HortCRSP

UC Davis Horticulture Collaborative Research Support Program
Exploratory Projects
Performance Report

Check Report Type:
✓ 2nd Quarter Reporting Period (January 1, 2011 to March 31, 2011) - Due April 30, 2011
___ 3rd Quarter Reporting Period (April 1, 2011 to June 30, 2011) - Due July 31, 2011
___ 4th Quarter Reporting Period (July 1, 2011 to September 30, 2011) - Due October 31, 2011

Title of Project *Geographic information accessibility for improving horticultural-based income generation in the Mzimba district of Malawi*

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Part I - Performance Indicators

Please see uploaded .xls table

Part II - Monitoring and Evaluation Plan Matrix

Purchases to date (purchases_to_date.xls)

Progress to date on our plan:

Objective #1: GIS base mapping and database development				
Activities	**Outcomes**	**Measure of success**	**Documentation and impacts of success**	**Progress to date**
• Acquisition of satellite imagery for study area – approximately 50 km^2 region of Embangweni • Acquisition of pre-exisiting GIS data layers from private and public sources • New GIS spatial and attribute data development using on-screen digitizing and satellite imagery, GPS field data collection integration, and with collaborative communication between BSC and WRM partners about features	• Satellite imagery acquired • Data layers acquired • GIS and GPS data developed	• GIS base mapping and database developed	• Monthly reports	• Monthly reports o MzimbaReport2011_Jan.pdf o MzimbaReport2011_Feb.pdf o MzimbaReport2011_Mar.pdf • Acquisition of topographic maps and satellite imagery – imagery datasets are highlighted in MzimbaReport2011_Mar.pdf o IKONOS (50 km^2) o ALOS (full area) o TM (full area) • Acquisition of pre-existing data layers from Malawian Survey Office. Development of a soil texture map and shapefile in collaboration w H. Kaunda. These layers are highlighted in MzimbaReport2011_Jan.pdf • GPS data points collected and new GIS spatial data developed. These new data sets are highlighted in MzimbaReport2011_Mar.pdf • Survey to collect farmer data completed with

to map and attribute information for those features				IRB approval ○ Survey.doc, Malawi IRB_Application.doc, IRBapproval.pdf • Monthly anemometer readings are being collected (anemometer_data file)
Objective #2: GIS/GPS skill training				
Activities	**Outcomes**	**Measure of success**	**Documentation of success**	**Progress to date**
• Develop training materials specific to WRM horticulture programs and goals for the Embangweni region • Conduction of two training sessions (January and June 2011) for WRM staff focused on GIS database development (January) and GIS data analysis (June) • Ongoing collaborative communication between BSC and WRM partners before, during and after training sessions	• Training materials developed • Staff trained • WRM partners and BSC staff jointly working	• WRM staff trained in GIS/GPS skills	• Monthly reports	• Monthly reports ○ MzimbaReport2011_Jan.pdf ○ MzimbaReport2011_Feb.pdf ○ MzimbaReport2011_Mar.pdf • January training ○ Geographic information systems demonstration (ZAINE) ○ GPS overview (GPS.ppt) ○ Anemometer download (anemometer_tutorial.doc) • Collaborative communication between BSU and WR partners about features to map, and information for those features. A documented example of this communication can be seen in gpspoints_questions.ppt
Objective #3: Integration of geographic data and analyses in current WRM horticulture projects and future CRSP proposal				
Activities	**Outcomes**	**Measure of success**	**Documentation of success**	**Progress to date**
• Preliminary GIS data analyses and reporting • Continued analyses of GIS datasets will be proposed in a CRSP Pilot Project (fall 2011) that will continue to integrate GIS with horticultural decision-making and activities with continued focus on farmers'/WRM input of and farmers'/WRM data dissemination in determining best locations for future WRM horticultural programming in the areas of crop production, irrigation farming and agribusiness	• GIS data analyzed and reported	• GIS/GPS data analysis integrated in WRM current horticulture projects and future CRSP	• Monthly reports	• Monthly reports ○ MzimbaReport2011_Jan.pdf ○ MzimbaReport2011_Feb.pdf ○ MzimbaReport2011_Mar.pdf • Irrigable area analysis (overview in MzimbaReport2011_Mar.pdf)

Part III - Narrative

During the second quarter, the primary activities are as listed by month below. These activities are highlighted in our monthly reports (uploaded):

- MzimbaReport2011_Jan.pdf
- MzimbaReport2011_Feb.pdf
- MzimbaReport2011_Mar.pdf

January

1 District trip

The team met for the first time in January. The main objectives of the trip were equipment set up and training, meet with potential collaborators in Lilongwe and the Mzimba District, and perform field visits with World Relief District Team for relationship building with farmers of the District.

2 Area specialist visits

During the January trip the team set up appointments and visited with several people working in horticulture and post processing in the Mzimba District and in the capiall city of Lilongwe. The following list represents government and higher education professionals who are involved in extension and research in aspects of horticulture and food processing

- **Department of Agriculture District Office**
  - There needs to be a focus on the market and value added processing
  - Fruit production is being promoted – generates more income than vegetables
- **Mbawa EPA**
  - Challenge is getting perishables to market quickly
  - Currently there are three Small Holder Production and Marketing Schemes in Mzimba. The program is in its third year. Around 50 farmers work as an association on a designated piece of land (around 20 ha) with inputs being funded by a revolving fund. Treadle pump irrigation is used to support continuous production throughout the year with a warehouse and collection center built for transport and storage.
- **Mbawa Agriculture Experimental Station**
  - Horticulture isn't currently a part of the Mbawa EPA
  - The town of Jenda is key for any marketing project for people living in southern Mzukuzuku.
- **Bunda College of Agriculture**
  - Bunda faculty could have a part in a future project as advisors, review and evaluation, research opportunities for staff and students, and multiplication of planning for experiments.
  - Bunda staff collaborate with NGOs, USAID, EU, African Union National Research Council and with a network of twenty-five African universities for research and teaching exchanges.
  - Connections with US universities include: Penn State, University of California and University of Iowa.
  - Concerning post-processing, the challenges are infrastructure, transportation and electricity. Consistency and volume are also concerns and challenges.
- **Ministry of Agriculture – Horticulture Division**
  - Horticulture is underdeveloped in Malawi.
  - Some VCA have been done for some horticulture crops
  - Citrus-producing areas are under attack by pests. Rehab of old trees is being done by FAO and Malawian Government.
  - Other horticulture crops being promoted: pineapple, banana, citrus, macadamia, cashew, avocado, Irish potatoes

3 Training and demonstrations

Demonstrations of GIS and GPS technology and their uses helped the Team determine data that would be important in locating, managing and scaling up a horticulture project. Training included informal discussions and short demonstrations using ArcGIS 9.3. The two field Promoters (Lupakisho Chitete and Lauren Tembo*)* demonstrated successful mastery of using the Garmin GPS receivers to acquire a point location in geographic coordinates.

4 Field data collection protocol and survey design

The GPS points to first be collected in Mzukuzuku were to be:

- Agricultural deals
- Artificial dams or wells
- Electricity locations
- Existing irrigation schemes
- Existing processing plants

- Extension blocks or club meeting locations
- Storage facilities or warehouses

The farmer survey was developed in collaboration with all team members and contains approximately 40 questions divided among nine sections:

A. Household data
B. Income
C. Land use
D. Farming organizations
E. Marketing
F. Land management inputs
G. Extension services
H. Support services
I. Field location coordinates

The team traveled to Chamalaza to visit an irrigation scheme in that village and test out the survey questions.

5 Anemometer installation

The distinct wet/dry seasons of Mzimba require complete consideration of irrigation options for a successful horticulture projects. Not only do sources of irrigation water need to be considered, but also the energy needed to move the water from its source. Currently human energy using treadle pumps have been the main energy source for moving water. The Team is interested in considering other forms of energy that would be more efficient. Wind energy is one of these forms.

To begin gathering information on wind speeds, two anemometer towers were installed to log wind speed and direction data. The locations for the towers were: 1) along a floodplain near the Laswozi River and 2) next to the World Relief District office near the Embangweni town center. These locations were considered exemplary of the larger area in terms of their elevation, aspect and proximity to a perennial stream as an irrigation water source.

The anemometers were manufactured by Onset®. Two anemometers were connected to each of the two towers and placed at a 6.5 m and 10 m height above the ground surface. The anemometers were connected a HOBO® data logging device at 1.5 m above the ground surface.

The anemometers were programmed using HOBOware® Pro 2.3.0 software to collect and average data at 1 second and 30 second intervals respectively. Hudson and Dameseko were trained on how to download datafiles from the HOBO® logger and restart the anemometers.

6 Soil texture map

Hudson Kaunda, Field Agriculture Coordinator provided expert knowledge on soil texture classes in Mzukuzuku. The soil texture regions designated on the topoquad will be transferred into a shapefile by the BSU team.

February

1 IRB approval

The team submitted an application for IRB approval to the Bridgewater State University board in February along with the survey developed in January and a informed consent form. There were major concerns of the BSU IRB having to do with collecting information from minors - child-headed households in the Mzimba region. Although the team felt these households were of very high importance to include in our work, the probability of successfully acquiring IRB approval within a reasonable time frame appeared to be low and that any successful horticulture program as an outcome of our work would benefit these households equally, if not more so. We were also requested to not collect GPS locations of individuals' homes as a means of ensuring anonymity of an individual. We will attach a respondents' geographical location to a village location. We received notification of IRB (#2011090) approval on February 11.

2 Anemometer readings

The first full month of anemometer readings were sent from Mzimba in February. Values (table to the left) show the 6.5 height anemometer to be slightly over 1 meter per second and around 2.5 meters per second at the 10 meter height

The team was faced with the unfortunate news that the HOBO® logging device was removed by a vandal sometime between February 22 and 28th. Future analysis of wind data for the Mzukuzuku region will be generated from the WR Office anemometer site readings.

3 WR meetings with EPA

Damaseko met with EPA officials to gather information on crops species and varieties to target in a horticulture project in Mzimba. He reported that they have chosen one variety for oranges, mangoes, bananas, tomatoes, cabbage, and onions. They also discussed the inclusion of pineapples though they are not grown in the area but there is potential.

4 Malawi Survey Office shape files

The shapefiles purchased in January from the Malawian survey office were reprojected to UTM coordinates and analyzed to determine what the contents of each shapefile.

Cont.shp – Height contour lines in feet above sea level. Digitized from the topoquad basemaps.
Dambo.shp – polygons representing marshes and dambos.
Jenda_Euthini road.shp – single line representing road S112
Rd.shp – detailed roads layer, contains several classes of road (primary, secondary, tertiary)
Riv.shp – rivers and streams
Ta.shp – polygons representing the boundaries of the Traditional Authorities
Trigs.shp – appears to be benchmark locations measures in meters above sea level
Vil.shp – village locations. Do not seem to coincide with the location of villages on topoquad map.

Fore.shp –boundaries for the Perekezi and South Viphya forests.

5 UMass Amherst Wind Energy Center

Since early in the project, Dr. Utama Abdulwahid at the University of Massachusetts at Amherst Wind Energy Center has been gracious in offering the team advice in set up and management of the anemometers and also in analyzing the data we've been gathering. Dr. Abdulwahid has provided us with two methods of estimating the energy produced by the wind. A very simplified calculation:

Power in the wind = 0.5 x air density x swept area x average wind speed cubed

A more complex method is based on the power curve of a specific turbine. The power curve values with the inputs of bin width, the average wind speed and the rated power (Watts) for the turbine return energy produced in kilowatts per hour. Since we haven't identified a turbine manufacturer, or allocated resources to the production of a homemade turbine, we used the AWP3.6 Wind Generator manufactured by African Windpower as a model for beginning to estimate energy.

The graph to the right shows energy that would be generated by the AWP3.6 which has a rated wind speed of 12 m/sec. For this calculation an average wind speed of 5 m/sec was used. Total annual energy is estimated at 3.2 million kWh in a year. This total assumes the wind speeds follow the Raleigh distribution.

March

1 GPS readings from the field

The first GPS readings were sent from the field in March. The 65 locations are withing or close to the TA Mzukuzuku. The locations recorded include agrodealers, dams and wells, electricity points, meeting locations, irrigation schemes, and storage facilities. A GIS point shapefile was created from the points. This layer will be used for location-allocation and other analyses and in June training and demonstrations.

2 Zaine Venter on board through summer

Zaine Venter will be graduating with his BS in Geography this spring. We worked with the University to create an hourly position so he can remain on board with our grant work through the end of August.

3 Imagery acquisition

Advance Land Observation Satellite (ALOS) imagery was purchased from East View Cartographic in late March. The data bands include spectral RGB and a NIR band, all with a spatial resolution (10 m). The date of collection was during the wet season (January 9) in 2009. The imagery will be used to update acquired shapefiles, for vegetation analysis and to create new layers of the point, line and polygon locations. This data is added to the IKONOS imagery purchased in December. The 50 square km area of high resolution (4m RGB, NIR, 1 m Panchromatic) IKONOS imagery was purchased to test its utility versus price for producing data layers to be used in the GIS. Two Landsat Thematic Mapper (TM) images (RGB, NIR, all 30 m) were acquired from the NASA WIST data portal. The images, one from the wet season and one from the dry season of 2010 represent a snapshot of coverage in the region of pre- and post- harvest land use. The larger spatial resolution data, as compared with the ALOS data, will be used for vegetation analysis and not useful for identifying smaller features.

4 ASTER DEM and irrigation viewshed mapping

The area to be reached by irrigation water source (boreholes, rivers, wells) can be modeled through viewshed analyses. The process takes into consideration an "observer point" (location of water source) and "observer height" the estimated elevation from the surface the water can be lifted using a pump (treadle, wind powered, solar powered, etc.). A viewshed analysis requires an elevation raster data set to determine which areas can be "seen" from the observer point. ASTER 30 m pixel resolution data was acquired from the NASA WIST data portal for the study region. The images above show a preliminary modeling of areas within and near Mzukuzuku that would be irrigable (in green) from perennial streams with a lift height of 5 m (left) and 7 m (right).

Part IV - Training report for people trained in countries outside the United States.

1. Did you bring trainees from their country of residence to another country (not the United States) for training (i.e. you brought trainees from Mexico to Costa Rica for a workshop)?

- No

2. Did you train people in their own country of residence?

- Yes

Program Name	Anemometer training
Start Date	1-11-11
End Date	1-11-11
Method of Training (Traditional Learning or Distance Learning)	Traditional
Training Type[1] (select one from list at bottom of table (please note that some are not applicable to our projects))	Technical Program - On-the-job Training
Short Description of Activity	Demonstrate how to use Onset HOBO loggers and HOBOware Pro software
Short Description of Objective	Train WR staff on how to download records and restart logging device.
Training Provider (typically your university)	Bridgewater State University
Total Cost of Instruction (room, books, equipment, registration fees, handouts, etc.)	--
Total Participant Expenses (per diem meals, hotel, etc.)	--
Total Travel Expenses (airfare, taxis, etc.)	Part of overall January trip costs
Did this project have non-USAID funding sources? If yes, indicate how much and who provided funding.	No
Describe trainee selection process	World Relief District employees (field promoters) and their supervisor – project Co-Investigator (H. Kaunda)
Number of Males Trained	3
Number of Females Trained	0

Program Name	GPS demonstration and receiver training
Start Date	1-10-11
End Date	1-10-11
Method of Training (Traditional Learning or Distance Learning)	Traditional
Training Type[1] (select one from list at bottom of table (please note that some are not applicable to our projects))	Technical Program - Tailored Program
Short Description of Activity	Overview of GPS technology and uses and then hands-on training using Garmin receivers
Short Description of Objective	Train WR Promoters how to record lat/long values for points of interest
Training Provider (typically your university)	Bridgewater State University
Total Cost of Instruction (room, books, equipment, registration fees, handouts, etc.)	--
Total Participant Expenses (per diem meals, hotel, etc.)	--
Total Travel Expenses (airfare, taxis, etc.)	Part of overall January trip costs
Did this project have non-USAID funding sources? If yes, indicate how much and who provided funding.	No
Describe trainee selection process	World Relief District employees (field promoters) and their supervisor – project Co-Investigator (H. Kaunda)
Number of Males Trained	3
Number of Females Trained	0

Program Name	GIS demonstration
Start Date	1-10-11
End Date	1-10-11
Method of Training (Traditional Learning or Distance Learning)	Traditional
Training Type[1] (select one from list at bottom of table (please note that some are not applicable to our projects))	Technical Program - Seminar
Short Description of Activity	GIS demonstrations showing how GIS can be applied to solve problems
Short Description of Objective	To give WR District employees ideas about how GIS can be used so that in going forward we can all make data development decisions most applicable to horticulture considerations
Training Provider (typically your university)	Bridgewater State University
Total Cost of Instruction (room, books, equipment, registration fees, handouts, etc.)	--
Total Participant Expenses (per diem meals, hotel, etc.)	--
Total Travel Expenses (airfare, taxis, etc.)	Part of overall January trip costs
Did this project have non-USAID funding sources? If yes, indicate how much and who provided funding.	no
Describe trainee selection process	World Relief District employees (field promoters) and their supervisor – project Co-Investigator (H. Kaunda) and World Relief Country employees/Co-Investigators M. Jemitale and G. Nkanaunena
Number of Males Trained	5
Number of Females Trained	0

Part V - Trip Report

Date of Trip **January 3 – 15, 2011**

Location of Trip **Malawi (Lilongwe and Mzimba District)**

Travelers **Darcy Boellstorff and Zaine Venter (BSU Student) traveled from the US, Gibson Nkanaunena and Moses Jemitale traveled to Mzimba from Lilongwe and Hudson Kaunda and Damaseko Nyirongo traveled within Mzimba.**

Purpose of Trip **Relationship building, field visits, data collection, training**

Some select photos from trip uploaded in file jan_photos

Description of Activity	Analysis of Activity	Action Taken
1. Test internet connections at WR Country and Mzimba District office to determine applicability of server GIS 2. Pre-trip briefing with BSU and WR Country staff 3. Anemometer installation and training 4. GIS/GPS training 5. Visits with Ministry of Agriculture, Bunda College of Agriculture, District Office of Department of Agriculture 6. Field visits in Mzukuzuku 7. Data collection 8. Survey development 9. Debriefing with WR Country staff	1. Determined that internet connection at Country office is good, reliable but perhaps not efficient enough to use ArcGIS Server as a means to collaborate. District Office internet connection is not reliable or efficient enough to use ArcGIS Server 2. WR and BSU exchanged ideas about Hort CRSP proposal and horticulture in Mzimba 3. Anemometer towers w/ two anemometers each were installed in Mzimba and WR field staff were trained on how to download records and restart devices 4. Training sessions went as planned and set the stage for further data collection and analysis 5. Team collected expert ideas and opinions on horticulture potential and considerations in Mzimba 6. Team gathered first hand field knowledge about current activities and farmers' considerations from the Mzukuzuku Traditional Authority of Mzimba 7. Collection of existing GIS datasets from Survey Office and soil texture areas from H. Kaunda 8. Team developed a 9-section, 45-question survey to distribute to Mzimba farmers 9. Reported to WR Country staff an overview of the work that was accomplished during the Mzimba trip	1. Will not be using ArcGIS Server for this project. Are considering software (free, open source) for sustainable use during and after project in Malawi. 2. Ideas will be used in formation of future work 3. Wind speed database being developed 4. GIS – productive collaboration and idea exchange on data and analysis. GPS – field collection of data points 5. Ideas gathered will be used in formation of future work, new potential collaborative relationships started 6. Incorporation of existing knowledge/projects and local considerations in future work 7. Data sets incorporated in GIS, can focus on data development areas not covered 8. IRB approval through BSU and survey distribution initiated 9. Overall considerations and reflections of trip to be taken into account in future activities

Part VI – Materials

All documentation highlighted in this report are in an uploaded file malawi_materials_quarter2.rar