"Synergizing fertilizer micro-dosing and indigenous vegetable production to enhance food and economic security of West African farmers" Project Number 107983

By

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

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Acronyms	Definition
CARD	Centre for Regional Action for Rural Development
COVADES	Corps volunteers to African Development Economic and Social
ERAD	Studies and Applied Research for Sustainable Development
FAFA	É ease of Support to Agricultural Commodities
GSAT	Food Security Group
MFIs	Micro-Finance Institution
NGO	Non-Governmental Organization
PACER	Support Project for the Rural Economic Growth
PAFICOT	Support Project for Cotton Sector Textile
PAMRAD	Support Project in Rural World in Atacora and Donga
PANA	Program of National Action Adaptation to Climate Change
PDAVV	Agricultural Diversification Project by the Valuation of Valley
ProCGRN	Conservation Project and Natural Resource Management
AHFS	Bill Security by Food Agricultural Intensification
CSAE	Communal area for Agricultural Development
CSAE	Communal area for the Development of Agriculture
SFA	Solidarity France Africa
SONAPRA	National Company for Agricultural Promotion
SPSS	Statistical Package for Social Sciences
UCCoPMA	Communal Cooperatives Union of Producers of Vegetables
URCoPMA	Regional Union of Cooperative Producers of Vegetables
IDRC	Research Centre for the Development International

Key messages from the synthesized Baseline report

- Female vegetable farmers are older than their male counterpart with an average age of 45.65 years and 50.27 years for Benin and Nigeria, respectively. Majority of the male and female vegetable farmers are middle-aged with age range of 31-55years.

- 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%) lease their farm land in Nigeria while very few male (3.10%) and female (0.62%) in Benin lease their farm land. Few male (19.94 and 24.84%) and female (12.4 and 11.18%) 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 1296.8kg/ha above the recommended rate of 112.5kg/ha, while vegetable farmers in Nigeria applied 26kg/ha below the recommended rate of 80kg/ha.

- With respect to sourcing for seed, 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 least amount of fertilizer(less than 50%). In the two countries, cultivation of three types of vegetables yielded most income for the farmers.

- Majority of vegetable farmers with small farm holdings in Benin Republic (100%) and Nigeria (67.1%) experience food shortage of 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.

Summary

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 complementarities 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 Republic. This report was written as an addendum to the baseline report of the project outcomes and to identify drivers and aspects that will help the participants achieve project objectives. The report answered four major questions that arose from the baseline reports earlier submitted viz; Educational level of farmers, land acquisition, land area under vegetable cultivation, current use of fertilizers by farmers and use irrigation to cultivate during the dry season, how easy is water supply, any cost associated with accessing water, any dispute in relation to the use of irrigation water, with emphasis on gender distribution; How do the project respondents' source seeds, how are seeds priced, what are the marketing methods by form (fresh, dried, processed), as well as by frequency (weekly or daily) and the estimated volume of UIV output sold; How profitable could using micro-dosed fertilizer rate be?. Should farmers invest or not invest in fertilizers?; How does UIV crop diversification affect productive resource use, resilience and gender equity in the selected MICROVEG (Project 107983) communities?; What are the gender dimensions of these baseline characteristics? What aspects should MICROVEG project address in order to ensure that it achieves or exceeds the set target of the outcomes? The study involved 2712 households in seven states spanning three agro-ecological zones. One hundred and forty four (144) communities in sixty-two (62) Local government Areas (LGAs) were covered for the purpose of data collection. Data were collected from 2172 households comprising 1091 farming households, 630 consumers and 450 UIV marketers in Nigeria and 239 households from five areas in Benin Republic. Using both quantitative and qualitative methods of analyses the results showed that the mean age of the farming household head is about 46 years. The average age of women UIV farmers is more than that of men; hence women UIV producers are older than men in both countries. As regards land acquisition for UIV production, men generally acquire land through inheritance while women do acquire land through gifts and lease in both countries. In essence, what this means is that women do not effectively "own" land for UIV production in the study area. In terms of educational status, female UIV farmers have more years of formal education than their male counterparts; however, the reverse is the case in Benin Republic, as men have more years of formal education than women.

As regards production inputs, the main sources of seed are purchase from market and seeds sourced from last season planting. The main sources of water are dug out well and borehole. However, in some cases the dug out well are empty during the dry season. In terms of gender, women in Nigeria source water mostly from dug out well while their Beninoise counterparts' source their water from borehole. That women in Benin were able to afford to source water from borehole is an indication of the impact of previous intervention programs by donor agencies considering its cost and the welfare status of the women. Most farmers obtain water from less than 200 meters in both countries. Farmers cover more kilometer to source water in Benin than in Nigeria. Fertilizer use is more common among men in Nigeria, while it is more common among women in Benin republic. Fertilizer use in Nigeria is below the recommended level while it is above the recommended level.

For marketers, the average age was 38 years in Benin and 42 years in Nigeria. All the UIV marketers are female in Benin while 91% are female in Nigeria. Most UIV marketers in Benin are non-literate whereas most have at least primary school education in Nigeria. Marketers in Nigeria cover shorter distance to source

their UIV. *Solanum* sp. is the most marketed during the rainy season in Benin and during the dry season in Nigeria. Most marketers source their vegetable from the farmgate both countries. For every dollar invested in UIV marketing, there is an expected return of $0.22 and $0.18 in Benin and Nigeria respectively.

In terms of food security, the results suggest that small scale UIV farmers are more prone to food shortage in the two countries compared to vegetable farmers with medium or large farm holdings. In other words, small scale UIV farmers are more vulnerable to food scarcity and increase in the prices of food items in West Africa. Further result reveals that male vegetable farmers experience food shortage more than women. This might be because men are household heads with responsibility to feed hence resulting into limited food availability in male headed households than that of women. Since food shortage does not mean total absence of food, this also suggests that men have more coping strategies than women to handle food shortage period.

Further result from analysis implies that while women prefer the consumption of *S. macrocarpum* than other vegetables in Benin Republic, Nigeria women vegetable producers consume all the available UIVs. In addition, vegetable producing households in Benin republic consume more calories than their counterparts in Nigeria. About 97.5% and 77.4% of men and women are food secure in Benin Republic relative to about 63% and 34% of male and female vegetable producers in Nigeria. This shows that vegetable producing households in Benin Republic are more food secured than their counterparts in Nigeria.

In terms of crop diversification and resource use, More than 70% of the farmers cultivate either one or two types of UIVs in Nigeria. Similar trend was observed along the gender lines as most male (47,66%) and female (26.17%) respondents also cultivate one and two types of UIVs, while the least percentage (6.06% male and 1.84% female) cultivate all the four types of UIVs. In Benin republic most UIV producers plant two types of UIVs, and this includes both men and women. This suggests that multiple cropping of UIVs is usually encouraged, possibly to provide mitigation against possible crop failure and ensure food and nutritional security. This is common in both countries. In the two countries, it is cultivation of three types of UIVs that yielded most income for the farmers.

Introduction

Underutilised Indigenous Vegetables (UIVs) represent a diverse and widespread set of vegetables that are consumed widely across many countries in Africa, Nigeria and Benin Republic inclusive. Leaves, fruits, and roots from over 1,000 species of vegetables form the backbone of traditional diets (Muhanji et al., 2011) but in many cases have been ignored at the expense of introduced vegetables like spinach and cabbage (Adeka et al., 2009; Okeno et al., 2003; Omiti et al., 2005). These include both wild and domesticated leafy greens such as nightshade (*Solanum spp.*), spider plant (*Cleome gynandra*), amaranth (*Amaranthus cruentus*), and jute mallow (*Corchorus olitorius*). Government policies take little account of the role UIVs play in the agricultural sector and have done little to promote research and investment (Figueroa et al., 2009). UIVs are often a more sustainable alternative to exotic crops such as spinach or cabbage, as they can be pest-resistant, require fewer inputs, and are well adapted to local agroecological conditions (Ekesa et al., 2009). Though their full economic potential is yet to be completely realized, UIV production value in Nigeria run into millions of USD, especially in the recent times with the difficulty encountered in accessing imported high valued horticultural crops. UIVs are the cheapest source of macro and micronutrients; in addition, they provide vitamins A, B, and C, as well as minerals like calcium, iron, and potassium (Adebooye 2004; Orech et al., 2007; Uusiku et al., 2010). A highly nutritious diet is important in an area of the world where daily intake of fruits and vegetables is well below dietary recommendations and affordability of vegetables remains a challenge for the poor (FAO, 2012).

UIVs are especially important to smallholder farmers, as over 90% of them grow horticultural crops of some kind (NICANVEG 2014; Muendo and Tschirley, 2004). UIVs in particular are especially important to women, who are involved in all aspects of the UIV supply chain and dominate both intermediary and retail activities, providing an important income generating opportunity (NICANVEG 2014; Weinberger et al., 2011). Farm gate prices of UIVs witnessed continual increase of up to 30% recently, and its current supply is estimated to meet only about 60% of the demand (NICANVEG 2014). The UIV market promises to keep growing with the rapidly expanding population of Nigeria. Nigeria's population is growing at an annual rate of 2.8 percent and is expected to outstrip that of the United States of America by 2050. This represents a unique opportunity to enlarge the scope of UIV production and marketing to improve the livelihood of the stakeholders. Meeting urban consumers' demand provides both opportunities and challenges to UIV producers as Nigeria has the 6th largest urban population in the world and it increases at a rate of 4.4 percent annually (World Bank Indicators 2014). If a large market exists for higher quality UIVs in the formal or informal urban market, growers would have a reason to improve the quality of the UIVs produced and thus achieve higher profits.

In spite of the importance of UIVs to poor rural women in West Africa, their production is generally low (yields and quality) due to acute soil fertility and land degradation problems.

The Nigeria-Canada Indigenous Vegetables Project (NiCanVeg Project 106511) successfully **developed** new technologies that improved farming practices, post-harvest handling and value addition for indigenous vegetables which offered great opportunities for food security and economic empowerment of the poor rural population, especially the poor rural women of southwest Nigeria, while the Integrated Nutrient and Water Management in the Sahel (INuWaM Project 106516) developed the highly desirable technology of "microdosing" which is a technique of precision agriculture with unique benefits of reducing costs and ensuring adequate nutrients application for crops.

This project is a synergy of the two (NiCanVeg and INuWaM) projects. The promising results of the innovations that were developed by the two projects are being explored for complementarities 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.

This study was conducted with the objective of establishing the baseline condition of the project outcomes and to identify drivers and aspects that will help the participants achieve project objectives. The study

involved 2712 households in seven states spanning three agro-ecological zones in Nigeria and 239 households from five areas in Benin Republic. Given the need for valid comparison, we established a set of counterfactual households made up of non UIV vegetable growers in the same environment.

1.2 Research questions

This report as an addendum to the project baseline report answered the following questions:

What are the baseline conditions of the study area in terms of

(i) Educational level of farmers, land acquisition, land area under vegetable cultivation, current use of fertilizers by farmers and use irrigation to cultivate during the dry season, how easy is water supply, any cost associated with accessing water, any dispute in relation to the use of irrigation water, with emphasis on gender distribution.

(ii) How do the project respondents' source seeds, how are seeds priced, what are the marketing methods by form (fresh, dried, processed), as well as by frequency (weekly or daily) and the estimated volume of UIV output sold.

(iii) How profitable could using micro-dosed fertilizer rate be?. Should farmers invest or not invest in fertilizers?.

(iv) How does UIV crop diversification affect productive resource use, resilience and gender equity? (NiCanVeg/InuWaM had some post-project impact assessment report on this issue).

(b). What are the gender dimensions of these baseline characteristics?.

1.3 Objectives of the Study

The broad objective of this study was to provide an addendum to the baseline reports of indigenous vegetable production, processing and post harvesting handling for assessing the impact of the Project 107983 on a number of outcomes.

Specifically, this was to:

a) Provide an addendum to the baseline report of the indigenous vegetable sector among the participating households in Nigeria and Benin Republic, and

b) Analyze the drivers of the observed outcomes among the participating households and marketers in the study area

1.4 How the results of this study will be used

The results of this study will help to evaluate the impact of Project 107983. For instance, one of the outcomes of the project is to increase the income of 255,000 beneficiaries 50% of whom will be women by 40% by the end of the project, the results of this baseline survey will help determine whether the project

achieved this goal at the end of the project. While, that of access will answer whether 50% of the beneficiaries have access to market, land and farm inputs.

1.5 Contribution of Project 107983 to other Agricultural Development Objectives

The Project 107983 supports the government's strategic objective to enhance growth in sectors other than oil in order to achieve increased food security, reduce poverty, and create employment and improved opportunities in rural areas. The Project will do so by: (i) creating awareness of the nutritional benefits of UIVs to increase agricultural productivity and diversify sources of livelihood; (ii) building the capacity of participating groups to increase the stock of social capital; (iii) building biodiversity and resilience in food security, and (iv) promoting socially-inclusive and environmentally sustainable management of natural resources. The Project will also contribute to achieving the goals of the New Agricultural Policy (NAP) and the Rural Sector Strategy (RSS), the "Document Stratégique de Réduction de la Pauvreté" (DSRP) of Benin Republic (2007) as well as the Comprehensive African Agriculture Development Program (CAADP) target of 6% agricultural growth, objectives of TerrAfrica Partnership and its GEF Strategic Investment Program (SIP) for Sustainable Land Management (SLM) in Sub-Saharan Africa (SIP is led by the World Bank and NEPAD).

Additionally, the project in line with the goal of the CIFSRF fund will increase food security in developing countries through investments in applied research for agricultural productivity and nutrition; as well as harness Canadian expertise and knowledge in food security related science and technology to develop solutions with and for the developing world. This research will increase food security in the West African countries of Nigeria and Benin through investments in applied UIVs research for sustainable agricultural production and nutrition; and harness Canadian expertise and knowledge in food security related science and technology to develop solutions with and for Nigeria and Benin – as samples of developing country.

2.0 Methodology

2.1 Scope of the study

The report covered farming household, marketers as well as consumers' demographic characteristics and asset ownership patterns. It examines access to extension services, research activities as well as membership of farmers' organizations. The study also investigates household labour availability and priority crops, awareness of UIVs and adoption of technologies and examines access to farm inputs, output and markets. Moreover, it analyses costs and returns to farming households, marketers and coping strategies and poverty level in the study area. In all these components, the gender dimensions were explored to bring out issues that are germane for achieving the project's gender transformation objective.

2.2 Study Area

Nigeria

The project was carried out within the agrarian Southwestern ecology of Nigeria which constitutes about one sixth (~163,000 km^2) of the total land mass of Nigeria. This region comprise six States (Oyo, Ogun, Osun, Ondo, Ekiti and Lagos states) and is distinctly divided into three major agro-ecological zones (Rain Forest zone, Swamp Forest zone and Derived Savanna zone) with varying climatic conditions.

Since the focus of the project is to scale the innovations up and out to engage many more farmers and stakeholders in the UIV value chain while promoting business model through Innovation Platforms a seventh state – Kwara state which geopolitically belong to the North central zone but geographically is in the Southwestern zone was added.

The forest agro-ecological zone has annual rainfall in the range of 1600-2400 mm, with cropping seasons between April and November with dry spells from December to March. On the other hand, the derived savannah ecosystem have mean annual rainfall ranging from 800 to 1500 mm with cropping seasons between June and November. The soil types range from the sandy to clayey in texture with soil reaction ranging from acidic to slightly basic. Soil fertility statuses and crop species diversity also vary widely in different locations in the region. This project is being carried out in all the three agro-ecological zones where agriculture is widely practiced without any threat of flood.

Benin Republic

The study was carried out in five areas namely Benin Parakou / N'Dali, Tchaourou, Boukoumbé, Djougou / Ouaké and Bohicon / Djidja. These areas represent areas of intervention of micro-veg project for which the study was conducted.

In général the study was carried out in savannah and sahel zones. The scaling up will be carried out in six Departments (Borgou, Colline, Donga, Zou, Atacora and Alibori) with 10 major districts, making a total of 51 major districts. The peculiar characteristics of the savannah and sahel agro-ecological zones are : the savanna zone has annual rainfall in the range of 700-1500 mm with the soil texture to Loam sandy to sandy clayed with cropping seasons between June and October with dry spells from December to May. On the other hand, the sahel ecosystem have mean annual rainfall ranging from 400 to 600 mm with cropping seasons between June and September. Soil fertility statuses and crop species diversity also vary widely in different locations in the region.

2.3 Data collection

The baseline data were obtained through a farming households, marketers and consumers survey conducted in the year 2015.

The main instruments for data collection were well-structured questionnaires, Focus Group Discussion (FGD) guide, In depth interview guide and on the spot observation administered on farming households, marketers and consumers by trained enumerators under the supervision of the researchers. Altogether one hundred and forty four (144) communities in the seven States of the southwest Nigeria were covered for the purpose of the data collection. The UIV community was first identified through participation in the NICANVEG project, for those in non-NICANVEG states we used available official data at the various Ministries of Agriculture to locate both the communities as well as the respondents. The snowball technique was used to track the UIVs households. The set of counterfactual households were also chosen for comparison purposes, these comprise the non-NICANVEG households including conventional vegetable farming households. These counterfactual households were selected from the same communities as those of the UIV for similarity and comparability.

Since experience has shown that what people eat differ from location to location and given the need to cover the indigenous vegetables food base of the wider Southwest Nigeria as well as to identify more species that are consumed by the traditional population across the Southwest Nigeria, the survey covered all the six States in southwest Nigeria including Kwara state. All the major agro-ecological zones- the Swamp Forest, Rain Forest and Derived Savana in the zone were sampled. The agro-ecological zones have annual rainfall in the range of 800 to 2400 mm, with cropping seasons between April and November while dry spells run from December to March. For the purpose of this survey and since each state is made up of at least two of the three agroecological zone, fourteen (14) representative locations (two per state) were selected. In each of the locations we delineated counter-factual sites for the purpose of impact assessment. We selected 144 sites because of the wide ecological and socio-cultural diversities in the southwest Nigeria.

Table 1: Agro-Ecological Spread of MICROVEG project

	Rainforest	Savannah	Sahel
Rainfall	1600-3000 mm of bimodal pattern.	700-1500 mm	400-600 mm
Soil texture	Sandy loam to loamy clayey	Loam sandy to sandy clayed	Loam sandy to sandy clayed
Vegetation	Tropical high forest	Clear wooded savannah	Shrubby vegetation
Soil reaction	Slightly acidic to slightly basic	Acid to light basic	Acid to light basic
Humidity	Very humid atmosphere	Slightly humid atmosphere	Dry atmosphere
Farming systems	Tree crops and arable crops based cropping system	Cereal, tuber and legume based cropping system	Millet and legume based cropping system
Potential evapotranspiration	Low	Medium	Very high

Source: Microveg project document 2015

On a broad basis, gender analyses framework was utilized to collect information on the following: Local taxonomy of the underutilized vegetables, the production constraints, the investments required for production e.g. fertilizer, herbicide, fungicide, water for irrigation, labour cost etc., the beneficial management practices for leaf yield, diseases and pests problems, method of preparation for consumption, postharvest handling methods (processing, preservation and storage), marketing strategies and profitability, etc. A combination of consultations, focus group discussions, questionnaires and visits to farmers and vegetable markets were made to collect socio-cultural and economic/marketing data and identify the under-utilized vegetable species across the different agro-ecological zones of southwest Nigeria and their prevalence, uses and market channels. Because of the seasonality on the availability of these products, the visits were done as often as possible during the two seasons of 2015 in southwest Nigeria.

Given the need for valid comparison, we established a set of counterfactuals made up of conventional vegetable growers in the same environment (Table2). One hundred and forty four (144) communities in sixty-two (62) Local government Areas (LGAs) were covered for the purpose of data collection. Data were collected from 2172 households comprising 1091 farming households, 630 consumers and 450 UIV marketers.

Table 2: Studies locations and the names of responsible partners

States	**Rainforest**	**Savannah**
Oyo	Iyana Offa district, Akanran extension district, Iddo district, Omi Adio district, Aboderin district.	Shaki district, Igboho district, Atisbo district, Oyo district, Fiditi district
Osun	Ikire district, Ayedaade district, Ijeshaland district.	Iwo district, Odo Otin district, Igbomina district, Ejigbo district.
Ekiti	Ikere district, Ijero district, Ado district, Igbara district.	Ikole District, Ilemeje district, Oye District, Itapa District, Ido-Osi District.
Ondo	Akure district, Ile-Oluji district, Igbara Oke district, Idanre district.	Ikare District, Oka District, Owo District, Arigidi/Okeagbe District, Akoko North East District .
Ogun	Abeokuta district, Owode Egba district, Ogijo district, Sango Ota district.	Yewa district, Ewekoro district, Ifo district.
Kwara	Erinle district, Ajasepo district, Omu Aran dsitrict.	Ilorin district, Offa district,
Lagos	Ikorodu district, Ojoo district,	Ibeju Lekki district, Badagry district, Epe district.

Table 3: Benin Republic Sample size by gender

Stakeholders	Men	Women	Total
Producers	79	52	131
Marketers	0	50	50
Consumers	18	40	58
Total	97	142	239

Data Collection Instrument

Given the need for cost effective and adequate data collection with the prevalence of ICT in the study area we used the Open Data Kit (ODK) for the survey in Nigeria and in Benin questionnaire was conceived under CSPro software. Open Data Kit (ODK and CSPro) are an ICT facility that enables users to capture and instantly digitize information of a variety of formats, eliminating the need for paper questionnaire surveys and data entry. It allows preparing a digitally programmed questionnaire, facilitates intense monitoring of the collection process and gathering of data immediately after survey in a format prepared for analysis. It thus eliminates the need for paper surveys and significantly reduces survey time and time required for data entry. The smart phones and similar devices are equipped to support ODK and CSPro software.

First we setup our server that is **ODK or CSPro Aggregate** in our laptop. Then we search for the "**ODK or CSPro Collect**" app from Google Play on the device. We install the latest version to the mobile device. For more information about ODK or CSPro Collect and its requirements, visit the https://opendatakit.org/use/collect/ or cspro@lists.census.gov for CSPro. The questionnaires are subsequently saved to the phone‟s SD memory, where it can be accessed without internet connectivity. Questionnaire in

ODK or CSPro Collect is **ODK or CSPro Form** which is an xml file. There are several ways to create forms for ODK. One of them used in our Project is XLSForm. After completion of XLSForm we convert it into xml file. XLSForm is a standard form created to simplify the authoring of forms in Excel in a readable format even for non-technological persons. They are simple to get started with but also allow for complex XForms by someone familiar with the syntax described below. Here we have inscribed those syntaxes used in the context of our questionnaire.

We loaded the pre tested survey instrument on the smart phones, and conducted a three day training for the enumerators and supervisors on the exercise. We had two levels of quality assurance, first is the supervisors on the field with the enumerators. The supervisors are to monitor the data collection process to ensure that it went on as scheduled. Secondly, we had the ODK or CSPro team who monitors the data entered and assures first level cleaning in the sense that what was intended was what was entered.

We engaged 28 (in Nigeria) and 12 (in Benin) enumerators and four supervisors (in Nigeria) and 2 in Bénin). .

Photo: Respondents interview sessions in Tchaourou (Bénin).

Respondents interview sessions in Nigeria.

2.4 Determination of sample size

The sample size required to infer a statistically significant difference between two means was determined using the power of a test approach, which is the most common method for determining sample size (Lenth, 2001). NICANVEG results were used to determine the sample size, taking into account the fact that about 50 percent of the sample could be dropped due to not matching. With a test size (the probability of falsely rejecting the null hypothesis if it is true) of 5% (i.e., 95% confidence that a statistically significant impact is not actually zero) and a test power (probability of correctly rejecting the null when it is false) of 90%, the minimum estimated sample size of the treated groups is 402 observations from each group to detect a 40% increase in income. This suggests the sample interviewed of (1091 farming households, 631 consumers and 450 UIV marketers) achieves the minimum data required for the total sample of the control groups.

In Bénin, the choice of the surveyed villages was based on the importance of the production of vegetables in general and vegetables in particular leaves. A total of 239 players randomly selected but favoring gender (all categories), were investigated in this study

2.5 Data Analysis Procedure

We use descriptive statistics and simple inferential statistical methods to analyze the baseline conditions and to answer the major questions posed above. The descriptive statistical analysis was used to run paired tests to compare indicators of outcomes of MICROVEG interventions across treatment and control groups. This will include all the outcomes discussed earlier.

The qualitative data were transcribed and edited for grammatical errors. The data were imported into ATLAS.ti software for analysis. The data were then coded using inductive coding techniques while analysis and reports were presented under different sub-themes with the help of network diagrams.

3.0 Socio demographic features of the respondents

Given the overall importance of socio demographic status of respondents in their decision to adopt an innovation or not we examined these features among the respondents and the results are presented in this section. Key socio demographic features considered are age, marital status, gender as well as educational status of the respondents.

Table 4: Socio-demographics characteristics of UIV farmers

		Gender (%)		Age (year)	Marital status (%)				
Country	Sample size	Male	Female	Average	Never married	Married living together	Married not living together	Widowed	Others
Benin	n =131	60	40	42.40 (12.2)*	4.60	80.90	0.00	0.00	14.50
Nigeria	n =1088	64.52	35.48	46.65(13.14)	6.07	83.82	3.77	5.70	0.64

Source: Microveg Baseline Data Analysis, 2016.

**figures in parenthesis are standard deviation*

Table 4 shows the socio-demographic characteristics of UIV farmers in Benin and Nigeria. The table reveals that majority of the UIV farmers are male. Generally, UIV farmers in Nigeria are older than their Benin counterparts with an average age of 42.40 years and 46.65 years for Benin and Nigeria respectively. However, majority of the UIV farmers are middle-aged in both countries, implying that the UIV farmers are in their active and productive years. Majority of the UIV farmers in Nigeria and Benin are married and living with their spouses.

Table 5: Age of UIV farmers by gender

Country	Sex	Average	≤ 30 years (%)	31-55 years (%)	>55 years (%)
Benin	**Male**	40.28(10.75)*	26.6	65.80	7.60
	Female	45.65(13.53)	15.4	61.50	23.10
Nigeria	**Male**	44.67(12.28)	12.82	68.95	18.23
	Female	50.27(13.86)	9.59	54.66	9.85

Source: Microveg Baseline Data Analysis, 2016.

**figures in parenthesis are standard deviation*

The distribution of age by gender of the UIV farmers in Benin and Nigeria is presented in Table 5. Generally, female UIV farmers are older than their male counterpart with an average age of 45.65 years and 50.27 years for Benin and Nigeria respectively. This result implies that UIV production is in the hand of older women. Majority of the male and female UIV farmers are middle-aged with age range of 31-55years.

3.1 Educational Level of UIV farmers

Table 6: Level of formal education of UIV farmers

Country	Sex	No formal Education (%)	Primary (%)	Junior Secondary (%)	Senior Secondary (%)	Tertiary (%)
Benin	Male	51.00	14.00	19.00	13.00	4.00
	Female	87.00	6.00	8.00	0.00	0.00
	All	64.6	10.80	14.60	7.70	2.30
Nigeria	Male	19.52	30.48	3.42	26.21	20.37
	Female	11.13	28.76	6.74	33.68	19.69
	All	16.54	29.78	4.60	28.86	20.22

Source: Baseline Data Analysis, 2016.

**figures in parenthesis are standard deviation*

The result in Table 6 shows that the level of formal education (88.87%) among female UIV farmers is higher than the level of formal education (80.48%) among male UIV farmers in Nigeria. In contrast, the level of formal education (40.00%) among male UIV farmers is higher than the level of formal education (14.00%) among female UIV farmers in Benin. Similarly, there are more non-literate male UIV farmers in Nigeria, while there are more non-literate UIV female farmers in Benin. In all, there are more literate UIV farmers in Nigeria than in Benin.

3.2. Land ownership, Acquisition and Use

3.2.1 Land acquisition

Table 7: Land acquisition by gender

Country	Gender	Inheritance	Gift	Purchase	Lease	Share cropper	Other
Benin	Male	40(24.84)*	28(17.39)	3(1.86)	5(3.10)	1(0.62)	19(11.80)
	Female	18(11.18)	32(19.87)	5(3.10)	1(0.62)	0	9(5.59)
Nigeria	Male	217 (19.94)	64(5.88)	51(4.69)	349(32.08)	8(0.74)	13(1.19)
	Female	135(12.4)	36(3.31)	30(2.7)	176(16.17)	4(0.37)	5(0.46)

Source: Microveg Baseline data analysis, 2016. * Figures in parenthesis are expressed in percentages

Results in Table 7 shows the land acquisition by gender. Some male (32.08%) and few female (16.17%) lease their farm land in Nigeria. While very few male (3.10%) and female (0.62%) in Benin lease their farm land. Furthermore, few male (19.94 and 24.84%) and female (12.4 and 11.18%) in Nigeria and Benin, respectively, inherited their farm land. Also, few female (19.87%) and male (17.39%) in Benin obtained their farm land through gift. Very few male (0.74%) and 0.37 percent of the female got their farm land through share cropper. While only male (0.62%) practiced share cropping in Benin. The study revealed that majority of male UIV farmers both in Nigeria and Benin obtained their farm through inheritance. While majority of female UIV farmers in Benin got their farm land through gift and female in Nigeria through lease.

The results corroborate the interviews and focus group discussions with community leaders, and vegetable farmers that there were three main sources of land acquisition namely; inheritance, purchase, and leasing. However, access to arable land by gender varied across the communities. Women were not usually allowed

to inherit land as a result of the belief that the woman will marry and leave the father's family. But women who were economically buoyant could purchase land out rightly or lease land for a period of time. Other women had to depend on their spouses for access to land. This will pose a challenge to access to and by vulnerable women such as widows.

> *I inherited my father's land (okay); some other people also inherited from theirs* (**IDI with Male Vegetable Producer Association Leader in Ilora, Oyo State**).
>
> *Access to land is no equal for women as much as you have for men. This is because women do not have the capability to work like men with respect to farming. They do not have farming capability like men. But when it comes to harvesting women participate far more than men.* (**IDI with male community leader in Ogbomosho in Oyo State**).
>
> *In our place, it seems that men have control more over the land; however a woman can have money and purchase land. A woman can also rent land but for inheritance of land, it not common for a woman to inherit land* (**FGD with male vegetable producers in Ede, Osun State, Nigeria**).
>
> *If the individual is financially capable, it is possible for him or her to buy the land off (**FGD with vegetable farmers in Ikorodu, Lagos State**)*

Table 8: Location of UIV Land by gender

Country	Gender	Upland	Wetland	Others
Benin	**Male**	79(23.58)*	79(23.58)	33(9.85)
	Female	51(15.22)	51(15.22)	42(12.53)
Nigeria	**Male**	284(26.10)	411(37.78)	1(0.9)
	Female	153(14.06)	232(21.32)	1(0.9)

Source: Microveg Baseline data analysis, 2016 * Figures in parenthesis are expressed in percentages

Table 8 shows the location of UIV farm land. Few male (23.58%) and female (15.22%) had upland and wetland farm, respectively, in Benin. While some (37.78%) and few (26.10%) male in Nigeria had their farm land located in the wetland and upland, respectively. Few female (21.32 and 14.06%) UIV farmers in Nigeria had their farm land located in wetland and upland, respectively.

The baseline showed that male in both Benin and Nigeria had their UIV farm land located in the upland and wetland than their female counterparts. Male in Nigeria had their UIV farm located in wetland than upland. While in Benin, male and female had equally located in both upland and wetland. While both male and female in Nigeria had more of their UIV farm land located in wetland than upland. This showed that UIV farmers can grow their vegetable during the rainy and dry seasons.

3.2.2 Land area under vegetable cultivation

Table 9: Land area used for UIV by gender

Country	Land size (ha)	Total land		Up-land		Wet-land	
Benin	**Gender**	**Male %**	**Female %**	**Male %**	**Female %**	**Male %**	**Female %**
Male (n =79)	Small (< 1ha)	43.07	28.46	58.46	39.23	38.09	9.52
	Medium (1-3 ha)	10.77	9.23	1.53	0.0	21.42	9.52
Female (n = 51)	Large (>3 ha)	6.92	1.53	0.76	0.0	19.04	2.38
	Total	85.7	73.0	77.9	48.6	7.8	24.4
Nigeria	Small (<3)	63.51	34.74	64.06	35.2	36.95	20.5
Male (n =702)	Medium (3-6)	0.83	0.55	0.37	0.18	0.18	0.18
	Large (>6)	0.18	0.18	0.09	0.0	0.0	0.0
Female (n =386)	**Total**	327.91	192.17	217.67	126.44	110.23	65.73

Source: Microveg Baseline Data analysis, 2016

Results presented in Table 9 shows the total land area used for UIV by gender. In Benin, some (43.07%) of the male UIV farmers had total land less than one hectare (ha). Few (28.46%) female had total land area of less than one hectare. Only, very few male (6.92%) and female (1.53%) had more than three hectares farm land area. Majority male (58.46%) and some female (39.23%) had less than one hectare upland. While some male (38.09%) and very few female (9.52%) had less than one hectare wetland.

In general, in Benin, the grand total farmland of male was 85.7ha while that of female was 73.0 ha. The total upland for male was 77.9 ha and for female was 48.6 ha. While the total wetland for male was7.8 ha and female was 24.4 ha.

Furthermore, in Nigeria, majority (63.51%) of the male and some (34.74%) female UIV farmers had a total land areas of less than three hectares (ha). Very few (0.83%) male and (0.55%) female had between 3 and 6 ha total farm size. Only, very few (0.18%) male and female had above 6 ha total farm size. Also, majority (64.06%) male and some (35.2%) female had less than three hectare upland area. Very few (0.09%) male and none (0%) of the female had between 3 and 6 ha upland farm. While, some (36.95%) male and few (20.5%) female had between 3 and wetland farm.

In Nigeria, the grand total farmland of male was 327.91ha while that of female was 192.17 ha. The total upland for male was 217.67 ha and for female was 126.44ha. While the total wetland for male was 110.23 ha and female was 65.73 ha.

The result showed that land devoted for cultivation of UIV was larger in Nigeria than in Benin. Male in both Nigeria and Benin had access to land more than the female. Female in Benin had better access to wetland than the male while male had better access to upland than the female.

3.3 Agricultural Inputs Use for UIV

3.3.1 Constraints faced in procuring credit by UIV producers

Table 10: Constraints to credit by UIV producers

	BENIN		NIGERIA	
Reasons	**Male (%)**	**Female (%)**	**Male (%)**	**Female (%)**
Not aware of credit source	10.1	21.6	67.17	72.44
Not looking for credit	32.9	35.3	16.75	19.55
No security	7.6	7.8	3.52	1.28
Interest rate high	10.1	5.9	3.18	0.64
Personal/Other	39.2	29.4	9.38	6.09
Total	100	100	100	100

Source: Microveg Baseline data analysis, 2016

The results showed in Table 10 reveal that the distribution of the UIV producers according to the constraints to credit access by gender. In Benin access to credit is not considered a constraint among women as 35.3% are not looking for credit while 39.2% of men indicate that hindrance to credit access is due to personal and other reasons. However, in Nigeria, the major constraint was lack of awareness of the credit sources available, with about 67.17% for men and 72.44% for women. This indicates that hindrance to credit access is relatively higher for women in Nigeria than for men, and this could adversely affect women UIV producers.

3.3.2 Sources of seeds

Table 11: UIV Seed Sources

	BENIN			NIGERIA		
Source	**Solanum (%)**	**Teliferia (%)**	**Amaranthus (%)**	**Solanum (%)**	**Teliferia (%)**	**Amaranthus (%)**
Saved from last season	36.9	14.6	35.4	52.33	49.37	53.77
Free seed from a neighbor	6.9	2.3	3.8	1.59	1.26	-
Free seed from government	-	-	-	0.37	0.21	1.51
Free seed from NGO	-	-	-	1.59	1.46	1.01
Purchase from seed company	8.5	3.8	10.0	2.33	3.77	4.02
Purchase from NGO	-	-	-	0.25	-	-
Purchase from ministry	0.8	1.5	0.8	2.21	2.09	3.02
Purchase from another farmer	2.3	2.3	1.5	2.33	3.97	1.51
Purchase from market	12.3	75.4	15.4	19.36	29.92	32.66
Purchase from a seed fair	-	-	-	0.12	0.21	-
Purchase from agro dealer	-	-	-	2.94	6.28	2.01
Others	32.3	14.6	33.1	14.58	1.46	0.50
Total	100	100	100	100	100	100

Source: Microveg Baseline data analysis, 2016

In Table 11 above, compared with other sources, seeds saved from last season production and purchase from the market are the most prominent sources of UIV seeds available . These represent about 52.33 & 19.36%, 49.37 & 29.92%, 53.77 & 32.66%, for Solanum Spp., Teliferia ocidentalis, and Amaranthus spp. respectively in Nigeria and 36.9 & 12.3 %, 14.6 &75.4%, 35.4 & 15.4% in Benin. An exceptionally high percentage (75%) of the UIV producers in Benin purchased their seeds from the market. Similarly, institutional support by government for seed sourcing is relatively poor in Nigeria and non-existent in Benin.

Table 12: Determinants of Seed sources

	BENIN		NIGERIA	
Reasons	**Male (%)**	**Female (%)**	**Male (%)**	**Female (%)**
Cheaper source	3.8	7.8	16.71	11.94
Available source	63.3	49.0	52.73	52.35
Lack of cash	1.3	0.0	0.38	0.92
Near homestead	2.5	0.5	4.38	9.26
Free source	22.8	27.5	20.39	21.46
Others	6.3	15.7	5.41	4.07
Total	100	100	100	100

Source: Microveg Baseline data analysis, 2016

Table 12 above shows that compared with other factors, availability determines the source of UIV seeds in Benin and Nigeria.

3.3.3 Sources of water

Table 13: Source of Water for UIV production

	BENIN		NIGERIA	
Source	**Male (%)**	**Female (%)**	**Male (%)**	**Female (%)**
Rain water	2.5	0.0	0.85	0.26
Stream	-	-	7.83	4.40
Dug Well	27.8	25.0	52.99	53.37
Pipe borne	11.4	1.9	6.70	10.88
Borehole	49.4	59.6	31.48	30.31
Others	8.9	13.5	0.14	0.78
Total	100	100	100	100

Source: Microveg Baseline data analysis, 2016

The major source of water for UIV production as shown in Table 13 is dug well and borehole both in Nigeria and Benin. This could be due to the need to ensure adequate water especially for dry production of the UIVs. Compared with men more women (53.37 %) made use of well in Nigeria while more women (59.6%) made use of borehole in Benin.

Table 14: Distance to Water Source

	Distance (metres)	**<200**	**200-500**	**>500**
BENIN	Male (%)	74.2	21.6	4.1
	Female (%)	67.4	27.0	5.7
NIGERIA	Male (%)	93.59	3.85	2.56
	Female (%)	90.93	5.18	3.89

Source: Microveg Baseline data analysis, 2016

As shown in Table 14, more than 90% and 60% of the UIV farmers obtain water from a distance of less than 200meters in Nigeria and Benin. However compared with Nigeria, a larger number of the UIV farmers, (21.6% and 27%, male and female respectively) source water from a longer distance of between 200-500 meters in Benin. Furthermore, more women (5.18%) travel longer distance than men (3.85%) in Nigeria and 27% and 21.6% respectively in Benin.

3.3.4 Use of fertilizer by UIV producers

Table 15: Fertilizer Use for UIV Production by Gender

	Sex	INORGANIC FERTILIZER	ORGANIC
BENIN		n = 130	n = 130
		(%)	(%)
	Male	38.5	40
	Female	61.5	60
	Total	100	100
NIGERIA		n = 487	n = 193
		(%)	(%)
	Male	64.48	70.98
	Female	35.52	29.02
	Total	100	100

Source: Microveg Baseline data analysis, 2016

The results shown in Table 15 reveal distribution by fertilizer use for UIV production by gender. In Benin, more female gender made use of both types of fertilizer than men while the reverse is the case in Nigeria. Inorganic and organic fertilizer use by women UIV farmers in Nigeria is lower compared with men. This may be occasioned by financial capability and mobility of the men to procure fertilizer then women. However, UIV farmers in Benin applied fertilizer applied 1296.8kg/ha above the recommended rate of 112.5kg/ha, while farmers in Nigeria applied 26kg/ha below the recommended rate of 80kg/ha.

3.3.5 Economics of UIV production

Table 16: Economic analysis of UIV production (Based on 0.5 ha within 3 months)

Parameter	**BENIN**			**NIGERIA**		
	Quantity	*Unit Price*	*Amont CFA en **(US dollar)****	*Quantity*	*Unit Price*	*Amount NAIRA **(US dollar)****
Seed (Kg)	7	4000	28000 **(56)**	60	6500	390000 **(2000)**
Inorganic fertlizer (Kg)	425	300	127 500 **(255)**	250	200	50000 **(256.41)**
Organic fertilizer (Kg)	150	1000	150 000 **(300)**	40	50	2000 **(10.25)**
Others cost (herbicide, insecticide, fuel, water…)	-	-	425000 **(850)**	-	-	50000 **(256.41)**
Labor (land preparation, planting, weeding, irrigation, harvesting, …)	217	1500	325 000 **(650)**	240	187.5	45000 **(230.77)**
Amortization			5000 **(10)**	-	-	-
Total variables costs (A)			1060500 **(2121)**			537000 **2753.85)**
Average Yield adjusted (Kg)	20000			2,7750		
Price (Kg/F)			150 **(3.0)**			450 **(2.31)**
Gross product (B)			3000000 **(6000)**			1248750 **(6403.85)**
Net benefit (B – A)			1939500 **3879**			711750 **3650**
Benefit: Cost Ratio			1.8			1.3

Source: Mircoveg Baseline data analysis, 2016

*Figures in parentheses are at $1=CFA500 & $1=N195

Table 16 above shows the economic analysis of UIV production based on 0.5ha. In Benin and Nigeria, a net benefit of $3,879.00 and $3650.00 is realized from UIV production respectively. However, benefit cost analysis revealed that in Benin, every $1 invested in UIV production generate a return of about 0.8cents and 0.3cents in Nigeria.

3.4 Marketing of Vegetables

3.4.1 Socio-economic analysis of UIV marketers

Table 17: Socio-demographics characteristics of marketers of UIVs

	Gender (%)		Age (year)	Marital status (%)				
Country	Men	Women	Average	Never married	Married living together	Married not living together	widowed	Other
Benin	0	100	38.2(9.9)	2	90	-	-	8
Nigeria	8.22	91.78	42.29(12.93)	8	73.11	7.11	11.56	0.22

Source: Microveg Baseline data analysis, 2016 Figures in parenthesis represent standard deviation.

The results in Table 17 show the socio-demographic characteristics of the marketers in both Benin and Nigeria. In Benin, all the marketers were female, while in Nigeria, about 92% of the marketers were females. On the average, marketers in Benin and Nigeria were about 38 and 42 years old respectively. Most of the marketers in both countries were married and living together. However, there was no marketer married and not living together with their spouse or widowed in Benin, while in Nigeria has at least 7 and 11 % respectively in the two categories. The results showed that marketers in Benin were younger than their Nigerian counterpart.

Table 18: Age of UIV marketers by gender

Country	Sex	Average	≤ 30 years	31-55 years	< 55 years
Benin	Male (n=0)	-	-	-	-
	Female (n=50)	38.24(9.94)	26.0	70.0	4.0
	All	38.24(9.94)	26.0	70.0	4.0
Nigeria	Male (n=37)	41.73 (12.80)	1.55	5.33	1.33
	Female(n=413)	42.34 (14.38)	14.88	62.67	14.22
	All (n=450)	42.29(12.92)	16.44	68.00	15.56

Source: Microveg Baseline data analysis, 2016 Figures in parenthesis represent standard deviation..

Age of the UIV marketers by gender was presented in Table 18. The table showed that most of the marketers in both Benin (96.00%) and Nigeria (84.44%) were within the economic active age. In Nigeria, average age of the female marketer was higher than that of their male counterpart.

Table 19: Level of education of marketers by gender

Country	Gender	No formal Education	Primary	Junior Secondary	Senior Secondary	Tertiary
Nigeria (%)	Male (n=37)	10.81	27.03	35.14	16.22	8.11
	Female(n=413)	25.18	31.72	37.29	5.08	1.69
	All (n=450)	24.00	31.30	37.10	6.00	1.56
Benin (%)	Male	76.00	18.00	6.00	0.00	0.00
	Female	0.00	0.00	0.00	0.00	0.00
	All	76.00	18.00	6.00	0.00	0.00

Source: Microveg Baseline data analysis, 2016

Table 19 presented the level of education of marketers by gender. Most of the marketers in Benin (76%) had no formal education while few (24%) marketers in Nigeria were found in this category. In Benin, less than a quarter (24%) of the marketers had at least primary school education, while more than 68% of the respondents had at least primary school in Nigeria. None of the marketers had beyond junior secondary school in Benin, while 7.56% of the marketers in Nigeria had at least secondary school education. In Nigeria, larger proportion of female marketers (in comparison with the male) had no formal education. Though, most of the male (62.17%) and female (69.01%) marketers had at least primary school education, however, less than 2% of the female and 8% of the male had beyond secondary school education. In general, marketers in Nigeria had more formal education than their Benin counterpart.

Table 20: Average distance travelled from source to the market

Country Distance (Km)	Min.	Max.	Average	Standard Deviation
Benin	0.00	80.00	24.00	38.29
Nigeria	0.00	64.36	3.30	7.00

Source: Microveg Baseline data analysis, 2016

The results presented in Table 20 show the average distance travelled to the source of the vegetables. The maximum distance travelled in Benin and Nigeria was 80 and 64.36 kilometres respectively. On the average, marketers in Benin and Nigeria travelled up to 24 and 3.3 kilometres from the market to the source of procuring the UIVs. Hence, marketers in Benin covered longer distance in sourcing for the produce than their Nigerian counterpart. Marketers in Nigeria covered shorter distance to source the produce. This implies that Benin marketers have to develop technology to preserve the vegetables.

Table 21: Weekly amount of UIVs marketed

Period/ season	**Benin**			**Nigeria**			
	Solanum. macrocarpon	chayo Basilic	*Amaranthus Sp.*	*S. macrocapon*	*Telfaria occidentalis*	*A.viridis*	*A. hybridus*
rainy	615 (3040.43)	174 (441.00)	172.5 (722.79)	11.02 (24.59)	22.70 (44.72)	4.26 (11.84)	4.01 (11.80)
Dry	81 (162.5)	120 (214.8)	196.5 (1281.97)	18 (42.56)	16.30 (37.21)	3.24 (9.78)	8.61 (20.45)

Source: Microveg Baseline data analysis, 2016 Figures in parentheses represent standard deviation.

Table 21 presented weekly amount of UIVs marketed per season. During the raining and dry season, vegetable marketers in Benin sold more volume of vegetables than the Nigerian marketers. Results showed that in a week, the largest volume of *S. macrocarpon* (615kg) was sold during the raining season followed by Basil. (174kg) and *Amaranth sp*. (172.5kg). In the dry season, however, Amaranthus sp. was sold in highest proportion (196.5kg). In Nigeria, *T. occidentalis* were sold in greater quantity (22.70kg) per week during the raining season than *S. macrocarpon* (11.02kg), *A. viridis* (4.26kg) and *A. hybridus* (4.01%). This may be an indication of its acceptability in the market. The same could be said of *T. occidentalis* in Nigeria. In the dry season, *S. macrocarpon* (18kg) were sold more than *T. occidentalis* (16.30kg), *A. hybridus* (8.61kg) and A. viridis (3.24kg) in Nigeria. This implies that *S. macrocarpon* sold more than thrice the volume of other vegetables in the raining season; however, it was the least volume sold during the raining season. This may imply that *S. macrocarpon* has the least resilience to withstand the dry season; hence, marketers opt for the more available Basil and Amaranth.

3.4.2 Marketing method by location

Table 22: Source of UIV marketed

	Benin		Nigeria	
Source of indigenous vegetables	Frequency	Percent	Frequency	Percent
Farm gate	43	64.17	369	82.00
Local market	16	23.88	70	15.56
Urban market	3	4.47	4	0.89
Others	5	7.46	7	1.56
Total	67	100	450	100.00

Source: MicroVeg Baseline data analysis, 2016. Figures in parenthesis represent standard deviation.

The result presented in table 22 show the sources from where marketers procure UIVs. Most of the marketers bought vegetables from the farm gate in both Benin (64.17%) and Nigeria (82.00%). Less than a quarter of the marketers in each country obtained the procured the produce from the local market while the rest patronized the urban markets and other sources.

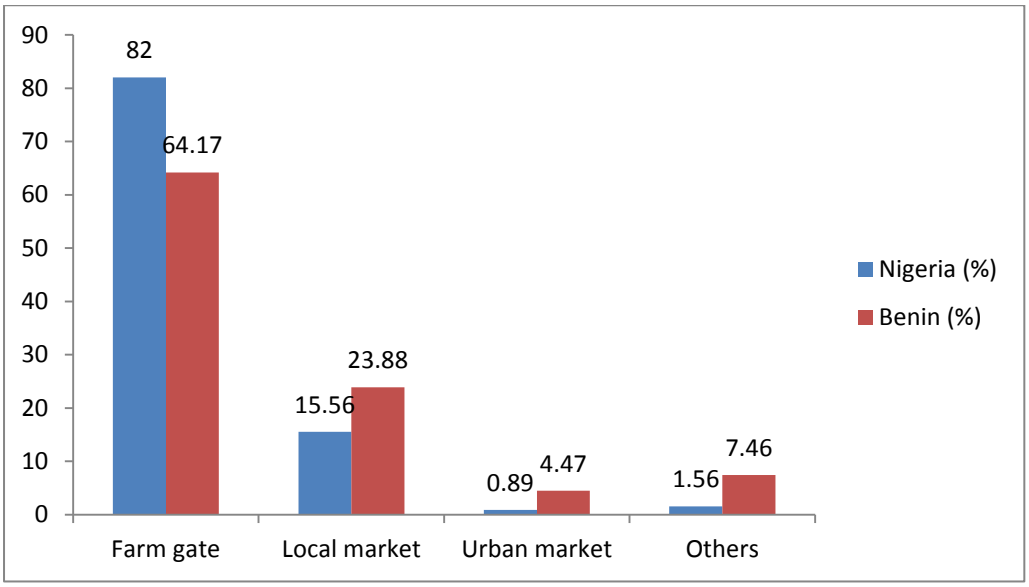

Fig. 1: Sources of UIV marketed

3.4.5 Economic Analysis of UIV Marketing

TABLE 23: GROSS MARGIN ANALYSIS OF UIVs MARKETER

		Benin			Nigeria		
ITEM	Units	Quantity	Price/Unit ($)*	Total Value ($)*	Quantity	Price/Unit ($)*	Total Value ($)*
Total Revenue (TR)							
Output	Kg	19800.00	0.43	8478.50	4481.55	0.72	3233.15

Total Variable Cost TVC							
Vegetable product	Kg	20000.00	0.26	5138.48	7448.50	0.31	2294.52
Cost of labour	manday	2.00	2.57	5.14	12	10.26	123.52
Cost of handling materials	Dollar			14.19			14.19
Cost of value addition	Hours	200.00	8.56	1712.83	176.48	1.28	226.26
Cost of shed	Dollar	Per month	5.14	61.66	Per month	2.37	28.42
Transportation cost	kilometre	24.00		1.71	181.92	0.31	56.05
Total Variable Cost				6934.01			2742.96
Gross Margin(TR-TVC)				1544.48			490.23
Gross Margin per kilogram				0.08			0.11
Cost-Benefit ratio				1.22			1.18

Source: Microveg Baseline data analysis, 2016 *$1=#195

The results in Table 23 show the gross margin analysis of the UIV marketers. In Benin, the total output and total variable cost was 19800kg and $6934.01, while in Nigeria, it was 4481.55kg and $2742.96 respectively. Gross profit in Benin was $1544.48 and $490.23 in Nigeria. For every kilogram of vegetable marketed, a profit of $0.08 and $0.11 would be expected in both Benin and Nigeria respectively. However, cost-benefit ratio revealed that for every one dollar investment invested in UIV marketing there is likely to be an expected return of $0.22 and $ 0.18 in Benin and Nigeria respectively. This implies that though in Benin, higher marketing output lead to higher variable cost and lower gross margin per kilogram than in Nigeria, the return on investment is higher in Benin than in Nigeria.

In both countries, the form in which the vegetable is presented by all the marketers was fresh. The unit of commercialization is in bunches. Constraints identified by the marketers included the barrier to entry formed by the marketing cartel and the unions, market glut, lack of preservation technique and value addition.

3.5 Assessment of food security status of farmers

Table 24: Food Shortage and UIV Farm size

Country	Farm size	Food shortage duration (month)				
		0-3	3-6	6-9	9-12	Total
Benin	Small	100	0	0	0	100

	Medium	0	0	0	0	0
	Large	0	0	0	0	0
	Total	100	0	0	0	0
Nigeria	Small	65.9	19.7	9.4	3.6	98.5
	Medium	1.1	0.2	0	0	1.4
	Large	0.1	0	0	0	0.1
	Total	67.1	19.9	9.4	3.6	100

Source: Microveg Baseline Data analysis, 2016

The results in Table 24 presents the food shortage duration in number of months and farm size of vegetable producers in Benin Republic and Nigeria. The result shows that majority of vegetable farmers with small farm holdings in Benin Republic (100%) and Nigeria (67.1%) experience food shortage of between zero to three months. In addition, about 98.5% of vegetable farmers that experience food shortage in Nigeria and Benin Republic across the year are small scale farmers. This suggests that small scale UIV farmers are more prone to food shortage in West Africa compared to vegetable farmers with medium or large farm holdings. In other words, the result reveals that small scale vegetable farmers would be more vulnerable to food scarcity and increase in the prices of food items in West Africa.

Table 25: Food Shortage by Gender

Country	Farm size			Food shortage duration (month)		
		0-3	3-6	6-9	6-12	Total
Benin	Male	59.26 (32)	0	0	0	59.26 (32)
	Female	40.74 (22)	0	0	0	40.74 (22)
	Total	100 (54)	0	0	0	100 (54)
Nigeria	Male	42(336)	14(114)	5.9(48)	2.7(22)	64.3(520)
	Female	26(207)	6(47)	3.5(28)	0.9(7)	35.7(289)
	Total Nigeria	67(543)	20(161)	9.4(161)	3.6(29)	100

Source: Microveg Baseline Data analysis, 2016

Majority of the vegetable farmers that experienced food shortage as shown in Table 25 in Benin Republic (59.26%) and Nigeria (64.3%) are men. This reveals that male vegetable farmers experience food shortage more than women in West Africa. This might be because they are household heads with a household to feed thus resulting into limited food availability in male headed households than men. Since food shortage does not mean total absence of food, this might mean than men have more coping strategies than women to handle food shortage period.

3.5.2 Frequency of consumption of UIV

Table 26: Average Weekly Consumption of UIV by Gender

Country	Type of UIV	UIV quantity (average) consumed (kg)		
		Male%	Female%	Total%
Benin	*Solanum macrocarpum*	6.16	6.23	6.2
	Ocimum basilicum	1.86	1.83	1.84
	Amaranthus spp	5.36	4.71	5.03
	Total	13.38	12.77	13.07
Nigeria	*Solanum macrocarpum*	0.30	0.44	0.40
	T. occidentalis	0.56	0.63	0.61

	Amaranthus spp	0.18	0.24	0.22
	Amaranthus spp	0.73	0.91	0.86
	Total	1.77	2.22	2.09

Source: Microveg Baseline Data analysis, 2016

On a weekly basis, the consumption of vegetables across households in the two countries as shown in Table 26 establishes that women in Benin Republic consume more of *S. macrocarpum* (6.23%) while women in Nigeria consume all the vegetables (2.22%). However, men consume other vegetables more than women in Benin Republic. This implies that while women prefer the consumption of *S. macrocarpum* than other vegetables in Benin Republic, Nigeria women vegetable producers consume all the available UIVs.

3.5.3 Food Security by gender in Benin Republic

Table 27: Food Security based on daily per capita Calorie intake by gender in Benin republic

	Daily per capita calorie (%)			
Country	**Benin Republic**		**Nigeria**	
Sex	**Male**	**Female**	**Male**	**Female**
<1000	0.76	0.76	0.09	0.09
1000-10000	37.40	28.24	56.99	33.08
10000-20000	13.74	6.87	6.43	2.11
20000-40000	3.82	3.82	0.83	0.28
>40000	4.58	0	0.18	0
Mean	710289	10041	6192	5986
Food security	97.5%	77.4	63%	34%

Source: Microveg Baseline Data analysis, 2016

The result of daily per capita caloric intake of respondents in the two countries (Table 27) reveals that majority of men and women in Benin Republic and Nigeria consume within the calorie range of 1000-10000kcal. The mean calorie consumption in Benin Republic among men and women is 710,289 and 10,041 respectively. In Nigeria, the mean calorie consumed is 6,192 and 5,986 among men and women respectively. These infer that vegetable producing households in Benin republic consume more calories than household in Nigeria. In addition, about 97.5% and 77.4% of men and women are food secure in Benin Republic while about 63% and 34% of male and female vegetable producers in Nigeria are food secure. This shows that vegetable producing households in Benin Republic are more food secured than their counterparts in Nigeria.

3.6 Crop diversification and resource use efficiency

3.6.1 UIV crop diversification

Table 28: Diversification of UIV crop enterprises

No of UIVs planted			**Male**		**Female**	
	Freq	%	Freq	%	Freq	%
1	411	37.74	268	24.61	143	13.13
2	393	36.19	251	23.05	142	13.04
3	153	14.05	87	7.99	66	6.06
4	47	4.31	27	2.47	20	1.84
Other veg	85	7.80	66	6.06	20	1.84
Total	1089		699		390	
Benin						
1	32	24,6	18	56,2	14	43,8
2	76	58,5	44	57,9	32	42,1
3	22	16,9	17	77,3	5	22,7
Other veg	-	-	79	60,8	51	39,2
Total	130					

Source: Baseline data analysis 2016

As stated in the methodology, the project considers four UIVs in Nigeria and three in Benin Republic. These are Ugu (*Telfaria occidentalis*), Igbagba (*Solanum macrocarpon*), Tete abalaye (*Amaranthus vividis*) and Efo tete (*Amaranthus hybridis*) in Nigeria and in Benin Republic, the project revolve around three indigenous vegetables that are Gboma (*Solanum macrocarpon*), Aléfo (*Amaranthus hybridis*) and Chayo (*Occimum graticimum*).

We examined crop diversification and its effect by looking at how many of the UIVs are cultivated by the respondents. Result in Table 28 shows that most respondents (37.74%) cultivate only one of the UIVs while only 4.31 % cultivate all the four types in Nigeria. More than 70% cultivate either one or two types of UIVs in Nigeria. Similar trend was observed along the gender lines as most male (47,66%) and female (26.17%) respondents also cultivate between one and two types of UIVs, while the least percentage (6.06% male and 1.84% female) cultivate all the four types of UIVs.

In Benin republic most UIV producers plant two types of UIVs, and this includes both men and women. This suggests that multiple cropping of UIVs are usually encouraged, possibly to provide a mitigation against possible failure and ensure food and nutritional security. This is common in both countries.

3.6.2 UIV diversification and resource use

Table 29: UIV crop diversification and resource use

No. of UIVs planted	Farm size (ha)	Dist. to water (km)	Water source	Wet-land (ha)	Manure (kg)	Herb (lts)	Fert (NPK) (kg)	Fert (Urea) (kg)	Income per season ($)
1	0.27 (411)	0.09 (411)	Dug well	0.19 (187)	60.87 (24)	9.77 (114)	189.62 (411)	77.56 (411)	2,805.51 (411)
2	0.53 (393)	0.13 (393)	Pipe borne	0.27 (229)	28.71 (36)	5.68 (125)	665.27 (393)	411.55 (393)	4,346.63 (393)
3	0.25 (143)	0.13 (153)	Bore hole	0.43 (105)	9.10 (15)	11.58 (44)	50.01 (153)	68.77 (53)	4,489.83 (153)
4	0.86 (47)	0.09 (47)	Dug well	0.39 (37)	46.74 (47)	5.45 (23)	126.24 (47)	32.14 (47)	2,933.89 (47)
Other veg.	0.04 (85)	0.23 (85)	Pipe borne	-	84.57 (8)	7.89 (28)	201.38 (85)	23.83 (85)	4,044.90 (85)
1	0.15 (0.25)	0.023 (0.016)	Dug well	0.081 (0.14)	11 (38.4)	0.56 (1.16)	33.5 (7.26)	15.63 (28.05)	678.09 (4830.17)
2	0.04 (0.11)	0.024 (0.034)	Pipe borne	0.34 (0.93)	9.1 (18.2)	5.57 (34.49)	16.09 (36.62)	6.72 (15)	1355.85 (2162.29)
3	0.27 (0.44)	0.015 (0.019)	Bore hole	0.16 (0.4)	24.7 (41.8)	0.5 (1.37)	21.77 (38.12)	10.91 (24.47)	1896.95 (2552.11)
Other veg.	-	-	-	-	-	-	-	-	-

Source: Microveg Baseline data analysis (2016) *1$ = N195 and 583.83 cFA

The results in Table 29 show how far the UIV farmer who diversifies uses the productive resources available to them. Results from the table show that whereas 0.27ha is planted sole to one UIV with $2,805 income per season, only 0.25ha is committed to three UIVs with an income of $4489 obtained from its cultivation. With this result it may be advised that diversification of UIVs be encouraged since it brings in more income at the end of the season to the resource poor farmers.

For Benin republic, the size of farmland committed to two UIVs is smaller than that for one UIV in which case it also pays to engage in multiple UIV crop cultivation for more efficient resource use.

In terms of distance to water, those who cultivate two and three types of UIVs travel 0.13km to source water from either borehole or public pipe borne water for their operations. However, those who cultivate one type or all the four types travel less (0.09km) to source water from dug out wells.

However, in Benin Republic distance traveled to source water ranged between 0.015 for three UIVs to 0.024km for two UIVs. In other words water source is closer to the farmers in Benin than in Nigeria, but the source of water is similar in that farmers in Benin also source water from dug well, borehole and pipe borne water as necessary.

In terms of type of land used for cultivation, the results show that farmers who diversify use mostly wetland for their operations. 0.43ha of wetland was committed to farming three types of UIVs as opposed to 0.19ha for one and 0.39ha four all the four types in Nigeria. In Benin, the largest size of wetland 0.34ha is committed to cultivating two UIVs while 0.08ha is used This suggests the need for regular supply of water (irrigation) if UIVs are to be cultivated and diversified for optimum returns to the farmers.

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 UIVs used least amount of fertilizer. This may be the reason why the returns obtained from cultivating either mono-cropping and multiple cropping of all UIVs is low. In the two countries, it is cultivation of three types of UIVs that yielded most income for the farmers.

4.0 Conclusions

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 complementarities 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 Republic. This report was written as an addendum to the baseline report of the project outcomes and to identify drivers and aspects that will help the participants achieve project objectives. The report answered four major questions that arose from the baseline reports earlier submitted viz; Educational level of farmers, land acquisition, land area under vegetable cultivation, current use of fertilizers by farmers and use irrigation to cultivate during the dry season, how easy is water supply, any cost associated with accessing water, any dispute in relation to the use of irrigation water, with emphasis on gender distribution; How do the project respondents' source seeds, how are seeds priced, what are the marketing methods by form (fresh, dried, processed), as well as by frequency (weekly or daily) and the estimated volume of UIV output sold; How profitable could using micro-dosed fertilizer rate be?. Should farmers invest or not invest in fertilizers?; How does UIV crop diversification affect productive resource use, resilience and gender equity in the selected MICROVEG (Project 107983) communities?; What are the gender dimensions of these baseline characteristics? What aspects should MICROVEG project address in order to ensure that it achieves or exceeds the set target of the outcomes? The study involved 2712 households in seven states spanning three agro-ecological zones. One hundred and forty four (144) communities in sixty-two (62) Local government Areas (LGAs) were covered for the purpose of data collection. Data were collected from 2172 households comprising 1091 farming households, 630 consumers and 450 UIV marketers in Nigeria and 239 households from five areas in Benin Republic. Using both quantitative and qualitative methods of analyses the results showed that the mean age of the farming household head is about 46 years. The average age of women UIV farmers is more than that of men; hence women UIV producers are older than men in both countries. As regards land acquisition for UIV production, men generally acquire land through inheritance while women do acquire land through gifts and lease in both countries. In essence, what this means is that women do not effectively "own" land for UIV production in the study area. In terms of educational status, female UIV farmers have more years of formal education than their male counterparts; however, the reverse is the case in Benin Republic, as men have more years of formal education than women.

As regards production inputs, the main sources of seed are purchase from market and seeds sourced from last season planting. The main sources of water are dug out well and borehole. However, in some cases the dug out well are empty during the dry season. In terms of gender, women in Nigeria source water mostly from dug out well while their Beninoise counterparts' source their water from borehole. That women in Benin were able to afford to source water from borehole is an indication of the impact of previous intervention programs by donor agencies considering its cost and the welfare status of the women. Most farmers obtain water from less than 200 meters in both countries. Farmers cover more kilometer to source water in Benin than in Nigeria. Fertilizer use is more common among men in Nigeria, while it is more common among women in Benin republic. Fertilizer use in Nigeria is below the recommended level while it is above the recommended level.

For marketers, the average age was 38 years in Benin and 42 years in Nigeria. All the UIV marketers are female in Benin while 91% are female in Nigeria. Most UIV marketers in Benin are non-literate whereas most have at least primary school education in Nigeria. Marketers in Nigeria cover shorter distance to source

their UIV. *Solanum* sp. is the most marketed during the rainy season in Benin and during the dry season in Nigeria. Most marketers source their vegetable from the farmgate both countries. For every dollar invested in UIV marketing, there is an expected return of $0.22 and $0.18 in Benin and Nigeria respectively.

In terms of food security, the results suggest that small scale UIV farmers are more prone to food shortage in the two countries compared to vegetable farmers with medium or large farm holdings. In other words, small scale UIV farmers are more vulnerable to food scarcity and increase in the prices of food items in West Africa. Further result reveals that male vegetable farmers experience food shortage more than women. This might be because men are household heads with responsibility to feed hence resulting into limited food availability in male headed households than that of women. Since food shortage does not mean total absence of food, this also suggests that men have more coping strategies than women to handle food shortage period.

Further result from analysis implies that while women prefer the consumption of *S. macrocarpum* than other vegetables in Benin Republic, Nigeria women vegetable producers consume all the available UIVs. In addition, vegetable producing households in Benin republic consume more calories than their counterparts in Nigeria. About 97.5% and 77.4% of men and women are food secure in Benin Republic relative to about 63% and 34% of male and female vegetable producers in Nigeria. This shows that vegetable producing households in Benin Republic are more food secured than their counterparts in Nigeria.

In terms of crop diversification and resource use, more than 70% of the farmers cultivate either one or two types of UIVs in Nigeria. Similar trend was observed along the gender lines as most male (47,66%) and female (26.17%) respondents also cultivate one and two types of UIVs, while the least percentage (6.06% male and 1.84% female) cultivate all the four types of UIVs. In Benin republic most UIV producers plant two types of UIVs, and this includes both men and women. This suggests that multiple cropping of UIVs is usually encouraged, possibly to provide mitigation against possible crop failure and ensure food and nutritional security. This is common in both countries. In the two countries, it is cultivation of three types of UIVs that yielded most income for the farmers.

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