Implementation Plan for Year 2 (FY 2013)—*FINAL April 26, 2013*

Improved Modeling of Household Food Security Decision Making and Investments Given Climate Change Uncertainty:

Associate Award AIDOAA-LA-11-00010 under Food Security III, CDG-A-00-02-00021-00

Introduction

This project covers a three-year period from October 1, 2011, through September 30, 2014. The implementation plan presented here is for Year 2 (October 1, 2012, through September 30, 2013).

Purpose of Award

The complete Program Description for this award is contained in Attachment A. Briefly, the purpose of the activities supported under this Award is to link the multiple-year household survey datasets that MSU has been involved in collecting in Kenya and Zambia, and MSU's coupled climate, crop, land use, and water availability models developed for East Africa, in order to improve understanding about how rural households are adapting to climate change (in terms of agricultural production practices and technologies, and perhaps other income-earning strategies), and about the impacts of anticipated future climate scenarios on farm household production, income, and food security. This information will help refine the climate change models and estimates of future household technology adoption and investment decisions, with implications for country program and policy priorities.

Status Report and Items Remaining from Year 1 (FY 2012)[1]

Activity 5. Calibration and initial use of crop-climate model for Zambia

1. The calibration of the DSSAT crop model for maize in Zambia has been completed. Modeling maize production using historical climate data and varying agronomic practices (fertilizer levels, irrigation or rainfed) has been largely completed for one maize variety using daily rainfall data from meteorological station in Eastern and Central Zambia.
2. What remains for Year 2 is to run the crop model with additional station data for the remaining two zones (Northern and Southern). Due to the lack of daily rainfall data[2] for these zones, this will be completed using monthly station rainfall data and a daily weather generator. However, the new dataset being prepared by FEWSNET/UCSB will provide additional historical climate data with a higher spatial and temporal resolution.[3] It is

[1] Attachment B contains the full description of Activities 5, 8, and 10-13 given in the Year 1 Implementation Plan.
[2] Efforts to obtain daily rainfall data from the Zambia Meteorological Department have been unsuccessful so far. Before giving access to these data, ZMD wished to conclude an MOU with MSU. An MOU was drafted but was then was overtaken by events before signature, as ZMD no longer needed one of the key proposed contributions from MSU (four automated weather stations). An alternative plan involving support for B.Sc. training of ZMD staff is still under discussion. A further issue is incomplete rainfall data for some stations.
[3] We understand that this is a dataset for Africa at a high spatial resolution (0.05 degrees). Precipitation data will be

anticipated that this database will be available in April 2013[4]. Once available, the data will be converted to daily precipitation data, linked to satellite temperature data, and run through the crop model to produce maps of maize yield under various scenarios of climate and agronomic practices.

Activity 8. Analysis of Zambia weather station and African Rainfall Estimation Algorithm (RFE) data.

1. Daily precipitation data could be obtained for only two meteorological stations, Chipata and Lusaka. Planned analyses were conducted for these two datasets. (See progress report presented in Washington, D.C., on Sept. 19, 2012.) For reasons explained in footnote 2, we do not expect to be able to obtain further daily rainfall data from the Zambia Meteorological Department, and have obtained temperature data for only a few stations. Therefore, monthly rainfall data will be analyzed for stations with sufficient data, including those in and near the three zones chosen for the household modeling. Temperature trends will be analyzed with the available station data and, for the crop modeling, supplemented with satellite data.
2. Spatial (GIS) time series precipitation data, such as that mentioned in the proposal, is not yet available, but is anticipated to be available in February 2013. Through Gary Eilerts, we were put into contact with Chris Funk and his FEWSNET project team at U.C. Santa Barbara who are completing the dataset. Planned analyses of historical precipitation trends and extremes will be carried out for Zambia once the data have been received.

Activity 10. Initial design of household models

1. This activity has been largely completed, though not to the desired extent. Models have been prepared for the Northern, Eastern, and Southern zones, based on previous models used by Sigel and Alwang, and Haggblade and Plerhoples. A set of available crop budgets has been assembled.
2. What remains for Year 2 is to improve the labor and other input/output coefficients and output prices through special-purpose focus group surveys conducted during November 2012 and February 2013, and through analysis of the 2-3 most recent years of Crop Forecast Survey data, and data from the 2012 Rural Agricultural Livelihoods Survey (RALS), when it becomes available.

Activity 11. Design of procedures to link the climate-crop-household models.

1. This linkage primarily involves inserting simulated crop yields (determined by weather and agronomic practices) into the household model. For example, simulated yields based on the climate for that area and year, and using various levels of fertilizer inputs, will be inserted into the household model. Our initial expectation was that we could develop and calibrate DSSAT crop models for several key crops. However, the necessary data to calibrate the crop model for additional maize varieties and for other crops is not yet available for Zambia, so we expect to confine our crop modeling in Year 2 to two or more varieties of maize.

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available at a monthly time step from 1920 to 2011, and pentadal (every 5 days) data for 1981 to 2011. Monthly ar temperature data will eventually be available for the same time period and spatial resolution.

[4] A beta version is currently available, but the MSU team feels that it is better to wait for the official release of the data, in order to avoid having to redo some or all of the analysis done on the beta dataset if it is superseded.

2. What remains for Year 2 for maize is to calibrate the crop model for the Northern and Southern zones.
3. For other crops, we planned to use statistical yield models to estimate weather-determined yields for insertion in the household model. Initial results from such models have been disappointing, partly due to inadequate rainfall data and hence imperfect specification in the model of rainfall characteristics that affect yield (e.g., rainfall during crucial crop growth periods, length of dry spells, etc.), and perhaps inadequate data or specification of other factors affecting yield. What remains for Year 2 is (a) to refine the statistical specification of the models further (already done), and (b) to incorporate better weather variables based on simulated daily rainfall generated from the monthly rainfall data (see point 2 under Activity 5), and based on the FEWSNET/UCSB data.

Activity 12. Downscale general climate models for future scenarios for Zambia.

1. This activity (Output 8) was completed in Year 1. Four GCMs have been chosen and downscaled, incorporating land surface data for Zambia.
2. What remains for Year 2 is to map the results and write them up (to be included in the technical report mentioned above.)

Output 11[5]: Technical report including maps of results of GCM downscaling.
Expected by: May 2013.

Activity 13. Testing and initial use of the household models.

This activity was not undertaken. It will need to be carried out in Year 2 (see below).

Year 2 (FY 2013)

Zambia

1. *Rainfall data analysis*
    a. Analysis of monthly rainfall data for stations in the Northern and Southern zones and preparation of graphs of seasonal and 9-year moving average annual rainfall (already completed).
    b. Analysis of high-resolution data from FEWSNET/UCSB.
    c. Incorporation of results into technical report.

Output 12: A technical report on findings of the analyses described in 1.a and 1.b above.
Expected by: July 2013. Dependent on availability of the UCSB dataset.

2. *Development and use of climate-crop models*
    a. Calibrate the DSSAT model for two new maize varieties—medium- and long-duration (already completed)—and if possible for sorghum and/or beans.

[5] Ten outputs were listed in the Year 1 implementation plan. To avoid confusion, the designation of Year 2 outputs will start with Output 11.

b. Run the downscaled GCM data through a weather generator to derive daily data for the crop models (expected April 2013).
c. Use rainfall data to simulate maize yields for all of Zambia over the period of the historical data. This would be done for the two new maize varieties and for three levels of fertilizer.
d. Use the FEWSNET/UCSB data set as input for maize yield simulations under different climates and management practices for all of Zambia, and map those results.
e. Conduct simulations of projected future yields using downscaled GCM climate data. Produce maps of projected yield, and expected change in yield from current climate conditions.

Output 13: Maps and statistics of simulated maize yield change based on (a) results of the already-completed DSSAT modeling using daily rainfall data (for Chipata and Lusaka stations), (b) the FEWSNET/UCSB dataset, and (c) GCM-based future climate simulation results.
Expected by: August 2013. Dependent on availability of the UCSB dataset.

3. *Refinement of household model*
   a. Conduct analysis of labor data from recent Crop Forecast Survey data, and compare with results of focus group surveys carried out in November 2012 and February 2013. Use as basis for revising labor coefficients in the household model.
   b. Refine other input coefficients for maize based on the recent Burke et al. study of the cost of maize production, and on analysis of the 2012 RALS data.
   c. Update price coefficients.
   d. Using the 2012 RALS data, and if necessary data from the 2008 household survey, develop 2-3 farm household types for each of the three study zones, reflecting different farm and family sizes and levels of resource endowment. Include coefficients for these household types in the model.
   e. Carry out initial runs of the model in each study zone for each household type.

Output 14: Models for Northern, Eastern, and Southern Provinces with updated labor, input-output, and price coefficients.
Expected by: July 1, 2013.

4. *Refinement of linkage between climate, crop, and household models*
   a. Incorporate results of the DSSAT model for Northern, Eastern and Southern zones.
   b. Refine the statistical crop yield estimates based on incorporation of improved rainfall variables coming from additional rainfall data analysis, as described above for Year 2 activity 1. Work is needed to implement the procedures for incorporating the future climate scenarios into the crop yield models, and to validate the crop models in consultation with MSU and Zambian crop scientists.
   c. Use these improved rainfall variables in a revised econometric analysis of the impact of weather variables on household food security.
   d. Compare results of the statistical yield models to the yield data collected in the Crop Forecast Surveys during the 2000 to 2012 period.

Output 15 — Report on development of statistical crop yield models and comparison with survey data on yields.
Expected by: July 2013; dependent on availability of the FEWSNET/UCSB data.

5. *Estimation of larger-scale (e.g., national) yield and production outcomes*
    a. Inputs for this activity will be the estimated distribution of future maize yields for all of Zambia based on the GCM and DSSAT model results, and the calculation of changes from current to future yields. Both are described in Year 2 activity b.
    b. The projected future yields will be compared to yields shown in the 2012 CFS and RALS data.
    c. Using the weights from the CFS and RALS surveys to calculate maize area, total future production could be calculated at the provincial and national level.
    d. ***Note*** These calculations will represent a simplification in that the changes in maize production in response to future climate scenarios would not take into account any change in maize variety, production input levels, or area under maize. Analysis using the household model will allow for those changes to be incorporated.

Output 16 — Report on results of 5.b and 5.c.
Expected by: September 2013.

6. *Feedback workshops to share results of analyses with focus groups.* Originally scheduled for Year 2; postponed to Year 3.

Kenya

1. *Analyses of Kenya historical weather data.* The analysis will be completed using the same statistical approach and spatial time series climate dataset (from FEWSNET/UCSB) as that used in Zambia. Contacts will be made to seek daily rainfall data for the Embu and Katumani research stations, which is known to exist, and if possible also for the Kitale research station.

Output 17 — Report on results of Kenya activity 1.
Expected by: September 2013. Dependent on availability of FEWSNET/UCSB data.

2. *Development and use of climate-crop models.* DSSAT models have already been calibrated for short- and long-duration maize varieties. In Year 2, yield simulations will be conducted for two levels of fertilizer application in Kenya (already completed).

Output 18 — Report on results of Kenya activity 2.
Expected by: September 2013.

3. *Focus group surveys*. To be carried out by Ecodym starting in June for the three study zones, tentatively planned for Embu (Central/Mt. Kenya high potential small farms), Machakos (Central/East semi-arid small farms), and Rift Valley (medium- and large-scale farms).

Output 19 — Report on results of focus group surveys.
Expected by: July 2013.

4. *Initial development of household models.*
    a. Discussion is needed with the Tegemeo Institute regarding an appropriate collaborator for this activity. Some development of household models may have occurred under Tegemeo's Rockefeller Foundation-funded project.
    b. Data needed for model preparation or refinement will be collected, including that contained in crop budgets or available by analyzing the most recent national household survey.

Output 20:	Write-up of initial prototype household models.
Expected by:	September 2013.

Outreach. Outreach on project progress will be carried out in Zambia, in Kenya and in Washington, D.C., as follows:

1. Zambia: during the July trip by Olson and Crawford, an outreach seminar will be held at the Indaba Agricultural Policy Research Institute, hosting representatives of government ministries (e.g., Ministry of Agriculture) and donor agencies (e.g., USAID and SIDA).
2. Kenya: during the April/May trip by Olson, briefing sessions will be held at the Tegemeo Institute of Agricultural Policy and Development, and with representatives of government agencies (e.g., Ministry of Agriculture and KARI) and donor agencies (e.g., USAID/Kenya, USAID/East Africa, Rockefeller Foundation, and World Agroforestry Centre).
3. A Year 2 progress report seminar will be held in Washington, D.C., in September, 2013.

Proposed Time Table of Trips (to be confirmed with country partners)

April/May	Olson to travel to Kenya to work with Ecodym staff to initiate the focus group surveys.
July	Olson and Crawford to travel to Kenya and Zambia.
September	Olson and Crawford to travel to Washington, D.C.

Collaboration with related projects

c. Participation by Jenny Olson participation in: Climate Change Vulnerability Assessments: Recent Approaches and Results March 27 – 28, 2013, Washington, DC. Role: Breakout Group One Facilitator, March 27.
d. Association of American Geographers, Annual Meeting 2013, Los Angeles. Paper Session (Jennifer M. Olson, Organizer: 3101 Climate change and food security in East and Southern Africa: Current challenges in basic and applied research, Thursday, April 11, 2013. Session was organized with Chris Funk of UC Santa Barbara and his team, and will include 3 presentations by MSU climate change researchers and 2 presentations by the UCSB team and their collaborators from NOAA and NASA.[6]

[6] For details, see: http://meridian.aag.org/callforpapers/program/SessionDetail.cfm?SessionID=17544&cal=true

Attachment A: Program Description[7]

Program Description

Introduction

The activities proposed for implementation under this associate award will contribute directly to the goals of the Feed the Future (FTF) initiative. FTF focuses on sustainable reductions in hunger and poverty, with two key objectives: "accelerating inclusive agriculture sector growth and improving nutritional status" (FTF 2010, v). Climate change is recognized as a cross-cutting issue to be considered in designing programs to address FTF goals. The FTF Guide recommends that assessment of climate risk should be incorporated into food security efforts, stating: "Ensuring a sustainable and resilient agricultural development strategy requires countries to understand the potential implications of current and anticipated climate risks and vulnerabilities on the strategic objectives of their food security programs" (FTF 2010, 30-31).

Relatedly, the FTF Global Food Security Research Strategy notes that "advances in modeling of climates, production systems and actual or potential threats (e.g. pathogens, drought) can help guide research investments." (FTF 2011, 38). In addition, Zambia and Kenya include significant areas that fall into two of the Research Strategy's priority production systems, namely maize-based production systems in Southern and Eastern Africa and the East Africa highland system in which maize is also important. Regarding the former system, the Research Strategy notes that "maize is the defining crop for millions of food-insecure smallholders," and that "sustainable intensification equates with improving resilience in the face of frequent drought through improving soil moisture holding capacity and diversification for both fertility and income growth" (FTF 2011, 31)

Background

An increasingly important limiting factor for increased food production in Africa and Asia is climate, particularly low or erratic precipitation. Efforts to increase food production need to consider expected changes in climate as they affect agricultural productivity. These changes will affect high productivity zones, availability and access to food in neighboring deficit zones, as well as regional trade patterns. Efforts to develop agricultural responses resilient to climatic changes are limited by a lack of information on current and future environmental limitations, particularly at the sub-national level, and on their likely impacts on household food security.

Coupled climate, crop, land use and surface water simulation models can allow realistic analyses of the direct and interactive impacts of climate, soils and technological factors on crop production at a small fraction of the staff, financial and time requirements associated with standard field-level research. Nationally representative farm household survey data can provide the basis for modeling household production and income-earning activities in major agroecological zones, and for evaluating the impact of climate and weather factors on household food security outcomes.

Michigan State University has two groups of faculty members and researchers whose work relates to the above topics. First, a group of geographers and agro-climatologists has a regional

[7] As set forth in the technical proposal for the award.

climate-land modeling framework calibrated for East Africa that explores current and future effects of climate and management factors on crop production. Second, the MSU Food Security Group, consisting of nearly 20 faculty members based on campus and in the field, carries out a number of projects related to food security, of which the most significant is the Food Security III Cooperative Agreement. FSG projects in eastern and southern Africa have included support for multiple years of nationally representative farm household surveys, collected by the Central Statistical Office in Zambia and by the Tegemeo Institute and the Central Bureau of statistics in Kenya. These surveys include panels of the same households covering three different years in Zambia (with a fourth panel wave planned in 2012) and five different years in Kenya. Years and sample sizes are shown in Table 1. A map of the survey coverage in Zambia is in Annex F.

Table 1. National Farm Household Panel Surveys in Zambia and Kenya

Zambia		Kenya	
Year	**Sample Size**	**Year**	**Sample Size**
2001	6,922	1997	1,581
2004	5,421	2000	1,422
2008	8,094	2004	1,372
2012	(coming mid-2012)	2007	1,266
		2010	1,850

The East Africa regional modeling framework generates mapped results at the 18 x 18 kilometer scale, and site-level, higher-resolution results at the 6 kilometer scale. Climate data coupled to a process-based crop model can identify the effects of climate, climate variability and management practices such as fertilizer use, crop variety and planting dates on yields of rice, maize and other crops. The climate model coupled to a surface water model can provide information on the impact of climate change on water availability for human consumption, irrigation, or electricity generation. The model results can inform decisions on what crop varieties and management practices would be the most productive under current and projected future climate change. It can also provide information on the impact of climate change and variability on the amount of production available for household food security and trade. This type of modeling analysis can therefore directly support the value chain development objectives addressed by USAID.

In addition to modeling future crop productivity and water availability, analysis of historical data (remote sensing and meteorological station data) can provide information on climate trends from the 1960s to present, and their impact on maize and rice productivity. Critical questions being asked by governments, such as how rainy seasons are changing in length, start date, and reliability, or whether droughts are becoming more frequency and severe, can be examined.

There are several different potential approaches to defining the onset and cessation of the rainy season. For onset there are two potential approaches we are likely to use:

(1) Onset = first four rainfall events of 10 mm or more with no 7-day dry spell between any two such rainfalls. The reverse would be the cessation of the rainy season. Or,

(2) from Liebmann et al. (2007), using a formula for accumulated rainfall: Where the rainy season is the longest period for which anomalous accumulation remains greater than the annual

mean accumulation. This would also define the cessation point. For reliability, each station has data for a reliability function based on rainfall probability as outlined in Tshecko (2004).

The research and the policy-making process is being informed by engagement with rural communities to learn of their strategies for responding to current and expected climate change. Ecodym will be engaging with rural communities in Kenya through focus group discussions. MSU will hire local consultants to conduct focus group discussions in Zambia. Such information can inform the experimental design and the interpretations of modeling results, and results in more realistic and effective adaptation mechanisms.

MSU's Food Security Research Project (FSRP) in Zambia, funded for 2010-2015 by USAID and SIDA, will include nationally representative household data collection and food policy analysis that supports the goals of FTF and the Comprehensive African Agriculture Programme (CAADP). Climate change research by University of Zambia faculty and collaborators will be supported under the FSRP competitive grants program, and will focus on identifying farm household coping and adaptation strategies in response to climate change. The household-level economic modeling proposed for this Award will provide information on the impact of potential FTF project interventions and of climate variability on different household wealth categories, and support economic, nutrition and food security impact analysis of project interventions and climate change.

Purpose of Award

The purpose of the activities supported under this Award is to link the multiple-year household survey datasets available to MSU, and MSU's coupled climate, crop, land use, and water availability models, in order to improve understanding about how rural households are adapting to climate change (in terms of agricultural production practices and technologies, and perhaps other income-earning strategies), and about the impacts of anticipated future climate scenarios on farm household production, income, and food security. This information will help refine the climate change models and estimates of future household technology adoption and investment decisions, with implications for country program and policy priorities.

Proposed Activities

Briefly summarized, the proposed activities are as follows. The work will be carried out in two pilot countries, Zambia and Kenya, with Zambia activities beginning in Year 1 and Kenya activities beginning in Year 2.

1. Historical analysis of rainfall patterns over space and time using weather station data and a new promising Africa-wide data source, African Rainfall Estimation Algorithm (RFE). RFE and the Rainfall Estimation Algorithm refer to the same thing. RFE is the acronym for the operational product (daily precip. estimates across the African continent at 0.1 deg. spatial resolution), which is based on version 2.0 of the algorithm implemented in 2001. Data are currently available back to 2001 but efforts are underway to extend the data series back to 1982. Data are available via ftp at ftp.cpc.ncep.noaa.gov/fews/newalgo_est/ Nick Novella (Nicholas.Novella@noaa.gov) is the primary NOAA contact for this program.
2. Analysis of impact of past climate variability and trend changes on maize yields, using climate-crop models, and on indicators of household well-being such as food security and

income, using the multiple-year household data. As a comprehensive, dynamic crop model, DSSAT simulates crop growth and productivity on a daily or more frequent basis and directly links the effects of water supply on plant growth and development. Maize, for example, is very sensitive to a short dry period during its flowering stage. DSSAT should better reflect the overall impact of precipitation amounts and timing during the growing season than the Water Resource Satisfaction Index (WRSI) model, which is based on the mass water balance approach. Dynamic crop growth during the season is not explicitly accounted for in WRSI.

3. Projection of future climate scenarios and their impacts on maize yield and output. The results of downscaled GCMs and linked crop modeling will be georeferenced. The output will be in the form of maps and data (e.g., maps of change in temperature, precipitation during growing season, change in maize yields, etc.). The scale of analysis is flexible; we have been using 6 km for the high-resolution, localized analyses.
4. Construction of farm household models, and incorporation into those models of projected future climate change and maize yield scenarios in order to identify impacts on future household production, farm and off-farm incomes, and food security. The result will be a prototype model that would provide household-to national-level information on impacts of recent and future climate change and variability (see Table 2).
5. Use of focus groups to guide the design and interpretation of (1) and (2), and feedback groups to discuss the outcomes of (3) and (4).
6. Outreach to key stakeholders in the pilot countries and in the U.S.

Attachment B: Year 1 Implementation Plan, Activities 5, 8, and 10-13

5. Calibration and initial use of crop-climate model

MSU project staff will carry out this activity based on meteorological station data, other climate data, soils, crop characteristics and other data for the country of Zambia. Once calibrated using meteorological station and satellite data, the crop-climate model will be used to estimate yields of different maize varieties during the historical periods of interest (when household surveys were conducted), and to analyze their vulnerability to future climate change and variability. Maize varieties of interest will include those most commonly grown, and new varieties being developed by GART/ZARI for resistance to drought and acid soils. The principal activities during Year 1 will include:

a. Collecting and compiling point-specific and spatial climate and other data for Zambia.
b. Developing and calibrating the DSSAT (Decision Support System for Agrotechnology Transfer) crop model for maize in Zambia, and running DSSAT for Zambia.
c. Preparation of maps of seasonal maize yields (kg/ha) for the historical periods of interest.

Output 2: Calibrated and functioning DSSAT model for maize for Zambia.
Expected by: April 2012

Output 3: Results of DSSAT model: data and maps of yield during periods of historical interest when household surveys were conducted.
Expected by: May 2012

8. Analysis of Zambia weather station and African Rainfall Estimation Algorithm (RFE) data

Statistical analysis to identify trends in temperature and precipitation using weather station data and the African Rainfall Estimation Algorithm RFE 2.0 gridded (GIS) 1982-2010 climate database. The analyses will identify changes in:

a. Frequency, length and severity of droughts;
b. Changes in amounts and timing of rainfall;
c. Growing season precipitation totals, and variability between years;
d. Onset, end and duration of rainy seasons

Output 6: Technical report on the above.
Expected by: August 2012.

10. Initial design of household models

Activities during Year 1 will include:

a. Analysis of existing household survey data in the three target zones to determine representative farm household types in terms of family and farm size, resource levels, and principal agricultural and nonagricultural production or income-earning activities. Existing reports on food economy zoning in Zambia will be another source used in determining representative household types.[8]

[8] See http://www.fews.net/pages/livelihoods-country.aspx?loc=6&gb=zm&l=en

b. Incorporation of crop budget information from Output 4, as appropriate for each household type.

c. Construction of initial pilot household models for each target zone, in the form of whole-farm budgets or linear programming models.

Output 7: Pilot household models for each target zone
Expected by: June 2012

11. Design of procedures to link climate-crop-household models
The analysis and integration of the climate, crop-climate and household modeling results will be informed by the focus group discussions. For example, information on whether and how communities are coping with climate variability or extremes may help inform the modeling of how households choose maize varieties. Also, the results of analysis of drought trends may inform interpretation of household modeling results. During Year 1, climate data and crop-climate modeling results will be inserted in the household models to examine the importance of climate relative to other production factors in determining crop mix and household output and income.

12. Downscale general climate models for future scenarios for Zambia
General Climate Models (GCMs) will be downscaled to the selected resolution (i.e., 6 km) and run to produce data to inform the crop modeling and other project GIS work. The GCMs to be used are CSIRO, CCSM, HadCM and ECHAM (SRES A1B). See Annex C for explanations regarding these models.

Output 8: Current and projected climate data layers from four GSMs for Zambia.
Expected by: June 2012.

13. Testing and initial use of the household models
The purpose of this activity is to validate the performance of the household models with respect to observed mix of farm household activities, and to identify needed changes in model structure or values of key input/output variables or starting levels of household resources.