Synergizing Fertilizer Micro-dosing and Indigenous Vegetable Production to Enhance Food and Economic Security of West African Farmers

MicroVeg
18-Month Project Update

Newsletter
January 2017

SPOTLIGHT

MicroVeg Empowers Us: Farmers Testify

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MicroVeg Project in the news in Canada.

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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 Project 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 vegetables production and value addition technologies 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.

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We have successfully concluded our fertilizer microdosing and water management studies in Benin Republic and Nigeria. While the comprehensive report has been forwarded to the funding body and approved, the key messages from our findings are summarized 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 (CAD0.021), ₦4.29 (CAD0.020) and ₦6.25 (CAD0.029) for Tete, Igbagba and Ugu, compared to ₦1.94 (CAD0.009), ₦1.36 (CAD0.006) and ₦1.75 (CAD0.008), 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 27kg/ha to 36kg/ha in the humid forest, from 32kg/ha to 48kg/ha in the savanna (Nigeria) and from 23kg/ha to 37kg/ha in the dry savanna region of Benin.

**SPOTLIGHT**

**MICROVEG PROJECT FEATURED IN THE NEWS IN CANADA**

Canadian Media Houses have been publishing information on MicroVeg Project. The first of such news was published by Ms Bouchra Ouatik, in Québec Science Magazine on June 1, 2016 while the second news item was published by Victoria Martinez of the Communications Unit of Canadian Lightsource (CLS), University of Saskatchewan on August 3, 2016. The article in Québec Science Magazine is titled “The garden isn’t always greener on the other side of the fence”, while the CLS article is titled “Improving food security and livelihoods for rural West Africa”. Please visit the following links for details:

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. Significant messages from our studies are summarized 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 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 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.

See more pictures below:
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 summarized 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/soil-db/](http://gis1test.usask.ca/soil-db/). 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.

MEETING OF THE INTERNATIONAL SCIENTIFIC AND IMPACT ADVISORY BOARD (ISIAB)

The ISIAB Meeting held 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. Comments of the ISIAB include:

- 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.**
Our studies on crop diversification, resource use efficiency, resilience and gender equity have produced interesting results and the summary is given below:

- Female vegetable farmers are older than their male counterparts with an average age of 45 years and 50 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 (89%) among female vegetable farmers is higher than the level of formal education (81%) among male vegetable farmers in Nigeria. In contrast, the level of formal education (40%) among male vegetable farmers is higher than the level of formal education (14%) among female vegetable farmers in Benin.

- For land acquisition, some male (32%) and few female (16%) farmers lease their farm land in Nigeria while very few male (3%) and female (0.6%) farmers in Benin lease their farm land. Few male (20% and 25%) and female (12% and 11%) 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 129.7kg/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.
Men and women farmers in Nigeria and Benin Republic have been testifying to the benefits derived from MicroVeg Project since the project started. Pa Amos Atoyebi, 65 years old male farmer in Ilorin, Nigeria said, “I did not believe in this project when it was first introduced to us because many projects in the past did not do us any good. However, this project proved all of us wrong because, we received good training on reduced use of fertilizer, agronomic practices and general field management. The project supported us with irrigation pumps and accessories and good quality seeds. The radio jingles improved our sales and we are now a happy people with better financial base”. At several locations farmers asserted that they were already considering leaving vegetable farming to try other crops while others stated that they were already considering quitting farming entirely due to lack of incentives and market access. But now with the training modules of MicroVeg Project, they have changed their minds with determination to do more, especially now that demand for vegetables is more than supply due to the promotion jingles on radio and television.

A female farmer, Mrs. Ayena Alimatou, 57 years old from Ina, Benin stated “MicroVeg has empowered us beyond our imagination. Those scientists are our husbands. They train us and give us good quality seeds”. She asserted that farmers now realize higher profit from their vegetables sales and that they can meet the immediate needs of the family better than before. Mr Jacob Ayoade, the President of Lagos State Vegetables Farmers Association said, “We all know that as the head of the family, it is the responsibility of a man to provide for his wife and children, and as a man, one must be able to make vital contribution to his immediate community. Our enhanced vegetables sales and profits have made us better men in the family and in the society”.

Mrs. Sarah Ollia, a 47-year old woman farmer from Kwara State who is one of beneficiaries of the project proudly posed for picture in her beautiful Ugu farm at the Unity Area-Ilorin, Kwara State Nigeria. Following the fertilizer micro-dosing training that she received from MicroVeg Project, she established her Ugu farm by following all the agronomic trainings. She expressed her surprise at seeing the seeds growing luxuriantly with glossy
Vegetable production based on 0.5ha land area resulted in a net benefit of $3,879 and $3,650 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 0.3 cents in Nigeria.

In Benin, the total output and total variable cost were 19,800 kg and $6,934, respectively while in Nigeria, they were 4,482 kg and $2,743, respectively. Gross profits were $1,545 and $490 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 kg of NPK and 441 kg of Urea on 0.5 ha 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%) 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.
Our Project is using the Innovations Platform (IP) and Satellite Dissemination Approach (SDA) to scale up the fertilizer microdosing and value addition technologies. At the IP level we focused on identifying the actors as well as the key issues/challenges and possible activities to mitigate the challenges facing the actors and stakeholders. We focused on the gender and group dynamics and cohesion as well as attendance at meetings to show level of commitment of the actors. At IP level, we also discussed the seed production and supply dynamics. Our key messages from the IP and SDA are summarized 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 (46% 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 while 14,376 women recruited average of 2.5 farmers). In Benin Republic, the scaling up has reached 25,017 indirect beneficiaries (45% 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 of the south of the country 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 (6280 kg), 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%).

### 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. 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.
MICROVEG PROJECT

Picture Gallery

FARMER’S SUPPORT

YOUNG VEGETABLES SCIENTIST CLUB (YVSC)

PARTNERS IN SUCCESS

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