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Texas A&M University

Training on Impact Assessment

Section 1:

Kenyan Team

Section 2:

West African Component Mali

Texas A&M University

Training on Impact Assessment

Kenyan Team

During November-December 2002, four Kenyan researchers visited Texas A&M University to receive formal training in the use of the Decision Support System (DSS) for impact assessment. The team of scientists consisted of two agricultural economists from the Ministry of Finance and Planning, a GIS specialist and an animal scientist from the Kenya Agriculture Research Institute within the Ministry of Agriculture. Each scientist holds a key position within his or her parent institution. The trainees were provided an overview and hands on use of the DSS suite of economic and biophysical models. The objective of the training was to give the trainees working knowledge of the models and to enhance their skills to a level where they would carry out impact assessment studies and begin to learn to modify models as needed.

The training was organized into four main training modules. The first module involved a general overview of the DSS suite of models and examples of previous work that had been conducted using the impact assessment methodology. Detailed examples of inputs, outputs and products were given.

The second module dealt with development of the spatial sampling frame and household surveying techniques. In this module, the trainees were systematically introduced to the methods of developing a spatial sampling frame that encompasses the area to be studied during the impact assessment, methods for carrying out spatial scaling and geographic synthesis with emphasis on using GIS software (ArcView, ArcGIS, ACT) and databases (Microsoft Access). The use of base data sets such as climate, soils and population data in building the spatial sampling frame was demonstrated. Trainees were then given the opportunity to use the techniques and software to develop a sampling frame for a designated area in Kenya. After development of the sampling frame, techniques for selecting households for rapid appraisal surveys were demonstrated. With regard to household survey techniques, the development of survey instruments and techniques for conducting rapid appraisals were discussed. The team was then shown the process of taking rapid appraisal survey data and determining farm typology using cluster analysis techniques. Selection of representative farms from farm type clusters was also demonstrated. Development of an intensive survey instrument for gathering data needed for impact assessment models was discussed and examples from Mali and Kenya were provided.

The third training module was comprised of training and hands-on use of the impact assessment models. The trainees were divided into two groups according to their area of specialization. Team members specializing in planning and economics were trained on the economic models (ASM and FLAM) whereas those specializing in agronomy and GIS were trained on biophysical models (PHYGROW, NUTBAL, SWAN, LANDDEMAND) and geospatial analysis.

- For the Economist group, their training focused on various aspects of economic impact assessment and the use of quantitative methods to quantify the impact so that informed policy decisions could be made. The participants were provided training on using the Kenyan Agriculture Sector Model (KASM) for impact assessment. This training proceeded on three fronts. The trainees were first provided hands on a small sector model that was specifically developed for this training. Once the trainees had grasp on using this stylized sector model and were comfortable using GASM program for this purpose, they were exposed to the full version of KASM. The trainees were trained to use this model through using the Excel spreadsheet interface developed for KASM. The trainees conducted exercises of technology impact, population impact, and changes in trade policies. They were exposed to the KASM output that included consumer and producer surplus measures, prices, area and production, import and export of various crop and livestock commodities included in the model. Lastly, the trainees were taken to the GAMS coded version of KASM. They were exposed to major components of the model and as to how they would add new variables and form new equations that might be required for different type of impact assessments. They were also given hands on training on setting up loop in the KASM for comparing results of base model with those under the impact assessment being considered. The trainees were imparted a sufficient knowledge of GAMS and KAMS where they can work on their own and conducted impact assessment. The trainees were also provided material for training both electronically and in hard copies.

- Farm level modeling (FLAM) concepts were demonstrated in details and the theoretical background on farm budgets, partial farm budgets and production functions. The farm programming models and GAMS implementation was discussed with emphasis on comparing economic and technical efficiency, shadow values, risk and multi-period modeling.

- For the group training on biophysical models, their training focused on the parameterization and use of the PHYGROW, NUTBAL and SWAN biophysical models. With regard to PHYGROW, trainees were provided an overview of the model and how the model is used for providing forage yields and environmental impact data to the impact assessment process. The trainees were instructed on how to build parameter files, develop grazer profiles, determine and adjust stocking rates, assigning livestock grazing preferences and acquiring spatially explicit weather data. Trainees were shown methods for extracting soil data from GIS data layers and databases. Parameter estimation tools and database were demonstrated for use when model parameter data was limited or unknown. Trainees were given the opportunity to create a set of parameter files for sites in Kenya and shown ways to post-process data needed for display of results and cross-linkage with the economic models.

- For the Nutritional Balance Analyzer (NUTBAL) decision support tool, trainees were shown how the model can be used assess the nutritional status and weight change for free-ranging animals and how the model can be used to provide inputs into the ASM and FLAM for livestock demand numbers needed by these models. Trainees built NUTBAL cases for different livestock kinds found in Kenya and examined model output for different classes of animals. The use of the LANDDEMAND spreadsheet for determining the amount of area required to support a given number of livestock based on their demand profiles and forage base was demonstrated. The cross-linking of NUTBAL and PHYGROW outputs to the LANDDEMAND spreadsheet were shown, as were the linkages to the ASM model for land area inputs.
- Trainees were introduced to the Soil, Water, Air and Nutrition (SWAN) model and provided an overview on how the model can be used to provide crop yield and environmental impact data for the impact assessment process. Trainees were introduced to the model structure and associated databases including soils, climate, crop management practices, crop coefficients, hydrology and nutrient flows. They had hands-on experience on model setup and output interpretation.

For all biophysical model training, broad emphasis was placed on model linkages and data sharing, and the passing of data from biophysical models to the economic models.

The fourth training module dealt with the development of metamodels and geographic synthesis of impact assessment results. After training on the economic and biophysical models as two separate groups, the two teams were reconvened and provided instruction on how to build regression metamodels from PHYGROW and SWAN model output, and how to incorporate these metamodels into the ASM and FLAM economic models. Instruction on developing metamodels environmental impact assessment was also demonstrated. Techniques for spatial representation of both economic and environmental impact results and how to link outputs back to the spatial sampling frame were discussed. The trainees were shown how GIS tools can be used to assist in this process. Methods for scaling up biophysical data and scaling down economic data were also discussed.

After training in the models the team was then asked to develop a relevant impact assessment project for Kenya. The team deliberated and decided that deforestation and farm expansion in the upper Tana River basin in Kenya was an important economic and environmental problem that requires an impact assessment of various alternatives being proposed by the Kenya government. This deliberation and subsequent meetings of the team after their return to Kenya resulted in the formation of a proposal submitted for Year Six activities entitled "Impacts of Emerging Reforestation Policy and Farming Technology to Mediate Deforestation and Cropping Extensification in the Upper Tana River Basin of Kenya"

Following the training, the trainees expressed their gratitude and thanked the IAG team for a job well done. They appreciated the commitment and organization skills of the IAG team in trying to introduce complex models in a simple and clear way. The complexity of the models did not overwhelm them; in contrary they appreciated the benefits of the integrated system. Their main concerns was that they needed more time to increase their knowledge on the mechanics of the models and understanding various outputs. They were also concerned by lack of comprehensive institutional support for these new methods and recommended an increase in number of trainees.

The IAG assessment of the training was good and contingent on additional funding; increasing the number of participants and a longer-term training would meet the expectations of policy makers. Basic tools such as computers would enhance the acceptability and increase utility of our products.

Texas A&M University

Training on Impact Assessment:

West African Component Mali

Introduction

Critical needs for agricultural research institutions within sub-Saharan Africa (in particular West Africa) include the following:

- Increasing human capital of agricultural researchers in the areas of policy analysis and computer based simulation models
- Making better use of remotely sensed data and other GIS data layers
- Providing information to policy makers on a wide range of impacts from various agricultural alternatives and scenarios at varying levels of governance
- Utilizing systems oriented approaches to NRM analyses that integrate concepts from the economic, biophysical, and environmental disciplines

The Texas A&M University (TAMU) Impact Assessment Group (IAG) has responded to these needs through the development of methods and training modules tailored to the developing country context. The TAMU IAG methods have been developed to:

- Improve the quality of NRM analysis through holistic methods that forge links among economic, biophysical, and environmental disciplines using an integrated suite of models housed collectively in a decision support system (DSS)
- Provide more timely and relevant information pertaining to agricultural policy makers regarding economic, environmental, and biophysical impacts at varying levels of scale
- Make use of recently developed GIS databases and remotely sensed data (land cover, climate, etc.)

The utility of the TAMU methods and proof of concept have been demonstrated through a series of case studies that were completed in collaboration with the Institute D'Economie Rurale (IER) and documented (refer to the Mali compendium http://cnrit.tamu.edu/cnrit.). The TAMU/IER case studies include: (1) the impacts of new technology at the farm, regional, and national levels; (2) the effects of weather induced risk and drought management; and (3) the intensification of mixed crop-livestock systems. As the Sikasso Case Studies were being completed and interactions with our Malian colleagues increased, part of the TAMU research agenda within SANREM shifted to transferring the analytical capacity of the DSS into the hands of our host country partners.

TAMU Approach to Training

The goal of TAMU training program is to *develop capacity for research scientists from multiple disciplines to jointly conduct spatially explicit impact assessment through integration of economic, biophysical, and environmental analysis*. Specifically, the training program aims to:

- Engage a wider base of host country researchers and scientists (~20) in the Mali case studies and supporting analyses conducted by TAMU/IER
- Increase the human capital of host country researchers and scientists through enhancing their

analytical skills in GIS, economic models, biophysical simulation, and impact assessment
- Strengthen agricultural research institutions capabilities in utilizing state-of-the practice analytical methods and computer software
- Strengthen agricultural research institutions ability to retrieve, analyze, and store GIS data
- Create a cadre of scientists capable of working as interdisciplinary team(s) to analyze a broad range of impacts and consequences stemming from a variety of agricultural and policy options

- Provide legacy databases and installed models to foster sustainability of acquired knowledge within institution
- Enhance intra and inter institutional capacity through the formation of interdisciplinary teams of scientists trained to perform impact assessment in an integrated manner for their institution(s).
- Demonstrate trainees' and teams proficiencies through the writing of a report at the completion of training.

The transfer of the large and analytically based models within the DSS TAMU has developed a ***training methodology*** that has the following features:

- Staged approach that trades-off between practical use of models and theoretical development as trainees progress and acquire new analytical skills (See Appendix)
    - Stage I: Simplified computer access spreadsheet, meta-models
- Employs an integrated, team oriented approach with scientists from multiple disciplines that are trained to work together on common research questions
    - Holistic approach to impact assessment that improves upon traditional economic oriented methods
- Utilizes spatially explicit analysis that centers around a variety GIS data layers
- Participatory in nature:
    - Expose a large number of scientists to TAMU DSS methods and approaches through workshops
    - Select trainees on basis of motivation, ability, and potential for using methods
    - Demand driven and flexible to trainees needs and research program
- Balance of intensive training within each trainees specialty with training required for integrated, systems based approach to analysis
- Use of existing data bases developed in case studies to provides trainees with familiarity and utility of training course in their own research.

Traditional impact assessment methods estimate the effects of changes in a system on selected variables. A well-known application of impact assessment is on estimating the economic benefits from technological system. These types of analyses are typically confined to an economic system. For broader policies, that can encompass several changes and perhaps simultaneous policies that have conflicting goals, a larger pathway of impacts is developed, and spillovers into different areas of society occurs. Unintended consequences of new technology, for example, could occur as land is converted and discharge rates of various effluents are increased. In these cases more robust analysis is required as system changes push model's assumptions to their limit and beyond as model variables can be changed that had been thought of as being static. In short, such situations go beyond the ability of any one model to analyze such changes in isolation.

Integrated impact assessment is an approach that from the outset considers impact analysis to be a multi-dimensional process. Impacts are estimated through the interaction of several different types of systems that typically would include economic, biophysical, environmental, and hydrological. Using spatial techniques, impacts are defined and scaled along a broad spectrum. This type of analysis can analyze simultaneous changes to systems and can account for a much greater pathway of impacts than can conventional impact assessment.

At Texas A&M, the Impact Assessment Group (IAG) has been working on integrated impact assessment for the past five years or so. An interdisciplinary team of scientists has been working on estimating the impacts of new technology and various other policy options. The novelty to this team's work has been the broad range of impacts that have been estimated, which includes a host of economic, biophysical, and environmental indicators. The methods have been exercised and applied in several case studies in West and East Africa.

It is noted that this type of analysis is intended only for impacts that are quantifiable using some type of analytical procedure. There will remain impacts that by their nature will be difficult to quantify, or beyond the modeling techniques of even a broadly defined inter-disciplinary team.

This training course is based on this research and presents a state-of-the-practice methodology to estimate impacts in this burgeoning information age. This training course prepares participants to conduct integrated impact assessment. Two levels of analysis are treated: Expert and User-Friendly.

Structure of Training Program

Given the wide range of potential course participants, the training program is broken up into a handful of stages. It is intended that not all participants would proceed through all of the stages in this training program due to time and resource limitations. Table 1 lists the type of participants that are likely to be involved with this type of training, and gives a summary of the various stages of training.

In Stage 1, the emphasis is on **functionality**, and assuring that participants are able to generate output from the DSS. The bulk of the training in this stage centers on building participants capacity for accessing the DSS output. The *entry point* for the DSS in this stage is through a spreadsheet module that serves as a model integration platform and a report generator. Participants do not access the DSS in any other manner in this stage, but are given sufficient training to appreciate the workings of the various models and model linkages that are contained within DSS. Changes in model data parameters would be limited to "point and click" types of options available within the spreadsheet; participants would be limited to the pre-existing model runs loaded into the spreadsheet module. The *target group* is general users of agricultural output including administrators from government ministries, agricultural technicians, and agricultural research scientists.

In Stage 2, the emphasis is on **application**, and assuring that participants are able to utilize the DSS, under its existing structure, to satisfy their research interests. The *entry points* in this stage are in two locations: one would be the spreadsheet module/report generator as in Stage 1. The other entry point would be through the data input files and data input ports that are available in the DSS models. This *requires* participants to be: (1) Familiar with the DSS models that they desire to apply to their research, many of which accept input in a user friendly "point and click" manner; (2) Able to follow the DSS model integration procedures and update the spreadsheet integration platform with the changes that they have made. In general, this will require the updating of meta-functions and the knowledge of statistical estimation. This allows users to apply their local agro-ecological, socio-economic, and environmental conditions to the DSS. The *target group* is agricultural technicians and agricultural research scientists.

In Stage 3, the emphasis is on **adaptability**, and assuring that participants are able to adapt the DSS, through modifying existing model structures, to suit their research interests. The *entry points* in this stage are in three locations: the first two remain the same from the earlier stages. The new entry point would be in the DSS models, where participants would be able to modify existing DSS modules to better suit their research needs. In some instances, this stage requires participants to learn new software languages (GAMS) in order to modify existing code. Examples would include adding additional equations to models. The *target group* is research scientists at agricultural institutions working as an integrated team to analyze new technology and policy alternatives.

In Stage 4, the emphasis is on **model development**, and providing participants with the capacity to construct new variations of the models to suit their research interests. This stage requires significant analytical and theoretical background in order to create new model structures and to modify models to test new hypotheses. As such, much of this training would necessitate formal academic courses through a Masters or Ph.D. program at a land grant university. Through their increased capacity, participants in this stage would be able to introduce new assumptions and structures into the DSS. This allows country-specific research agendas and new and emerging areas of research to be included in the DSS. The *entry points* in this stage include the locations from the previous stages: spreadsheet, model input files, and model code. In addition, participants would enter through modules and models that they have developed; upon reaching this step, ownership is established and potential for future sustainability is greatly increased. The *target group* for this stage is agricultural research scientists that have interest in working in an inter-disciplinary team and have a sufficiently long commitment to their host institution.

Table 1 Structure of stages defined within the training program

Stage Number	Purpose	Target Audience	DSS Entry Points	Skills Required
1	Functionality under existing structure and data	Ministry administrators	1. Spreadsheet platform	1.Office 2000
2	Application of local data to existing DSS structure	Agricultural technicians	1.Spreadsheet platform 2.Model data input files and data interfaces	1.Office 2000 2.Statistical estimation techniques 3.DSS model integration procedures
3	Adaptation of existing DSS structure to local conditions	Agricultural scientists	1.Spreadsheet platform 2.Model data input files and data interfaces 3.DSS model source code	1.Office 2000 2.Statistical estimation techniques 3.DSS model integration procedures 4.GAMS 5.Impact assessment theory

4	Development of new model structures	Senior agricultural researchers	1.Spreadsheet platform 2.Model data input files and data interfaces 3.DSS model source code 4.Newly developed DSS modules and corresponding models	1.Office 2000 2.Statistical estimation techniques 3.DSS model integration procedures 4.GAMS 5.Impact assessment theory 6.Economic policy analysis

Training Course Syllabus

The Mali training course is divided into four workshops that comprise a sequential approach to performing integrated impact assessment; being generic in nature, the content of each seminar is tailored to the particular stage of training. The outcomes of this training are for all trainees to achieve Stage 1 for all of the models within the DSS. Trainees are expected to achieve Stage 2 only for models that are within their area of specialty since the skills required increase at higher stages.

The following describes the content of each seminar.

Seminar 1 Introduction to Traditional and Integrated Impact Assessment

- Basic concepts of traditional impact assessment
- Types of traditional impact assessment
    - Ex-post vs. ex-ante impact assessment
- Basic procedure used in traditional impact assessment
- Economic impact assessment
    - Economic surplus measures
- Integrated impact assessment

- Identify policies to be analyzed (establish case studies for workshop participants)
    - In Stage 1 of training policies are assigned to workshop participants; in later stages participants have more leeway in choosing their own problems
- Identify expected impacts in each system
    - Identify how impacts will be estimated
- Identify decision alternatives (policy instruments) to be varied
- Identify variables that remain fixed

Seminar 2 Spatial Analysis

- Extrapolation of primary data
- Aggregation of processes from lower to higher scales of resolution
- Learn techniques to establish areas of geo-graphic similarity (i.e. simulation zones)

Seminar 3 DSS Model Suite: Estimating Impacts Within Component Models

- Familiarize all participants with basic functioning of each model within DSS (Stage 1):
    - Inputs
    - Outputs
    - Assumptions
    - Limitations of model
- In-depth training on models within participants primary field of discipline
    - Depth increases as participants strive towards Stage 2
    - Parallel training among the various disciplines
- In-depth training on models for participants in other disciplines as desired

Seminar 4 Integrating DSS Models

- Discussion on why models need to be connected and benefits derived from closed loop systems
- Identify data and information requirements of models within DSS
- Identify models to be connected within DSS
- Identify information flows within
- Present methods to connect models with emphasis on meta functions
- Connect models using input-output analysis
    - Meta functions
- Establish and verify that model equilibrium and model assumptions are valid and consistent among the DSS suite of models
- Arrange systems to fit into a larger structure that estimates the integrated impacts

Seminar 5 Integrating DSS Model Results: Impact Assessment Case Study

- Assemble final outputs and feed them forward to the impact assessment engine
    - Spreadsheet interface in early training stages
    - CME interface in later training stages
- Team discussions on individual model outputs and how they fit together
- Writing of report
    - Development of tables and figures for team report
- Presentation of team report to group

The first two seminars and part of Seminar 3 have been completed as part of the June and October 2002 workshops. The upcoming workshop in the summer of 2003 will complete the third seminar, and will also include Seminars 4 and 5.

Results

The TAMU/IER training began with two workshops on the suite of the TAMU DSS and impact assessment methods ('99 and '02). These workshops presented the application of the TAMU DSS to a series of Sikasso case studies and exposed Malian agricultural scientists from a variety of institutions and backgrounds to the TAMU DSS. A total of forty persons attended each of these impact assessment workshops. From these workshops a core group of sixteen Malian researchers were identified as trainees for the second phase of training, where the transfer of TAMU methods to the host country would take place.

IER was selected as the lead institution in this "hands-on", intensive phase of the training program. The first intensive training workshop was held in June 2002 at IER in Bamako. This was a three-day workshop that allowed trainees to gain familiarity with the entire suite of the TAMU DSS as well as the general methodology used by TAMU in conducting integrated impact assessment. This included the input requirements for each model, demonstrations of how models are run, and sample model outputs using data from the Sikasso case studies. Three interdisciplinary teams of scientists from seven Bamako research institutions were formed during this workshop (see Appendix). On the final day trainees worked as teams on several exercises that demonstrated the integrated nature of impact assessment.

A second workshop was conducted in October 2002. This workshop contained four days of intensive training within each of the trainees' specialty, two days of GIS training, two days of interdisciplinary team development (2 days). On the biophysical side, thre days of intensive training were split between NUTBAL (animal nutrition model), PHYGROW (forage growth model), and SWAN (crop growth model). For economics, one day of intensive training was spent on FLAM (farm level model). The GIS training was conducted by Malian scientists from the Sotouba research station (Dr. Cheick Hamala) and included instruction and exercises on how to create and utilize GIS data layers in Arc-View (a GIS software package). Trainees' feedback included requests for additional training on GIS, the crop growth model, SWAN, and additional training on farm (FLAM) and sector level economic modeling (ASM).

The third and final workshop is to be conducted in Bamako during the summer of 2003. The primary objectives of this workshop will be to: (1) complete the intensive training for the biophysicists (SWAN) and economists (ASM), and (2) have each team conduct a mini-case study during the training period and write up their findings by the end of the workshop. Upon completion of the training, all of the trainees will have reached Stage 1 on the primary models within the DSS.

Our efforts to expand the DSS and impact assessment training have included outreach to two regional organizations in West Africa, CILLS and INSAH. Parallel to our training in Mali, we have engaged CILLS and INSAH on the utility of the TAMU DSS in analyzing agricultural and NRM policy for the greater West Africa region. Representatives of these organizations have attended our Bamako DSS workshops and have been kept informed of the outcomes of our June and October training workshops. In June 2002 TAMU made a formal presentation of the DSS to CILLS that included representatives from eleven of the thirteen CILLS countries were in attendance. In this Dakar presentation, the utility of the DSS in analyzing contemporary agricultural policy was demonstrated using the Sikasso case studies.

Subsequently a proposal has been submitted to CILLS and INSAH to establish a West Africa regional center of excellence where agricultural scientists from the CILLS member countries would receive training on the DSS, impact assessment methods, and GIS. The format of this training would be similar to approach taken in Mali with interdisciplinary teams working together on common research questions and with recognition of the various stages that trainees (and teams) would need to progress through. At present the proposal is still under review by CILLS.

Recommendations

The following discusses the outcomes of the training initiatives, and provides lessons learned for future training should additional resources be obtained.

Positives:

- Created demand and interest on behalf of trainees for utilizing the TAMU DSS tools and impact assessment in the their research.
- Increased GIS skills and GIS awareness among trainees

- Increased trainees skills in developing model output and in understanding the primary functioning's for the major components of the DSS (PHYGROW, NUTBAL, FLAM, ASM, and SWAN)

Negatives:

- Logistics inherent to developing countries.
- Limited availability of computers
- Lack of institutional support for new methods and continued reliance on ad-hoc methods
- General lack of incentives provided to researchers for increasing their skills
- Turnover of decision makers

Future

The final workshop of the Mali training is tentatively planned for the end of June. In accordance with trainee feedback, this workshop will provide intensive training on SWAN, ASM, and FLAM. The inter-disciplinary teams will each conduct analysis during the workshop that will be written up as a report to be completed by the end of the workshop.

Contingent on additional funding, longer-term training would expand the training to include

APPENDIX

Table 1 List of Training Workshop Participants

Name	Institution	Team	Discipline	Background
Hamady Djouara	IER/ESPGRN	2	Ag-Eco	
Youssouf Cisse	IER/ECOFIL	1	Ag-Eco	
Oumar Doumbia	IER/LABOSEP (Sotouba)	1	Soil Science	
Kolado Bocoum	CPS/MDR	2	Ag-Eco	
Bakary Toure	STQ/CIGQE	2	Environment	
Mme. Sow Penda Sissoko	IER/ESPGRN Sotouba	3	Ag-Eco	M.S. Ag Economics
Nouhoum Sangare	DNAMR	3	Plant Breeder	
Cheick Hamala Diakite	IER/LABOSEP	3	GIS	Ph.D.
Lassana Dione	IER/LABOSEP	2	Soil Science	

Djibril Kaba	DNAER	1	Livestock	
Mme Maiga Haidara	DNCN	2	Livestock	M.S.
Bara Ouologuem	IER	3	Animal Nutr.	
Abdoulaye Ballo	IER/LABOSEP (Sotouba)	-	GIS	

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