnerability.

SECTION 4

TEXAS A&M DECISION SUPPORT SYSTEM: MODELS AND RESULTS

Impact Methods to Predict and Assess Contributions of Technology (IMPACT)

Dr. Neville Clarke
Texas A&M University

USAID Grant No. PCE-G-00-97-00051-00

The results described in this part of the workshop provided "proof of concept" for a methodology for impact assessment that was developed in Mali and other locations over the last two years. The reports in this part of the workshop describe (1) methods developed and (2) results of case studies which were used as research platforms. While the case studies reflect specific assessments of impact of new technology, the methods are more general in their utility. It is this suite of models that will be further developed and evaluated for use to assist decision makers in developing improved methods to assess food security.

The purpose of this workshop is to plan for further development and evaluation of the IMPACT models and methods to improve the assessment of status and estimate the economic and environmental impact of options to enhance food security. As described in the announcement of this planning workshop, its product will be a refinement of the plan of action for a pilot study in Mali to develop methods and their practical use in assessing the status of food security now and in the future and the impact of new technology or policy options on food security.

These presentations cover research done for the USAID Office of Agriculture and Food Security of the Center for Economic Growth and Agriculture (Global Bureau). The overall objective was to develop and evaluate methods to assess the impact of the introduction and use of technology resulting from USAID investments in agriculture and natural resources for developing countries. A suite of integrated interactive models was created for use in developing countries to assess the economic, environmental, and sociologic impact of such technologies. The research, conducted in East and West Africa, involved acquiring relevant data bases and expert opinions through collaboration with national and regional partners, establishing a spatial framework using GIS methods to organize and analyze spatially explicit information, development of biophysical models to estimate production and environmental consequences of new technology and adaptation and use of economic sector and farm level models to estimate their economic consequences. Environmental consequences of technologies adopted by farmers in developing countries were estimated at field, area, and watershed levels. Methods were developed and evaluated to estimate the adaptation of new technology to geographically similar zones in areas that were both contiguous and noncontiguous to the locations where the technology was developed.

The approach involved using case studies of research sponsored by USAID as platforms for development and evaluation of the methodology, thereby providing both new methodologies and illustrative examples of the utility of the products. The project has demonstrated the proof of concept for the approach and, while the resulting products are judged to be imperfect, they are usable for the stated purposes. Further development is being continued under the Global Project of the SANREM CRSP.

Studies were done in both East and West Africa. In our reports for the workshop, we will focus our comments on the West Africa studies because of their obvious relevance to the Mali Pilot Study which is the subject of this workshop. Following this overview, abstracts of individual presentations are presented as background for the workshop.

Design Matrix For This Study

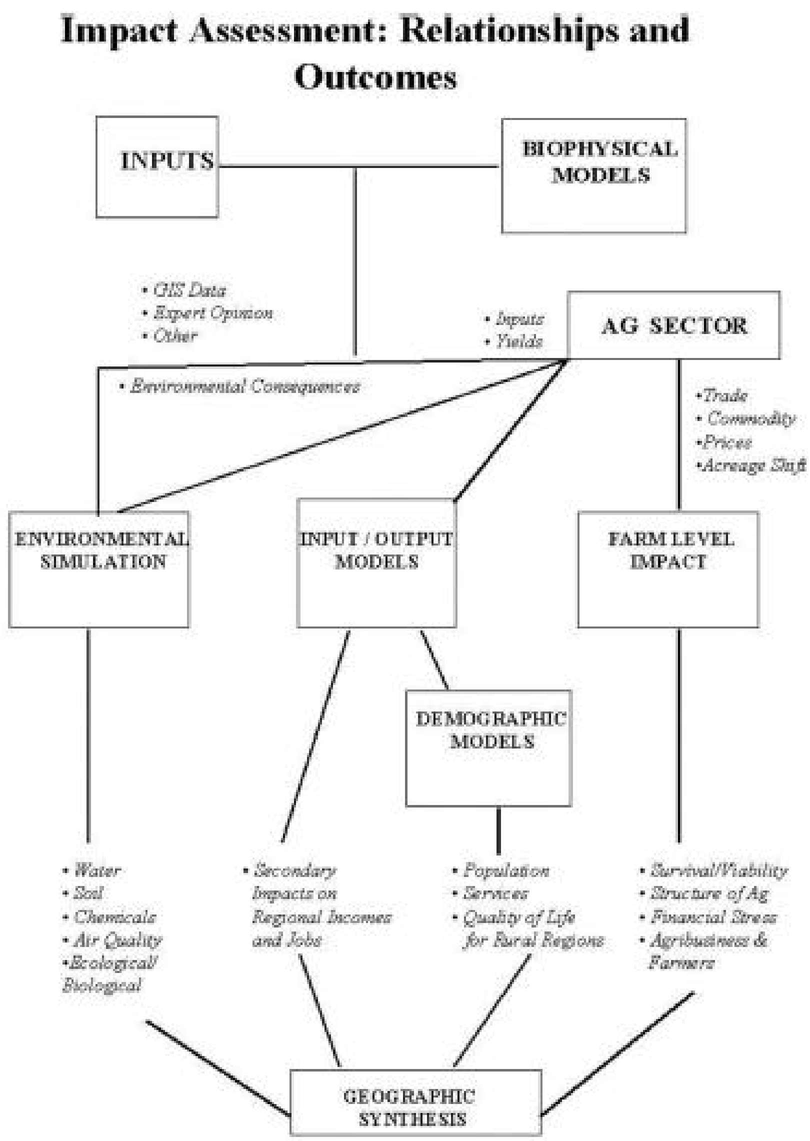
The objective of this project is the development of methodologies for impact assessment. The approach involved using “real world” case studies as a platform for development. Case studies were chosen to be representative of the USAID research portfolio and reflect geographic and commodity diversity, thereby adding robustness to the product. The following design matrix for the project shows how these variables were reflected in the study.

Design Matrix for the Study

Location	East Africa	West Africa
USAID Grantee	International Livestock Research Center and national collaborators	INTSORMIL and Peanut CRSPs and national collaborators
Initial Evaluation	Kenya	Mali
Commodity	Small Holder Dairy	Sorghum
Technology	Evolution of dairy technology	Sorghum production system
Regional Extrapolation	Uganda, Tanzania	Senegal, Burkina Faso

The Concept of IMPACT

The conceptual framework for IMPACT is shown in figure one. The distinguishing aspect of this methodology is the interactive linkage of models that assess environmental, economic, and societal consequences of the introduction of new technology. The suite of models may be used together or in parts, depending on the nature of the assessment. The geographic and institutional scales at which the methods have been developed and tested include farm or household, watershed, sub-national (provincial) and national levels. As the methods evolve, there is ongoing effort to provide better means of relating the output of models at these various levels of scale.



Developing a spatial framework and analysis capacity for related data and information that are linked to the suite of models is another important feature of IMPACT. This provides a means of organizing and processing related data bases into a geographically coherent manner. The processed data is referred to in this method as foundation data, which can be used repeatedly for similar analyses. Spatially explicit analysis of related geographic variables provides a basis for establishing areas of similar agro-environmental characteristics. This offers a more precise mechanism for establishing appropriate sampling frames for the assessment and is used in estimating areas of geographic equivalence where a technology package or policy option developed for one site might be adaptable to another. The methods have been used to predict the adaptability of technology developed in one country to geographically equivalent regions in adjacent countries. Ensuring usability of the products is a major challenge for this project. Workshops and longer term training will be limited in this effort, but continued in subsequent activities. Packaging the data and models into usable forms for counterparts in developing countries is part of the overall effort. Potential users of IMPACT in developed country locations will have full access to both methods and information.

Summary
Principal Elements of the Approach for Developing IMPACT

The concept of IMPACT was implemented by employing a set of general principals that are discussed in the remainder of this section of the report.

- Building on previous experience
- Linking economic, environmental, and societal consequences of change
- Ensuring that common bases for primary data are used among the models
- Risk assessment
- Enlightened use of spatially explicit analysis
- Linking the biology of land use and economics within politically defined boundaries
- Managing Scale and Resolution
- Estimating things that are difficult or impossible to measure
- Evaluation of outputs, expert opinion, factors affecting adoption
- Capitalizing on current and previous research data
- Using case studies for developing and extending analytic capability
- Developing proof of concept
- Evolution of methods during the research to reach the form presented in the results
- Participatory approach with national partners for capacity building

Generic Approach

- Definition of the Dimensions of Assessment
- Establish a baseline scenario against which effects of change will be estimated
- Define explicit scenarios to be modeled
- Establish a spatial framework for the analysis
- Identify sources of expert opinion or knowledge at the appropriate level of scale
- Define information needs, acquire information, estimate missing data
- Parameterize and modify or develop models
- Define linkages between models for input-output and iterative relationships
- Acquire or estimate inputs to models
- Iterative analyses and evaluation of model outputs - separate and aggregate
- Interpretation
- Capacity building and transfer to user(s)
- Importance of clear definition of goals and procedures in a multidisciplinary operational environment
- Meeting the needs of different decision makers

Summary

The Design Matrix For This Study

The main components of the specific experimental design used to develop methods in the two case studies includes the following:

- Chose case studies with existing data and related background
- National collaborators as experts and users
- Modeled missing input data
- Developed model interfaces
- Constructed sector models at country/province levels
- Defined zones of agro-environmental equivalence
- Rapid appraisal and in depth interviews as needed
- Introduced sociologic-cultural variables as constraints on adoption
- Evaluated intensification and extensification strategies
- Predicted adaptation and adoption at locations other than site of origin of data
- Conducted Evaluative workshops

Dimensions of the Assessment

Subject Matter Questions	Spatially Linked Questions
Initial Conditions Terms of the technology or policy to be assessed Baseline conditions into which the technology or policy will be introduced Define missing data and plans for acquiring or estimating them Assumptions about adoption and factors affecting it Externalities affecting adoption Historical data and information needed for stochastic analysis	**Initial Conditions** Definition of the geographic area in which the assessment will occur Economic and statistical data defined by political boundary Historical data on representative farms Experimental and demonstration data for the technology package being assessed Natural resource, environmental, and meteorological data (georeferenced) Relevant agro-environmental zones (geographically equivalent)
Products and outputs resulting from change Economic outcomes Environmental outcomes Societal outcomes	**Locations of outcomes of technology or policy adoption** Commodity shifts along economic and risk based gradients Intensification vs extensification Prediction of adaptation using geographic equivalence Adaptation vs Adoption

Examples of Products or Outputs of Models:

- Assuming decisions are driven by economic and risk aversion strategies at the farm level, what changes result from introduction of new technology or introduction of new policy? Examples include :

  - Changes in quantities, prices, and location of food
  - Changes in producer and consumer benefits - Who will benefit and who will be disadvantaged by adoption of the technology or policy?
  - Defining change at national, provincial, farm or household and other levels of institutional scale
  - Shifts in land use among and between commodities
  - Intensification and extensification to meet changing demand and their effects

- What will be the long term environmental and natural resource consequences?

  - Soil
  - Water
  - Downstream consequences of upstream practices

Economic Impacts of Improved Technology and Alteration of Risk Aversion in Mali

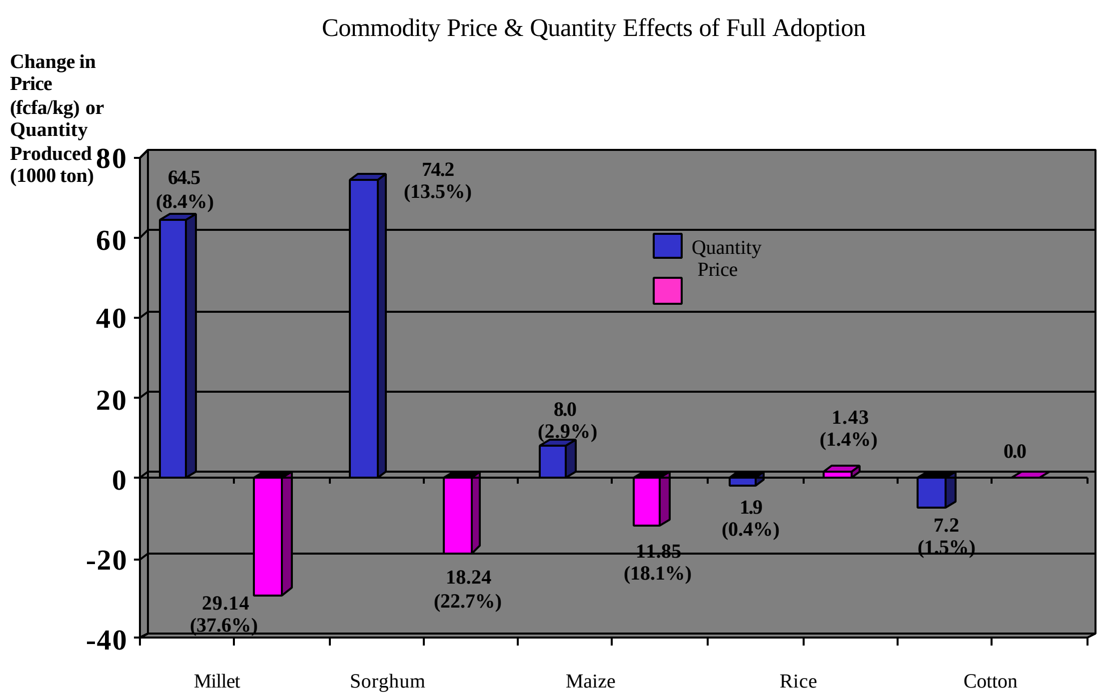
Dr. Bobby R. Eddleman

Texas A&M University

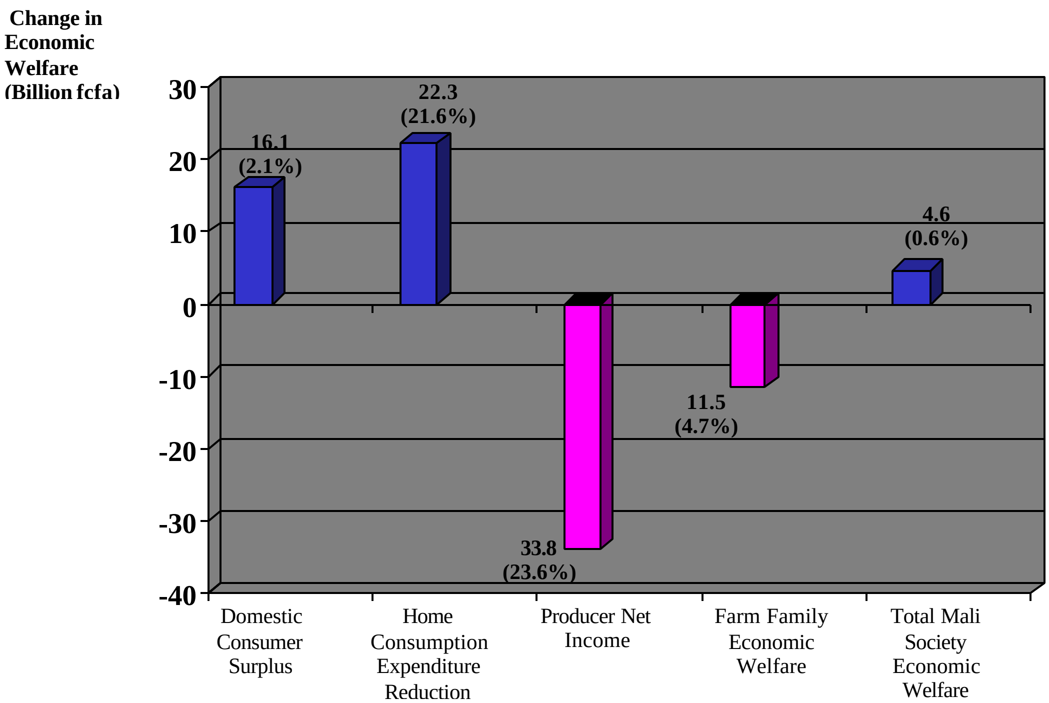
An agricultural sector model (ASM) for Mali was constructed and used to estimate economic impacts to Mali from adoption of variety, fertility and tillage/water retention improvements for sorghum and millet production. The Mali ASM is a price-endogenous mathematical programming approach that simulates the agricultural sector under a given set of supply and demand conditions. ASM maximizes consumers' plus producers' economic surpluses under conditions of subnational regional constraints on land, labor and minimal nutritional requirements for farmer and family self-consumption. It assumes economically driven decisions by farmers; is interactive among commodities, locations (subnational production regions), and consuming groups; and includes relationships among quantities and prices of commodities produced and consumed (supply and demand balances). The Mali ASM was used to appraise technology improvements by setting up alternative scenarios reflecting crop and livestock yields and per unit production costs for different technology and adoption rate conditions. The evaluation of the INTSORMIL related technology to improve sorghum and millet production was selected as a test platform to develop and apply these methods which have a more general utility that will be used in the Mali Pilot Study on FIVIMS.

Variety improvements included breeding shorter season and higher yielding sorghum and millet varieties, *Striga* resistant sorghum varieties, and food quality sorghum varieties suitable for processing into value-added products for sale in urban markets. Cultural practices involved ridge tillage and contouring to improve water retention of soils and increased use of manure and/or inorganic fertilizers to increase crop yields. Impacts of improved sorghum and millet technologies on price, quantity produced and consumed, and economic welfare in Mali are assessed.

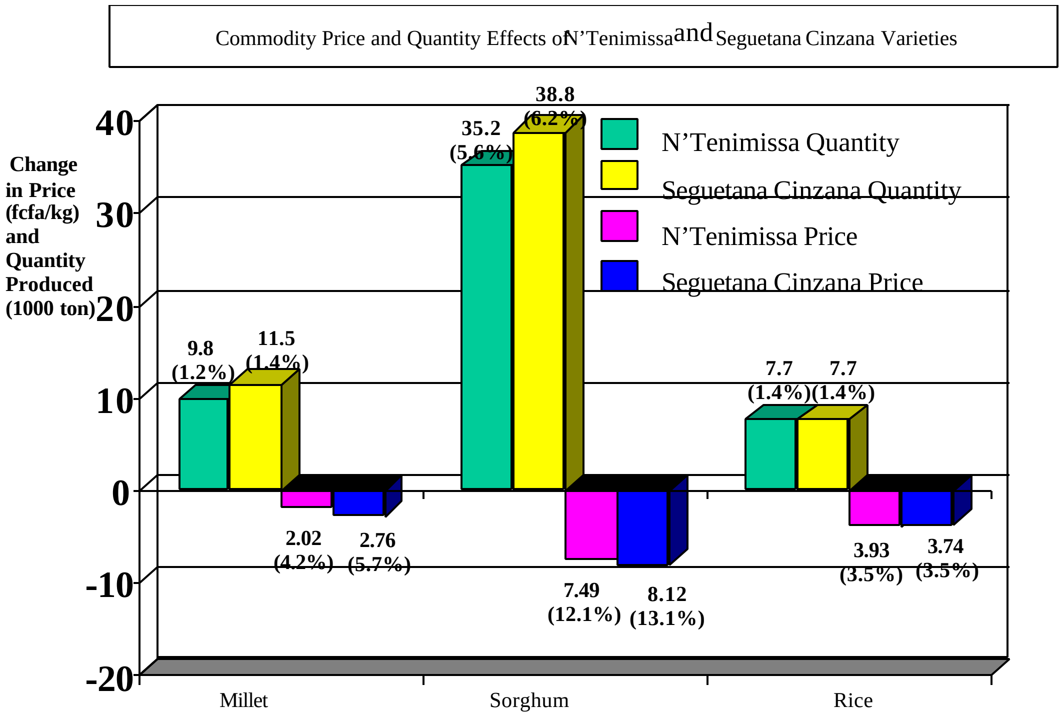
Full adoption of existing sorghum and millet varietal and cultural practices would reduce sorghum price by 18.24 fcfa/kg (22.7%) and millet price by 29.14 fcfa/kg (37.6%) compared with base 1997 model solutions. Sorghum production would increase 74.2 thousand tons (13.5%) and millet production would increase 64.4 thousand tons (8.4%). Consumers in cities, towns and regional markets experience economic gains of 16.1 billion fcfa (2.1%) annually with regions in Mali having the largest concentrations of people in cities and towns gaining the most (e.g. Bamako, Koulikoro, Segou, Sikasso, Kayes). In contrast, producers experience a 33.8 billion fcfa (23.6%) annual reduction in the returns to their labor, land, management and risk. This loss is partially offset by a 22.3 billion fcfa (21.6%) annual reduction in home-consumption expenditures for food by farmers and their families. Annual net loss in economic benefits to producers and rural families is 11.5 billion fcfa (4.7%) annually.



Economic Welfare Effects of Full Adoption

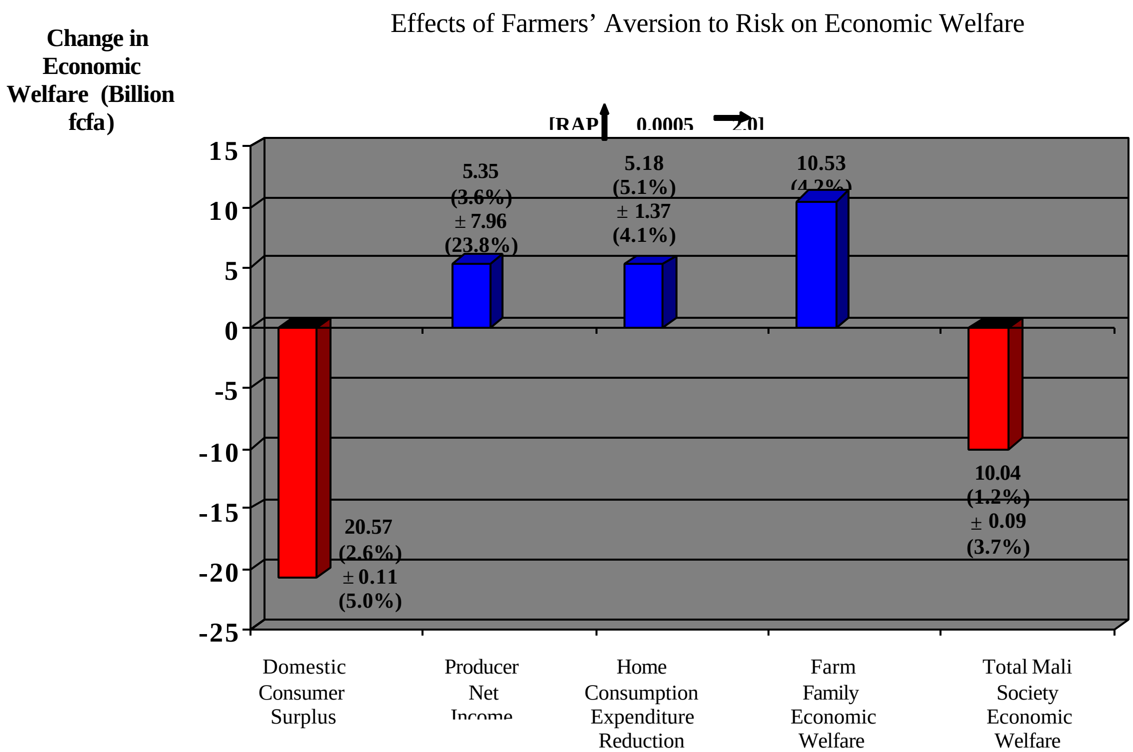


N'Tenimissa, a high-yielding, white-seeded, tan-plant, guinea-type variety tolerant of sorghum head bugs and ideal for processing into white flour mixes and value-added products (breads, biscuits, confectioneries, sorghum crunch, composite flours), and Seguetana Cinzana, a *Striga*-resistant, guinea-type variety resistant to head bugs, are introduced into the model and allowed to compete with local varieties under full adoption conditions. Introduction of N'Tenimissa variety reduces the prices of sorghum and millet by an additional 7.49 fcfa/kg (12.1%) and 2.02 fcfa/kg (4.2%), respectively. Sorghum production increases an additional 35.2 thousand tons (5.7%) and millet production increases an additional 9.8 thousand tons (1.2%). In comparison, sorghum price decreases 8.12 fcfa/kg (13.1%) and quantity increases 38.8 thousand tons (6.2%) when Seguetana Cinzana is introduced. Millet price decreases 2.76 fcfa/kg (5.7%) and quantity increases 11.4 thousand tons (1.4%). Regional consumers in towns and cities gain 5.57 billion fcfa (0.7%) annually from N'Tenimissa and 6.11 billion fcfa (0.8%) annually from Seguetana Cinzana. Producers and their families experience a net economic loss of 1.65 billion fcfa (0.8%) from N'Tenimissa and 1.93 billion fcfa (1.0%) from Seguetana Cinzana.



Increased risk aversion by producers to avoid uncertainty alters production, demand and welfare. When the risk aversion parameter (RAP) increases from a value of 0.0005 to 2.0, regional consumers in cities and towns lose economic benefits amounting to 20.57 billion fcfa (2.6%) annually while simultaneously experiencing a 0.11 billion fcfa (5.0%) reduction in their economic welfare variability. In contrast, producers experience a 5.35 billion fcfa (3.6%) gain in net returns to land labor, management and risk which is augmented by a reduction in home consumption expenditures of 5.18 billion fcfa (5.1%) annually. Producers net income variability decreased by 7.96 billion fcfa (23.8%) while home consumption expenditure variability decreased 1.37 billion fcfa (4.1%).

The loss in domestic consumer economic welfare was substantially greater than the gain in returns to farmers' production resources and home consumption expenditure decreases for them and their families. Consequently, total economic welfare to the Malian society is reduced 10.04 billion fcfa (1.2%) annually while economic welfare variability is reduced by .09 billion fcfa (3.7%) annually. Increased aversion to risk in order to avoid uncertainty that may appeal to individual producers and farm family households may have aggregate sector effects through market adjustments that diminish economic welfare to domestic consumers as a group and to society as a whole.



Evaluating Risks and Impacts at the Farm Level of Introducing New Technologies in Mali

Harvey Hill

Texas A&M University

Part of the challenge of conducting *ex-ante* economic analysis is estimation of the future uncertainty, or risk farmers will face. Much of the risk in SSA agriculture is due to the uncertainty associated with the biological processes in agricultural production Uncertainty in rainfall dominates risk factors. But, the dynamic characteristics of economic systems (i.e., market variability) also impose risks. As Mali's economy develops, the risk associated with economic change will likely increase. The increasing variability in the biological environments (i.e., climate change) of Mali also accentuates the need for incorporating risk into the analysis of technological impacts on agriculture. The objective of this research, therefore, was to adapt stochastic methods to evaluate farm level economic impacts in SSA. The case study used examined the result of implementing new technologies in Mali with the incorporation of uncertainty of future outcomes under alternative technology assumptions. This objective was met by: 1) quantifying the risks faced by Malian small holder farmers; 2) generating statistically significant probabilistic forecasts of the economic outlook for given alternative technology assumptions; and 3) determining the preferred strategies for implementing new technologies on small holder farms in Mali.

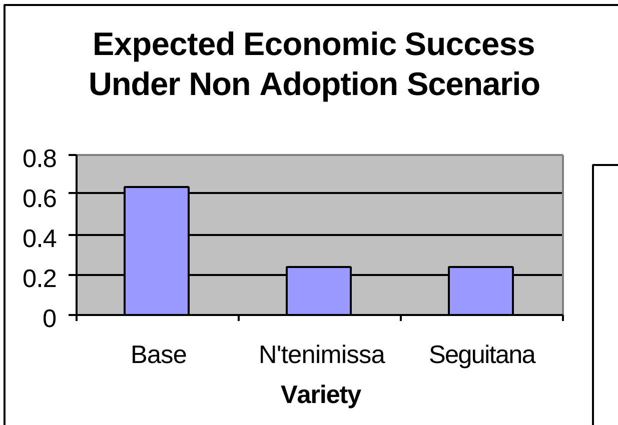
The simulations used the Farm Level Income and Policy Simulation Modeling System model (FLIPSIM). The FLIPSIM model is a Monte Carlo simulation model that analyzes the economic and financial impacts of alternative technologies, production practices, and policies on representative or case farms in developing countries. Because FLIPSIM is a whole farm simulation model, all on and off-farm activities are taken into account. Computations in FLIPSIM are performed with a series of table lookup functions, accounting equations, and identities. Stochastic crop prices and yields were generated with table lookup functions from empirical probability distributions provided by the analyst. Crop production, sales, and on farm use for both family consumption and livestock feed, were calculated using mathematical accounting equations. Identities were used to calculate receipts for crops and livestock as well as changes in herd dynamics. It is important to note that FLIPSIM does not use any econometric relationships.

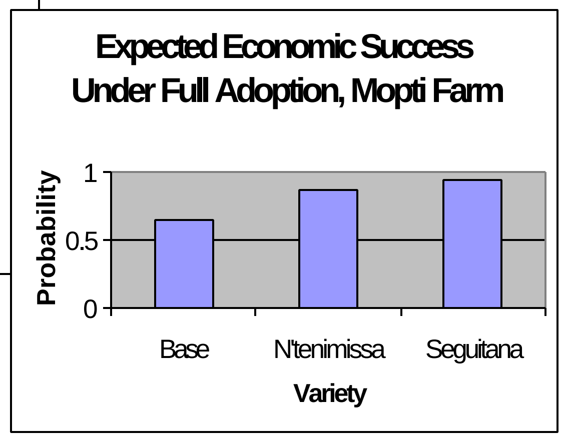
The impacts of introduction of two specific germplasm improvements were analyzed. These varieties were developed by scientists from the Institut D'Economie Rurale (IER) and their US collaborators with support through the USAID INTSORMIL CRSP. The two improved varieties of guinea-type sorghum studied were N'Tenimissa and Seguetana. N'Tenimissa is a white-seeded sorghum that has been recorded to yield a 25 percent yield increase over local varieties in field tests. The Seguetana is a *Striga* resistant variety. Seguetana is shown to out yield indigenous varieties by 33 percent under field conditions. The yield increases provided by INTSORMIL were the same for all of the regions in this study.

Case farms were used to evaluate the farm level economic impacts of implementing new technologies in Mali. Regional experts selected farms in representative Malian agro-ecological environments. The determining factor in the selection process was the annual rainfall that each area receives. The case farms in these regions were also targeted for the introduction of the improved sorghum varieties. The case farms selected for this study were located in Mopti, Segou, and Koulikoro. This study assumed that the improved sorghum varieties would be introduced and cultivated in the same cropping system currently used with local varieties of sorghum. Current farming practices include animal traction and manure, ridge tilling, and hand harvesting.

Because of data limitations, the macroeconomic decision variables in FLIPSIM, such as the inflation rate, remained constant. The Mali Agriculture Sector Model (ASM) was used to determine the changes in crop prices under the two technology scenarios. The percent change in regional prices for each crop was calculated in the ASM under both scenarios. These changes were assumed to be accurately calculated in Mali ASM.

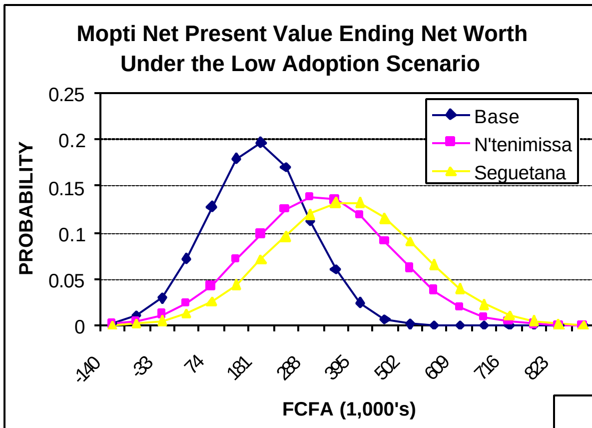
The effects of introducing N'tenimissa and Seguetana were assessed assuming three levels of adoption, low adoption, non-adoption, and full adoption. In the low adoption scenario, the varieties were adopted on the case farm but not widely at the regional or national level. The additional sorghum production at regional and national levels was not sufficient to affect the price. Consequently, the case farmers reaped the rewards of a higher sorghum yield without the effects of price changes. In the non-adopting scenario, the technology was widely adopted at the regional and national level but not on the case farm. Agricultural prices declined in the non-adopters scenario caused by the increased yield of the improved varieties. Consequently the case farm faced a lower price regime with lower yields than the regional average resulting in lower expected net returns. In the full adoption scenario, the improved sorghum technology was adopted at the regional and national levels, as well as on the case farm, in this scenario the producers' net returns improved marginally.

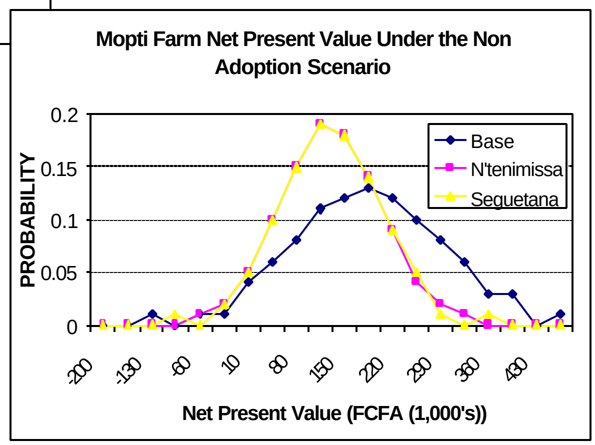




Results from the FLIPSIM analysis showed the preferred technology alternative was the adoption of Seguetana sorghum. Farmers who adopted Seguetana sorghum early benefited the most. They witnessed incremental declines as more producers adopted the technology and prices adjusted downward for most foodstuffs. The benefit of adopting Seguetana sorghum was greatest in the Mopti example. Adverse farming conditions magnified the effect of improved yields in Mopti. In Segou the ability to produce cotton limited economic effect on the farm of the introduction of Seguetana sorghum as the price for cotton remained constant while foodstuff prices declined with increased sorghum production. Koulikoro benefitted from the increased yield, a positive movement in the rice price and stable cotton prices.

The use of the farm level model can assist farmers and policy makers in understanding how economic effects modeled at the national and regional level in the ASM can be translated to the farm level. By combining the macro figures produced by the ASM with the FLIPSIM analysis sets of policy and technology initiatives can be assessed to determine which strategy or strategies minimize producers' risk while maximizing farm, national and regional level benefits.


Mopti Net Present Value Ending Net Worth
Under the Low Adoption Scenario
PROBABILITY
0.25
0.2
0.15
0.1
0.05
0
-140
-33
74
181
288
395
502
609
716
823
FCFA (1,000's)
Base
N'tenimissa
Seguetana


Mopti Farm Net Present Value Under the Non
Adoption Scenario
PROBABILITY
0.2
0.15
0.1
0.05
0
-200
-130
-60
10
80
150
220
290
360
430
Net Present Value (FCFA (1,000's))
Base
N'tenimissa
Seguetana

Methods and Data Bases for Spatially Explicit Analysis To Estimate the Impact of INTSORMIL Technology in Mali, Senegal, and Burkina Faso

Dr. John Corbett

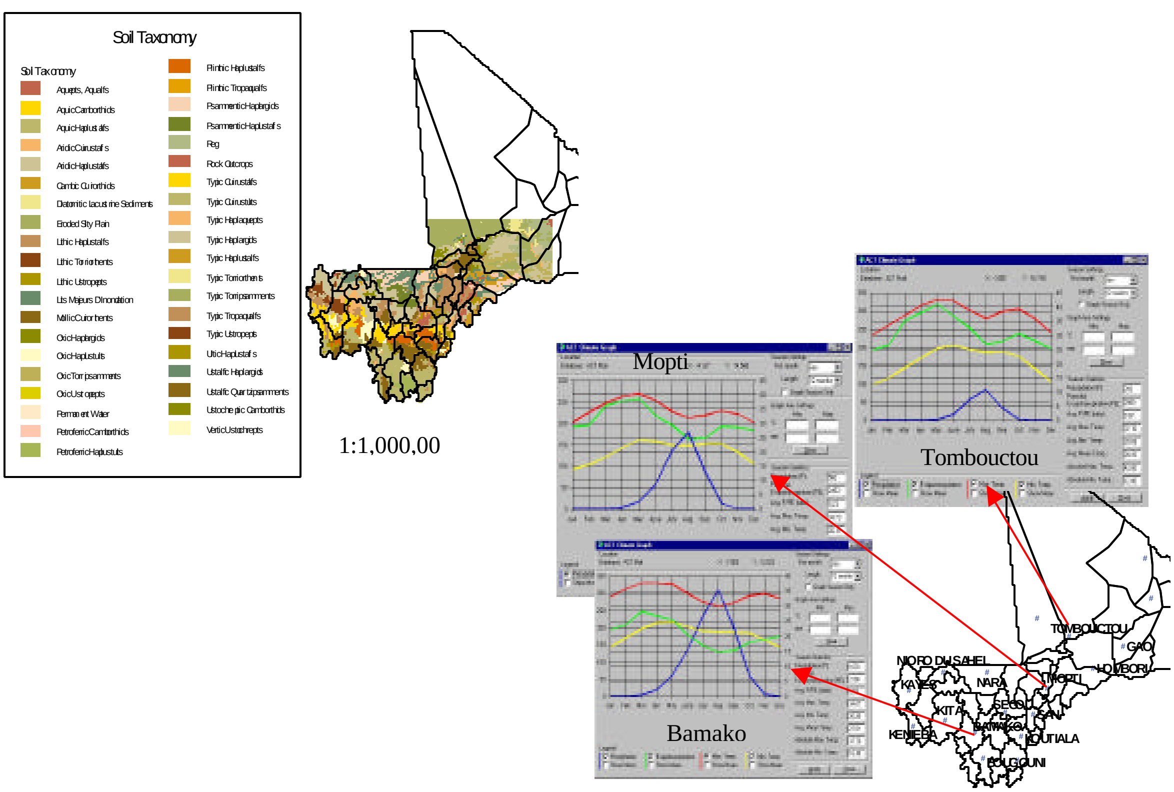
Texas A&M University

Using spatial information system methods, relevant data bases and descriptions of the environmental, human, and agricultural characteristics of Mali, Senegal, and Burkina Faso were placed in a spatially coherent framework. These data were further integrated for use in analysis of the impact of the introduction of a new sorghum production system in Mali and adjacent countries. For this case study, a general methodology was developed using the spatial framework to relate economic, environmental, and biological assessments of new technology. One output of this study was the completion of a Mali "Almanac Characterization Tool" or ACT. The Mali country almanac joins 11 other completed country almanacs for sub-Saharan Africa.

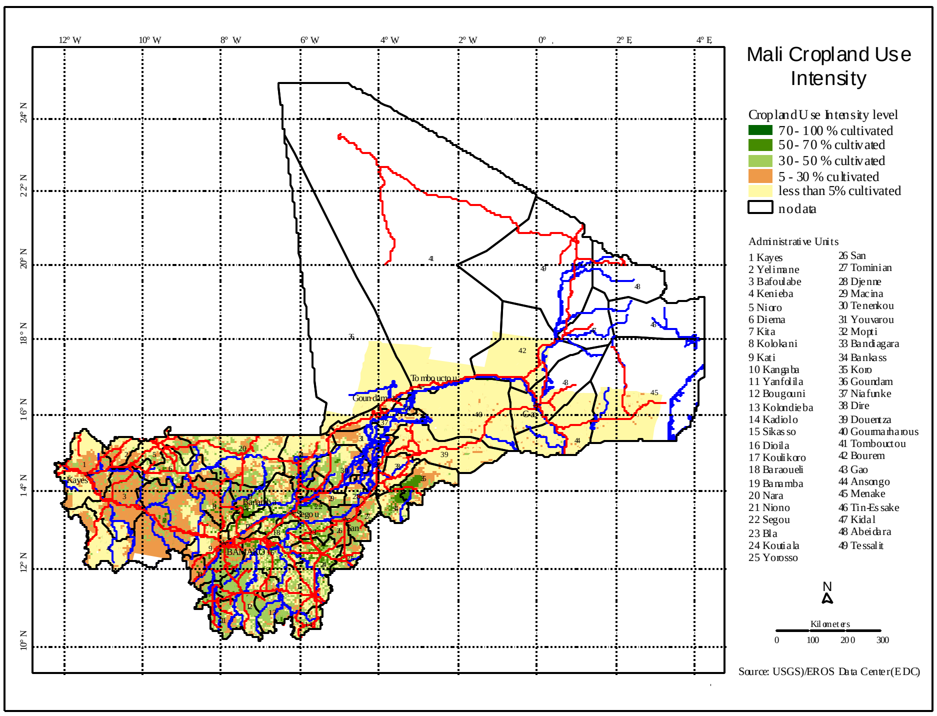
With the foundation data in place in the ACT for Mali and adjacent countries, the spatially coherent framework contributed to several of the key analyses done in this case study. The object oriented design of the ACT enables the construction of linkages between multi-disciplinary data at multiple resolutions. The IMPACT group took advantage of this structure not only to set the spatial sample frame but also to report results extrapolated across the region.

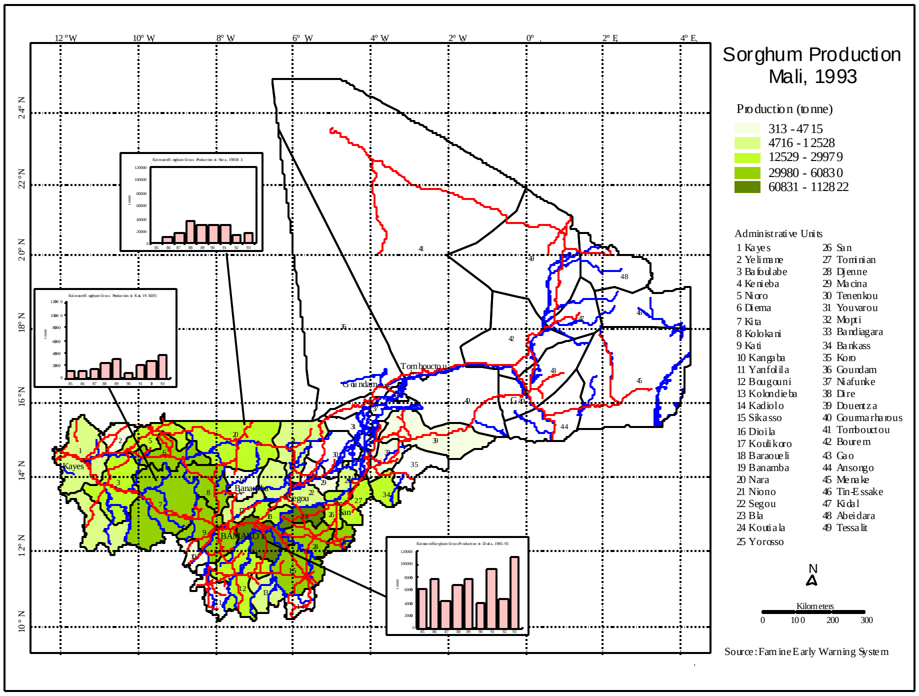
The framework allows for definition of appropriate sampling frames for planning and characterization of experimental sites to evaluate the new technology. Specific characterizations also provide a definition of areas from which representative individual farms or households are selected for more detailed study using farm level economic models. Using the concept of ***geographic equivalence***, estimates were made of areas into which the new technology under evaluation may be adapted.

Spatial sampling methods were used to link crop simulation and economic models. The relevant historical data for economic models are stratified by political boundaries in which they are collected. Biophysical models that produce information on the performance of various crops and rangeland ***are not defined by political boundaries***, but by geographic zonation characterized by environmental and natural resources. The main factors used to estimate areas of geographic equivalence were precipitation, the ratio of precipitation to evapotranspiration, rainfall patterns, and soil types. The ACT was used to define areas across the countries of interest based on these variables and we produced a set of “simulation zones” that have specific areal extent (polygons). A crop simulation model (EPIC) was used to estimate the performance of the relevant commodities within those simulation zones. The simulation zones were then aggregated within political boundaries (area weighted averages), providing a means of combining the output of biophysical models and economic data in a common spatial framework- defined for economic analysis by political boundaries. This provided a means of estimating the performance of common commodities within politically defined boundaries using existing practices. In the case of sorghum (and peanuts which were also studied), the method also allows for comparison of existing performance to that predicted using the new technology developed in INTSORMIL. From this, other models in IMPACT predict economic and environmental consequences of introduction of the new technology.



The Environmental Policy Impact Calculator (EPIC) was used to simulate the performance of economically important crops in the region. The model has been extensively used in the US and other countries and was adapted for use in Mali, Senegal, and Burkina Faso. It is a geo-referenced hydrology-based crop production and environmental response model which predicts variability of yields, erosion, nutrient loss, and pesticide loading in response to management input and weather dynamics. Research is continuing to refine the inputs and model parameters to better fit its use in this region of SSA.




Sorghum Production
Mali, 1993
Production (tonne)
313 - 4715
4716 - 12528
12529 - 29979
29980 - 60830
60831 - 112822
Administrative Units
1 Kayes
2 Yelimane
3 Bafoulabe
4 Kenieba
5 Nioro
6 Diema
7 Kita
8 Kolokani
9 Kati
10 Kangaba
11 Yanfolila
12 Bougouni
13 Kolondieba
14 Kadiolo
15 Sikasso
16 Dioila
17 Koulikoro
18 Baraoueli
19 Banamba
20 Nara
21 Niono
22 Segou
23 Bla
24 Koutiala
25 Yorosso
26 San
27 Tominian
28 Djenne
29 Macina
30 Tenenkou
31 Youvarou
32 Mopti
33 Bandiagara
34 Bankass
35 Koro
36 Goundam
37 Niafunke
38 Dire
39 Douentza
40 Goumarharous
41 Tombouctou
42 Bourem
43 Gao
44 Ansongo
45 Menake
46 Tin-Essake
47 Kidal
48 Abeidara
49 Tessalit
N
Kilometers
0
100
200
300
Source: Famine Early Warning System
12° W
10° W
8° W
6° W
4° W
2° W
0°
2° E
4° E
24° N
22° N
20° N
18° N
16° N
14° N
12° N
10° N
Kayes
Tombouctou
Goundam
Segou
BAMAKO

Comparing the Analysis of the Economic Impacts of Improved Technology Using an Economic Surplus Approach and An Agricultural Sector Model

Harvey Hill

Texas A&M University

The objective of developing the suite of economic, environmental, and biophysical models (IMPACT) is to assist decision makers assess how alternative technologies impact and enhance the sustainable production of food. To develop and appraise the models in Mali, we evaluated the impact of the introduction of new germplasm and cultural practices developed with support from the USAID INTSORMIL CRSP. Part of the overall study involved using two methods to compare the economic impact of a set of new technologies in Mali .

The first method, the Agricultural Sector Model (ASM) is a global equilibrium model that estimates the sub-national, national and international impacts of improved technologies. The second, the Economic Surplus model (ESM), is a simpler model that requires less resources to develop than the ASM approach but conversely yields less information. Comparing the results using these methods provides a basis for evaluating the trade-off between simplicity and the value of information. In turn this allows one to determine, for individual assessments, if the cost savings obtained by using the ESM outweigh the benefits of the added information provided by the more costly ASM.

Results from the ASM are reported elsewhere in the workshop. Like the ASM, the ESM was used to estimate the economic impacts on Mali's economy of the adoption of variety, fertility, and tillage/water retention improvements for sorghum production. The ESM is a static price-endogenous model that calculates the price equilibrium before and after a technological innovation. The current version is deterministic in nature and assumes risk neutrality. The ESM approach assumes economically driven decisions by farmers and consumers. Unlike the ASM approach the ESM maximizes producer and consumer surplus at the national level only. The land allocation is estimated via a system of equations for three crops: groundnuts, millet, and sorghum. The system uses historic relationships to estimate the hectares that will be planted to each crop given a set of expected yields, prices, and input availability. The land allocated to the remaining crops is adjusted proportionately to reflect changes in the groundnut, millet, and sorghum, planted hectares.

The innovations studied in Mali focused on varietal and cultural practice adoption. Variety improvements included breeding shorter season, higher yielding, *Striga* resistant sorghum varieties suitable for processing into value added products for the urban market. Cultural practices include ridge tillage, contouring for improved water management, and expanded use of organic and inorganic fertilizers. Full adoption of these varieties and cultural practices are estimated to have the following impacts (see following table).

Table 1. Estimated Welfare Effects of the Introduction of N'tenimissa and Seguitana Sorghum Varieties on The Malian Economy

Sorghum Variety	N'tenimissa		Seguitana	
	Model			
Variable	Economic Surplus Model	Agricultural Sector Model	Economic Surplus Model	Agricultural Sector Model
Sorghum Production Change (thousands tonnes)	110.70	109.40	141.60	113.05
Millet Production Change (thousands tonnes)	138.10	74.27	138.00	75.92
Sorghum Price Change[1]	-11.43 (-15.90%)[2]	-25.73 (-32.00%)	-14.51 (-20.02%)	-26.36 (-41.16%)
Millet Price Change	-15.23 (-17.80%)	-31.20 (-40.20%)	-15.23 (-17.80%)	-31.90 (-41.16%)
Consumer Surplus Results (Billions of fcfa[3])	14.10	21.70	22.50	22.26
Producer Surplus Results (Billions of fcfa)	-49.97	-39.00	- 49.30	-39.73
Home Consumption Benefit	40.80	25.816	40.90	26.92
Total Welfare Change	4.93	8.56	14.10	9.45

[1] All prices are in fcfa/kg units where fcfa stands for the French Central African franc
[2] Percentage changes are not based on the same exact base numbers hence some differences will be observed in addition to differences in the models responses to the yield changes.
[3] Production and consumer/producer benefits reflect weighted yields assuming varying adoption rates for different cultural practices

The variables in the ES model moved in the same direction as the ASM in all categories. It over estimated the impact of improved varieties on national production particularly in the case of millet as well as overestimating the home consumption benefit. It did produce similar estimates of the producer and consumer surplus benefits and net welfare effects.

As noted earlier because of the simpler nature of the ESM approach it is more difficult to reflect as effectively the substitution relationships between commodities which affects its ability to estimate changes in production. Experience in other settings suggests that the ASM estimate is likely to be more representative of historical experience than the ESM. This implies that its use in *ex ante* analyses such as this would also be more accurate than the ESM. A main reason for this is the ASM use of more detailed cross sectional data rather than national aggregates. The initial results of the ESM represent a first product from a model still under development. Results of the comparison indicate the use of Economic Surplus models to assess the impact of new technologies may be feasible. With additional experience, the ESM may more nearly reflect observed results. The situations under which it can be used in lieu of the more complex ASM remain to be determined. The appeal of the simpler approach is compelling in terms of its potential cost savings.

This research is one part of a process aimed at assessing the value of introducing the Malian varieties and agronomic technologies into neighboring countries with similar environments. Work is in progress to assess the capacity of the ESM approach to estimate *ex ante* the value of introducing the above varieties into Senegal and Burkina Faso. In the Senegalese case the results will be compared with the findings of a Senegalese ASM.

Plans for Environmental Impact Assessment in Mali and West Africa

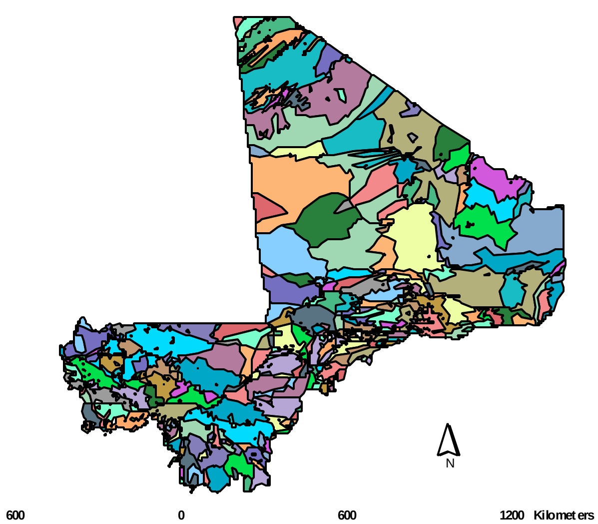
Dr. Jerry Stuth

Texas A&M University

The complexity of agricultural and natural resource systems presents decision makers with the daunting task of understanding how changes in policy or introduction of new technologies affect productivity of agricultural systems, human decision making at the local level, behavior of economic systems, human well-being and natural resources use. Until recently, this kind of analysis has been limited by the computational capacity required to represent the complexity of these systems in an integrated manner. The factors involved in such analyses are spatially explicit. They are influenced by complex human behavior, and respond to weather, markets, technologies and policy. They are influenced by the behavior of systems external to the process being studied.

To model the environmental consequences of policy options and technology intended to enhance food production requires understanding how the relevant processes operate at different scales. The methods and products of the analysis must be cast in an appropriate analytical environment for target user(s). Spatial stratification of natural resources is being accomplished by extending methods involving climatic clusters/soils for a spatially explicit framework, as described elsewhere in this workshop.

Unique Soil and Climate Combinations

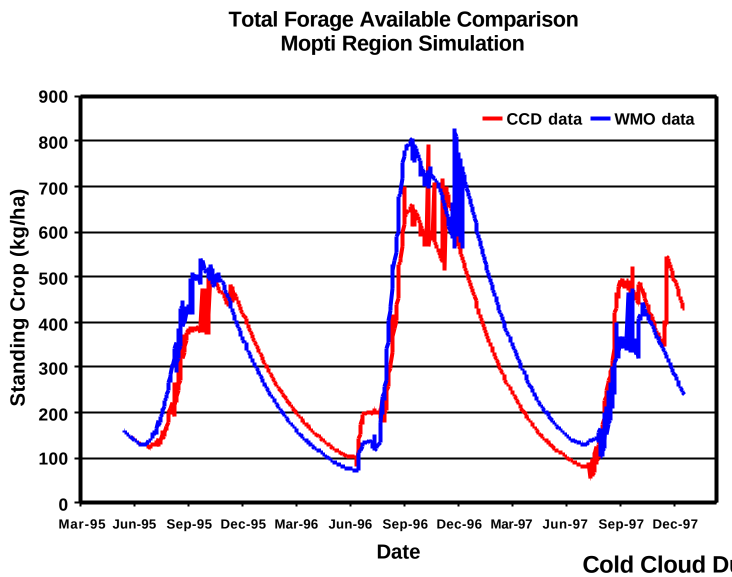


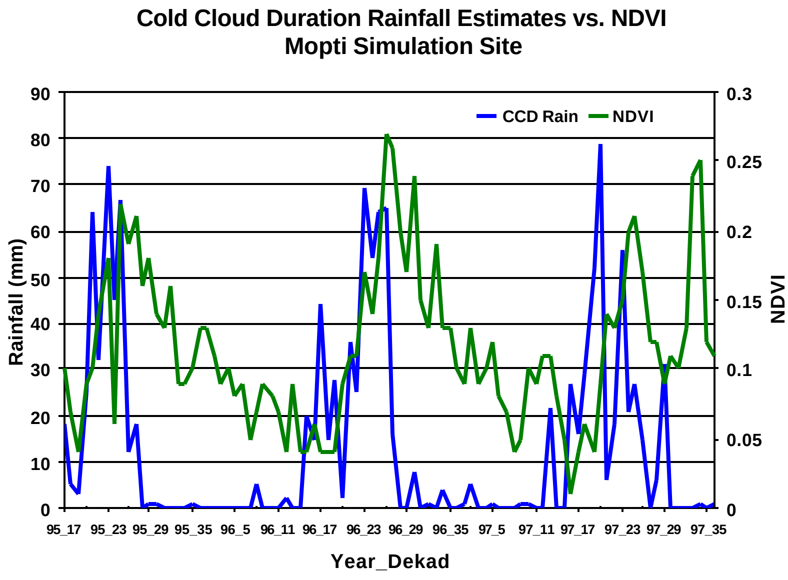
The methods for environmental impact assessment are not as fully developed as the economic models and their refinement will continue in the Mali Pilot FIVIMS study. The PHYGROW grazingland model and EPIC/APEX cropping systems models are linked with the SWAT basin hydrology model within this framework to support both economic and environmental analyses. Primary biophysical processes to be initially estimated will include: water runoff, soil loss, soil nutrients loss, pesticide escape, variability in crop and forage production, and livestock response.

To further establish a spatial framework for biophysical processes involved in environmental assessment, the EROS-Crop Use Intensity Level (CUI) database (crop-rangeland landscapes stratified by soil type) and the Mali 1:200,000 vegetation map will be used to further stratify the climatic/soil framework. A new landscape modeling framework will be pursued involving creation of coupled virtual landscapes (VL) which allow abstract representation of different compositions of cropland and rangeland conditions in a scalable manner. This will allow representation of biophysical responses at farm, provincial, national, regional or watershed/basin levels. A livestock production component will also be developed with georeferenced sampling to predict diet quality using an analytical procedure involving near infrared spectrophotemetry and animal performance within the NUTBAL-PRO model. This in turn will be used to explore enhancing the quality of information derived from the new generation satellite imagery, moving past current NDVI interpretations.

In the Mali Pilot Study for FIVIMS, environmental tasks will focus on: 1) establishing working relationships with in-country and regional partners as well as the international organizations, 2) training and other capacity building, 3) defining roles of Cold Cloud Duration (CCD) precipitation estimates and NASA/EROS Normalized Difference Vegetation Index (NDVI) greenness data in providing synchronization of model responses. This will allow aggregation and scaling of forage and crop model responses, 4) determining the role of NDVI/CCD/LANDSAT/ SPOT imagery in addressing desertification issues, drought risk, vulnerability analysis, crop shifts and yields, native vegetation change, livestock response, and 5) establishing on-ground survey methods to support assessment of land degradation analysis and diet quality of livestock. Preliminary studies have compared CCD precipitation estimates and NDVI greenness data to geo-referenced biophysical models of rangeland vegetation growth within the Mopti region and associated CCD/NDVI grid coordinates. CCD precipitation data tended to be more erratic at low rainfall events. Forage production estimates were generally less with CCD estimates than with matching WMO historical data but seldom varying more than 50 kg/ha in standing crops for any individual species in a community. Runoff was generally overestimated with the CCD data due to occasional high estimates of rainfall. However, most runoff events differed by less than 1-cm. Filtering methods need to be explored to dampen these erratic high event estimates. CCD showed strong relationships between NDVI values and PHYGROW's forage value index and green standing crops (herbage, trees, total forage). This suggests that NDVI data linked with a properly stratified spatial framework can be used with biophysical models to support scaling and extrapolation needs in environmental impact assessment.

Other exploratory analyses are being pursed to determine if NDVI data can be a useful indicator of change in land use, land degradation and possibly drought risk/vulnerability analysis. Greater collaboration with our national, regional and international partners will be necessary to fully investigate this aspect of environmental impact assessment.





Application of the Mali Agricultural Sector Model to Assess Options to Enhance Food Security

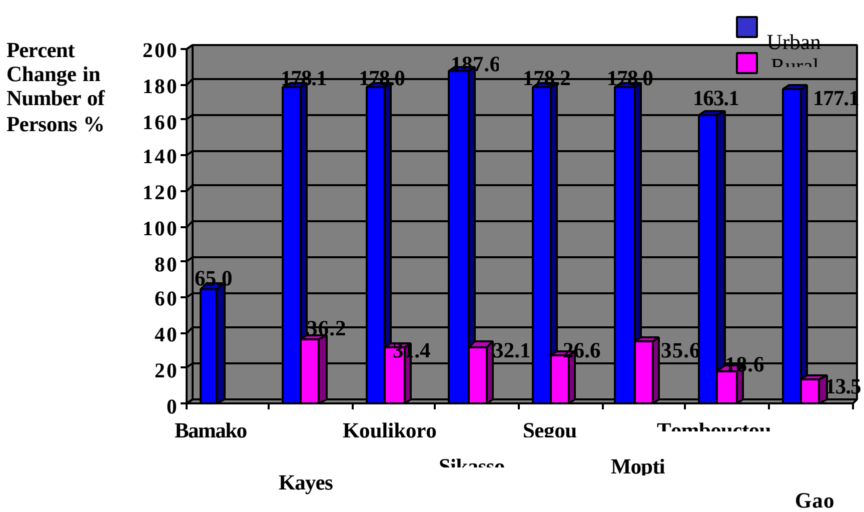
B. R. Eddleman, C. C.. Chen, A. Kergna, and B.A. McCarl

Malian Institute of Rural Economy and
Texas A&M University

Elsewhere in this workshop, the collaboration with INTSORMIL and IER scientists leading to the development and proof of concept of a suite of interrelated models for impact assessment is presented and discussed. This workshop deals with evaluating and planning for the further development of these models in assessing the consequences of options for technology or policy innovations to achieve the goals of food security using environmentally sound approaches.

To illustrate the potential utility of the Mali Agricultural Sector Model (MASM) for application in assessing the impact of options to improve food security, several arbitrary scenarios were defined and the MASM was run to estimate the results of several possible interventions. The demand for food resulting from projected population growth in both rural and urban areas for the year 2015 was assumed.

Projected Population Change by 2015



The scenarios modeled included (a) using the same technology level existing today for food production with projected population increase, (b) increasing production of food by intensifying current land use, (c) increasing production of food by bringing new lands into production, (d) improving the productivity of Malian agriculture through technological innovation, (e) including in the model the importation of food in an open market scenario, and (f) combinations of these options. These scenarios were selected to illustrate how the MASM might be used in more specific assessments of options that would be defined during the pilot study by decision makers at various levels of government.

The *qualitative* results of these analyses are not surprising. With projected population increases, the need for increased food supply drives decision makers to seek options to improve the efficiency of production to meet new demands. Limited land and water resources require that in taking this approach, special care must be used to sustain the utility of these resources. What is demonstrated by these results is the ability to make *quantitative* estimates of the outcomes of various options for enhancing food security.

With current technology and the population increase projected for 2015, the cost of food is projected to increase by a factor of 2 to 4 depending on the commodity. With current technology, production would have to be increased by 20 to 30% to meet increased demand at these much higher food prices. A twenty percent increase in land devoted to cropping, using current technology, would increase production by 30-40% for most commodities. In this scenario, prices are estimated to increase by a factor of 1-2. Intensifying production on current crop land at levels sufficient to maintain current prices would require annual increases in yields of between three and five percent per year over the next 20 years.

This would be difficult to achieve given the resources available. Combinations of these options, coupled with the assumption that food imports would be driven by free market decisions creates a model output suggesting that with aggressive introduction of new technology and favorable policy environments for agriculture, the food needed to maintain the current level of nutrition at current prices could be achieved. Domestic consumers in town and cities, farmers and their families, and foreign exchange earnings would all benefit from a mixed strategy involving productivity increases, intensified land use and food imports for Mali. Further studies are needed to assess the environmental consequences of these scenarios. The specific results of these analyses are provided in the accompanying tables.

Mixed Strategy With Food Imports - Full Adoption, 20% Increase in Cropland Area, Crop Yield Increase to Maintain 1997 Commodity Price & Food Imports

Commodity	Price Change (%)	Production Quantity Change (%)	Yield Increase Needed (%)	
			Total	Annual
Maize	-1	41	4	(0.2)
Rice	6	18	10	(0.6)
Groundnuts	-6	58	10	(0.6)
Cotton	-9	4	---	---
Sorghum	6	61	4	(0.2)
Millet	-3	36	4	(0.2)
Cowpea	-6	37	4	(0.2)

These results indicate that the MASM can be used to quantitatively assess the economic impact of various options and alternatives for enhancing food security in Mali as will be needed to meet future population driven demand. As proposed in the draft plan of work, MASM will be combined with other models in the suite and scenarios such as those done in this early indicative experiment will be done on scenarios that are defined by decision makers to represent more "real world" situations. The suite of models will be improved as new requirements and opportunities are identified through their use in these case studies.

Welfare Effects of Alternative Development Strategies

Strategy	Domestic Consumers ~~Surplus~~	Home Consumption ~~Expenditure~~	Producers Economic ~~Surplus~~	Rural Family ~~Surplus~~	Foreign Economic ~~Surplus~~	Total Economic ~~Surplus~~
Base 1997 Value (billion fcfa)	776.84	-129.57	133.86	(4.29)	4.86	785.99
		---------Percentage Change from Base Value -------------				
Full Adoption	15	-373	536	(89)	-100	44
Extensification	38	-170	287	(62)	118	59
Intensification	69	-28	103	(39)	-100	81
Mixed Strategy	68	-34	89	(28)	202	78
Intensification/ Imports	69	-27	30	(2)	52	69
Mixed Strategy/ Imports	68	-30	34	(3)	1065	76

Technical Workshop – Summaries of Discussions

After one day and half mainly devoted to presentations from National, Regional and International Institutions, the participants engaged in discussions and agreed to the importance of developing Methods and Models to improve the assessment on the Status and Estimate of the Economic and Environmental impact of Options to Enhance Food Security.

The overall objective is to provide to Decision-Makers methods and tools to better address new technology and policy options to meet the goal of the World Food Summit in 2015. To reach this objective, the participants recognized the need to develop national capabilities in modeling at different levels of decision-making: government, research, university, non-governmental organizations, private sector and community based organizations. An institutional coordination unit for modeling should be created in order to harmonize and diffuse national modeling efforts and results.To optimize the diffusion and integration of models, the participants recognized the need to develop a model interface for easy use and greater impact among users. National efforts should be associated with involvement in regional institutions to create an enabling environment for the sustainable use of models.

In order to meet these objectives, the Planning Workshop concluded that the main issues to consider are :

- Data Collection
- Data Analysis
- Scale / Time Issues
- Modeling Process – Participatory Approach
- Capacity – Building
- Information Dissemination and Diffusion

SECTION 5

SENIOR DECISION MAKERS SESSIONS – CONCLUSIONS AND RECOMMENDATIONS

Assessment and Reaction to the Discussions of the Workshop by Texas A&M

Dr. Neville Clarke and Dr. Bobby Eddleman

Impact Assessment Group, Texas A&M University

The results of the discussions of Technical Group are summarized in Volume One of the report of the Workshop. There were excellent and useful discussions on many aspects of the goals and objectives of the Pilot Study and suggestions for further development and use of the models resulting from the INTSORMIL studies. In this section, members of the Texas A&M group provide their interpretation of and reaction to these discussions in terms of modifications to the draft plan of work for the Pilot Study and the actions to be considered in further developing and using the models to assess options that impact food security. We regard this as the initiation of an ongoing participatory process with national and regional partners, as well as with FAO, for implementing the plan of action.

In general, the overall approach depicted in the draft plan of action tabled at the outset of the workshop was accepted by the members of the workshop. There were, however, many useful interventions that will modify the details of the approach in the pilot study. We place these recommendations in the context of the overall objectives of the pilot study which are to use the study to enhance decision maker tools at national, regional, and global levels by conducting relevant case studies as a basis for evaluating and improving the suite of models.

There were a number of key transcending issues that emerged from the discussions. While the potential utility of the suite of models was well recognized, members of the workshop stressed the importance of capacity building and making the models more “user-friendly” in developing countries. This resulted in a follow-on plan by FAO and Texas A&M to seek additional funding for this part of the total effort. It was recognized that the models may need to be adapted to meet the needs of decision makers at various levels of government. At this point, the intent for the models be useful at the cercle and household level as well as at national, regional and global levels.

One of the very appropriate concerns discussed in the workshop was the need to ensure that the models can deal with site-specific issues and options. We responded by pointing out that the models provide a general framework in which specific analyses are conducted. The specificity of the application comes through defining specific input data and scenarios for evaluation. We do not envision this suite of models being used as a "desk-top" capability by senior decision makers. Rather, they will require some level of technical expertise, even with additional effort to make the applications "user-friendly".

We suggested the following "next steps" that need to be taken to implement the recommendations of the members of the workshop:

- Develop a better understanding of the models and how they work on the part of our national and regional partners. This will require capacity building at several levels, ranging from mentoring to workshops to long term training

- Strengthen the IER partnership, adding natural resource management and information management into the collaboration

- Solidify relationships with other CILSS organizations and to use this as a basis for capacity building at the regional level

- Increase the emphasis on soil and water management and other aspects of ecosystem health with continuing effort to better link economic, biophysical, environmental, and socio-cultural models

- Improve the connections with decision makers in the Government of Mali, and with their technical staff to ensure models are institutionalized (via the National Task Force, *inter alia*).

- Make good use of the Advisory Committee in the ongoing development and evaluation of models

- Continue plans to link the these studies with the SANREM West Africa Project

There were a number of opportunities recognized to continue the process of improving the suite of models to make them more responsive to user needs. The key points were:

- •Provide additional capability to model natural resource management and issues related to environmental degradation

- •Develop a more robust livestock sector model to reflect the importance of this commodity in Mali and West Africa

- •Develop improved linkages between quantitative biophysical models and satellite imagery to enhance the utility of extensive monitoring systems

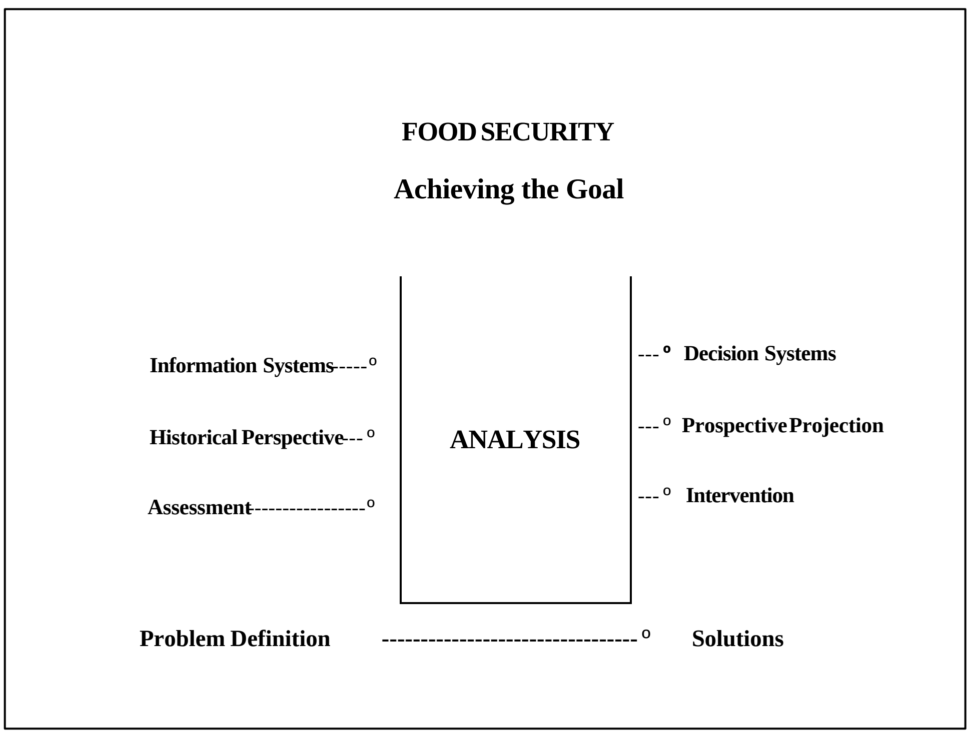
- •Place increasing emphasis on the socio-cultural factors that affect adoption of technology and express this in heuristic rule bases within the overall suite of models.

- •Improve the linkages between models

- •Packaging information and models for decision makers at various levels of scale

- •Promoting the development and acquisition of improved data and making use of this in the suite of models

In the pilot study, the further development and application of the suite of models is intended to address the issues of food security by taking the agenda past problem definition through analysis into providing options to create solutions to meeting the objectives of enhanced food security in the context of environmentally sound and sustainable use of natural resources. The following illustration shows the relationships between problem definition and solutions and the role of analysis using the integrated suite of models in linking these two components of the total agenda.



Needs for and Use of Texas A&M Models by the Government of Mali: Conclusions of Workshop

Dr. Alpha S. Maiga[1] *and Dr. Bino Teme*[2]

[1]Director General IER
[2]Scientific Director IER

Throughout the 25 presentations that have been given during the workshop, the utility of Texas A&M models and methods has been discussed at different levels, from national, regional to international level with the inputs of FAO. The Government of Mali recognized the efficiency of the models as tools that save time and improve use of resource to address the scope of Food Security and Natural Resource Management, two issues at the heart of the country. But to reach the full efficiency, further development is required:

- Working assumptions need to be established with a good knowledge of country realities. They need to be pragmatic and clearly defined in order to integrate the multiplicity and complexity of the country,
- Analysis should move past prices and quantities to deal with methods to reduce production costs (removal of subsidies) and use of lower cost inputs,
- Economic assessment need to integrate all cost including transportation,
- Current non-competitive agriculture should be bring on stream,
- Risk assessment is a vitally important component to the overall assessment - the variability of the rainfall, the crop failure in high yielding crops, the degradation of the natural resources, the depletion of nutrients, the environmental cost (health, pollution…) for the society under full technology adoption scenario are key to the chain of analysis,
- Model development should be part of the National Action Plan. The CPS and IER have just created a national program on Soil Fertility Management. This initiative should be connected with model development and give the way ahead for a national integration,
- The communication with decision-makers should be enhanced – Model's outputs should provide the information needed to make informed decisions and state

assumptions under easy delivery forms (brief, options). Decision-Makers need several elements (environmental, economic, societal…impact) to consider for actions. They want the result and the means to reach them summarized in a way easily understandable.

The challenge will be to address these different issues, from model ‘s development to institutional integration, and part of the success will be in the development of a model ‘s interface for easy use and greater impact among users, especially among decision-makers.

Overview of Goals and Approaches for the Mali FIVIMS - FAO Perspective

Dr. David Wilcock

FAO - FIVIMS

FIVIMS is a framework within which a wide range of activities may be carried out at both national and international levels in support of improved information to achieve World Food Summit goals. At the national level, it is implemented through a network of information systems that gather and analyze data relevant for measuring and monitoring food insecurity and vulnerability. FIVIMS is based on existing national and sub-national information systems related to food security. It responds to the information needs of different user groups within the country itself. FIVIMS is operated and controlled by the country involved. It is country driven and user focused, designed in response to the needs of national decision-makers. The goal is to contribute to the reduction of food insecurity and vulnerability by better access to more comprehensive up-to-date information, enhancement of food security policy formulation, improvement of the design and targeting of interventions and by monitoring of progress.
To this end, it was agreed that the development of FIVIMS at country level should be promoted by UN Administrative Committee for Coordination (ACC) Thematic Groups on Rural Development and Food Security, a mechanism established to ensure appropriate inter-Agency coordination for World Food Summit follow-up at the field level. The principal orientations are to develop a consensus on standards for the information systems, to define short-term (transitory) and long-term (chronic) food security problems, to promote systems like FIVIMS type at the national level and to stress the uses and the improvement of the existing systems for sustainability.

In Mali, the development of a national FIVIMS will require:

- The establishment of an inter-ministry committee and / or a Thematic Group on Rural Development and Food Security to discuss the idea,
- A assessment-study of the information system’s “institutional landscape”, information needs of action plans, followed by a workshop for validation,
- The identification of funds needed to establish the network that will connect the

current sources of information and build national capacity,

- The promotion of better collaboration between health/nutrition, agriculture, weather, trade, social affairs information systems.

In order to achieve the Mali FIVIMS, it is proposed to develop a plan of action for the year 2 000 that will include:

1 Development of an integrated information system on Food Security for Mali,
2 Continuation of the collaboration between Texas A&M and IER on the development of models for improved decision-making,
3 The development of a Mapping-GIS Pilot project in collaboration with IER and ICRISAT. This may involve the use of KIMS,
4 The creation of a FIVIMS Network with existing information systems (MDRE/CPS, MS/CPS, SAP/PRMC, OMA, CILSS/INSAH/AGRHYMET, IER, FEWS, FAO…)

Preliminary actions needed to initiate the Mali FIVIMS will be:

- The development of better definitions for Malian Food Security problems,
- An assessment of information needs,
- The identification of donors and qualified staff to implement the network, and resource mobilization to fund these activities.

At this time, two additional observations can be made about the development of improved information systems in Mali:

- The GIS map of local administrative boundaries for the country (involving 701 local government units) is almost complete. Assistance might be given to finalize that map base, which can serve as a basis for better coordination among information systems; and
- There are other proposed information collection activities that can help in the development of a better national system : SNISA (a system for improved agricultural and food statistics), and two major new national surveys, the Agricultural Census and the Dietary and Health Survey, to be conducted in 2 000.

Senior Decision Makers Session – Summaries of Discussions

The optimal use of models for food security and natural resource management depends on the existence of a broader commitment to action by the Government of Mali to meet its international convention obligations i.e. as a signatory to the World Food Summit, the Convention to Combat Desertification, and several other related international agreements. It is in the context of the broader goals that the models will find utility as a set of decision aids to decision-makers at multiple levels of scale. Recognizing this and to ensure that all objectives mentioned above will be undertaken, Decision Makers session resulted in the proposition of a suite of recommendations:

- A National Task Force on Models for Food Security, comprised of participants in the technical workshop plus representatives from other relevant parts of the GOM, should be formed to plan and put into operation an overall initiative and coherent strategy to deal with food security and the environment.
- It was clearly recognized in the workshop that the responsibility for this task force and its results are the responsibility of Malians and that regional and international organizations will play a facilitatory role.
- Members of this group should be experts from relevant regional and national institutions related to Natural Resource Management, Food Security and Health Information Systems.
- The National Task Force on Models for Food Security should be extended by an informal group of expert know as Advisory Committee.
- The Advisory Committee should be limited to those who are involved in modeling activity development and improvement.

These groups should be organized in an international network to allow communication among international, regional and national institutions and to have access to international information networks.

Concluding remarks and Adjournment

Dr. Idriss Alpharouk

Director General, INSAH

The workshop on “Development and Evaluation of Models and Methods to Improve the Assessment of Status and Estimate the Economic and Environmental Impact of Options to Enhance Food Security” provide excellent awareness and feedback about general needs for models for planning and monitoring progress towards achieving food security and NRM goals. The utility of the Texas A&M suite of models is recognized as efficient tools and methods to enhance decision –making. This success is also due in large part to the great effort and interventions of the participants. Their discussions and recommendations draw the general framework for model ‘s development in Mali. A major concern stands, in the impact assessment process, in the integration of numerous and specific factors affecting agricultural operations and adoption of technology in Mali.

These factors are key to the chain of analysis that leads to ultimate the impact at the farm, regional and national levels. To address this issue, major consideration should be accorded to farmer’s risk assessment. Farmer’s risk perception adds often complex and site specific considerations to decisions regarding the adoption of a technology.

Taking example of the uncontrolled set of factors that farmers have to face every year, such as the climate variability, the diverse source of pest invasion, the availability of the seeds, the accessibility of the land, the land tenure insecurity, the infrastructures that will determine the access to markets, the fiscal system, the access to credit and to health... illustrate the difficulties of agriculture development and food security improvement in Mali.

Assessing the economic and environmental impact of technology requires a good knowledge of the priorities of the issues facing the farmers and a careful and methodical integration of these varieties of factors. Challenge is to capture this dimension in the impact assessment process, and part of the challenge hold on to the limiting factor of data availability and reliability.

APPENDICES

Appendix 1

Agenda

Planning Workshop

Development and Evaluation of Models and Methods To Improve the Assessment of Status and Estimate the Economic And Environmental Impact of Options to Enhance Food Security

December 7-9, 1999
Palais des Congrès
Bamako, Mali

Tuesday December 7, 1999

9:00 AM Convene Workshop

Chairperson : Dr. Mamadou Goita, General Secretary, MDRE

1. Welcome by Dr. Idriss Alfarouk, Director General of INSAH

2. Opening Comments by Senior Representative of Government of Mali (Dr. Mamadou Goita, General Secretary, MDRE)

- Agriculture and Natural Resources as a National Planning Initiative (Dr. Lamine Keita, Centre D'Analyse et de Formulation de Politiques de Developpement, Secretariat General de la Prescience de la Republique)

- Perspectives on Need for Enhanced Assessment Capabilities by Senior Representative of Government of Mali (Dr. Bino Teme, Director Scientific, IER)
  (1) Food security and vulnerability
  (2) Environment and natural resources
- FAO Perspective (Dr. David Wilcock, Director of Food Insecurity and Vulnerability Mapping Information System FIVIMS)

- Overview, Goals and Results of Workshop (Dr. Neville Clarke, Texas A&M)

10:30 Coffee and Informal Discussion

11:00 Needs of the Government of Mali for analysis of the impact of alternative policy options and use of technology to enhance food security and ensure protection of natural resources and environment.

Chairperson : Mr. Makan Fily Dabo, ME

- The National System for Integration of Agricultural and Food Security Statistics – SNISA (Mr. Abou Doumbia, CPS)

- The National Action Plan Responding to The Convention to Combat Desertification (Dr. Salif Kanoute, Coordinator National Environmental Action Plan

- The Mali Famine Early Warning System (Mr. Salif Sow, National Representative FEWS)

- Regional Perspective (Dr. Gaoussou Traore, Director INSAH – AGROSOC, Agro-Socio-Economic Research / PRISAS Programme Regional de Renforcement Institutionnel en Securite Alimentaire au Sahel)

- The use of Natural Resource Data in Assessment of Food Security (Mr. Djaby Bakary, AGRHYMET)

- Discussion

13:00 Lunch and Informal Discussion

14:30 Texas A&M Decision Support System: Models and Results

Chairperson : Dr. Neville Clarke, Texas A&M

- Overview and Purpose (Dr. Neville Clarke, Texas A&M)

- Geographic Overview of Mali (Dr. John Corbett, Texas A&M)

- Development of the Mali Agricultural Sector Model and Assessment of the Impact of INTSORMIL CRSP Production System (Dr. Bobby Eddleman, Texas A&M)

- Discussion

17:30 Recess

Wednesday December 8, 1999

8:30 Texas A&M Decision Support System: Models and Results (suite)

Chairperson : Dr. Neville Clarke, Texas A&M

- Farm-Household Level Models and Their Use in Assessing the Impact of INTSORMIL CRSP Production System in Mali (Mr. Harvey Hill, Texas A&M)

- Methods and Data Bases for Spatially Explicit Analysis to estimate the Impact of INTSORMIL Technology in Mali, Senegal, and Burkina Faso (Dr. John Corbett, Texas A&M)

- Methods For and Results of Impact Assessment at Farm and National Levels of INTSORMIL in Senegal and Burkina Faso (Mr. Harvey Hill and Dr. Bobby Eddleman, Texas A&M)

- Preliminary Analysis for Environmental Impact Assessment in Mali and West Africa (Dr. Jerry Stuth, Texas A&M)

- Discussion

10:00 Coffee and Informal Discussion

10:30 FAO-Worldwide Information System (WAICENT)

Chairperson : Dr. David Wilcock, Director of Food Insecurity and Vulnerability Mapping Information System FIVIMS

- FAO Data Bases and Information (Dr. Cristina Petracchi, WAICENT-FAO)
- Relationship to Mali -FIVIMS- GTOS (Dr. David Wilcock, FIVIMS-FAO)
- Discussion

12:30 Lunch and Informal Discussion

14:00 Plan of Action for The Mali FIVIMS-GTOS Pilot Studies

Chairperson : Dr. Neville Clarke, Texas A&M

- Synopsis of Draft Plan of Action (Dr. Neville Clarke, Texas A&M)
- Results of Initial Sector Models Runs on Basic Scenarios (Dr. Bobby Eddleman, Texas A&M)
- Questions and Discussion

15:30 Coffee and Informal Discussion

16:00 Synthesis of Needs of the Government of Mali and the Draft Action Plan -- Group Discussion

Chairperson : Dr. Bino Teme, Scientific Director, IER

- Crop Modeling at LaboSEP (IER) : Overview of ongoing and forthcoming activities (Mr. Sibiri Traore, SEP - IER)
- Review and informal discussion of needs for decision support systems and data

bases for food security and environmental planning in Mali

- Enriching the plan of action to improve utility by the Government of Mali
- Contributions and collaboration by Malian and Regional institutions

17:30 Recess

Thursday December 9, 1999

8:30 Discussion Leading to Summary and Consensus Statement

9:30 Coordination Meeting with Pilot Study Collaborators

Chairperson : Dr. Bino Teme, Scientific Director, IER

- Review of separate and joint responsibilities
- Schedule of related events
- Commitments for action
- First Thoughts on the Second Workshop

10:30 Coffee and Informal Discussion

11:00 Review of Summary Statement

- Conclusions from the preceding sessions

11:45 Concluding Remarks and Adjournment (Dr. Bino Teme, Scientific Director IER)

12:00 Lunch and Informal Discussion

13:00 Senior Decision Makers Session

Chairperson : Dr. Gaousou Traore, Director INSAH – AGROSOC

- Purpose (Dr. Gaoussou Traore, INSAH -Director Agro-Socio-Economic Research)
- Summary of Models and Results Relative to Decision Making on Status and Options to Enhance Food Security (Dr. Neville Clarke and Dr. Bobby Eddleman, Texas A&M)
- Needs for and Use of Texas A&M Models By the Government of Mali : Conclusions of Workshop (Dr. Alpha S. Maiga, Director General IER and Dr. Bino Teme, Scientific Director IER)
- Discussion by Senior Decision Makers
- Examples of High Priority Issues for Potential Assessment
- The Way Ahead

15:00 Overview of Goals and Approaches for the Mali FIVIMS - FAO Perspective (Dr. David Wilcock, Director of Food Insecurity and Vulnerability Mapping Information System FIVIMS)

15:45 Concluding Remarks and Adjournment (Dr. Idriss Alpharouk, Director General INSAH)

19:00 Reception at Akwaba restaurant

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Appendix 2 **Contacts Participants**

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Appendix 3 Advisory Committee – Provisional List of Participants

Name	***Institution***	***Observations***
Alpha Kergna	IER,MDRE	Chairperson of the Advisory Committee
Bakary Touré	ME, Environ Plng	
Daouda Tangara	Chamber of Agriculture	
Adama Boré	DNAMR MDRE	
Lamine Keita	CAFPD President Office	

Appendix 4 Summary of Institutional Involvement

Institution	Contribution
Texas A&M Impact Assessment Group	Development and application of integrated suite of models for assessing impact of change, overall project leadership and coordination
FAO-FIVIMS SECRETARIAT	Guidelines for National FIVIMS, sponsorship of Mali FIVIMS, institutional coordination in FAO
FAO-GTOS Secretariat	FAO focal point for on sustainable development, access to global and regional data bases on terrestrial systems
FAO-WAICENT	Collaborator on development and use of models and data bases, capacity building workshops, enhancing analysis capability
FAO-GIEWS	Linkage of famine early warning data bases and analysis to Mali Pilot Study
FAO-Interdepartmental Working Group on Desertification	Linkages with counterparts in Sahelian countries; assistance in obtaining existing relevant data bases needed for analysis desertification; Advisory on methodologies for desertification assessment and linkages with the OAD international initiative

Institut D'Economie Rurale (IER)	Collaboration on data acquisition and model development for the integrated suite of models with emphasis on economic and GIS components
Ministry of Rural Development and Water	Cosponsors of the Pilot Study. Collaboration with the Celle de Planification et de Statistique (CPS) as agency with prime responsibility for agricultural and population statistics. Evaluation and use of methods.
Ministry of Environment, Office of Environmental Planning	Cosponsors of the Pilot Study. Collaboration in the process of developing the National Environmental Action Plan and CCD Program, evaluation the use of Texas A&M methods these activities
Institut du Sahel (CILSS)	As a regional organization, INSAH focuses on promotion and coordination of research and development in the area of food security, natural resources management, and population/development through (*inter alia*) case/pilot studies in member countries, exchange and dissemination of information and capacity building. With related studies by Texas A&M, the West Africa Project of the SANREM CRSP, FIVIMS, GTOS, and CCD experiences from this national study in Mali will be used to develop principles that can be applied to neighboring countries in West Africa. Within its mandate in concert with established goals, INSAH will be a principle partner in these studies at both national and regional levels and will be heavily involved in facilitating training and capacity building in national programs.

Centre Régional de Formation et d'Application en Agrométéorologie et Hydrologie Opérationnelle (AGRHYMET) (CILSS)	Linkage with study on livestock sector and use of semi-arid lands in the Sahel, collaboration with Goddard SFC, EROS, and FAO-ARTEMIS in providing weather and related data from satellite imagery
West Africa Project - SANREM II	Collaboration in developing decision support tools for decision makers at levels from household to national
International Livestock Research Institute (ILRI)	Collaboration on modeling mixed crop-livestock systems in semiarid regions of the Sahel
USAID - Mali	Continuing inputs on needs for national and regional ex ante and ex post impact assessment of investment opportunities for West African countries and evaluation of products

Appendix 5

Overall Schedule - June 1999 to August 2000

EVENT	J J A	S O N	D J F	M A M	J J A
1. First draft of Pilot Study Action Plans following travel to West and East Africa	*				
2. Development and Revision of Models in IMPAC	*------------	-----------------	-------------*		
3. Second Draft Action Plan Based on Meetings with FAO 11-16 July 99	*				
4. Coordination with National and Regional Collaborators in Bamako for Mali Pilot	*				
5. Planning Workshop on Mali Pilot in Bamako			o		
5a. Terms of Reference for Collaboration			o		
6. Baseline and two intervention scenarios		* -----	------*		
7. Model Evaluation and second iteration			*-----------*		
8. Two studies on Specific Topics			*-----	---------------	------------6
9. Evaluation and Training Workshop				o	
10. Long Term Training			*------------*		
11. Annual Report					*

Appendix 6 The suite of Texas A&M Models : Overview and general approach

The current sets of tools that are actively used in the impact assessment process are listed below.

Spatial Characterization Tool (SCT)/Almanac Characterization Tool (ACT) – required to establish the spatial extent of the technologies and (or) policies, extract socio-environmental data to classify socio-environmental zones and conduct geographical equivalence analysis for regional extrapolation.

Agricultural Sector Model (ASM) – equilibrium multiple objective function model needed to conduct national and sub-national level of multiple primary commodities and secondary products using responses to technology and policy.

Farm Level Income and Policy Simulation Model (FLIPSIM) – establishes the household level response to technologies and subsequent response in terms of income, net worth, and household survival (income, nutrition).

Erosion Productivity Impact Calculator (EPIC) – geo-referenced, hydrologic-based crop production and environmental response simulation model needed for determining variability of crop yields, erosion, nutrient loss (N, P) and pesticide loading in response to management input and weather dynamics.

Phytomas Growth Model (PHYGROW) – geo-referenced hydrologic-based multiple plant/animal species simulation model capable of reflecting complex grazing land environments in terms of plant response, animal selective grazing, animal response (stocking, performance) and complete water balance.

Soil and Water Assessment Tool (SWAT) – spatially-explicit, basin-scale hydrology model capable of generating, routing and assessing dynamics of runoff, erosion and agricultural chemicals in large multiple sub-basin systems.

Nutritional Balance Analyzer (NUTBAL PRO) – protein and energy balance simulation model for cattle, sheep, goats and horses with ability to predict gain/loss and milk yield.

Statistical Analysis System (SAS) – a statistical analysis package used to generate critical coefficients for the weather generators, establish adjustments to coefficients due to the ENSO effects.

MINITAB Statistical Analysis Package – a statistical analysis package used to conduct multivariant analysis for principle component cluster analysis in support of defining production system types (household level) and associated socio-environmental zones from household surveys.

Climate Generator (WxGEN) - weather generator used to produce variation in weather for each of the representative farms and associated virtual landscapes for each of the socio-environmental zones, regionally synchronized with southern oscillation index stage sequences.

Soil Parameter Generator (SPG) – program which translates traditional soils profile data and generates and stores in database format, critical soil parameters for the hydrologic-based biophysical models.

ArcView GIS – a commercial GIS tool needed to create shape files of survey data, weather stations and other support data used in the analysis in the Spatial Characterization Tool and Almanac Characterization Tool.

Land Demand – a spreadsheet-template that allows computation of land area required to support forage demand of a specified population of livestock considering intake requirements and forage production capacity of the land supporting them.

WINDISP3 Satellite Imagery Analysis Tool – a software package for displaying and analyzing time-series satellite images. The software is tailored specifically for monitoring vegetation and weather via satellite images for early warning of droughts, crop failures, and fire danger. Other related data sets, such as maps and tables can be displayed and analyzed in the context of the satellite images.

CCD Precipitation Extraction System - a software tool that allows an input file of longitude and latitude values log into the Internet and extract from the EROS data center cold cloud duration estimates of Africa.

FAO Plants and Soils Databases - this on-line databases were used to assist in parameterization of biophysical models.

Common Modeling Environment (CME) - this tool is designed to allow models to be placed on-line or on local hosts without altering those models. A special translator language links with a JAVA interface that the model developer can define access to model inputs and model location to use the system, either remotely or on the user's machine. Currently, PHYGROW and EPIC have translators available and can share a common soils database. Because the interface is written in JAVA the system allows delivery of models over the Internet via a web browser.

The integrated suite of models and the general approach includes the following:

- Acquisition of primary and secondary economic, natural resource, and environmental data related to the agriculture of the political entity under evaluation

- In cases of missing information, biophysical models are used to estimate the needed data (EPIC, PHYGROW, NUTBAL, *inter alia*)

- A spatial framework is established and related geographically based information on natural resources, weather and related variables is acquired, validated, and organized for ready access; historical data and models for estimating data gaps provides the basis for the stochastic elements of the suite of models

- The technology or policy option to be considered is defined in terms of such things as cost of production, environmental consequences, and potential areas of application

- National and (sometimes) provincial multi-commodity agricultural sector models are created for the relevant area under study with established baselines and projected adoption profiles. This is an economic surplus model with interactive components and includes estimates of the elasticity of demand. The model assumes farmers make decisions that minimize risk and maximize economic benefit. The output includes prices and quantities of food and shifts in land use based on economic advantage. These outputs serve as useful proxies of indicators of the status of food security and vulnerability.

- Biophysical models such as EPIC and PHYGROW estimate the environmental consequences of shifts in land use and intensification of input use in enhancing production at the level of field and pasture. Basin scale hydrologic models such as SWAT are used to estimate the consequences of upstream agricultural practices on soil erosion and downstream concentrations of agricultural chemicals.

- The farm-level economic model (FLIPSIM) is used to assess the impact of technology or policy options on farm level income, risk, and household nutrition

- A new software package that creates a JAVA-based common modeling environment for ready interaction between models has been developed and is being refined for use in developing country situations. This is intended to provide a mechanism to deliver an integrated, pre-configured suite of models to help produce a capability for optimization of environmental and economic of alternative methods to enhance production of food.

- GIS methods are being used to create a spatial framework for data and models that can be used to estimate adaptation zones for new technology based on geographic equivalence to the site where research is conducted and to provide ready access to pre-processed information that is routinely used in defining problems and running one or more of the suite of integrated models. This capability is being made available in CD-ROM form in development that has been partly sponsored by USAID's OFDA program.