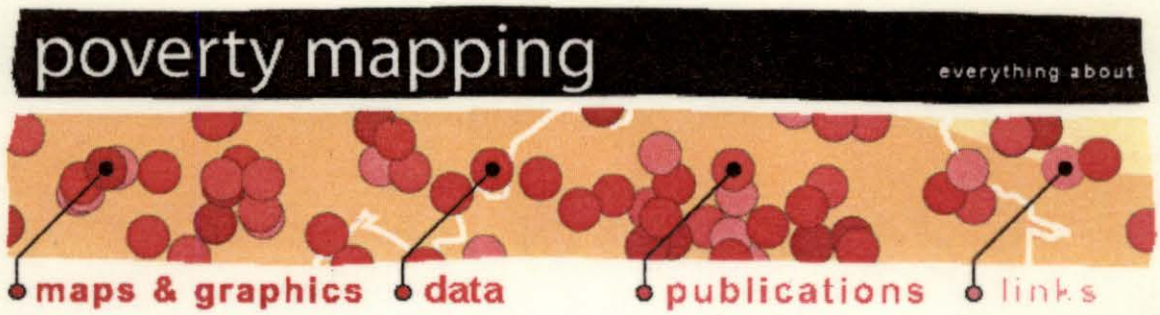
Improving Methods for Poverty and Food Insecurity Mapping and Its Use at Country Level: The Country Case Study Proposals and Work Plans

A Joint Project of the Consultative Group on International Agricultural Research (CGIAR), the United Nations Environment Program (UNEP) and the Food and Agriculture Organization (FAO)

(GCP/INT/761/NOR)



15 November 2002

CGIAR UNEP GRID Arendal CIAT

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IMPROVING METHODS FOR POVERTY AND FOOD INSECURITY MAPPING AND ITS USE AT COUNTRY LEVEL (GCP/INT/761/NOR)

Final Report of CIAT FAO Letter of Agreement
26 September 2001 – 25 September 2002

I Introduction

The Food and Agriculture Organization (FAO) provided the International Center for Tropical Agriculture (CIAT) and partners with funding to manage and carry out country level case studies on poverty and food security mapping for eight developing countries This report presents the results of the first year of our multi year partnership with FAO and the Global Resource Inventory Database (GRID) Arendal under the Norway funded project entitled **Improving Methods for Poverty and Food Insecurity Mapping and Its Use at Country Level (GCP/INT/761/NOR)**

The report structure follows the six outputs specified in the original letter of agreement (LOA) between FAO and CIAT Part II of the report discusses the call for proposals the review process and the final selection of the eight case studies as planned in the LOA Part III presents the efforts of all project partners to incorporate and employ cutting-edge poverty and food security mapping methods Parts IV V and VI discuss our efforts to ensure that the eight country case studies implement an Internet communication strategy designed to improve our knowledge of poverty problems and share our techniques with others interested in using these or similar technologies

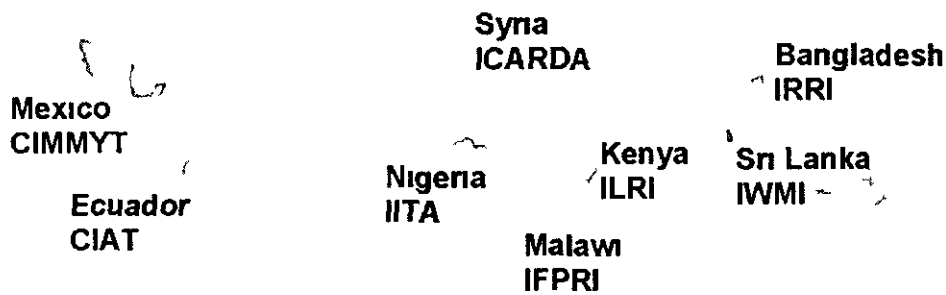
The report concludes with some comments about project progress so far and a perspective on the next 2 years of the project Appendices on the status of the proposal development process case study progress to date and a contact list for all the Consultative Group on International Agricultural Research (CGIAR) professionals working in the project follow the conclusion

II Report of Country Case Study Selections

The Steering Committee (SC) and the Project Management Group (PMG) of the FAO/GRID/CGIAR Poverty Mapping Project chose eight proposed country case studies to be supported by the project (Figure 1) The proposed studies were chosen after a call for proposals internal and external reviews a methodological workshop and a revision process

Shortly after the project LOA was signed CIAT drafted a call for proposals that was then sent out to the PMG and the project SC The SC and PMG made comments and suggestions that were subsequently incorporated into the call for proposals (Appendix A) The call for proposals asked proponents to place particular emphasis on the research questions initially formulated in the larger project proposal funded by Norway

Proponents were asked to follow a set of criteria for selecting the country for the study that would give the collection of case studies geographical balance and methodological innovations The project sought case studies in line with the larger food security goals of the World Food Summit (WFS) and FAO Nine CGIAR centres submitted case study proposals to be considered for funding



Case Study Countries

Figure 1 The case study countries and the Consultative Group on International Agricultural Research (CGIAR) centre carrying out the study

The project implemented an internal and external review process to select proposals for funding In addition to selecting the studies to be funded the review process encouraged proposal revision to steer the projects towards incorporating innovative methodologies and communications strategies serving larger project goals John Weeks of San Diego State University Andrew Nelson of the World Bank and Norbert Henninger of the World Resources Institute were employed as external reviewers to evaluate each of the nine proposals We asked them to rate each proposal according to specified criteria, to rank the proposals from most to least deserving of funding and to make specific suggestions on how each proposal could be improved

The SC and PMG decided that a workshop on food security and poverty mapping methodology could help our emerging network share methods and could also improve the country case studies The workshop was held in April 2002 at FAO headquarters in Rome Geographic information scientists from each CGIAR study proponent attended the Rome workshop FAO and GRID made presentations on their parts in the larger Poverty Mapping Project John Weeks prepared a seminar on spatial analysis and interpolation methods for poverty data Study proponents gave short presentations on their proposed study The workshop functioned as a mechanism for case study proponents to learn new

methods make suggestions on proposed projects and exchange ideas on how to map food security and poverty

During the Rome workshop the SC and PMG decided to make a commitment to secure funding for all nine proposals To date funding for eight of the nine proposed projects has been secured Consideration of the China case study has been indefinitely postponed The review process turned out to be much more important in revising and improving proposals than for selecting the ones to be funded

III Report of Country Case Study Methodologies

One important goal of the case studies is to apply innovative methods to food security and poverty mapping Project resources were used to establish the proposal process to employ external experts to advise us on methods and to develop the methods workshop described above This section gives an overview of some of the methods that will be employed by the case study researchers to help us bring innovative methods to food security and poverty mapping in the country case studies Readers will find more detailed descriptions of the case study methodologies in the full proposals in Appendix D The following paragraphs discuss the incorporation of innovative methods for spatial interpolation of socio economic variables the use of the small area estimation technique analyses of poverty-environment relationships and a livelihoods approach to poverty mapping

Most of the case study proponents will use some of the spatial interpolation and nearest neighbour analysis methods suggested by Dr Weeks during the Rome Methods Workshop These methods focus on incorporating effects of spatial autocorrelation into the analysis The International Maize and Wheat Improvement Centre (CIMMYT the Spanish acronym) georeferenced the latest Mexico census according to municipality centroids They will be used to make surfaces of demographic variables The International Institute of Tropical Agriculture (IITA) will do something similar for Nigeria but they will use a nutrition survey carried out in an earlier project The International Centre for Agricultural Research in the Dry Areas (ICARDA) will use a United Nations Development Program (UNDP) survey to make a similar point pattern analysis

The International Food Policy Research Institute (IFPRI) International Rice Research Institute (IRRI) and CIAT are using some variation of the small area estimation technique to map poverty and food security The technique was developed in decades past but has received further improvements recently by researchers at the World Bank The basic principle of the method is to estimate variables from a relatively low cost survey sample onto maps of an entire country The key to the method is to find the statistical relationship between variables in the survey and variables in a national census Then for those variables in the survey for which corresponding data are unavailable in the census the method permits estimation based on the statistical relationship The method is particularly useful for information that the census neglects such as income and factors related to nutrition Our employment of the small area estimation method marks the first time this technique has been use for variables focused on food security

Several of the case studies will examine poverty and environment relationships CIAT will look at the effects of natural hazards such as drought El Nino and landslides on food security in Ecuador ICARDA will compare food security measures to detailed maps of agro ecological systems for Syria IWMI is analysing food security in the context of water resources at the basin level in Sri Lanka

A final methodological approach that deserves mention is the International Livestock Research Institute s (ILRI s) livelihoods mapping method for Kenya The method requires that livelihood assets are identified and mapped putting the focus on the presence or absence of those factors most important for making a living

The country case studies will continue to be subject to external evaluation to ensure that our methodologies are sound and innovative A proposal was made at the last SC meeting to plan for these methods to be published in a special volume of a peer reviewed scientific journal

IV Plans of Country Case Studies

Each case study proponent planned its country case study in the context of the proposal development process The main features of the process are the case study budget and the logical framework analysis which can be found in each proposal in Appendix D

The eight case studies are using logical framework analysis to plan monitor and evaluate each project Project proponents put the goals outputs and activities into the logical framework table For each of these elements measurable indicators of their impact are listed along with the means of verification We encouraged the use of quantifiable indicators and the use of dates to track progress The table also includes important assumptions that forced case study proponents to evaluate the risks related to donor investments in the poverty mapping and food security activity

V Poverty Mapping Web Site for the Country Case Study Work

The CGIAR centres will provide content for www povertymap net by making our project reports useful on Internet platforms and by creating geospatial metadata for a future search mechanism Both of these issues were discussed during a meeting of the case study principal investigators (PI) in Sioux Falls South Dakota in May 2002 as part of the Geospatial Applications to Support Sustainable International Agriculture (GASSIA) Workshop

At Sioux Falls the PIs learned the use of different tools to create geospatial metadata, including validation programs to ensure compliance with recognized standards We also received software for creating metadata and setting up Z39 50 compliant spatial data clearinghouse nodes All the poverty and food security maps that emerged from this project are required to include structured metadata according to the ISO standards Each centre will register their metadata records in a clearinghouse node on their corporate Web site In a future phase of the project a search mechanism can be created that will search

the clearinghouse nodes for poverty and food security maps according to theme location time period and other possible search characteristics

VI Report on Web Site Mapping Capability

The larger mapping project of FAO GRID CGIAR on poverty and food security includes a strong communications strategy to help us achieve impact As part of this strategy the CGIAR centres will develop dynamic mapping Web sites to communicate the results of each case study During the Sioux Falls meeting all the poverty mapping participants agreed to use ArcIMS map server software to develop dynamic mapping Web sites

In late 2001 CIAT and GRID contacted the Environmental Systems Research Institute (ESRI) and secured a donation of ArcIMS software Subsequently the CGIAR centres developed a larger agreement with ESRI folding the ArcIMS donation into an overall package of software The CGIAR centres are now implementing the new software arrangement

All country case study proponents participated in a 3½ day ESRI led training session in how to use ArcIMS software The training covered map server administration technical considerations for serving maps XML programming for developing a site and other aspects of ArcIMS

VII Report of First Phase of Country Case Studies

All eight CGIAR centres carrying out studies have started work on the project even though not all have finalized contracts to receive funding Appendix B summarizes the progress to date on each of the eight case studies

All investigators began to collect data for the case studies during the second half of 2002 This work involved getting survey and census data ordered and ready to geographically reference Many of the researchers have put together data inventories

Research partners are holding meetings within the countries to bring together national partners and to get opinions on stakeholder views of the topic Efforts are being made to ensure that the case studies are in line with national poverty reductions strategies

VIII Conclusion

CIAT and partners made substantial advances in the development of the country case study component of the larger FAO GRID CGIAR Poverty Mapping Project during the first year of funding The initial objectives have been met and new additions to the overall project were initiated The case studies are now well positioned to make a substantial contribution to the overall activities being carried out in the Poverty Mapping Project The remaining 2 years of the project can now focus on case study implementation and dissemination of results through the poverty mapping network

APPENDIX A
Call for Proposals – CSI/FAO/GRID Poverty Project

Introduction

The new CSI/FAO/GRID poverty project seeks CSI partners to conduct a country level case study on indicators and mapping of food insecurity and poverty Four CSI partners will be selected to conduct case studies Although we expect to select case studies from each developing world region (Latin America Sub saharan Africa North Africa West Asia and Asia) proposals will be judged based on their overall contribution to project goals

All CSI partners that had paid their membership dues by December 2000 are eligible to submit a proposal The project management and steering committee of the CSI/FAO/GRID Poverty Project will select projects to be funded (see attached proposal for more information on this project)

The objectives of the case studies are

- To develop innovative methods and techniques for analyzing the temporal and spatial dynamics of food insecurity and poverty
- To develop a GIS based system for mapping indicators of food insecurity and poverty on a country wide basis The system or its component parts will be made available to decision makers researchers and the public in general
- To develop work that serves as a model for future analysis at the country level

Research Questions

Some general research questions may include

1 What are the critical factors related to food insecurity and poverty for the country? What indicators could be used to permit evaluation of these factors?
2 What are the spatial patterns of food insecurity and pove y for the country of interest? What processes lie behind the patterns?
3 Given our knowledge of processes and patterns related to food insecurity and poverty how can the case study analysis be used in the development of policy interventions or resources allocations?
4 What is the relationship between food insecurity and the environment? What are the importance of climate soils topography and other environmental variables in the level of poverty? In the selected country is there any evidence to support the poverty trap theory? What is the role of markets population pressure and other socio economic variables on the relationship between poverty food insecurity and the environment?

5 According to FAO a significant proportion of the food insecure are subject to economic and environmental shocks Where are these populations and what are their vulnerabilities?

However each proposal should develop its own research questions in line with the general objectives of the project We encourage different approaches and innovative methods

Methods

The analysis information and data produced will serve as a tool for policy makers researchers and other analysts in their efforts to contribute to the World Food Summit goals of reducing the number of malnourished by half by 2015

The project will require the development of sub national data related to food security problems for an entire country Researchers carrying out the study will need to consult with in country experts to develop a conceptual framework that considers factors related to food insecurity in that country The framework should include indicators that permit analysts to study the spatial and temporal distributions of factors related to food security problems The case studies should use the Committee on World Food Security paper Suggested Core Indicators for Monitoring Food Security Status as a guide in indicator selection (see attached document)

The project should develop innovative spatial analysis methods for mapping food insecurity and poverty We expect to go beyond traditional mapping of socioeconomic factors in computer cartography systems We hope to identify modifiable drivers of food insecurity and poverty by exploring innovative approaches to enrich current understanding Ideally the studies will consider the interplay between rural and urban poverty The studies might consider the effects of external shocks such as droughts civil war and invasion of new crop diseases How does vulnerability to these shocks affect food security outcomes? The projects should employ spatial analysis They should address questions of geographic scale in analysis and decision making We encourage the development of projects that examine distance and location spatial patterns and processes and relationships between humans and the environment

The information and data developed for the project will be made available on the Internet or CD ROM for use by analysts studying food security and poverty problems

Criteria for Selecting Projects to be Funded

1 well designed conceptual framework
2 logical selection of country for the case study
3 indicator selection in line with Committee on World Food Security guidelines
4 use of innovative methods especially those that bring spatial analysis techniques to poverty mapping efforts
5 feasibility potential to get the job done

6 fit between proposal objectives and overall project (FAO/CSI/GRID) objectives
7 in kind and human resources brought to the project

Considerations for Selecting Country Case Studies

Level of poverty and food insecurity The countries chosen should have significant poverty and food insecurity problems As an example from Latin America, we would exclude Costa Rica as a pilot country simply because the percent of food insecure and poor is much lower than other Latin American countries Larger and more advanced countries like Argentina are of less interest due to their level economic development and capacity to develop their own analysis infrastructure for studying these issues

Population We want countries with significant population A population of one million would be an absolute minimum and three million may be a better minimum figure Since these are pilot studies the smaller countries can be tackled in the future

Geographical Balance If possible we want pilot country work in the three major developing world regions Latin America, Africa and Asia We want countries that are perhaps representative of other regions of a continent However the selection committee will choose pilot countries based on overall project objectives

Availability of information Proposed projects should take advantage of already existing information that can be readily incorporated into GIS Often the poorest countries have the least developed information about their biophysical and socioeconomic environment We should avoid excluding countries solely based on their lack of information One challenge of this type of work is to develop useful analyses of food insecurity in data poor environments However we will have to recognize that lack of information in some cases could make developing an analysis system impractical Proposed projects should balance the availability of information with the practicality of carrying out the pilot study

Connection with on-going initiatives As a practical matter we may want to choose countries that are already involved in FIVIMS or CGIAR activities If a FIVIMS partner is weak with respect to mapping and GIS we could help this country by addressing this weakness CGIAR centers would be interested in working in countries where they already have well developed crop improvement or natural resources management initiatives already in place

Project Proponent Terms of Reference

1 The CSI partner will develop geographically referenced systems for analyzing poverty and food security at the national level for 1 country within their developing world region
2 The CSI partner will bring project resources to bear on developing methods for poverty and food insecurity analysis We are looking for innovative ways to study poverty and provide information for policy makers

3 The centers will participate in project meetings for sharing results information exchange and project management
4 These systems will be made available on CD ROM and the Internet either on the center s corporate web site or on the project web site (http //www povertymapping net)

Deliverables

1 Three biannual reports that will be published on povertymapping net (after the first six months twelve months and 18 months) The biannual reports will describe progress in the development of the study obstacles successes methodologies used and new insights These reports will be no longer than 3 pages of text plus graphics and tables
2 A final report that will be published on povertymapping net at the end of the two year project period We expect project proponents to publish their results in international refereed journals The reports should include guidelines on poverty mapping and analysis for researchers and policy makers
3 Multi platform media (web page CD printed report) that will serve as a tool for decision makers and others interested in poverty and food security of the particular country The CD/web page should include the following elements
   a Written report that includes analysis of poverty and food security for the country
   b Bibliography and links to resources related to the project
   c Maps of key variables and indicators related to poverty and food security for the country
   d A mapping interface that permits viewing and query of geographic information related to poverty and food security

   The web site can be housed on the corporate web page of the participating CGIAR/CSI center or on www povertymapping net The web page should have dynamic mapping capability using ArcIMS or a similar map server technology The web page should allow users to access statistical textual and geographic information The web sites must acknowledge the FAO/GRID/CSI project donor funding the CSI and the FAO/FIVIMS project This project should take advantage of training and software provided by CSI
4 Each proponent will be required to present the results of their research at a workshop in the final year of the project

Proposal Guidelines

The maximum proposal length is five pages of text one page budget and one page logical framework in standard CGIAR formats Proposals may include a one page bibliography and one page CV s for principal scientists in the project Proposals may include letters of agreement with national institutions that may participate in the project Proposals should be printed in 12 pt Times New Roman type with one inch margins The maximum amount of funding available to complete country case studies is US$100 000 to be disbursed in payments of US$33 333 at the beginning of Year 1 Year 2 and upon

delivery of final outputs The deadline for submitting a proposal is November 1st 2001 The Selection committee will decide which projects are to be funded by the end of 2001 The work will start shortly thereafter Proposals should be sent to

Gloria Stella Torres
Land Use Group
International Center for Tropical Agriculture (CIAT)
g torres@cgiar org

We ask that anyone that is planning to submit a proposal please contact Glenn Hyman immediately to inform him that you intend to participate in this project If you have questions about the project and your possible participation contact Glenn by email at g hyman@cgiar org

APPENDIX B
Changes Made to the Case Studies Following the Rome Methods Workshop and Progress on the Eight (8) Country Case Studies

CIAT

Project – Geographic dimensions of food security in Ecuador with focus on social and environmental drivers vulnerability and resilience
Changes since Rome – greater linkages with on going FIVIMS efforts more emphasis on impacts and decision making process
Work Completed

- had a stakeholder meeting in Ecuador in June
- produced a diagnostic report based on stakeholder meeting outlining the hypotheses for causes of food insecurity selected candidate sites for local scale case studies
- are building a strategic alliance with an existing – but dormant Ecuadorian food security network
- have acquired an internet domain name and are building interactive web mapping site
- have made contacts with the World Bank to acquire 2001 population census data.
- have made contacts with the Ministry of Agriculture to acquire 1996 agriculture census data
- are completing data inventory

CIMMYT

Project – Geospatial dimension of poverty and food security in Mexico
Changes since Rome – emphasis to measure spatial autocorrelation expanded focus on decision makers
Work Completed

- Designed a database structure for storing all state level data and confirmed that it can be linked to ArcGIS data easily
- Obtained the most recent maps of municipality boundaries
- Extracted a large amount of climate data for centroids of municipalities
- Recompiled the FILTER program to handle 8K points
- Negotiated zero cost access to the national database of roads
- Obtained the most recent census data
- Planned stakeholder workshop for November

IFPRI

Project Improving Welfare Policy Design and Targeting through Spatial Analysis of Poverty and Vulnerability in Malawi
Changes since Rome – dropped Mozambique from analysis incorporation of agro ecological and socioeconomic correlation analysis will examine vulnerability as a dynamic concept

Work Completed

- Requested small area estimation software and guidance from World Bank to apply for Malawi
- Requested spatial data from Malawi Department of Surveys
- Requested market price and rainfall information form National Statistical Office and the Department of Meteorology in Malawi
- the Malawi Complementary Panel Survey data from which is to be used in the final stage of our research was completed earlier this month

IITA

Project – Geography of the drivers of malnutrition in Nigeria using household survey data throughout the country

Changes Since Rome – Incorporation and emphasis on spatial statistics better specification of data development development of user oriented mapping application

Work Completed

- Basic data entry for the food demand study has been completed
- Village and HH level data for the food consumption study has also finished
- Workshop held on 8 August for state coordinators of both the rural food demand and the food consumption study to initiate the georeferencing of the databases
- A data collection scheme for georeferencing the villages was agreed upon

ICARDA

Project A Multi Scale Integrated Approach to Poverty Mapping in Syria

Changes Since Rome will obtain the UNDP survey data to attempt point pattern analysis suggested by Dr Weeks in Rome will integrate survey into the spatial frameworks (agroecozones) as well as ICARDA s nutritional survey data which are limited to a small part of the country

Work Completed

- Scanned topographic maps

Note ICARDA has not yet received funding for their project

ILRI

Project – Poverty and Natural Resources Management Linkages in Kenya

Changes since Rome – are taking a pilot study approach for extrapolation to other countries are taking a livelihoods mapping approach for one district

Work Completed

- have held 2 planning meetings with SNV a Dutch NGO based in Kajiado district doing complementary research wrote up a LOA to collaborate and share data/maps (they have household surveys and we are helping them to geo reference them)
- drafted ideas for indicators for each of the 5 livelihood assets that may be possible to map and started listing what data regarding each indicator is available and where
- met with Robin Reid of ILRI s PLE program and Steve Staal of ILRI s Dairy program

and established several complementary ongoing ILRI efforts that will provide valuable data for our livelihood maps

- met with IFPRI and ICRAF teams to discuss available data and USAID/IFPRI s interest and possible contributions towards livelihood maps within the new African agricultural initiative

IRRI

Project Poverty and Food Security in Bangladesh Implications for the Design of Policy and Agriculture R&D&E Interventions

Changes since Rome – new specification of spatial interpretation tools new emphasis on development outputs aimed at decision problems in agricultural R+D

Work Completed

- conducted a stakeholder workshop in April
- conducted a follow up methodology workshop in July involving key agencies
- developed a work plan with key collaborating agencies including exchange visits for collaborative development of database and analysis
- gave a lecture on poverty mapping at a World Bank funded workshop on poverty in Dhaka in July established a strategic alliance with a major policy analysis institution involved in developing the Poverty Reduction Strategic Paper and the Chronic Poverty Study for Bangladesh with agreement to share data

IWMI

Project Food Insecurity and Poverty in Sri Lanka Mapping Indicators for Analyzing the Dynamics of Temporal and Spatial Variability for Identifying Future Policy Interventions and Resources Allocations

Note The IWMI LOA is at present still being negotiated IWMI submitted a revised proposal that is going through one more round of revision It is expected that the IWMI funding will commence before the end of 2002

APPENDIX C
Contact List for CGIAR Professionals Working in FAO-GRID-CGIAR Project

CG Center	First Name	Last Name	Occupation	Email
CIAT	Andrew	Farrow	Geographer	a farrow@cgiar org
CIAT	Glenn	Hyman	Geographer	g hyman@cgiar org
CIAT	Simon	Cook	Crop Biologist	s cook@cgiar org
CIAT	Elizabeth	Barona	GIS Specialist	e barona@cgiar org
CIAT	Gregoire	Leclerc	Geophysicist	gregoire@teledetection fr
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CIMMYT	Jeff	White	Agronomist	j white@cgiar org
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CIMMYT	Javier	Becerril	Economist	jbecerril@cimmyt exch cgiar org
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IFPRI	Jordan	Chamberlin	Geographer	j chamberlin@cgiar org
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IRRI	Hossain	Mahabub	Senior Economist	m hossain@cgiar org
IRRI	Bose	Manik Lal	Project Scientist	m bose@cgiar org
IITA	Tunrayo	Alabi	GIS Specialist	t alabi@cgiar org
ILRI	Patti	Kristjanson	Agricultural Economist	p kristjanson@cgiar org
ILRI	Russ	Kruska	GIS Analyst	r kruska@cgiar org
IWMI	Madar	Samad	Economist	SAMADM@iwmihq exch cgiar org
IWMI	Intizar	Huzzain	Economist	IntizarH@iwmihq exch cgiar org
IWMI	Upali	Amarasinghe	Statistician	UpaliA@iwmihq exch cgiar org
IWMI	Lal	Muthuwatta	GIS/RS expert	LalM@iwmihq exch cgiar org
ICARDA	De Pauw	Eddy	Agroclimatologist	e de pauw@cgiar org
ICARDA	Aw Hassan	Aden	Socio economist	a aw hassan@cgiar org
ICARDA	Mazid	Ahmed	Agricultural economist	a mazid@cgiar org

Address of Organization

Address 1	Address 2	Address 3	City	State/Dept	Country	Postal Code	Telephone	Fax
CIAT	A A 6713		Cali	Valle	Colombia		57 2 445 0000	57 2 445 0073
CIAT	A A 6713		Cali	Valle	Colombia		57 2 445 0000	57 2 445 0073
CIAT	A A 6713		Cali	Valle	Colombia		57 2 445 0000	57 2 445 0073
CIAT	A A 6713		Cali	Valle	Colombia		57 2 445 0000	57 2 445 0073
CIAT	A A 6713		Cali	Valle	Colombia			
CIAT	A A 6713		Cali	Valle	Colombia		57 2 445 0000	57 2 445 0073
CIMMYT	A P 6 641		Mexico	D F	Mexico	6600	52 5804 2005	52 5804 7558
CIMMYT	A P 6-641		Mexico	D F	Mexico	6600	52 5804 2005	52 5804 7558
CIMMYT	A P 6-641		Mexico	D F	Mexico	6600	52 5804 2005	52 5804 7558
CIMMYT	A P 6-641		Mexico	D F	Mexico	6600	52 5804 2005	52 5804 7558
CIMMYT	A P 6-641		Mexico	D F	Mexico	6600	52 5804 2005	52 5804 7558
IFPRI	2033 K Street NW	IFPRI/FCND	Washington	DC	USA	20006 1002	1 202 862 5667	1 202 467 4439
IFPRI	2033 K Street NW	IFPRI/EPTD	Washington	DC	USA	20006 1002	1 202 862 8282	1 202 467 4439
IFPRI	2033 K Street NW	IFPRI/EPTD	Washington	DC	USA	20006 1002	1 202 862 8131	1 202 467 4439
IRRI	DAPO Box 7777	Metro Manila			Philippines		63 2 845053	63 2 8450606
IRRI	DAPO Box 7777	Metro Manila			Philippines		63 2 845053	63 2 8450606
IRRI	DAPO Box 7777	Metro Manila			Philippines		63 2 845053	63 2 8450606
IITA	International Institute of Tropical Agriculture (IITA)	GIS Lab	Ibadan	Oyo	Nigeria	PMB 5320	234 2 2412626	
ILRI	Box 30709	Naivasha Road	Nairobi		Kenya		(254 2) 630 743	(254 2) 631 499
ILRI	Box 30709	Naivasha Road	Nairobi		Kenya		(254 2) 630 743	(254 2) 631 499
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APPENDIX D
Final Proposals after Revision

Improved Mapping and Spatial Analysis of Food Security and Poverty in Ecuador
CIAT

1 Collaborators

International Center for Tropical Agriculture (CIAT)
Food and Agriculture Organization of the United Nations – Ecuador (FAO)
The Ecuadorian Foundation for Ecological Studies (EcoCiencia)
Planning Office of the President of Ecuador (ODEPLAN)
World Food Programme – Ecuador (WFP)

2 Need to be addressed

Food is the most basic human need and access to food (as opposed to food availability, McGuire 2000) is major concern for poor people Ecuador has a population of 12 million and the potential to feed a population of over 100 million (Gomez and Gallopin 1995) Yet almost one fifth of Ecuador s inhabitants are undernourished (FAO 1999a) and over a quarter of children under 5 years of age are affected by chronic malnutrition (Larrea et al 2001a) This situation is deteriorating Due to *el niño* related floods and the economic crises of the past five years poverty has increased by 50% and now afflicts three quarters of Ecuador s population (Larrea et al 1996 Larrea et al 2001b) During this period Ecuador has been dollarised privatised and decentralised or is moving in those directions In order to modernise the state national institutions are being stealthily dismantled As a result initiatives at the national level are being neglected or have never been implemented for example the national Food Insecurity and Vulnerability Mapping System (FIVIMS) in Ecuador suffers from a lack of coordination and dynamism and more effort is currently being put into developing a provincial level FIVIMS (Quevado Moreano Miranda de Larra, Rivadeneira, *pers comm*) The need for national level assessments (using sub national level data) of food insecurity remains high but the institutions capable of doing this or of securing funds for this are few

3 Project Goal

The goal of this project is to identify the lack of access to food within Ecuador and test hypotheses regarding the causes of food insecurity in Ecuador This will be achieved by identifying how access to food varies spatially how access to food varies temporally and crucially how the drivers of accessibility change over space and time This project aims to benefit many different institutions in both targeting their resources and their research,

specifically the capacity of the Ecuadorian government to design policy or development interventions necessary to improve food security

4 Project Purpose

The purpose of the project is to identify the linkages between food security and the spatial dimensions of the wider socio economic and biophysical environment A number of important initiatives to study poverty and food insecurity have been undertaken in Ecuador or are currently in progress (Larrea et al 1996 1999 ODEPLAN 1999 World Bank 1996 FAO 1999a FIVIMS 1999 Hentschel et al 2000) This project will add value to these studies by analysing explicitly the role of environment access distance and spatial structure in poverty and food security by asking questions such as

What are the relationships between poverty and access to markets services and information? What are the roles of biophysical factors such as natural hazards, drought stress and soil fertility in food insecurity and poverty?

The project will use geographical analysis to identify distance decay effects patterns of spatial variation physical accessibility and spatial correlations between biophysical and socio economic variables

We propose to identify the distribution of vulnerability of current and future populations to hazards such as floods or economic collapse that undermine efforts to build food security and reduce poverty within a conceptual framework that identifies

- Poverty and food security conditions and driving forces
- Analysis of risk of perturbations and vulnerability of food security
- Possible futures and scenarios for improved food security

This framework allows us to organize specific activities (Figure 1) and generate six specific outputs contributing to World Food Summit goals of reducing the number of poor and malnourished We will share our results through dynamic mapping via the Internet on the web in partnership with a wide range of stakeholders in Ecuador

5 Project Outputs and Methodology

The project will deliver the following outputs

1 Selection of factors and details of the approach (Workshop)
2 Mapping of variables which describe poverty access to food and probable environmental drivers
3 Analysis of linkages between food security / poverty and potential drivers
4 Analysis of the vulnerability of populations at risk to external or internal shocks
5 Identification of the resilience of populations at risk
6 Scenarios (futures) modelled from the methods quantified in outputs 2 5

Activities and outputs are detailed below and summarised in Figure 1 The reasoning behind the project design is articulated in the logical framework in Table 1 of this document

In Outputs 1 2 and 3 we concentrate on food security and poverty conditions and the identification of driving forces Outputs 4 and 5 focus on populations vulnerable to declining food security the risks they face and their strategies to sustain their livelihoods Output 6 will explore scenarios for analysing possible futures of food security and poverty in Ecuador

5 1 Output 1 Results of Project Launch Workshop

We will establish and refine the project framework in a workshop to launch the project to be held in Quito Ecuador in June 2002 Experts will be invited from the collaborating partners organizations and other interested Ecuadorian government and non government organizations

The workshop will consist of sessions to discuss the perceptions and current knowledge of food security in Ecuador the impact of economic shocks and natural hazards on food security the relationships between environment and poverty in Ecuador and possible future scenarios for the poor and food insecure Links between this project and the Food Insecurity and Vulnerability Information and Mapping Systems (SICIVA) initiative in Ecuador will also be discussed as will issues such as data acquisition intellectual property rights and web mapping capabilities

5 1 1 Activity 1 Define expected outcomes of the workshop

We will use expert knowledge gathered at the workshop to define

- Three candidate case study areas defined at the province level
- Hypotheses for the causes of food insecurity and poverty in Ecuador and potential driving forces that should be analysed spatially
- Five candidate scenarios for possible futures of food security and poverty in Ecuador
- Details of a joint CIAT FAO EcoCiencia ODEPLAN WFP food security web site
- Logistical concerns and memoranda of understanding between the collaborating organizations
- Possibilities of further research specifically a replication of this project using the 1998 LSMS survey and 2001 population census data

5 1 2 Activity 3 Define and contact participants of the workshop

The intention of the workshop is not to communicate with every possible organisation working in the development sector in Ecuador This would only lead to a confused

agenda or lots of bored representatives Thus the participants will be limited to those organisations working on mapping and information systems or who have a national mandate with respect to food security and poverty in Ecuador (Annex 1)

5 1 3 Activity 5 Collate and publish information on website

A project website will be created and will have it s own domain name (e g www mapalimentaria net) This site will contain interactive mapping capabilities as well as documents explaining the goals of the project and links to related websites

5 2 Output 2 Conditions mapped of Food security/Poverty and potential driving forces

We will conduct a geographical analysis of the current condition of food security in Ecuador and the potential driving forces that affect access to food

We will map food security conditions from the 1990 census and socio economic surveys using innovative methods for estimating survey variables for administrative districts (Bigman 2000 Hentschel et al 2000) Larrea et al (1996) and Moreano et al (1994) used similar techniques to estimate income and under nutrition respectively for Ecuador Our analysis will use the same methods but focus on alternative variables of food security We will also apply neural network extrapolation (Leclerc et al 1999) allowing us to compare alternative methods These maps will allow us to define food security hotspots i e areas that suffer from poor food security or conversely those that are relatively food secure

Biophysical conditions will be mapped taking into account the driving forces defined in Output 1 These will include basic information such as temperature rainfall soil terrain and land cover From these variable we will map derived themes such as soil fertility drought stress and actual and potential land use EcoCiencia, will contribute their biophysical data to the project (see Annex 2)

Social conditions such as population density health status and education levels may be some of the driving forces identified in the launch workshop These data will generally be available in survey form and will be mapped using the survey to census methodology mentioned above or directly from the census

Economic factors such as market locations and quality of the infrastructure are essential inputs to the mapping of market integration a potential driving force in rural areas of Ecuador (World Bank 1996) Market Integration will be modelled using CIAT s accessibility analyst tool (Farrow and Nelson 2001) This cell based analysis tool allows users to create a map of time taken to reach a particular destination The user selects parameters such as slope and road surface that define a friction surface (in which each cell has a value for the time required to traverse it) and the location of target destinations This tool has been successfully applied to problems as diverse as accessibility lost in

Central America due to Hurricane Mitch (Winograd et al 1999) and the effect of market access on milk prices received by farmers in Colombia

5 2 1 Activity 6 Define dependent variable

There are a number of variables that can be chosen to represent the many responses to food insecurity These responses vary in their use of resources and their reversibility and range from a change in diet to permanent migration and complete abandonment of farming activities (in rural cases) (Maxwell and Frankenburger 1992) FAO in their FIVIMS use a baseline figure of between 1846 and 2335 kilocalories per day[1] to denote chronic levels of food insecurity (FAO 2000) This methodology does not explicitly address issues of transitory food insecurity or of vulnerability to food insecurity However this is a valid variable given the rates of under nutrition observed in Ecuador Thus to be consistent with FIVIMS activities we will choose daily consumption as the dependent variable

Data for consumption (in terms of calories) do not appear in the 1990 census however in the 1994(5) Living Standards Measurement Survey (LSMS) there are a number of variables that can be used to derive a figure for consumption that includes food grown for consumption

The World Bank has created a model of consumption which they use in order to estimate poverty indicators for *parroquias* (parishes) in Ecuador This model uses the following variables from the census

Household size age and sex of members education and occupation housing quality access to public services principal language spoken and location of residence

The dependent variable from the LSMS is *ln* per capita consumption expenditure for household

The World Bank and Larrea methods use consumption expenditure as a proxy for poverty In this project we are more interested in food insecurity rather than poverty therefore the dependent variable will be slightly different However we will use the same method to estimate food insecurity at the *parroquia* level

5 2 2 Activity 7 Define independent variables according to hypotheses

One of the results of the workshop (Output 1) will be the definition of hypotheses for the causes of food insecurity in Ecuador These hypotheses are likely to vary according to location and the experience of the individual or organisation Literature suggests that in the rural Amazon access to markets and services is a key determinant of poverty and food insecurity whilst in the rural sierra access to land and illiteracy are the most important

[1] 1846kCal is the lower limit of the daily energy requirement for an adult female with light activities while 2335 kCal is for an adult male Children will have significantly lower daily energy requirements

problems (Larrea et al 1996) Therefore a number of these independent variables can be anticipated before the workshop and will include

- Access to land
- Access to markets
- Access to education
- Access to skilled labour
- Access to technology (improved varieties fertilizers pesticides machinery information insurance)
- Soil fertility
- Levels of non farm income (including remittances)

Not all of these are spatial but nearly all have a spatial component

5 2 3 Activity 8 Compile inventory of data and meta data

The vast majority of the activities proposed here will rely on existing data since there is neither the time nor resources available to mount a large data collecting exercise Therefore a key activity will be the creation of a data inventory the result of which will be a meta data bank A preliminary inventory can be seen in Annex 2

All governmental sources will be surveyed as well as non governmental organizations The meta data will conform to Federal Geographic Data Committee standards and will contain variables such as date of collection/survey date of publication original scale of mapping currentness index source of data spatial extent and projection parameters (FGDC 2000)

5 2 4 Activity 9 Analyse data in terms of appropriateness

The dependent variable that we will map dates from the early 1990 s and is statistically representative at the *parroquia* level Any analysis performed in combination with other data sets will have to take into account when the data were collected at what scale they are accurate and how error will propagate when these datasets are combined Ideally we will have data at sub *parroquia* level that can be aggregated Problems will arise when we have data, such as soil data that have been generated from few points and which have been interpolated over large areas and whose metadata do not contain error statements

5 2 5 Activity 10 Create points for dependent variable

For the purposes of further analysis such as multivariate regression we will represent each *parroquia* with one value for the dependent variable However the location of this value is important if we wish to apply spatial statistics and when we want to look for patterns such as clusters of *parroquias* with high levels of food insecurity The real world *parroquia* is not a single entity but a collection of individuals and households aggregated using the administrative boundaries to define the set

There are a number of methods that will be considered including the centroid and weighted mean centre The centroid is also known as the centre of gravity or the centre of mass and is relatively easy to compute However this computation has difficulty with multi part polygons i e those that are composed of islands those that rivers divide or that are compartmentalised for whatever reason

An alternative method would not assume that the polygon is of the same density for example when we are creating social indicators the polygon does not represent a homogeneous surface of people some areas have more people than other areas This information can be used to give a more accurate point approximation of the population aggregated to a polygon Since the population is not a surface but in fact a number of points it is possible to think of the polygons as a number of potential point locations At each point location there can be zero one or more persons The distribution and weight of these points can then be used to calculate the weighted mean centre of the polygon In reality we do not know the location of every individual within a particular district we therefore use proxies such as town locations (and sizes) or remotely sensed proxies of habitation such as night lights These and other proxies such as accessibility to markets can be modelled to give population surfaces

An alternative to the centroid or weighted mean centre is the weighted point of minimum travel or weighted median centre (Lee and Wong 2001) This is the point of minimum distance/time to all points weighted to take population size into account and can be calculated using CIAT s accessibility analyst

5 2 6 Activity 11 Summarise values of independent variables at the dependent variable point locations

In all cases we will have only one value for the dependent variable for each *parroquia* Likewise the value for the independent variable will be a percentage of different classes of the variable for example 60% bad soil 30% tired soil and 10% good soil or in the case of accessibility it will be an average of the *parroquia* as a whole This methodology has the disadvantage of losing data resolution An alternative approach would be to convert the *parroquia* into grid cells and we would assume the same value for the dependent variable for each cell However this would create data for the dependent variable and automatically increase the degree of spatial autocorrelation

5 2 7 Activity 12 Publish condition maps on a project map web server

The results of Output 2 will be maps of the condition of food insecurity in terms of consumption as well as maps of the condition of various potential determinants of food insecurity according to the hypotheses of the participants of the workshop

These maps will be published on a map server in CIAT with links from UNEP/GRID s povertymap net site CIAT has experience of installing and maintaining on line maps using ESRI s ArcIMS software

There is presently little web mapping experience in Ecuador and although it would be preferable to publish these maps on a server in Ecuador this would currently place too great a burden on our FIVIMS partners

5 3 Output 3 Spatial Analysis performed of linkages between Food security/Poverty and potential driving forces

We will apply statistical and spatial analyses to the maps produced in Output 2 in order to test and identify the driving forces of food security/poverty Exploratory data mining techniques will also be used to test for less obvious driving forces

We will start this activity with simple methods such as overlay analysis moving on to multiple regression models and then to geographically weighted regression We will analyse correlations between accessibility and poverty by overlaying access indices with poverty measures at the village level We can compare the results of accessibility models with a wide range of variables related to food security and poverty In contrast to standard regression geographically weighted regression does not assume that observations of predictor variables are independent of one another nor does it assume that the structure of the model remains constant over the study area (Brunsdon et al 1996) This methodology can add a new dimension to poverty mapping by explicitly incorporating spatial structure of the biophysical and human environment into the analysis

Multivariate methods of Categorical Principal Components Analysis will also be applied in order to capture interactions between social and environmental factors CIAT has applied alternative clustering techniques such as the Geographical Analysis Machine in Honduras (Openshaw 1987 Leclerc et al 1999) We will apply this technique to Ecuador in order to uncover patterns hidden from other analyses These patterns could be useful in the identification of processes and driving forces of food insecurity and poverty

5 3 1 Activity 13 Analyse distribution of dependent variable in terms of clustering

The first activity of the spatial analysis is to analyse the location and attributes of the dependent variable to determine whether there the distribution of the food insecure is in any way non random Even a seemingly random distribution may be determined by spatially variable factors however the existence of clusters would encourage further analysis

We will employ a number of point based spatial statistics to identify clusters These include diagnostic statistics like the locational quotient and nearest neighbour analysis as well as more complex measures like the spatial auto correlation coefficient (Geary s Ratio and Moran s I indices)

Each *parroquia* is represented spatially by a polygon and by a point The location of this point is often the centroid however with more information about the distribution of the

population it is possible to define more precisely the centroid (see Activity 10) However without this information the point could be placed anywhere within the polygon this placement may have repercussions when we undertake a nearest neighbour analysis Thus we will also attempt to analyse the sensitivity of the location of the points for each *parroquia* by randomly placing the point within the polygon and running the analyses

5 3 2 Activity 14 Analyse distribution of independent variables in terms of spatial autocorrelation

Tobler s first law of geography (1970) states that things close to each other are more similar than things that are far away from each other This is known as auto correlation and it can apply in time as well as space This contravenes the assumption in ordinary least squares that each incidence of the independent variables are independent of each other

There are a number of algorithms that exist to test whether spatial auto correlation is present how strong it is and if it is negative or positive

We will undertake these tests both globally (e g Moran s I Geary s ratio) for the whole dataset as well as locally (e g LISA Gi*)

5 3 3 Activity 15 Use spatial filtering techniques to improve multiple regression method

If there is no spatial auto correlation then a conventional multivariate regression can be run However if spatial auto correlation exists then we will use spatial filtering techniques to separate the spatial component from the non spatial component of the independent variables (Getis and Griffiths 2002)

5 3 4 Activity 16 Use geographically weighted regression method

An alternative method to spatial filtering is that of geographically weighted regression This methodology creates a regression model for each instance of the dependent variable and the user defines the radius of the circle that subsequently defines the number of instances to include in the regression equation

5 3 5 Activity 17 Interpret the results in order to test hypotheses and improve food security model

The ideal result of the spatial analysis will be a regression equation that explains the dependent variable (food insecurity) in terms of the independent variables such that a change in one of the independent variables will result in a predictable change in food insecurity This equation is likely to change spatially to the extent that different hypotheses of the determinants of food insecurity will be shown to be unlikely in some locations whilst in others will hold true

This will also provide us more insights into the causes of food insecurity in Ecuador and allow us to explore scenarios of possible futures with decision makers at all levels in Ecuador

5 3 6 Activity 18 Submit article to peer reviewed journal

This spatial analysis will be submitted to a peer reviewed journal either in the development the geographic the health or the econometric fields
The process will also be published on the project home page mounted either in CIAT one of our collaborating organizations or on povertymap net

5 4 Output 4 Analysis undertaken of population at risk to external shocks and decreasing food security

The project team will develop a spatial analysis of the population and the areas at risk to perturbations or external shocks in Ecuador Emphasis will be placed on perturbations that are likely to have an affect on the driving forces of food security and poverty identified in Output 3

Perturbations include natural hazards such as flooding drought desertification landslides earthquakes and volcanoes Many risk maps already exist for these hazards based on geological knowledge and past events however it is likely that new maps will have to be produced Data sources for these maps will include terrain information soil maps vegetation cover and land use We will apply natural hazard mapping techniques to map landslides flooding and drought risk (Winograd et al 2000a Winograd et al 2000b Leclerc et al 1999)

Macroeconomic shocks affect the entire country However the vulnerability to those shocks *varies* spatially Although a global drop in oil or banana prices will apply to the whole country those areas where bananas are grown for export or oil is drilled are more likely to be affected Mapping vulnerability helps us identify those sectors of the population that will become food insecure as a result of a macroeconomic shock

5 4 1 Activity 19 Define the perturbations most prevalent and important in Ecuador

We will analyse the literature and consult experts in order to identify the perturbations or shocks that are most prevalent in Ecuador and that cause the most damage in terms of altering the population s ability to remain food secure These shocks will affect the productive capacity of Ecuador as a whole the productive capacity of specific sectors or shocks that affect the productive capacity of individual production units (farms or fields) These shocks will also affect not only the production but also the profitability thus a change in prices will not directly affect the yield in a particular field but may affect the profitability of that crop Similarly economic shock will have impacts on non farm

incomes Shocks to the economy as whole are likely to have impacts on the whole country but these effects may take time to manifest themselves (lag) Thus structural adjustment may have impacts on the education of a country five years after an austerity policy has been implemented

However it is likely that we will concentrate on climatic natural disasters because due to time and budget constraints we cannot analyse all shocks in great depth plus the fact that climatic natural disasters are those that we have experience in mapping and that have affected Ecuador in the past especially El nino events

5 4 2 Activity 20 Define the methodology for mapping these perturbations

The methodology for mapping these perturbations will depend on the perturbation itself Climatic natural hazards have a spatial and a non spatial component The spatial component of drought includes variables like rainfall temperature soil and land cover characteristics whilst the non spatial component could include access to irrigation and the choice of crop
Landslides are more localised and more difficult to pinpoint they depend heavily on soil and geologic properties and are influenced by land cover they are often triggered by climatic events such as hurricanes or heavy rainfall events
The incidence of flooding depends on rainfall patterns as well as soil and catchment area properties including land cover
Methodologies for mapping these perturbations have been developed by CIAT scientists in projects in Honduras where vulnerable *municipios* were identified according to vulnerability of the population and infrastructure These methodologies will be expanded to take into account damage to agricultural production and loss of accessibility due to landslides

5 4 3 Activity 21 Research El Nino phenomenon

A key activity will be research into the *el niño* phenomenon since historically this has been responsible for some of the worst flooding in Ecuador The events in 1982/83 and 1997/98 were particularly severe with up to 300 deaths and 50 000 people affected (700 000 affected in 1982 83) (CRED 2002 Vos 1999) An *el nino* event is predicted for the period 2002 2003 and the project will monitor the events as they happen

5 4 4 Activity 22 Publish perturbation maps

The results of Output 4 will be maps of the climatic perturbations These maps will be published using ESRI s ArcIMS software on a map server in CIAT with links from UNEP/GRID s povertymap net site

5 5 Output 5 Analyse coping strategies of population at risk

Our project activities will include an analysis of coping strategies (resilience) of the populations in three case study sites We will map vulnerability in those sites and then attempt to extrapolate to the whole of Ecuador

The case study sites will be chosen according to the perturbation risk maps produced in Output 4 and the candidate case study sites identified in Output 1 These case study areas are likely to include a coastal urban area, a rural primarily indigenous sierra area and a newly colonized Amazon area

Piggy backing existing development projects and including the communities in the surveying procedure is likely to a more successful strategy than simply arriving in a region and doing a survey The response rate is likely to be higher and if the respondents know the purpose of the study (or agree with its necessity) then the responses are likely to less guarded or the questions less prone to misinterpretation

Potential projects that exist at smaller scales include Proyecto Paramo (Sierra) EcoCiencia in Sucumbios (Amazon) and Esmeraldas (Coast) and CIAT s project with yuca producers in Manabi (Coast) Alternatives could include FAO s provincial FIVIMS activities in Chimborazo (Sierra) or WFP s work in Loja (Sierra)

Surveys and consultations with local experts will be utilized in order to define coping strategies at the household level Coping strategies will be investigated with respect to their ability to increase resilience of great interest are strategies that incorporate agricultural intensification extensification and migration

Combining the perturbation risk maps with the analysis of coping strategies will allow us to produce vulnerability maps for the case study areas We will then extrapolate or scale up these results in order to produce vulnerability maps for the whole of Ecuador The results of this analysis will be available in the form of a peer reviewed scientific publication and the maps will be available on the project s website

5 5 1 Activity 23 Define the methodology for assessing the coping strategies of the populations to be studied

There are a number of methods available to assess the coping strategies of the populations in the case study These include a georeferenced survey of a sample of households in the case study locations interviews with experts or focus groups (non random samples) or rapid rural appraisals

It is likely that a survey will provide us with the principal results and that the other methods will be used to give more detail or aid in the extrapolation of results to other areas

5 5 2 Activity 24 Undertake survey and/or RRA and/or participatory rural assessment and/or focus group sessions

Surveys will be carried out in each of the three case study areas They will cover sufficient households in a random sample in order to be representative at the *parroquia* level for the case study area The number of households will depend on the population of the parroquia however the average population of a parroquia is approximately 7000 (excluding Guayaquil Quito and Cuenca) and the average number of households is approximately 1500 (INEC 1990) For each parroquia the sample size will depend on the variables to be measured the confidence limits and the permissible error for instance a variability of 10%
Experts from each of the case study areas will be sought and they will be asked questions concerning the results of the spatial analysis and with regard to the coping strategies of the population

5 5 3 Activity 25 Interpret results of data acquisition

The purpose of this output is to identify the different coping strategies that the populations have when faced with a climatic perturbation We want to be able to identify how these strategies change according to the assets available the social networks and the education levels of the households that are studied We want to see how these vary spatially and how these strategies can be assessed for the whole population

5 5 4 Activity 26 Combine coping strategy assessments with the perturbation maps to give vulnerability maps

This activity assumes that maps of the effects of climatic perturbations have been produced and that the coping strategies identified in the case study areas can be extrapolated to the nation as a whole If not then the results are only likely to be valid for the case study areas themselves

5 5 5 Activity 27 Define methods for verification of models developed in Output 3 and risk maps produced in Output 4

One of the most important results of the case studies will be the verification of the results of the spatial analysis performed in Output 3 and the perturbation maps produced in Output 4 Verifying these results may not be that easy given the significant time that has passed since the census of 1990 and the surveys in the case studies It is also possible that questionnaires at the household level may reveal patterns that are significantly different to the models derived for the parroquia

5 6 Output 6 Construct and run a food security/poverty model

Our final result will be an exploration of possible food security outcomes in terms of different scenarios based on possible policy interventions global economic integration and environmental change (such as climatic events or land degradation)

The initial scenarios defined in Output 1 will be reassessed according to the driving forces of food security/poverty identified in Output 3 Where driving forces are modifiable i e access to land market integration as opposed to factors such as climate potential policy interventions can be discussed with decision makers in order to formulate scenarios where these policies are applied

Models exist which simulate land use change according to a set of scenarios that determine the value of the pre determined driving forces Scenarios such as nature conservation policy interventions natural events and land degradation or global market forces have been developed for Ecuador and Central America (de Koning 1999 Farrow and Winograd 2001) We will develop a food security/poverty simulation model based on the same concepts of modifying the value and location of driving forces in order to map possible futures of food security/poverty

5 6 1 Activity 28 Dissemble the scenarios according to the drivers of food security and perturbations

The scenarios that were developed in Output 1 will have to be dissembled according to the determinants of food insecurity from Output 3 If the regression model is assumed to be constant through time then the determinants can be changed according to these scenarios and the resulting food insecurity can be mapped for various possible futures This will be a useful tool for discussion and may allow the exploration of policy interventions if these can also be dissembled in terms of the determinants

5 6 2 Activity 29 Create vulnerability maps for each of the scenarios

This activity uses the result of Activity 29 and Output 5 to model the potential changes in vulnerability given possible futures of food insecurity and coping strategies and climatic perturbations

5 6 3 Activity 30 Publish maps on the mapserver

6 Information Products and Communication Strategy

The principal products of this project will be the maps of condition of the dependent and independent variables and the spatial analysis itself

A number of stand alone information products already exist or are in the process of being developed these include INFOPLAN from ODEPLAN Almanaque de Ecuador from Alianza Jatun Sacha – CDC and the Biodiversity Monitoring System of EcoCiencia

ODEPLAN have INFOPLAN which should be confirmed as the government s primary information tool (Rivadeneira, *pers comm*) this is currently a stand alone CD but may be updated in the near future The Almanaque de Ecuador is a stand alone product but is likely to be updated EcoCiencia s Biodiversity Monitoring System has not yet been released and is currently being reviewed

None of these tools is the perfect vehicle for the maps and documents that will be produced in this project and a more flexible approach is needed As a result the maps will be published on a map server and will therefore be accessible to all users with an internet connection The map server will be accessible via the project homepage which will also contain working papers and metadata

Our principal users will be the three organisations that have FIVIMS activities in Ecuador FAO ODEPLAN and WFP Obviously we would like to communicate our results to as wide an audience as possible For his reason we are in contact with CIMMYT and Alianza Jatun Sacha – CDC with respect to taking advantage of their contacts with three universities in Ecuador As part of the Almanaque de Ecuador project they will be holding courses at universities in Quito Cuenca and Loja, these courses could include material from our project either methodological documents or maps

All products will be available in Spanish and English

7 Summary

Through the application of innovative spatial analysis this project will identify the current condition environmental drivers and sensitivity to external shocks of poverty and food security in Ecuador Our analysis will complement existing studies and add value to them by focusing on geographical processes and patterns We will analyse food security and poverty conditions the driving forces behind these problems and vulnerability and risk of affected sectors of the population We will synthesize our results into a model of poverty and food security that can be used to simulate future scenarios We will share our work through an Internet based communication strategy that includes dynamic mapping on the web and links to multiple networks of stakeholders interested in food security and poverty problems

Table 1 Logical Framework

Narrative summary	Measurable Indicators	Means of Verification	*Important Assumptions*
Goal To improve policy and decision making aimed at decreasing the number of malnourished and poor people in Ecuador	Policies and decisions are based on information and insights from the project	Project evaluations by collabo ating organizations and external rev ew s by FAO	
Purpose To apply geographic information science to improve our understanding of conditions principal driving forces and future scenarios of food security and poverty in Ecuador and to share knowledge with decision and policy makers and other stakeholders	Use and adoption of these methodologies in Ecuador and other countries	Information available on the project web site and at www povertymapping net a university thesis publications in refereed journals and in outlets aimed at raising awareness of poverty and food security issues in Ecuador	Successful execution of the project by the CIAT FAO ODEPLAN and EcoCiencia team Methodologies developed in this project are easy to replicate
Outputs 1 Project launch workshop held Capacities and needs defined candidates for driving forces of food security/poverty defined candidate scenarios for possible futures defined and candidate case study areas identified	• Candidate food security/poverty driving forces defined 3 candidate case study areas defined Candidate scenarios of possible futures defined Needs and capabilities of all collaborators defined Project website on line May 2002	• Report accessible via project website	• Experts from all collaborating organisations are able to attend the workshop
2 Conditions mapped of Food security/Poverty and potential driving forces	• Food security condition map produced Bio physical social and economic driver maps produced Maps available July 2002	• Maps accessible via project website	• Data are available from collaborating organisations and other data holding bodies
3 Spatial Analysis performed of linkages between Food security/Poverty and potential driving forces	• Candidate driving forces tested New driving forces tested Results available November 2002	• Analysis accessible via project website Publication in peer reviewed journal	
4 Analysis undertaken of population at risk to perturbations and food security degradation	• Perturbation risk maps produced available March 2003	Report and maps accessible via project website	
5 Coping strategies defined for population at risk to perturbations and food security degradation in 3 case study areas	• Coping strategy results incorporated to produce vulnerability maps available September 2003	• Report and maps accessible via project website Publication in peer reviewed journal	• Good relations with communities in the case study areas are good and can be maintained
6 Food security/poverty model developed as a synthesis of previous outputs	• Food security model developed Scenarios adapted for model Vulnerability maps of possible futures produced and made available December 2003	• Report and tool available from project website Publication in peer reviewed journal	Collaborating organisations and other interested parties can successfully access website

Table 2 Proposed timetable of activities

Output	*2002*				*2003*						*2004*		
	J	S		N	J	M	M	J	S	N	J	M	M
1 Selection of factors and details of the approach (Workshop)	■												
2 Analysis of linkages between food security / poverty and potential drivers		■	■	■									
3 Mapping of variables which describe poverty access to food and probable environmental drivers					■	■							
4 Analysis of the vulnerability of populations at risk to external or internal shocks							■	■					
5 Identification of the resilience of populations at risk								■	■	■	■		
6 Scenarios (futures) modelled from the methods quantified in outputs 2 5											■	■	■

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Narrative summary	Measurable Indicators	Means of Verification	Important Assumptions
Goal To improve policy and decision making aimed at decreasing the number of malnourished and poor people in Ecuador	Policies and decisions are based on information and insights from the project	Project evaluations by collaborating organizations and external reviews by FAO	
Purpose To apply geographic information science to improve our understanding of conditions principal driving forces and future scenarios of food security and poverty in Ecuador and to share knowledge with decision and policy makers and other stakeholders	Use and adoption of these methodologies in Ecuador and other countries	Information available on the project web site and at www povertymapping net a university thesis publications in refereed journals and in outlets aimed at raising awareness of poverty and food security issues in Ecuador	Successful execution of the project by the CIAT FAO ODEPLAN and EcoCiencia team Methodologies developed in this project are easy to replicate
Outputs 1 Project launch workshop held Capacities and needs defined candidates for driving forces of food security/poverty defined candidate scenarios for possible futures defined and candidate case study areas identified	• Candidate food security/po erty driving forces defined 3 candidate case study areas defined Candidate scenarios of possible futures defined Needs and capabilities of all collaborators defined Project website on line May 2002	Report accessible ia project website	• Experts from all collaborating organisations are able to attend the workshop
2 Conditions mapped of Food security/Poverty and potential driving forces	• Food security condition map produced Bio physical social and economic driver maps produced Maps available July 2002	• Maps accessible via project website	• Data are available from collaborating organisations and other data holding bodies
3 Spatial Analysis performed of linkages between Food security/Poverty and potential driving forces	• Candidate driving forces tested New driving forces tested Results available November 2002	• Analysis accessible via project website Publication in peer reviewed journal	
4 Analysis undertaken of population at risk to perturbations and food security degradation	• Perturbation risk maps produced available March 2003	• Report and maps accessible via project website	
5 Coping strategies defined for population at risk to perturbations and food security degradation in 3 case study areas	• Coping strategy results incorporated to produce vulnerability maps available September 2003	Report and maps accessible via project website Publication in peer reviewed journal	• Good relations with communities in the case study areas are good and can be maintained
6 Food secur ty/poverty model developed as a synthesis of previous outputs	• Food security model developed Scenarios adapted for model Vulnerability maps of possible futures produced and made available December 2003	Report and tool available from project website Publication in peer reviewed journal	• Collaborating organisations and other interested parties can successfully access website

Output 1 **Project launch workshop held Capacities and needs defined candidates for driving forces of food security/poverty defined candidate scenarios for possible futures defined and candidate case study areas identified**	
Activities	**Person responsible**
1 define expected outcomes of the workshop	A Farrow
2 define location of the workshop	A Farrow
3 define and contact participants of the workshop	A Farrow
4 run the workshop	C Larrea / A Farrow
5 collate and publish information on website	A Farrow / C Perrea
Output 2 **Conditions mapped of Food security/Poverty and potential driving forces**	
Activities	**Person responsible**
6 define dependent variable	C Larrea / A Farrow / G Leclerc
7 define independent variables according to hypotheses	A Farrow / C Larrea
8 inventory of data and meta data	A Farrow
9 analysis of data in terms of appropriateness	A Farrow / G Leclerc
10 create points for dependent variable	A Farrow
11 summarise values of independent variables at the dependent variable point locations	A Farrow
12 publish condition maps on a project map web server	A Farrow / E Barona / C Perrea
Output 3 **Spatial Analysis performed of linkages between Food security/Poverty and potential driving forces**	
Activities	**Person responsible**
13 analyse distribution of dependent variable in terms of clustering	A Farrow / G Leclerc / C Larrea
14 analyse distribution of independent variables in terms of spatial autocorrelation	A Farrow / G Leclerc / C Larrea
15 if spatial auto correlation exists use spatial filtering techniques to improve multiple regression method	A Farrow / G Leclerc / C Larrea
16 use geographically weighted regression method	A Farrow / G Leclerc
17 interpret the results in order to test hypotheses and improve food security model	A Farrow / G Leclerc / C Larrea
18 submit article to peer reviewed journal	A Farrow / G Leclerc / C Larrea

Output 4 **Analysis undertaken of population at risk to perturbations and food security degradation**	
Activities	**Person responsible**
19 define the perturbations most prevalent and important in Ecuador	A Farrow / M Winograd
20 define the methodology for mapping these perturbations	A Farrow / M Winograd
21 research into el niño phenomenon	A Farrow
22 publish perturbation maps	A Farrow / E Barona / C Perrea
Output 5 **Coping strategies defined for population at risk to perturbations and food security degradation in 3 case study areas**	
Activities	**Person responsible**
23 define the strategy for assessing the coping strategies of the populations to be studied	A Farrow / G Leclerc
24 undertake survey and/or RRA and/or participatory rural assessment and/or focus group sessions	A Farrow / G Leclerc
25 interpret results of data acquisition	A Farrow / G Leclerc / G Hyman
26 combine coping strategy assessments with the perturbation maps to give vulnerability maps	A Farrow / G Leclerc
27 define methods for verification of models developed in Output 3 and risk maps produced in Output 4	A Farrow / G Leclerc
Output 6 **Food security/poverty model developed as a synthesis of previous outputs**	
Activities	**Person responsible**
28 dissemble the scenarios according to the drivers of food security and perturbations	A Farrow
29 create vulnerability maps for each of the scenarios	A Farrow
30 publish maps on the mapserver	A Farrow / E Barona / C Perrea

ALTERNATIVAS MENUS ECONOMICOS - 2003

MENU – E1	
Muchacho frio Ensalada de Papa Arroz Perla Cascos de Tomate Jugo Postre	**$12 000**
MENU – E2	
Trucha con Nueces Patacones Arroz con Verduras Jugo Postre	**$12 000**
MENU – E3	
Pollo Terriyaqui Arroz Pure de Papa Jugo Postre	**$12 000**
MENU – E4	
Lasagna de Carne Ensalada Verde Pan Frances Jugo Postre	**$12 000**
MENU – E5	
Lomitos en Salsa Madera **$ 12 000** Papa Ana Ensalada Mixta Arroz Almendrado Jugo Postre	

MENU – E6

Pernil de Pollo a la Orly **$ 12 000**
Arroz al Perejil
Trilogia Caliente
Papa a la Crema
Jugo
Postre

Goulsh a la Hungara **$ 12 000**
Pure de Papa
Verdura al Dente
Arroz con Pimenton Rojo
Jugo
Postre

Milanesa de Cerdo **$ 12 000**
Yuca Frita
Arroz Blanco
Ensalada de Zanahoria y Repollo
Salsa Tartara
Jugo
Postre

Arroz con Pollo **$ 12 000**
Papa francesa
Cascos de Tomate
Jugo
Postre

Pollo con Champinones **$ 12 000**
Papa Francesa
Ensalada de Verduras
Jugo
Postre

Nota El postre de todos los menus es variedad de " Tartaletas "

Annex 1 Participants invited to the launch workshop

Organisation	Contact person(s)	Comments
EcoCiencia Fundación Ecuatoriana de Estudios Ecologicos Isla San Cristóbal 1523 y Isla Seymour Casilla 17 12 257 Quito T (593 2) 2451 338 339 (593 2) 2242 417 F (593 2) 2249 334	Malki Saenz (BioDiv monitoring tool) Fernando Rodriguez (GIS) Luis Suarez (BioDiv) Galo Medina (DG)	Potential data providers for the case study areas of Esmeraldas and Sucumbíos Malki worked with Carlos Larrea on the socio environmental maps of Ecuador They have a well run GIS lab and provide GIS and RS interpretation services for all projects in EcoCiencia
FAO (United Nations Food and Agriculture Organisation) – Ecuador Edificio de Ministerio de Agricultura y Ganaderia Avenidas Eloy Alfaro y Amazonas Casilla 17 21 0190 Quito T (593 2) 2554321 F (593 2) 2905887 E fao ecu@field fao org	Jesus Miranda de Larra (Rep) Fernando Carvajal Janet Pavon	Currently most interested in supporting their proposal for province level FIVIMS Produced the nutritional profile of Ecuador with ODEPLAN in 2001
WFP (United Nations World Food Program) – Ecuador Av Amazonas 2889 y La Granja 6to Piso Quito T 2460330 2460332 Ext 1604	Hannah Laufer (Rep) Marcelo Quevedo (VAM) Ivette Valcarcel (VAM)	VAM Ecuador has drifted away from national FIVIMS efforts and is now a bottom up approach The concentrate on vulnerable groups (defined in a national workshop) in vulnerable provinces e g Loja They are very keen to be partners and would like to use our results or methodologies where possible

Organisation	Contact person(s)	Comments
ODEPLAN Calle Benalcazar Edificio la Union 3er Piso T 2580737 Ext 18	Luis Rivadeneira (director of INFOPLAN) Patricia Martinez (policy implementation)	This is the planning office for Ecuador i e the policy makers but it has been severely cut back since the 1998 constitution and now has less power and resources than before INFOPLAN is still the government s information tool
Marcelo Moreano E mmoreano@uio telconet net		Marcelo a medic is currently a freelance consultant working for FAO/ODEPLAN He was once the Secretaria General de Planificacion Direccion General de Planificacion Social in CONADE – the more powerful predecessor of ODEPLAN
Programa Especial de Seguridad AlimentariaDe Ecuador (PESAE) FAO Av 10 de Agosto 5470 y Villalengua Quito Telefono 455 172 E mail JaimeDurango@field fao org	Jaime Durango (Director)	
CESA Central Ecuatoriana de Servicios Agricolas Inglaterra 532 y Vancouver (Inglaterra N 3130 y Mariana de Jesus) T (593 2) 524 830 F (593 2) 503 006 E cesa uio@andinanet net landrade@andinanet net	Lautaro Andrade (delegate of REDPESA)	

Organisation	Contact person(s)	Comments
Alianza Jatun Sacha – CDC Pasaje Eugenio de Santillán N34 248 y Maurián Casilla 17 12 867 Quito T 432 240 432 173 432 246 F 453 583	Pablo Almeida Head of Geo informatics Marcia Penafiel Head of Projects	Data providers they have created a land use map for Ecuador They also specialise in capacity building They seem similar in character to EcoCiencia They are working with CIMMYT to develop the country almanac for Ecuador
World Bank	Jesko Hentschel	
	Peter Lanjouw	
	Jean Olsen Lanjouw	
	Javier Poggi	
CIMMYT	Dave Hodson	CIMMYT are preparing an almanac for Ecuador due to be released in June/July The almanac could be used as a vehicle for project products and/or a source of data
INEC Instituto Ecuatoriano de Estadisticas y Censos		Statistical Office
SIISE – Sistema Integrado de Indicadores Sociales del Ecuador Ave Amazonas y Santa Maria esquina Edificio Tarqui 5o piso casilla 17 16 158 CCI Quito T (593 2) 2231749 2902748 2522435 F (593 2) 2521864 E siise@siise gov ec	Vladimir Brborich	Social indicators system

Organisation	Contact person(s)	Comments
MAG Ministry of Agriculture		
CEPLAES Centro de Planificacion y Estudios Sociales		
FLACSO Facultad Latinoamericana de Ciencias Sociales		
University of Azuay Cuenca	Paul Ochoa	They have set up a GIS MSc course
University of California Berkeley	Alain de Janvry	Guru for poverty and environment linkages in Latin America
	Tomoki Fujii	Agricultural economist looking at spatial analysis of poverty in Ecuador
Civil Defence		Contingency plans for natural disasters
Ministry of the Environment		Contingency plans for natural disasters

Annex 2 Preliminary inventory of data to be used in the project

Existing socio economic data	Source	Year	Scale/Resolution	Availability
Poverty map	Larrea et al	1996	Parroquia	Available from Carlos Larrea and in INFOPLAN
Poverty map	Hentschel et al	2000	Parroquia	Available from World Bank
Population Census	INEC	1990	Household/individual	Available from World Bank and Carlos Larrea
Population Census	INEC	2001	Household/Individual	Not yet available
Demographic and health survey	DHS	1987	4713 individuals	Available from DHS
Living Standards Meausrement Survey	World Bank	1994	4391 households Representative for 8 regions only	Available from World Bank and Carlos Larrea
Administrative boundaries		1998	4 regions 21 provinces (Galapagos) 212 muncipios (Galapagos) 975 parroquias	INFOPLAN
Market locations			202 populated places	INFOPLAN
Transport Infrastructure			3 road classes	INFOPLAN
Services (health education) (*)				
Qualitative data Rapid rural appraisals focus groups expert opinion ?				
Land Tenure				

Existing biophysical data	**Source**	**Year**	**Scale/Resolution**	**Availability**
Agricultural Census	INEC	2000	N/A	Not yet available
Survey		1995		
Land Use Survey	SEAN	1991	3137 sites	
Contours	CLIRSEN/EcoCiencia		100m (0 100m) 200m (1000m and above)	Can be bought relatively cheaply from CLIRSEN
Soils	Gonzalez et al	1986		In our collection
Remaining Vegetation	Sierra Rodrigo 1999 Quito Proyecto INEFAN/GEF y Wildlife Conservation Society	1996	1 1 000 000	In our collection
Potential land use	EcoCiencia			INFOPLAN
Land Use	ORSTOM/CDC	1994 (198*)		In our collection
Erosion	ORSTOM			
Temperature				
Precipitation				
Soil water holding capacity				
Modelled data	**Source**	**Year**	**Scale/Resolution**	**Availability**
Accessibility to markets and services				
DTM				
Natural hazards – drought prone landslide prone flood prone				

Geospatial Dimensions of Poverty and Food Security – A case study of Mexico
CIMMYT

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Introduction

The multiple activities of international agricultural development seek to increase food security reduce poverty and conserve the natural resource base for agriculture and other human activities Implicit in these efforts are notions of how food security and human welfare vary geographically and what forces drive this variation Quantifying food security and human welfare has proven difficult however especially where temporal and spatial variation are considered (Deichmann 1999) Nonetheless case studies demonstrate the potential utility of such efforts Hentschel et al (2000) combined census and survey data to examine spatial variation in poverty in Ecuador

This project proposes to develop new methodologies for characterizing spatial and temporal variation in food insecurity and poverty using Mexico as a case study Emphasis is giving to statistically rigorous analyses that account for complexities in analyzing spatial data from diverse sources These include effects of spatial autocorrelation lack of statistical independence between variables and loss of information through aggregation These are not simply questions of statistical elegance Failure to account for spatial autocorrelation and other forms of interdependence can severely bias estimates of effects of explanatory variables and lead to gross misinterpretation of causal relations (Bivand 1998) On the other hand correct accounting for autocorrelation can improve the understanding of underlying explanatory factors (Lee and Wong 2001)

A GIS based system for mapping indicators of food insecurity and poverty will be developed that analyses variation at three spatial scales country wide regional and state The analyses will emphasize generic tools and methodologies that should be readily transferable to other countries

This effort should lead to improved priority setting and impact assessment by allowing stakeholders to relate activities to spatial and temporal variation in food security and human welfare By examining possible causal relations the work should also illuminate underlying effects of factors such as climate soils and access to markets Such information should lead to improved targeting and scaling up of interventions across various spatial scales – a topic of increasing concern in international arenas (Gundel et al 2001) We further expect that emphasis on spatial information through maps will

greatly enhance the potential impact of the results as compared to more conventional reports through tables and figures (Smelcer and Carmel 1997)

Why Mexico?

Mexico is an ideal country for examining dimensions and causes of spatial variation in food security and human welfare Its 102 million inhabitants are distributed over extremely diverse environments Northern Mexico has desert regions with settlements concentrated in irrigated valleys and coastal areas The Altiplano (highlands) share climatic similarities with regions of Central and South America and large areas of sub Saharan Africa Southern Mexico has humid tropical areas including rainforests that resemble many medium to high rainfall areas in Asia and Africa At the same time the socio economic environment includes indigenous communities both in marginal and favorable environments border towns where economies are closely linked to commerce with the US and petroleum regions where oil extraction dominates the local economy While the UNDP ranks Mexico in the top end of the medium development category (rank of 51 among 162 countries UNDP 2001) some experts suggest that Mexico also has the World s largest inequalities in distribution of wealth and human welfare There are many areas of Mexico with extreme poverty Estimates of moderate to severe child malnutrition in rural areas are below 10% in some states while in others they exceed 25% (Avila Curiel et al 1997) Using a poverty line defined as twice the expenditure to achieve a minimum nutritional requirement the incidence of rural poverty was 53% for Mexico for the period 1994 to 1998 Thus in spite of relatively high income levels Mexico has a high incidence of rural poverty a pattern common in Latin American countries Furthermore the incidence of rural poverty is considerably higher than the incidence of urban poverty (de Janvry and Sadoulet 1999)

The dominance of maize in Mexican diets will facilitate the focus on food security Maize is the staple food of Mexicans particularly of the rural poor The per capita consumption of maize is approximately 250 g/day (Avila Curiel et al 1997) During the rainy season of 2000 approximately 7 5 million hectares were planted to maize out of a total of 12 5 million hectares planted to annual crops (SAGARPA 2001) About three million small scale farmers plant maize These farmers depend to a greater or lesser extent on their maize production for their own consumption Among these farmers even though maize production may not contribute importantly to their cash income an adequate maize production is key to welfare and security maize production can represent an important component of their livelihood strategies However for many poor farmers in isolated areas particularly indigenous people maize production is fundamental for their welfare given that they have limited opportunities to participate successfully in regional and national markets Even for those farming households that have other sources of income such as off farm and non farm labor or remittances having their own maize allows households to cope better with temporal variation in income (e g the recent downturn in the economy)

Most maize is produced under rainfed conditions in small farms with low yields and hence low total production and a high proportion is kept for self consumption

particularly among the rural poor Besides small landholdings three factors affect their ability to produce adequate amounts of maize for self consumption rainfall variability storage losses and market accessibility Rainfall variability determines to a great extent yield and production The amount of storage losses determines the amount of maize available throughout the year Accessibility to markets determines the potential to access other sources of income and to purchase outside food These factors are not only important to poor Mexican farmers but also are relevant for poor farmers that rely on their own production for self consumption throughout the developing world

Poor subsistence oriented farmers and their households have usually been by passed by modern agricultural technology Currently poverty alleviation and farming support government programs such as PROGRESA and PROCAMPO provide many of these households with cash transfers New research suggests that in the case of farming households policies that directly promote agricultural production would have greater impacts not only in production but also on household income and welfare than direct cash transfers (Yunez Naude and Rojas Castro in press) This suggests that providing improved technology to poor farming households may be an important tool in poverty alleviation Given the social economic and environmental heterogeneity of Mexico it is necessary to target the efforts to develop and transfer appropriate agricultural technologies to the poor

CIMMYT currently conducts research on the adoption and use of improved maize germplasm among poor households in marginal areas of some of the poorest states in Mexico (Chiapas and Oaxaca) This research integrates data on poverty and agroecology into a GIS to target the areas where the research is taking place The data collected in this project will be used to validate the findings of the proposed project CIMMYT is also carrying out research on evaluating storage losses under the conditions and with the traditional technologies used by small scale maize farmers throughout Mexico as well as into new participatory methodologies to identify germplasm suitable for the needs of subsistence oriented farmers Clearly CIMMYT and others can benefit from research that integrates many of these aspects not only to target further research but also to scale up the results of on going research

Taken alone the diversity of environments and socio economic conditions of Mexico make the country an ideal platform for studying variation in food security and human welfare However another powerful argument lies in the availability of quality data on socio economic conditions infrastructure and other factors that are among commonly used indicators of food security and human welfare (Committee on World Food Security 2000)

The Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH National Survey of Household Incomes and Expenditures) is a key resource maintained by INEGI The year 2000 survey involved over 10 000 households stratified between localities with more or less than 2 500 inhabitants and measured the structure and distribution of income as cash or equivalents and spending patterns of the households with categories for consumable (food beverages and tobacco) and durable goods The survey also obtains

additional information on the households such as building materials family structure and economic activities of household members Comparable data from previous surveys are available for 1984 1989 1992 1994 1996 and 1998

Additional resources for socioeconomic data include the year 2000 census (XII Censo General de Poblacion y Vivienda) as well as the 1990 and 1995 censuses The Consejo Nacional de Poblacion (CONAPO 2000) uses nine indicators from the census to create an index of social marginalization for over 70 000 localities CIMMYT has used these data previously to study marginalization in relation to adoption of maize in the states of Chiapas and Oaxaca as well as to transportation access in Guanajuato This extensive census data are readily manipulated at various spatial scales and appear to be of very high quality

In the areas of health and nutrition there are additional data sources including national surveys The Encuesta Nacional de Salud of 1994 (ENSA II) surveyed 12 000 households (60 000 individuals) for variables related to health and the Secretaria de Salud (Health Secretariat) can provide additional statistics on births and mortality disaggregated by age groups and sex The Encuesta Nacional de Alimentacion y Nutricion en el Medio Rural 1996 (ENAL 1996) surveyed 38 222 households for variables related to nutrition and collected anthropometric measurements on 31 601 children under five years of age

CIMMYT s GIS and Crop Modeling Laboratory has an extensive data on the physical environment including climate surfaces soils topography and land cover (see Appendix 1) To examine relations between food security and the environment we expect to acquire additional data on transportation infrastructure and current land use from INEGI the Instituto Mexicano de Transportes and other official sources Most official sources are willing to make their data available to CIMMYT for no or minimal charges since the intended applications are non commercial and would complement their own work To account for temporal variation we have the options of using data from the ENIGH and censuses over time as well as annual data on climatic conditions and economic activity

Methodological Approach

As Deichmann (1999) Bivand (1998) and Bigman and Loevinson (1999) emphasized characterizing geographic variation in socio economic measures presents multiple methodological challenges

- Lack of universal indicators for traits related to human welfare and food security
- Different time frames Because of the high costs of conducting censuses or major surveys data are seldom available with sufficient frequency across years to permit understanding temporal variation
- Discontinuous distribution – While variables such as climate land use and topography have meaningful values at <u>any</u> location data related to human conditions are usually associated with individuals households or communities and thus are discontinuous over the landscape

- Aggregation – Census and survey data are usually presented in spatially aggregated forms that can obscure important local variation
- Spatial autocorrelations – Adjacent geographic features often have correlated values (e g adjacent municipalities may have levels of prosperity that are more similar than one would expect by chance) This autocorrelation can result in spatial correlation among errors in regression analyses resulting in inaccurate parameter estimation and potentially ignoring information that can greatly enhance interpretation of results In contrast correct accounting for autocorrelation can greatly enhance the interpretation of possible causal relations (Lee and Wong 2001)
- Statistical independence – Modeled surfaces for variables such as temperature transportation access and land use suitability are often calculated using a digital elevation model (DEM) as an explanatory variable Where such underlying commonality occurs the data sets will not be statistically independent and apparently simple comparisons (e g to determine whether temperature or access are more important determinates of food security) will be invalid
- Normality – Socio economic data are often recorded or presented as counts rates or percentages (e g number of rooms in a house portion of households with running water) Such data often fail tests for normality of error and statistical analyses require non parametric approaches

No single methodology addresses all of these problems Thus we will evaluate various promising approaches and incorporate them as appropriate The approaches include

Interpolation Our experiences with the CONAPO marginalization index show that administrative and census unit boundaries hide major variation if used as aggregated units Boundaries of municipios (the next administrative unit below states) often run from valley bottoms to the crests of mountain ranges Interpolating data or otherwise modeling point data to create surfaces allows describing variation in a much more powerful manner From modeled surfaces data may be re aggregated according to map units based on similarity indices (e g cluster analysis) or related to continuously varying parameters such as climate topography and access indices (already available in raster format)

A key issue in interpolation is what method to use Methods that assume normality such as inverse distance splines and ordinary kriging are inappropriate for many socio economic parameters We will evaluate non parametric methods including kernel density (Bowman and Azzalini 1997 Bailey and Gatrell 1995) and indicator kriging (Deutsch and Journel 1999)

Fuzzy logic Assignment of entities to discrete classes is often problematic (Kemp et al 2001) Class membership is traditionally based on absolute criteria specified with Boolean algebra (e g if mean temperature > 30 C then climate is hot) Using fuzzy logic however membership is allowed to vary over a scale from 0 (non member) to 1 (full member) Such an approach is highly appropriate for classifications such as rural vs urban or employed vs unemployed

Spatial and temporal autoregression Specialized methods related to those used for time series analysis can estimate the effect of spatial autocorrelation in regression analyses Although not implemented in standard GIS packages various software tools are available for spatial and temporal autoregression and related analyses (e g the Rookcase add in of Sawada [1999] and the FILTER program [Lauren Scott] for Getis spatial filtering [Getis 1995])

Work Plan

Details of the planned activities are outlined in the logical framework presented in Appendix 2 and a time chart in Appendix 3 The initial phase (second semester of 2002) will focus on compiling and evaluating spatial data and software tools from diverse sources In some cases this may require contracting Mexican experts to ensure that data are correctly interpreted and organized for analysis To this end a small workshop will be held for consultation within Mexico Most data sets will be obtained within Mexico but we will also explore using remote sensing products such as nighttime near infrared emissions as indirect indicators of human activity (Elvidge et al 1997) A national staff scientist will be recruited during the first year to assist with data collection processing and analysis

The first semester of 2003 will focus on preparing data for the actual analyses (e g interpolation of point data and spatial regressions) Our past experiences with climate marginalization and transportation surfaces showed that such processing often has to be repeated several times because errors or inconsistencies emerge that require contacting the original data sources for clarification Thus while the processing of individual variables is relatively straightforward we expect this to require patience and close attention to detail

Several methodological issues will have to be dealt with as the data are compiled These include

1 Can georeferenced data from surveys which offer detail but limited spatial coverage be used to estimate realistic values for a wider range of locations? For example the ENIGH employed a sub sample of households within a sub sample of municipalities for all of Mexico These are meant to represent carefully stratified surveys for state or national level analyses We will examine the feasibility of estimating variables from surveys such as the ENIGH with regression models Thus for a parameter of welfare or food security Z the model might be

$$Z = a*U + b*V + \quad + f*Y + \varepsilon$$

where a, b and f are linear regression coefficients and U V and Y are variables values of which are obtained from data sets with detailed national coverage (e g census climate topography) Such regressions are sensitive to spatial autocorrelation so global and local autocorrelations will be examined If needed Getis filtering will be used to separate direct and spatial effects

2 For analytic approaches that require point data (e g global and local indices of spatial autocorrelation Getis filtering) what is the best way to define polygons and to locate representative points within polygons? Use of modeled (interpolated) surfaces provides the option of defining a diverse set of regions (e g through cluster analysis) but such groupings would not respect polygons for census or administrative units One approach is to respect major administrative units and use simple topographic or climatic criteria to subdivide units with very high internal environmental variation Implicit in this process is consideration of the modifiable areal unit problem (MAUP Jelinski and Wu 1996) Once polygons are defined approaches will be compared for assigning data to point locations such as centroid weighted centroids or largest urban centers

3 How to can temporal variation in welfare and food security best be handled? The census and survey data are available over multiple years but at differing intervals and with variations in sampling units (e g due to changes in administrative boundaries)

4 In final classifications of regions as food insecure or having very low human welfare rigid classification criteria may give unrealistic groups Fuzzy logic offers an approach for more flexible classifications and will be tested when appropriate

These issues will first be examined in the first semester of 2003 including a survey of software tools that facilitate integration of the analyses with standard GIS and statistical analysis software

During the same semester the initial analyses of spatial variation in food security and welfare will be conducted for all states and if software permits for all municipios in Mexico Typically we will seek to explain spatial variation in indicators through stepwise regressions and principal component analysis All such work will include assessments of spatial autocorrelation and if necessary Getis spatial filtering will be used

In the second semester we will attempt to extend the analyses work to a larger spatial scale possibly AGEB polygons defined within municipalities or rural vs urban locations as identified in the 2000 census Due to the volume of detail this entails we expect to focus on the southern states of Oaxaca, Guerrero and Chiapas By the end of the second year we should also have addressed temporal variation using the time series available from the various national censuses of population and housing

This work will set the stage for 2004 when we will examine the effects of spatial scale on our initial findings and determine whether revised analyses are required During this phase we will use CIMMYT s independent studies on household welfare in rural areas of Chiapas and Oaxaca to validate the outputs

The final activities of the project will include writing the reports and preparing the WWW site with interactive maps and downloadable data Techniques for WWW based mapping are evolving rapidly so we prefer not to commit ourselves to a specific software

or methodology at this time If resources allow we will also release the data sets in user friendly GIS tool/data combinations such as the Almanaque de Guanajuato

Application of Results

The food security and poverty maps are expected to be of direct use in guiding and assessing CIMMYT s activities in Mexico CIMMYT is involved in projects expected to have farm level impact in several areas of Mexico (typically in association with INIFAP or NGOs) The proposed maps should form a useful foundation for priority setting and assessing impact in these efforts

The maps will also be made available to government agencies universities and NGOs National and state governments in Mexico continually seek to identify socially marginalized populations that are at risk as reflected in Federal programs such as PROGRESA and PROCAMPO Government generated indices are often suspected of reflecting political agendas and we expect that our independent assessment will be welcomed by many sectors

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Budget (USD)

	CSI FAO Project				CIMMYT				
Item	**Y 2002**	**Y 2003**	**Y 2004**	**Total**	**Y 2002**	**Y 2003**	**Y 2004**	**Total**	**TOTAL**
Data	4000	2000	0	6000	1000	0	0	1000	7000
Software	2000	2000	1000	5000	2000	2000	2000	6000	11000
Hardware	2000	1000	0	3000	1000	1000	1000	3000	6000
Personnel	10000	14000	14000	38000	5000	5000	5000	15000	53000
National									
International	5000	5000	5000	15000	12000	12000	12000	36000	51000
Consultants	3000	2000	2000	7000	0	0	0	0	7000
Lab and office space	0	0	0	0	4000	4000	4000	12000	12000
Workshops	2000	0	2000	4000	2000	0	2000	4000	8000
Misc supplies	0	0	0	0	500	500	500	1500	1500
WWW resources	0	0	2000	2000	0	0	3000	3000	5000
Travel	1000	1000	1000	3000	0	0	0	0	3000
Vehicle	0	0	0	0	2000	2000	2000	6000	6000
Overhead (20/)	5800	5400	5400	16600	0	0	0	0	16600
Total	**34800**	**32400**	**32400**	**99600**	**28500**	**25500**	**30500**	**84500**	**184100**

Appendix 1 Key data sets to be used in the project

Data set	Description	Scale/ level of detail	Years	Status
Socio-economic				
General censuses of population and housing	Populations by gender and age quality of housing etc	By localities with more than 4 housing units	1990 1995 2000	A[2]
CONAPO index of marginalization	Calculated from census data	As for census	1990 1995	A
Nat Survey of Household Incomes (ENSA)	Detailed survey of income sources and expenditures including remittances	10 000 households		E
National Survey of Food and Nutrition (ENAL)	Detailed survey of food consumption and nutritional status			E
National Health Survey (ENSA II)		12 000 households 60 000 individuals	1994	E
Transportation network	Detailed vector database of Ministry of Transportation	?	2002	O
Transportation access	To be calculated by CIMMYT from MoT vector	1 km grid	2002	[O]
Biophysical				
DEM	Raster data for elevation	1 km grid		A
Climate	Interpolated monthly climate normals and derivative models	1 7 km grid		A
Soils	FAO soil classes	1 250 000		A
Municipal boundaries				A
Land cover	USGS classification	1 km grid		A
AGEB boundaries	Census unit boundaries		2000	O

[2] A = Available in digital form at CIMMYT E = Exists but not yet with CIMMYT O = Offered to CIMMYT but not yet obtained

Appendix 2 Logical framework for the proposed activities

O er ll goal	Indicator(s)	Ass mpti (s) d risks
Contribute to the alleviation of po erty and i creased s stainab l ty of agriculture in de elop g countries by i creasing the eff ency of the research and development process	Increase use of q ant tat ve nd cators of human welfare and food sec ty n *agricultural research and d lopm t* efforts	A ilab l ty of adequate geospatial data of fa tors *A a lab l ty of ew technology for* farm rs
Intermediate goal	**Indicator(s)**	**Assumption(s) d ri ks**
Impro p o ty s tt g target ng research d ffus o and mpact assessment by increasing the availab l ty of rel able quantitati e i dicators of food sec ty and human welfare (FS & HW)	• Availability of improved geospatial characterization of variation in human welfare	Reasonable access to geospat al data on parameters us d to characteri ariat o n h man welfar CGIAR centers NARS have s ff cient research and e tens o capac ty to apply new m th d l g es
Purpos	**Indicator(s)**	**Assumption(s) and sks**
Develop mp o ed m thod log es fo characterizing spat al and temporal variat food secur ty and po erty us ng Mex co as a case study	• Availability of improved methodologies for geospatial characterization of variation in human welfare	
O tputs	**Ind cator(s)**	***Assumption(s) and risks***
1 Case study f g sp t al ar at o m human welfare n M co w th mphas on food security ind cators 2 Imp o ed m thodolog es fo characte g geo p tial ar t food security and human welfare 3 Data sets of FS & HW at three spatial scales Mex co	Report ailable on experi nces of haracteriz g spatial ar ation in human welfare M co Report ailable on methodologies for terpolati g and an lyz g data. D ta s ts a ailabl p blicly	Ava lab l ty of ad quate geospatial d ta on ndicators of h man welfare Able to identify methodol g es and software fo stat st cally valid spat al temporal analyses
Activities for 2002	**Milestones for 2002**	***Assumptio (s) and sks***
1 Acquire and organ ze key soc oeco om c data s rv g as po s bl d cators fo characte zing w lfare and food secu ity	• Base data assembled from censuses and surveys in compatible format for geospatial analyses	Data are labl through INEGI and other sources Data are re d ly o ert ble to appropriate formats
2 A q re and o gan ze ronmental d ta fo analyzi g ariat on in welfare and food security	• Base data assembled from INEGI USGS and other sources and are in compatible format for geospatial analyses	Data are lable f om the arious sources Data are readily convertible to app opriate formats
3 Evaluate methodolog es fo spatial terpolat o us g -param tri approaches and for spat al temporal regressions	• Report available on assessments for different interpolation methods • Report available on spatial temporal regressions	M thodolog es p o tractabl fo req d data sets
4 Prepare fo and conduct ational workshop on spatial character zation f welfare and food security	• Workshop held	Local and part c pants a ail ble

Activities for 2003	Milestones for 2003	*Assumption(s) and risks*
1 Use regress on models to estimate survey variates as functions of data with more completes geographic coverage	Variates estimated	Regression models provide adequate estimations
2 In estigate approaches for assigning po nt locations to represent polygons	Report o methodologies	Different methods identified
3 Assess software for spatial analysis and fuzzy logic	Report on software options	Different software available
4 Interpolate data relating to human welfare over all of Mexico	Interpolated data sets as gridded surfaces	Interpolations suff c ently accurate to be worth using
5 Analyse relations between ndicators and possible causal ariables at state level o er all of Mexico	Data sets a ailable for national level characterization	Aggregated nature of some data do not mask important ariation
6 Analyse elat ons between nd cators and poss ble causal variables at municipality level over all of Mexico	Data sets a ailable for regional level characterization	Aggregated nature of some data do ot mask important ariation Resolution of explanatory data (e g cl mate, soils and topography) is s ff c ent to ident fy useful relations
7 Analyse rel t ons between nd tors and possible causal ariables at h gh resolut on fo states of SW Mex co	Data sets a ailabl fo state level characterizat o	Resol t on of explanatory data (e g cl mate soils and topography) is sufficient to dentify useful relations
8 Analyse temporal ariation m ind cators	Report available on tempo l ariation	Suffic ent t me series data available Time series show clear trends
Activities for 2004	**Milestones for 2004**	***Assumption(s) and risks***
1 Data at state and regional levels are val dated against independent surveys cond cted by CIMMYT	Report available on al dation effort.	Spatial co erage of ndependent surveys allows meaningful val dation
2 Experiences at different spatial scales are compared and evaluated	Report available o effects of spatial scale	D fferences in scale reflect meaningful variatio that can be derstood with available data.
3 Based on review of spatial scales additional analyses are co ducted	Report a ailable descrb ng rev sed analyses cross the three scales Re ised data sets available	Opportunities or problems are dentif d n the cross scale analyses
4 Prepare for and conduct national workshop held to present results to Mexican scient sts and pol cy makers	Wo kshop held	Outp ts of project are of s ff c t interest to potential part cipants
5 Final written report is prepared	Published report available	Outp ts of project are of s ff c t interest to merit publication
6 WWW site is prepared	WWW s te with interact e maps and down loadable data sets	That WWW software and server are a ailable

Appendix 3 Time chart for proposed project activities

	2002		2003				2004		
Activity	**J S**	**O D**	**J M**	**A J**	**J S**	**O-D**	**J M**	**A J**	**J S**
A qu re and organize key soc oeco om c data serv ng as possible indicators for characterizing welfare and food secu ity									
Acq re and o gan e onm ntal data for analyz ar atio welfare and food security									
Evaluate methodolog es fo sp t al nterpolation using non parametric pp o h s and fo spatial temporal regress ons									
P epare fo and d t tu l wo kshop to solic t np ts on data s and m thodolog es									
Use regression models to estimate survey ar ates as funct ons of data with more completes geograph c co erag									
In estigate app oa h fo ass gn ng point locations to represent polygons									
Assess software for spatial analys s and fuzzy log									
Interpolate data elat ng to human welfare all of Mex co									
Analyse relat o s betw d cators and possible ca sal ari bles at state le el o e all f Mex co									
Analyse lat ons b twe n ndicators and poss ble aus l ari bles at m p l ty level o er all of M									
Analyse relations between indicators and poss ble c usal ar ables at h gh resol t o fo states of SW Mex co									
Analyse temporal ar at o m d cators									
D ta t state and reg onal levels are al dated against i d p d nt rvey co d cted by CIMMYT									
Experiences at different spatial scales are compared and al ted									
Bas d re ew f p t al s al s dd t o al an lys s ar cond cted									
Prepare fo and cond ct tio al workshop h ld to pres t results to Mex can sc entists and pol cy makers									
F nal report prepared and distributed									
WWW s te estabi shed									

Explanation of major revisions to proposal

1 Expanded description of statistical approaches with emphasis on dealing with spatial autocorrelation
2 Provided a detailed list of data sources in Appendix 1
3 Expanded discussion of potential subsequent use (now as last section of main text)
4 As a complement to logical frame have provided a more detailed time line as Appendix 3
5 Have expanded list of activities to provide greater detail

Assistance to the Government of Syria in Establishing a National Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS)
ICARDA

PROJECT AGREEMENT

FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS

TECHNICAL CO OPERATION PROGRAMME

Country Syria

Project title Assistance to the Government in Establishing a National Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS)

Project symbol TCP/SYR/2901 (A)

Starting date Jun 2002

Completion date Nov 2003

Government counterpart institutions
Responsible for project execution
Ministry of Supply and Internal Trade
Ministry of Agriculture and Agrarian Reform
Central Bureau of Statistics

FAO contribution US$ 217 000

I BACKGROUND AND JUSTIFICATION

Syria, with a population of 16 4 million in 2000 is a middle level developing country with a fairly high growth of per capita GDP in recent years Syria has made good progress in improving its national diet The per caput daily calorie intake has increased by 25% since the early 1970s The level of nutrition in the country is currently satisfactory reaching an average of 3351 calories per caput per day in 1999 At present Syria has no serious food supply shortages except in years of severe drought It is self sufficient in most food items and food insecurity is not a threat at the present time

However even though the status of poverty in the country is not exactly specified there is a clear concentration of poverty amongst the small nomadic population and desert shepherds Also the urban unemployed landless labourers and rural families in rainfed areas with no land or with small holdings are at risk and susceptible to food insecurity especially in years of severe drought

Hence while the general picture remains satisfactory and despite the overall reduction of under nourishment in Syria there remain pockets of food insecure and under nourished households among several vulnerable groups located in various parts of the country

In addition it is to be noted that 50% of the Syrian population is below 14 years of age and that Syria will have a population of 24 6 million by the year 2010 when its food consumption will be 98% higher than in 1992 94 Based on the population projection the consumption needs for key food items in the year 2010 are given below requirements on the assumption of some improvements in the consumption of livestock and fish products and slight reduction in the consumption of wheat It is the policy of the government to upgrade the quality of the national diet by raising the proportion of animal based products in total food consumption

In this scenario the elimination of food insecurity and under nourishment as well as the reduction of the risk for food insecurity and vulnerability are of concern to the Government of Syria Such an effort requires reliable and accurate information on the extent and magnitude of food insecurity and vulnerability at national and sub national levels with the view to enable proper orientation and inclusion of food insecure vulnerable groups into the national programmes and actions for poverty elimination and food security

Although some progress has been made in recent years on poverty related statistics there is little in depth information specifically related to food insecurity and vulnerability i e the nature of their underlying causes the characteristics of the food insecure and vulnerable households their geographic location and coping strategies Hence the need to further develop food security related statistics and data This is particularly true for Food Insecurity and Vulnerability Mapping System (FIVIMS) related information where no such detailed information has ever been compiled as the country lacks an operational food security information system

The proposed project is a ground breaking new initiative in filling this food insecurity and vulnerability information gap In order to develop a food insecurity/vulnerability database at national level a methodology for poverty/food insecurity mapping proposed by the International Center for Agricultural Research in the Dry Areas (ICARDA) will be followed (Section III)

A gender disaggregated FIVIMS information will be useful in targeting programmes more effectively to the needy where a majority of these are women due to the significant male outmigration from the rural areas and will provide the basis for monitoring progress in reducing food insecurity and under nourishment over time This is especially needed now more than ever before given that the government is implementing major policy reforms and structural adjustments which are likely to have strong impact on the food security situation of the country particularly the food insecure and vulnerable groups The Thematic Group (TG) of the ACC Network on Rural Development and Food Security in Syria has endorsed FIVIMS as a priority activity

FAO technical assistance would support the introduction of the methodologies required for the project implementation of including food security indicators (who are the food insecure where are they located and why are they food insecure and/or vulnerable)

The project will be implemented by the Ministry of Supply and Internal Trade (MSIT) in collaboration with the Ministry of Agriculture and Agrarian Reform (MAAR) and the Central Bureau of Statistics (CBS) and the International Center for Agricultural Research in the Dry Areas (ICARDA) While MSIT will be the lead government unit responsible for the implementation of the project ICARDA will be responsible for the coordination of technical support services and delivery of essential project outputs (Annex 6) The project will also support MAAR and CBS efforts in collecting analysing and disseminating information related to food security according to geographical agroecological cultural and socio economic parameters Although the information generated by the project will be initially located at the MSIT the data will be equally shared with CBS MAAR and other stakeholders The national counterpart institution appears to have the necessary capacity and skilled manpower to support the project implementation and to absorb and utilize its technical assistance outputs

The government has indicated its desire to ensure the sustainability of the project by funding necessary follow up activities The established high level commission on eradication of poverty and food insecurity chaired by the Prime Minister will promote awareness of food security matters at the highest levels of the Government

Information generated by the national FIVIMIS system will have direct use for various policy relevant decisions and intervention programmes/projects Groups identified as vulnerable and/or food insecure could be useful in designing poverty and food insecurity alleviation programmes under the National Strategy for Poverty Alleviation better targeting of subsidies food aid and food for work programmes

The project will complement ongoing FAO and UN country assistance programmes and projects These include the FAO Special Programme on Food Security the policy assistance project GCP/SYR/006/ITA WFP s Vulnerability Analysis mapping programme (by Please briefly elaborate on how it would effectively complement and not duplicate) UNFPA and WHO s Healthy Villages initiative Under the UNDAF exercise the UN Country Team has endorsed the need to identify the target beneficiaries for all development partners (???)

The project will also contribute to the WFS follow up as it will establish a national FIVIMS system which will provide the following

A baseline information on undernourishment in Syria and a continuous monitoring system of the situation of food security in the country thereby allowing progress to be gauged on how WFS targets are being achieved at national level

Policy relevant food security information which can be used for tangibly reducing undernourishment in the country

II OBJECTIVES OF THE ASSISTANCE

Development objective

The ultimate goal of the project is to contribute to the reduction of under nourishment and food insecurity in Syria

Immediate objectives

1 To establish a national household food security and nutrition monitoring system for identifying the food insecure groups and those vulnerable to food insecurity their location and the causes of their food insecurity/vulnerability

2 To make available timely flow reliable national and sub national information suitable for the formulation implementation and monitoring of interventions to improve household food security and nutrition

3 To strengthen the national institutional and technical capacity for the establishment and monitoring of food insecurity and vulnerability indicators as well as for the management of the related information system

III METHODOLOGY

There are strong indications that in Syria external shocks arising from drought and land degradation have an impact on human welfare While not explaining poverty in full access to and the stability of the natural resource capital particularly natural vegetation climate soil and irrigation water are major determinants of the viability and welfare of rural livelihood systems The challenge is to identify in the absence of statistical information the poor and vulnerable segments of society and to understand their

poverty particularly in the interactions between the production environment and the natural resource base

To capture the role of the natural resources endowment (land water natural vegetation and climate) the case study will adopt an integrated and multi scale GIS approach It will combine biophysical information in the form of agroecological datasets and land utilization types as a representation of livelihood systems It will then integrate the multi disciplinary datasets in GIS to allow upscaling of site specific poverty indicators obtained by rapid rural appraisals and household surveys and for mapping poverty and food insecurity at national level The general approach is outlined in Appendix 1

The basis for mapping poverty will be a spatial framework of combined agroecological zones and production systems The agroecological zones will be established by integration of available climatic soil terrain and land cover digital datasets The agro ecozones established through the integration of agroecological and production system zones will be characterized in terms of climatic conditions (including drought risk) terrain and soils land degradation and will be evaluated in terms of potentials and constraints for rural land uses They will also be characterized in terms of produce capital and labor intensity access to roads and processing facilities land holding size tenure arrangements and management practices

The zones thus differentiated will be the basis for multi scale poverty/food insecurity surveys These surveys will use direct and proxy poverty indicators related to income access to safe drinking water proper sanitation housing standards education land resources agricultural inputs health and nutrition At both levels of study some of the poverty indicators recommended by the Committee on World Food Security for monitoring food security status will be incorporated

The socio economic work will initially focus on the characterization of the general socioeconomic conditions in each agroecozone This will be achieved through informal surveys at community level in several villages of each agroecozone This Level 1 study will allow the identification of the hot spots of poverty/food insecurity in Syria and the capturing of communal knowledge and perceptions on the dynamics and drivers of poverty It will also be the basis for developing a formal survey procedure and indicators for poverty/food insecurity characterization at household level

Within the poverty hot spots a Level 2 study will be conducted at household level using formal survey procedures The objective of the household surveys is to understand the nature of the livelihood systems in the poverty hot spots the degree of poverty/food insecurity the nature and effectiveness of the coping strategies and to assess the vulnerability to external shocks

The information from the household surveys will be statistically analyzed and converted into appropriate poverty indicators From the understanding gained through the surveys of the poverty drivers and coping mechanisms pockets of poverty risk and vulnerability will be identified and mapped In addition proxy indicators will be identified at

community level that have a direct link to poverty at household level which will allow upscaling to each agroecozone

The outlined approach using an agroecological framework as the basis of a sampling strategy has potential for the rapid detection of rural poverty/food insecurity hot spots and understanding its drivers and coping mechanisms It would also prepare the foundation for developing a national monitoring system which will allow regular and systematic updating of the food security situation in different parts of the country

IV PROJECT OUTPUTS (RESULTS)

OUTPUT 1

A series of food security suveys conducted complemented with the compilation of existing secondary information including agroecological land use and agricultural systems data

OUTPUT 2

A national database on household food insecurity and vulnerability information generated from various data collection and compilation activities

OUTPUT 3

Information on the prevalence of household food insecurity and and under nourishment of the Syrian population – disaggregated by gender age and geographical location developed and made available to Government and donor agencies

OUTPUT 4

National FIVIMS indicators on food insecurity and nutritional status of the population developed and disseminated

IV WORK PLAN

Upon project inception the project methodology will be reviewed and a detailed planning/timing of activities will be prepared in close collaboration with CSO

The project will assist the Government in the collection analysis and dissemination of the information required for the implementation of the FIVIMS through the below phased approach and indicative activities

Pls revise the coherence activity/outputs and insert all planned training activities (including on the job practical training) where appropriate

ACTIVITIES RELATED TO OUTPUT 1

- Hold a project inception workshop
- Develop an agro ecozone framework combining georeferenced data on agroecologies and livelihood systems
- Characterize the agro ecozones in terms of agroecological and socioeconomic opportunities and constraints drought risk land degradation as well as vulnerability to weather variability and resource degradation
- Develop checklists for Level 1 and questionnaires for Level 2 socioeconomic surveys
- Conduct informal surveys at community level in representative villages of each agroecozone
- Hold a training workshop for extension staff in charge of Level 2 surveys
- identify villages representing particular types of poverty/food insecurity to conduct more detailed household surveys
- conduct household level poverty/food insecurity surveys in the selected poverty hot spots
- Identify household level poverty/food insecurity indicators that can be upscaled to the level of the agroecozone

ACTIVITIES RELATED TO OUTPUT 2

Establish a national FIVIMS database through

the processing of the above primary and secondary information

the development of a database system for the food insecurity and vulnerability information

ACTIVITIES RELATED TO OUTPUT 3

- analyze the data collected from the community and household surveys
- prepare geo referenced food insecurity maps

ACTIVITIES RELATED TO OUTPUT 4

- propose a national adapted FIVIMS as a system to monitor the food security situation and take appropriate measures to tackle the problem
- propose models for FIVIMS monthly quarterly six monthly and annual bulletins and reports as a mechanism for disseminating information to users including Thematic Group members
- design food insecurity models and indicators broken down by region and districts
- produce on the basis of the analysis of the existing information and the data obtained from the surveys information relevant to the formulation of effective government policies for reducing (and eventually eliminating) food insecurity and hunger in the country

- organise a final workshop with high Government officials involved in the formulation and implementation of food security related policies and programmes to discuss the project findings and recommendations and decide on future Government steps to guarantee the further use of FIVIMS related information and the adequate management of the system

The workplan in Table 1 represents a draft which will be further detailed at project inception by the Project Contractor in consultation with the partner institutions

Table 1 Project workplan

Outputs/ Activities	YEAR 1				YEAR 2	
	I	II	III	IV	I	II
Project inception workshop	X					
Development of agro ecozone framework	X					
Characterization of agro ecozones	X					
Development of survey checklists and questionnaires	X					
Community level surveys		X				
Training workshop		X				
Household level surveys			X			
Identification of agro ecozone level food insecurity indicators				X		
Establishment FIVIMS database				X		
Establishment GIS on food insecurity					X	X
Proposal for a sustainable FIVIMS including reporting and dissemination mechanism					X	
Food insecurity models and indicators by agro ecozone					X	
Recommendations for policy makers						X
Terminal workshop						X
Progress reports		X		X		X
Technical report						X
FIVIMS Web site				X		
Terminal report						X

V CAPACITY BUILDING

Capacity building will be achieved through the input of the various national consultants ICARDA technical support services training seminars and through the process of consultations/workshops which will result from the national FIVIMS programme

VI INPUTS TO BE PROVIDED BY FAO

1) Personnel

National Consultants

- 1 Statistician for 8 months (TOR Annex 2)
- 1 Economist for 8 months (TOR Annex 3)
- 1 Data Analyst for 8 months (TOR Annex 4)

FAO Backstopping missions (TOR Annex 5)

- 2 missions (at project inception during the data collection and analysis and at the end of project) for a total of 2 weeks by the regional Food Systems Economist/RNEE Cairo
- 1 one week mission (at project inception) by an ESSS Statistician
- 1 one week mission (at project inception) by an ESAF Officer

Administrative support

Temporary labour to support the FAO Representation in the project operations and secondary administrative tasks

Management/Technical Support Services (through ICARDA subcontract) (TOR Annex 6)

Under the overall supervision of the FAO Representative the technical coordination of the project will be entrusted to ICARDA which will assume the role of Project Contractor and assure managerial/technical support services in accordance with the Terms of Reference outlined in Annex 6

2) General Operating Expenses (up to US$ 5,000)

General operating expenses related to the project at country level reporting costs preparation of Terminal Statement Costs related to the distribution and collection of questionnaires would also be covered under this line (an additional amount of US$ 3 000 has been budgeted to this end)

3) Materials and Supplies (up to US$ 12 500)

GIS software (US$ 1 000)
Digital maps and satellite imagery (US$ 11 500)

4) Equipment (up to US$ 14,000)

4 PC Pentium III computer units (US$ 8 000)
1 laser jet printer (US$ 1 500)
1 photocopier (US$ 1 500)
10 GPS units (US$ 3 000)

5) Direct Operating Cost (US$ 13 000)

To cover miscellaneous expenses at FAO Headquarters related to the implementation of the project They are calculated on the basis of rates established by FAO

6) Study Tours (up to US$ 10 000)

Study tour for two senior officials of the Ministry of Supply & Internal Trade and Ministry of Agriculture for two weeks to gain experience from other countries in the developing world that have established national FIVIMS or where an information system similar to FIVIMS is being implemented with the aim of exchanging experiences country of visit to be determined by the Project Steering Committee Estimated cost of each tour (including DSA round trip ticket and miscellaneous expenses) US$ 5 000

VII REPORTING

The Project Contractor (ICARDA) with the support of the project team will submit monthly and six monthly reports including at the end of the project Each National Consultant will be required to prepare a report containing the main results conclusions and recommendations of his/her mission Backstopping officers will be expected to prepare back to office reports of their missions describing progress made in project implementation constraints encountered and recommendations for future implementation The Project Contractor will prepare a report on national FIVIMS implementation progress and a Terminal Statement at the end of the project which will be finalised by FAO Lead Technical Unit for submission to the Government

VIII GOVERNMENT CONTRIBUTION AND SUPPORTING ARRANGEMENTS

The Government through the Ministry of Supply and Internal Trade (MSIT) in collaboration with the Ministry of Agriculture and Agrarian Reform (MAAR) and the Central Bureau of Statistics (CBS) will assign a National Project Coordinator at senior level

A Project Steering Committee will be set up with the participation of the three concerned national institutions/bodies which will be mandated to ensure inter coordination of the project activities and full participation of the respective entities in the project implementation and in the decision process for FIVIMS management including decisions regarding respective institutional responsibilities

The Government will make available counterparts and trainees and provide the necessary office space support staff and local transport in support of the project

The Government will be responsible for the arrangements for timely clearance of experts customs clearance of equipment tax free local purchase of project equipment and supplies etc

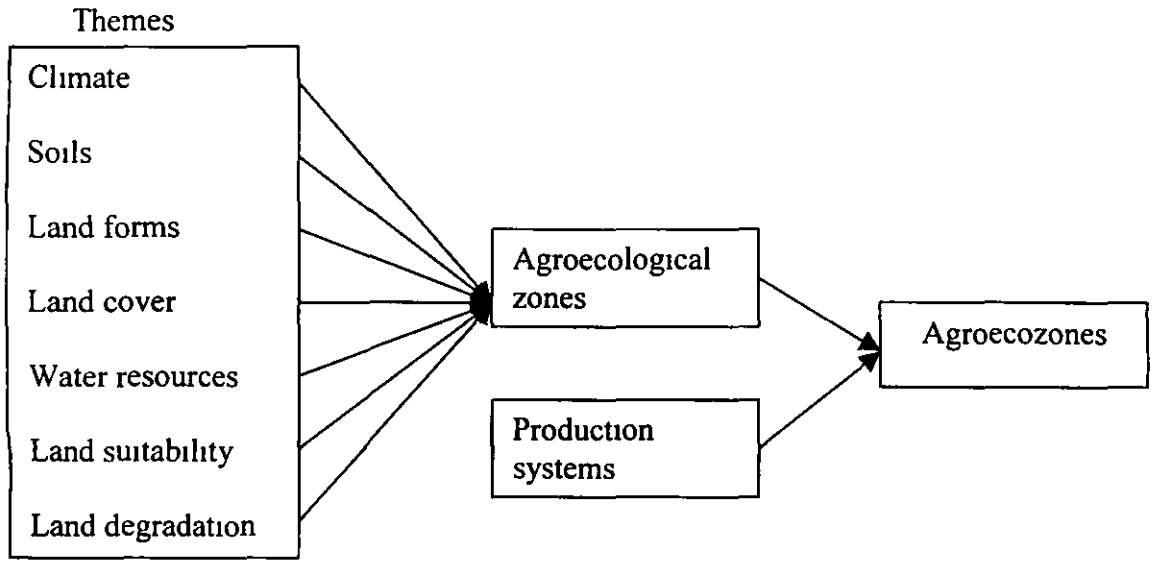
The Government will fully support the follow up activities required for the efficient running of the system and for the effective functioning of the FIVIMS responsible national units

IX. PROJECT BUDGET

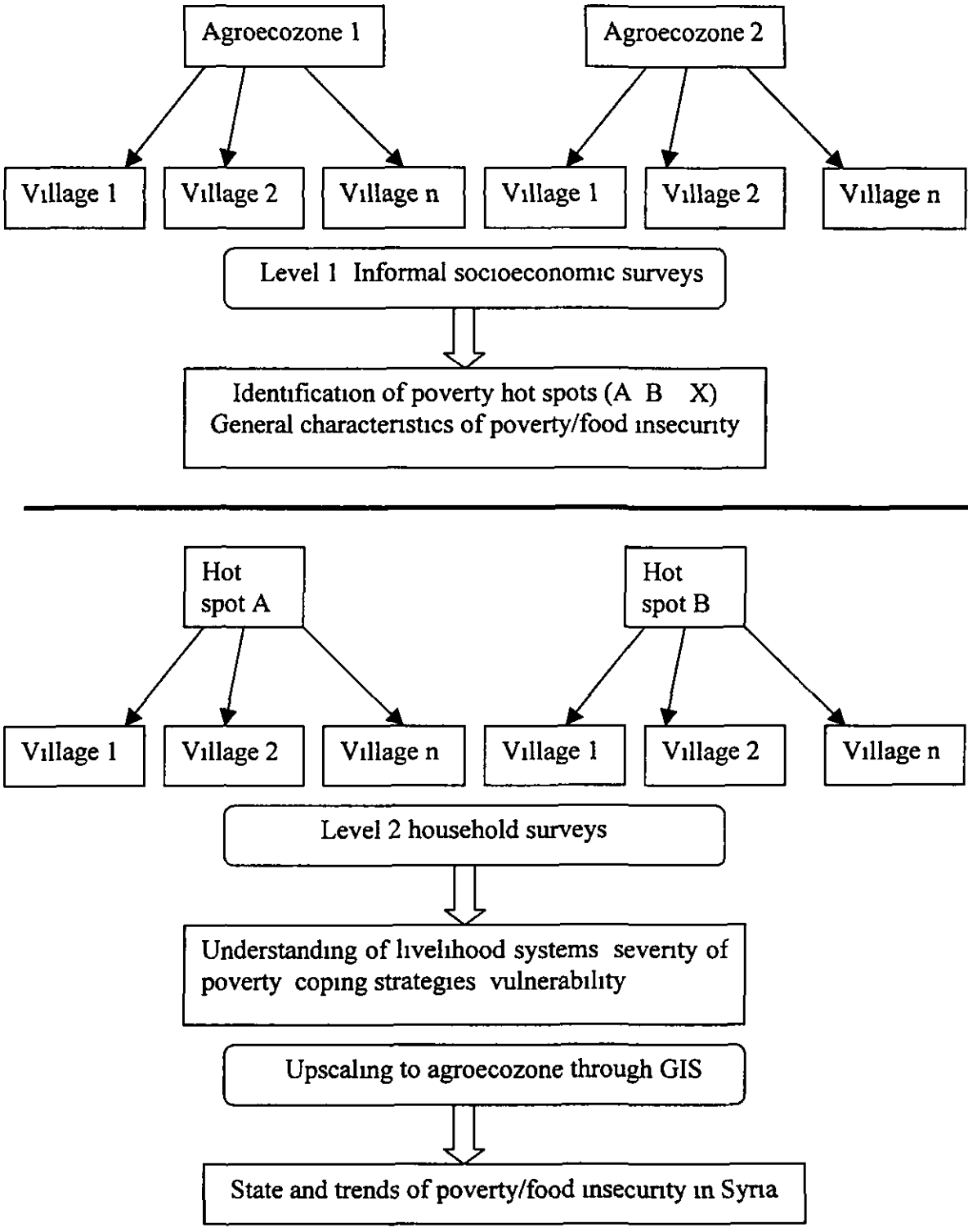
Component	Description	Cost
5543	Consultants National	48 000
5652	Casual labour temporary assistance	3 000
5694	Travel – Training (study tours)	10 000
5693	Travel STS	8 000
6000	Expendable equipment	12 500
6100	Non expendable equipment budget	14 000
6116	Evaluation	1 000
6121	Honorarium STS	13 000
6122	Standard supervisory technical services	8 000
6123	Supervisory functions of LTU	1 914
6300	General operating expenses budget	5 000
6118	Direct operating costs	13 000
???	Managerial/Technical support services contract	80 000
	TOTAL	217 414

ANNEX 1 APPROACH TO POVERTY MAPPING

Step 1 Establishing an agroecological framework for poverty mapping



Step 2 Characterization and mapping of poverty



ANNEX 2

Terms of Reference

National Consultant Statistician

Under the overall supervision of the FAO Representative the technical supervision of the FAO Statistical Development Service (ESSS) and the Project Contractor (ICARDA) and in collaboration with the National Project Coordinator the RNE Food Systems Economist the national consultant will be responsible for the following activities

Review statistical data relevant to FIVIMS requirements available in the CSO DSO (?????) and other institutions and determine the gap in information
assist in the design of questionnaires
assist in the preparation and conduct of the in country training programme
assist with the survey activities at the regional and local levels
assist in the collation and processing and analysis of the data
assist in the preparation of geo referenced food insecurity maps
participate in the design of food insecurity indicators
prepare a technical report

Qualifications
University degree in Statistics with experience in agricultural statistics and surveys At least 5 years experience in responsible position in economic planning data collection and analysis of sample surveys in Syria Expertise in data analysis and good report writing skills will be a plus Good managerial and communication skills are required

Languages
Fluency of Arabic basic knowledge of English

Duty station
Damascus Syria – with in country travel

Duration
8 w/m

ANNEX 3

Terms of Reference

National Consultant Economist

Under the overall supervision of the FAO Representative the technical supervision of ESAF and the Project Contractor (ICARDA) and in collaboration with the National Project Coordinator the RNE Food Systems Economist the national consultant will be responsible for the following activities

review existing reports both published and unpublished on food security/insecurity in Syria and prepare a short background report and a bibliography for reference purposes during the implementation of the project
participate in the poverty/food insecurity surveys and prepare reports as required
analyse the information and the data obtained from outputs 1 and 2
Assist in the design of food insecurity models and indicators broken down by agroecozone region and districts
Assist with designing the National FIVIMS for monitoring the food security situation including the modalities of transmitting the information to policy makers and to the development partners
Assist in the preparation of an overall report on the national FIVIMS comprising the above components and taking into account the results of the analysis of the in depth studies poverty/food insecurity surveys as well as the conclusions and the views of the final workshop in which high level Government officials will participate
Produce a consultancy report with findings and recommendations

Qualification
Advanced degree in economics five years experience in economic planning and policy analysis responsible positions either in government service private sector or NGOs
Good analytical and writing skills

Languages
Fluency both in English and Arabic (written and spoken)

Duty Station
Damascus Syria with in country travel

Duration 8w/m

ANNEX 4

Terms of Reference

National Consultant Data Analyst

Under the overall supervision of the FAO Representative the technical supervision of ESSS (???) and the Project Contractor (ICARDA) and in close collaboration with the National Project Coordinator national statistical and economic consultants the national data analyst will be responsible for computer data entry and processing More specifically he will be responsible for the following activities

developing a user friendly data management system
data entry of information to be collected through survey questionnaires
participate in undertaking surveys as required
assist in the training programme
Conducting data processing activities as required
Reporting

Qualifications
Expertise in database management software (Microsoft Access and Dbase) as well as other popular software programmes Good communication skills and ability to work under pressure

Languages
Good command of English and fluency of Arabic

Duty station
Damascus Syria

Duration
8 w/m

ANNEX 5

Terms of Reference For FAO Technical Support

1) Regional Food Systems Economist (RNEE)

In addition to the General responsibility of providing overall technical supervision/support as representative of the Lead Technical Unit the Regional Food Systems Economist will carry out the following 2 technical backstopping missions

First visit to Syria for one week (together with ESS and ESAF officers) to

- provide the overall conceptual framework for designing FIVIMS for monitoring food security situation and on how to use the data for policy purposes
- finalize the detailed arrangements for the implementation of the project
- participate in the inception workshop
- discuss and finalize detailed workplan and ensure its adequacy to achieve the technical objectives of the project
- interview/select/contract national consultants and hold technical briefing meetings

A second visit for one week towards the end of the project to

- provide needed technical support for holding the National Workshop
- participate as resource person in the National Workshop
- discuss Government follow up actions to the project with Government Representatives
- support the finalization of the project report

2) ESAF Technical Support

The ESAF senior officer will undertake a mission of 1 week at the inception of the project

Specific activities will include

- Provide leadership in the in field application of the FIVIMS methodology
- Support the regional and country FAO staff on normative methodological matters

3) ESS TECHNICAL SUPPORT

ESS officer will make one backstopping mission during the inception with the Food Systems Economist and ESAF Officer

Specific activities will include

- Provide technical support in the incorporation of FIVIMS data collection instruments in national Agricultural Census (???? Not consistent with this project)
- Technically support the international statistician/data analyst
- Provide Government and project team with technical advice related to statistics

ANNEX 6

Contract with ICARDA

The International Centre for Agricultural Research in Dryland Areas (ICARDA) located in Aleppo Syria is a well known CGIAR centre and has proven expertise and experience in agro ecological characterization GIS techniques and methods of socio economic analysis at community and household level

ICARDA will contribute to the implementation of the project as Project Contractor through a managerial/technical support services contract that will entail the following responsibilities

- to produce a geographical information system related to the key variables and indicators of poverty/food insecurity in Syria
- to coordinate and analyze the poverty/food insecurity surveys at community and household level
- to provide technical assistance to the national partner institutions with developing and maintaining the FIVIMS database and the Project Web site
- to assist with the selection of the national consultants and with the coordination of their activities
- to coordinate the training activities anticipated by the project
- to provide progress reports as per TCP requirements

As part of this managerial/technical support services contract ICARDA will specifically be responsible for the following deliverables

- compilation analysis and integration of agroecological data and other secondary information sources
- organization of an inception workshop for the representatives of the Ministries involved in the project
- preparation of checklists and questionnaires for the poverty/food insecurity surveys
- conducting rapid poverty/food insecurity surveys at community level in representative villages of each agroecozone
- conducting a training workshop for the MAAR/BOS staff in charge of the poverty/food insecurity surveys
- coordination and analysis of household level poverty surveys in selected poverty/food insecurity hot spots
- on the job training in use of GIS tools for poverty/food insecurity mapping and socio economic surveys for poverty/food insecurity
- production of digital maps of key variables and indicators related to poverty and food security
- development of a GIS project containing all relevant data layers generated from the poverty/food insecurity surveys
- organization of a terminal workshop
- delivery of a technical report including methodology analysis of poverty and food security for the country disaggregated food insecurity models and recommendations for policy makers

ICARDA Logical Framework

Project A MULTI-SCALE INTEGRATED APPROACH TO POVERTY MAPPING IN SYRIA

Narrative Summary	Objecti ely Verifiable Indicato s	Means of Ve fication	Risks and Assumptio s
Goal contr bute to the use of GIS for identification location and understanding of poverty and food insecurity in the dry areas	Methods developed in the case st dy are applied in other parts of the dry areas	Publications mp ct studies	
Purpose to develop no ative methods for analyzing the temporal and spatial dynamics of poverty and food insecurity Syria	Approaches methodolog es and procedures fo mapp g po erty in Syria and other dryland areas available GIS made ava l ble as ternational public good	Research publ t on Web site	
Outputs			
1 Dig tal maps of key variables and indicators related to poverty and food security	Maps made available through the Web site	Web site	
2 GIS project	CD and Web-enabled map viewing/querying interface completed	Web site CD	
3 Institutional Web site dedicated to the case study	Web site operational and access ble	Web site	
4 Research report with methodology and analysis of poverty status and trends in Syria	Report published on the Web site Peer review journal publications	Research report journal p bl cat on	

Activities	Mean of Verificatio	Risks and Assumptions
Integration of available agroecological layers and datasets t to agroecological zones	Progress eports	
Integrat on of agroecological zones and production system zones into agro-ecozo es	Progress reports	
Characterization of the agro-ecozones in terms of ag oecological and socioeco omic opport n ties and nstra nts drought risk land degradation, as well as vulnerability to weather variabil ty and esource degradation	P ogress reports	
Checklist and questionnaire development for socioeconomic s rveys	Progress reports	
Informal surveys at commu ty level in representative llages of each agroecozone	Prog ess reports	
Training workshop for extension staff in charge of Level 2 surveys	Progress reports	
Identification of villages representing particular types of poverty/food nsecurity to conduct more detailed household surveys	Progress reports	
Household level poverty surveys in selected poverty hot spots	Progress reports	
Identification of household level poverty indicators that can be upscaled to the level of the agroecozone	Progress reports	
Mapping of the poverty indicators for Syria	Web site CD	
Development of the GIS Web pages and mapping user interface	Web site CD	
Wr te f nal project report, research report and at least one peer review journal p bl cation	Final report research report, publication	

Mapping and Beyond - Improving Welfare Policy Design and Targeting through Spatial Analysis of Poverty and Vulnerability A Study of Malawi
IFPRI

Introduction

There are still many important research questions regarding the construction of accurate and meaningful spatial representations of human welfare particularly with regards to food security poverty and household vulnerability maps By focusing on Malawi this proposed research aims to address some of these issues but to go further It will do this by matching key welfare policy design issues facing the country to the most appropriate types and scales of welfare related maps It is expected that the lessons learned from this matching process will provide guidelines on cost effective problem specific approaches to mapping human welfare and targeting interventions to improve welfare that are of broader application

Malawi has an estimated poverty headcount above 60 percent for a population of some 11 million In the face of this the Malawi government is drafting a Poverty Reduction Strategy making important decisions regarding policy and investment strategies with regard to a broad range of welfare enhancing interventions These include formal safety net programmes education and agricultural development efforts Moreover there is a strong push to decentralize government authority in the design and provision of such interventions The lack of disaggregated information is now a critical constraint to effective targeting of development efforts Spatially explicit information about the likely incidence of economically vulnerable households in Malawi represents a key information gap

Building on IFPRI s considerable research into poverty in Malawi here we take as our starting point the hypothesis that the vulnerable are usually poor but that the poor are not equally vulnerable Conceptually the condition of being poor is static a characterization of the actual present welfare status of a household or individual Vulnerability on the other hand is a dynamic concept reflecting the potential impact of agro ecological and socio economic changes or shocks to the welfare status of individuals and households For any given shock the vulnerable are those whose welfare will be adversely affected to a larger degree than is the norm for the population Not all of the poor will necessarily be affected by all shocks Examining the issue from a spatial perspective we seek a closer understanding of just what spatial factors determine which households in Malawi are particularly likely to see a disproportionate reduction in their welfare due to a range of negative shocks We will pay particular attention to the spatial dependence of poverty and vulnerability on environmental conditions

It is not expected that a single vulnerability index will adequately capture the level of risk to natural or socio economic shocks which households face The vulnerability of a household will differ depending on the type and severity of the shock We will seek to

identify key determinants of both general and shock specific household vulnerability That is the combination of characteristics (socioeconomic and environmental) which determine whether or not a household can endure a change in its agro ecological or socio economic environment without a reduction in welfare

This study will rely heavily on measures of welfare related to household consumption Consequently the impact of shocks will be traced through money metric changes in consumption While consumption will be broadly defined to include for example the impact on household welfare of access to health care it should be understood that this study will focus most specifically on household *economic* vulnerability Human and social capital issues in their own right for example will not be addressed

Research Questions

What are the key correlates of the incidence and spatial variability of household poverty and economic vulnerability in Malawi?

What are the most appropriate ways in which to aggregate and represent this poverty and vulnerability in map form? How might the current set of strategic policy decisions facing national and local governments in Malawi best be informed and improved by access to new forms of spatial data on human welfare? How reliable do such maps have to be to inform different types of decisions?

Approach

Components

IFPRI working with counterpart national institutions has over the past four years undertaken detailed analyses of poverty in Malawi A detailed household consumption and expenditure survey from 1997 98 has been analyzed to establish regional basic needs poverty lines and consumption based household welfare indicators Poverty in these analyses is defined as a level of consumption and expenditure by individuals in a household calculated to be insufficient to meet their basic needs

Following the completion of a poverty profile and a determinants of poverty analysis more recent research focused on the construction of poverty maps of Malawi – small area estimates of poverty and inequality based on the application of household welfare models derived from the survey data to household level data from the national census These maps were produced by adapting the methods of Elbers et al 2001 Final poverty maps were completed in early 2002 Among the poverty measures mapped are poverty headcount ultra poverty headcount, depth of poverty severity of poverty and mean household welfare indicator (Inequality measures were also computed but will not be examined in the research proposed here) The poverty maps for Malawi provide one of the three components of the foundation to the research being proposed

The second component is a rich library of spatial data sets on Malawi that IFPRI researchers have assembled over the past several years Most of these coverages are at the sub district scale These coverages include agro ecological variables demographic and

other social statistics infrastructure and information on social services Many of these coverages are listed in Annex 2

The final component is the up coming analysis of a household panel survey for Malawi The Complementary Panel Survey (CPS) is being conducted by the Centre for Social Research of the University of Malawi with IFPRI s assistance The CPS was designed to enable a closer understanding of the dynamics of poverty in Malawi – what demographic characteristics agro ecological and environmental conditions or social and economic resources of households are important determinants of whether some fall into or deeper into poverty while others are only transitorily poor This analysis goes to the heart of household economic vulnerability in Malawi and is central to the latter stage of the research proposed here When the final survey round is completed in September 2002 five detailed interviews will have been done with over 600 households since 1997 Using funding provided through a co financing agreement with the World Bank IFPRI will be conducting a dynamics of poverty analysis of this data set in collaboration with the Centre for Social Research in the last quarter of 2002

It should be noted that these three components have been or will be assembled in close collaboration with Malawian counterparts While the specific research proposed here will not closely involve these counterparts we will use our working relationships with Malawian researchers and policy makers for compiling additional information if needed eliciting comment on preliminary results during the analyses and disseminating our research findings and new data products Moreover in this proposal we budget adequate resources to allow for consultations with and data acquisition from colleagues in country as well as to facilitate the dissemination to them of our research results

Activities

Three phases to the research are proposed

1 First, surfaces of the range of poverty measures derived in the poverty mapping analysis for Malawi will be developed and examined The recently completed poverty maps for Malawi have been done at the scales of the sub district Traditional Authority (average household population of 6000) and the local government ward (avg hh pop 2650) It is feasible using the Elbers et al methodology to develop poverty maps at more local levels This will be done at the enumeration area level (avg hh pop 250) and for agglomerations of enumeration areas (minimum hh pop of 500) The standard errors on the resulting poverty estimates will be used to judge the validity and usefulness of maps developed at these extremely local scales

   These very local poverty maps will be used to create poverty surfaces of Malawi by converting the original vector poverty map coverages to raster format at a 1 km resolution We will evaluate alternative interpolation and smoothing techniques for surface generation

Thereafter both the original maps and the gridded surfaces will be assessed using various spatial and image processing tools

- With the original maps assessments of whether the spatial distribution of the non poor differs from that of the poor or the ultra poor will be done using k function analyses Such analysis will provide important insights into the ultimate value of poverty maps If we find that there is little difference between the distribution of the poor vis a vis the non poor in Malawi the value of geographic targeting using poverty maps is called into question
- Poverty measure slopes would be derived to identify areas on the surfaces where there are sharp transitions in poverty measures Understanding what accounts for such areas will provide insights into the spatial factors associated with local welfare beyond those obtained by a point pattern analysis alone

This phase of the research will be done in the final quarter of 2002

2 The second phase would involve the range of other spatial data available for Malawi A variety of spatial dependence and correlation analyses will be undertaken primarily using the poverty surfaces as dependent variables and the other spatial data as candidate independent variables Most of these analyses will be done using raster coverages within a spatial regression framework

At the center of this phase of the project will be a full inter sectoral regression analysis that incorporates both socio economic and agro ecological variables to predict aggregate poverty levels in an area Models based on the spatial data will be derived and the spatial distribution of the residuals from these models examined and analyzed Both areas with good model performance and poor model performance will be more closely examined to understand what spatial variables are most important in accounting for the level of model performance

In addition to the full model analysis sectoral assessments will be undertaken The sectoral assessments will be done to provide specific information to development planners in those sectors For example the results of an examination of the relationship between poverty patterns and spatial education and literacy variables will be of particular interest to the education sector while understanding the level of correlation between poverty measures and agro ecological factors will assist agricultural development planners

There are several analytical issues confronting us in this phase of the proposed research Chief among them is the issue of endogeneity in the poverty measures used Several of the potential independent variables that we would like to correlate with the poverty maps may themselves have been used in the models used to develop the poverty maps For the most part we are interested in correlations and associations between spatial variables and poverty measures

Endogeneity is not fatal to the analysis in this case However if we seek to extend the analysis to consider spatial determinants of poverty we face more serious econometric problems

This phase of the research activities will begin in the final quarter of 2002

3 Finally we will continue with our interest in examining household economic vulnerability The Complementary Panel Survey (CPS) for Malawi will be analyzed within a dynamics of poverty framework in the last few months of this year Our intention for the second year of the proposed research is to fully investigate how these results can be coupled with the poverty maps to do a better job at highlighting areas of vulnerability in Malawi

Although the dynamics of poverty analysis remains to be done we expect to use the results of the analysis to develop a spatial model of household economic vulnerability for Malawi The enumeration areas in which each survey household is resident are geo referenced so spatial assessments of the panel data will be possible Key household characteristics and agro ecological variables identified in the CPS analysis as correlated with household vulnerability would be spatialized insofar as possible In some cases spatial data on key variables from the dynamics of poverty analysis would exist in other cases proxy spatial variables for these key variables would have to be identified We will also examine the spatial performance of the model to gain additional insights into the spatial correlates of household economic vulnerability primarily by examining the spatial pattern of model residuals

As stated earlier several times household economic vulnerability is a dynamic concept Most of the spatial data that we have for Malawi is static The major data challenge we will face in this stage of the analysis will be acquiring time series data to allow us to examine changes in household economic vulnerability over time Among the data sets we would have to develop or locate would be seasonal or monthly rainfall data and spatially disaggregated price series

This final phase of the research activities will be done in the second and third quarters of 2003

Outputs

Our work will focus on identifying the spatial correlates of the poverty maps and the appropriate application of the results of the household dynamics of poverty analysis within a spatial context to provide indicative maps of household vulnerability A key output of the work will be the definition of appropriate ways in which vulnerability related spatial information can help guide key strategy policy and investment decisions faced by governments – both national and local This process will allow us to enrich our understanding of how different aspects of household economic vulnerability can best be presented within a spatial framework to inform welfare policy decisions in Malawi

An important part of this process will be to examine where shortcuts proxy spatial variables or higher levels of spatial aggregation might be appropriate in providing the minimum levels (i e minimum cost) of information sufficient to satisfy specific policy and targeting needs The findings of the process will be described in a project publication which will serve as a research planning document for IFPRI and local researchers and also allow for peer review assessment of the initial linkages being made between maps and welfare policies

The analyses findings and outputs generated will be summarized in two reports The first will be targeted to policymakers and practitioners in Malawi and will describe the analyses and provide a compilation of the maps and related outputs generated The second will address the broader poverty and spatial analyst community and will take the form of preliminary guidelines on the relationship between specific policy and targeting needs and the most appropriate types of spatial measures of vulnerability

New spatial datasets for Malawi will be an additional outcome of this work

In summary the outputs are as follows

A report on *Preliminary Guidelines for Matching Vulnerability Maps with Policy Needs* The report will summarize the findings with regard to matching different types and levels (national vs district vs sub district) of policy or investment decisions with different types and scales of spatial information on poverty food security and vulnerability

A *Final Report on Vulnerability Mapping in Malawi* This report will be targeted to national and local policymakers as well as to analysts It will summarize the datasets created during the life of the project synthesize the research findings and point to new opportunities for the application of this spatial information on human welfare and economic vulnerability

A series of maps and tabular outputs together with explanatory texts targeted to the policy users and uses in Malawi

Compilation of databases analytical tools country and cross country reports and draft guidelines in WWW/CD compatible format for publication purposes

Food Insecurity The project as designed by CSI/FAO/GRID has both poverty and food insecurity at its primary foci Although we adopt the broader perspective of consumption poverty and household vulnerability food insecurity will lie at the center of our proposed research Given the overwhelming rural nature of Malawi and the dominance of subsistence agriculture in its rural economy a focus on vulnerability necessarily implies that household food insecurity will receive close attention Our research on poverty dynamics should also allow us to make a more comprehensive assessment of the determinants of food insecurity for households in Malawi including assessments of the role which educational attainment market access access to social services or household demography might play in rendering a household vulnerable to food deficits and reduced welfare levels It is our intention to take this assessment of household vulnerability

beyond a simple consideration of agricultural production and agro climatological statistics alone

Poverty, Food Insecurity and Vulnerability Related Research at IFPRI

IFPRI has an established international reputation with regard to its research on the policy aspects of poverty and food security IFPRI coordinates the CGIAR system s commissioned study on the Impact of Agricultural Research on Poverty Reduction (e g Kerr and Kolavalli 1999 Hazell and Haddad 2001) During 2001 IFPRI established an in house Poverty Group led by a member of the Senior Management Team (P Hazell) charged with synthesizing and disseminating the broad range of IFPRI s research in this area The Poverty Group has recognized poverty mapping as an important component of a poverty focused research portfolio and is stimulating cross divisional thinking on policy relevant spatial analysis of poverty and vulnerability IFPRI s recent and current poverty mapping activities cover Malawi (Benson Chinula, and Kanyanda, 2002) Mozambique (Simler and Nhate forthcoming) Vietnam (Minot, 1998) Tanzania Nicaragua and Honduras IFPRI is also a member of FIVIMS and the CGIAR s Consortium on Spatial Information

Research Partners and Users

IFPRI will continue to work with its established research partners in Malawi Indeed these strong existing relationships are seen as critically important in gaining access to key policy makers in the government as well as to other analysts and data sources that might need to be tapped to carry out the proposed study As a result of our existing working relationships these research activities should be accelerated and strengthened and the findings made available to those who can most use them Research partners include the National Economic Council the Centre for Social Research the National Statistical Office the Famine Early Warning System (FEWSNet) the EU Food Security Network (RESAL) and donors supporting food security and social safety nets efforts in the country

Personnel

Todd Benson a Research Fellow in the Food and Consumption Nutrition Division (FCND) will lead the IFPRI study Until recently he was outposted in Malawi to provide technical assistance to the Poverty Monitoring System of the government In addition to expertise in poverty analysis and mapping he also has GIS skills and seven years of full time research experience in Malawi
Stanley Wood a Senior Scientist in the Environmental and Production Technology Division (EPTD) will contribute expertise in the area of spatial and biophysical analysis

Jordan Chamberlin a GIS Senior Research Assistant (EPTD) will provide technical GIS operation and database support

Ingrid Rhinehart a Senior Research Assistant (EPTD) will provide spatial econometric support to the analysis of the poverty maps and to the correlations assessments of the poverty maps with other spatial coverages

Manohar Sharma a Research Fellow (FCND) is leading the dynamics of poverty analysis of the Malawi Complementary Panel Survey He will assist the other researchers in undertaking a spatial assessment of the results of the dynamics of poverty analysis

Ellen Payongayong a Scientist (FCND) is responsible for the Complementary Panel Survey data set She will assist in the spatial application of this data set for the research here

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Simler K and V Nhate (forthcoming) Small area poverty estimates for Mozambique *FCND Discussion Paper Washington DC IFPRI*

Annex 1 Log frame for the proposed IFPRI Poverty Mapping Project

Hierarchy of Activities/Objectives	Achievement Indicators/Milestones	Means of Verification	Important Assumptions
Goal To facilitate national economic and social development with emphasis on welfare gains for the most vulnerable groups			
Intermediate To provide policy makers and analysts with better information for improving policy design and investment planning			
Purpose To generate new assessment approaches for and new information on the spatial dimensions of human poverty and vulnerability	**Indicators** Spatial information more widely generated and used in policy and operational design in Malawi	Spatial analysis and map based data found more often in policy and design documents	Spatial insights into the human condition can improve policy formulation
Outputs 1 User and policy specific vulnerability maps for Malawi 2 Local User/Analyst Report 3 Peer Oriented Spatial/Poverty Analysis Report 4 Electronic products for WWW/CD publication	**Indicators** Maps and related data produced according to reporting schedule Final reports and digital products produced within 2 years of project start	Maps reports and other products disseminated to and in use by in-country stakeholders and the broader research (peer) community	
Activities (1) Produce user and policy specific vulnerability maps	**Milestones** Maps tables and explanatory notes made available according to timetable	Products in the hands of & used by local analysts & policymakers	Existing IFPRI and collaborator data and network are available to the study
(2) Conduct research into better matching policy and targeting needs and spatial vulnerability information	New knowledge and methods being generated to better relate maps and policy	New methods and results presented in R&D fora	
(3) Preparation and dissemination of final reports	Two reports produced (1) Local user oriented (2) Spatial/Poverty analyst oriented	Reports in use by local stakeholders Peer reviewed report available	
(4) Preparation of all materials in digital formats for publication through CSI FIVIMS GRID	Electronic files available in spatial and tabular formats on CD or WWW	Web site hits and CDs distributed	CSI FIVIMS GRID formats and protocols agreed

Annex 2 IFPRI spatial datasets on Malawi

Census enumeration areas

IFPRI has digital coverages of both the 1987 and the 1998 census enumeration areas The EAs respect the administrative boundaries of the country – Region District traditional authority EA – so any data collected on such a basis can be mapped using the EA maps We possess the census data at the EA level for both censuses

In collaboration with the National Statistical Office of Malawi IFPRI has now in press a publication entitled *Malawi – An atlas of social statistics* This atlas presents about 70 pages of maps at the sub-district Traditional Authority level on a range of social statistics most of which are drawn from the 1998 national census Household level census data was used to construct the maps

The following is a sample of the maps included in the atlas The data used in producing these maps will also be available for the correlation analysis stage of the research proposed here

Population density
Population growth rate
Sex ratio
Dependency ratio
Mean age of the population
Mean household size
Households headed by women (percent)
Children ever born alive per woman aged 12 years and above
Orphanhood death of at least one parent
Population per public primary health care level facility
Literacy rates for individuals aged 15 to 24 years
Net primary enrollment rates
Gross primary enrollment rates
Mean maximum educational level in households years of education
Ratios of primary school pupils to teachers and primary aged children to teachers
Economic sector of activity for economically active individuals aged 10 years and older
Persons per room in dwelling
Traditional housing percent of population living in such housing
Population acquiring water for household from protected source
Population without toilet facilities
Asset ownership
Mean distance to nearest road & road length per person

Agricultural Extension spatial units

These units are those the Ministry of Agriculture uses to collect food crop production data every year IFPRI has such production data for most smallholder crops levels going back to about 1980 AT the lowest level there are 154 units covering the country

Health and education institutions

A survey of all of the health institutions in the country was carried out in 1998 A wide range of other information is also included in the database In 2001 DfID funded a similar infrastructure survey of all educational institutions in the country IFPRI has both data sets which includes geo-references

Agro ecological zones soils agro climate

Brown Young and Stobbs natural region map of the country at the 1 250 000 scale There are 51 natural regions The data that goes with the natural regions includes topography natural vegetation generalized soil and agro-climate

- the Land Resources Evaluation Project (LREP) maps from the late-80s 1 250 000 scale maps of soils agro-climate zones and land use and land cover (from aerial photography) were produced for the country These two maps were overlaid to create land use units which were then used to generate crop suitability maps Although all of the maps have been digitized from the LREP no national coverage has yet been put together Some coverages are only in raster format with the original vector digitizing files gone missing Possibly some additional digitizing will be required to generate national vector coverages of these maps

  There is also an earlier national soils map at 1 1 000 000 scale that has been digitized This is a modification of the earlier work of Brown Young and Stobbs This is only in raster format

Other coverages

Natural vegetation A 1 1 000 000 scale digital vector version exists

DEM – from EROS Data Center

Hydrography – Coverages at 1 50 000 for the central region and 1 250 000 for the country

Roads –Detailed coverages have been made but some are problematic because of the dated map sheets used Updated coverages have recently been created and could be acquired

Meteorological data – Extensive (250+ stations) set of monthly rainfall and temperature means for Malawi that could be used to create more refined climate surfaces

Constituency and Local Government Ward boundaries

"Livelihoods Information and Mapping" in Kenya
ILRI

1 Background

Under the FAO Netherlands Partnership Programme s (FNPP) Food Security Component support has been granted to the Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS) initiative FIVIMS is a direct follow up of the World Food Summit of 1996 and monitor the number of hungry people in the world In addition FIVIMS also supports ongoing national information system activities relevant to food insecurity and vulnerability to improve the quality of information available in the decision making process by promoting data sharing among partners and conduct of integrated analysis

Under the Food Security component of the FAO Netherlands Partnership Programme the project entitled Integrating FIVIMS into the UNDAF/CCA Process the UN Development Group and the FIVIMS Inter Agency Working Group (IAWG) Secretariat have agreed to use FIVIMS methods and tools to strengthen the Common Country Assessment (CCA) and the UN Development Assistance Framework (UNDAF) at country level with a pilot approach to be developed in Bangladesh and Kenya This Letter of Agreement with the Institute (ILRI) allows the piloting of new methodologies in identifying and characterizing the most food insecure and vulnerable groups

Kenya has been selected as a pilot country based upon the following criteria

1 *Level of poverty and food insecurity* In Kenya, 46% of households live below the GOK determined absolute poverty line and 44% of households are considered to be food insecure each year (GOK Ministry of Finance and Planning 2001) The Government of Kenya is making a concerted effort however to develop the capacity to analyse and tackle these issues and this project will contribute greatly to this capacity building effort in mapping poverty analysis and the development of food insecurity and information mapping systems
2 *Population* Kenya s population is roughly 28 million with around 13 million people living in poverty
3 *Geographical balance* Kenya while unique in some respects is also quite representative of much larger areas of eastern and southern Africa
4 *Availability of information* this project will build upon years of collection of spatial and other databases by ILRI for Kenya and other countries ILRI s Kenya spatial poverty and environmental database coupled with our collaborative poverty mapping project with the Central Bureau of Statistics represents a unique resource upon which to build
5 *Strengthening of CCA/UNDAF process* The CCA/UNDAF country team is an important user group for food insecurity and vulnerability information in Kenya The results of the study will strengthen the information based decision making by the group and assists in populating a common database

6 *Connection with on going initiatives* Kenya is in the start up phase of developing a national Food Insecurity and Vulnerability Information and Mapping System (FIVIMS) that this project will provide critical information to and as a host to 5 Future Harvest/CGIAR centers has many ongoing research activities with multiple local partners relating to better understanding the livelihood strategies of poor households

This project builds upon ongoing ILRI/partner research that is developing fine resolution poverty maps for Kenya These poverty maps are based upon income/consumption measures and are providing a very important first step in better understanding where the poor are This project recognizes that people s well being relates to many more things than just income flows per se and therefore this project aims to develop broader based livelihood maps These livelihood maps will incorporate the income based measures plus different types of livelihood assets that are important to poor households They will capture the underlying ecosystem goods and services (food water biodiversity etc) – the building blocks towards achieving food security and the basis for different livelihood strategies The development of livelihood maps will involve the use new spatial analytical tools and recent high resolution satellite and remote sensing data

This project aims to facilitate different users groups (particularly policy makers) access to more comprehensive information that is up to date and easy to interpret to enhance poverty and food security policy formulation to improve the design and targeting of interventions directed at improving poor people s livelihoods Developing approaches that more holistically define and map livelihoods will allow much more rigorous analysis of the underlying causes and changes that are occurring over time It will also facilitate monitoring of progress in achieving poverty reduction goals through providing focused and precise information about the nature and extent of poverty food insecurity and vulnerability

The objectives of this project are

1 Conduct a half-day workshop with the CCA/UNDAF country team as a key user group to identify information needs
2 Taking a pilot study approach test approaches data requirements and field surveys needed for the development of a food security and poverty information system for Kenya, as a solid input into preparation of CCA
3 Throughout the project provide in service training to a selected number of government staff as part of the high priority area of capacity building possibly participating in the Geo livelihood group sub committee of the Kenya Food Security Steering Group
4 Develop livelihood maps for one pilot district in Kenya (Kajiado district) as input into the next CCA
5 Review approach and results from pilot study with all relevant partners including CCA/UNDAF country team
6 Based on poverty mapping results in pilot district, apply and validate approach in 2 additional districts that represent different livelihood systems

7 Conduct a final one day workshop with all relevant national and international partners including CCA/UNDAF country team to show results of the study and to validate the approach
8 A final report will be prepared explaining all the study results process followed and will provide a number of high-quality easy to understand livelihood maps for Kajiado district and data/maps that are available at that point for the other 2 districts as a solid input into the next CCA

This will be done by taking a collaborative approach that builds upon ILRI s existing spatial databases (e g poverty and livestock systems maps) and explores ways in which to incorporate data and approaches of other institutions that have been involved in defining livelihoods and locating food insecure and vulnerable areas (e g FIVIMS WFP CHANIS FEWSNET)

2 Terms of Reference

2 1 Description of Activities/Services

Activity	Quarter			
	1	2	3	4
1 Conduct half day user information needs workshop (CCA/UNDAF country team)	x			
2 Methods/approaches refinement with partners Meetings	x	x		x
3 Fieldwork Training of partners (e g GPS use) Surveys (e g ground truthing)		x	x	x
4 Information systems data acquisition and development System development Data collation and management Map production	x	x	x	x
5 Application of approach to broader areas Analysis of spatial factors behind community level poverty and exploration of NRM links with poverty/livelihood measures Apply and validate approach in 3 additional districts that represent different livelihood systems			x	x
6 Dissemination efforts In service training to GOK staff in conduct of livelihood mapping Workshop with partners policymakers and CCA/UNDAF country team	x	x	x	x

2 2 Definition of Outputs

The expected outputs from this project will be

Data/mapping inputs into the CCA/UNDAF and PRSP process through a FIVIMS baseline report on Food Insecurity and Vulnerability by December 2002 (The FIVIMS CCA project working with John Owuor and the Kenya national system is responsible for this report It will be primarily prepared by consultants who will analyze existing data One of the sources that should be included in the report are Kenya wide and Kajiado specific maps illustrating potential relationships between patterns of poverty from CBS poverty maps and the overlay of livelihood mapping)

A first set of livelihood maps for Kajiado by April 2003

Action plan for development of similar maps for apply and validate approach in 3 additional districts that represent different livelihood systems

Increased individual skills and capacities within partner institutions to produce livelihood maps and undertake analyses of the driving forces and conditioning factors behind poverty and the critical linkages with natural resource management strategies The first core of a network of African practitioners involved and a selected number of members from the Geolivelihoods sub committee under the KFSSG trained in these methods by 30 September 2003

CDs and web based tools developed and disseminated by 30 September 2003 These will allow a wide variety of decision makers and users to access the spatial databases collated and to carry out simple spatial analyses of their own design for their own purposes

Reports as specified in the LOA final should focus on lessons learned with potential applications to other countries

Soft outputs

An opportunity to introduce these new livelihood maps effectively into Kenyan policymaking and poverty reduction efforts policy maker workshop held by mid 2003

An opportunity to influence and improve the collection analysis and distribution and use of livelihood poverty and food security related data for Kenya and other ILRI partner countries

A better understanding of the relationships between natural resource management strategies and different agricultural systems (e g cash crop/dairy food crop/small ruminants tree crop/dairy goats etc) and livelihood strategies/poverty This is information that is in high demand by policy makers and researchers who are attempting to improve the targeting of interventions (i e technologies policies and institutional development)

In particular this pilot study on livelihood mapping is a contribution by FIVIMS to the following initiatives

- Common Country Assessment process (UN Development Assistance Framework)
- Poverty Reduction Strategy Papers approach (PRSP)
- Millennium Development Goals (MDG)

2 3 Duration and Timing

This project will begin as soon as the LOA is signed (Oct 1 2002) and be completed by 30 September 2003 Timing of activities is shown in section 2 1

2 4 Monitoring and Progress Reporting

A mid term report will be provided by 31 Mar 2002 The progress report should contain
- results from the initial workshop with CCA/UNDAF and PRSP country team
- produce preliminary results of pilot development of livelihood maps
- results of the assessment
- assessment of data requirements for more comprehensive FS and poverty information system
- workplan for next two months on in service training activities

The final report should be completed by end of September 2003 The final report should contain
- livelihood maps for Kajiado district
- relevant data/maps developed to date for Kajiado and 2 other pilot districts available for all partners on CD ROM
- challenges faced in applying approach more broadly across other pilot districts
- summary of all training activities
- reflect on needs from end users like CCA/UNDAF team
- Lessons learned recommendations etc

The final statement (certified as to its correctness by the responsible officer) specifying actual utilization of funds should be received by November 30 2003

3 Inputs to be provided free of charge by the recipient organization

ILRI will contribute inputs valued at a total of $104 000 (see budget for a breakdown)

4 Inputs to be provided in kind by FAO

None

Budget

$99 500 is requested from the FAO/FNPP FIVIMS CCA Project

Items	Year 1 (2002 2003) US $	
	Requested from CSI	ILRI in kind
Scientist input (R Kruska P Kristjanson P Thornton R Reid) R Kruska 2 person months P Kristjanson 1 person month R Reid 1 person month P Thornton 1 person month	50 000	60 000
Technical assistance (full time GIS technician geographer database management programming) GIS technician 12 person months Geographer 6 person months	36 000	24 000
Administrative support	0	20 000
Field related expenses (local travel lodging)	6 000	0
Data purchase (satellite images 5 @ $600 each)	3 000	0
Software (ArcViewGIS @ $1 500) hardware (GIS workstation@ $3 000) reports and CDs	4 500	0
Total	**99,500**	**104 000**

Budget Notes

Scientist input 5 person months per year is requested from FOA, and ILRI will provide an in kind contribution of 6 person months on the poverty/livelihood mapping work (GIS specialist, agricultural economist, agricultural systems analyst) related to other on going activities

Technical assistance support for web-based programming GIS assistance and database management is requested from CSI to a total of 18 person months per year ILRI will provide an in kind contribution of an additional 18 person months to the project

Administrative support the in kind contribution from ILRI will amount to $20 000 in terms of office space and computers and budgetary and secretarial support

Local travel some CSI support for local travel within Kenya is requested primarily for data gathering and ground truthing

Data purchase some data layers may either need to be purchased outright or (more likely) assistance will be given for data collation and/or digitization

Software Hardware Reports and CDs some CSI support is requested for purchasing a GIS workstation and software for the GIS technician as well as for printing reports and making CDs

6 Monitoring/Certifying Officer David Wilcock FIVIMS Coordinator FAO-ESD Executive Secretary IAWG FIVIMS (or replacement)

Mapping and Analysis of Poverty and Food Insecurity in Bangladesh
IRRI

Our Ref Your Ref

LETTER OF AGREEMENT

Provision of funds from the Food and Agriculture Organization of the United Nations to the

International Rice Research Intitute (IRRI)
Los Banos Republic of the Philippines

(PR number)

Annex 1 Terms of Agreement

Annex 1 Terms of Agreement

Title "Mapping and analysis of poverty and food insecurity in Bangladesh"

1 Background

Under the FAO Netherlands Partnership Programmes (FNPP) Food Security Component support has been granted to the Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS) initiative FIVIMS is a direct follow up of the World Food Summit of 1996 and monitor the number of hungry people in the world In addition FIVIMS also supports ongoing national information system activities relevant to food insecurity and vulnerability to improve the quality of information available in the decision making process by promoting data sharing among partners and conduct of integrated analysis

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Bangladesh with a population of 129 million (based on 2001 Population Census) and a population density is 880 persons per km^2 faces acute pressure on its land resources About 80% of the population in Bangladesh is rural and lives off the land and the natural resources are already overexploited The incidence of poverty is still high (head count index of 47% in 2001) despite some improvement particularly over the past decade (down from 59% in 1998) The country remains highly vulnerable to floods and typhoons As succinctly summarized by Sen (2000) the presence of rather strong geographic effects on poverty cannot be ignored In particular one needs to go beyond division or district to identify pockets of severe distress i e areas which are more vulnerable to widespread starvation and intensified destitution during bad agricultural years and/or during the routine lean period even during a normal agricultural year

The relationship between agricultural development and poverty is not a straightforward one Various trends have been observed which favour or worsen the livelihood conditions of the rural population that depend on agriculture

1 The arable land base is very low at 0 075 ha per person and farm sizes have declined from an average of 1 4 ha in 1960 to 0 9 ha in 1998 and 0 7 ha in 2001 Studies have shown a close correlation between poverty and land endowment
2 There have tremendous impact of rural infrastructure and new agricultural technologies on improving productivity hence compensating for small land holdings by increased intensification

3 However income from crop production has remained stagnant due to the adverse terms of trade of crop products the moderate growth in agriculture achieved over the past decade is mainly from non crop agricultural sectors
4 The mobility of rural labor from agriculture to non farm activities and the additional non farm income earning opportunities have benefited resource rich households

The general implications on the role of the crop sector in alleviating rural poverty and improving food security are that interventions should target at releasing land and water resources for agricultural diversification and releasing labor resources for rural non farm activities Because the influence of each of the above factors varies spatially there is a need for more careful geographical targeting of agricultural research development and extension (R&D&E) interventions particularly to reach the rural poor The objective of this Project is to develop methodologies and digital geo referenced sub national data sets that allow more comprehensive analyses of the relationships between human well being and geographical factors in areas where the poor concentrated thereby improving the targeting of R&D&E programs

2 Terms of Reference

The objectives of the Project are to

i) Develop methodologies to compute various economic and non economic indicators of human well being that can be comprehensively mapped at *upazila* (sub district) level These include methodologies for (a) assessing natural resource endowment risks and vulnerability that influence agricultural productivity (b) computing objective measures of physical accessibility (c) improving small area estimation of income poverty by building on existing approaches particularly augmenting with GIS based techniques that enable the use of area characteristics besides household characteristics and (b) comparing the statistical estimation with participatory stakeholder scoring of key indicators of human well being It is expected that these methodologies would allow more precise identification of where the rural poor are concentrated in Bangladesh
ii) Characterize the biophysical and socio-economic (with emphasis on engagement in agriculture) features and carry out spatial analysis to determine relationships between income poverty and other dimensions of human poverty geographical and environmental factors for a better understanding of why spatial poverty traps occur
iii) Identify policy and agricultural R&D&E interventions that take into consideration geographical differences in the potential for exploiting the natural resource base for enhancing agricultural productivity versus strategies for diversifying livelihoods

Emphasis will be given to rural poverty as the rural poor are largely dependent on agriculture for their livelihoods and for food security The Project will constantly involve national counterparts when appropriate in defining research needs methodology and database development and interpretation of the results Emphasis will be given in

capacity building in the form of in service training to enable the relevant national agencies to continue keeping the databases live and to use the products from this Project

The Project will complement other similar on going efforts at improving the mapping of human welfare in Bangladesh principally the national FIVIMS project and the World Food Program s Vulnerable Group Development activities In addition the Project will have the active involvement of national agencies that are doing comprehensive mapping of physical infrastructure and agro ecological mapping development of the GIS based Country Almanac for Bangladesh agricultural research prioritization as well as policy analysis related to the Poverty Reduction Strategic Paper (PRSP) and the Chronic Poverty Study for Bangladesh The outputs of the Project will therefore enter into the various national databases to be used for supporting policy formulation

2 1 Description of Activities/Services

Consultation meetings planning and methodology workshops have already been held by IRRI in 2002 with various national agencies that have interest and stake in the Project including the Planning Commission (the national FIVIMS focal agency) and the Bangladesh Institute for Development Studies (BIDS) which is responsible for the PRSP for Bangladesh The Project has received strong support from the key agencies that it will involve If needed IRRI will conduct a workshop with the CCA/UNDAF country team to review the study design and the initial steps that have been taken with agencies that are directly involved in the Project Specific research and product development activities of the Project are outlined below

I Methodology and database development

In order to develop and map various indicators of the key factors affecting the well being of rural populations both economic and non economic a suite of methodologies need to be developed

a Natural resource endowment and vulnerability
With the involvement of the Bangladesh Agricultural Research Council (BARC) the Project will use the comprehensive GIS based climatic and soils database created under BARC s UNDP funded project on Utilization of Agroecological Zones Database for Agricultural Development to develop methodology for mapping composite soil fertility and climatic risk indicators to reflect the natural resource endowments of rural populations Agriculture related data (including area production prices of inputs and outputs labour wage rates) will be compiled at *upazila* level from various sources (including the 1996 Agriculture Census and other statistical compilations of the Bangladesh Bureau of Statistics and the Department of Agricultural Extension) and combined with demographic related data (from the 2001 Population Census) to derive measures of agricultural productivity Spatial statistical techniques will be applied to analyze the relationship of productivity factors with the resource endowment socio economic and risk factors for profiling the agricultural production characteristics of *upazilas* These analyses would provide additional dimensions to BARC s AEZ project and the resulting mapped indicators would add to the GIS database of BARC which would

be of use to various agricultural agencies through the Country Almanac that BARC is developing with the assistance of CIMMYT

b Physical accessibility

The Project will involve the GIS Unit of the Local Government and Engineering Department (LGED) in using its comprehensive road and social infrastructure database and developing methodology to compute and map various physical accessibility indicators at different spatial scales to estimate local level (shorter travel range) and regional/national level accessibility Accessibility indices will be computed from origin destination travel costs between settlements and the various facilities that provide economic social and health services (e g markets health centres schools) are calculated taking into consideration road length and quality as well as location and quality of services This analysis also serves to demonstrate how the rich infrastructure database of LGED can be used to derive and map accessibility measures for planning and geographical targeting of infrastructure development and upgrading programs to benefit the most disadvantaged rural areas

c Economic measures of poverty

As income data (direct economic measure of human well being) are not readily available at spatially disaggregated levels comprehensively over the entire country the Project will build upon approaches developed for small area estimation of poverty (i e estimate the incidence of poverty in small administrative areas such as districts sub districts)

i *Statistical approach using regression analysis linking household sample survey data with geographically comprehensive data*

Data from nationally representative sample surveys on household income (such as the 2000 Household Income and Expenditure Survey and the IRRI/BIDS socio economic survey of households from 62 villages in 2000 01) will be used to estimate the functional relationships linking household income or probability that households are poor with key household community and area variables (examples listed in Table 1 of the Appendix) that significantly contribute to the variance among household incomes The outputs from (a) and (b) above and other relevant GIS map layers that will be sourced will provide the area characteristics The functional relationships are then used to estimate poverty incidence at *upazila* level for the entire country and the results mapped

ii *Participatory stakeholder scoring of key indicators of human well being to derive a multi dimensional measure of poverty*

A set of statistically significant and mutually independent explanatory variables determined from the functional relationships in the statistical approach will be selected and their corresponding measures/indicators mapped and presented to a group of stakeholders who will be asked to rank the indicators based on their perceived importance of these variables Their scores will be used for computing weighted combinations of the selected indicators which may be considered as multi-dimensional poverty indices

While Approach (i) would provide a formal and statistically more robust basis for estimating poverty incidence it may be argued that the stakeholder scoring approach (ii) has greater local relevance By analyzing and juxtaposing the spatial patterns of poverty incidence obtained from the statistical approach and the stakeholder scoring approach we can identify where discrepancies occur which are likely candidates for mistargeting of poverty alleviation programs

II Analysis of spatial pattern of rural poverty

Spatial analysis will be carried out of the various poverty indices to identify clusters of contiguous poor communities using global and local measures of spatial auto correlation These clusters would constitute pockets of high poverty incidence

III Determination of implications for agricultural R&D&E interventions

By focusing on specific areas of high poverty incidence some qualitative analysis will be made of the nature of constraints faced by the communities where opportunities for improving agricultural productivity have not been fully realized and what technological policy and fiscal interventions are needed to do so The results of the analysis and interpretation of policy implications will be discussed with key policy making institutions in Bangladesh

IV Capacity building of national partners

In carrying out the above activities there will be substantial efforts at developing spatially coherent multi thematic data sets from a variety of sources and consolidating these within a GIS platform (Table 2 in the Appendix lists the main data sets and their sources) Various GIS techniques (e g spatial interpolation accessibility analysis) will be used to generate mapped indicators for various dimensions of human well being – economic non economic resource endowment vulnerability and accessibility In working together with national partners the IRRI research team will share and transfer knowledge and skills through workshops and training both in country and at IRRI

Recognizing that other projects principally the national FIVIMS project and the Vulnerability Analysis and Mapping project of the World Food Programme are also undertaking mapping of the various dimensions of human welfare food insecurity vulnerability – for various purposes we will work towards closer collaboration with these projects where possible to exchange ideas establish common data formats and protocols The data outputs from the Project will be made available not only to the national FIVIMS project but also to our partner national agencies for their use as may be appropriate beyond the scope of this Project

2 2 <u>Definition of Outputs</u>

1 A GIS based electronic atlas comprising integrated geographically referenced data sets such as the following
   i Key indicators/measures for various dimensions of human well being that are used for estimating poverty incidence These would include

- community based indicators mapped at district and sub district levels for a variety of variables relating to human resources physical assets production systems etc and
- area based indicators mainly maps of environmental and physical factors such as agro climate agronomic constraints and physical accessibility

ii Maps of estimated poverty indices

The electronic atlas will have simple map making and statistical summary tools The geo referenced data and mapping tools will be made available to participating and interested agencies in appropriate formats (CD ROM web based) depending on client preference It is expected that the data set will contribute towards a more comprehensive national FIVIMS database Wider and free distribution of officially sanctioned data outputs through the Internet will be coordinated with the FAO/UNEP/CSI project

2 A suite of methodologies for generating geographically referenced single indicators and composite poverty indices and for analyzing spatial patterns of and relationships between poverty incidence and various agrarian characteristics

3 Implications derived and guidelines determined for (a) targeting key policy and agricultural R&D&E interventions where the poor are concentrated (b) establishing priorities among alternative poverty alleviation measures and (c) improving the design of these programs to enhance their impact on the livelihoods and food security of the poor

A final one day workshop will be held with all relevant national and international partners including the Local Consultative Group country team to present the results of the study and validate the approach with a range of key stakeholders

A final report will be prepared detailing the study results methods and processed followed and making recommendations for continued mapping activities in Bangladesh It will provide a number of high quality easy to understand poverty maps as a solid input into the preparation of the next CCA/PRSP

2 3 Duration and Timing

12 months starting from the signing of the LOA

1 4 Monitoring and Progress Reporting

a) The Recipient Organization shall submit to Mr Maarten Immink, FIVIMS Coordinator a i (ESDG) at FAO a mid term progress report no later than 31 May 2003 *(or the end of the 5th month from the signing of the LOA)*
b) The Recipient Organization shall submit to coordinator Mr Maarten Immink FIVIMS Coordinator a i (ESDG) an itemised statement of expenditures (certified by the Chief Accountant or similar officer of the RO) prior to receiving final payment for the works/services performed
c) The Recipient Organization shall submit to Mr Maarten Immink, FIVIMS Coordinator a i (ESDG) a final report within 3 months following the completion

of the project foreseen in December 2003 *(or 12 months from the signing of the LOA)*

d) The Recipient Organization shall submit to Mr Maarten Immink FIVIMS Coordinator a i (ESDG) a final audited statement of accounts showing the utilization of funds as determined under this Agreement within 6 months following the completion of the project If the legal status of the Recipient Organization precludes the provision of audited financial statements a statement certified as to its correctness by the officer responsible for maintaining them will be provided In such cases the Organization shall have the right to review the relevant records

3 Inputs to be provided free of charge by the Recipient Organization

The following are provided by the Recipient Organization in kind

i Research expertise and project coordination

Personnel	**Person year**
Project coordinator & Principal Scientist (IRRI)	0 60
Senior Economist (IRRI HQ)	0 15
Project Scientist (IRRI HQ)	0 75
Research Assistant (IRRI HQ)	0 75
IRRI Bangladesh Liaison Scientist (IRRI Dhaka Office)	0 05
Technical Assistant (IRRI Dhaka Office)	0 05

ii Research data and statistics

- Data from an IRRI conducted detailed household socio economic survey on a nationally representative sample of 62 villages in 2000 01 Estimated cost of the survey is $200 000
- Various data sets compiled from statistical and survey reports that provide additional information pertinent for estimating indicators of human well being in Bangladesh
- Various geographical data including soil maps and climatic data to be used for generating area characteristics

iii Laboratory facilities

Geographical Information Systems (hardware peripherals and software) at the IRRI GIS/IP Laboratory

iv Project start up expenses since April 2002

- IRRI staff travel to Dhaka (three trips involving three scientists)
- Holding of three meetings and workshops with stakeholders and national partners
- Purchase of data from various national agencies including the detailed 1996 Agricultural Census data
- In service training of national collaborator at IRRI

4 Inputs to be provided in kind by FAO

None

5 Monitoring/Certifying Officer

Maarten Immink, FIVIMS Coordinator a i FAO ESD

Appendix 1

Table 1 Main household, community and area characteristics for estimating income poverty categorized by asset groups

Assets	*Household level*	*Community level*	**"Area" based**
Natural	***Land quantity & quality***		Land & soil quality Climate related Hydrology related Natural disaster events Special problems (e g arsenic in water)
Human	***Demographics*** Labor force Education related Health related		
Physical	***Housing quality*** ***Transportation means*** Agric equipment	 ***Public transportation services*** Educational services Electricity supply Irrigation facilities Markets	Accessibility related Road accessibility To urban centers To markets
Social	***Political connections*** Social status	***Extension services*** Information network Health services	

Table 2 Main data sources

	Data source	**Description**	**Geo-referencing**	**Source agency remarks**
A	Household level socio-economic sample surveys	2000-01 household survey of 62 nationally representative villages	Sub-district	IRRI
		2000 Household Income & Expenditure Survey (HIES)	Sub-district	Bangladesh Bureau of Statistics (BBS)
		1999 Poverty Monitoring Survey	21 region	BBS
		1998 Local Level Development Monitoring Project survey	64-district	BBS
		2000 Demographic & Health Survey	Sub-district	Mitra & Assoc DHS+
B	Censuses	1996 Census of Agriculture	Sub-district	BBS (officially released at 64-district level)
		2001 Population Census	Sub-district	BBS (presently only preliminary counts available at 64-district level)
		1996 Irrigation Census	Sub-district	Ministry of Agriculture (NMIDP)
C	Mapped data	Administrative boundaries	Sub-district	Local Govt & Engineering Dept (LGED)
		Road infrastructure	Vector	LGED
		Irrigation infrastructure	Vector	LGED
		Markets, social infrastructure	Vector (point)	LGED
		Soil (with attributes)	Vector	Soils Resources Development Institute (SRDI) updated maps digitized for 300 out of 464 sub-districts
		Agro-ecological zones	Vector	Bangladesh Agricultural Research Council (BARC)
		Land use and cropping systems	Vector	BARC
		Agro-climatic zones	Raster	BARC
		Climatic data	Point	Bangladesh Meteorological Department (BMD)

	Hiera chy of Objecti es	Objecti ely Verif able Indicators	M fV fc t on	As mpt o s a d Risks
GOAL	All vi t g poverty f food nsecure and vul erabl pop l t ns through underst d g th irc m tan wh re they ar co t ted			
PURPOSE	Strat gi de t f ed f imp ed g graph cal targ t g f programs t cel rat ex t p ths f m poverty	K y t nal g ad pt and use th l tro tlas f h man well be g as an aid f mpl m t g and m t g po rty ll t program	Pr gre ports f th tudy H t t W b t S b pt t CD-ROM Part p t dat base pdat g Ag y rep rts	Th k y mpl m t g ь y d rtak t oord nat tw rk f dat tod g for d t pd t g b y nd th durat f th pr j t I t rag y pe ss d t har g
OUTPUTS	1 Ar as de t f ed wh re th poor and food nsecure populations are concentrated, and relati nsh p with patial poverty traps d term ed 2 C t devel ped f determ g p t f poverty ll iat and food se urity program part larly for targ ting k y p l y and agri ltural R&D terve t ns where th poo are e ce trat d	1 A GIS-based lectr atlas (with use nt rf and dat man p lat tool) that l des - int grated data sets sed t stimat measure f h man well being and - maps at th bnat nal l l pl tly h w g th sp t al d t b t f po rty and vul rab l ty 2 Comparat ve vide ce f correspo d th rank g of poo and food nse ure areas us g loc l pert p and t t t l naly is f rv y d ns d t 3 Cl t f d mp m t tern and gu d l f r ge graph l targ t g f po rty ll viat nd food se urity prog am prese t m thods d	At th d f the tudy pe d fun t nal GIS based lectr tlas h man well b g nstall d at key nat nal mpl m t g g CD-ROM f th dat sets di trib t d t the l vant g W b t co ta g m t databas and perm ss bl dat sets (compat bl f rm t w th CSI W b b ed GIS) va l bl f p bl w g R lt f p tizat f poo and food ecur areas pre t d t rel t mpl m t g thro gh ns l t w ksh p and d g t l and p ed p rt Key perso l f m rel vant ge tra d us g the lectro tl	Cooperat from m ustod an g pplyi g dat t h gh l vel f d saggreg t Agreem t h ved fr m dat t b t g g l l f t da set C mm tm t fr m mpl m t g g y t pport d m t th l t tlas
ACTIVITIES	1 R f an ly d gn and d l p dat base d gn 2 Devel p cons ltat w th stak holders vari us (and lt rn t) measur s/ d cat rs f poverty and vuln rab l ty f rel an t loc l d t ns 3 C llect process and gan ze th rel va t data sets eq red f mp t g sel t d m asur 4 Map th p tial in d ce f po rty and food nse ur ty us g the tw d ff t ppro h (d bed p p sal doc m t) 5 *U th analysis framework and m ps t devel p g del f sel t g gri ltural R&D&E pr j t and pr gram that an h th g eatest mpact po rty d f od secur ty*			

Food Insecurity and Poverty in the Ruhuna Benchmark Basin in Sri Lanka Mapping Indicators for Analyzing the Dynamics of Temporal and Spatial Variability for Identifying Future Policy Interventions and Resources Allocations
IWMI

SUMMARY

IARC International Water Management Institute (IWMI)

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Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI) 114 Wijerama Mawatha, Colombo 7 Sri Lanka HARTI is a leading national research organization in Sri Lanka The institute functions under the Ministry of Agriculture and Livestock Development and conducts research on social and economic issues and policy options relating to agriculture and rural development in Sri Lanka

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ABSTRACT

This proposal is for a case study to develop and test effective methods for locating and characterizing poverty and food insecurity in Sri Lanka The study will to contribute to the CSI/FAO/GRID Poverty Project to develop innovative methods and techniques for analyzing the temporal and spatial dynamics of food insecurity and poverty The analysis

will be carried out at two levels First at the national level where an attempt will made to develop a GIS based system for mapping indicators of food insecurity and poverty on a country wide basis At this level the basic unit of analysis will be administrative districts The second level of analysis will attempt to develop indicators to map poverty and food insecurity in river basins The major reasons for selecting river basins as the basic geographical domain for mapping poverty and food insecurity are a) the crucial role water plays in poverty alleviation and food security at the household level b) the widespread recognition of river basins as the most appropriate unit for developing and managing water resources The principal research questions addressed in the study are a) What are the spatial patterns of food insecurity and poverty in Sri Lanka and what processes lie behind the patterns? b) To what extent is differential access to water have a bearing on poverty and food insecurity The methodological challenge of the study is the creative use of data collected from administrative boundaries for locating and characterizing poverty and food insecurity in river basins

DURATION OF PROJECT Two years

TOTAL COST OF THE PROJECT

Total estimated costs of the project = US$80 000

Contributions to the project from the respective agencies will be as follows

1	Amount requested from CSI/FAO/GRID poverty project[3]	=	US$30 000 00
2	Contributions from IWMI	=	US$45 000 00
3	Contributions in kind from IWMI/HARTI	=	US$5,000 00
	Total	=	US$80,000 00

[3] (US$15 000 per years for two years)

Project Title Food Insecurity and Poverty in Sri Lanka Mapping Indicators for Analyzing the Dynamics of Temporal and Spatial Variability for Identifying Future Policy Interventions and Resources Allocations

Introduction

Sri Lanka s record of improving the quality of life of its population is well documented For a low income county Sri Lanka s achievement in some areas of human welfare such as health and education has been described by many observers as remarkable In 1999 life expectancy at birth of 73 years was higher than the world average of 66 years (World Bank 2002) [4] The mortality rate of children under 5 years (19 per 1 000 live births) is about half the rate of upper middle income countries (World Bank 2002) An adult literacy rate of 91percent is higher than the world average of 73 percent %(UNDP 2000)[5]

Despite these achievements in social welfare poverty continues to be a major problem in the country Some 25% of the population are below the national poverty The majority of the poor live in rural areas are dependent on agriculture for their livelihood According to a World Bank estimate (World Development Report 2002) only about 7 percent of the population are below the international poverty line of population living on less that one dollar a day But about 45 percent of the population live on less than $2 per day Evidence from a number of surveys indicates indicate a high incidence of undernourishment amongst young children Data also indicate some 43 percent of the population lacked access to safe drinking water while 37 percent lacked access to sanitation In terms of food security the average daily calorie (2004 Kcal) and protein supply (53 grams) per person are much below the average levels for developing countries (2 600 Kcal and 70 grams respectively) The daily calorie supply of a substantial proportion of the population is even below the minimum nutritional requirement of about 2 250 Kcal per day

Poverty and food security in Sri Lanka as in most other countries is diverse phenomena with considerable spatial variability According World Bank statistics (WDR 2002) in the survey year 1995 96 about 27% of the rural population and 15% of the urban population are below the national poverty line

Recent estimates made by the Department of Census and Statistics show that administrative districts in which the irrigation schemes are largely concentrated have recorded significant reduction in poverty levels between the two recent inter census periods In contrast districts where rain fed farming predominates have recorded an increase in the poverty level

There is a clear need for locating and characterizing the poverty spatially within the country and within sectors Undifferentiated social welfare programs have proved to be very costly in budgetary terms Moreover such transfer programs disproportionately

[4] World Bank, 2002 World Development Report 2002 New York Oxford University Press
[5] UNDP 2002 Human Development Report 2002 New York Oxford University Press

benefit the non poor There is an urgent need for improved methods for reaching the poor and derive maximum benefits from allocating resources for poverty alleviation

The proposed study will contribute to the CSI/FAO/GRID project on poverty mapping aimed at developing innovative methods and techniques for analyzing the temporal and spatial dynamics of food insecurity and poverty The more specific aim is to conduct a GIS based poverty and food security analysis in Sri Lanka

Problem Definition

There is clear evidence of substantial spatial variations in poverty and insecurity in Sri Lanka According to the Human Development Report three districts perform well both in terms of human development and a lower incidence of poverty [6] All other districts perform poorly in either of these indices or both The spatial variation in poverty is attributed to differences in economic opportunities and performance among the districts

At present most poverty and food insecurity information at sub-national level in Sri Lanka are analyzed and presented for larger administrative areas Some of them are at a coarse resolution of district boundary levels and some are at a relatively finer resolution at divisional secretariat level Hence most poverty alleviation and food security programs at present are targeted at the district or divisional secretariat level However these areas cut across several river basins where natural resources endowments especially the availability of water resources vary substantially over space and time Given that 75 percent of the present population is rural and most of them depend on agriculture for their livelihood water plays a crucial role in any attempt to improve food security and alleviate poverty At the same time increasing scarcity of water and mounting competition from non agricultural sources means that there will be less water available for food production and improving livelihoods of the rural poor Thus pro poor interventions require a good understanding of the relationship between water and poverty so that strategic poverty reduction interventions can be identified

It is now accepted that a a river basin is the most appropriate unit for developing and managing water resources especially as water availability at the basin level becomes the primary constraint to agriculture Given the crucial role of water in the poverty alleviation and food security considerations this study will analyze the spatial patterns of poverty and food insecurity in river basins

Within a river basin hydrologically homogeneous areas called hydronomic zones will be identified [7] Hydronomic zones allow us to better understand complex hydrological interactions with basins and help us to define characterize and develop water management strategies for areas with similar hydrological characteristics Most economic activities within hydronomic zones are often spatially correlated Therefore the

[6] The three districts are Colombo Kalutara and Gampaha which are the more urbanized districts (National Human Development Report, 1998 UNDP Sri Lanka)

[7] Hydronomic zones are defined as hydrologically homogeneous areas in a basin for which similar recommendations can be made

causes effects and spatial dependence of poverty and food insecurity in hydronomic zones can be relatively easily identified In turn these can be used for better targeting of interventions for food security and poverty alleviation programs

Research Questions

The key research questions that will be addressed in the study are a) Who are the poor and where are they located in the river basin? b) How does the spatial distribution of the poverty and food insecurity vary across the administrative districts in the country and in different hydronomic zone and major farming systems in the basin? How does differential access to water in a river basin determine people s choice of production systems and how does their choice affect poverty and food security? d) What type of land use crop choices and cropping patterns should be promoted in hydronomic zones where the poor are concentrated? e) What water management strategies should be adopted to improve poor people s access to water for domestic and productive purposes?

Analytical Framework

The analysis will be carried out at two levels At the national level and at the river basin level The objective of the national level analysis is to identify spatial patterns of food insecurity and poverty by administrative districts for the country as a whole There are 22 administrative districts in the country The analysis will be based on secondary data, primarily from population census compiled for each district by the Department of Census and Statistics The basin level analysis will be a more rigorous analysis of poverty and food insecurity in a single river basin Within the basin the geo referenced unit of analysis will be a Grama Niladari division[8] (GND) The analysis will be based on census data available at the GN division level and will be supplemented by primary data by through socio economic surveys and other data collection methods

Study Site

The *Ruhuna Benchmark Basin*[9] (RBB) will be selected for the basin level analysis The RBB consists of 9 river basins (see Figure 1) and covers an area of about 5 581 square kilometers The total population in the basin is 1 25 million The three largest river basins Kirindi Oya Walawe river and Menik Ganga represent three different stages of development The water resources of the Kirindi Oyabasin are fully developed and utilized This basin often faces seasonal water scarcities Walawe river basin is intermediately developed The Menik Ganga basin is underdeveloped

Approach to Poverty and Food Insecurity Mapping

Four major steps are proposed for the mapping of poverty and food insecurity

1 Data needs assessment, data collection and/or estimation at different spatial scales

[8] A GN division is the smallest administrative unit in the country About 250 families live in each GND

[9] The Ruhuna Benchmark Basin is considered as a field laboratory for IWMI s research in Sri Lanka

2 Mapping data in a GIS and Statistical Spatial Data Analysis (assessment of spatial distribution of poverty and food insecurity and identification of their relationships with socioeconomic and other variables

3 Vulnerability analysis and mapping

4 Communication strategy (devising a communication strategy to inform the results of the study to an audience within and outside the country)

Data Identification Collection and/or Estimation

The study will use data from multiple sources and at different scales of aggregation Some of the data at household level are available from the population census (the most recent census in Sri Lanka was conducted in 2001) These are aggregated to obtain information at GND level Information available only at the GND level will be obtained from the respective GND offices Data at the river basin level will be obtained from the databases for RBB available with IWMI Agro climatic data are available from the IWMI GIS/remote sensing laboratory database and the Department of Meteorology of Sri Lanka Data on the socioeconomic situation food consumption and nutritional status are available from different sources Some of these are the household consumption and expenditure survey by the Census and Statistics Department (the most recent one was held in 1995) the 2001 socioeconomic survey conducted by IWMI on infrastructure development and poverty alleviation

1 Population census data will be used to obtain the following information at the administrative district and GND level The data is available at the Department of Census and Statistics

Demography

- Population and population density
- Population distribution in term of rural urban and estate population
- Household size
- Sex ratio
- Age structure
- Ethnicity
- Religion
- Economically active population
- Migrant population (% of total)

Human Development

- School enrolment rate including enrolment at institutions of higher learning
- Literacy rate
- Type of employment type
- Male and Female participation rates

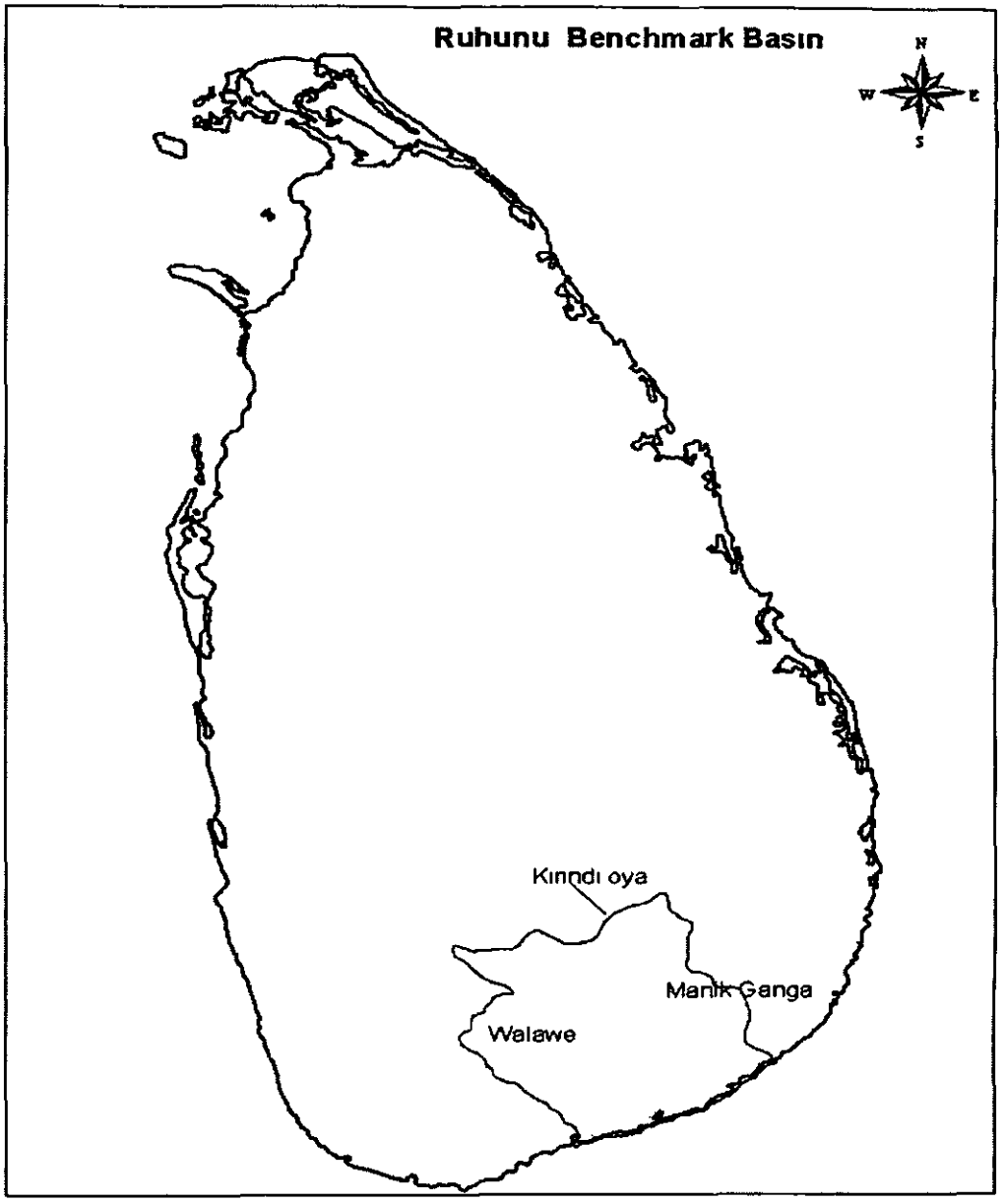

Figure 1 The Ruhuna benchmark basin

Housing and Basic Amenities

- Type of housing
- Availability of toilet facilities
- Source of drinking water
- Type of lighting
- Type of cooking fuel

2 The following secondary information on infrastructure is collected at GND level (*Source* GND offices)

- Road density
- Number of schools
- Number of teachers
- Number of marketing centers
- Number of health service centers
- Number of trained health care personnel (serving midwives)

3 The following information will be obtained (extracted) at GND level (*Source* IWMI remote sensing/GIS lab Meteorological Department of Sri Lanka)

- Elevation
- Rainfall (average 50% and 75% exceedence probability rainfall and time series)
- ETp (potential evapotranspiration)
- Temperature (average and time series)
- Water availability (surface water and groundwater)
- Soil type and quality
- NDVI (last few seasons)
- Land use types
- Malaria risk maps

4 The following secondary information at GND level will be obtained from different socioeconomic surveys Where the required data are not available primary data are expected to be collected (see details below)

- Income generating activities and average income
- Expenditure
- Cropping patterns and crop productivity
- Crop production and consumption

Statistical Spatial Data Analysis and Mapping

In rural areas most households have multiple sources of income It is hypothesized that vulnerability of households to poverty and food insecurity is inversely related to the number of income generation activities of the household (figure 2) The study will analyze the spatial variations and the nature of various income earning activities of households within a river basin Within each hydronomic zone of the basin the dominant farming systems will be identified The dominant farming systems will form different strata for the statistical data analysis

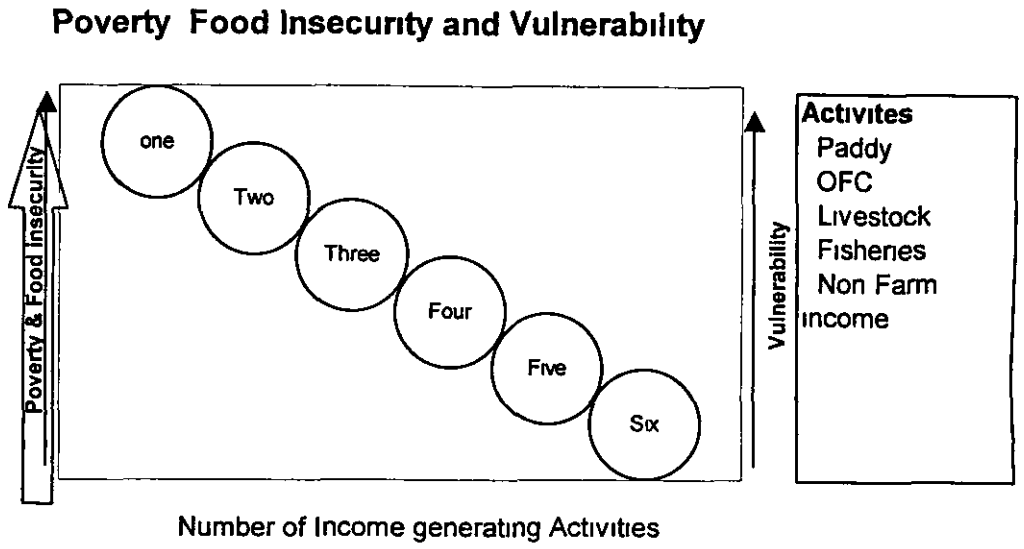

Figure 2 Poverty food insecurity and vulnerability

The statistical spatial data analysis consists of both univariate and multivariate data analysis The analysis will improve the understanding of the locational and relational characteristics of poverty and food security within and between GNDs (and hence within and between hydronomic zones and within river basins etc) and within and between different income generation activities

The univariate analysis consists of

- estimating summary measures such as means medians variances etc
- plotting summary measures (histograms etc)
- identifying homogeneous/heterogeneous spatial units or different income generation methods etc with respect to the above summary measures
- identification of local patterns spatial trends of poverty and food insecurity indicators and other attributes
- assessing spatial auto correlation of poverty and food insecurity measures and other attributes

The multivariate analysis consist of

- bivariate correlation analysis of poverty and food insecurity measures with socioeconomic variables and other attributes
- regression analysis for identifying the extents of the contributions of socioeconomic and other attributes to poverty and food security (spatial auto correlation of residuals of the regressions are estimated for validating the model Spatial auto-correlation is assessed through statistics such as Moran s I and Geary s C)

The GIS would includes maps of

- poverty and food insecurity measures (quantitative) and levels (low moderate high and very high etc)
- socioeconomic and agro ecological information which is significantly related to poverty and food insecurity
- a visual information system based on regression models to look at different scenarios of poverty and food insecurity with respect to the changes in different explanatory (link) variables

Vulnerability Analysis

In this analysis we assess the degree of vulnerability of households to poverty and food insecurity with respect to the shocks and/or fluctuations of the internal and external factors of different spatial units Internal factors are demographic factors water availability both for production and household purposes income generating systems (including the production system) etc External factors such as input cost prices government policies etc are estimated here The vulnerability of household will be determined by assessing the probability of a selected welfare measures e g incomes consumption deviating from the norm i e a community agreed upon minimum level

Maps depicting locations of household units that are vulnerable to transient and chronic poverty will be generated

Communication Strategy

The GIS information base and the analytical reports will be displayed in the websites of IWMI and HARTI The results of the mapping study will be presented at workshops and seminars that will be arranged for policy makers of Sri Lanka

Methods

The project proposes to use Arc/Info and Arcview GIS software packages Four broad poverty measures will be used a) economic measures that include monetary measures of household well being b) social or non monetary indicators c) demographic indicators and d) vulnerability measures Measures of food insecurity will include a) the national balance sheet b) direct measures of consumption and c) outcomes of nutritional status

The study will make use of data from a variety of government and non governmental agencies including international agencies such as the country offices of the World Bank and the Asian Development Bank Where necessary secondary data will be supplemented with data collected through participatory appraisal and formal questionnaire surveys

Beyond visual spatial analysis of poverty the study will employ diverse methodologies to establish the causes of poverty Such methodologies will range from

the application of participatory rural appraisal techniques to using appropriate econometric analysis variables derived from poverty mapping

Goal

The goal of the project is to contribute to increasing food security and poverty alleviation in Sri Lanka by advancing scientific frontiers in assessing and effective targeting of poverty and food security interventions

Objective

The objective of the study is to develop a GIS base to analyze the spatial and temporal dynamics of food insecurity and poverty in Sri Lanka

Outputs

The major outputs of the project are

1 A comprehensive assessment of the temporal and spatial dynamics of the food security and poverty situation in Sri Lanka
2 Development of protocols for interpretation of various poverty and food security indicators and mapping products
3 A multimedia platform including a GIS based system of mapping indicators of food security and poverty in Sri Lanka, which serve as tools for policy makers and others interested in food security and poverty in Sri Lanka

Activities

The following major activities are expected to deliver the above outputs

1 A thorough literature survey of past research on identifying and analyzing indicators on spatial dynamics of food security and poverty of different countries
2 Identifying appropriate indicators for food security and poverty at different spatial unit levels and appropriate indicators of factors which are related to temporal and spatial dynamics of food security and poverty in Sri Lanka
3 A small workshop of personnel of IWMI the local partner organization of the Department of Census and Statistics and other appropriate agencies for identifying the data available at different spatial unit levels
4 Secondary data collection and computing the indicators at different spatial units
5 Primary data collection where required and computing appropriate indicators
6 Storing indicators in a GIS system and creating maps
7 Analysis to identify the linkage between exogenous factors and their impacts on food security at the macro level and at the household level Development of a decision support system/scenario building model for developing policy interventions and making resource allocation decisions for food security and poverty alleviation
8 A workshop with local organizations to demonstrate the decision support model
9 Developing a multi platform media (web page CD published reports) to serve as a tool for the policy makers of Sri Lanka and others interested in food security and

poverty issues in Sri Lanka Preparing a thematic map showing the degree of severity of the poverty level which can be used to identify priority areas for corrective actions

Beneficiaries and Impacts

The immediate beneficiary is the CSI/FAO/GRID poverty project Outputs 1 2 and 3 would provide deliverables as mentioned in the call for the project proposal document These include

1 Three biannual reports (after 6 months 12 months and 18 months respectively) will be published in the poverty net on the ongoing development of the projects including the methodology obstacles successes and new insights gained
2 Final report of the project including the analysis of factors and their linkages to the temporal and spatial dynamics of the food security and poverty in Sri Lanka
3 A CD/web page including written reports on the analysis of food security and poverty of Sri Lanka a bibliography and links to resources related to the project maps and key variables and indicators related to food security and poverty in Sri Lanka, mapping interface that provides viewing and query facilities in GIS on food insecurity and poverty

The other immediate beneficiaries are the policy makers researchers and other interested individuals on issues of food insecurity and poverty issues of Sri Lanka The documents and the models (GIS Decision Support Systems) posted in the CD and/or website would be helpful to policy makers and researchers in developing appropriate policy interventions and resource allocations for food security and poverty alleviation in Sri Lanka The ultimate beneficiaries of the project are the people in different spatial units are affected by food insecurity and poverty who will potentially benefit from interventions based on the findings of this study

Project Implementation and Management Issues

The project will be implemented by a core group of researchers from IWMI and HARTI IWMI is primarily responsible for the literature survey and coordinating the workshop for selecting indicators at the appropriate spatial unit HARTI is responsible for collecting the secondary and primary indicators and computing indicators IWMI is responsible for developing the GIS based system for presenting the indicators The researchers of IWMI and the partner institute are responsible for the analysis of establishing linkages between indicators and developing the decision support systems IWMI will lead in administering the project including quality control of the data, publishing biannual reports preparing the CD/web page for the project results

Dissemination Strategy

The biannual reports and the final report will be published in the poverty mapping website (www povertymapping net) The results of the study will be published as IWMI research reports and in international refereed
journals A summary of the final report and the model will be available in the websites of HARTI and IWMI The reports and the usefulness of the model will be demonstrated to policy makers through a workshop

Monitoring

The indicators for monitoring the progress of the project are given in the log frame (annex 1)

Budget

The complete budget for the project is shown in annex 2 Of the complete budget IWMI would contribute computers GIS packages and training for local partner (if required)

Annex 1 Log frame

Brief Description	Objectively Verifiable Indicators	Sources of Verifications	Risks and Assumptions
Overall goal The goal of the project is to contribute to increasing food security and poverty alleviation in Sri Lanka by advancing scientific frontiers in assessing and effective targeting of poverty and food security interventions	Significant reduction in the rate of mis targeting of poverty alleviation programs and food security interventions Increase in food security and decreasing poverty in Sri Lanka	Global and national statistics of food security and poverty	
Purpose To develop a GIS based model with appropriate indicators with special emphasis on water to analyze the spatial and temporal dynamics of food insecurity and poverty in Sri Lanka	Adoption of the information and the model by policy makers and researchers for developing future policy interventions and making resource allocation decisions	Policy and research papers indicating the use of the model and information	Assumption Policy makers and researchers use the information
Outputs			
a) Comprehensive assessment of the *temporal and spatial dynamics of food insecurity and poverty* in the Ruhuna Benchmark Basin in Sri Lanka	1 Reports prepared every 6 months to the CSI/FAO/GRID poverty project 2 Working paper published by July 2003 on spatial and temporal dynamics of poverty in the Ruhuna basin in Sri Lanka 3 Research report/journal articles published by December 2003 on the linkages of factors relating to food insecurity and poverty in Sri Lanka 4 Final report prepared by July 2004 for CSI/FAO/GRID poverty project	Publications in poverty mapping net, in IWMI and in ARTI Peer reviewed IWMI research report and journal articles	Data availability Cooperation of national organizations providing data
b) Multi platform media to serve as a tool for decision makers and others interested in food security and poverty issues in Sri Lanka	A GIS based system prepared by September 2004 including 1 The maps of key variables and indicators explaining the temporal and spatial dynamics of food insecurity and poverty in Sri Lanka at different administrative boundary levels and at a few river basins 2 Written reports on the analysis of food security and poverty in Sri Lanka 3 Bibliography and links to resources related to the project 4 A mapping interface that permits viewing and query of geographic information related to poverty and food security and making policy decisions	A web page published in the web sites of IWMI and ARTI and in the poverty mapping net CD ROM Presentations in workshops	Degree of acceptance of policy makers and researchers

Brief Description	Objectively Verifiable Indicators	Sources of Verifications	Risks and Assumptions
Activities for Output (a)			
a 1 Literature survey of past research	Variables/indicators of food security and poverty in Sri Lanka are identified by September 002	Project monitoring reports Budget reports	
a 2 Workshop for assessing the data availability	Appropriate spatial units at which data are available are identified by September 2002		
a 3 Data collection and indicator quantification	Secondary and primary data collected by January 2003		
a 4 Analysis of linkage of factors affecting food security and poverty	Working paper published by June 2003		
a 5 Research report/Journal article preparation	Research reports/Journal articles prepared by June 2003		
a 6 Final report preparation	Final report prepared by December 2003		
Activities for Output (b)			
b 1 Storing indicators in a GIS system and creating maps	Data storing completed and maps created by June 2003	Project monitoring reports Budget reports	
b 2 GIS policy decision making tool development	Policy development tool developed by December 2003		
b 3 Multi media platform development	A web page and a CD including project proposal progress reports research reports journal articles and the GIS tool are created by December 2003		
Budget	Total US$80 000 CSI/FAO/GRID poverty project US$30 000 IWMI US$45 000 In addition contribution of US$5 000 in kind from IWMI and ARTI		

Annex 2 Budget (in 000 US$)

Items	CGIAR/FAO/UNEP Component			IWMI Component			Grand Total
	Year 1	Year 2	Total	Year 1	Year 2	Total	
Personnel[1]							
International Staff				12 0	8 5	20 5	20 5
National Staff				5 0	5 0	10 0	20 5
Travel[2]							
National	2 0	1 0	3 0				3 0
International		1 0	1 0				2 0
Workshops & training[3]	1 0	1 0	2 0		1 0	1 0	3 0
Publications[4]	1 0	1 0	2 0	0 5	1 0	1 0	3 0
Subtotal	4 0	4 0	8 0	17 5	15 5	33 0	41 0
Indirect cost[5]	1 0	1 0	2 0	4 4	3 9	8 3	10 3
Inflation[6]					1 2	1 2	1 2
Contingencies[7]				1 0	1 5	2 5	2 5
Sub Total	5 0	5 0	10 0	22 9	22 1	45 0	55 0
Contract Research[8]	10 0	10 0	20 0				20 0
Contribution in kind by IWMI and HARTI							5 0
Total[9]	15 0	15 0	30 0	22 9	22 1	45 0	80 0

Notes

1 Personnel cost includes Senior International Researcher total of 1 month @ US$10 000/month Senior Regional Researcher total 1 5 months @ US$7 000/month and national research officer 6 months @ US$1 000/month Data collection and support 8 months @ US$500/month

2 Includes in country travel for IWMI staff and air travel and per diem for attending one international conference/workshop

3 Includes the planning workshop at the beginning of the project and end of the project workshop in the second year

4 Includes progress reports final report and web site development

5 IWMI standard indirect cost recovery rate at 25 percent of the budget

6 IWMI standard dollar inflation rate of 3 percent per annum for the second year

7 1 percent of the budget

8 Research contracted to local collaborator (HARTI) This includes salaries of the local researchers research assistants enumerators for data collection (both secondary and primary)

Use of Geo-spatial Predictive Drivers for Reducing Malnutrition Levels of Poor Rural Households in Nigeria IITA

Budget requested from CSI FAO GRID US$ 105 627

Project Description

Despite recent reductions in undernourishment (SOFI 2000[10]) Nigeria has been far less successful in combating its high level of malnutrition Planning and effective implementation of targeted programs at national state and even community levels are required to further reduce the current level of undernourishment among children and the population and to improve their poverty status simultaneously Unfortunately little data exist on malnutrition levels of various age groups Studies that have been conducted in the past are often fairly old and drawn from surveys with deviating methodologies or focused on specific aspects of nutrition[11]

A sustained programme will only be feasible if it is based on adequate information For instance a preliminary study of Kormawa *et al* (2001) showed that without knowledge of dietary requirements urban poor in Nigeria are not likely to take advantage of the nutritional opportunities that the diverse markets in major cities offer

Poverty is the root cause of undernourishment and malnutrition For Nigeria in particular poverty indicators have steadily worsened since 1986 (FOS 1999[12]) Furthermore poverty and performance of the agricultural sector are closely related in Nigeria (D Situa 1994[13]) Targeting the rural poor is therefore pivotal to fulfil the objectives set by the World Food Summit 1996 to reduce undernourishment to half the present level by 2015 to eradicate hunger and to achieve food security

A major challenge for targeting the rural poor lies in the spatial complexity of the problem Rural poverty is a function of for instance restricted access to suitable land labour or financial resources market access for agricultural input/output Each of these parameters has a spatial dimension which can be exploited for building our understanding in possible moderators for improving rural livelihoods on different aggregation levels Unfortunately Nigeria can be described as a data scarce environment which makes scaling up or scaling out (following Harrington 1997[14]) of household or village level surveys difficult and not in all cases justified

5 Objectives

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[10] FAO 2000 Food Insecurity when people must live with hunger and fear starvation The State of Food Insecurity in the World 2000 FAO Rome

[11] Nigeria Demographic and Health Survey (NDHS 1990 1999) the Participatory Information Collection (PIC 1993) Opportunities for Micronutrient Interventions (OMNI 1993) Multi-Cluster Indicator Survey (MICS 1995 1999) Benchmark Survey (BMS 1996) Baby Friendly Hospital Initiative Impact Evaluation (BFHI 1999)

[12] Federal Office of Statistics (FOS) 1999 Poverty and agricultural sector in Nigeria, FOS Abuja, Nigeria.

[13] D Situa & Bysmouth 1994 Poverty alleviation through agricultural projects EDI seminar report No 30

[1] Harrington, L W 1997 Pieces of a puzzle Striving for coherence in research on sustainable systems In Maize Productivity Gains through Research and Technology Dissemination Proceedings of the Eastern and Southern Africa Regional Maize Conference 5 Arusha (Tanzania) 3 7 Jun 1996 Ransom, J K Palmer A.F E Zambezi B T Mduruma, Z O Waddington S R. Pixley K V Jewell D C (eds) Addis Ababa (Ethiopia) CIMMYT p 99 104

This research sets out to identify and parameterise key factors and socio economic / policy drivers that affect poverty malnutrition and undernourishment levels in Nigeria The core assumption of the research is that rural malnutrition is closely linked to rural livelihoods and poverty which in turn are closely related to the prevalent economic conditions (input/output markets access to roads transport marketing information) and the entrepreneurial potential of the household (education age of head of household) Since most of these factors can be aggregated the village level a simple proxy for the spatial distribution of poverty and malnutrition can be obtained

The objectives of this study are outlined as follows

(1) Characterise the livelihoods and food security status of the rural poor on a household level Parameters that are measured include the recommended core indicators for monitoring food security outcomes of the Committee on World Food Security which are linked with poverty characteristics that are being collected The datasets have been collected by an IITA core funded study into rural livelihoods and food demand structures in Nigeria (Appendix I) and by a food consumption and nutrition survey funded through USAID and others (Appendix II) Other data sources that are considered include the Nigeria 1990 census and the DHS surveys of 1990 and 1999

(2) Collect and generate spatial information on key poverty affecting parameters and processes The villages in which the data of (1) is collected are not yet georeferenced in addition better information is required on nation wide road quality population density and health and education facilities near the studied villages of the food consumption and nutrition survey

(3) Analysis of datasets Spatial attributes such as land cover climate and distance to towns/markets/amenities will be incorporated in logistic/OLS regression analyses of the datasets The specific research questions that will be addressed through spatial analysis are the following

[a] Do regression analyses of household and village level information in combination with geo spatial themes identify key parameters / drivers of poverty and malnutrition on the household village and local government area (LGA) level

[b] Is it possible to use the key parameters in [a] for the definition of village / LGA level predictors for the occurrence of poverty and malnutrition

[c] To what extent does spatial analysis of the datasets within the represented domain add to the model of [b]

[c] Is it possible to develop the model in [b] sufficiently robust for spatial analysis with the use of spatial data that is available for Nigeria and if not what key information is still required

(4) Through the combination of the (point scale) household survey data and multi disciplinary spatial information sources, identify external constraints to adequate nutrition levels These external factors that affect rural livelihoods and malnutrition include amongst others sources for balanced nutrition access to input/output markets land quality/natural resources and presence of agricultural extension/institutional development organisations (farmer groups NGO s agricultural extension, commercial advisors)

The output of this research will be developed in close contact with the target audience through ongoing IITA projects such as the Rural Sector Enhancement Project (RUSEP) which links state and national government institutions and NGO s to shape a coherent agricultural development policy[15] The target audience has been identified as policy makers and other key players on national and sub national levels In this set up the results can play a practical role in ongoing policy making on the national and state level within the project timeframe and thus can make a contribution to reaching the 2015 deadline of the Rome Declaration and before changes in social economical and political conditions catch up on the research findings and project design

Methods

This research builds on two ongoing surveys Data collection is half way for a collaborative survey of IITA with the Project Co ordination Unit of the Federal Ministry of Agriculture and Rural Development to map food demand in conjunction with rural and urban poverty in 10 states in Nigeria A complementary study at IITA with the National Planning Commission investigates food consumption and nutrition in 12 States The studies are summarised in Appendix I and II respectively with a description of their objectives parameters collected and sampling scheme

→ **Identification of Data Resources**

To ensure the accessibility of existing datasets collaboration with federal and state level organisations is pivotal Through the contacts of IITA s existing projects further collaboration will be sought with mapping and GIS departments of these organisations

→ **Data Collection**

Food Security Core Indicators

The Committee on World Food Security s (CWFS) suggested core indicators for monitoring food security status [16] formed the basis for the parameters on which this proposal will focus These include anthropometric measurements household livelihood and food security parameters village and agro environmental indicators and policy and marketing conditions A list has been compiled of indicators that have either been measured or can be inferred from datasets available for Nigeria within the scope of this research (Table 1)

Anthropometric/Household/Village Parameters

Data collection has taken place for the rural food demand survey and the food consumption and nutrition survey and is currently being entered but neither study has georeferenced their survey locations Instead the location of the villages will be taken from village names locations in existing datasets and from a second visit to the villages During this visit additional village level data such as distance to schools markets and amenities will be collected where this had not been done during the initial survey

[15] IITA 2001 IITA Strategic Plan for 2001 2010

[16] http //www fao org/docrep/meeting/x8228e htm

The use of the DHS 1990 and 1999 data remains an option however the 1999 data is not yet georeferenced The preparation and analysis of DHS data entails a substantial additional workload on the limited staff that is available at IITA This is not the case for the aforementioned surveys each of which have a substantial teams committed to the preparation and analysis of the data

The census data of 1990 has been published and is available in paper format and access to a digital copy is being investigated This data will be studied and assessed in view of future extrapolation possibilities however there are doubts about the accuracy of this information on the Enumeration Area level (500 household groupings) and elements of the survey may well be out of date

Table 1 Selection of indicators and factors from Committee on World Food Security suggested core indicators for monitoring food security status that are available or can be inferred for the purposes of the proposed study

NUTRITIONAL STATUS INDICATORS	PROXY
Food Consumption Status	
1 Average per person dietary energy supply (DES)	1 measured
2 Starchy foods as % of DES	2 measured
3 Percentage of population undernourished	3 measured
Health Status	
Under 5 mortality rate	existing datasets
Nutritional Status	
<5 years underweight ratio	measured
VULNERABILITY FACTORS	PROXY
Food Access	
1 Consumer / food prices index	1 measured
2 Income levels (< US$1 a day)	2 measured
3 Percentage of income spent on food	3 measured
4 Road Access	4 Road density/market access
Household Characteristics	
1 Average income	1 measured
2 Average household Size	2 measured
3 Ratio dependants/wage earners	3 measured
Socio-Cultural Conditions	
1 Girl net enrolment in primary school	1 years in education distance to education facilities
2 Access to primary health care	2 distance to care
Environmental	
1 Arable land per household	FORMECU (1996) LULC dataset 1976
2 Rate of deforestation 1976 1993/95	+ 1993/5 analysis for
3 % Forested area	10 km radius around village
	map of enumeration area
	population density *e g NCGIA 1990*
	Kruska *et al 2002*
Risks Hazards Shocks	
1 Rainfall Variation drought risk	probability analysis (in progress)

Spatial Data Sets

Contacts will be made with key mapping agencies and departments in the country to obtain recent maps on geo spatial themes such as roads soils and if possible data on the presence of health care and educational amenities at LGA level Other themes such as land use and land cover have already been obtained (FORMECU 1996) Also the delineation of the relevant LGAs requires updating Maps are typically available through ADP zonal or state offices Maps of the census Enumeration Areas are also available but have not yet been digitised

→ **Spatial Mapping and Analysis**

Represented Area Delineation

The two IITA surveys followed a weighted random sampling scheme The choice of villages in the food demand study (Appendix I) restricts the area that can be represented to those areas that can be defined as non urban whereas the household results of the health and food nutrition study (Appendix II) predominantly relates to the health and nutrition status of children under five Prior to any spatial analysis a clear delineation of urban and non urban areas is required and the limitations to using spatial analysis tools need to be defined

In view of the characterisation criteria used for defining non urban villages i e a combination of distance to feeder roads village size and presence of amenities it is proposed that it will be possible to delineate spatial domains of a limited size that are suitable for spatial analysis by using datasets on road type and density Satellite based classifications of built up areas dis aggregated population density data and presence of amenities Whilst this spatial domain will not cover entire states it will indeed cover most agricultural areas The distance to urban areas can further be used to investigate its importance with respect to remittances opportunity labour costs and marketing opportunities

Analysis of Food Demand Study

The use and analysis of spatial data is proposed to follow the logic expressed by Bigman & Folack[17] to develop a predictive model of mean poverty indicators by community based on estimates within household surveys

A model will be developed using logistic and/or OLS regression to describe driving factors of poverty and malnutrition separately on the basis of the food demand study and the food and nutrition survey respectively with poverty and malnutrition indices derived from the nutrition indicators and selected parameters from Table 1 The driving factors for these indices are environment based (e g distance to amenities market access agro ecology land use intensity state/LGA policy) household (HH) based (education HH size food consumption patterns etc) or are collected in a single error term

[17] Bigman & Folack 2000 The World Bank Economic Review Vol 14 No 1 129–45

Poverty Malnutrition = α |environment| + β |HH| + ε(spatial non spatial) [1]
The possibility of dis aggregation of the error term in spatial and non spatial elements at this stage is dependent on the continuity of the spatial domain that is represented by the selected villages and households

Geo spatial factors (annual rainfall patterns soil population density) that are included in the analysis can be used to break up the dataset into separate more homogenous zones this is expected to reduce the error term in the model The resulting sub models are used to define a model that excludes HH factors by establishing a correlation between major HH parameters and village/environmental factors

$$|HH| \sim |environment| \quad [2]$$

so that

$$\text{Poverty Malnutrition} = \alpha\,|environment| + \varepsilon(\text{spatial non spatial}) \quad [3]$$

These models will be based only on nutritional indicators and vulnerability factors that are present in both datasets on a EA/village level or as geospatial parameters derived from the GIS database With the model independent of HH conditions a combined dataset is created which increases the sampling density of individual villages in states that are sampled in both datasets This combined village level dataset can form the basis of actual spatial analysis of rural areas to reduce the error term in the poverty and malnutrition models (Figure 1)

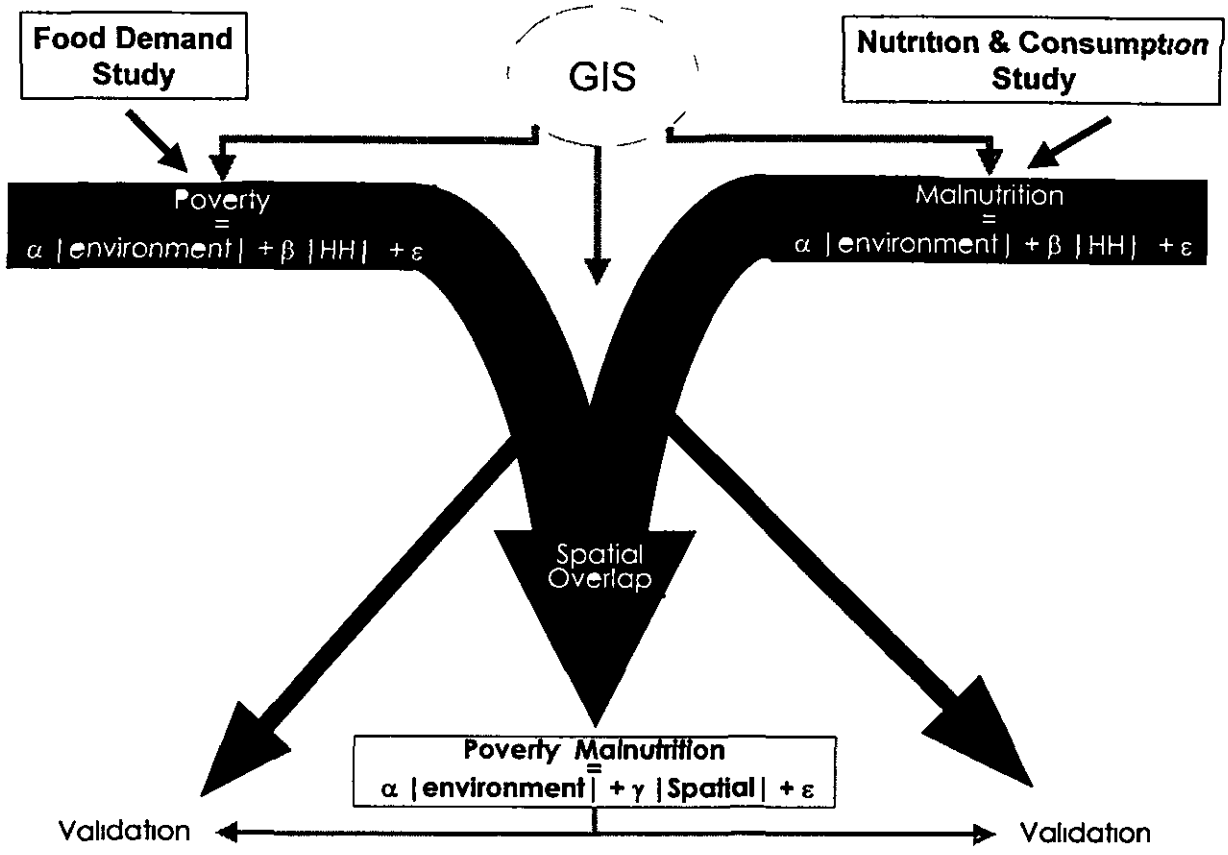

Figure 1 Schematic overview of the proposed logistic and spatial analysis Spatial analysis will be performed on a village Enumeration Area (EA) or LGA level within the represented area

→ **GIS inclusive Decision Support**

Intervention pathways that hold a strong promise for application in practice will be developed through the collaboration with government officials from the Federal and State Ministries of Agriculture and Rural Development Health Education and the office of the Special Advisor on Food Security to the President A GIS inclusive decision support methodology will be presented that is based on ACT software and used during stakeholder meetings for the purposes of presenting the research findings and to offer a spatial dimension to the decision making process of the end users

→ **Capacity Building**

Collaborating NARES scientists will play leading roles in the field survey aspects of the project In addition to the training and hands on experience they have already received through the poverty mapping survey training will be organised for the collaborating NARES in the use and uses of spatial referencing including the use of GPS Multi scale research findings will be presented and discussed at regional policy seminars and workshops and through policy briefs targeted at key policy makers and the private sector

7 Stakeholders

The following stakeholders will be involved in planning and implementing the project

Federal ministry of Agriculture and Rural Development
Federal and state ministries of Health
Federal department of Agriculture and Land Resources (FDALR)
Office of the Special Adviser on Food Security to the President
NARES

Leading Scientists

Dr Bauke van der Meer GIS Application Specialist (IITA)
Dr Patrick M Kormawa Policy & Market Studies (IITA)
Mrs Bussie Maziya Dixon Consultant (IITA)
Mr Tunrayo Alabi (IITA)

Expected uses and users of Research Results

The target beneficiaries include rural poor through improved policy making based on better information and understanding of the spatial distribution patterns of poverty and malnutrition issues

Planning Departments of the various ministries listed constitute the direct end users of research results and products Government Policies subsequently benefit from the increased knowledge and understanding of the intervention pathways to reduce poverty and malnutrition

The spatial data analysis and model results are directly relevant for end users on their level of aggregation Meanwhile the spatial and inter scale relationships that are established will contribute to a greater understanding amongst researchers to which extent the assessment of intervention pathways can be based on information on aggregated data levels

Logical Framework

Project Title Use of predictive drivers for reducing malnutrition levels of children in poor households in Nigeria	**Objective Verifiable Indicators (OVI)**	**Method of Verification (MOV)**	**Assumptions**
Goal Improved nutritional status of poor rural households through better targeting of health agriculture and marketing policies and projects resulting from application of innovative GIS and analysis methodologies for policy makers	Improved WFS key poverty indicators for Nigeria improved policies and projects targeted at malnutrition of children in rural poverty demand for GIS inclusive decision support methodologies increased	SOFI reports 2002 2015 FIVIMS intra country data improvements on state and LGA level linked to policies and successful projects	Implementation of Policies by key stakeholders
Purpose Quantification and improved understanding of the spatial and policy dimensions of rural poverty and malnutrition through surveys and developed geo spatial analysis methodologies	Improved model for poverty and malnutrition indicators and drivers through the inclusion of spatial data and additional spatial analysis Successful demonstration of research findings at workshops using GIS inclusive decision support methods	Project bi annual reports policy briefings refereed publications GIS inclusive decision support tools distributed on CD ROM and available on the internet	Accessibility of spatial data Favourable political security and financial environment to researchers and policy makers
Output 1 Federal and state level spatial and georeferenced datasets on key poverty drivers and indicators	Availability of metadata and datasets on internet	Accessibility of data on internet and distribution on CD ROM amongst key stakeholders with GIS capacity	Existence availability and accessibility of spatial data
Output 2 Characterisation of rural poverty and nutritional status of rural population with extra attention on children <5 years	Rural poverty and child nutrition characterised including spatial dimensions and distribution of key determining drivers and parameters	Project bi annual reports refereed publications and on internet Data stored in IITA Research Database Management System (RDBMS)	Timely availability of relevant data
Output 3 Logistic/OLS regression and spatial analysis of the occurrence patterns and drivers of poverty and malnutrition using multi scale multi disciplinary GIS data	Results published on internet and presented to project members and key stakeholders	Project bi annual reports refereed publications and on internet (meta)data available through CSI Reports CD ROM distribution and web based access	Timely availability of relevant data
Output 4 Identification of external constraints and GIS inclusive discussion of results with end users	Survey data and spatial analysis prepared for inclusion in GIS database ACT database for poverty and malnutrition mapping in Nigeria	Project bi annual reports refereed publications and on internet (meta)data available through CSI Reports CD ROM distribution and web based access	Timely availability of suitably detailed and accurate spatial datasets

11 Budget

Budget CSI-Poverty

Exchange rate Naira/US$ May 2002
116 3

	IITA	Item	Annual	Duration (months)	TOTAL	SUM	
	GENERAL						
1	Tech ical s pport	GIS/www cons ltant		6	$45 000 00		
2		Support Staff	$7 200 00	24	$14 400 00	$59 400 00	
3	Cap tal Eq pme t	CD-rew te			$150 00		
		PC stations pn ter			$2 500 00	$2 650 00	
4	Travel	2 sits to CSI Institute		1	$6 000 00		
		Travel for data collection		2	$4 500 00	$10 500 00	
5	Workshop	Closing workshop w th stakeholders at IITA		0 25	$5 000 00	$5 000 00	
	IN PROJECT GRANT ALLOCATION						
6	Local Contracts	2-3 data-entry contracts			$6 000 00	$11 000 00	
	OTHER						GRAND TOTAL
7	Overhead on non-cap tal tems project adm nistration	22.8%			$17 077 20	$17 077 20	$105 627.20

Budget Notes

1) Two 3 month consultancies are budgeted for technical/statistical support and to aid in web development
2) A database manager is required to coordinate and manipulate incoming and existing data to make input from different sources compatible with analytical and GIS applications and to assist in the GIS modelling process He will be assisted by 0 5 secretarial support
3) Capital requirements include up-to-date computer equipment for the database manager
4) Two 2 week trips to fellow CSI institute for GIS and modelling collaboration budgeted as US$ 3 000 pp including air fare residence and per diem Data collection travel includes hotel costs + per diem
5) A workshop will be held at the end of the project with key stakeholders to present methodology and results
6) 2 3 small contracts will be awarded by IITA to national collaborating institutions in order to generate data layers that are considered pivotal to the GIS analyses
7) IITA calculates an overhead of 22 8% on non-capital items

In Kind Contribution

IN KIND Contribution

Exchange rate Naira/US$
116 3

IITA		Annual	Duration (months)	TOTALS	UM	
Technical support	0 25 GIS Application Specialist	$150 000 00	24	$75 000 00		
	0 25 Policy and Marketing Specialist	$185 000 00	24	$92 500 00		
	0 5 Secretarial Support	$1 461 74	24	$2 923 47	$170 423 47	
Use of office and laboratory space	Use of GIS-lab + support staff					
Use of conference facilities						
Use of installed equipment	A0-Digitser PC Network, Internet access A0-A3-printing and multi-media facilities library access					TOTAL IITA
Use of vehicles						$170 423 47

APPENDIX I Survey on Rural Livelihood, Poverty and Food Demand in Nigeria

Investigators

Mr D Adejobi (Ph D student University of Ibadan)
Ms Eunice Obamiro (Ph D student University of Hohenheim Stuttgart Germany)
Dr P Kormawa Dr V Manyong Dr K Amegbeto Dr J D H Keatinge (IITA)
Lund Univesity Sweden Prof Goeran
University of Hohenheim Stuttgart Germany Prof Werner Doppler

Funded by IITA with University of Lund Sweden

Objectives

- To develop a novel poverty index and use the index to characterize rural poverty levels by livelihood category
- To examine and quantify the relationship between poverty levels and rural livelihoods in Nigeria
- To determine the food demand and consumption patterns by poverty and livelihood patterns
- To determine optimal household production system that will take the farming households out of poverty
- To suggest policy relevant recommendations for reducing poverty and hunger at the household level

Parameters Collected

Category	Parameters	
Village Level		
Education	Primary School	Secondary school
Health	Hospital / Clinic	Tap / Well Water
Other	Electricity	
Enterprise	Formal credit	Pesticide & Herbicide
	Fertilizer	Improved Seed
	Extension	Veterinary Doctor
Household Level		
Composition Description	Size of HH	Wealth possessions
	Age distribution	
Income	Enterprises	Farm revenues
	Remittances	Livestock revenues
		Tree crop revenues
Expenditure Food consumption	Per crop	
	Purchased / non purchased	
	Staple / non staple	
Expenditure Non food	*e g* fuel soap tobacco etc clothing, equipment, maintenance taxes	
Expenditure Farm	Seeds	Equipment
	Inputs	Maintenance
Individual Level		
For HH head + spouses	Years in education	

Sampling method

A multi stage stratified random sampling procedure was used in selecting the sample for this study

State and ADP Selection
First country was divided into three zones northern middle and southern Nigeria In each of the zones 3 states were randomly selected (*Figure 1*) Each state is divided up into Agricultural Development Project (ADP) zones typically 3 5 per state Each of these zones was sampled proportional to the number of LGAs within a zone

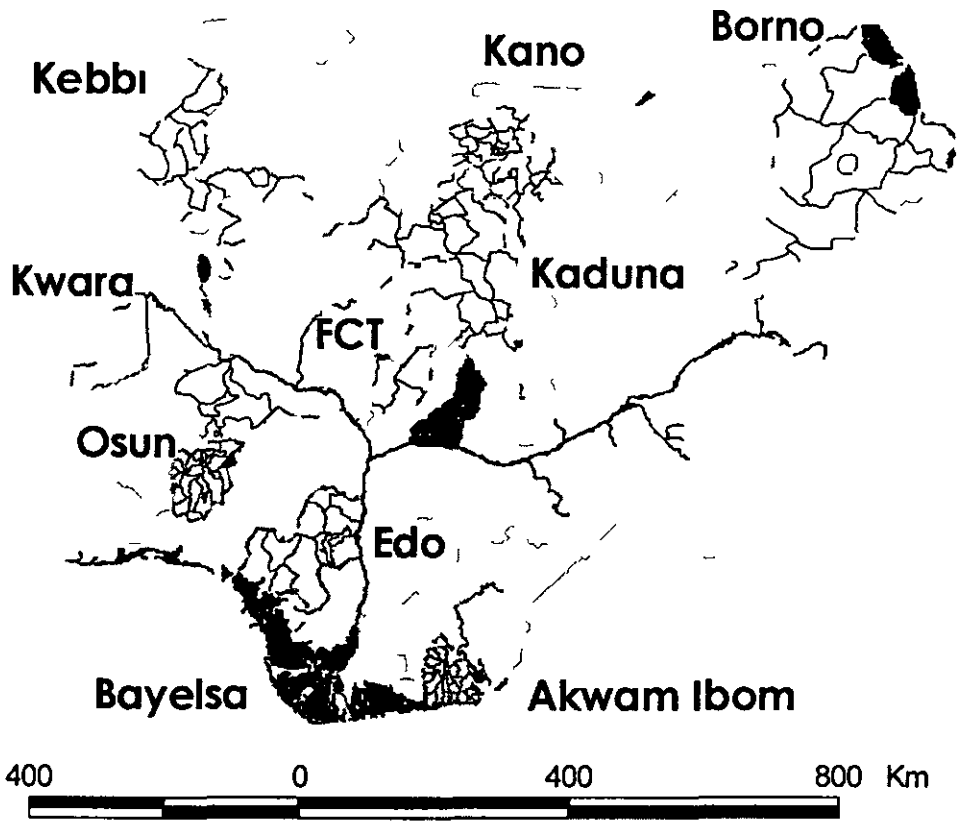

Figure 1 States selected for the Food Demand survey Kebbi Kano Borno = AEZ1 Kwara, FCT and Kaduna = AEZ2 Osu Edo Bayelsa and Akwam Ibom = AEZ3

Local Government Area Selection
The number of Local Government Areas (LGAs) selected from each ADP zone was proportional to the size of the zone The proportionality factor is stated as follows

$$S = \frac{n}{N} * 10 \qquad [1]$$

where

S_z = the number of LGAs sampled from a zone
n = the number of LGAs in a zone

N = the number of LGAs in all the zones in the state selected

10 is the desired number of LGAs from each state selected for the survey except for Abuja State where all the LGAs (6) were sampled

Village Selection
The third stage involved getting the list of villages for each of the selected LGAs provided by the state ADP and 10 villages were randomly selected

Household Selection
An IITA research team joined the enumerators with the assistance of their supervisors and it involved the following steps

(i) House listing in the selected village by using chalk to number the houses
(ii) Household listing in each of the listed houses with the addresses of each household to facilitate recall
(iii) Random selection of households from the list of households by writing the number of the household in small pieces of paper the pieces of paper were rolled into balls and put in a bucket where the enumerator picked specific numbers which was equal to the number of respondents expected from the village

The sampling strategy focussed on covering a large number of villages and as a consequence a reduced number of respondents per village While this would reduce the representativity of the households for each village the increased spatial distribution would improve the estimate on the LGA aggregation level Between 350 and 400 household questionnaires were expected to be administered per state These questionnaires were distributed according to a proportionality factor based on the population of each LGA

$$S_l = \frac{p}{P} * 400 \qquad [2]$$

Where
S_l = number of questionnaires per LGA
p = the population of a LGA selected
P = the total population of all the selected LGAs

Thus the number of households S_v per village was

$$S = \frac{S}{v} \qquad [3]$$

Where
v = number of villages selected from a given LGA

APPENDIX II Food Consumption and Nutrition Survey (FCNS)

IITA Bussie Maziya Dixon

Collaborators National Planning Commission 11 State Universities Federal and State Ministeries of Health Ministry of Agriculture and Rural Development National Primary Health Care Development Agency

Primary Funding Agencies USAID IITA

Background

The current data used in nutrition circles in Nigeria are often fairly old and drawn from surveys with deviating methodologies or focused on specific aspects of nutrition (*e g* NDHS 1990 & 1999 MICS 1999 BFHI 1999 PIC 1993 OMNI 1993 MICS 1995 BMS 1996) Even recent reports fell short of covering all relevant aspects of nutrition Generally most surveys used classical techniques that had little or no community participation This survey was designed as a holistic national survey to generate up to date data in all aspects of nutrition covering Food Security Health and Healthy Environment in Nutrition and Care for planning and programming in Nigeria This information is also useful to agencies with primary and secondary mandates in nutrition

Objectives

The overall objective of the FCNS is to determine the nutritional status and nutrient intakes of the rural and urban populations in Nigeria The purpose of the study is to

- Assess the extent and nature of food insecurity in Nigeria
- Conduct a food consumption survey and include anthropometric and biochemical assessments to determine nutritional status of women and children under 5
- Collect information and awareness from households on home health practices and food processing

Specific objectives are to

1 Determine nature and extent of food insecurity and food consumption patterns
2 With quantitative methodologies assess nutritional status of women and children
3 Determine the micronutrients (vitamin A iron zinc and iodine) status of women and children from food intake and biochemical indices
4 Elicit from household and communities information on home health practices and food processing (including food fortification)

Parameters Collected

Category	Parameters	
Enumeration Area/Village Level		
(To be collected)		
Household Level		
Composition Description	Size of HH	Primary occupation head
	Age Distribution	Energy source
Hygiene	Water Source	Refuse Disposal
	Toilet	Tidiness/personal hygiene
Income	Annual income	
Food consumption	Per crop	Availability
	Staple/non staple	Consumption frequency
	Purchased/non purchased	
	Coping strategies	
Expenditure Non food		
Expenditure Farm		
Individual Level		
Mother + Child <5years	24 hr dietary recall	
	Anthropometric measurements	
	Age weight, height	
	Biochemical	
	Blood Retinol Zinc Concentration Ferritin	
	Urinary Iodine	
Health Child < 5	Illness treatment immunization prevention against malaria, diarrhea	
Care Mother	Workload	Economic rights
	Empowerment	Ethnic/cultural/religious
	Birth control	practice
Infant Feeding		

Sampling Scheme

The design targets the entire federation of Nigeria The federation was initially stratified according to major agroecological zones and predominant food crops within agroecological zones It is postulated that a large sample size spread across agro ecological and food type zones shall be fairly representative of the whole country

National Zonation

A stratified multi stage procedure was used with stratification at 2 levels [AEZ * PFC] *i e* Agro Ecological Zone by Principal Food Crops The AEZ were based on meteorological length of growing period taken from the CIMMYT Maize Research Atlas (1999) (*Figure1*) The PFCs taken from Manyong *et al* (1999) range from mainly cereal food crops in the north to root crops in the south in different combinations (*Figure 2*) The resulting zones are listed in *Table 1*

State Selection

In each PFC zone a random sample of one of the states within the particular PFC was taken (with the exception of a PFC in zone 3 where 2 states due to the larger number of states present were taken) Selection probabilities of states ranged from 1/18 to 1/48 [i e proportional to sizes of sub groups] Twelve states were selected (*Figure 3*)

Table 1 Agroecological zones (based on meteorological length of growing period (LGP) CIMMYT 1999) and subdivision in principal food crops zones (Manyong *et al* 1999)

AEZ 1 (LGP 31 210 days)	**Selected**		**Other**	
PFC1	**Kebbi**	Sokoto	Zamfara	Niger N
PFC2	**Kano**	Katsina	Jigawa	Bauchi
PFC3	**Borno**	Yobe	Gombe	Adamawa N
AEZ 2 (LGP 211 270 days)				
PFC4	**Nassarawa** **Kaduna**	Plateau	Niger S	
PFC5	**Taraba**	Adamawa S		
PFC6	**Kwara**	Benue	Kogi	
AEZ 3 (LGP 271 365 days)				
PFC7	**Osun**	Oyo	Lagos	Ogun
PFC8	**Edo**	Ondo	Ekiti	
PFC9	**Bayelsa**	Delta	Rivers	
PFC10	**Akwa Ibom** **Imo**	Cross River Ebonyi	Anambra Abia	Enugu

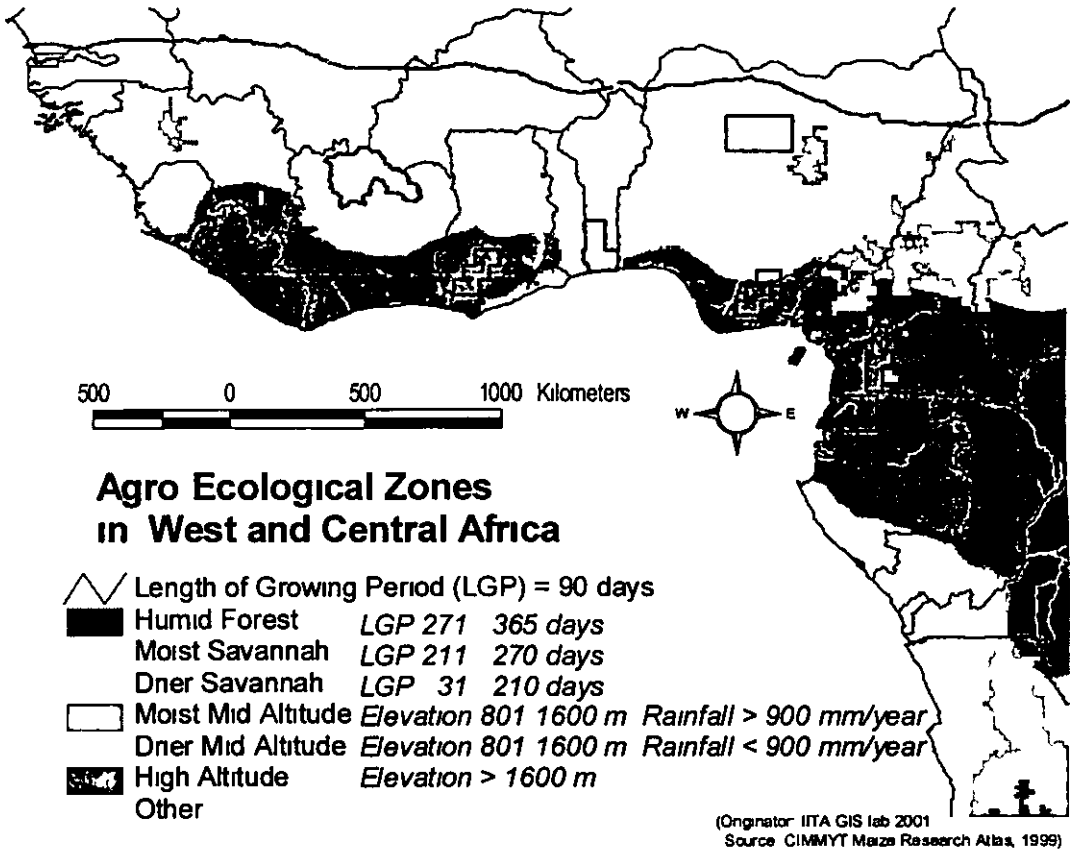

Figure 1 Map showing the different AEZs in West Africa

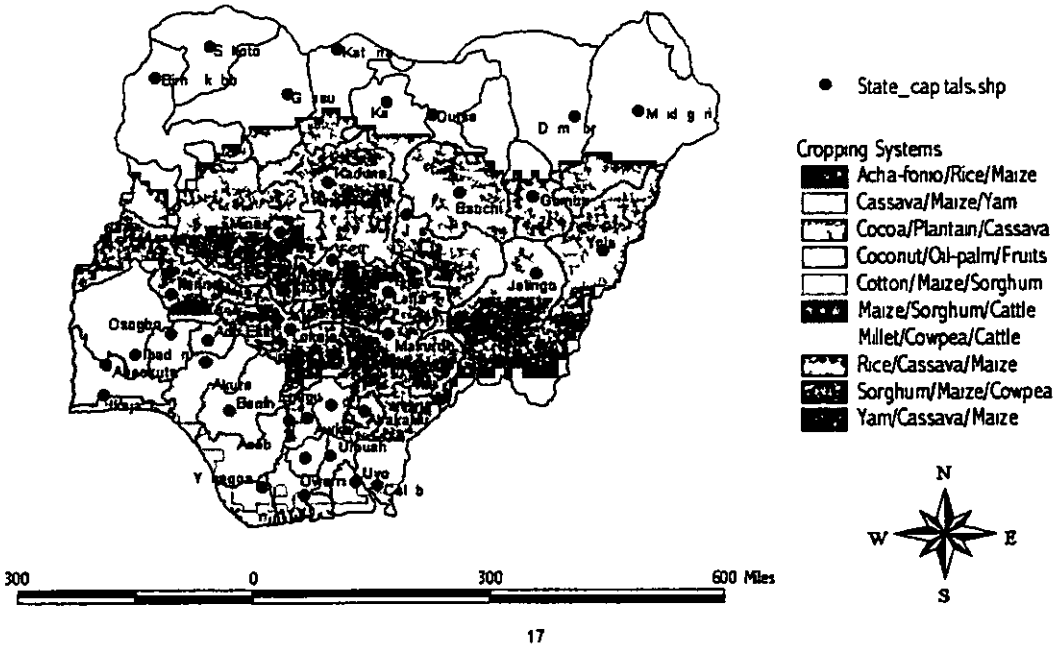

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Figure 2 Map showing the food crops distribution in Nigeria.

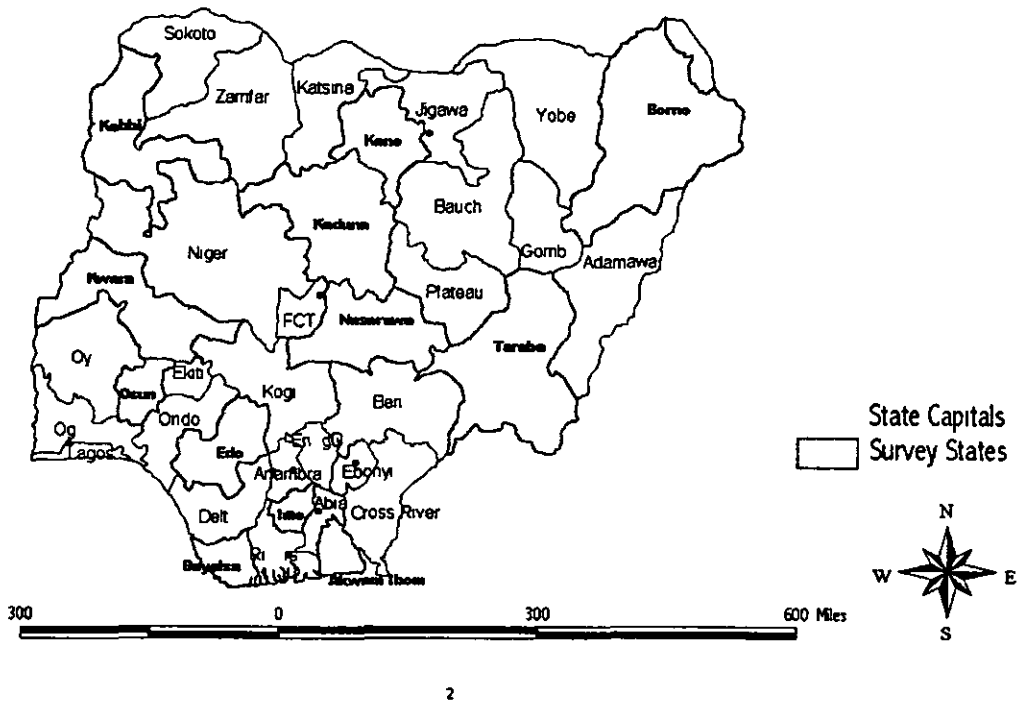

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Figure 3 States selected for Food consumption and nutrition survey

Local Government Area Selection

A total of 72 LGA were selected according to the following procedure

To ensure that the LGA s in the sample represented a range of rural/medium/urban conditions for each selected state a listing of LGA was obtained and grouped according to the level of urbanization (urban medium and rural) assigned by Nigeria s Federal Office of Statistics This led to a total of 36 sample categories (12 states times 3 LGA groups)

To ensure that each category was represented, a single LGA was selected from each category The allocation of the remaining 36 samples was proportional to the total population in each of the sample categories Sample sizes for this stage of sampling are given in Table 2

Enumeration Area Selection

The enumeration area (EA) is the smallest geographical cluster of household as delineated by the National Population Commission for purposes of enumeration with 500 households per area A comprehensive list of all the enumeration areas (EAs) in selected LGAs was obtained from the National Population Commission (NPC) while the population of each of the enumeration areas was obtained from the LGA headquarters

the borders for the enumeration areas do not follow new LGA borders therefore only EAs that fell entirely within a selected LGA were sampled Three EAs per LGA were randomly selected from the list of EAs within a selected LGA It is from these selected EAs that a further breakdown of EAs will be made for the selection of households

Table 2 Distribution of sample by LGA categories and states

AEZ	State	Urban	Medium	Rural	Total
	Kebbi	1	1	2	**4**
1	Kano	2	3	4	**9**
	Borno	2	3	3	**8**
	Kaduna	1	2	2	**5**
2	Nassarawa	1	1	2	**4**
	Taraba	1	2	3	**6**
	Kwara	1	2	2	**5**
	Edo	1	2	3	**6**
3	Osun	2	2	3	**7**
	Imo	2	2	4	**8**
	Baleysa	1	1	1	**3**
	Akwa Ibom	1	3	3	**7**
LGA categories selected		**16**	**24**	**32**	**72**

Household Selection

A list of all the households in each EA was made From each EA 30 households were randomly selected The number of households was proportional to the number of households in the selected EA from the target population of HHs with under five etc will be randomly selected The 24 hour dietary intakes recall section of the questionnaire would be administered to the selected HHs

To qualify for enumeration a household should have

a a mother
b a child of this mother aged less than five years

Where the mother has more than one child aged under 5 years old the youngest child should be selected for sampling

In a household where there is more than one eligible mother and child pair the youngest mother and her child should be selected

Household Participation Refusal

If the household representative refuses the interview he/she may not object to an interview with another knowledgeable household member In the case of full refusal document this information

Individual Selection

Further selection procedures include selection of persons for 24 Hour Dietary Recall biochemical/anthropometric/health measures and pregnant women