



**Synergizing fertilizer micro-dosing and indigenous vegetable production to enhance food and economic security of West African farmers  
(CIFSRF Phase 2)**

Project Number 107983  
Location of Study: Nigeria and Benin Republic

By

<sup>1</sup>Adebooye O.C., <sup>2</sup>Akponikpe, P.B.I., <sup>3</sup>Oyedele, D.J., <sup>4</sup>Peak, D & <sup>5</sup>Aluko, E.R.

<sup>1</sup>Osun State University, Osogbo, Nigeria

<sup>2</sup>Université de Parakou, Parakou, Benin Republic

<sup>3</sup>Obafemi Awolowo University, Ile-Ife, Nigeria,

<sup>4</sup>University of Saskatchewan, Saskatoon, Canada

<sup>5</sup>University of Manitoba, Winnipeg, Canada

**18-month project update (3<sup>rd</sup> Interim Technical Report)**

March-September, 2016

September 19, 2016.



Global Affairs  
Canada



International Development Research Centre  
Centre de recherches pour le développement international

## 1. Project summary

The agrarian, rural and resource-poor inhabitants of Nigeria and Benin depend on indigenous edible vegetables for daily supplies of vitamins and nutrients. Since these indigenous vegetables had not been a subject of organized research, this research project was initiated to develop new technologies to improve farming practices, post-harvest handling and value addition for these indigenous vegetables. This offers tremendous opportunities for food security and economic empowerment of the poor rural population, especially the resource-poor women farmers. This project is a synergy of the Nigeria-Canada Indigenous Vegetables Project (NiCanVeg Project 106511) and the Integrated Nutrient and Water Management in the Sahel (INuWaM Project 106516). The promising results of the innovations that were developed by the two projects are being explored for complementarity to accelerate large-scale adoption and impacts of underutilized indigenous vegetable and fertilizer micro-dosing innovations to increase food and nutritional security and economic empowerment of resource-poor farming communities in Nigeria and Benin. The project has developed, tested and deployed two approaches for scaling up fertilizer micro-dosing innovations to improve production. We are to reach over 255,000 households. This project aims at:

- Refining and deploying technologies for fertilizer micro-dosing, water management, value addition and seed production for growing indigenous vegetables.
- Testing, demonstrating and deploying two different models (Innovations Platform IP and Satellite Dissemination Approach SDA) for reaching and benefiting more farmers with sustainable vegetable production and marketing innovations.
- Scaling the capsule technology to advance indigenous vegetables production, increase yields and income through value addition, preserve soil and water ecosystems, and enable fertilizer cost saving.
- Promoting policy advocacy for the integration of the successful scaling up model into local, national and regional food security programs in West Africa.

## 2. Progress towards Results/ Outcomes

### **A. Comprehensive report on fertilizer micro-dosing and water management studies for indigenous vegetables.**

We have successfully concluded our fertilizer microdosing and water management studies in Benin Republic and Nigeria. The comprehensive report is attached as Appendix 1. We present below the key messages from our findings in 6 bullet points below:

- Fresh vegetable shoot yields were consistently significantly higher by 30-55% in savanna agro-ecology compared with the forest agro-ecology locations in Nigeria.

- Fresh leaf yields of the vegetables at 40-60 kg urea-N/ha increased by 46-57% compared to control (no fertilizer) across all the locations.
- The highest economic returns were generated at a fertilizer application rate of 60kg per plot as every naira of variable cost incurred by the farmer returns ₦4.57, ₦4.29 and ₦6.25 for *Tete*, *Igbagba* and *Ugu*, compared to ₦1.94, ₦1.36 and ₦1.75, respectively under the control (no fertilizer).
- In Nigeria, an optimum urea fertilizer micro-dose rate of 40-60 kg/ha urea-N was established for the three vegetables during two cycles of planting, while in Benin *Amaranthus* had the highest yield at 40 kg urea-N versus 60 kg/ha for *Solanum macrocarpon* and *Ocimum gratissimum*.
- The average water use by the three vegetables ranged from 285-377 mm of water in the forest and savanna agro-ecologies, respectively.
- For every one mm (1 mm) of water, the fresh biomass yield of *Amaranthus* and *Solanum macrocarpon* increased from 27 kg ha<sup>-1</sup> to 36 kg ha<sup>-1</sup> in the humid forest, from 32 kg ha<sup>-1</sup> to 48 kg ha<sup>-1</sup> in the savanna (Nigeria) and from 22.5 kg ha<sup>-1</sup> to 36.6 kg ha<sup>-1</sup> in the dry savanna region of Benin.

**B. Value addition for indigenous vegetables through food fortification studies, processing and preservation and utilization.**

Our studies on value addition, processing, preservation and food fortification have progressed impressively in Benin, Nigeria and Canada. Our preliminary report is attached as Appendix 2. Significant messages from our studies are listed in 5 bullet points below:

- In Nigeria and Benin Republic, a fast, low-cost, locally adaptable sun drying apparatus was developed to convert fresh vegetable leaves into dry forms within a 4-hr period. Adoption of this apparatus at the village level will reduce post-harvest losses and increase economic returns to farmers.
- Optimized incorporation of dried vegetable leaves powder (up to 2.5% incorporation) into local foods such as *Petits cailloux* and *Toubani* in Benin Republic was successfully achieved. In Nigeria, a green bread and snack (chin-chin) was developed with up to 5% (w/w) incorporated dried vegetable leaves. Sensory evaluation showed acceptability of these products to consumers. Technology transfer to the food industry was initiated with potential for pilot-scale green bread production within the next 2 yrs.
- Production of polyphenol, a highly healthy natural product, from dried vegetable leaves powder was optimized (highest yield, up to 35% weight of dried leaves) for a 4-hr aqueous extraction at 50-60 °C and 1:20 powder: water ratio. The polyphenol can be used to formulate functional foods for human consumption.

- Optimized incorporation of polyphenol concentrate into fruit juice was achieved using peach and orange fruit drinks. Colour changes became noticeable when >0.5% level of concentrate incorporation into the fruit juices was formulated. Sensory and chemical quality tests are ongoing.
- Preliminary work was concluded on adapting the Evaporative Cooling Storage System for vegetable leaves preservation with the capacity to preserve spinach leaves for up to 9 days without noticeable quality deterioration. The system is inexpensive and environmentally friendly since it is made of local materials and does not use chemical refrigerants, respectively.
- In Benin syrup (soft drink) is being developed using the leaves and stem of *O. gratissimum* through two scenarios (leaves and/or stem soaked in water or soaked in sugar syrup) for 4 hrs before processing. Consumer sensory evaluation revealed that the syrup was very well appreciated (an average score of 4 on a scale of 5) by every range of age.

### C. Publications:

In this reporting period, our project published eight scientific articles in high impact journals:

- Ogundele, R.A., D. J. Oyedele, O. K. Adekunle (2016) Management of *Meloidogyne incognita* and other phytonematodes infecting *Amaranthus cruentus* and *Telfairia occidentalis* with African marigold (*Tagetes erecta*) and Siam weed (*Chromolaena odorata*). *Australasian Plant Pathology*. doi:10.1007/s13313-016-0438-z
- Adams, A.M., A.W. Gillespie, G.O. Kar, S. Koala, B. Ouattara, A.A. Kimaro, A. Bationo, P.B.I. Akponikpe, J.J. Schoenau, D. Peak (2016) Long term effects of reduced fertilizer rates on millet yields and soil properties in the West-African Sahel. *Nutrient Cycling and Agroecosystems*. doi:10.1007/s10705-016-9786-x
- Bachmann, E., D. Natcher, S. Kulshreshtha, Baco M.N. Akponikpe P.B.I, and D. Peak (2016) Profitability and Institutional Constraints to the Adoption of Fertilizer Microdosing in Northwest Benin. *Sustainable Agricultural Research* doi:10.5539/sar.v5n3p11
- Natcher, D., E. Bachmann, J. Pittman, S. Kulshreshtha, M.N. Baco, P.B.I. Akponikpe, D. Peak (2016) Knowledge Diffusion and the Adoption of Fertilizer Microdosing in Northwest Benin. *Sustainable Agricultural Research*. doi:10.5539/sar.v5n3p1.
- Sunday B. Akinde, Abiodun A. Sunday, Folasade M. Adeyemi<sup>1</sup>, Iyabobola B. Fakayode, Odunola O. Oluwajide<sup>1</sup>, Adetoun A. Adebunmi<sup>1</sup>, Julius K. Oloke, and Clement O. Adebooye (2016) Microbes in Irrigation Water and Fresh Vegetables: Potential Pathogenic Bacteria Assessment and Implications for Food Safety. *Applied Biosafety*. doi: 10.1177/1535676016652231

- Famuwagun AA, Taiwo KA, Gbadamosi SO, Oyedele DJ (2016) Optimization of Production of Bread Enriched With Leafy Vegetable Powder. *Journal of Food Processing and Technology* 7:605. doi:10.4172/2157-7110.1000605
- Ayanwale, A.B., Amusan, C.A., Adeyemo V.A. and Oyedele D.J. (2016). Analysis of Household Demand for Underutilized Indigenous Vegetables. *International Journal of Vegetable Science* doi:10.1080/19315260.2015.1103350
- Egah J., Baco M. N., Lokossou R. S., Moutouama F. T., Akponikpe P.B. I., Djenontin A. J. Tossou R., Sokpon N. 2015. Incidence des stratégies de conservation de l'eau et des sols sur la sécurité alimentaire des ménages au nord-ouest du Bénin. In Michel Fok, Ousmane Ndoye, Siaka Koné (eds.). AGRAR-2013 : Ire conférence de la recherche africaine sur l'agriculture, l'alimentation et la nutrition. Yamoussoukro, Côte d'Ivoire, 4-6 juin 2013. L'agriculture face aux défis de l'alimentation et de la nutrition en Afrique : quels apports de la recherche dans les pays cotonniers. LES PRESSES AGRONOMIQUES DE GEMBLoux. Pp. 342-349. ISBN 978-2-87016-138-8. www.pressesagro.be

**D. Documentation of the impacts of crop diversification on resource use efficiency, resilience and gender equity.**

This portion of our milestone is included in our addendum to baseline report and attached as Appendix 3. We combined the data sets for Benin and Nigeria, and ran detailed statistical analyses. Our results are summarized in 10 bullet points below:

- Female vegetable farmers are older than their male counterparts with an average age of 45.65 years and 50.27 years for Benin and Nigeria, respectively. The majority of male and female vegetable farmers are middle-aged with an age range of 31-55 years.
- The level of formal education (88.87%) among female vegetable farmers is higher than the level of formal education (80.48%) among male vegetable farmers in Nigeria. In contrast, the level of formal education (40.00%) among male vegetable farmers is higher than the level of formal education (14.00%) among female vegetable farmers in Benin.
- For land acquisition, some male (32.08%) and few female (16.17%) farmers lease their farm land in Nigeria while very few male (3.10%) and female (0.62%) farmers in Benin lease their farm land. Few male (19.94 and 24.84%) and female (12.4 and 11.18%) farmers in Nigeria and Benin, respectively, inherited their farm land.
- In terms of use of fertilizer, vegetable farmers in Benin applied fertilizer at the rate of 129.7 kg/ha which is above the recommended rate of 112.5kg/ha, while vegetable farmers in Nigeria applied 26kg/ha which is below the recommended rate of 80kg/ha.

- With respect to seed sourcing, results showed that seeds saved from last season production provided about 51% of the planting material while seeds purchased from the market provided 12-32% of the planting material. An exceptionally high percentage (75%) of the vegetable producers in Benin purchased their seeds from the market.
- Vegetable production based on 0.5ha land area resulted in a net benefit of \$3,879.00 and \$3650.00 in Benin and Nigeria, respectively. Benefit cost analysis revealed that in Benin, every \$1 invested in vegetable production generates a return of about 0.8 cents and 0.3cents in Nigeria.
- In Benin, the total output and total variable cost were 19800kg and \$6934.01, respectively while in Nigeria, they were 4481.55kg and \$2742.96, respectively. Gross profits were \$1544.48 and \$490.23 in Benin and Nigeria, respectively. For every kilogram of vegetable marketed, a profit of \$0.08 and \$0.11 would be expected in Benin and Nigeria, respectively.
- Vegetable farmers who diversify use the productive resources available to them more efficiently. Results showed that farmers who diversify use mostly wetland for their operations, especially during the dry season for maximum productivity and profit. In terms of fertilizer use, those who plant two UIVs use the most volume (665.27kg of NPK and 441kg of Urea on 0.5ha of farmland) whereas those who planted all four vegetables used the least amount of fertilizer (less than 50%). In the two countries, cultivation of three types of vegetables yielded highest income for the farmers.
- Majority of vegetable farmers with small farm holdings in Benin Republic (100%) and Nigeria (67.1%) experience shortage of food for between zero and three months every year.
- Different forms of business models exist in the UIV value chain. This varies from the use of “cartel” in marketing to “contract” farming in production. The particular model engaged in depends on the location and the business environment.

**E. Preliminary report on the efficiency of the scaling up models (Innovations Platform and Satellite Dissemination Approach)**

We attach the reports on scaling up as Appendices 4a&b, for Nigeria and Benin, respectively. These report highlights activities at the IP by identifying the key issues, challenges and possible activities to reduce challenges facing the actors and stakeholders. The report also highlights the gender and group dynamics and cohesion as well as attendance at meetings to show level of commitment of members. This report presents the major tools used at SDA and immediate outputs of the SDA. We also discuss seed production and supply dynamics. Our key messages are summarized in 10 bullet points below:

- In Nigeria, we are scaling up indigenous vegetable innovations at 41 districts made up of 31,254 farmers (45% women) as direct beneficiaries. In Benin Republic (13 districts), the scaling up has reached 5,969 direct beneficiaries (45.55 % female).
- In Nigeria, the direct beneficiaries recruited a total of 68,509 demo farmers (i.e. 16,877 men recruited average of 1.95 farmers (32,844 farmers) while 14,376 women recruited average of 2.5 farmers (35,625). In Benin Republic, the scaling up has reached 25,017 indirect beneficiaries (44.87 % female).
- The total number of direct beneficiaries and demonstration farmers is now 99,763 (51% women) in Nigeria while the figure is 30,986 (45% female) in Benin Republic.
- In Benin Republic the project extended to three new and highly populated districts and 12 new operational innovation platforms (IP) have been established. The IPs engaged a total of 3,982 actors made up of 54% processors, 42% marketers, 0.2% transporters, 0.2% extension service, 1% seed suppliers and 2.2% input / fertilizer suppliers. In Nigeria, vegetable producers, marketers, transporters and government agencies constitute 58%, 18%, 14% and 11%, respectively of the actors at the IP level.
- The male gender is 59% (952) of the total actors in the innovation platforms with 100% dominance of the transportation business and 82% dominance of government agencies while the female gender is clearly dominant (81%) in vegetables marketing.
- At the IP level in the vegetable value chain, fewer male gender (25-30%) had problems with transportation, marketing, access to land, access to loan, control of pests and diseases and access to fertilizer and inputs compared to 70-75% in the female gender.
- Our project distributed high quality seeds of *ugu* (6280kg), *igbagba* (769 kg) and *Tete* (2200 kg), to target farmers in the seven States of Nigeria and *Tete* (1125 kg), *igbagba* (935 kg) and *Ocimum* (1540 kg) in Benin Republic.
- In Benin the Satellite Dissemination Approach was established with a total of 90 demonstrations in 9 villages with technologies reaching a total of 2451 (47% female). In Nigeria, our innovations reached a total of 5,679 farmers consisting 3200 women (56.3%).
- In Nigeria, we have established a total 181 Young Vegetable Scientists Clubs (YVSC) and trained 171 teachers (99 female=54.7%) on the practices of fertilizer microdosing and indigenous vegetables production. We have integrated a total of 19,750 students into the club. In Benin 37 YVSCs have been established (from Agricultural Education System and 32 from the General Education Systems. These YVSCs are reaching a total of 14,059 students (1 460 agricultural students and 12 569 ordinary education students) whose capacity have been built via the innovations of the project.

- In Nigeria, it is noteworthy that the schools are generating revenue from the sales of the vegetables ranging from ₦5000 to ₦30,000 in three months. Fresh vegetable markets have developed around the target schools in Benin generating an average of CFA 50 000 F per school per vegetable cropping cycle.

#### **F. GIS-based mapping of water, soil, and nutrient resources for the MicroVeg project**

Our project is developing both an offline (for researchers) and an online (for NGOs, extension agents, and farmers) GIS-based suite of visualization tools for the MicroVeg project. This project geo-references all of our surveys and agronomic trials and samples, providing a wealth of spatially resolved information for our database. Our major activities are detailed in Appendix 5 but summarized in 3 bullet points below:

- ArcGIS based research tools: We are using ESRI's ArcGIS to develop maps of Benin and Nigeria that can be used to not only increase the inference space of our research sites/plots but also to develop new testable hypotheses and locations in which to sample soil and water. We will be implementing different climate change scenarios to determine the sustainability and identify potentially vulnerable farmers into this database over the next six months.
- Web-based mapping tools: With the help of the UofS Social Science Research Lab (SSRL), we are building an online database to house research data from IDRC development research projects at <http://gis1test.usask.ca/soildb/>. The database is constantly being updated with new features; currently, we have uploaded precipitation and temperature (global raster from 1960-1990), elevation, roads and water bodies, and soil polygons. Over the next 3 months, the data from our baseline survey and from the agronomic trials will also be added.
- By using data from biophysical and social science aspects of our project, we are implementing new tools into the website. For example, it will be possible to link agronomic recommendations with the local language to facilitate translations, or to calculate costs to get to market for farmers. The website will have some functional limitations compared to using ESRI's ArcGIS, but will not require advanced training to utilize.

#### **G. Meeting of the International Scientific and Impact Advisory Board (ISIAB).**

The ISIAB Meeting at the Sun Beach Cotonou from August 17-21, 2016. All the Board members (Dr Shamie Zingore, Dr Victor Afari-sefa, Prof Victor Okoruwa and Prof Simi Afonja-Represented by Dr Monica Orisadare) attended the meeting. The impression of ISIAB members is in a report marked Appendix 6. Summary of the ISIAB report are:

- The project has made a very good start and the progress to date is commendable. Success areas of note include completion of the baseline report and scaling of activities enabled by engagement with development partners.
- The project is well coordinated and operating effectively in a trans-disciplinary manner. Cooperation between project members across countries and institutions is also very good and commendable.



- Regional integration of project implementation requires strengthening. The agronomic component is well integrated, but other components such as socio-economics (e.g., baseline analysis and food science should be better integrated).
- The project M&E plan and impact assessment requires clarification in terms of indicators and how they are measured and tracked. M&E should facilitate continual exchange and feedback of information between research and scaling components of the project.

#### **H. Field Visit and Project Review Meeting**

A joint field visit comprising officer of the IDRC (Dr. Innocent Butare), project scientists from UofM, UofS, UNIOSUN, OAU and UP, and NGOs was conducted from April 16-24, 2016 in Nigeria and Benin Republic. The report of this activity is attached as Appendix 7. This was the first of such visit to Project 107983. The purposes of the field visit were:

- To gain first-hand knowledge of what is happening on the field
- To ensure that the 4 major teams implementing this project follow the same protocol.
- To ensure that what is seen on the field shows value for money and is able to justify amount of money invested into the project
- To determine what will be indicators of success for this project
- To determine if the project is keeping to timelines on all the project activities.
- To use the sites visits to determine if there is need for re-evaluation of plans to ensure the project achieve the set milestones.

### **3. Challenges encountered/ Actions taken**

*Identify and analyze 2 - 3 key challenges faced by the project team. Describe the action taken by the project to address each one of them.*

- (i) Understanding the *modus operandi* for the scaling approaches was a major challenge for the NGOs and scientists. We confronted the challenge through organization of two major workshops in Cotonou, with the help of consultants on scaling up models. The two workshops provided the opportunity and practical experience for all the NGOs and scientists to fully understand the operations of the models.
- (ii) Team building and communication challenges which we resolved through mutual understanding. Necessary logistics have been put in place to enhance more robust within-project communication and interaction.
- (iii) There was an administrative challenge with respect to purchase of a project vehicle by Obafemi Awolowo University which resulted in late release of money. The challenge was resolved through an understanding between IDRC and Obafemi Awolowo University.

### **4. Strategic priorities for the next 6 months**

*Confirm your planned activities for the next 6 months, be selective, this is not the place for an updated workplan, but to get a quick understanding of the 2 - 4 main priorities of the project for the next period.*

The project will produce relevant documents on the following milestones during the next reporting period:

- i) The project will invest in rigorous training of farmers, 50% women on fertilizer micro-dosing and water management.
- ii) We will increase capacity for stakeholders (private partners, NGOs) on value addition of indigenous vegetables.
- iii) The Project will evolve serious mechanism for training and demonstrations on value addition of indigenous vegetables.
- iv) We will focus on value addition for indigenous vegetables through extraction, identification of bioactive compounds and formulation of functional (health-promoting) food products.
- v) Writing of jointly authored papers for publication and attendance at international conferences.
- vi) ISIAB meeting will hold at the University of Manitoba in addition to an annual review meeting to evaluate project activities.
- vii) Draft policy document on indigenous vegetables for submission to governments in Nigeria and Benin
- viii) CIFSRF Project Workshop will hold at the University of Saskatchewan in October 2016. This workshop will also serve as annual meeting for our Project.

## 5. Linkages with DFATD

*Mention here if you had any interaction/meetings with DFATD/Canadian Embassy during the reporting period. Explain briefly (max. 2 sentences) the outcomes of those exchanges.*

- (i) Prof Adebooye and Ms Jacinta Uramah were invited to the Canadian Embassy in Abuja by Global Affairs Canada(GAC) to attend a stakeholders meeting on GAC funded project in Nigeria. They presented the MicroVeg project at the event. Friday 20th May, 2016.
- (ii) Professor Duro Oyedele and Professor Adeolu Ayanwale represented the MicroVeg Project at the FARA Conference, Kigali, Rwanda in June 2016. They made an oral presentation on Project 107983 at a special event during the conference.
- (iii) MicroVeg Project was published by Quebec Science magazine on June 1, 2016. <https://www.idrc.ca/en/article/garden-isnt-always-greener-other-side-fence> and <https://www.pressreader.com/canada/qu%C3%A9bec-science/20160601/281827167978354>

## 6. Key numbers to be used for infographics

*Those are cumulative numbers since the beginning of the project, please update only if the numbers have changed from the previous reporting period.*

Number of farmers (women/men)	37,223 farmers ( who are direct beneficiaries) in Benin and Nigeria, and 93,526 farmers (who are demo/recruited farmers)
Number of innovations/solutions	Capsule technology for microdosing of indigenous vegetables Seed production systems Value addition and processing
Number of Masters and PhD students	15 PhD and 16 M.Sc. students 12 Bachelor students (See Appendix 8)

<b>Number of publications</b>	<b>8 published high impact journal articles</b> Regular update of project website: <a href="http://www.microveg.org">www.microveg.org</a>
<b>Other key numbers</b>	<b>5,569 people made up of transporters, government official, input sellers, processors and marketers.</b>

### **ANNEX: Progress towards milestones**

*List the milestones given in your grant agreement for this reporting period and refer to the hard evidence in attached annexes (as needed). If applicable, explain why any are not achieved and how the project will readjust. Also include details on any unfinished milestones from the previous reporting period that were completed during this reporting period.*

The milestones and the level of achievements are discussed below:

<b>Milestone</b>	<b>Achievement (in %)</b>	<b>Evidence/Indicator</b>	<b>Comment</b>
<b>Comprehensive report on fertilizer micro-dosing and water management studies for indigenous vegetables</b>	100% achievement. Project has developed a comprehensive report on fertilizer microdosing and water management studies	The comprehensive report is submitted as Appendix 1.	Report ready.
<b>Value addition for indigenous vegetables through food fortification studies, processing and preservation and utilization.</b>	70% achievement. A first report on food fortification, processing, preservation and value addition studies is attached to this report.	The first report is submitted as Appendix 2.	Report ready.
<b>Specialized training of Nigerian and Benin staff through visits to the University of Manitoba and University of Saskatchewan.</b>	50% achievement. Candidates have been nominated and the University of Manitoba has issued relevant letters. Visas are being processed at the embassy.	Visa under processing	Visa delay.
<b>Writing of at least 2 high impact papers for publication in reputable journals.</b>	100% achievement. Our project has published six high impact papers in this reporting period.	The papers are listed in this report and some are available on IDRC website.	Papers published.
<b>Documentation of the impacts of crop diversification on</b>	100% achievement. See Appendix 3.	Included in Appendix 3	Report ready

<b>resource use efficiency, resilience and gender equity</b>			
<b>Preliminary report on the efficiency of the scaling up models(Innovations Platform and Satellite Dissemination Approach)</b>	75% achievement. We have set up significant numbers of IP and SDA. We are progressing with data gathering to make conclusive statement on the efficiency of the models. See Appendices 4 a&b.	Report included as Appendices 4a&b.	Report attached to this report.
<b>GIS-based information system</b>	75% accomplished; expected to be fully online and usable by December 2016	Appendix 5	Attached to this report.
<b>Addendum to Baseline Survey Report</b>	100% done.	Submitted as Appendix 3.	Submitted with this report
ISIAB Meeting	100% done	See Appendix 6.	Comprehensive ISIAB report
<b>Field Visit and Project Review Meeting</b>	100% done	See Appendix 7	Comprehensive field visit report