



**Report on Trip to Zambia  
Climate Change and Household Modeling Project  
November 7-14, 2011**

**By Jennifer Olson and Eric Crawford<sup>1</sup>**

**Overview**

We visited Zambia from November 7 to 14, 2011 to discuss the new project, “Improved Modeling of Household Food Security Decision Making and Investments Given Climate Change Uncertainty” (Cooperative Agreement Associate Award No. AID-OAA-LA-11-00010 under Food Security III Leader Award GDG-A-00-02-00021-00), funded by the Bureau for Food Security.

We held several planning and coordination meetings with the MSU FSRP and IAPRI team<sup>2</sup> in Lusaka. We also met with several stakeholders in Zambia related to climate change and agriculture including the Meteorological Department, the University of Zambia and the Golden Valley Agricultural Trust/Zambia Agricultural Research Institute. These meetings are described below. In addition to sending travel notification, we contacted the USAID Economic Growth office upon our arrival, but were not able to meet with them during our visit. A detailed calendar of activities and list of persons met, with their contact information, is attached as an annex.

In general, our visit was very productive. Those with whom we met were uniformly interested in collaborating in concrete ways that will contribute to project effectiveness. As the examples in this report indicate, there are excellent opportunities for synergy between the BFS-funded associate award and the FSRP associate award and related IAPRI activities. In addition, there will clearly be opportunities for the BFS-funded award to contribute to human and institutional capacity-building in Zambia, beyond what was explicitly planned.

**IAPRI Team**

We discussed three main topics with the FSRP/IAPRI team: (1) ways in which activities under the BFS-funded associate award could support climate change work by IAPRI,

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<sup>1</sup> Respectively, Associate Professor, Department of Telecommunications, and Professor, Department of Agricultural, Food, and Resource Economics.

<sup>2</sup> The USAID- and SIDA-funded FSRP is now working within the newly established Indaba Agriculture Policy Research Institute (IAPRI). A transition is underway in which USAID funding for activities through the MSU FSRP associate award, will be gradually handed over to IAPRI. Activities in-country are now being implemented under the banner of IAPRI. This report will occasionally use the FSRP acronym to refer to prior activities, or to the MSU associate award itself.

especially that being funded by the competitive grant to UNZA researchers; (2) recruitment of a Zambian researcher to lead in-country activities under the BFS-funded associate award; and (3) options for collecting input-output data for crops other than maize, for use in building farm household models.

Topic (1) is discussed in the next section. Regarding topic (2), on the recommendation of Antony Chapoto we met with Brian Mulenga, a Zambian M.S. degree holder with previous experience working with FSRP. We briefed him on our proposed work plan in Zambia, and he expressed interest in the position. Chapoto was interested in recruiting Mulenga as a researcher under IAPRI. We agreed that BFS project funds budgeted for a Zambian researcher would be sufficient to support a significant part of Mulenga's expected annual salary. It was agreed that Mulenga would be offered an initial three-month contract, with possibility of renewal. Crawford and Chapoto drafted a contract with the following scope of work to start on December 1, 2011:

1. Gather cost and price information for crop inputs and outputs, including wage rates and transport costs.
2. Assemble information on typical cropping patterns within Zambia by province and district, either through existing reports or by analyzing survey data, e.g., from prior Crop Forecast Surveys.
3. Follow up with Dr. Kabamba Mwansa at GART to obtain information about their maize variety testing sites and the yield and other characteristics of principal maize varieties released recently.
4. Assist in making arrangements for farmer focus groups to be conducted in early 2012 in three villages, one each in Southern, Eastern, and Northern Province.
5. Search for documents, and make copies of key documents, in the following areas among others:
  - a. Reports published by Met Department staff, especially those involving analysis of impacts of climate change on agriculture;
  - b. Theses or other research publications by UNZA students and professors on topics related to incidence and impacts of climate change on agriculture.
  - c. Reports on maize varietal improvement research and on farming systems research projects carried out by ZARI or other teams;
  - d. Studies that contain estimates of production costs or crop or farm budgets;
  - e. References listed in the proposals submitted for the climate change competitive grant (available from Dr. Chapoto).
6. Gather information about ZARI programs, such as location of research stations and senior staff in the areas of agronomy and socioeconomics.
7. Any other duties as assigned by Drs. Chapoto, Crawford, or Olson.

Regarding topic (3), the possibility was discussed of adding a module to the next Supplemental Survey, on a subset of households, to collect input requirements (including labor) and yields on crops other than maize. FSRP team members were not in favor of doing this, partly because efforts to collect labor data on maize fields during the 2009-10 Crop Forecast Survey did not result in good quality data. A revised approach was used to collect labor data in 2010-11, with the data currently being analyzed by Dingiswayo Banda in MACO. Crawford will contact Banda regarding his assessment of the quality of

that data. In any case, it appears likely that crop input-output data will need to be collected through a combination of literature review, consultation with knowledgeable agronomists in Zambia, and key informant interviews with farmers in the three zones targeted by the study.

### **University of Zambia (UNZA)**

Early in our visit we met with Lydia Chabala (Soil Science) and Elias Kuntashula (Agricultural Economics), who (along with Rebecca Lubinda, Agricultural Economics) have obtained a competitive research grant (approx. \$95,000) from FSRP to examine the impact of climate change on households and land use in six districts. Their revised research proposal, timeline, budget and other issues were discussed and suggestions made for refinements of the approach, budget and time line. The study will begin in January 2012, and will include statistical analysis of meteorological station data, land use change analysis using Landsat TM and air photos, and household surveys and analysis of previous FSRP survey data.

We discussed collaboration between their study and the pilot study funded under the BFS-funded associate award. Conclusions were as follows:

1. **Meteorological station dataset.** The results of their analysis of station data will be compared with that done by the MSU group. The two groups will use the same meteorological station data (e.g., with missing values computed, etc.) to ensure that the comparison of results of different methodologies is valid. Jenny will share the final version of the MSU analysis with the UNZA team.
2. **Satellite imagery.** Lydia will communicate to Jenny what TM & ETM images they need, and Jenny will compile images available in the US and send them to Lydia on DVDs.<sup>3</sup> Lydia needs two images: one for 2005 and 2010, for Chongwe District (15.07 to 15.20 S, and 28.45 to 29.00 E).
3. **Interview questions.** We will use similar questions on the two groups' surveys and key informant/focus group interviews about the impact of and response to extreme events (droughts, floods), and perceptions of changes in the climate / seasons. Jenny will send draft questions to Elias, who will be leading this part of the UNZA study.
4. **Survey households and data.** The team's proposed sample of 1,800 households was discussed, and it was recommended that a smaller sample be considered. In their six selected districts, the UNZA team will do their survey on a sub-set of the households covered by the FSRP/CSO Supplemental Survey. The UNZA team will work with the FSRP to obtain lists of the households surveyed.<sup>4</sup> The next round of the Supplemental Survey is planned for 2012. While the UNZA team planned to do their survey in 2013, it was recommended that they work on designing their survey instruments during the first several months of 2012 so that they could take advantage of any possible opportunities to include questions of

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<sup>3</sup> This has already been done.

<sup>4</sup> The Supplemental Survey is linked with and "supplemental" to the CSO's Post-Harvest Survey. Supplemental Surveys were carried out in 2001, 2004, and 2008.

interest in the Supplemental Survey, thereby broadening the scope of data available to them. The UNZA team will also have access to earlier rounds of Supplemental Survey data, which can be used to complement data from the UNZA survey. Conversely, information from the UNZA survey will complement the data from the 2012 Supplemental Survey.

5. **Data entry.** The FSRP data process specialist, Margaret Beaver, may be able to provide support to the UNZA team on desirable methods for data entry and data cleaning, by making available written training materials and/or by including them in training already planned for CSO and Ministry of Agriculture and Livestock personnel.

We also met with Ms. Suman Jain (Department of Mathematics) and Dr. Phiri Elija (Chair, Soil Science Department). Prof. Jain is a member of the Government of Zambia's climate change research group. She has been involved in many climate change research activities for Zambia including writing reports and papers (e.g., a working paper for the World Bank on impacts of climate change on agricultural income). Both she and her husband (Prof. Jain in the Physics Department) and Dr. Hensingo, a climatologist also in the Physics Department and others have been involved in the Zambia NAPA (National Adaptation Plan for Action) and other government climate change policy activities. She gave us a paper copy of the Zambia NAPA document.

Ms Jain is going to the University of Cape Town the week of November 14 to attend a regional workshop on using their CORDEX (Coordinated Regional Climate Downscaling Experiment) model, which is an amalgamation of downscaled GCM (global climate model) data within a RCM (regional climate model). Olson gave her the e-mail contact for Nathan Moore (Department of Geography, MSU) and said that he knows the Cape Town Climate group. Ms. Jain is doing statistical analysis of the meteorological station data to look at changing rainy seasons and variability. She also has a Masters' student who has prepared a thesis proposal to do seasonal statistical forecasting using meteorological data, which she shared with us. We told her about the FEWSNET project and suggested that they connect. Ms. Jain was not familiar with FEWSNET. She and others are also working on a cross-national hydro-climate project of the Zambezi River basin. Lastly, we briefed her about the competitive research project of Chabala, Kuntashula, and Kubinda.

We agreed with Ms. Jain to collaborate on the following:

1. **Analysis of meteorological station data.** The MSU CLIP (Climate Land Interaction Project) group would share with her (and the Zambia Met Department) our statistical methods for analyzing trends and extremes, and she will share with us her methods and results. She will also help us obtain daily or other data that we need.
2. **Comparison of CORDEX and CLIP's downscaled climate data results.** She would be interested in having us run DSSAT with CORDEX data, to compare those results with ours from downscaled GCM data.

3. **The MSU climate change project group will keep them informed** of our activities. We will invite or have them co-host any outreach seminars that we carry out in Zambia.

### **Meteorological Department, Ministry of Communications and Transport**

A meeting was held at the FSRP offices to discuss potential collaboration between the FSRP and BFS-funded projects with the Zambia Met Department (ZMD). Mr. Overseas Mwangase, Deputy Director of ZMD, attended. Mr. Mwangase has a B.Sc. in meteorology from University of Nairobi, and has done work on climatology since then. The former director, Maurice Muchinda, is a climatologist. Mr. Muchinda did research with the FAO on the impacts of drought/climatic extremes on agriculture (an AgShare project). Dr. Joseph Kanyango, another former director, is currently a member of the IPCC 5<sup>th</sup> assessment team.

ZMD staff contributed to the Zambia NAPA report. They currently have people looking at the links between weather and biology/health, and hydrology. They are part of the USAID-funded eight-country project including the Water Resource Institute at the University of Dar es Salaam, NOAA and the University of San Diego looking at Zambezi River Basin flooding to develop an early warning system. They are creating a hydrological model, and adding new weather stations in the western part of Zambia (source of Zambezi River) to inform the model.

We and the FSRP team expressed a desire to obtain daily rainfall and temperature data. Mr. Mwangase indicated that normally, when ZMD provides daily data, they would like one of their staff members to participate in the data analysis, partly for capacity building and partly to ensure that ZMD has a say in what is done with the data. They have experienced problems in the past where people did not acknowledge ZMD as the data source, and then criticized the data and/or manipulated the data in ways that ZMD disagreed with.

Mr. Mwangase indicated that he would very much like to be part of our team. We agreed on the following:

1. **ZMD involvement.** ZMD will be welcome to be part of the team, come to our workshop/ meeting in January/February, and help interpret the analytical results.
2. **Statistical analysis methods.** ZMD would be very interested in learning how MSU will do the statistical analysis of the rainfall data, especially the trend analysis and the analysis of extremes. Olson confirmed that we would share the methodology, both with ZMD and with FSRP staff, which had previously attempted to fill in missing rainfall data values and are interested in how MSU does that.
3. **ZMD daily rainfall and temperature data.** They are willing to share the daily data. Olson said that we do not need all the stations and all the years. When we finalize the choice of our case study sites we will communicate with them again to discuss getting the daily data.

4. **Spatial layer/map.** They would be extremely interested in the results of the kriging of the meteorological station data, which basically gives a map of spatially interpolated station data. FSRP is also extremely interested in having such a product to link weather data to their household survey data.
5. **Buying new weather stations.** The FSRP group is interested in purchasing some automatic weather stations, and ZMD very much welcomes that. Olson strongly encouraged FSRP to work with ZMD so that ZMD would decide on the best locations for the stations, and would manage the stations and the data. This was agreed. Olson indicated that MSU would let FSRP staff know the cost of a recommended station that would collect basic rainfall, temperature, humidity, barometric pressure, etc.<sup>5</sup> Olson recommended that one such station be installed at the GART/ZARI research station north of Lusaka.<sup>6</sup>

Issues related to meteorological station data and methods of processing it:

1. Monthly rainfall, min and max temperatures, and humidity (for some stations) for 1950 or so to 2010. Updated files obtained from Solomon were sent by Jenny to her team members at MSU.
2. 1990-2010 dekadal rainfall (from Nicky Mason). These files have latitude, longitude, and altitude for the stations. Working with ZMD, Nicki developed a process for filling in missing values, but she would like to know the methodology that MSU team member Jeff Andresen (Department of Geography) would recommend. Nicky provided the data without filled-in values, which was sent to Jenny's team members.
3. Working with ZMD, Nicky also interpolated between stations to fill in weather data for every district. She is not comfortable with her approach, and would really like us to provide a better method. Margaret Beaver gave Jenny a data file with the centroids of the SEAs (standard enumeration areas) and can send a shape file of those boundaries. The FSRP/CSO surveys are linked to the SEAs, so that is the unit for which they would prefer to have estimated weather data.
4. Lastly, Nicky asked what would be a good indicator of weather for the growing season? Total rainfall, or what? What can they use without having a crop model?<sup>7</sup>

### **Golden Valley Agricultural Research Trust/Zambia Agricultural Research Institute**

With Steven Kabwe, IAPRI Outreach Director, we traveled to the GART/ZARI station at Chisamba about 55 km north of Lusaka where we met with Mr. Kabamba Mwansa, maize crop breeder/agronomist. A summary of our discussions follows.

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<sup>5</sup> This has already been done, by e-mail from Olson to Nicky Mason on Dec. 6, 2011.

<sup>6</sup> The University of Indiana, through an NSF project led by Tom Evans, is putting in automatic rain gauges in Eastern Province where they are doing their surveys.

<sup>7</sup> In Jenny's Dec. 6 e-mail to Nicky, she communicated Andresen's recommendation that the easiest weather index would be the ratio of actual to potential evapotranspiration, which requires temperature, rainfall, and solar radiation, and (ideally) other variables. Solar radiation can be estimated from satellite data.

ZARI is doing research in collaboration with the major seed companies. ZARI changed its maize breeding strategy around 10-12 years ago to address 4 main limitations:

1. **Drought**, since droughts are becoming more frequent and maize has been particularly vulnerable to breaks in rains during the flowering stage. Breeding is being done to reduce the plants' tolerance to dry periods, and they have had some success. They earlier released 6 drought resistant varieties (including hybrids GV640 and GV659 and OPVs, non-hybrids) through an exchange program with seed companies, and have released 7 more recently. Some were from CIMMYT. Three more are in the pipeline. So far 3 are being distributed to farmers, and they seem to like them (they stay green during dry spells). ZARI/GART plans on all of the new varieties being Bt by 2016. They are recently working to reduce vulnerability to heat.
2. **Low soil fertility**, especially low N. Fertilizer is too expensive for smallholders who cannot rotate fields. Marginal lands are increasingly being put under cultivation, and settlements are encroaching onto prime agricultural land.
3. **Acid soil**, especially in the North where pH is < 3, but also some problems in region 2 (central Zambia). They are testing some new germ plasm (less success than drought tolerance).
4. **Pests**, such as stem borers. They are testing some germ plasm for this.

GART has one main breeding and research site, at Chisamba, and several (7?) testing sites around the country. Each site is focusing on testing varieties for one or more of the main stresses. Each has a meteorological station with long-term weather data, and has done soil testing, etc. So Mwansa will work on getting yield and other data for the main three varieties (OPV 521, MRI 624 and MRI 737) from these stations, for use in the MSU crop model. On a related topic, Mr. Mwansa said that he did not know of anyone in Zambia doing crop modeling.

The coordinates of 3 of the stations are as follows:

Station	Altitude (m)	Latitude	Longitude
Golden Valley	1170	14.17 S	28.37 E
Kabwe	1207	14.27 S	28.28 E
Mt. Makulu	1281	15.53 S	28.25 E

## **Next Steps**

Activities identified for follow-up are listed below:

### **General:**

- Prepare/finalize revised work plan
- Follow-up to November trip to Zambia
  - Confirm choice of 3 study locations
  - Initiate contacts with UNZA, GART/ZARI, and ZMD
  - Establish regular contact with Brian Mulenga, Zambian researcher hired under the project
- Plan February 2012 research collaborators meeting and community focus group interviews

### **IAPRI:**

- MSU team to advise on:
  - Specifications of automatic weather stations or rain gauges to buy
  - Best indicators of weather during growing season to use in analyzing maize production obtaining geo reference data in future surveys
- MSU team will provide spatially interpolated rainfall data map
- Discuss plans for next Supplemental Survey and possible linkage with survey planned by UNZA team, e.g., inclusion of questions regarding climate vulnerability and adaptation

### **UNZA (Chabala and team):**

- Develop common set of Met station data (with missing data estimated)
- MSU to provide satellite imagery for use in Prof. Chabala's Ph.D. research on land use
- Develop common set of questions for surveys and key informant interviews. (Jenny to send them suggested draft questions.)
- Zambia project to provide SS data and HH lists to UNZA
- MSU (Margaret Beaver) to advise UNZA on data entry software and cleaning methods

### **UNZA (Prof. S. Jain):**

- Share statistical methods for analyzing trends and extremes in the ZMD weather station data
- Jain to assist in obtaining daily Met data
- Compare results of crop modeling based on predicted climate scenarios from (a) MSU/CLIP model data and (b) CORDEX data (synthesis of multiple African regional models)
- MSU and UNZA to co-host outreach seminars
- Provide Prof. Jain with info on FEWSNET

**ZMD:**

- Follow up to obtain daily data.
- Recommend what automatic weather stations to buy.
- Share methodology for filling in missing data.
- Provide spatial layer (boundary of climate zones) which they can link to district/SEA data.
- Met Dept to participate in February planning meetings.

**GART/ZARI:**

- Obtain maize yield, rainfall, temp, and soils data for key maize breeding test sites.
- Explore possibility of providing training in crop modeling, and identify the need for any additional resources to support that.

## Annex

### Calendar of Activities, Persons Met, and Contact Information

#### Monday, Nov. 7

- 2:30 a.m.: Arrival, Lusaka
- 10:00 a.m.: Staff meeting with Food Security Research Project (FSRP) team
- Afternoon: Planning sessions at FSRP office

#### Tuesday, Nov. 8

- 10:00 a.m.: Meet with UNZA climate change researchers, Lydia Chabala (Soil Science) and Elias Kuntashula (Agricultural Economics) to discuss proposed activities to be funded by FSRP grant, and coordination with research under BFS associate award.
- 1:00 p.m.: Meet with MSU/FSRP researchers, Thom Jayne and Dave Tschirley
- 2:30 p.m.: Meet with MSU/FSRP researcher, Nicky Mason
- 4:00 p.m.: Meet Brian Mulenga, prospective Zambia research fellow for BFS-climate change study

#### Wednesday, Nov. 9

- 12:30 p.m.: FSRP seminar by Gilbert Mudenda (Institute for Policy Studies) on land issues in Zambia
- 3:00 p.m.: Meeting with FSRP team and Overseas Mwangase, Deputy Director of Meteorological Department; discuss collaboration on FSRP and BFS associate award activities and access to Met data on daily rainfall and temperature.
- 4:00 p.m.: Crawford and Chapoto meet with European Union representatives Eddy Delaunay-Belleville (Economic, Rural Development, and Private Sector Development Section) and Peter Oates (Technical Advisor to the Ministry of Agriculture and Cooperatives for the Inception of the Performance Enhancement Programme)

#### Thursday, Nov. 10

- 9:30 a.m.: Travel to Golden Valley Agricultural Research Trust (GART) and ZARI agricultural research station
- 10:30 a.m.: Meet with Dr. Kabamba Mwansa, maize breeder, to discuss collaboration with BFS associate award activities, data needs, etc. Also met Simunji Simunji (agronomist) and Douglas Moono, R&D Manager.
- Afternoon: Work at FSRP office

#### Friday, Nov. 11

- 10:00 a.m. Meet Chabala and Kuntashula at UNZA to continue discussion of coordination between of their FSRP-funded research and that funded under the BFS associate award.
- 11:30 a.m.: Meet Dr. Suman Jain (Dept. of Mathematics) to brief her on BFS-funded project, learn of her climate change research activities, and discuss collaboration. Also met Dr. Phiri Elija, Head of Soil Sci. Dept.

2:30 p.m.: Meet with FSRP team to discuss their survey plans for 2012 and 2013, and coordination between FSRP and BFS-climate change activities.

**Saturday, Nov. 12**

8:30 a.m.: Crawford and Olson meet to discuss scope of work for Brian Mulenga

10:00 a.m.: Olson departure

Afternoon: Work at hotel

**Sunday, Nov. 13 Work at hotel**

**Monday, Nov. 14**

9:00 a.m.: Crawford meets with Antony Chapoto and Brian Mulenga to review scope of work and terms of proposed 3-month contract under BFS-climate change study

10:00 a.m.: Crawford meets with Thom Jayne

10:30 a.m.: Crawford departure for airport and return to East Lansing

**Contact Information**

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