Rural Household Food Security Status among Indigenous Leafy Vegetables Producers and Non Producers: Evidence from Coffee Bay, South Africa

A. Mayekiso, A. Taruvinga, and A. Mushunje
The University of Fort Hare, South Africa
Email: anelemayekiso@ymail.com, {ataruvinga, amushunje}@ufh.ac.za

***Abstract*—Indigenous Leafy Vegetables (ILVs), despite having a clear potential to improve rural household food and nutritional security, the evidence base for this association still remains poor, missing, mixed and inconsistent. With the emerging interest of linking biodiversity to food security in the face of climate change, there is therefore a need to appraise the ILVs - food and nutrition security nexus. This paper employed descriptive statistics and household food security proxy indices on a sample of 238 randomly selected rural households (ILVs producers and non producers) to appraise the connection between ILVs and household food security. Results reveal significant improved household food security status of producers compared to non producers worth further probing with robust models (Propensity Score Matching) on wider geographical areas.**

***Index Terms*—indigenous leafy vegetables, household food security**

I. Introduction

According to Asfaw [1, p. 316], indigenous vegetables are described as "edible plants that are biologically indigenous to an area, while introduced vegetables are those vegetables that have been introduced into a particular area and have not physiologically adjusted to the local conditions and subsequently require many agricultural inputs". Against this background, literature highlights that, most communities affected by poverty and under nutrition live in areas rich in biodiversity including wild and indigenous vegetables [2]. Of interest to note is the fact that, ILVs have been reported to be good in nutritional qualities such as macro and micronutrients [3]. However, there is still a high prevalence of malnutrition; especially micronutrient deficiencies among low income group of the population in South Africa [3]. Thus far, the use of indigenous vegetables has been proposed as part of the solutions to the problems of micronutrient and malnutrition among these populations [3]-[5].

Despite claimed several benefits; production of ILVs is still characterized by low volumes [6], [7] and currently declining [8]. Their production is more common in rural areas on small scale mainly for subsistence purposes with minor informal trade record [8]. The paper therefore explores food groups consumed by rural households and their household food insecurity access status based two different groups (ILVs producers and non producers).

II. Problem Statement

There is limited literature with respect of the contribution of ILVs to food security. The few that is available seem to have focused more on nutritional components of ILVs [9], [10] as well as benefits of consuming ILVs or any other indigenous foods at the expense of how production of ILVs can contribute to household food security for the rural population [3]. The observed lack of household food security strategies and policies that include ILVs and other wild foods further suggest lack of scientific evidence to link ILVs and other wild foods to household food security. Thus far, given the claimed benefits of wild foods (ILVs) need arises for researchers to provide scientific evidence on the ILVs food security nexus across various localities.

III. Objectives

- To estimate food groups consumed by ILVs producers and non-producers.
- To estimate food insecurity access status of ILVs producers and non-producers.

IV. Related Literature

Hart [11] noted that; (a) indigenous vegetables have an ability to grow relatively well in semi-arid areas where other exotic plants fail to grow, (b) ability to provide at least two food stuffs during their life cycle and (c) the ability of either the fruit or the leaves, or both, to be dried and stored for consumption in the winter months. Thus far, these vegetables can make a significant contribution in terms of household food security. Literature also argues that although ILVs may be consumed in small quantities by many rural households; they influence the intake of cereal staples, manage hunger and play a central role in household food security for the poorer rural communities

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[3], [12]. Thus, ILVs provide variety to otherwise monotonous cereal based diets [13], [14]. Providing different types of these ILVs can reduce this monotony by adding different tastes and colours to diets of rural people [3].

On a positive note, Kalaba *et al.,* [15] suggested that increasing production of ILVs by rural communities could be used as a strategy to improve food security and cash income for people living in rural areas. From a nutritional point of view, literature argues that ILVs have multiple nutritional benefits [16] that can improve micro-nutrient intake if the production and consumption of indigenous crops can be increased [17]. A study conducted on nutritional value of ILVs and their contribution to human health, by Nangula *et al.,* [9] suggested that many of the ILVs are good sources of micronutrients especially vitamin C, iron, zinc, calcium and magnesium. These vegetables may help to meet daily nutritional requirements especially for rural and urban poor communities [18]. Nangula *et al.,* [9] also reported that in many instances ILVs have levels of the micronutrients that are higher than those of exotic vegetables such as spinach and cabbage.

Lately, Van Jaarsveld *et al.*, [10] based on a study that was conducted on nutrient content of eight ILVs and their potential contribution to dietary reference intake, concluded that, ILVs can potentially make a considerable contribution towards the requirements for nutrients, particularly vitamin A and iron, which are micronutrients of public health significance in South Africa. Similar findings were also earlier on shared by Steyn *et al.,* [19], arguing that malnutrition could be addressed by ILVs given their high nutritional status. Shrestha and Dhilion [20] also highlighted that the nutritional and health benefits of ILVs as well as indigenous food are well known. Similarly, Singh and Garg [21] suggested that ILVs are the important dietary supplements and sources of elements such as minerals, proteins, folic acid and vitamins for resource poor communities.

Despite the above claimed benefits, Modi *et al.,* [17] argue that, the value of ILVs in food security has not been given sufficient attention in South Africa. And there are no formal interventions that seek to encourage people to produce and use ILVs as source of essential nutrients for people who are food insecure in rural communities. Turner [22] stated that the use of wild and indigenous resources for food has been an under estimated economic activity in rural communities which could help in improving the rural economy and alleviate poverty. The reduction in the production of ILVs has encouraged research to be done for under-utilized crops and ILVs that are such an important part of the livelihoods of many rural communities [23]. According to Kepe [24], ILVs carry a label of food for the poor and famine food tag for some people where some groups in rural societies do not ordinarily eat these vegetables under circumstances of adequate food availability but they would consume them under difficult conditions of droughts and food scarcity. Literature therefore cautions the indigenous foods - food security nexus based on the following reasons;

- The amounts of nutrients reported for the same species from different studies vary widely [3], [25].
- The bioavailability of micronutrients also needs to be determined for cooked vegetables as most of the available data are on raw samples [25].
- The abundance and diversity of these vegetables have not been adequately determined [3].
- Very large quantities of raw vegetables are required to make just a small portion/serving of relish [3].

Thus far as correctly summarized by Mavengahama [3, p. 6], "there are widely varying opinions as to the importance, abundance, and ease of cultivation of these vegetables and even on the need to domesticate and cultivate them, yet not much empirical evidence is available to support or rebut these observations and for seemingly abundant vegetables such as *Amaranthus* spp. (pigweed) and *Bidens pilosa* (black jack), people do not indiscriminately consume all available plants but select depending on certain (un) desirable characteristics like leaf hairiness, astringency (bitterness) and leaf size (which influences ease and speed of gathering/harvesting)". Similar sentiments were also shared by Tormote [26].

V. Methodology

The study used cross-sectional survey data from Coffee Bay area of the Eastern Cape Province of South Africa. The area was purposively selected based on the following assumptions. According to Coastal and Environmental Services [27], 67% of Coffee Bay area is dominated by natural vegetation, which includes forests, grassland, shrubs and indigenous plants. The obvious assumption made here is the fact that there are many ILVs in the area, and most people utilize these vegetables, especially poor people who highly depend on them as their source of food.

Therefore a better representation of the value of ILV production could be estimated in this area. This is further supported by the fact that Coffee Bay and some surrounding agricultural cooperatives are the dominant suppliers of ILVs including their seedlings and seeds within the Eastern Cape Province [28]. Through targeting the respondents dietary history, a 24-hour dietary recall was conducted to obtain food groups information from respondents` food intake [29]. The respondents were asked to recall all foods eaten and beverages taken in the previous twenty-four hours prior to the interview. The respondents were asked to recall all foods eaten and beverages taken in over the twenty-four hours preceding the interview. A scale of twelve food groups was used in assessing the dietary diversity of the respondents, as summarised in Table I below, following an approach taken by FAO [29].

A single point was awarded to each of the food groups consumed over the reference period giving a maximum sum total dietary diversity score of 12 points for each individual in the event that his/her responses are positive to all food groups. A value of zero would therefore mean a low Dietary Diversity Score (HDDS) and the closer the score is to 12, the higher the dietary diversity of the respondent.

TABLE I. THE CATEGORIES OF FOOD GROUPS

Food groups	Points
Any bread, rice, or any other foods made from millet, sorghum, maize, wheat or any other locally available grain	1/0
Any potatoes, yams, cassava or any other foods made from roots or tubers	1/0
Any vegetables	1/0
Any fruits	1/0
Any beef, pork, lamb, rabbit, chicken, duck, other birds and organ meats	1/0
Any eggs	1/0
Any fresh or dried fish, or shellfish	1/0
Any foods made from beans, peas and lentils	1/0
Any yoghurt, milk or milk products	1/0
Any food made with oil, fat or butter	1/0
Any sugar	1/0
Any food such as coffee or tea	1/0
Total	12/0

Key: If the answer is yes award 1 point and if the answer is no award 0 points

This was complemented by the Household Food Insecurity Access Scale (HFIAS), assessing whether households have experienced problems with food access during the last 30 days [30]. The instrument consists of nine occurrence questions and nine frequency questions; these questions ask about the changes households made in their diet or food consumption patterns as a result of limited resources to acquire food. Thus, HFIAS measures the level of food insecurity during the past 30 days as self-reported by the household. The measured results are then assigned a categorical designations (food secure or mildly, moderately, or severely food insecure) or given a numerical value (0-27), with higher numbers representing a greater level of food insecurity [31]. Table II summarises the generic HFIAS questions used in this study.

TABLE II. THE HOUSEHOLD FOOD INSECURITY ACCESS SCALE (HFIAS) GENERIC QUESTIONS

Questions	Response options: 0= Never 1= Rarely (once or twice in the past 30 days) 2= Sometimes (three to ten times in the past 30 days) 3= Often (more than ten times in the past 30 days).
Did you worry that your household would not have enough food?	
Were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	
Did you or any household member eat just a few kinds of food day after day due to a lack of resources?	
Did you or any household member eat food that you preferred not to eat because a lack of resources to obtain other types of food?	
Did you or any household member eat a smaller meal than you felt you needed because there was not enough food?	
Did you or any other household member eat fewer meals in a day because there was not enough food?	
Was there ever no food at all in your household because there were no resources to get more?	
Did you or any household member go to sleep at night hungry because there was not enough food?	
Did you or any household member go a whole day without eating anything because there was not enough food?	

For each of the above questions, a respondent considered what has happened in the past 30 days. The respondent also indicated whether this never happened, rarely (once or twice), sometimes (3-10 times), or often (more than 10 times) in the past 30 days. A HFIAS score variable is calculated for each household by totaling the codes for each frequency of occurrence question. The maximum score for a household is 27 (if the household response to all 9 questions was "often", coded with a response code of 3); the minimum score is 0 [30]. The higher the score, the more food insecurity (access) the household experienced. The lower the score, the less food insecurity (access) a household experienced.

VI. RESULTS AND DISCUSSION

Table I provides the basic sample characteristics from the study area. A total of 238 respondents were considered for this study with a mean household-head age range of 47-56 years. The median education level was 2, implying that, on average; respondents were educated up to primary level. Basic sample statistics also suggest that the considered sample had more females than males with an average monthly income below R1000. Sample results further reveal an average household size of 7 family members with a minimum of 2 and a maximum of 15. A majority of the respondents had access to extension, market and credit services.

With reference to access to arable land, basic sample results indicate that on average the majority of the respondents did not have access to land for cultivation. Lastly, with reference to membership to community organizations, basic sample statistics reveal that, on average a majority didn't belong to any local social farming network club. The asymmetry of distribution was both positively and negatively skewed, as shown in Table III. Most of the household characteristics had skewness values below and close to 1; this suggests that the distribution did not differ significantly from a normal symmetric distribution.

TABLE III. BASIC SAMPLE STATISTICS

Variables	N	Mean	Std. Dev	Skewness	Min	Max
Gender	238	1.65	.479	-.619	0	1
Age	238	3.46	1.210	-.304	1	5
Educ	238	1.97	.811	.860	1	3
Inco	238	2.38	.817	.267	1	3
HHS	238	7.08	2.545	.748	2	15
ATM	238	.66	.485	-.546	0	1
DTM	238	.66	.482	-.584	0	1
ATE	238	.84	.404	-1.228	0	1
ATC	238	.78	.424	-1.203	0	1
ATL	238	.08	.293	3.515	0	1
ORG	238	.29	.471	1.197	0	1

Key: GEND: Gender (0= male; 1= female), **AGE:** Age (1=<25; 2=26-35; 3=36-46; 4= 47-56; 5= >56), **EDUC:** Education (1=no education; 2=primary education; 3= secondary education), **INCO:** Income per month (1= no income; 2= <R1000; 3=R1000-R3000), **HHS:** Household size, **ATM:** Access to market (0=no access; 1= access), **DTM:** Distance to market(0=close; 1= far), **ATE:** Access to extension (0= no access; 1= access), **ATC:** Access to credit (0=no access; 1= access), **ATL:** Access to arable land (0=no access; 1= access), **ORG:** Membership to CBOs (0= non membership to CBO; 1= membership to CBO).

A. *Cultivated ILVs from the Study Area*

The results from the study area indicate that different types of ILVs were commonly grown as summarized in Fig. 1. The major ILVs grown from the study area included the following vegetables: Group 1; amaranth, black jack, spider plant and Chinese cabbage (55%), Group 2; pumpkin leaves and pigweed (28%), Group 3; chenopodium album (9%) and Group 4; night shade and goose foot (8%). Previous studies report production and consumption of wild foods from the same area [28].

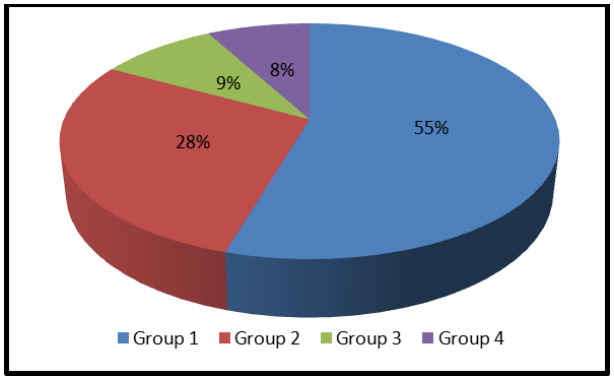

Figure 1. Cultivated ILVs from the study area.

B. *Food Groups Consumed from the Study Area*

This section focuses on reported food groups from the study area based on a 24-hour dietary recall. Fig. 2 presents results of the reported food groups from the study area by participation status. The distribution reveal that the following food groups were common for both categories: food group 1 (100%), food group 11 (90%), food group 12 (91%). Also of interest is food group 3 (vegetables); a huge difference was noted between the two groups, where vegetables were very popular among participants (91%) and not that popular for non-participants (30%).

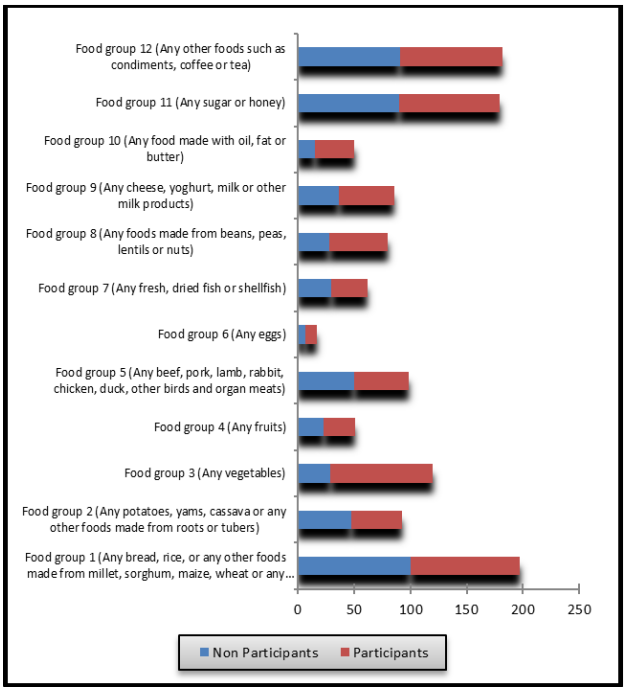

Figure 2. Food groups consumed from the study area by ILVs production status.

This distribution suggests that rural diets are dominated by food groups rich in starch, sugar and condiments. Similar comparable observations were also noted by several authors [32], [33]. These results further suggest that participation in ILVs production may improve rural households` diets in the following food groups: group 3 (vegetables), group 8 (food made from beans, peas, lentil or nuts) and group 10 (food made of oils, fat or butter). This may be explained by an observation noted by Mavengahama [3], who argued that, "although they (ILVs) may be consumed in small quantities, they influence the intake of cereal staples, manage hunger and play a central role in household food security for the poorer rural groups".

C. *Household Dietary Diversity*

In this section the study paired participants to non-participants in terms of their HDDS. Table IV presents a consolidated summary of the calculated HDDS for both categories. Results reveal that on average participants had a higher HDD score (7) compared to their non-participants counterparts (5) although both groups were classified in the moderately food secure category.

TABLE IV. HOUSEHOLD DIETARY DIVERSITY SCORE (HDDS) BY PARTICIPATION STATUS OF RESPONDENTS

	Low Dietary Diversity	Medium Dietary Diversity	High Dietary Diversity
Dietary Diversity Score	0 - 4	5 - 8	9 - 12
Participants		7	
Non Participants		5	
Food security proxy	**Insecure**	**Moderately secure**	**Secure**

Thus far, the study tests the significance of the median differences of the two groups as shown in the Table V. Results reveal that, there is sufficient evidence to reject H_0 since the median of difference between ILVs participants` HDDS and Non-ILVs participants` HDDS is not equals to zero (statistically significant with a *p-value* of 0.047).

TABLE V. HYPOTHESIS TEST SUMMARY

Null Hypothesis	Test	Sig.	Decision
The median of difference between ILVs participants' HDDS and Non-ILVs participants' HDDS equals 0	Related-Samples Wilcoxon Signed Rank Test	0.047*	Reject the null hypothesis

Significance level = 0.05

The implied message suggests that although the two groups were classified in the moderately food secure category, ILVs participants had a better dietary diversity score which may suggest being more food secure than their non-participants counterparts. These findings support several conclusions from literature which suggests that indigenous vegetables still play significant roles in nutrition, food security and medicine [3], [19].

D. Household Food Insecurity Access

In this section the paper provide results on the calculated household food insecurity access of the respondents. As earlier on highlighted in the methodology chapter, the higher the HFIAS, the more food insecurity the household experienced and the lower the score, the less food insecurity a household would have experienced [30]. Table VI presents the observed Household Food Insecurity Access Scale (HFIAS) by participation status of respondents.

TABLE VI. HOUSEHOLD FOOD INSECURITY ACCESS SCALE (HFIAS) BY PARTICIPATION STATUS OF RESPONDENTS

HFIAS	Low	Medium	High
	0 - 9	10 - 18	19 -27
Participants		10.7	
Non-Participants		13.6	
Food security Proxy	**Less food insecure**	**Moderate**	**More food insecure**

Results as displayed in Table IV indicate a lower HFIAS for participants compared to non-participants (Participants HFIAS = 10.7; non-participants HFIAS = 13.6). By classification these results suggests that both groups can be classified as moderately food insecure. We therefore test the significance of the median differences of the two groups as shown in the Table VII. Results reveal that, there is sufficient evidence to reject H_0 since the median of difference between ILVs participants` HFIAS and Non-ILVs participants` HFIAS is not equals to zero (statistically significant with a *p-value* of 0.045).

TABLE VII. HYPOTHESIS TEST SUMMARY

Null Hypothesis	Test	Sig.	Decision
The median of difference between ILVs participants' HFIAS and Non-ILVs participants' HFIAS equals 0	Related-Samples Wilcoxon Signed Rank Test	0.038*	Reject the null hypothesis

Significance level = 0.05

The implied message suggests that although the two groups were classified in the moderate food insecure category, ILVs participants were more less food insecure than their non-participants counterparts.

These findings suggest the potential contribution of ILVs towards addressing rural household food security through improved intake of vegetables and several other food groups; like food made from beans, peas, lentil or nuts and food made of oils, fat or butter.

VII. CONCLUSION

The paper concludes that rural diets from the study area were dominated by food groups rich in starch, sugar and condiments at the expense of fruits, vegetables and protein sources. Producers of ILVs showed an improved intake of food groups: 3 (vegetables), 8 (food made from beans, peas, lentil or nuts) and 10 (food made of oils, fat or butter). Food security proxy indictors for the two groups (producers and non producers) revealed a significant difference; suggesting that producers were more food secure than non producers. We therefore argue that, ILVs have a potential to improve rural households' dietary diversity through improved intake of vegetables and other food groups, thus reducing food insecurity at household level. We therefore call for wider and robust studies across different agricultural systems to jointly evaluate the ILVs – food security nexus.

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Anele Mayekiso was born in Libode, Eastern Cape Province of South Africa. She obtained her B. Agric and M. Agric from University of Fort Hare. Ms. Mayekiso's research interests include; food security and natural resource economics.

Amon Taruvinga was born in Zimbabwe. He got his B.Sc. (Hons) degree in Agricultural Economics from University of Zimbabwe and he received his Ph.D. in Agricultural Economics from University of Fort Hare, South Africa. He is currently a lecturer in the Department of Agricultural Economics and Extension at University of Fort Hare, South Africa. Dr. A. Taruvinga's area of specialization is Environmental Economics.

Abbyssinia Mushunje was born in Zimbabwe. He got his B.Sc. (Hons) degree in Agricultural Economics from University of Zimbabwe and he received his Ph.D. in Agricultural Economics from University of Fort Hare, South Africa. He is the current HoD, Agricultural Economics and Extension department at University of Fort Hare, South Africa. Prof. A. Mushunje's area of specialization is livelihoods economics, food security and climate change.