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Nutraceutical Phyto-Agrobiodiversity among Lake Victoria Basin's Smallholdings Revealing Dietary Diversity

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Abstract

"Nutraceutical Plant-Agrobiodiversity" (NCPAB) with a multi-meaning implication as applied in our current research project context is a less commonly used term than is dietary diversity. On one hand, NCPAB may be taken as a basis of dietary diversity. Beyond that, however, as our studies in the Lake Victoria Basin using the X-ray Fluorescent (XRF) Analysis for assigning nutrametric grades to mineral micronutrient dense variation indexing (nutraceutical diversity) suggest, small hold farming practices in the region might be important determinants limiting the NCPAB crop range richness and distribution on farm units. With the XRF Mineral Micronutrient Dense (XRF-MINIMIDE) grading method, MINIMIDE data mining as a reflection of NCPAB richness appears to be confined to a small range of only 10 to 15 farm unit crop species. The small number implies possible diminishing of agro-biodiversity on today's family smallholdings in the Lake Basin. Among other factors, land fragmentation leading to even smaller sized farm holdings and the associated households' worsening impoverishment needs, reduced soil fertility due to over use of land, nutrient fluxes and constricting list of underutilised indigenous plant species could or might already be affecting household food, nutrition, health and the general wellbeing of the occupant operators much more today than probably before. Our data are raising issues that warrant finding ways by which indigenous/underutilised plant agro-biodiversity can be retained/rescued/restored back to a stable agro-ecosystem by premium-value nutraceutical use which can lead to conservation on the farm units upon which a bulk of the rural people primarily depend on for much of their nutrahealth wellbeing. Prior to considering the up-scaling and out-scaling of the findings of our XRF-MINIMIDE grading method, coupling the XRF technique with an NIRS procedure could form the applicability value of our results for the user community.

Key words: Nutraceutical; Biodiversity; Small Holder Farmers; Lake Victoria Basin; X-Ray Fluorescent

Introduction

Cultivated and wild plants as food and medicine make essential contributions to human health, which in turn provides rationales for conservation. Wild and cultivated plant diversity reasonably facilitate dietary diversity and positive health outcomes, although it is still a challenge to demonstrate this relationship and have it documented as a policy for implementation (Belanger and Johns, 2008)

Biodiversity conservation includes landscapes used for farming and pastoralism. Rural communities use and manage biodiversity for sustainability of their livelihoods and maintenance of natural and modified ecosystems (Eilu *et al*., 2003).

Great efforts have been and are still being vested in reducing hunger, micronutrient deficiencies, obesity and related cardiovascular and degenerative diseases although, these health challenges are still in dire need of alternative innovative solutions. Deployment of agricultural biodiversity is an approach that entails greater use of local biodiversity to ensure dietary diversity and may have far reaching results as opposed to single-nutrient intervention strategies (Frison *et al*., 2006). Holistic food-based approaches that combine research to assess and document nutritional and healthful properties of traditional foods, investigating options in which nutritionally valuable traditional foods can contribute to better livelihoods seem to be the sustainable way forward (Frison *et al*., 2006). These approaches ultimately address millennium development goals 1 and 7.

East African food systems are based on a rich diversity of traditional cereals, legumes, leafy vegetables, indigenous fruits and animal-source foods that are cultivated and gathered from the wild. East African communities value traditional foods and retain knowledge of their use and cultural importance (Johns and Eyzaguirre, 2006).

The Lake Victoria Basin (LVB) is characterised by small holder farmers who farm their land for plant foods to ensure households are food and nutrition secure. Hence promotion of the traditional or indigenous, neglected and under-utilised crops is one of the strategic means to empower poor rural farmers.

"Nutraceutical Plant-Agrobiodiversity" (NCPAB) has a multi-meaning implication and has been applied in our research project context as a basis for dietary diversity. This paper presents an analysis of women small holder farming land use patterns, which is core to the project, and the status of selected plant foods in the LVB.

Materials and methods

Experimental design

The project study was a nested design with the 3 countries as a primary hierarchical level (n=3), and the following sites in each country, Uganda (Ikumbya and Makuutu – Iganga district), Kenya (Bunyore and Majengo – Vihiga district) and Tanzania (Kiilima and Itahwa – Bukoba district). The other lower design levels are as illustrated in Figure 1.

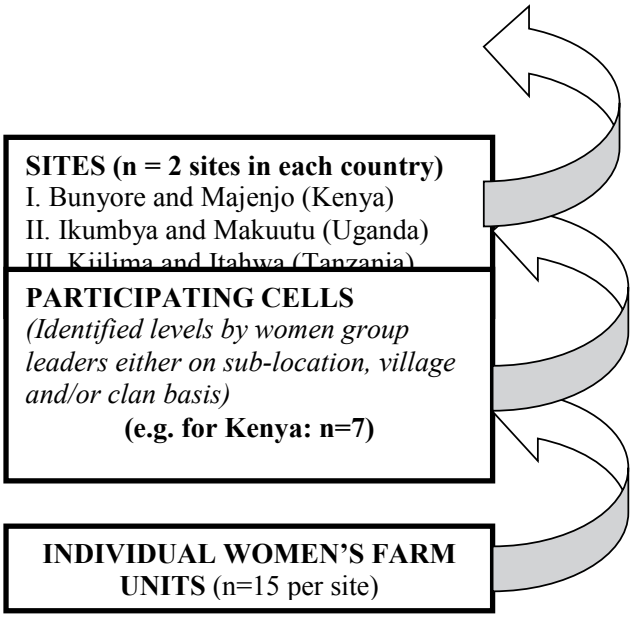

Figure 1: Nested experimental design showing lay out for selection of women farmer respondents as key informants and their farm units as the project pilot sites

Key informant interviews

Key informant interviews were conducted to capture plant biodiversity and land use types that are reflective of the small holder farms in the Lake Victoria Basin (LVB) project study sites. Based on the experimental design, small holder women farmers were chosen through a multi-stage purposive sampling procedure from two sub counties or locations in each of the LVB project districts (Bukoba, Iganga and Vihiga).

Data and Statistical analysis

The data generated from the key informant interviews was computed and analysed using SPSS ver. 12 (SPSS Inc. 1989-2003) and descriptive statistics derived to report findings.

Results and Discussion

Characteristics of women small holder farming land use patterns of the LVB

Women small holder farmers of the LVB typically farm on acreages of less than 2 acres. This project revealed that plant foods produced by women smallholder farmers are valued for household food and nutrition security. Women small holder farmer's land use farming activities are confined to three landscape terrain types (*upper, steep and valley*) and three farmer's farm locations in relation to the housing unit (*immediately next to the housing unit; farthest away from the house or in between these two locations*). These two criteria were found to have an implication on biodiversity of plant foods produced and utilised by the women farmers (Akundabweni *et al*., 2008 b - In the press). The location of the farm area contents and cultural landscape form the concept of this project that yield nine possible land use types reflective of women small holder land use farming patterns (Figure 2).

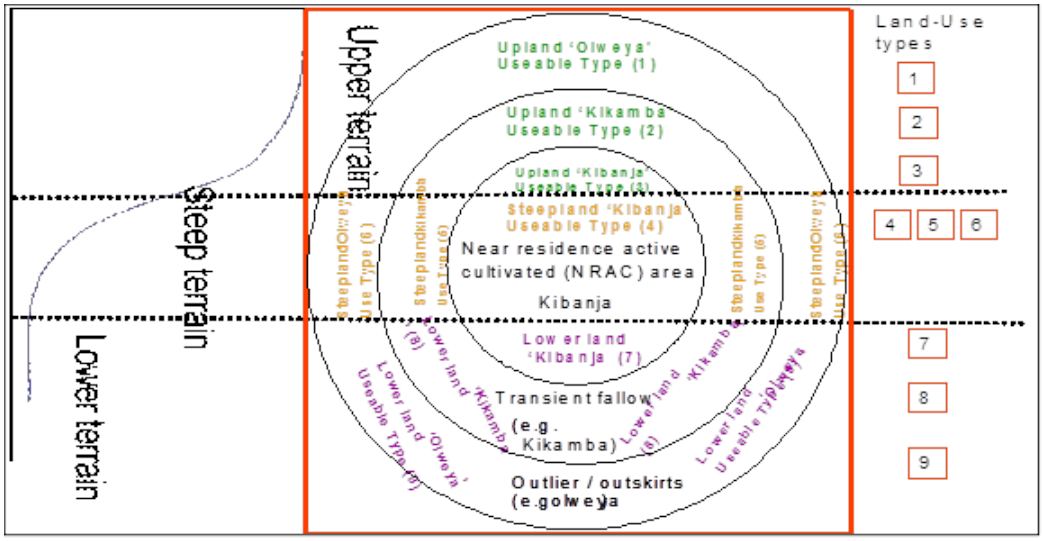

Figure 2: Nine land use types reflective of women small holder farming activities in the Lake Victoria Basin, generated from two criterion (i) farm location in relation to the housing unit: *kibanja* - *fa*rm area contents immediate to housing; *kikamba* - in between farm area contents and *olweya* - farm are contents farthest away from housing and (ii) the landscape terrain type: upper, steep (slope) and lower (valley). The upper land terrain was predominantly farmed by women small holder farmers in project sites compared to the steep and low lands, 63.6% in Bukoba, 66.7% in Iganga and 86.2% in Vihiga (Table 1). Women farming activity dominance was highest on the *kibanja*-upland type for Bukoba farmers, *kikamba*-steep land for Iganga farmers, and the *kibanja*-upland and *kikamba*-upland types for Vihiga farmers (Figure 3).

Table 1: Percentage (%) of women small holder farmers farming on the three landscape terrains in project target sites of the Lake Victoria Basin region

Farm landscape terrain type	Bukoba (Northern Tanzania)	Iganga (Eastern Uganda)	Vihiga (West Kenya)
Upper land	63.6	66.7	86.2
Steep land	36.4	4.2	13.8
Low land	-	24	-

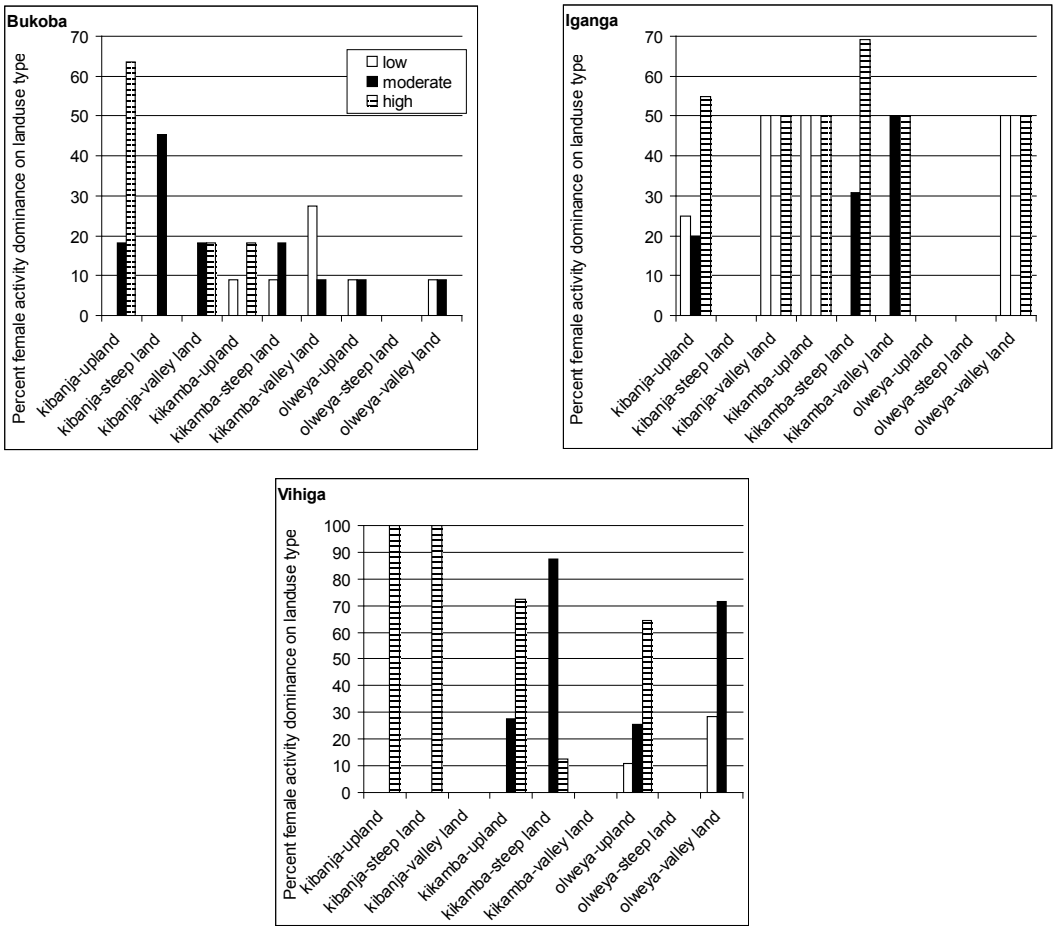

Figure 3: Women small holder farming activity dominance in Lake Victoria Basin project sites of Bukoba, Iganga and Vihiga Districts

Status of selected indigenous plant food types produced on women small holder farms

There were varied Iganga and Vihiga women small holder farmer responses as regards to the most underutilised, neglected and disappearing plant foods (Figure 4). Uncertain sources of seed for these indigenous plants and the low national government's effort vested in their promotion has led indigenous plants taking second place to the high income plants. *Iganga*

women farmers reported a range of plant food types that have been neglected over the years with *Dioscorea* spp most (23%) neglected, *Solanum* spp as the disappearing species and *Aloe laterita* as most underutilised (Figure 4). Vihiga women reported *Cleome gyandra* (20%) as most underutilised and *Corchorus olitorius* as the disappearing species. Plant species that were neglected were *Amaranthus, Corchorus olitorius* and *Cleome gyandra* and *Solanum nigrum* complex (Figure 4).

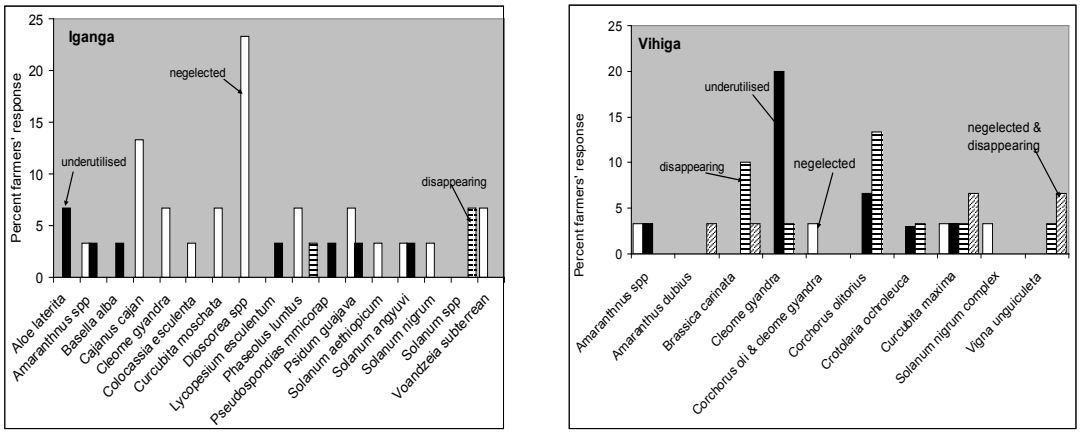

Figure 4: Plant food types women small holder regarded as neglected, under utilized and disappearing in LVB project sites of Iganga and Vihiga Districts

Nutriametric agro-biodiversity in this study refers to germplasm diversity variation range, scored in terms of nutria-grades, might have a potential to fulfil some nutraceutical prioritization function (Akundabweni *et al.,* 2008a). Nutra-grades were computed from X-ray fluorescent (XRF) analysis of mineral contents of germplasm collected from women farms (Akundabweni *et al*., 2008b). "Nutraceutical Plant-Agrobiodiversity" (NCPAB) in our research project is a reflection dietary diversity on the women small hold farms. Typically the LVB project pilot women small holder farm units had a low number of plant/ crops. This was corroborated by the plant food types the farmers identified as under utilised, neglected and disappearing over the years (Figure 4).

Conclusion

The choice, variation and mineral micronutrient content of plant types produced on small holder farms is highly controlled by women small holder farmers. Varied plant types found on these farms contribute to household diets. Dietary diversity is highly dependent on what is produced on these farms. Women small holder farmer are central to on-farm plant agro-biodiversity conservation, utilization, and commercialization for sustainable land use. The various small holder farms serve as pockets of plant agro-biodiversity conserved more especially for the neglected and disappearing plant types that need to be protected and the respective seed preserved. The spatial location of plants in relation to the housing unit can serve as collections of plant agro-biodiversity conservation since farm activities revolve around the smallholder farm units.

The X-ray Fluorescent – Mineral micronutrient dense (XRF-MINIMIDE) grading technique used in our previous work (Akundabweni *et al*., 2008 a and b) coupled to techniques such as Near Infrared Spectroscopy (NIRS) provides useful confirmatory results for up scaling and out scaling of nutraceutical plant agro-biodiversity in the user communities.

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