UNIVERSITÀ
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Land, Environment, Agriculture and Forestry (LEAF) Department

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PhD Program: **Land, Environment, Resources and Health (LERH)**

Batch: XXXII

The role of non-wood forest products in diets and livelihoods: quantifying the contributions

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Ciclo: XXIII

Il ruolo dei prodotti forestali non-legnosi (PFNL) per l'alimentazione e nei mezzi di sussistenza: quantificando i contributi

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ABSTRACT

English:

There is a growing amount of evidence suggesting a strong correlation between forests and healthy, diverse diets, as well as an increasing number of studies attesting to the rise of vibrant emerging niche and experiential Non-wood forest product (NWFP) based markets (Rowland *et al*., 2016, Ickowitz *et al.,* 2016, Powell *et al*., 2015; Ickowitz *et al*., 2014; Wong & Prokofieva, 2014). Still, forests in general are rarely considered in food and nutrition policies and programmes, and NWFPs in particular hardly receive adequate attention in land-use planning and rural development strategies. Arguably, there is not enough globally comparable data to “make a case” for their value. This thesis tests the hypothesis that NWFPs indeed play an important role in diets and livelihoods. The study has two main components: the first part looks at the age-old debate of “what is a non-wood forest product”, which is at the basis of quantifying contributions. The second part is divided into two components: (1) assessing the degree to which NWFPs contribute to diets and livelihoods in selected areas, motivations behind gathering (e.g. hunger or emergency, culture, income) and perceptions of their status in the wild and; (2) understanding prospects for improving livelihoods with the main-collected products (in this case insect-based NWFPs). All of this work aims to support official data collection on NWFPs, and better inform policies and decision making related to forests, land-use and healthy food systems more broadly.

Italiano :

Vi è una crescente quantità di prove che suggeriscono una forte correlazione tra foreste e diete sane e diversificate, nonché un numero crescente di studi che attestano l'ascesa della vivace nicchia emergente e dei mercati esperienziali basati sui prodotti forestali non legnosi (PFNL) (Rowland *et al.,* 2016, Ickowitz *et al*., 2016, Powell *et al*., 2015; Ickowitz *et al*., 2014; Wong & Prokofieva, 2014). Tuttavia, le foreste in generale sono raramente considerate nelle politiche e nei programmi alimentari e nutrizionali, e in particolare le PFNL difficilmente ricevono adeguata attenzione nella pianificazione dell'uso del suolo e nelle strategie di sviluppo rurale. L’argomento principale è che non ci sono abbastanza dati comparabili a livello globale per "fare un caso" per il loro valore. Questa tesi mira a verificare l'ipotesi che le PFNL svolgano effettivamente un ruolo importante nelle diete e nei mezzi di sussistenza. Lo studio avrà due componenti principali: la prima parte esaminerà l'antico dibattito su "cos'è un prodotto forestale non legnoso", che è alla base della quantificazione dei contributi. La seconda parte è divisa in due componenti: (1) valutare il grado in cui i PFNL contribuiscono alle diete e ai mezzi di sussistenza in aree selezionate, identificando le motivazioni alla base della raccolta (ad esempio fame o emergenza, cultura, reddito) e percezioni del loro stato in natura e ; (2) comprendere le prospettive per migliorare i mezzi di sussistenza con i prodotti più raccolti (in questo caso PFNL a base di insetti). Tutto questo lavoro ha lo scopo di supportare la raccolta di dati ufficiali sugli PFNL e di informare meglio le politiche e il processo decisionale in materia di foreste, uso del suolo e sistemi alimentari sani in modo più ampio.

Acronyms and abbreviations

CFS	Committee on Food Security
CIFOR	Centre for International Forestry Research
EUROSTAT	Statistical Office of the European Union
FAO	Food and Agriculture Organization of the United Nations
FFQ	Food Frequency Questionnaire
FRA	Forest Resource Assessment
HLPE	High Level Panel of Experts
ISIC	International Standard for Industrial Classification
ITC	International Trade Centre
KTB	Kenyan Top Bar Hive
MAPs	Medicinal and Aromatic Plants
MFP	Minor Forest Produce
NACE	Statistical Classification of Economic Activities in the European Community
NTFP	Non-timber forest products
NWFP	Non-wood forest products
SDG	Sustainable Development Goal
SWOT	Strengths, Weakenesses, Opportunities, Threats
RDA	Recommended Dietary Allowance
TEEB	The Economics of Ecosystems and Biodiversity
OPM	Office of the Prime Minister
WFP	Wild Forest Products
WHO	World Health Organization
UBOS	Uganda Bureau of Statistics
UGX	Ugandan Shillings
UNCPC	United Nations Central Product Classification System
UNECE	United Nations Economic Commission for Europe
UNHCR	United Nations High Commission for Refugees
UNSTATS	United Nations Statistics Office
USD	US Dollars

1. INTRODUCTION

1.1 Structure of the thesis

This thesis begins by (i) exploring definitions and terminology on non-wood forest products (NWFPs)[1], which is at the basis of understanding their role and quantifying contributions. The lack of a clear definition and term for NWFPs has contributed to poor data, leading to their invisibility in forest as well as food security and nutrition policies, and related decisions and interventions. This activity was mostly carried out as desk research based on an in-depth and extensive literature review of existing/available papers (including both scientific as well as grey literature on the topic). By disentangling terms and definitions, the aim is to contribute to research and policy developments within this domain, as well as to potentially have indirect positive impacts regarding "on the ground" activities, not least data collection.

Clarity on terms and definitions also aims to support the hypothesis that NWFPs play an important role both locally (e.g. through direct consumption) as well as at higher scales (e.g niche products with value addition for high-end consumers). In other words, despite being traditionally labeled as secondary forest products, they actually play a significant role within diets, for income and for the well-being of many communities. In order to support this statement an (ii) on-the-ground survey was performed in Uganda, enriched with additional focus group activities in Zambia, to investigate the importance of wild gathered NWFPs for food and local livelihoods. Within this framework, (iii) the highest ranked products collected where analysed in more detail – in this case insect-based wild food – to explore the potential for developing "ento-economies" within the study area, appraise key bottlenecks to developing the sectors, understand threats to sustainability, and in turn learn useful lessons for informing future activities in this area and field of activity.

Specifically, the methods employed for the research activity are summarized in section 2, with results and discussion summarized in section 3. Key conclusions drawn based on the findings are assembled in section 4. The thesis structure is illustrated below in Figure 1.

[1] The term "Non-wood forest products" is used instead of "Non-timber forest products" (NTFPs), which has a slightly different meaning. The terminology will be discussed at length throughout the course of this paper.

Figure 1. Thesis structure

Introduction (section 1)

- **Background –** global and interconnected environmental and health challenges; biodiversity loss, homogenization of diets, food and nutrition insecurity
- **Justification –** Why NWFPs? Why now? Historical trajectory until today
- **Research questions and objectives –** what role do NWFPs play in diets and livelihoods?

Methods (section 2)

What is a NWFP? (section 2.1)

- Disentangling terms and definitions for improving official statistics (Desk review: Scopus, Google Scholar)

To what extent do NWFPs contribute to diets and livelihoods in select areas? (section 2.2)
&
Prospects for improved livelihoods? A deeper look into potential ento-economies (section 2.3)

- Household surveys (n= 134) on NWFP collection and food frequency questionnaires (FFQ)
- Focus group discussions (n = 120 persons)
- Market surveys
- Key informants
- Literature review
- SWOT analysis (section 2.3)
- Nutrisurvey (to translate quantities into nutrients) (section 2.3)

Results and Discussion (section 3)

(section 3.1)

A proposal for improving official statistics on NWFPs (accepted in the *International Forestry Review*)

(section 3.2)

- Main NWFPs collected
- Contributions of NWFPs to diets relative to other foods
- Quantities collected
- Main motivations for consumption & gathering
- Opportunity costs of collection

(section 3.3)

- Results of SWOT analysis
- Key opportunities and trade-offs of gathering (income generated, nutrients obtained vs time spent collecting)
- Prospects for commercialization

Conclusions (section 4)

1.2 Background

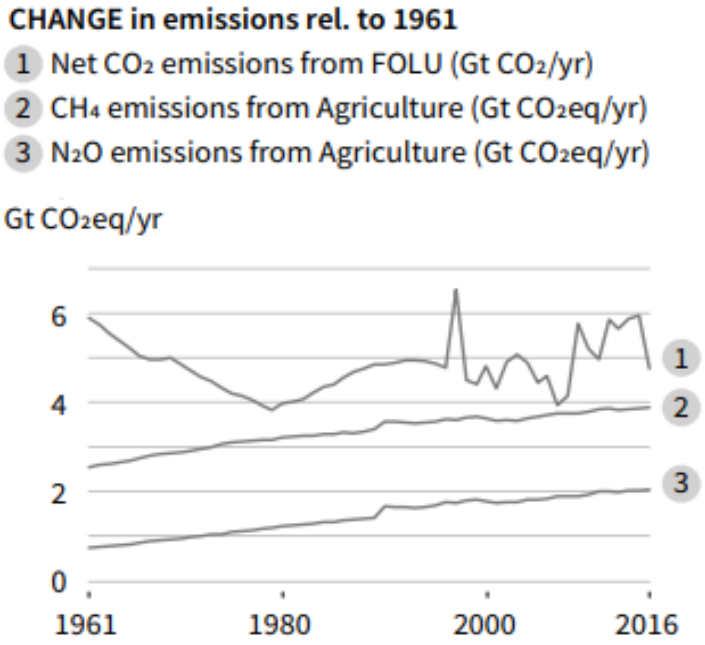
Despite producing enough food to feed the world, it is now well documented that conventional agricultural strategies have not succeeded in eliminating hunger, and have contributed to global warming, more unbalanced diets that lack nutritional diversity, enhanced the exposure of vulnerable food groups to price increases and accelerated the loss of biodiversity (FAO *et al.*, 2016; Vira *et al.* 2015; FAO, 2013). Although biodiversity is widely recognized as the foundation of food systems (FAO, 2019; Sunderland, 2017; Sunderland, 2011; Frison *et al.* 2011), over the past 10 000 years, agricultural production systems have become progressively less diverse. Fewer than 200 plant species currently make contributions to food production globally, regionally or nationally – and just 12 crops and 14 animal species provide 98 percent of the world's food needs (FAO, 2019). Moreover, agriculture expansion continues to occur at the expense of natural resources: the conversion of forests and wild ecosystems to intensive agricultural production is now widely recognized as one of the leading drivers of biodiversity loss and climatic change (Millennium Ecosystem Assessment, 2005; Secretariat of the Convention on Biological Diversity, 2010; FAO, 2019). Nearly three-quarters of all tropical deforestation between 2000 and 2012 was caused by commercial agriculture, almost half of which was due to illegal conversion for commercial agriculture (Lawson, 2014). This particularly affects forests and associated ecosystem services (Millennium Ecosystem Assessment, 2005), from provisioning services (food and materials) to regulating e.g. habitat provisioning, clean water, soil conservation and protection and carbon sequestration, and cultural ones, for instance, spiritual, recreational, landscape and aesthetic.

This bears stark contrast to the approximately 7 000 plants species and several thousand animal species that have commonly been contributing to diets since the Neolithic, and have adapted to harsh environments and climatic conditions (Dounias, 2016). Indeed, before the domestication of food, foraging i.e. the practice of gathering wild resources from forests and wild ecosystems – formed the very basis of diets, health and lives more broadly. This vast variety of wild plants and animals, such as game, fruits, seeds, roots, nuts, insects, medicinal and aromatic plants and fungi are still used today as a source of food, medicine and culture in parts of the world. While vital gains were made during the green revolution to improve yields particularly of key grains (Ingram, 2011), the intensive domestication of plants, animals and landscapes in commercial agriculture to increase the quantity of food produced largely came at the expense of food quality, and of the environment more broadly.

The so-called homogenization of natural landscapes has directly and indirectly led to diet simplification, or unbalanced diets. Diet is today the main risk factor in the global burden of disease (Forouzanfar *et al.*, 2016). Malnutrition in all of its forms now affects one in three people in all countries, regardless of development status: an estimated 26 percent of the world's children suffering from stunting, 2 billion people from one or more micronutrient deficiencies and 1.5 billion overweight and 500 million obese peoples (FAO, 2013; WHO; 2017). The pandemics of undernutrition and obesity – coupled with that of climatic change – have been described as a "synergy of epidemics", - or the "Global Syndemic" – co-occurring in time and place, interacting with each other, and sharing

common underlying societal drivers (Willet *et al.*, 2019). In short, food systems are both driving malnutrition, but also contributing to climate change, generating 25-30 percent of greenhouse gas emissions. Most of these emissions are from land-use changes and methane (CH4) and nitrous oxide (N2O) from cattle and fertilizers (IPPC, 2019; World Resources Institute, 2014) (Figure 2). Moreover, findings in 2014 found that rise in CO_2 levels are making staple crops less nutritious and could result in 175 million people becoming zinc deficient and 122 million becoming protein deficient by 2050 (Smith *et al.* 2018). According to the EAT Lancet Commission on Food, Planet and Health – composed of world leading scientists in nutrition, health and sustainability – one of the key strategies for a "great food transformation" required to reverse these trends involves reorienting agricultural priorities from producing high quantities to producing diverse, healthy food that enhances biodiversity rather than increasing the volume of just a few crops (Willett *et al.*, 2019).

Figure 2. Greenhouse Gas Emissions



Source: IPPC, 2019.

At the same time, more evidence is pointing to the direct benefits from non-cultivated ecosystems such as forest and tree-based systems for food and nutrition as well as for income, energy, construction materials and medicines, both for subsistence and cash uses, as well the as indirect benefits deriving from ecosystem services that support and enhance crop production (HLPE, 2017; FAO *et al.*, 2016; Rowland *et al*., 2016; Ickowitz *et al.,* 2016; Fungo *et al.*2016; Ickowitz *et al*., 2014; Vinceti *et al.* 2013; Barucha & Pretty, 2002; Burlingame, 2002; Daudet; 2012). Forests in general and NWFPs in particular have been found to make a much more significant contribution to nutritional and socio-economic resilience of rural lives and livelihoods than previously thought, particularly for communities living in proximity to forests (Rasolofoson *et al.* 2018; HLPE, 2017; Rowland *et al.* 2017, Powell *et al.*, 2015; Malleson *et al.*, 2014; Ickowitz *et al.* 2014; Vinceti *et al.*

2013). The role of diversified diets based on local biodiversity and traditional and indigenous foods, which include many NWFPs, and the importance of capitalizing on traditional culture and food sources is well documented by case studies from around the world (FAO, 2009; FAO, 2013b; FAO, 2012;). Some wild varieties are still more sought after than domesticated counterparts because of superior medicinal or nutritional properties (e.g. wild liquorice roots from *Glycyrrhiza* species) (Wang *et al.,* 2018).

In spite of this evidence, NWFPs and other edible “”correlates” (i.e. wild foods, underutilized foods) – which are the focus of this thesis – continue to be secondary or marginal objectives of forest management and rural development strategies, have not had any real weight in land-use planning decisions, and have rarely been taken seriously in nutrition interventions. The perception that NWFPs are mere famine foods and that the energy expended collecting is not worth the harvest is still widespread (Shackleton, 2014); as such their contributions to nutrition and food security have largely been overlooked. It has also been argued that there is not enough globally comparable data to “make a case” for their economic value, which has resulted in timber-centric forestry agendas focusing largely on yields and productivity, and their poor consideration in nutrition and food security policies (Shackleton & Pandey, 2014) despite multiple and time-old calls to reorient forestry “Beyond Timber” (Tieguhong *et al.*, 2017; Shanley *et al.,* 2008; Ashton & Panayoutou, 1992).

Although in recent years there has seen a surge of interest by global scientists and economists to make nature’s value visible (e.g. TEEB, 2008), a large portion of forests and wild biodiversity known as NWFPs continues to remain largely invisible. Internationally comparable data on NWFPs such as wild edible nuts, mushrooms, fruits, herbs, spices, aromatic plants, game and insects and other non-edible forest resources such as medicinal products, fodder and fibres is incomplete. This is largely because in most cases their use and trade are confined to the informal sector and hence, they are not reported in formal statistics. Questions on forest products and NWFPs moreover are generally lacking from nationally-implemented surveys. In turn, their contribution tends to go unrecorded and they are often absent or under-represented in national and policy decision-making (Sorrenti, 2017). Ambiguous terminology and definitions are at the core of this problem and make gathering comparable statistics challenging.

1.3 Justification: Renewed interest in non-wood forest products?

NWFPs have historically been secondary or marginal objectives of forest management and rural development strategies, have not had any real weight in land-use planning decisions, and have rarely been taken seriously in nutrition interventions. Yet long before the advent of agriculture some 10 000 years ago, humankind depended on foraging NWFPs and other wild resources, including fruits, seeds, roots, nuts, fungi, and game. Wild plants and animals have been used for food, shelter, utensils, health, fibre, energy, for millennia by communities around the world, and have also contributed to cash income and ancient traditions and rituals. Many NWFPs formed the basis of livelihoods and international trade. Frankincense, for instance, the common name for the oleo-gum-resin

of *Boswellia* trees, was widely used in Ancient Egypt and Rome, with trade dating back to at least 2000 BC (Kew, 2014). The Phoenicians used Argan oil – from the *Argania spinosa* tree – for food and cosmetics. It is well documented that Cinnamon – from the bark of *Cinnamomum verum* – was traded to Greek and Roman empires via Arab traders, becoming a valuable commodity during the 13th and 14th centuries in Europe. Countless other NWFPs such as vanilla, cloves and nutmeg drove the spice trade between Asia and Europe, and were key drivers of global expeditions from the 14th to 16th centuries. Others like gum Arabic *(Acacia sp.),* Brazil wood dye and Amazonian rubber (*Hevea brasilensis)* boasted significant trade during the colonial period (Sills *et al*., 2011). Shea nut kernels and butter (*Vitellaria paradoxa*), known in francophone countries as *karite*, have provided local communities in West Africa with food, skin-care products and household income for at least 200 years (Wardell, 2013).

Through time, the prospects of domestication allowed early cultivators to enhance productivity by means of modifying growth parameters, which saved time and effort. Many wild fruit- and nut-bearing trees came under domestication as horticultural crops. Fruit trees represented more complex forms of reproduction inasmuch as farmers could "fix" desired traits; they also represented a more settled way of life, as most trees bore fruit up to eight years after planting (Zohary *et al.,* 2012). Domestication also represented a shift in food production from forest to cropland (Zohary *et al.,* 2012). Five of the "biblical seven species" are tree crops and incidentally, founder crops of the Mediterranean, from which staple agricultural products of long-standing economic importance derived – olive oil, wine, raisins, dates and common figs. These products are today commonly thought of as agricultural products. Throughout the world and over time, many other NWFPs like rubber, quinine, oil palm, and cocoa were brought into cultivation, and products like Brazil nuts and rattan were harvested on an industrial scale. Through time, most high value NWFPs became considered agricultural crops (Shanley *et al.*, 2015) – an issue which will be discussed at length throughout this thesis.

Technological developments emerging from the chemical industry during the late 19th century also led to the replacement of many NWFPs by cheaper synthetic substitutes or cultivated crops, including a large number of key internationally traded products such as gums, resins, balata, fibres and medicines, making some NWFPs on international markets obsolete. The synthetic dye aniline replaced the natural blue dye obtained from the indigo plant *Indigofera suffruticosa.* Similarly, cochineal (*Dactylopius coccus*) fell from its place as key commodity during the 17th century to virtually obsolete due to the rise in artificial food colorants and dyes; and in most parts of the world plastic quickly overtook vegetable ivory *(Phytelephas macrocarpa)* in the making of buttons, in addition to countless other crops that became domesticated on a larger scale. Although most food-based NWFPs continued to enjoy widespread use at a subsistence level, many other NWFPs witnessed a decline in production and trade or a change in purpose (e.g. pine resins increasingly used as a fragrance and food flavour and less so for waterproofing ships). While the opening up of global trade allowed some products such as bamboo shoots, argan oil, pine nuts, brazil nuts and some mushrooms to reach significant and recorded production and trade value, aggregately, NWFPs became (and continue to be) almost invisible in official statistics – which has contributed to their poor representation

on international policy agendas, not least in forestry (Sills *et al.*, 2011; Muir *et al.*, forthcoming).

Although there was indeed a honeymoon period for NWFP-sensitive policy and research activities – around the time that the 1992 Rio Conference established that tropical conservation needed to head in a more people-oriented direction, and with the ground-breaking publication *Not By Timber Alone* (Panayotou & Ashton, 1992) – several challenges contributed to the waning of enthusiasm for NWFPs over the years. Some argued that NWFPs never lived up to their promise partly due to commercialization challenges that came to pass (Belcher, 2003; Sunderland *et al.*, 2011). An additional factor that further complicates NWFPs management and related research is that NWFPs are often collected as a *complement* to the main land management objective(s), and hence are typically seen as marginal or "secondary" products (Shackleton & Pandey, 2014). Compounding the challenge was and still is that NWFPs are a part of an informal economy, inasmuch as they are often collected for subsistence, without legal permits or traceability of any kind. These factors – coupled with the plethora of terms and definitions used to describe them – have contributed to the marginalization and underutilization of NWFPs in forestry and rural development. Edible NWFPs and other wild foods, moreover, have never been taken seriously in nutrition interventions.

The honeymoon period in which NWFPs were perceived as wins for both poverty and conservation was short lived, and NWFPs are unlikely to fill the role of key staples in meeting energy requirements or *lifting* rural dwellers out of poverty (exceptions could be those NWFPs oriented towards high-end niche consumers or mass products like cork or chestnuts). Notwithstanding, a growing and irrefutable body of literature has emerged illustrating the role of biodiversity in general and forests, trees and NWFPs and wild foods in particular in making production systems and livelihoods more sustainable and nutritionally resilient (FAO; 2019; Fungo *et al.* 2016; Sunderland *et al.*, 2013; Vincenti *et al.* 2013; Frison *et al.* 2011; Toledo and Burlingame, 2006; Johns and Sthapit, 2004). Conversely, research published in 2018 suggests that throughout sub-Saharan Africa, forest loss has been negatively associated with child diet diversity and consumption of nutritious food (Rasolofoson *et al.,* 2018; Galway *et al.*, 2018). It has been said that here is now "*a much more nuanced and realistic argument centred on the value of NWFPs to food and nutrition security based on evidence gathered in the last five years*" (Sunderland. in FAO, 2016). The global policy shift from calories to nutrients – articulated in the New Global Research Agenda for Food (Haddad *et al.*, 2016) – makes this a timely moment to re-consider the contributions of NWFPs to diets and food security.

From the perspective of livelihood improvement, growing consumer interest towards "wild" products and experiences, in part due to the mounting evidence on the salutary benefits of forests (Mao *et al.,* 2017), the declining nutritional content of domesticated crops (Gruber, 2017*;* Davis *et al.,* 2004) and concerns about the safety, ethical, ecological and social credentials of food, make NWFPs well-positioned to contribute to the current sustainable development agenda. Recent studies, for instance, attest to the rise of vibrant emerging niche and experiential NWFP-based markets (TRAFFIC, 2018; FAO, 2017; Wong & Prokofieva, 2014), particularly for the nutraceutical and cosmetic products. In

western-countries, this phenomenon has been described as “re-wilding” (Wiersum, 2016). Although there is no consensus about what rewilding is, and different opinions on the degree of “wildness” and conversely, human intervention that constitutes rewilding, Wiersum (2016) characterizes it as a relatively new and multidimensional phenomenon which involves both the biological process of “de-domestication” and new forms of culturally-embedded interactions between people and nature. The author posits that this involves the reintroduction of more “naturalistic” forms of food production, with the aim to increase the experiential value of forests in respect of forest food gathering through nature conservation areas, for instance, which are frequent cites for wild product harvesting (Wiersum, 2016; Wolfslehner *et al.*, 2019).

1.4 Problem statement: research questions and objectives

In spite of the mounting evidence on the contribution of NWFPs to nutrition and to livelihoods, key bottlenecks for further integration of NWFPs in land-use decisions, nutrition interventions and rural development strategies remain. These include, but are not limited to: (1) lack of globally comparable official statistics on NWFPs; (2) continued challenges to sustainable NWFP commercialization; (3) lack of information on the dietary contributions of edible NWFPs and their nutritional composition; (4) intensifying competition between forest uses in view of climatic changes (Sorrenti, 2018; HLPE, 2017).

Against this backdrop, the below research questions were assembled with reference to research area(s) presented in sections 2.2. and 3.2:

- To what extent does NWFP collection (i. e. gathering) contribute to diets and livelihoods?
- To what extent does NWFP consumption contribute to diets relative to other foods?

Specifically:

- What quantities of NWFPs are collected?
- How frequent is NWFP consumption and collection?
- What is the main purpose of NWFP collection? (i.e. consumption, sale)
- What are the main motivations behind NWFP consumption and collection?
- How many hours are expended collecting?
- What are the perceptions of availability in the wild?
- Who is participating in NWFP value chains for top products collected?

Based on these questions, the following general objective was formulated: **to contribute advancing knowledge on NWFPs and their role in supporting diets and rural livelihoods and tackling key bottlenecks** by focusing on the following main research objectives:

1. To disentangle terms and definitions related to NWFPs, which is at the basis of quantifying contributions and improving data.

2. Appraising the role played by NWFPs in diets and livelihoods through the following methods:
a. Assessing frequency of consumption and collection in select areas and identifying motivations behind gathering (e.g. hunger or emergency, culture or income) and perceptions of status in the wild;
b. Taking a closer look at the top products consumed and collected, namely edible insects and honey, to understand prospects for improved livelihoods.

All these objectives aim to contribute towards supporting decisions and policies in favour of improved use of NWFPs and of “wild biodiversity” and lanscapes in nutrition interventions and food value chains, better integration of NWFPs in forest management and land-use planning and more systematic NWFP data collection in support of these ends.

2. RATIONALE AND METHODOLOGY

This section describes the rationale for and methods used towards the aforementioned research objectives. In particular section 2.1 describes methodological approaches defined to address objective 1, while section 2.2 describes methodological approaches developed to address objectives 2(a) and 2(b).

2.1 Disentangling non-wood terms and definitions for improved forest statistics

Collecting data as well as measuring and monitoring progress on agricultural production and the associated use of natural resources is widely acknowledged as central to better decision making and achieving the United Nations Sustainable Development Goals (SDGs). At the same time, in spite of recent efforts by global scientists and economists to make nature's value visible, a large portion of forests and wild biodiversity known as NWFPs continues to remain largely invisible. Comprehensive global data for forest products other than wood (otherwise known as NWFPs) does not exist, leaving many forest and wild products unaccounted for, notwithstanding widespread acknowledgement of their importance as a source of resilience in the food system (HLPE, 2017). Data on NWFPs remains scarce since few countries systematically monitor and collect this information. Even when data is available, it is often partial or fragmented and lacks comparability across countries and over time (Sorrenti, 2018). As a result, NWFPs are poorly represented in policies or planning related to forests, biodiversity, land-use and food and nutrition security, and related decision-making.

A desk review of existing NWFP definitions and terms in academic literature via traditional search engines (Scopus, Google Scholar, Web of Science) was used to undertake this study (Table 1). The search was not limited to forest sector literature; agricultural and food and nutrition journals were also reviewed. As such, in addition to traditional forest-terms such as "non-wood forest products", "non-timber forest products" and "wild forest products", literature was also scanned for other terms such as "wild edible plants", wild food plants, neglected and underutilized species and so on were also assessed (see Table 1 for key search words). Papers were subsequently analysed for relevance to the research question and "selected" if a unique definition was clearly provided. The results – presented in section 3.1 – tried to be as comprehensive as possible, although not all variations of definitions were chosen because it was impractical and not conducive to the purpose of the exercise, which was to outline the diversity of terms and definitions in use.

Table 1. Scopus search findings

Search word	Results (no. of articles)
Non timber forest products	1 304
Non-wood forest products	241
Wild edible plants	311
Wild food plants	128
Neglected and underutilized species	39
Wilderness	7 709

Source: author's own elaboration

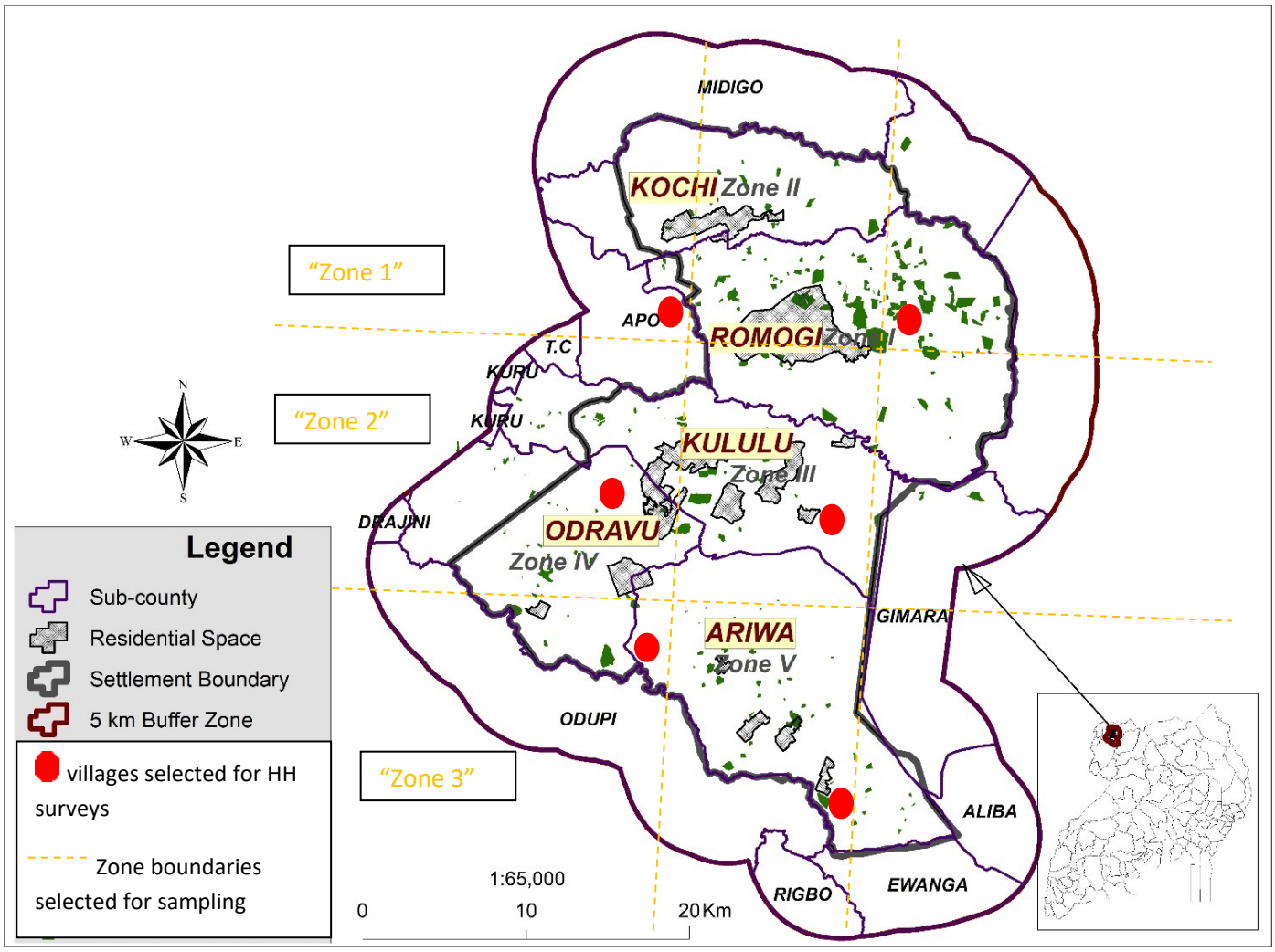
It is important to underline that the question of terminology and definitions is not an issue of semantics. Lack of harmonization has been the driving factor behind the lack of globally comparable NWFP data (Sorrenti, 2017). Harmonization of terms and definitions is at the basis of statistical and economic activities. Harmonization is also increasingly vital to alleviate the reporting requirements countries have towards various international conventions and bodies, and can be an incentive to report on a sector if clarity of terms and definitions exist. Arguably, NWFP terms in use can be considered more or less synonyms; different individuals and institutions opt for different terms depending on their needs and objectives (FAO, 1999; Belcher, 2003). The reality is that most institutions and individuals will likely continue to use their term of choice, particularly if there are legal/fiscal implications that may be characteristic of a particular country or region. Notwithstanding, for the purposes of improving official data, greater clarity on terms and definitions is needed for globally comparable NWFP data, without which a significant portion of forests and wild biodiversity will continue to remain invisible. As such, the authors initiated this study to disentangle existing terms and definitions and break down their relative components in an effort to move beyond the terminology debate, improve NWFP data and make the sector and products more visible, particularly to those making important decisions about land and food production.

2.2 Weighing in on wild food contributions, motivations for gathering and prospects for "ento-economies" in northwest Uganda

Study design, sampling and data collection. A mixed-methods approach was used to obtain data, with the idea of using triangulating techniques to get a more accurate picture of NWFP and wild food contributions. The methods – which included a questionnaire on collection and consumption, a food frequency, market surveys, focus group discussions and key informants, were all developed under the supervision of the University of Padova and advisors from CIFOR during year two of the PhD programme. The methods were subsequently piloted in May 2018 in northern Zambia (one of the original sites selected for the PhD).

The study built on a larger wood-fuel assessment carried out by FAO and UNHCR in 2017, which stipulated a 5km buffer zone around a displacement setting for the project (Figure 3). The area was divided into three zones, and two villages were selected in each zone to administer surveys randomly, with the support of cadastral maps (the maps have five official zones but zones one and two were merged and three and four were also combined given the proximity of the zones – Table 2).

Figure 3. Study area and sampling strategy



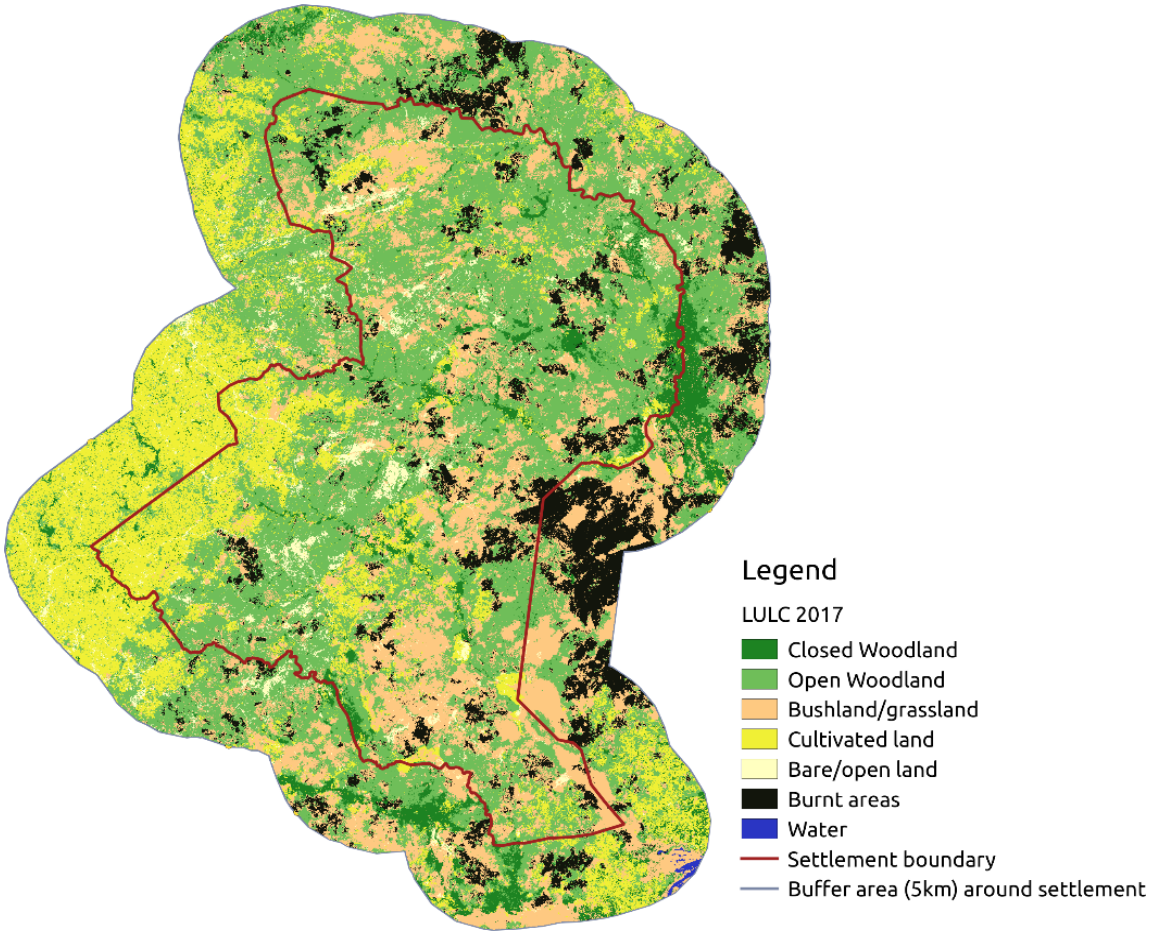
Source: FAO & OPM, 2018.

Table 2. District and sub-county characteristics

Sampling zones	Zone(s)	Sub-county	Population	Number of Households (approximate)	Host community area (ha)	Total area (ha)
Zone 1	Zone 1	Romogi	51 600	6 450	2 161.5	2 248.7
	Zone 2	Kochi	46 300	5 787	220.4	325.5
Zone 2	Zone 3	Kululu	46 800	5 850	368.5	484.7
	Zone 4	Odravu	68 900	8 612	370.7	560.8
Zone 3	Zone 5	Ariwa	26 300	3 287	346.1	461.5
	Total				**3 467.2**	**4 081.2**

Source: FAO & OPM, 2018.

Figure 4. Vegetation type in study area



Source: FAO & OPM, 2018.

Data collection was performed via **household surveys** (*n* = 134) (one by one) and via paper-based questionnaires administered by a team of six individual surveyors (one project lead and five enumerators) in November 2018. The household questionnaire focused on the types of wild foods collected, frequency and motivations behind consumption, quantities collected and sold (if applicable), perceptions of resource availability and seasonality. Market surveys were also conducted as far as Arua (100 km from the project sites) to understand supply and demand trends for wild products in the sub-region and flow of products, unit prices and peak season for different products.

Additionally, eight **focus group discussions** were held in Ariwa and Romogi sub-counties, and an additional two with refugee communities in Zone 5 (Ariwa) to understand if the refugee influx has in any way affected wild food use and availability. Discussions were held with men and women separately to ensure men and women felt comfortable speaking freely. A maximum of 12 community members participated in each focus group. Individuals were selected with the support of the village chairpersons who were asked to identify individuals from different households and from different parts of the village. Key informants - wild product harvesters, beekeepers, processers and traders - were also

interviewed to obtain information on quantities gathered, market prices and trends and availability of wild resources.

A dietary assessment in the form of a brief food frequency (and specific focus group questions) complemented the survey in order to determine the degree to which wild foods contribute to diets relative to other foods. Food groups were divided by farmed foods (cultivated) and forest and wild foods (defined as *collected* from the wild, uncultivated). Given the difficulty in drawing the line between wild and domesticated foods, wild foods were described to survey respondents as plants or animals gathered on land which is not under their ownership; in other words, anything edible that is *collected* and not obtained through cultivation or tending (Muir et al, forthcoming). The brief food frequency method was chosen because our specific purpose was getting an overview of wild food consumption and relative contribution to diets. Detailed information on all aspects of the diet were beyond the scope of this study.

Another motivation behind using a food frequency is it is a rapid and simple instrument, effective in low-resource settings (Rodrigo *et al.*, 2015). A full-length questionnaire was not practical and would have entailed a high respondent burden given that it was one part of a larger survey on wild foods. Its track record as an effective method for affecting consumption patterns and for health promotion and nutrition education purposes (Rodrigo *et al*., 2015; Thompson *et al.,* 2000) was also taken into consideration. A brief food frequency with a longer recall period (annual) was moreover preferred over a 24-hour recall because the focus was capturing consumption of wild and often seasonal foods which are often not captured during 24-hour recalls. The high margin of error for quantitative estimates during the brief food frequency, however was a motivation for removing quantities consumed from the food frequency questionnaire; quantitative estimates were obtained on foods collected/harvested during the part of the survey on frequency of collection, which appeared to be provide more accurate results during the pilot.

Data processing. Data processing was perfmored using FAO's open-source "open foris collect" software. The questionnaire, developed and digitized during year two, was originally intended to be carried out with the support of mobile technology in the field. In the end, a paper-based questionnaire was used to avert any possible technical failtures in the field, but the software was still employed during data entry to faciltate analysis of results.

The latter part of 2018 and the first part of 2019 was dedicated to data entry and data cleaning (e.g. removing entry errors), which was finalized in February 2019. The data entered into *Openforis* was then extracted and imported in Microsoft Excel workbooks. The remainder of 2019 was spent analysing and summarizing the data, results of which are presented in section 2.2. Other findings from the field work (e.g. focus group discussions, key informants, market surveys) were also incorporated into the analysis. A Strength, Weaknesses, Opportunties and Threats (SWOT) analysis of the respective value chains was also conducted to better understand factors negatively influencing the specific sectors, opportunities and mitigating threats.

Nutrisurvey software was employed to determine the nutritional value of quantities collected. Given that many wild foods are not a part of the core foods available in the programme, these were inserted manually based on available literature. It is important to note that nutritional composition data is extremely complex as it requires harmonizing different sources of information. Given that this was beyond the remit of this study and that nutritional information on wild food is not always readily available, only certain products were assessed, for which information was already available in existing national databases (e.g. Harvest Plus) or published in affirmed journals.

3. RESULTS AND DISCUSSION

This chapter reports results from the different research activities performed. In particular, section 3.1 outlines results of the desk review applying the methodology summarized in section 2.1 to clarify definitions and terms as the basis for the fieldwork performed and for improving the visibility of NWFPs in related policies and interventions. Sections 3.2 and 3.3 present results of the field work performed in Uganda and Zambia using methods outlined in section 2.1 and 2.1. The first part (section 3.2) focuses on wild gathered NWFPs (consumption and collection) in general, from here on also referred to as wild food, seeking to provide an overview of main products collected and consumed and the degree to which they contribute to diets, including motivations behind gathering and consumption. The second part (3.3) uses these results to look at the main products consumed (in this case insect-based products) to evaluate prospects for developing ento-economies in the sub-region. All of this work is aimed at better informing policies and interventions related to NWFPs specifically and forest management, land-use and food and nutrition security more generally.

3.1 Into the Wild: Disentangling non-wood terms and definitions for improved forest statistics

Section 3.1 presents results relative to research objective 1, outlining key non-wood terms and definitions used to date, laying out the main reasons for disaccord and finally attempting to put an end to the circular terminology debate. This is done first by clarifying boundaries between agricultural and forest products, so forest products currently under agriculture can be "reclaimed"; (2) drawing on lessons from the fisheries sector that provides some similarities with regards to distinguishing between wild catch and farmed fish, and associated activities; (3) moving beyond *product* classification systems towards *activity* classifications *(International Standard Industrial Classification of all Economic activities)* to capture gathering of NWFPs that may not be accounted for under crops nor under forest products, given that they may be harvested outside of these boundaries (e.g. "bush", non-forest land). In doing so, clarity is provided on key bottlenecks that have contributed to the well-acknowledged data gap on NWFPs, as well as a means to closing in on this gap to get a better understanding of the contributions of NWFPs and wild gathering to lives and livelihoods. Results reported within section 3.1 (i.e. this section) have been also organised under the form of a stand-alone paper[2], representing one of the outputs of this Doctorate research.

3.1.1 The Age-old terminology debate

References to "minor or secondary products of forests" date back to the beginning of the century at least. Products like brazil nuts, shea butter, oriental spices, myrrh and acai are cited in literature far before the modern notion of NWFPs emerged and include some of the oldest traded commodities (Plotkin, 1992; Iqbal, 1993; Salo *et al*., 2013). The term "naval stores", used to denote products obtained from resin tapping of mainly pine trees

[2] Muir, G *et al.* (forthcoming). International Forestry Review. Accepted with minor reviews.

(genus *Pinus)* dates back to the 1600s when wooden ships were waterproofed using resin. Countless other products can be found in literature dating to the Ancient Egyptians, Romans, Greeks and Phoenicians. As a category or group, NWFPs have been largely referred to as "minor or secondary products of forests" regardless of their value to local people or the national/international economies since the beginning of the century at least (FAO, 1995; FAO 1990). Throughout much of the 1980s, NWFPs gained wider currency under the banner of "non-wood products" and related terms (Myers, 1990; Peters, 1989; Hecht, 1988; Posey, 1985). In 1989 de Beer and McDermott's "non-timber forest products", or NTFPs – defined as *"all biological materials other than timber which are extracted from forests for human use"* – found fertile ground and "stuck" among practitioners and academics. Both the part of the tree harvested and the scale at which this harvesting takes place (e.g. small scale versus large-scale, industrial harvesting) became key components of this term and definition. Above all, this all-encompassing umbrella term set out primarily to distinguish itself from industrial scale interests such as timber extraction. Notwithstanding, the authors acknowledged some inherent problems with the term, including lack of clarity on the definition of forests, and the inclusion (or not) of related services (and the associated definition of such). Criteria for scale would likewise prove inherently problematic.

FAO spearheaded efforts to develop a clear and consistent definition on NWFPs in 1995, ultimately reaching consensus as an organization in 1999: "Non-wood forest products consist of goods of biological origin other than wood, derived from forests, other wooded land and trees outside forests." A fundamental difference between the terms adopted by FAO and de Beer and McDermott's NTFP was the exclusion of fuelwood and small woods used as domestic tools and equipment. Indeed, the new FAO working definition proposed a clear distinction between wood and non-wood forest products as a basis for building a classification system (FAO, 1999).

Over the years, much has been said about the term and associated challenges for data collection. Without a doubt, these newly established "all-encompassing" terms gave greater visibility and credence to the sector in the years to come. Nevertheless, various problems arose. Most agree that ambiguity in terminology made and still makes compiling official statistics, information and communicating lessons on the sector as a whole challenging (Shakleton & Pandey, 2014; Cocksedge, 2010; Vantomme, 2003; McLain & Jones, 2001; Ruiz-Perez & Arnold, 1996). As early as 1995, authors like Arnold and Ruiz-Perez posited that gaps in data and knowledge about the broader environments within which use and management take place make it difficult to predict future trends and thus elaborate policies. A decade later, Belcher *et al*. (2005) opined essentially some of the same problems, arguing that vast differences in the products and the social, economic and ecological contexts make it difficult to communicate lessons learned. Throughout the 1990s and at through the start of the new millennium, authors like Iqbal (1993), Vantomme (2003), Cocksedge (2010) and more recently, Shakleton & Pandey (2014) voiced similar concerns, further identifying inventory, research and by extension, value estimates of key species as key impediments demonstrating the value of NWFPs and further developing the sector.

Conceptually, Belcher (2003) argues that the distinction between wood and non-wood is of little use to community development, conservation or other aspects of forest management. Similarly, Mantau *et al.* (2007) opine that the dichotomisation of forest resources into timber and non-timber is overly simplistic, adding that reaching an operational definition for NWFPs is doubtful given the tremendous variety of products. The authors instead proposed a more holistic system, which distinguished between classes or groups of objects with similar characteristics, using comparative terms to highlight differences. In 1997, Padoch and Pinedo-Vasquez similarly argued that the dichotomy between timber and non-timber resources was inappropriate: "*We suggest instead that the scale of forestry operations and their degree of industrialization are more realistic and useful parameters*." (Padoch & Pinedo-Vasquez, 1997). Discussions about multiple use forest management, or deliberate management of a particular forest area in a specific time period for various goods and services abound (Sabogal *et al.*, 2013; Herrero *et al.*, 2012; Cronkleton *et al.*, 2012;), yet have not contributed to breaking down the wood/non-wood divide. Some have argued that "NTFP" is still more useful than NWFP as it is a better reflection of local use (Shackleton & Pandey, 2014).

Table 3 summarizes some key terms and definitions found in literature, illustrating the degree of disharmony around NWFPs. The situation becomes more complicated if other sources, such as policies, legislative frameworks, standards and technical norms (e.g. for product classification, grading and certification) are consulted. For instance, a recent FAO study (Muir *et al*. forthcoming) looks at the various terms in use in forest policies, and equally found a vast array of terms, even within the same policies. These ranged from the more common NWFP and non-timber forest products (NTFP) to non-wood product or activity, non-wood plant resources, by-products, secondary, side-use, wild products, productive services of forest, non-wood resources, non-wood benefits, other forest products, non-wood forest resources, ecosystem services, wild fauna and flora, side-use, extractive, non-extractive, services, tourism, medicinal plants, special forest products, among others. A study by Vidale and Tomasini (2018) found the same variety of terms used in standards and technical norms for product classification, grading and certification.

Table 3. Non-wood forest products, wild forest products and correlate terms

	Term	Definition	Source
Wild	*Wild*	A 'wild' thing is anything which was not obtained by cultivation from seed and tending, but from collecting, breaking off, pulling, picking, shaking, seizing or catching for use by humans.	Trier, 1963, in Vera, 2000
		Self-willed, wilful or uncontrolled in early Teutonic and Norse languages (from willed came wild); *wildeor*, a compound of *wild* and *deor*, meant beast, savage inhabiting a dismal region of forests.	Nash in Wuerthner, Crist & Butler, 2014
	Wild biodiversity	Wild foods, trees, forests, animals	Powell *et al*., 2015
	Wild nutrition	Nutrition from neglected crops, non-commercial foods, wild foods, indigenous edible species, "old foods".	Burlingame, 2000
	Wild food/Wild food plants	Wild food is defined as anything edible that requires no human input to increase its production	Daudet, 2012
		Plants, berries, fruit, nuts, mushrooms and game that are collected in the wild, to be consumed as food or drink.	Maes *et al*., 2013 in Schulp *et al*., 2014
	Wild edible plants (WEP)	Defining features: (1) They are locally available and their use is based on traditional ecological knowledge; (2) They are a low-input, low-cost option for increasing nutrition and reducing the need to spend limited cash resources; (3) They provide greater benefits to vulnerable populations (poorer households, women, and children who are often disproportionately affected by climate events; (4) They contribute to livelihoods and are available during times of drought or conflict-driven famine; They tolerate water stress better than their domesticated relatives possessing an "*innate resilience to rapid climate change, which is often lacking in exotic species*"	Shumsky *et al*., 2014
	Wild forest products	WFPs are products other than wood derived from wild and semi-wild forests, as well as from sources in early stages of domestication, such as fruit trees, bushes, and orchards. This definition covers a wide range of resources and products including plants, fungi, fauna and soil.	Wolfslehner *et al*., 2016.
	Wild forest food/forest food	Wild forest foods are a subset of wild foods and refer to uncultivated foods from forested areas, such as bushmeat, fish, fruits, leafy vegetables, nuts and seeds (not including forest-based agriculture, e.g., shifting cultivation or agroforestry systems)	Rowland, 2017
	Wildcrafting/wildcrafted products or species	The process of collecting from the wild; generally, a term applied to collecting material from the wild to sell or trade.	Vance *et al*., 2001
Terms with prefix non-	*Non-wood forest products*	**Non-wood forest products (NWFPs) are goods of biological origin other than wood derived from forests, other wooded land and trees outside forests.**	FAO, 1999
		Goods derived from forests that are tangible and physical objects of biological origin other than wood. *Explanatory notes 1. Generally includes non-wood plant and animal products collected from areas defined as forest. 2. Specifically includes the following regardless of whether from natural forests or plantations: gum arabic, rubber/latex and resin; Christmas trees, cork, bamboo and rattan. 3. Generally excludes products collected in tree stands in agricultural production systems, such as fruit tree plantations, oil palm plantations and agroforestry systems when crops are grown under tree cover. 4. Specifically excludes the following: 5. woody raw materials and products, such as chips, charcoal, fuelwood and wood used for tools, household equipment and carvings; grazing in the forest; fish and shellfish.*	FAO, 2015

	Term	Definition	Source
		[…] renewable resources that can be developed in a way that will improve people's livelihoods and that is compatible with or even encouraging of environmental conservation.	Belcher, 2003
	Non-timber forest products	The term NTFP encompasses all biological materials other than timber which are extracted from forests for human use; they are extracted using simple technologies by rural people living in or near forests; managed, secondary or degraded forests are sources of non-timber forest products, **plantations are not**.	DeBeer & McDermott, 1989
		[...] all tangible animal and plant forest products other than industrial wood, coming from natural forests, including managed secondary forests and enriched forests.	Ros-Tonen *et al*., 1995
		Essential ingredients for NTFPs include: **Biological products** (i.e., not abiotic products or ecosystem services); **Wild species** (indigenous, naturalised, or alien) which means that the bulk of the total species population is self-replicating without human agency. A small proportion of the total species population may be only recently cultivated or domesticated at a local level, or self-reproducing within human-dominated systems; **Harvested by humans**, and thus fodder consumed by free-ranging animals would be excluded (as it would be accounted for under benefits from agriculture rather than NTFPs), unless it was harvested by humans and transported to the animals to consume; **Consumptive and non-consumptive uses**; available from **any landscapes or ecosystems** (including human dominated); the broad scale management objectives are set, monitored, and regulated by those on whose land the NTFP occurs; most, if not all, of the benefits from the direct or indirect use accrue to local livelihoods and wellbeing. The benefits accruing can act as an incentive to conserve the species or site if the necessary enabling factors and institutions are in place.	Shakleton *et al*., 2011
		Plant and fungal material that is harvested as well as items that may be made from these materials; they may not be purely forest-related. This reflects the fact that woodlands contain open spaces, that peoples' gathering activities occur across different habitats and also that species do not necessarily occur where we might expect them.	Emery *et al*., 2006
	Non-wood forest products and services (NWFPS)	The term Non-Wood Forest Products and Services (NWFPS) is one of the terms used when talking about the broad scope of functions, besides timber production, that forests fulfil.	Janse & Ottitsch, 2005
	Non-traditional forest products	Non-traditional are biological and generally not cultivated. They are not timber; but can be made of wood. Collected in natural forests, these products are usually harvested and processed in small amounts. These products fall within four general categories: edibles such as mushrooms; medicinal and dietary supplements, including ginseng; floral products such as moss, grape vines, ferns, and other plant products used for decorations; and specialty wood products including hand crafted products such as carvings, utensils, and containers. They are also called non-timber forest products.	Hammet & Chamberlain, 1998
Other related terms	*Minor forest produce*	"Minor forest produce" includes all non-timber forest produce of plant origin including bamboo, brush wood, stumps, cane, tussar, cocoons, honey, wax, lac, tendu or kendu leaves, medicinal plants and herbs, roots, tubers and the like.	India *Forest Rights Act*, 2006
	Minor forest product	The term "minor forest products" denotes all the animals, plants and things a forest produces, besides timber, which are used by man.	DeBeer & McDermott, 1989
	Botanical forest products	Non-timber forest products are divided into two categories: *regulated* special forest products, which are derived from trees and are mainly taken from salvage timber (e.g. Christmas Trees, fuelwood, fence posts) and *unregulated* botanical forest products, which include: wild edible mushrooms; floral and greenery products; medicinal and pharmaceutical products; wild berries and fruit; herb and vegetable products; landscaping products; craft products; miscellaneous botanical forest products that do not fit into the above such as honey and "smoke woods".	Ministry of Forests and Range, British Columbia, 1995

Term	Definition	Source
Bush foods	Foods gathered or hunted from the surrounding area	Gittelsohn *et al.*, 1998
Special forest products or Secondary forest products	Species harvested from forests for other than timber commodities. Refers to the same group of species—plants, lichens, fungi, and other organisms—collected from the forest for various uses including subsistence, education, research, recreation, and commercial enterprise.	Vance *et al.*, 2001
Neglected and underutilized species (NUS); "orphan crops/minor crops"	Those crops often considered 'minor' because they are less important than staple crops and agricultural commodities in terms of global production and market value. However, from the standpoint of the rural poor who depend on many of these species for their food security, nutrition and incomes, they are hardly minor.	IPGRI, 2002
Semi-cultivated/semi-domesticated species	Techniques used to promote production of wild resources. E.g. By using special techniques to dig out the fleshy parts of the yam the Pygmy populations of Central Africa manage this wild resource in a way which guarantees a subsistence based on seasonal mobility.	Dounias, 2001
Para-cultivated species	Paracultivation defines a set of technical, social and cultural practices aiming at managing wild resources while keeping them in their natural environment; species which mobilize perennial harvesting practices aimed at managing the resources production while maintaining their original environment	Dounias, 2001; Dounias, 2016
Proto-cultivated/domesticated species	"first" domestication	Dounias, 2016; Clement *et al.*, 2010

The table groups “wild”-terms, terms that use the prefix non-, and other, related terms. Most of the wild-terms stress very little human intervention, if at all. These terms typically refer to plant-based products, although sometimes mention wild game. Some, but not all of the terms in Table 3 specify the source (e.g. forest). Overall, the prefix non- dominates, likely linked to the desire to distinguish these products from industrial, timber-centric forestry. It is important to note that for the purposes of official statistics, however, it is very rare to find a negative form to define a given thing; most terms are positives. Overall, all terms with the non- prefix tend to agree on source (forest) although the definition of forest is not the same in all definitions and imply varying degrees of human intervention. For example, according to the FAO’s Global Forest Resource Assessment (FRA) definition (FAO, 2015), products from plantations such as cork, gum Arabic, bamboo and rattan qualify as NWFPs; the original incarnation of NTFP (DeBeer & Mcdermott, 1989) does not include these products. Emery *et al.* (2006) arguably provide one of the most accurate interpretations of the environment in which these products are gathered, but the fluidity of the term is not conducive to official data collection, which requires tightly bounded units. Other terms used such as special products and botanical products illustrate that some of the terms are differentiated by degree of regulation. Others are products of culture and context (e.g. bush foods, wild crafting, non-traditional forest products). Finally, Dounias (2001 and 2016) illustrates, through the terms para-cultivated and proto-cultivated, how the line between wild and farmed is not as distinct as it may seem, complicating matters (Table 3). In fisheries legislation, there is a very similar discussion surround wild and fattened fish. In short, there are varying degrees of human intervention and the line between wild and domesticated is not only difficult to draw, but it is not static and may change depending on the context. While there are sound reasons that justify the plethora of terms, it is obvious that the variety of terms and definitions creates challenges for compiling official statistics. The terms NWFP and NTFP, among the most commonly used terms, are not mutually exclusive; NTFP simply implies the inclusion of additional categories of wood products that can be accounted for. So long as the purpose is explicitly stated from the outset of the data gathering exercise, both terms can and should be used.

3.1.2 The trouble with non-wood terms and definitions

Several issues have undermined NWFP terminology and definition convergence over the past three decades. These include, among others:

- **Different organizational priorities or institutional make-up**

Institutional makeup and (changing) priorities have arguably shaped terminology and associated definitions. Anthropologist Mary Douglas (1986) posited in *How Institutions Think* that “*institutions do the classifying*”. In other words, when institutions make classifications for us, “*we seem to lose some independence that we might conceivably have had otherwise*” (Douglas, 1986). The term NWFP is arguably as much a fruit of the desire to develop a sound classification system as it is an institutional classification. For instance, the fuelwood crisis of the 1980s in the Sahel put “fuelwood” at the top of the forestry agenda, giving rise to an entirely separate group of practitioners dedicated

exclusively to fuelwood and the set-up of tree plantations for fuelwood and charcoal production. This dichotomy may have contributed to the decision to exclude activities related to wood in all of its forms from FAO's newly created programme on NWFPs in 1991, and wood from its definition on NWFPs. Other organizations likely have similar reasons for their term of choice.

- **Contention over the exclusion of wood**

As aforementioned, according to FAO, NWFPs do not include wood and wood-based products, i.e. industrial wood, fuelwood or small woods such as poles, posts, utensils, masks, statues, and chips are excluded from the category. DeBeer & McDermott (1989) argues that the "non-wood" label "*unsatisfactorily excludes important material resources derived from forests by rural people such as fuelwood, building poles and small wood for handicrafts and tools"* (DeBeer & McDermott, 1989). The wide use of NTFP over NWFP suggests this opinion is widespread. Nevertheless, official statistics on fuelwood have been gathered by FAO and other international agencies since the 1960s (with significant revisions during the 2000s) (Whiteman *et al.*, 2002); the same attention has not been given to NWFPs. Merging fuelwood and NWFPs so late in the game would likely add another layer of confusion to the already difficult data situation for NWFPs.

- **Differing legal frameworks and associated legislative connotations among countries**

NWFPs mean different things in different countries. Oftentimes, there are legal implications associated with the term. "Minor Forest Produce" (MFP), for instance, has distinct legal connotations in India. The Panchayats (Local Government) Extensions to Scheduled Areas Act (PESA) in 1996 and the Scheduled Tribes and other Traditional Forest Dwellers Act, also known as Forest Rights Act of 2006, for example, consolidate the tenure rights of individuals or communities over Minor Forest Produce. The products are defined under the Act as "*all non-timber forest produce of plant origin including bamboo, brush wood, stumps, cane in addition to tussar, cocoons, honey, wax, lac, or kendu leaves, medicinal plants, and herbs, roots, tubers and the like*" (Government of India, 2007).

In Canada, NTFPs are divided into two categories: *regulated* special forest products, which are derived from trees and are mainly taken from salvage timber (e.g. Christmas Trees, fuelwood, fence posts) and *unregulated* botanical forest products, which include: wild edible mushrooms; floral and greenery products; medicinal and pharmaceutical products; wild berries and fruit; herb and vegetable products; landscaping products; craft products; miscellaneous botanical forest products that do not fit into the above such as honey and "smoke woods" (Ministry of Forests and Range, British Columbia, 1995) (Table 3).

In China, the term "productive forest products" is used for any production on lands belonging to the Chinese Forestry Department not differentiating between wood and non-wood goods, nor origin (e.g. plantation versus products harvested in the wild). Under such

a notion, products that in most countries are considered agricultural crops such as walnuts, cloves, olives, grapes, hazel and hickory nuts are actually considered forest products (Jianglong, 2011). China therefore links the term to land-use. This is at the heart of the definitional issue, and also illustrates the challenge associated with harmonization.

- **Lack of consensus on what constitutes "forest"**

Issues with the sub-components of the term have existed since it was first coined. In 1999 FAO took steps to define each of the sub-terms for improved information-sharing (FAO, 1999). These sub-terms have since evolved under the work of FAO's Forest Global Resources Assessment (FRA). A key issue has been the origin of the NWFPs in question and the associated definition of "forest". FAO's 1999 definition, for example, adhered to the FRA 2000 definition of forests and associated terms, which included plantations. Plantations were explicitly excluded from De Beer & McDermott's (1989) definition, which specified that NTFPs come from natural forests, because an inherent part of this category is conservation. These have since evolved and according to the FRA 2015 definitions, the term NWFPs now "g*enerally excludes products collected in tree stands in agricultural production systems, such as fruit tree plantations, oil palm plantations and agroforestry systems when crops are grown under tree cover*".

A good example which illustrates the complexity of the issue is coconuts, which still exist in the wild, but the lion's share of which come from well-established tree crop plantations on agricultural lands, of which their value is typically attributed to agriculture rather than to forestry because the designated land category is "crop/agricultural land". For example, the Forest Stewardship Council (FSC) explicitly excludes plantations managed for NWFPs (e.g. rubber, oil palm, coconuts) from the scope of forests and forest certification (Ref. FSC-DIR-20-007 EN, FSC Directive on FSC Forest Management Evaluations) on the basis of this grey area. Fodder is another more complicated example as it can derive from different landscapes, from natural forests to agroforestry systems to trees outside of forests to grasslands (for instance in Tunisia where alfalfa grass is grown on lands classified as forests and managed by the Tunisian Forestry Department, and the contribution of forest-based grazing activities, depending on fodder production, has been estimated by (among others) Merlo & Croitoru (2005). The determining factor here should be that if it derives *mostly* from forest or other wooded land (as per designated land use) it should be considered a NWFP.

In some countries, there are more explicit references to the types of products that qualify as NWFPs. In Canada, for instance, NWFPs can include products gathered in the wild, "*in either timber-productive or non-timber productive forests and lands*" (Ministry of Forests and Range, British Columbia, 1995) such as mushrooms produced in forests under varying levels of management, maple syrup, or products from agroforestry systems such as wild ginseng or wild blueberries planted as field crops.

Shackleton *et al.* (2011) posit that from the perspective of species-level conservation (versus ecosystem) NWFPs falling outside the strict definition of [natural] forest should still be included in the category. The origin of NWFPs continues to be a contentious issue,

not least when measured against De Beer and McDermott's original interpretation of NTFPs, as many of these products derive from forests that experience some degree of human intervention. FAO FRA's definition of forest and NWFPs might very well be a sound point of departure (with a few necessary amendments that will be discussed in the following sections) not least because these definitions are already used to collect data on wood by over 230 countries.

- **Products versus services**

Products and services constitute other contentious sub-components of the term NWFP. It has been suggested over the years that services (e.g. ecotourism, hunting but also ecosystem services like carbon sequestration, water from protected catchments, etc.) be included in discussions on NWFPs. This brought Lund (1998) to suggest a further revision of the term as *non-wood forest resources*. Indeed, the desire to underline the under-appreciated value of forests drove some experts to include ecosystem services in the definition of NWFPs (Shackleton *at al.,* 2011). The inclusion of services is in fact not uncommon in NWFP definitions (Table 3). Moreover, for the purposes of data collection, the inclusion of such intangible services like carbon sequestration, water provision and so on makes the value of the sector even more difficult to quantify. Shackleton *et al.* (2011) argue that the consensus appears to be gravitating away from the inclusion of abiotic products, following the popularization of the term ecosystem goods and services and their classification into four categories as used by the Millennium Ecosystem Assessments, and the different associated issues involving their conservation and use.

To varying degrees, different countries also include activities such as hunting and ecotourism, particularly medicinal plant- and wildlife-based tourism in tropical forests in their definitions (Muir *et al.*, forthcoming). Some countries exclude these services from their definition because they are covered under separate policies or strategies due to widespread use or cultural or historical importance (for example, although Scotland has a policy on NWFPs, hunting is not included in this policy (Muir *et al.*, forthcoming). It is worthy to note that in some industrialized countries, NWFPs are increasingly being commercialized as recreational services, where forest owners are selling "experiences", such as mycotourism in Spain, "traditional product" discovery in Italy (e.g. chestnut and truffle roads), forest bathing in Japan (and increasingly elsewhere such as in Europe and North America), Red Dzao spa in Viet Nam using wild plants, among many others, suggesting that recreational/tourism services might be worthy of inclusion in definitions. For the purposes of statistical gathering, however, this is ultimately settled by the type of statistical classification system to which it might belong (i.e. on products or goods, such as the Harmonized System (HS), the Central Product Classification (CPC) and the International Standard Industrial Classification (ISIC) or by activity, for instance the Statistical Classification of Economic Activities in the EC (NACE) or the International Standard of Industrial Classification of All Economic Activities.

- **Difficulty drawing the line between wild and domesticated (cropped)**

Different interpretations regarding the degree to which NWFPs should only include products harvested from the wild and/or if domesticated or semi-domesticated products should also fit into the category have made the debate on definitions particularly challenging. Most entities, not least the UN ISIC defines NWFPs as the gathering of *wild growing materials* (class 0230) (UN, 2008). From a botanical point of view, however, all current domesticated varieties derive from wild ancestors (and many from natural forests) and this tends to be the historical trajectory of most NWFPs, quite simply because domestication allowed for greater efficiencies in production and time/energy involved in harvesting. Products such as rubber (*Hevea brasiliensis)* or oil palm (*Elaeis guianeensis*), walnuts and almonds, for example, are often no longer considered NWFPs because many are plantation-derived, despite the fact that extraction from the wild continues (e.g. Indonesia, West Africa, the Amazon). Yet these products have rich historical legacies as having been key NWFPs in the past (Sills *et al*., 2011; Muir and Sorrenti, 2018). Many NWFP species are actually in a dynamic process of domestication (Vantomme, 2011), moving from traditional gathering/hunting practices in forests towards more intensive cultivation on farms. Homma (2012), in his seminal pieces on plant extractivism in the Amazon, describes at length the process that extends from the discovery of wil] resources to extractivism, management, domestication (e.g. “crops”) and ultimately the discovery of synthetic substitutes, which is the path of many (but not all) NWFPs (Homma, 2012).

Furthermore, this trajectory is not necessarily linear. In fact many products may be simultaneously farmed and also collected in the wild. *Rosa canina*, or *Mispilum germanicum* for instance have been widely cultivated in Europe (particularly until the 17th century) and can also be found growing in the wild (Myer *et al.*, 2012). Ros-Tonen *et al.* (2005) opine that it is important to distinguish between NWFPs from natural forests and managed areas (forest and tree crops agriculture) from the perspective of designing sustainable forest management systems. However, for the purposes of data gathering, the wild versus domesticated discussion presents obvious challenges if one tries to separate products from a botanical point of view. A good compromise for the purposes of statistical gathering could be to make a distinction between wild harvested products on forest land where one has access or harvesting rights versus cultivated products on *forest* land for which one has ownership/tenure rights (see below section 3.1.3).

- **Disaccord over the inclusion of both animal- and plant-based products as NWFPs**

NWFPs are classified in many different ways according to their end use: edible products, medicine, fodder for domestic animals, perfumes and cosmetics; colorants; ornamentals; utensils, handicrafts, and construction materials; and exudates like gums, resins, and latex. Vantomme (2003) comments that 90 percent of the total commercialised output by countries originates from five major categories of NWFP use, and in order of their reported financial values: food (fruits, berries, vegetables, mushrooms, nuts); exudates (gum arabic, pine resins); other plant products (bamboo, rattan, cork); honey; and ornamental plants, mainly Christmas trees and plant materials used for decorative purposes.

Bushmeat is not included, likely because of its informal and sometimes illegal nature, although some countries (mostly in Europe and Northern America) collect some statistics on game meat. Inland/freshwater fish is also missing, likely due to the same difficulties quantifying their contributions.

The United Nations (UN) International Product Classification tends to include in NWFP classification systems only plant-based products gathered in the wild (UN, 2008). Many other organizations, however, FAO among them, include wild game, hunting and bushmeat (including small-scale land-based fisheries or gathering insects for food), as well as wild honey collection, in their definitions of NWFPs. In this case there is an important discrepancy between definition and use of the term. The same is true for beekeeping and related products such as honey, beeswax, propolis, etc. While these commonly feature in definitions of NWFPs, they generally make up a different class according to the the IPC on “raising of other animals”, hence they do not qualify as NWFPs. In official statistics, most animal and animal products feature in the veterinary/zoological system as game, suggesting this might be the recommended pathway for statistical gathering.

3.1.3 Moving beyond the wood/non-wood divide

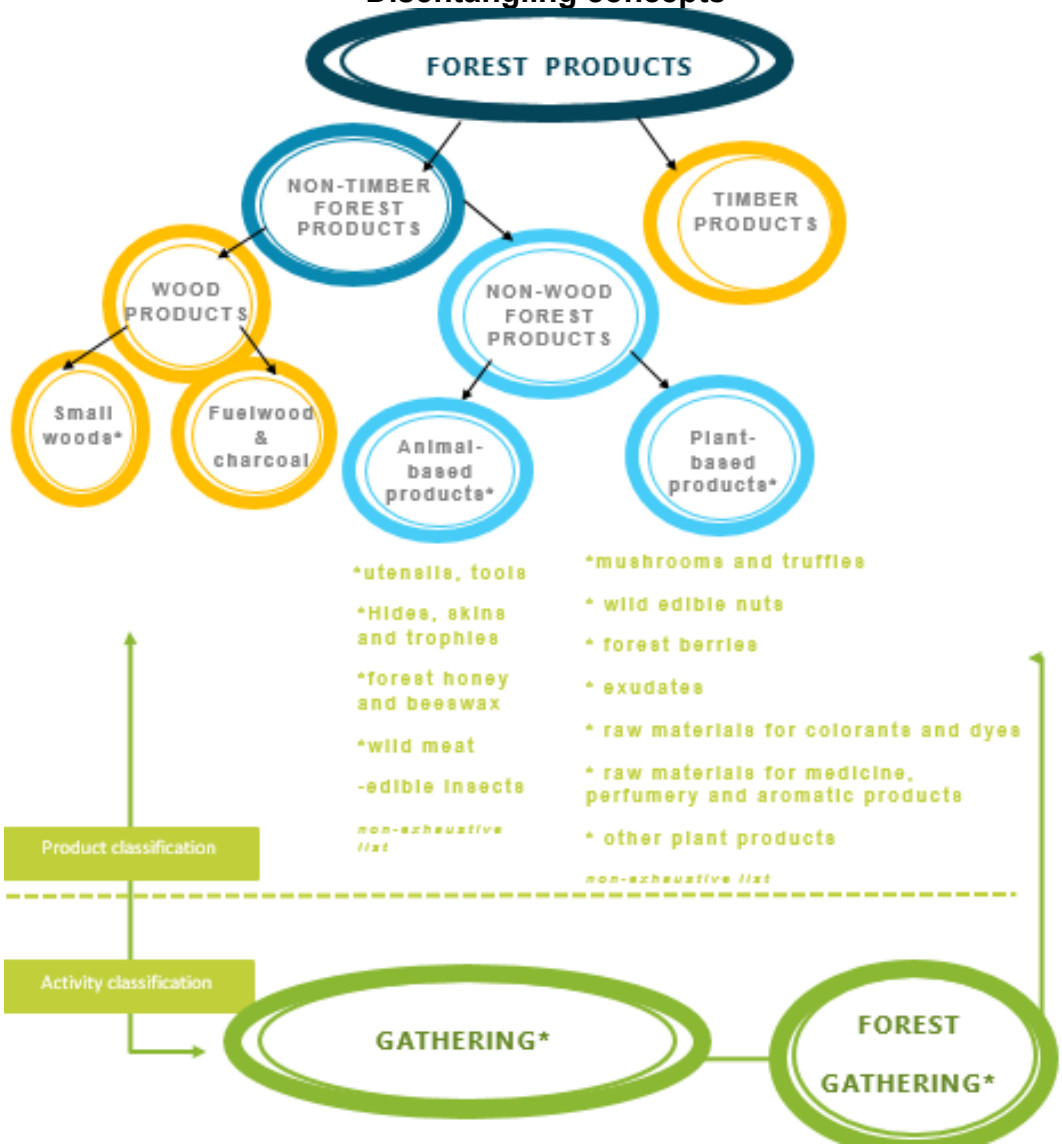
While sound and justified cultural, legal, ecological and institutional reasons make convergence on terms and definitions difficult, with appropriate guidance to countries and national entities collecting data, harmonization is still possible for the purposes of collecting data. The authors thus refrain from proposing yet another term and definition given the well documented abundance. They also acknowledge that, however unfortunate the negative prefix of the term is, *non-wood and non-timber forest products* appear be have gained wide currency as terms of choice and should be the points of departure for improving classification, even though it is well acknowledged that terms like wild forest products or natural forest products are more suitable for communicating with stakeholders, particularly those outside of the forest sector. Harmonization still can occur regarding the various sub-components of the terms, even if with a degree of compromise, by building on these existing terms and definitions.

Over the years, a number of scientists have proposed recommendations on how to overcome the terminology and definitions challenge. Most recently, Shakleton *et al*. (2011) propose a working definition potentially applicable across all disciplines. Others have sought to overcome NWFP invisibility addressing “major” NWFPs according to degree of commercialization and trade, without directly fleshing out terms and definitions. For instance, Vantomme (2003) suggests a phased approach to compiling statistics which first address NWFPs that are of national relevance and for which monitoring and evaluation is needed for policy and forest/rural development decision-makers. This would be followed by a second phase addressing minor NWFPs. As stated by Vantomme (2003), countries can make NWFPs more visible in their existing national production and trade statistics by including specific product codes for major NWFPs into their existing national product classification system, with the aim of including them in international statistical classifications in the future. Similarly, Padovani (1995) has proposed focussing

on products with a long tradition of international trade such as cork, gums, vegetable oils, essential oils and waxes.

These recommendations still hold today, but stand a better chance of coming to pass if: (1) greater clarity between forest and agriculture NWFPs could be made in statistical repositories; (2) related to this, if countries/statistical entities received improved guidance on how to report products on a gradient from wild to farmed; and (3) more emphasis is placed on NWFP-related *activities* instead of products alone. Figure 5 reports an overview of key-aspects dealing with NWFPs definitions as emerged from analysed literature.

Figure 5. Improving official NWFP statistics: Disentangling concepts



**Suggestion to include an explanatory note which includes products from fruit/nut plantations like pine nuts, chestnuts and brazil nuts – currently accounted for as agricultural products – in the definition of NWFPs if they adhere to FRA's definition of land use and criteria for height and canopy cover for forests and other wooded land. ** Adapted from FAO, 1999.*

Moreover, as per the representation in Table 4 below, the NWFP definition proposed still adheres to FAO's 1999 definition with the exception that it excludes "trees outside forests" as a compromise and as an initial first step to try to establish a measurable boundary between agriculture and forest products. This adheres to the FAO FRA 2015 definition of forest, in other words, land designated as forest and other wooded land, but not its definition of NWFPs, which is limited to forests exclusively. A further explanatory note (Table 4*)* is recommended in order to not unequivocally exclude products such as fruit/nut bearing trees which may be produced on an industrial scale such as karite nuts, kola nuts, gums, brazil nuts, pine nuts, among others, which are currently accounted for in agriculture under the Central Production Classification (CPC), the Harmonized System (HS) and the International System for Industrial Classiffication (ISIC), despite deriving from forests (as per FRA's definition) (FAO & UNDESA, 2015). By "reclaiming" farmed forest products under the NWFP banner, it would be possible to collect more detailed information on forest product statistics other than timber, and better capture the contribution of these products. While some products are still left out of this representation (e.g. fodder, utensils, handicrafts and construction materials, colorants with animals or parts, non-edible animal products use for tools, for instance), it is because their values are very rarely quantified and reported, and trade is not existing or in very small volumes. As such, it is unlikely for them tobe reported in existing international classification systems which were conceived to monitor trade volumes (e.g. ISIC, HS, CPC). That said, these products are far more likely to be captured under activity classifications for "gathering".

Until now, only products collected in the wild from forests have featured (if at all) under official NWFPs statistics: under the CPC, NWFPs feature under section 032 as "natural gums and resins, gums-resins and oleoresins", "natural cork, raw or simply prepared", "other wild edible products" and "parts of plants used primarily for dyeing and tanning, vegetable products n.e.c." (FAO & UNDESA, 2015, pp.39-41). The explanatory text captures NWFPs that *exist only in the wild;* those that imply a form of human intervention are explicitly excluded. As per this definition, all NWFPs that are to some degree managed or cultivated – which today includes a wide array of products – automatically fall into agriculture (still with some exceptions like cork, for instance). A more precise explanation would be NWFPs that exist "only or mainly in the forest" as per formal designated land use (Muir & Sorrenti, 2018).

This line of reasoning is already applied in some countries. For instance, Finland has collected data on wild, edible *forest* mushrooms since 1980 on the following species: *Boletus pinophilus, Boletus reticulatus, Cantharellus cibarius, Lactarius rufus, Lactarius trivialis, Lactarius utilis, and other* (Sorrenti, 2018). Japan's Statistics Bureau collects data on forest mushrooms, and the Forest Agency on the production of matsutake specifically, suggesting there is good reason to follow this line of practice (Sorrenti, 2018). Korea, Italy and Brazil also already collect data on forest nuts (e.g. chestnut, brazil nuts, pine nuts), although these are attributed to agricultural produce in international statistical databases.

There are several cases moreover that demonstrate different criteria are being applied to wood and non-wood products, inasmuch as wood products can also exist in planted/managed forests while NWFPs cannot exist in controlled environments, as per international classification systems. For example, chestnuts are currently considered

agricultural products while chestnut wood as a product of forests and logging. The same can be said for pine nuts and pine wood, brazil nuts and wood, and rubber and rubber wood, etc. All of these products should be attributed to forestry instead of agriculture, a relatively simple step that could begin to clear a pathway towards improved visibility of NWFP and forest contributions.

3.1.4 Closing in on the wild versus farmed debate: Lessons from fisheries

The second recommendation is to draw upon lessons from the fisheries sector. Forestry and fisheries faced similar historical trajectories in terms of public scrutiny during the late 1980s and 1990s respectively – in part generated by media events shedding light on the depletion of forest resources and fish stocks (Pauly & Zeller, 2003). Much like public mistrust of the forest sector associated with illegal logging and the destruction of rainforests and wildlife in the tropics, the fisheries sector also faced public environmental concerns over the unsustainability of the industry and growing number of endangered species such as the Southern Bluefin tuna (*Thunnus maccoyi*) and Northern cod (*Gadus morhua*) (Pauly & Zeller, 2003). Assessing the health of ecosystems, including resources assessment and the impact of forestry and fisheries operations, were a key motivation behind improving official fisheries statistics, particularly during the early 2000s with the development of the "*strategy for improving information on status and trends of capture fisheries*" (FAO, 2003) by the Advisory Committee on Fisheries Research (ACFR) and subsequent steps. In the forest sector, official statistics on forest resources have been collected by FAO for over 70 years, but the information on "forest products other than wood" was only collected between 1954 and 1971 in FAOSTAT, leaving a large part of the forest – NWFPs – unaccounted for, largely due to the aforementioned challenges of terminology, definitions, and breadth of products in the category. FAO FRA has made attempts to collect data on NWFPs since 2000. The approach used was to identify and describe products of national relevance "for which monitoring and evaluation are most urgently needed" (FAO, 2000). The products highlighted in FAO FRA 2000 include those widely used on national markets or gathered for export as a first attempt to help countries improve data collection (FAO, 2000). That said, only a fraction of countries report data on NWFPs.

The approach of fisheries, which distinguishes wild versus farmed fish, could prove equally functional in improving official statistics on NWFPs, which currently include only *wild* products. In fisheries, wild catch refers to "fishery products taken for all purposes – commercial, industrial, recreational, subsistence – and by all types of fishing units (fisherman, vessels, gear, etc.). Aquaculture meanwhile implies "a form of intervention in the natural rearing processes such as regular stocking or feeding; it also implies individual or corporate ownership of the stock being cultivated" (EUROSTAT, 2014). Fish in fact are considered common resources requiring collective management, which has led to a range of regulatory policies and legislation on fishing techniques permitted; they are typically not owned until they have been caught (EUROSTAT, 2014). In between these two ends are "enhanced capture" species (e.g. semi-wild), which include those raised in open spaces (e.g. oceans, lakes) where they grow using natural food supplies and released for instance by national authorities, or wild caught fish raised temporarily in holding facilities

(FAO, 2019). Although in the same way, the line between wild and farmed forest products is not easily drawn (e.g. wild-stimulated and woods cultivated ginseng, acai production, and so on), breaking down the different types of NWFPs produced on the wild to farmed gradient (Table 4), much like has already been done in fisheries, could significantly improve NWFP statistics.

Table 4. Positiong NWFPs in agricultural statistics

Product	Wild products	Non wood forest products **Goods derived** from forests and other wooded land **that are tangible and physical objects of biological origin other than wood.**			Agricultural products Any product, raw or processed, marketed for human consumption or animal feed.			Fishery products Fish, molluscs, crustaceans and other aquatic animals, residues and aquatic plants,		
		Wild forest products	Semi-wild forest products	Managed forest products	Agroforestry products	Crop products	Livestock products	Fish catch	Enhanced capture	Aquaculture
Definition	Products of biological origin other than wood collected outside forests and other wooded land.	Biological resources other than wood picked/gathered/harvested/caught in forests and other wooded land.	Biological resources other than wood picked/gathered/harvested/caught in forests and other wooded land subject to some form of human intervention to increase productivity.	Biological resources other than wood picked/gathered/harvested in managed tree production systems where primary designated land use is forest.	Products collected in in agroforestry systems when crops are grown under tree cover where primary designated land use is agriculture.	Actual harvested production from the field or orchards.	Products from live and slaughtered animals.	Fishery products taken for all purposes – commercial, industrial, recreational, subsistence – and by all types of fishing units (fisherman, vessels, gear, etc.).	Fishery products raised in open spaces (e.g. oceans, lakes) where they grow using natural food supplies and released for instance by national authorities and re-captured by fisherman as wild animals.	Farming of aquatic organisms through a form of intervention in the natural rearing processes such as regular stocking or feeding.
Notes	Medicinal and aromatic plants, for instance, collected on shrublands outside forests.	Wild fruit, nuts, vegetables, mushrooms, game, edible insects, honey, fodder, building/construction materials.	e.g. acai production in Amazonia; wild tubers/yams in sub-Saharan Africa.	Specifically includes the following regardless of whether from natural forests or plantations: gum arabic, rubber/latex and resin; Christmas trees, cork, bamboo and rattan. *Forest nuts and berries should also be included.*	For example, multipurpose trees on crop lands. *Land use criteria is the defining factor in this case*.	Includes products collected in tree stands in agricultural production systems, such as fruit tree plantations and oil palm plantation.	*Includes honey and beeswax; *honey harvested from forest should be included as a NWFP.*	Refers to catches of fisheries products operating inland, fresh and brackiwsh water areas and inshore, offshore and high-seas fishing areas.	Also includes wild caught fish raised temporarily in holding facilities.	Implies individual or corporate ownership of the stock being cultivated.

Source: FAO, 2015; FAOSTAT, 2018; EUROSTAT, 2014; author's own elaboration.

Moreover, the informal nature of NWFP trade and use could also be more easily captured through the activity of gathering. This activity can also be broken down by gradients – much like with fisheries statistics – to understand the *extent* to which gathering activities contribute to lives and livelihoods. Table 5 illusutrates how the fisheries sector attempts to capture the degree to which fishing contributes to livelihoods. The same approach could be used for capturing commercial, part-time and occasional foragers.

Table 5. Lessons from Fisheries for improved data on NWFP gathering?

Sector	Activity
Fisheries	Fishers: -**Full-time fishers** receive at least 90% of their livelihood from fishing or spend at least 90% of their working time in that occupation. -**Part-time fishers** receive at least 30% but less than 90% of their livelihood from fishing or spend at least 30% but less than 90% of their working time in that occupation. -**Occasional fishers** receive under 30% of their livelihood from fishing, or spend under 30% of their working time in that occupation.
Forestry – Breaking down the wild and farmed components of "NWFPs": A proposal	**Forest foragers:** -**Full-time foragers** receive at least 90% of their livelihood from foraging in forests or spend at least 90% of their working time in that occupation. -**Part-time foragers** receive at least 30% but less than 90% of their livelihood from foraging in forests or spend at least 30% but less than 90% of their working time in that occupation. -**Occasional foragers** receive under 30% of their livelihood from foraging, or spend under 30% of their working time in that occupation.

Source: FAO 2019b; author's own elaboration

3.1.5 From products to activities

For too long, NWFP data gathering (or the absence of such) has focussed on product classification systems. However, the very nature of NWFP gathering entails harvesting of products across landscapes, as underlined by Emory (2006). Thus, while the forest/agriculture boundary can serve to paint a more accurate picture of production and consumption of NWFPs, there are still many products that will not be captured because they are harvested from so-called “bush” or natural systems outside or in between forests and cropland. Nowhere is this more evident than in the collection of household-level data, where respondents often have a difficult time “placing” the origin of harvest because more often than not, gathering occurs across landscapes. Far easier would be to distinguish between products that households cultivate and tend to directly and those that they gather from land that is not directly cultivated and owned by the household.

As such, the third recommendation is to move beyond *product* classification systems towards *activity* classifications *(International Standard Industrial Classification of all Economic activities)* to capture gathering of NWFPs that may not be accounted for under crops nor under forest products, given that they may be harvested in between these boundaries. Gathering of NWFPs already exists under Group 023, Class 0230 of Section A on Agriculture, Forestry and Fishing (International Standard Industrial Classification, ISIC). The division includes the “extraction and gathering of wild growing non-wood forest products”, specifically mushrooms, truffles, berries, nuts, balata and other rubber-like gums, cork, lac and resins, balsams, vegetable hair, eelgrass, acorns, horse chestnuts, mosses and lichens.” While some of the same problems arise with regards wild or uncultivated versus managed production (e.g. cork), the emphasis on gathering could allow a greater variety of activities related to NWFPs to be captured with appropriate explanatory notes which break down gathering on the grounds of property and access/harvesting rights, as per Table 2.

The European Community has a similar classification system known as “Statistical Classification of Economic Activities in the European Community” to coordinate statistical information among industries (NACE codes). Under the NACE code system there is a specific business category for “gathering of wild growing NWFPs” – code 02.30 – however, similar to the ISIC, there is limited information reported under this category because many NWFP activities continue to remain informal, and the more formal activities are typically reported as agricultural (Vidale, 2018). The introduction of legislative measures to regulate gathering of NWFPs could – in some contexts – allow us to obtain important information on a largely informal and invisible sector, and at the same time monitor wild resources. In late 2018, for example, Italy introduced a standard gathering income tax of 100 Euros (essentially tax exemption) for the gathering of different types of NWFPs such as mushrooms, truffles, berries, medicinal and aromatic plants, so long as sales from these activities do not exceed 7 000 Euros (Sole24Ore, 2018). This is set to give unprecedented visibility to activities carried out by part-time or occasional foragers, and in turn, should lead to better data quality. These measures and methods need to be adopted however on a product-by-product basis, as experience has shown that blanket legislative measures for all products does not work (Laird *et al.*, 2011). For game meat,

among other products, similar information can be obtained from permits for hunting or gathering of NWFPs. A recent UNECE/FAO questionnaire, for instance, attempting to capture production of game meat in Europe, concluded that future questionnaires should request number of hunting licenses, which could be a good indicator of the value of game (UNECE & FAO, 2018). While much work is still needed on this front, it is clear that efforts to improve NWFP visibility should also include the *activity* of gathering rather than on product classifications alone.

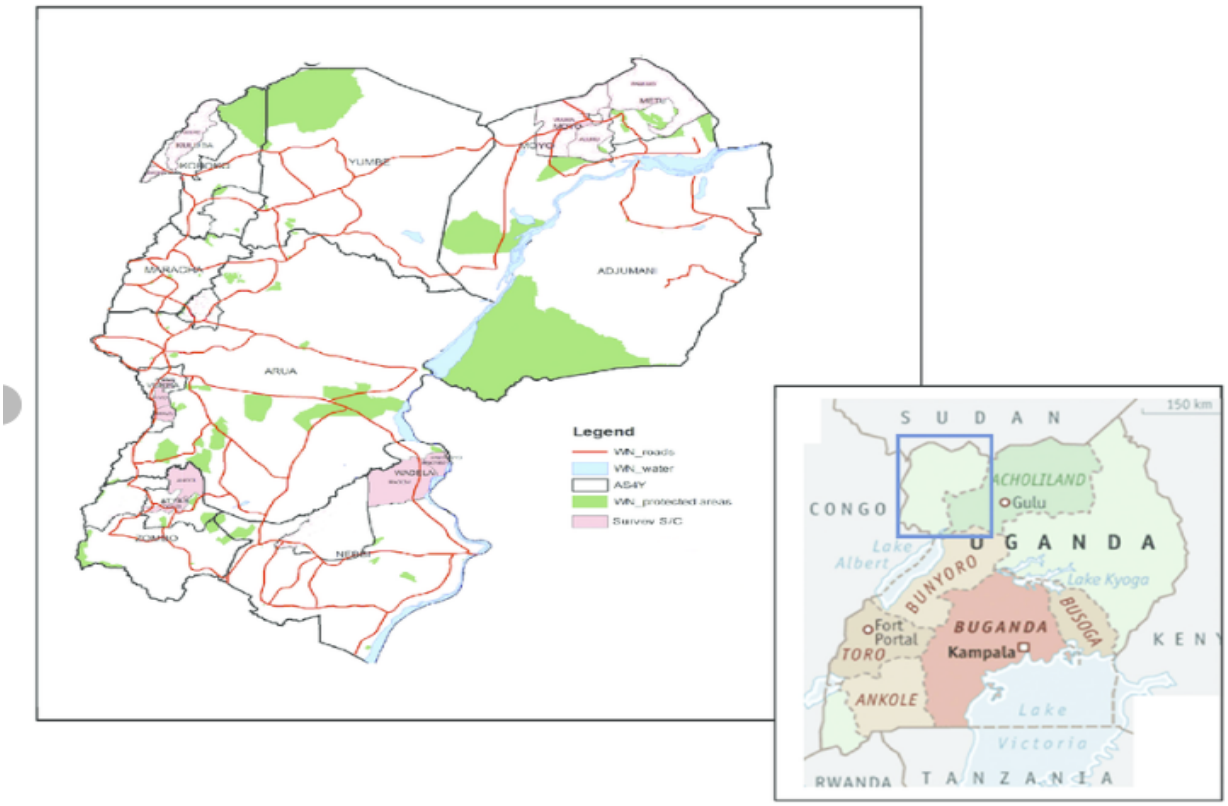
3.2. Weighing in on NWFP contributions to diets and livelihoods: evidence and lessons from northwest Uganda

This section showcases the main findings relative to research objective 2(a) regarding assessing the relative contribution of NWFPs to diets and livelihoods, motivations behind consumption and gathering and perceptions of status in the wild. The focus of the research is on wild edible NWFPs which are gathered. Although the inquiry also found many non-edible NWFPs in the study area (within the West-Nile sub-region, in the North-West of Uganda – Figure 6) such as fodder and building/construction materials which may indirectly contribute to diets and livelihoods, it was decided to maintain the focus on wild edible NWFPs, also referred to hereon as wild foods.

3.2.1 Case study area

Boasting some 18 783 species of fauna and flora, Uganda is considered one of the ten most biodiverse countries on the planet (CBD, 2018). It is also highly dependent on agriculture and increasingly characterized by “climate-sensitive production and/or yields” (FAO, 2018). These factors, coupled with poverty and two decades of civil war in the north of the country, have contributed to the persistence of food insecurity; more than 30 percent of the total population faces some level of chronic food insecurity (USAID, 2017).

Figure 6. West-Nile sub-region, Uganda



Source: Kansiime & Mastenbroek, 2016.

3.2.2 Status of Food Security and Nutrition in the West Nile Region

Micronutrient deficiency is a major contributor to childhood morbidity and mortality (Black, 2003). Prevalence of undernutrition is 25 percent of the population and the prevalence of wasting (low weight-for-height) nationally is 4 percent but 10 percent in the West Nile region (USAID, 2018; UBOS & ICS, 2018). In Uganda, the diet is composed mainly of plantains, starchy roots such as cassava and sweet potatoes and cereals (maize, millet, sorghum). While some pulses, nuts and leafy green vegetables complement the Ugandan diet, it is typically poor in micronutrient-rich foods (FAO, 2010). Just 34.4 percent of children age 6-23 months in the West Nile region register minimum dietary diversity[3] (slightly higher than the national average of 30 percent). Remarkably, the 2018 Demographic and Health Survey in the country found the percentage of children aged 6-23 months who consumed foods rich in vitamin A in the 24 hours preceding the survey was 83 percent in the West Nile, only the Teso region (86 percent) registered a higher value at the time of the survey. 47 percent of children consumed iron-rich foods (slightly higher than the national average of 37 percent). Notwithstanding, vitamin A and iron deficiency particularly among vulnerable segments of society remains high: 56 percent of children age 6-59 months in the West Nile region are anaemic and 16 percent Vitamin A deficient, slightly more than the national averages (53 percent and 9 percent respectively). Forty percent of women aged 15-49 in the region meanwhile have some degree of anaemia, against 32 percent nationally (Uganda Bureau of Statistics and ICF, 2018).

3.2.3 Use of NWFPs, including wild and semi-wild foods in Northern Uganda

Wild and semi-wild foods (e.g. foods found in the wild, but for which techniques are used to promote production) have been the focus of various studies in Uganda (Ojelel *et al.*, 2019; Ojelel & Kakudidi, 2015; Kikafunda *et al.,* 2011; Agea *et al.*, 2011; Tabuti *et al.*, 2004) including in northern parts of the country (ICRAF, 2018; Okidi *et al.*, 2018; Oryema *et al.* 2013; Loki and Elly K. Ndyomugyenyi, 2016; Anywar *et al.*, 2014). Common NWFPs and wild foods consumed include vegetables such as *Amaranthus dubius* (dodo), *Senna obtusifolia* and *Corchorus olitorius,* wild fruits such as *Vitellaria paradoxa* (shea)*, Vitex doniana, Borassus aethiopum* (african fan palm), *Tamarindus indica* (tamarind) and *Annona senegalensis*; mushrooms (e.g. *Termitomyces aurantiacus, Termitomyces eurrhizus* and *Termitomyces microcarpus, Armillaria mellea, Lentinus prolifer)* and edible insects such as *Ruspolia differens* and *Ruspolia nitidula*, and termites *(Macrotermes sp.)*, among many others (Odongo *et al.*, 2018, Kikafunda *et al.,* 2011; Okidi *et al.*, 2018; State of Uganda's Forestry, 2016; Nakalembe *et al.*, 2015). Vast differences exist among agro-ecological zones: Kikafunda (2011) identifies as many as 94 different types of wild edible plants in two districts in western Uganda alone, many unique to the region. Very little

[3] Children receive foods from four or more of the following food groups: a. infant formula, milk other than breast milk, cheese or yogurt or other milk products; b. foods made from grains, roots, tubers, and bananas/plantains (matooke, ndiizi, gonja), including porridge and fortified baby food from grains; c. vitamin A-rich fruits and vegetables; d. other fruits and vegetables; e. eggs; f. meat, poultry, fish, and shellfish (and organ meats); g. legumes and nuts.

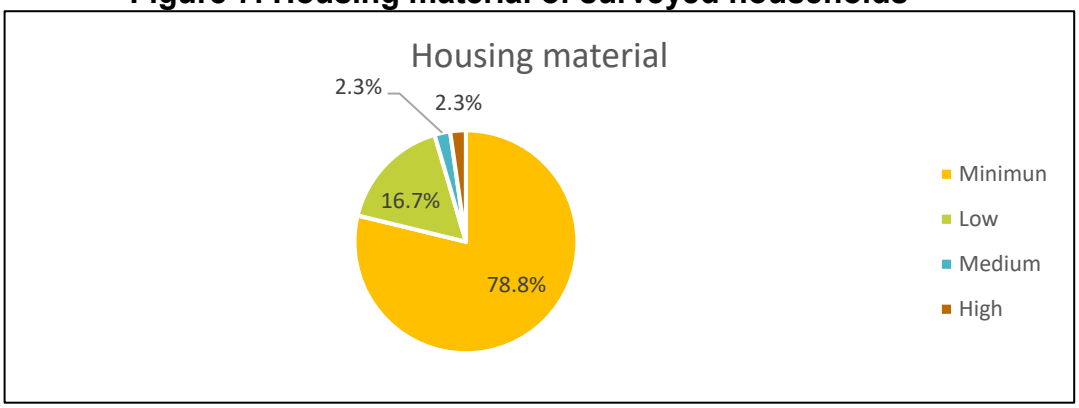
information exists, however, on frequency of consumption and relative contribution of wild foods to diets. Okidi *et al*. (2018) study on wild fruit and vegetable consumption in the Acholi sub-region is one exception.

Recently, the refugee influx from South Sudan in Northern Uganda has led to growing concern over their impact on the surrounding environment – mostly on woodfuel resources (FAO, 2017). FAO and ICRAF have recently broadened this scope to understand the impact on non-wood resources, particularly wild foods gathered in and outside of forests. ICRAF recently conducted inventories that demonstrate the presence of at least a dozen food tree species which are not only a part of the customary diet but also form part of the local value chains (ICRAF, 2018). These include *Vitellaria paradoxa, Borassus aethiopum, Tamarindus indica, Balanites aegyptiaca, Ficus natalensis, Grewia bicolor, Gardenia ternifolia, Ziziphus abyssinica, Ximenia americana var Caffra, Vitex doniana, Elaeis guineensis, Moringa oleifera, Anonna senegalensis, Ficus sur (fig species)* and *Lophira alata*, among others. With the exception of this present study, however, most of existing research in the region concentrates on wild food consumption among refugee communities, which is not surprisingly less frequent and common than in local, "host" communities, and positively correlated with time spent in the region (FAO & UNHCR; 2018; Wekesa, 2018;).

3.2.4 Survey results: Household and respondent particulars

A survey was conducted according to methodological approaches reported in sub-section 2.2. The average household size within targeted communities interviewed was 7 members. Up to 10 different ethnic groups were reported, Lugbara and Aringa being the most common. The majority reported Islam as their religion; this is quite typical of the Yumbe District. Wealth category – measured by housing material, a common indicator of wealth and social status (Psaki *et al.*, 2014) – was low amongst most households - the large majority (79 percent) reporting ownership of homes made of light material (e.g. bamboo, thatch grass, leaves, mud, etc.) (Figure 7).

Figure 7. Housing material of surveyed households



Minimum (made of light materials, e.g., bamboo, paddy straw, jute stick, leaves, mud, etc.); 2 = Low (made of light materials plus wood or galvanized metal); 3- Medium (combination of wood and galvanized metal); 4 = High (made concrete materials and galvanized roof)

Source: author's own elaboration.

All households however reported ownership/access to land for agriculture, albeit of varying dimensions (from 1000 m² to several hectares). Most households (88 percent) reported possession of livestock, an important productive asset. Most commonly, households possessed goats (40 percent), followed by cattle (27 percent), chickens (24 percent) and sheep (7 percent), among others.

The primary source of income reported was crop farming, which engages both men and women. Other activities mentioned include charcoal burning and brick making (only men and male youth take part). Fishing was also cited (men tend to fish, and women are typically involved in sales). Other sources of income noted by men but as not widely common include: market vending of various foods and casual labour for varying activities but mostly clearing of bush and cultivation. In addition to sales of agricultural produce, focus groups with women revealed the sale of wild foods, handicrafts, wood fuel, charcoal, tree planting (through local non-governmental organizations), tailoring and hair dressing as common income generating activities.

3.2.5 Wild food consumption and collection: an overview

The study focussed on non-wood resources obtained through the activity of **gathering** (within and outside of forests), referred to here on as wild gathered food/wild food. This was in part motivated by the fact that the desk review coupled with pilot testing of the survey in Zambia (May, 2018) found that, on the ground, particularly in low-resource settings, it is much more difficult to draw the line between wild and domesticated, and for households to differentiate the degree to which a wild food derives from a particular landscape (forests, wooded land, bush), also because it may derive from more than one. This forest/non-forest boundary is often shifting, and thus it was decided to focus on the activity of *collection.* In other words, households were asked about foods that they obtained through the activity of gathering.

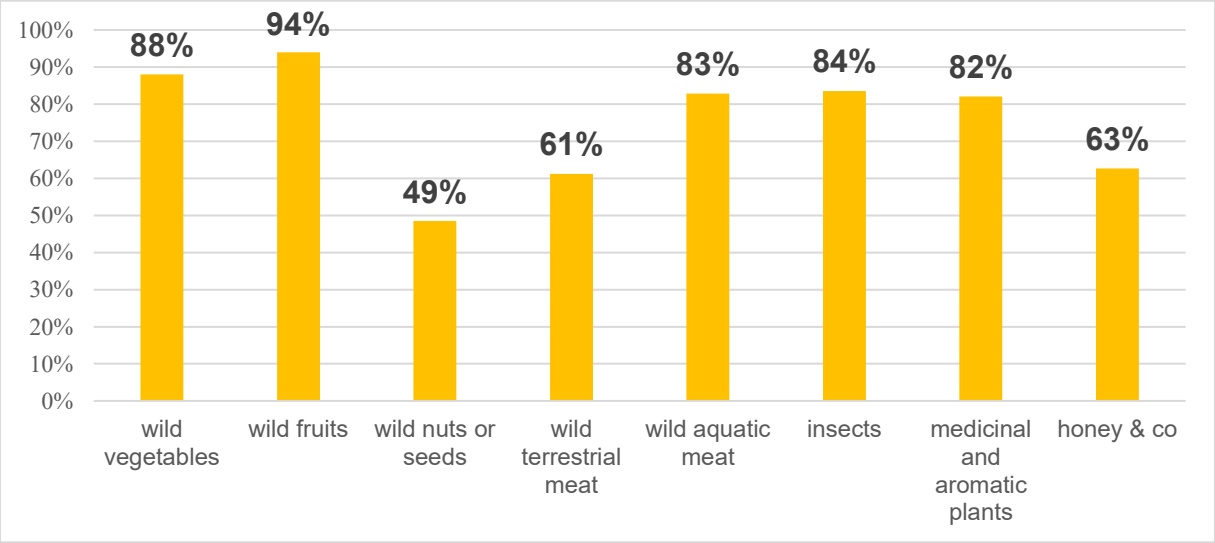
Findings suggest that wild food consumption is pervasive and systematic in the study area. Information was collected on frequency of consumption, relative quantities consumed and motivations behind consumption. Results show that 100 percent of households consume wild foods. On average, households consume about eight types of wild products each year. Findings indicate that the most consumed wild foods are termites (*Termites alates)* followed by honey (Image 1) and *Abelmoschus esculentus* (a wild, leafy green vegetable) consumed by 76 percent, 62 percent and 61 percent of households respectively. Two species of insects (*Termites alates and Ruspolia differens*) feature in the top 10 as well as two types of wild caught fish (Nile tilapia and mudfish).

When asked what types of wild foods are consumed aggregately by category (Figure 8) the situation is more or less consistent, but with slight differences: wild fruits (95 percent of households), wild vegetables (88 percent), edible insects (84 percent), wild aquatic meat (83 percent), medicinal and aromatic plants (MAPs) (82 percent), honey and associated products (63 percent), wild terrestrial meat (61 percent) and wild nuts and seeds (49 percent). To some extent this is not surprising – nutritionists have been advocating for the need for more information on food consumption at a below-species

taxonomic level, particularly on wild and underutilized foods – for nearly two decades (Burlingame, 2000; FAO, 2017). Collecting information at sub-species level rather than an aggregate level, although time consuming, inevitably leads to more accurate data. Conversely, in resource-constrained environments, it is evident that one simple question on the **activity** of wild food/product collection – as posited in the forthcoming paper Muir et al (output of research objective one) – can still be a good indicator of wild food *use*. Important to note that here also may be issues with underreporting for some categories, for instance wild terrestrial meat, or bush meat, given restrictions on the hunting of some animals (both aggregately at the food item level) and wild nuts – possibly reported under fruits (e.g. fruits like shea or balanites are harvested both for the flesh and nut). Other products that were likely underreported include wild terrestrial meat, or bushmeat, given restrictions on the hunting of some animals. This was confirmed during focus group discussions held with men, who reported regular consumption of wild meat but manifested concerns about being arrested. It is also important to note the collection of non-edible wild products such as thatch grass and plant materials for handicrafts and brooms by nearly 70 percent of households. The breakdown per product and per category of wild foods features in the below Tables.

Households consume an average of 7.6 different types of wild products per household each year. The most commonly consumed categories of products include wild fruits (95 percent of households), wild vegetables (88maps percent), edible insects (84 percent), wild aquatic meat (in this case fish) (83 percent), MAPs (82 percent), honey (63 percent), wild terrestrial meat (61 percent) and wild nuts and seeds (49 percent) (Figure 8). It is important to note that although respondents sometimes did not reply positively to questions on consumption of wild nuts and seeds, this is likely because they were reported under fruits (e.g. fruits like shea or balanites are harvested both for the flesh and nut).

Figure 8. Wild food consumption: percentage of households consuming wild foods in Yumbe, West-Nile sub-region, per food category



In total, households reported consumption of over 200 unique wild foods on an annual basis. These foods corresponded to the most collected food items as well, suggesting all households consume what they collect, with some selling surplus harvest. Tables 6 and 7 list the top wild foods consumed overall and by category. Interviews with market vendors – who were for the most part women – revealed that up to 60 different wild foods can be found in stalls in a single year, suggesting some but not all foods enter local markets (Picture 1). No significant differences were recorded between villages. Household surveys conducted by ICRAF in Arua, 91 km south of Yumbe, also found consumption of similar types of wild foods, particularly *B. aegyptiaca*; this was confirmed through a recent inventory (Duguma *et al.*, 2018).

Table 6. Main wild foods consumed within the case study area

MAIN WILD FOODS CONSUMED				
Rank	**Local name**	**Scientific name**	**Common name**	**Percentage of households**
1	Una	*Termites alates*	Termites, white ants	76%
2	Honey	*na*	*na*	62%
3	Sebika	*Abelmoschus esculentus*	*na*	61%
4	Ese	*Ruspolia differens*	Grasshoppers	58%
5	Idiliri	*na*	Anthill mushroom	54%
6	Foro	*Oreochromis niloticus*	Nile tilapia (from foro river)	54%
7	Asse	*clarias catfish spp*	Mudfish	50%
8	Iti	*Tamarindus indica*	Tamarind	49%
9	Lugba	*Balanites aegyptiaca*	Desert date	46%
10	Pilopilo (MAP)	*Capiscum s.*	*na*	46%

**na = not available*

Picture 1. Grasshoppers on sale in Arua market. © Giulia Muir

Table 7. Main wild foods consumed by category within the case study area

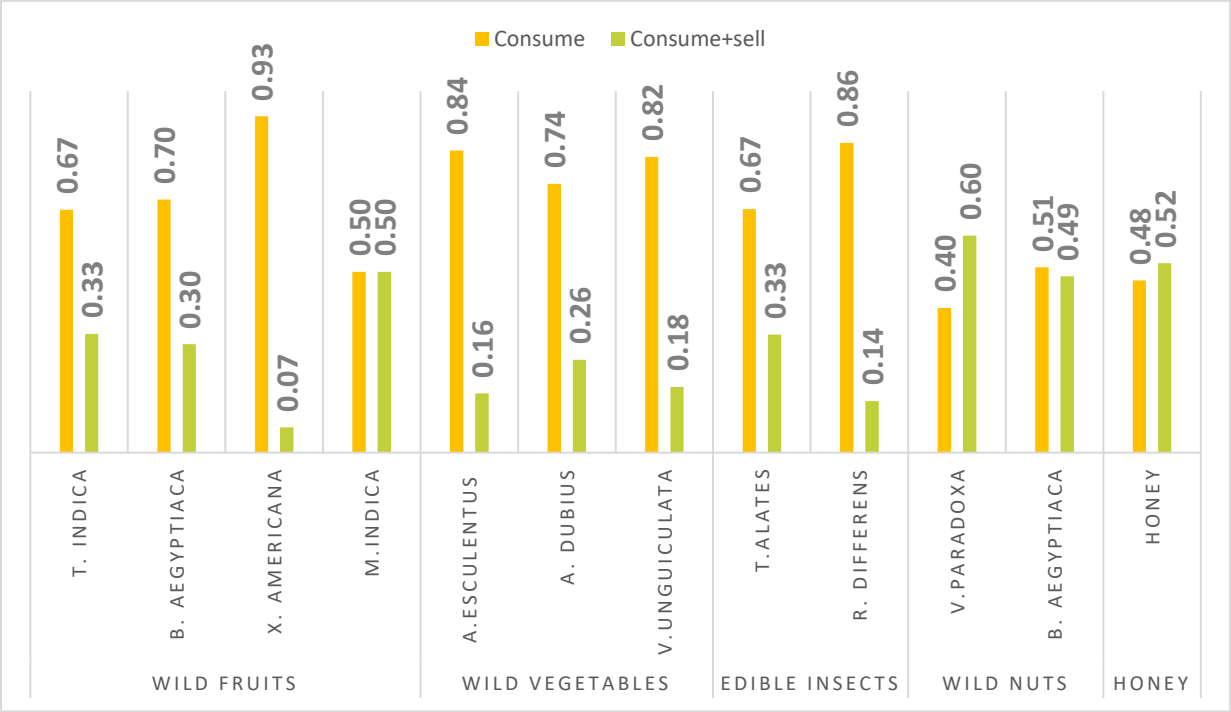
Rank	Local name	Scientific name	Percentage of households
WILD VEGETABLES			
1	Sebika	*Abelmoschus esculentus*	61%
2	Dodo	*Amaranthus dubius*	37%
3	Osubi	*Vigna unguiculata*	28%
WILD FRUIT			
1	Iti	*Tamardindus indica*	49%
2	Lugba	*Balanites aegyptiaca*	46%
3	Ochiki	*Ximenia americana var.*	44%
WILD NUTS & SEEDS			
1	Lugba	*Balanites aegyptiaca*	34%
2	Komoro	*Vitellaria paradoxa*	23%
3	Wekee	*Borassus aethiopum*	10%
TERRESTRIAL MEAT			
1	Opeh	Numida Meleagris	37%
2	Kabo	*Kobus kob* thomasi	32%
3	Endiringa/indiringa	*Madoqua spp.*	31%
AQUATIC MEAT			
1	Foro	*Oreochromis niloticus*	54%
2	Asse	*Clarias catfish spp*	50%
3	Doko	*Synodontis afrofischeri*	28%
MEDICINAL AND AROMATIC PLANTS – MAPS			

Rank	Local name	Scientific name	Percentage of households
1	Pilopilo	*Capiscum s.*	46%
2	Kilikili	*Cassia obtusifolia*	41%
3	Ezekize	*na**	37%
WILD MUSHROOMS			
1	Idiliri	*Termocytes sp.*	54%
2	Lidu	*na*	18%
3	Idrika ika	*na*	13%
EDIBLE INSECTS			
1	Una	*Termites alata*	76%
2	Ese	*Ruspolia differens*	58%
3	Changa	*na*	3%
HONEY & ASSOCIATED PRODUCTS			
1	Honey	*na*	62%

na = not available

Proof of Concept. Information was also obtained on wild food collection – a good proxy indicator for territorial availability and, for some wild food categories, of consumption, given that the majority of households reported that foods collected were mostly consumed (Figure 9). As mentioned in Section 3.1, while obtaining official statistics at a product level is more complicated and also resource-intensive, a lot of useful information can also be obtained through the lens of the *activity* "collection". Based on this reasoning, households were asked if they *collect* products (products which they do no tend/cultivate); **all households surveyed responded positively.** Wild products are collected mainly for home consumption, but also for sale (Figure 9).

Figure 9. Main uses of wild foods



Specific information for different wild food categories are provided below.

a. Wild fruits, nuts and seeds

Within the category of wild fruits, the top three fruits collected were *Tamarindus indica*, locally known as "Iti", followed by *Balanites aegyptiaca* or "lugba" and *Ximenia americana var caffra*, also known as "ochiki". Key informants and focus groups revealed fruits are collected by all household members. While women and children report that they collect fruits such as shea (*Vitellaria*) and desert date (*Balanites)* to take home for household consumption, and sometimes for sale in local markets, men revealed that they often collect fruits from the bush for their personal consumption when hungry. Both the flesh and nut are used. It is important to note that although mangoes – another commonly collected fruit – are known to be a crop from agroforestry, the majority of mangoes from West Nile sub-region are collected from the wild (or common land).

Shea and Balanites are among the few wild foods currently processed, although still in rudimentary stages. Shea nuts, for instance, are crushed manually for their oil and consumed within the household as well as sold in local markets, fetching 1 000 UGX[4] (i.e. USD 0.27)/100 ml. A rapid market survey in Arua found the oil on sale for slightly higher at 1 667 UGX (USD 0.44)/100ml. The difference in price could be due to the fact that Arua is more urban and populated, and people might be willing to pay more for products. At the same time prices may be accounting for distances travelled from "wild lands", and collectors may be also selling to middle-men, thus generating transaction

[4] Exchange rate at 1 USD = 3 689.68 UGX as per 2 September 2018.

costs that finally reflect on the final sale price. Focus groups in Ariwa sub-county revealed that *Balanites* oil can sell for 667 UGX (USD 0.18) for 100 ml. They noted, however, that oil extraction from both *Balanites* and shea takes time, as crushing is performed one nut at a time. Contrary to most wild products that are largely collected for home consumption (with excess harvest sold), collection of *Balanites* and shea appear to be collected for both consumption and sale (Figure 9).

b. Wild vegetables

Households cited as many as 38 different wild vegetables collected (and consumed) in one year. The main three wild greens collected include "Sebika" (*Abelmoschus esculentus)*, "Dodo" (*Amaranthus dubius)* and "Osubi" (*Vigna unguiculata);* this is perfectly in line with the main products consumed, reaffirming that collection is mostly for home consumption in the study area. 62 percent of households reported collection of *A. esculentus*. Most collection is for home consumption, although focus groups and direct observation revealed small trade of the wild greens occurring between villages. Wild spinach (*dodo*), wild okra (*sebika*), wild cowpea *(osubi)*, and other wild vegetables such as moringa are the most commonly traded greens. Prices in local markets ranged between 100 and 500 UGX (USD 0.027 and 0.13) for one bundle (between 100g and 500g depending on product) during peak season, which is typically from March/April to December.

c. Medicinal and Aromatic Plants (MAPs)

By far, the diversity and availability of MAPs exceeded other categories, with as many as 81 different plants varieties reportedly consumed by households on average between three and five times per month. In total 82 percent of households indicated consumption of MAPs. The main MAPs include "pilopilo" (*Capiscum sp.*), consumed by 46 percent of all households interviewed, "kilikili" (*Cassia obtusifolia)* by 41 percent. A small portion of households also reported consumption of *Moringa oleifera* (leaves and seeds) and aloe (*Aloe vera)*; "exotics" like neem (*Azadirachta indica*) were also reported by a small portion of households. A rapid market inquiry found a range of MAPS, such as leaves, bark and sap (sometimes a mixture) on sale. They are typically sold in smaller quantities, averaging 200 UGX (USD .053) per one cup (between 100-300g) depending on product. *Cassia obtusifolia* was particularly abundant in local markets and as far as Arua.

d. Wild mushrooms

In Uganda, several mushroom species such as *Armillaria mellea*, *Lentinus prolifer*, *Termitomyces aurantiacus*, *Termitomyces eurrhizus* and *Termitomyces microcarpus* among many others grow in most parts of the country (Nakalembe, 2015). Wild mushrooms are collected for food, medicine, and also for income. In the study area, 83 percent of households reported consumption of up to 18 different wild mushrooms. Among collectors of wild mushrooms, 58 percent report collection and consumption of the "anthill mushroom", known locally as "idriliri". These mushrooms belong to the

Termitomyces sp. as they arise directly from the fungal combs in termite nests (FAO, 2013). At least five different types of wild mushrooms are sold throughout the year in the study area, according to market vendors, typically between March and July, with the anthill (*Termocytes)* mushroom in high demand, averaging 4000 UGX (USD 1.06)/kg. Peak wild mushroom availability appears to be concentrated in April-May and July-September.

e. Bushmeat (wild terrestrial and aquatic meat)

About 61 percent of households reported consumption during household surveys. Some young men (but not the older ones) in the focus group discussions were somewhat cautious in revealing that they hunt antelopes, squirrels and several different birds. They revealed that they were uneasy due to the fear they held that if the wildlife authorities got to hear about it they would be arrested. The men also stated that if individuals (male youth/men) captured a squirrel or rabbit they typically roasted it and consumed it from the bush without taking home. This was also true for wild birds, suggesting individual consumption surveys may be more suitable than household surveys to capture wild food consumption. The most common birds consumed are: guinea fowls, doves (alibo) and weavers (ariyaka), but many other types are hunted by men/youth. Focus groups with men and boys in Romogi similarly revealed a vast knowledge of animals hunted; in total 13 different species were named by men. Consumption typically occurred once a month (1-2 animals, depending on size). From observations some households have captured guinea fowls from the wild to rear them for production, household meat and income. Birds, depending on type, can sell anywhere between UGX1000 (USD 0.27) and UGX10 000 (USD 2.65) per piece, with wild rabbit fetching as high as UGX 15 000 (USD 3.98) per animal.

Important to note is the consumption of fish from freshwater (i.e. rivers and streams) – often a “forgotten” NWFPs. 83 percent of households consumption of fish, sourced directly through fishing activities or from local markets. Fish appears to be one of the main sources of protein consumed by households; the only other main sources of protein are insects, when in season. Main types of fish consumed are “ngenge” (silver fish, *Rastreneobola argentea*), “foro” (Nile tilapia, *Oreochromis* sp.), “owhi” (mud fish, *Clarias catfish spp*). Prices ranged from 1000 UGX/ cup of silver fish to UGX 15 000 (USD 3.98) for one kg of mud fish. Further assessments are needed to determine the extent to which fish purchased is from aquaculture or from inland capture fisheries.

NWFPs obtained from insects are discussed more in depth in section 3.3.

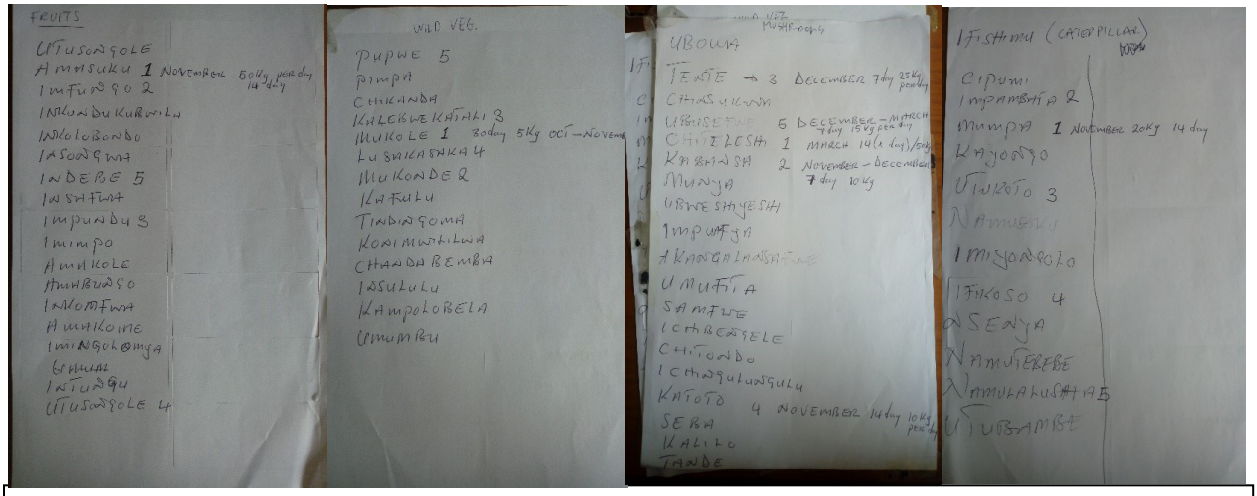
3.2.6 Relative contribution of wild gathered foods to diets

Assessments of *relative* contribution to diets confirm that wild foods make important contributions to diets, with some wild food groups such as fruits, fish and in some cases vegetables boasting consumption comparable to farmed varieties. According to the focus group discussion the “daily plate” typically consists of cassava (inyasa) and maize/posho,

served with beans (the most common sauce served in the main meal), wild green veggies (typically osubi and dodo) and some cultivated plants such as potatoes, cowpeas, okra and eggplants. Once or twice a week fish (small dried fish: dagger, mukene) and sweet potatoes (at least two times in a week) are added to the menu. Other cultivated crops such as pumpkin are consumed occasionally. Meats such as chicken, goat, beef and sheep are only consumed on special occasions, and eggs between 1-3 times per month. There were slight differences between wild products: for instance, some sub-counties appear to have more frequent consumption of particular products, such as *borrassus* in Kululu district, honey in Jotenga and so on.

Food frequency findings confirmed what was said during focus groups – with diets mainly made up of pulses and legumes (consumed daily by over 60 percent of households), white roots/tubers and plantains (56 percent daily), and grains (55 percent daily), with between 32 and 35 percent of households consuming cultivated vegetables and nuts/seeds on a daily basis. Findings also suggest that all households consume wild-gathered foods, with varying degrees of frequency. Some categories such as wild fruits and vegetables boast consumption comparable to cultivated varieties.

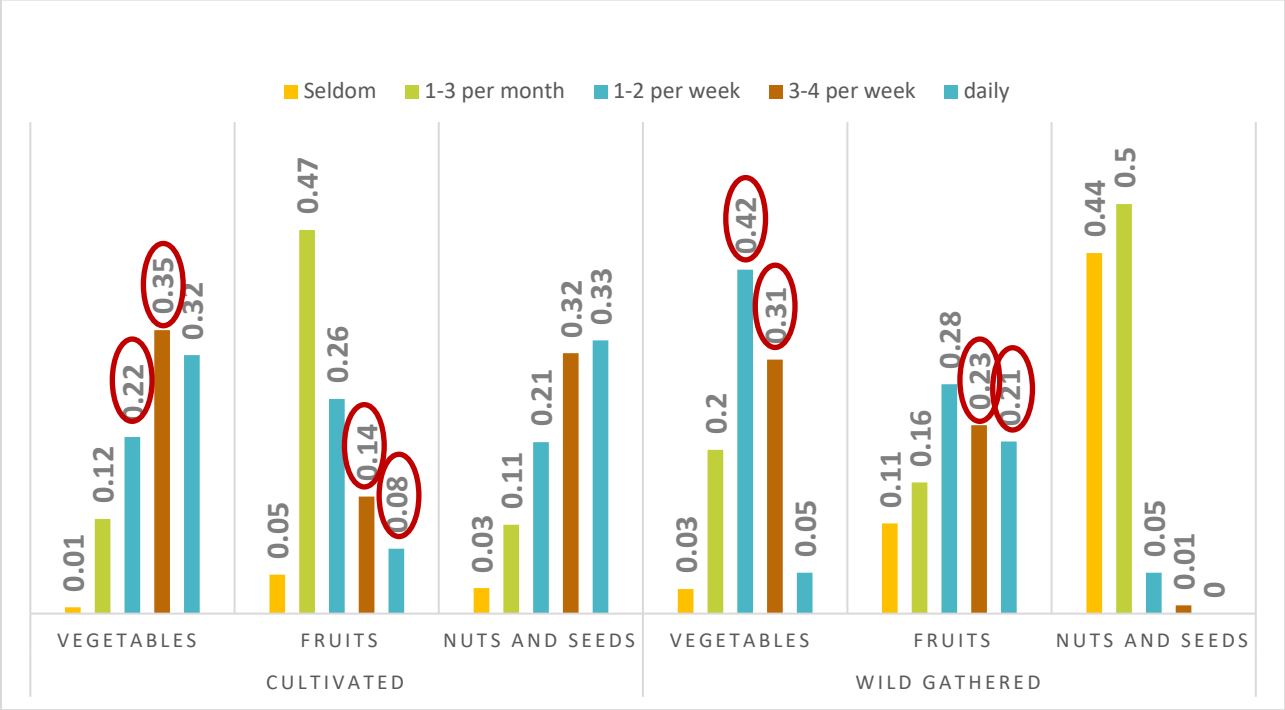
Interestingly, consumption of wild collected fruits for example appears to be more frequent than cultivated fruits, with 28 percent of households consuming wild gathered fruits between 1-2 times per week versus 22 percent for cultivated fruits, 23 percent consuming wild fruits between 3-4 times per week (versus 14 percent) and 21 percent on a daily basis (versus 8 percent). These findings were similar to those collected during focus groups in Luwingu district (Picture 2), northern Zambia (Muir, 2018, unpublished), which reported that the main source of fruit consumption was in fact from wild collected fruits (up to 16 different species). Focus groups reported that cultivated fruit consumption only occurred in households that owned fruit trees (e.g. guava), but on average tree ownership was limited to one or two trees and moreover only available in a short period of the year; fruit purchasing was also limited practice, suggesting high reliance on wild fruit consumption (Picture 2).



Picture 2. Wild gathered foods collected in Luwingu District, Zambia/Focus Group Discussions (May 2018).
© Source: Giulia Muir

Consumption of wild vegetables is weekly or more frequent for over 70 percent of households, with cultivated vegetables consumed weekly or more by 67 percent of households, with consumption on a 1-2 times /week basis by 22 percent (cultivated) and 42 percent (wild) of households and on a 3-4 times/week by 35 percent (cultivated) and 31 percent (wild) of households. Significantly more households however report *daily* consumption of cultivated than wild vegetables (32 percent versus 5 percent respectively) (Figure 10). Looking at the same contribution through the lens of wild food **collection at a species level**, sixty percent of households reported consumption of *Abelmoschus esculentus*, 37 percent of households reported consumption of *A. dubius*, and 28 percent *V. unguiculata* mostly for home consumption at least 1-2 times per week, sometimes more frequently, again confirming that in some rural contexts, collection can be a good proxy indicator for consumption.

Figure 10. Frequency of consumption of wild-gathered versus cultivated plants in Yumbe, West-Nile sub-region



For wild and domesticated animal-based products (Figure 11), results indicate that consumption is largely limited to 1-3 times per month regardless of whether the source was wild caught or domesticated, suggesting an overall inadequacy of protein availability and access in the study area. Among the different animal-source poducts, honey boasted greater frequency of consumption on a monthly basis (over 60 percent). It is interesting to note that insects and domesticated meat is consumed with comparable frequencies (54 and 55 percent respectively), with wild terrestrial meat not far behind (47 percent). Worthy of note is hesitation over the reporting of wild meat due to hunting restrictions, and consumption sometimes by male members of the family only, which could have influenced reporting on a household level. Focus groups (Picture 3) confirmed that insect consumption depends on availability – when in season, consumption is by extension more frequent. For bushmeat, consumption is more frequent in the dry season when it is easier to spot animals.

Figure 11. Frequency of consumption of domesticated and wild-gathered animal-based food in Yumbe district, West Nile sub-region

Picture 3. Focus group discussions, Romogi sub-county, Yumbe district. © Giulia Muir

3.2.7 Wild gathering contributes to seasonal evenness[5]

It has been posited that one of the most compelling theoretical arguments for the importance of diversity within the food system is that it provides seasonal evenness (Powell *et al.,* 2015). In other words, the more species or the more biodiverse the system, the greater the chance that one species or another is "in season" at all times. In much the same way, biodiverse food systems are likely to be essential in the face of social, cultural, economic and climatic change (Frison *et al.,* 2011; Johns & Sthapit, 2004; Dufour *et al.,* 2014).

Results from this study confirmed the finding that wild foods contribute to seasonal evenness (Powell *et al.*, 2015). **No positive correlation was found between lean seasons and wild food use; consumption is cyclical and associated with seasonal availability.** Uganda has two rainy seasons, February-May and September-November, with harvest periods for main food crops typically taking place in the months of December and January and from June to August. Focus groups, household surveys and key informants confirmed that collection of different wild foods takes place in all months of the year (Table 8); with the exception of bushmeat which is reportedly consumed during the dry season when it is easier to hunt and vegetation is lower. Wild gathering is not particularly time-intensive, contrary to popular perceptions; it often occurs even during times of plenty during travel to agricultural fields or, for children, returning from school. Frequency of consumption for most foods thus, not surprisingly, is linked to seasonal availability, particularly given that very little processing takes place. A few exceptions are wild nuts from which oil is derived. Wild vegetables, particularly leafy greens and medicinal and aromatic plants are also exceptions as most of them are available year-round. Terrestrial meat and some types of fish (e.g. *tilapia* sp.) are available throughout the year, although there are periods with peak availability.

[5]Powell *et al.* 2015

Table 8. Wild food seasonal availability for top consumed products, per category

Food item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Dry season/harvest period	Rainy season (land preparation)				Dry season/harvest period			Rainy season (land preparation)			Dry season/harvest period
Plant-based wild foods												
WILD FRUIT/NUTS												
Anonna senegalensis												
Balanites aegyptiaca												
Borassus aethiopum												
Ficus sur												
Mangifera indica												
Passiflora edulis												
Tamarindus indica												
Vitellaria paradoxa												
Vitex doniana												
Ximenia americana var (												
WILD VEGETABLES/MAPS/MUSHROOMS												
Aloe vera												
Abelmoschus esculentus												
Amaranthus dubius												
Vigna unguiculata												
***Moringa oleifera* leaves**												
***Moringa oleifera* seeds**												
Cassia obtusifolia												
Mushrooms (idrika, dilele, idrika ikare)												
Animal-based wild foods												

EDIBLE INSECTS												
Termite alate												
Ruspolia differens												
***Acheta* sp.**												
Terrestrial meat												
***Kobus kob* thomasi**												
Squirrels (majarigo)												
Birds (guinea fowls, doves-alibo, ariyaka – weavers, many other birds)												
Aquatic meat												
Synodontis afrofischeri												
Oreochromis sp.												
Clarias catfish spp												

Source: Focus group discussions, 2018; Adapted from Oreyma *et a*l., 2013

3.2.8 Motivations for consumption are manifold

Not all wild foods are equal; most wild foods are not "famine foods". The use of wild foods during times of food shortage has contributed to the long-standing perception and assumption, particularly in sub-Saharan Africa, that all wild foods are famine foods (Muller *et al*, 2008; Glew & Vanderjagt, 2006; Harris & Mohammed, 2003; JansenVanRensburg *et al*., 2004). The use of wild food gathering as an indicator of food insecurity under the category of consumption behaviour is testimony to this dominant school of thought (Maxwell *et al*., 2013; Maxwell *et al*., 2003; WFP, 2008). A study of seven different measures of food insecurity shows wild food use associated with mild, moderate or severe food insecurity (Maxwell *et al.,* 2013). The Coping Strategy Index in particular asks "*In the past month, how often has a household had to gather wild food or hunt…"* as a measure of food insecurity (Maxwell *et al.*, 2013). At the same time, there are also many studies, including the present, which suggest that wild food use is more dependent on availability than need (Dwyer 1985;Huss-Ashmore & Curry 1991; Dufour 1992). Increased use of forest food has also been a result of people having more time for hunting and gathering (Colfer and Soedjito, 2008), in addition to other factors such as social and cultural preferences and norms, knowledge and trade-offs in time, effort and convenience (Powell *et al.,* 2013).

When questioned for the present study, respondents were given five options regarding wild food use: free access, cultural/gustatory purposes, health/medicinal, hunger/food shortage and other (multiple answers were possible). By far, the main motivation for consumption of wild foods is free access (Figure 12). Cultural/gustatory preferences and hunger are also cited, but not as frequently. Some variation exists between wild food category. For instance, nearly 80 percent of households report consumption of grasshoppers due to ease of access (over 60 percent for termites). Traditional/gustatory preferences are cited by just over 20 percent of households (and just under 20 percent for termites). Less than 5 percent cite hunger/food shortage as a motivation for *Ruspolia d.* consumption, slightly higher for termites (20 percent). For wild nuts, hunger was never cited as a motivation for *Vitellaria* consumption and only by 13 percent of households for *Balanites a.* Free access was conversely cited by 76 percent of households for both as the primary motivation for consumption, with 24 and 7 percent of households respectively citing traditional/gustatory reasons as a motivation.

Similarly, the main motivation for consumption of the top three wild fruits eaten (*X. americana, V. paradoxa* and *T. indica)* is free access (65 percent, 60 percent and 48 percent respectively). Other motivations include health/medicinal (e.g. *T. indica and V. paradoxa*), traditional/gustatory and hunger/food shortage (the latter cited by about 15-20 percent of households). The main motivation for honey consumption is equally ease of access (nearly 50 percent), as well as medicinal/health and traditional/gustatory purposes (24 percent); this may also be linked to the nature of the product.

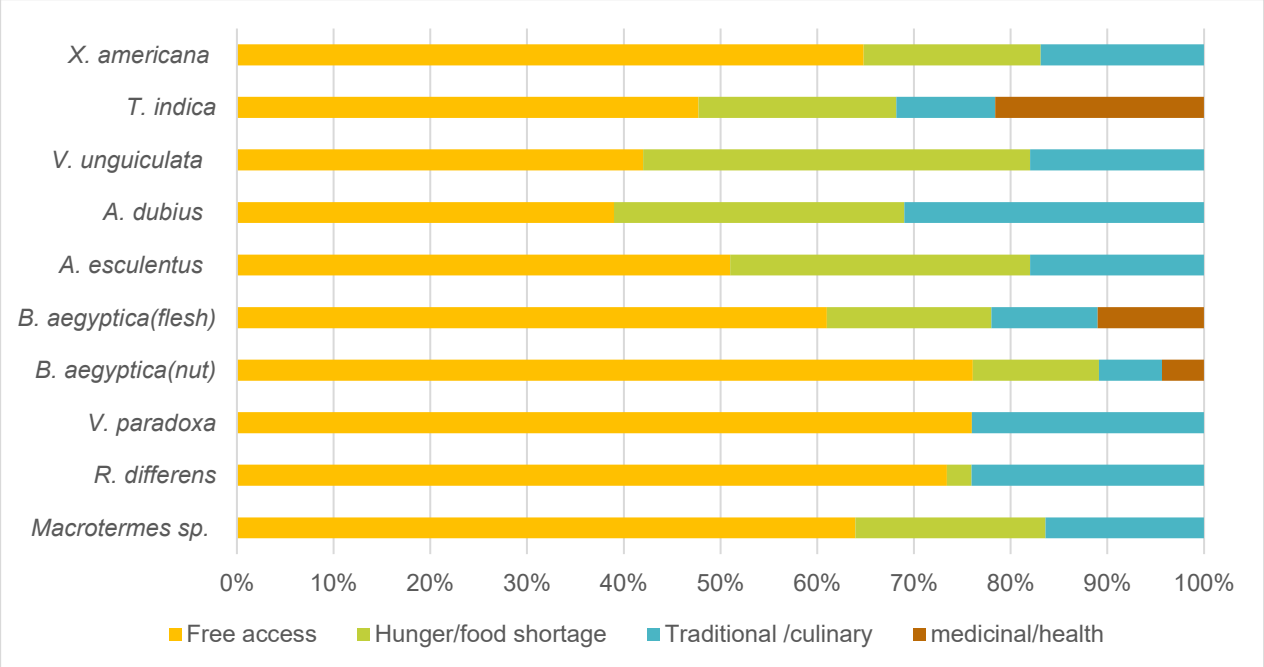
For wild vegetables, the main motivation is free access for all three of the main wild greens consumed, although for this category hunger was cited more frequently. Interestingly, although these wild vegetables can typically be found throughout the year, a higher proportion of households reported consumption due to hunger: for *V. unguiculata*., over 43 percent reported free access as their primary motivation, versus 40 percent reporting hunger/food shortage; traditional/culinary reasons were cited by some 18 percent of households. This suggests that while it is possible that some wild foods are more closely associated with hunger, it is erroneous to say this for the entire category of wild foods. This suggests that some wild foods might be more closely associated with hunger, but it is

erroneous to say this is the case for the entire category of wild foods and wild gathering in general.

Similarly, focus group discussions with South-Sudanese refugees in Ariwa sub-county suggests the main motivation for consumption of wild foods, particularly leafy greens (e.g. okra, dodo), edible insects and MAPs, is not hunger, but to diversify an otherwise monotonous diet of mostly beans and maize. Studies by ICRAF in a similar setting (refugee settlement in Arua, West Nile) found the main motivations for consumption were, in order of importance, to improve food taste, availability, diet diversification, cultural "*we have always collected food from the wild",* to reduce the expenditure on the cost of food and medicinal (Wekesa, 2019). Additionally, unlike with woodfuel, there is no conflict over wild and semi-wild resources. Refugee households are aware of some MAPs and edible insects in particular that are available to diversify an otherwise monotonous diet of mostly beans and maize, and often count on bartering with host communities. Conversely, host communities have a large wild "supermarket" available, yet lack access to staples such as maize, and thus regard the arrivals of refugees as a "blessing". However, it is known that many trees that are sought after for fuelwood are also sources of food and medicine, among other things. This has in turn affected availability of some productts.

In other words, there are different motivations behind collection and consumption of different wild food species and categories. In most rural settings, using wild foods as a proxy indicator for hunger and food shortage mask the many reasons why people collect wild foods: cultural, free access, health/medicine and sale, for instance. While hunger may be a key reason for consuming *some* wild foods, this cannot be said for the category at large. Findings from our study caution against using the terms wild foods and famine foods interchangeably. Motivations for collection and consumption were indeed found to be multiple, and more often than not are related to seasonal availability or cultural preference. In the words of one household head in Ariwa sub-county*: "this is our food".* Frequency of consumption in the study area bears correlation to seasonal availability. Put simply, many of these are freely available and accessible foods, sometimes in abundance, and in turn, they are consumed.

Figure 12. Motivations for wild food use in Yumbe, West Nile sub-region, Uganda

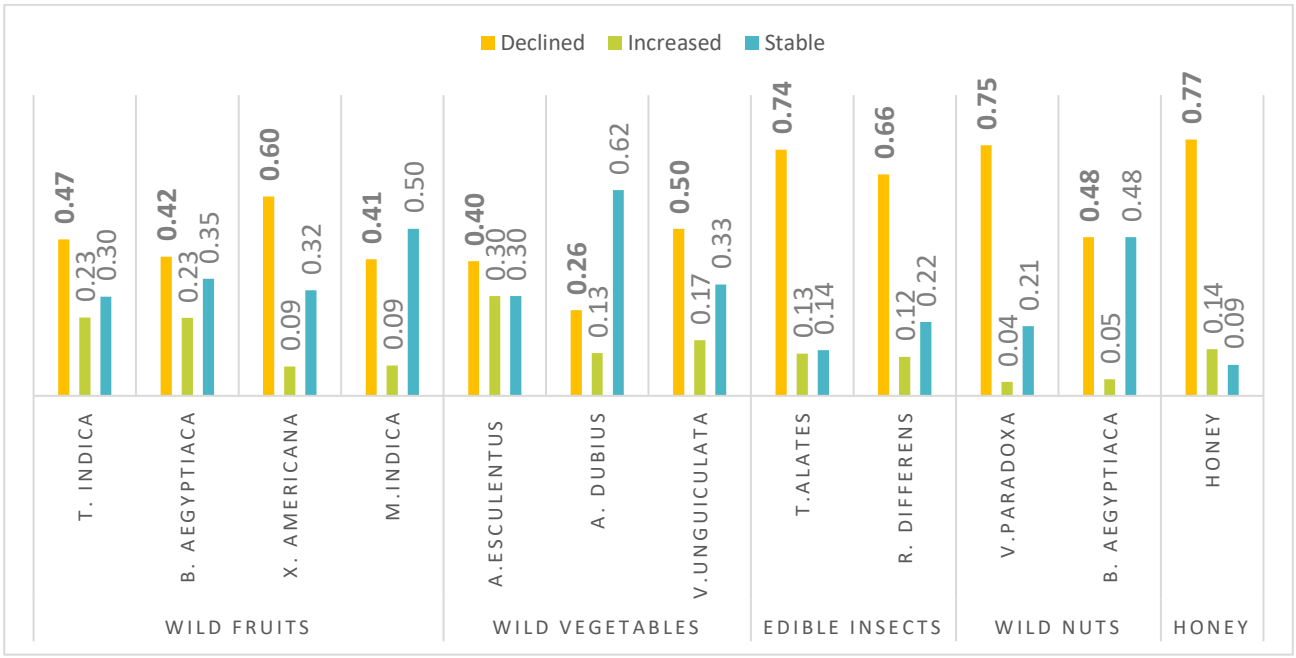


3.2.9 Perceptions of status in the wild

A common households' perception is that availability of some wild product categories has declined Figure 13)**.** On a yearly basis, hundreds of kilograms of wild food are collected**.** Within the study area, annual average harvested by collectors includes 134 kg of wild vegetables, 28 kg of termites, 13 kg of grasshoppers, 16 kg of *Balanites aegyptiaca*, 11 kg of *Tamarindus indica* and 9 kg of *Ximenia americana var caffra* Yet overharvesting was not cited as a reason for depletion, and harvesting practices observed appeared sustainable. Depletion in the wild is mainly due to other factors (environment/climate, refugees). In general, there were mixed perceptions on the availability of wild foods depending on product category. Perceptions of availability for the top wild fruits consumed for example are mixed, with a substantial portion (60 percent) citing the decline of Ximenia. There is a perception among host communities that other wild fruits and nuts have declined, such as *Vitellaria, Balanites* and Tamarind.

Focus groups revealed a general perception that the arrival of refugees has caused some resources, in particular *Vitellaria* (harvested for charcoal production) and *Balanites* to decline in availability. Generally speaking, there appears to be an abundance of wild greens/vegetables such as *Amaranthus dubius* and to a lesser extent *Abelmoschus esculentus*, with mixed views for osubi. . The same is true for grasshoppers and termites and some leafy greens (*Abelmoschus esculentus, Vigna unguiculata).* At the same time, unlike for woodfuel resources, there appears to be no conflict over wild food resources**.** Refugee households are aware of leafy greens, MAPs and edible insects, which can diversify an otherwise monotonous diet of mostly beans and maize. Focus groups with refugees also reveal that they often collect or count on bartering with host communities for these resources, but not all wild resources. Wild fruits and nuts, for instance, are largely considered "property" of hosts and are typically not gathered by refugees. Conversely, host communities have a large wild "supermarket" available, yet lack regular access to staples such as maize or oil, which they often obtain from refugees through bartering. Thus, the presence of refugees is also perceived as positive.

Figure 13. Households' perceptions of availability for different wild food categories



3.2.10 Opportunity costs of NWFP collection

A common assumption with reference to NWFPs is that too much time and energy is expended collecting NWFPs, making them not worth the effort to collect (Shackleton, 2014). We tested this hypothesis by asking respondents how much time they employ collecting NWFPs. By far, the categories that require most time expenditure and distance are hunting and fishing (on average 6-8 hours). Most plant-based NWFPs, however, are collected in the vicinity of households and require on average one or two hours to collect. Wild fruits and nuts resulted as slightly more time consuming and distant, but still less than reaching the closest markets (which were between 10 and 50 km), which would also require income. Table 9 lists the top wild gathered foods and number of hours spent collecting. The categories that require most time expenditure and distance are hunting and fishing. Most plants are collected in the vicinity of households and require on average one hour to collect. Wild fruits and nuts resulted as slightly more time consuming and distant, but still less than reaching the closest markets (which were between 10 and 50 km), which would require significantly more energy expenditure and income to purchase.

Table 9. Average time spect collecting

Rank	Local name	Scientific name	Average hours spent collecting
WILD VEGETABLES			
1	Sebika	*Abelmoschus esculentus*	1
2	Dodo	*Amaranthus dubius*	1
3	Osubi	*Vigna unguiculata*	1
WILD FRUIT			
1	Iti	*Tamardindus indica*	1.2
2	Lugba	*Balanites aegyptiaca*	1.2
3	Ochiki	*Ximenia americana var.*	1.1
WILD NUTS & SEEDS			
1	Lugba	*Balanites aegyptiaca*	1.3
2	Komoro	*Vitellaria paradoxa*	1.9
3	Wekee	*Borassus aethiopum*	1.2
TERRESTRIAL MEAT			
1	Opeh	Numida Meleagris	4.2
2	Kabo	*Kobus kob* thomasi	5.1
3	endiringa/indiringa	*Madoqua spp.*	5.3
AQUATIC MEAT			
1	Foro	*Oreochromis niloticus*	3.2
2	Asse	*Clarias catfish spp*	3.6
3	Doko	*Synodontis afrofischeri*	3.4
MEDICINAL AND AROMATIC PLANTS			
1	Pilopilo	*Capiscum s.*	1.1
2	Kilikili	*Cassia obtusifolia*	1
3	Ezekize	*na**	1
WILD MUSHROOMS			
1	Idiliri	*Termocytes sp.*	1.3
2	Lidu	*na*	1.1
3	Idrika ika	*na*	1
EDIBLE INSECTS			

1	Una	*Termites alata*	1.43
2	Isse	*Ruspolia differens*	1.98
3	Changa	*na*	1.56
HONEY & ASSOCIATED PRODUCTS			
1	Honey	*na*	3.4

**na = not available*

Related to to this, it is important to consider that in Uganda, one-third of the population lives on less than USD2 (UGX 6 000) per day (Uganda Poverty Assessment, 2016). In Yumbe district, only 27 percent of households depend on earned income, most rely on subsistence farming. Considering that on average the time spent gathering grasshoppers (just 2 hours, Table 9), for instance, and the potential economic benefits from sale (100g of grasshoppers accrue to between UGX 1 000 and 2 000 UGX), it is easy to see that that the returns are well worth the while. This of course is dependent on market access and demand from consumers with high purchasing power, as well as addressing bottlenecks to commercialization (section 3), although this is true of all products in general (including agricultural).

The benefits of gathering also include important micronutrient intake. A key data gap to be able to assess the relatve contribution of all the foods reported in the study area is the availability of nutrition composition information (HLPE, 2017; Stadlmayr, 2012), and factors related to bioavailability. This information is both vital for the integration of these foods in nutrition interventions and policies, as well as for product development (Egan, 2007). Table 10 illustrates the nutrition composition for selected nutrients of some of the key products collected, for which information is available. Although harmonzing this data is beyond the scope of the study, the table illustrates that many of these wild products are also important sources of micronutrients.

The Ugandan diet is typically poor in micronutrient-rich crops (FAO, 2010). Findings from this study also demonstrate a lack of protein intake (limited to 1-3 times per month). Dietary deficiencies can cause serious helath problems such as anaemia, incresed morbidity and mortality, stunted growth and impaired physical and cognitive development (Anderson *et al.*, 2011). These wild products become vital from the perspective of micronutrient and protein intake (unsuprisingly, less so from the perspective of calories and energy). This was also observed in Zambia and confirmed by key informants (Bertha Kaumba, government extension agent for nutrition, 2018). Table 11 shows the estimated contribution to the Recommended dietary allowance (RDA) of the wild foods selected (which are those for which nutritional composition data is available, at least in part. Termites and grasshoppers, for instance, when collected, contribute up to 62.5 percent and 35 percent of the RDA respectively. Considering they are one of the few sources of protein available in the study area, loss of access to these resources can also afffect health. Similarly, *B. Agyptiaca* and *T.indica* contribute important amounts of potassium, zinc, vitamins and dietary fibre, with tamarind contributing up to 58 % of RDA for Zinc. The obvious limitation here is that supply is not constant; based on the estimated number of times families collect these products (Table 11), these products individually contribute sporadically to RDA. On the other hand, taken aggregately, seasonal calendars (Table 8) demonstrate there is year-round availability of these foods, suggesting that at least one wild food resource is likely to be in season at any given time during the year and to be contributing to RDA for certain macro and micro nutrients.

Table 10. Nutrition composition for select NWFPs

Nutrition composition data												
Scientific name (references)	**Food name in English**	**Energy (kcal) kJ)**	**Protein (g)**	**Fat (g)**	**Carbohydrate available (g)**	**Fibre (g)**	**Vitamin C (mg)**	**Calcium (mg)**	**Iron (mg)**	**Magnesium (mg)**	**Potassium (mg)**	**Zinc (mg)**
Balanites aegyptiaca	Desert date, fruit, dried	(307) 1300	4.2 ± 3.3 (1.2–7.2)	0.6 ± 0.6 (0.1–1.2)	68.6	5.3**	/	164 ± 132 (87–362)	13.8 ± 6.0 (5.3–19.2)	44 (17–74)	1110	1.77 (0.98–2.65)
Tamarindus indica	Tamarind, fruit pulp, ripe, raw	(275) 1160	3.6 ± 1.1 (2.4–4.5)	0.8 ± 0.4 (0.4–1.2)	60.4	6.0 (4.3–7.7)	15.5 (11.3–19.7)	192(166–217)	3.1±1.6 (2.1–5.0)	66(38–94)	933(897–970)	3.1
Termites alate (Roasted)	Termites	595	38.3	46.9	6	5	/	91	35.2	/	/	14.8
Ruspolia differens	Grasshoppers		43.1 percent	48.2 percent				27.4	16.6			14.9

Source: Honfo *et al.* 2014; Stadlmayr, 2012; Harvest Plus, 2012; Kinyuru *et al.* 2010.

Nutrisurvey was used to test the degree to which these products were contributing to Recommended Dietary Allowance for select nutritients. As aforementioned, there were limitations to this exercise due to the poor availabiltiy of nutrition composition data for the wild products selected. Aggregately, the exercise shows that these foods are contributing to filling the micronutrient gap, but on a per item basis contributions to RDA remains low. Estimated edible portions were calculated per product type and furthermore divided among average number of household members (6.7).

Table 11. Contribution to Recommended Dietary Allowance for select NWFPs

Food description	Average quantity collected during daily harvest (HH)	Average number of times per month collection occurs	Estimated contribution to RDA per household member
Termites *(macrotermes sp.)*	1050g	3.7 times/ month	62.5 percent of protein; 54.5 percent fat; 28.7 percent Vitamin B2; 35.6 percent Vitamin B6
Grasshoppers (*Ruspolia differens)*	840 g	3.8 times /month	35 percent protein; 12.7 percent potassium
***Balanites aegyptiaca* (*desert date*)**	1.3 kg	2.73 times/ month	24 percent energy; 12.9 percent protein; 26 percent dietary fibre; 46.6 percent potassium; 37.2 percent zinc
***Tamarindus indica* (tamarind)**	0.92 kg	2.92 times/month	9.3 percent protein; 26.2 percent dietary fibre; 58 percent Zinc; 20.3 percent Vitamin C; 27.9 percent Magnesium; 27.1 percent Iron

Generally speaking and based on these economic and health benefits, it is easy to see the contributions of gathering to at least supplement incomes and diets. One must also take into consideration the opportunity cost of engaging in certain activities. It is said that wild food collection increases during lean times; to some extent this is obvious because more time is available to engage in collection. In addition, these statements also need to be viewed in context. For instance, keeping in mind that, with the exception of edible insects, wild meat and fish are sometimes the only source of animal protein, we assume that, in the absence of alternative economic activity or sources of animal protein, the time expended fishing and hunting is still worth while; a more in-depth dietary assessment (e.g. Golden *et al*., 2011) would need to be undertaken to calculate the impact of removing this source of wild nutrition would have on nutrition in the study area.

3.3. Prospects for "ento-economies" in the West-Nile sub-region? A closer look at edible insects and apiculture value chains

This section takes looks at the NWFPs which ranked highest in terms of consumption and collection to understand the degree to which these products can realistically contribute to livelihoods; three out of the top four of these happen to be obtained from insects – namely termites, grasshoppers and honey from bees – hence the focus of this section is on prospects for "ento-economies." Given the value chain focus, the assessment was extended to the neighboring and more populous Arua district.

3.3.1 Introduction

NWFPs obtained from insects supplement diets and livelihoods in many countries around the world. Entomophagy, or the consumption of insects, is practiced by an estimated 2 billion people across the world mostly throughout Africa, Asia and Latin America (FAO, 2013). Western honeybees produce 1.6 million tonnes of honey per year (FAO, 2019), also providing pollination services which support numerous important food crops that feed and nourish billions. The total economic value of insect pollination worldwide is estimated at €153 billion, representing 9.5% of world agricultural output in 2005 (Gallai *et al*., 2009).

In Uganda, the most commonly consumed insects are termites (Macrotermes spp.) and grasshoppers (*Ruspolia differens)* (Raheem, 2018). Grasshoppers in particular are considered a delicacy throughout urban areas of Uganda where they are common "snack foods", and also constitute regular parts of the diet when in season in rural areas. Bees and beekeeping-related activities also have a relevant socio-economic dimension: the West-Nile is known to be a primary honey-producing area, yet the degree to which honey contributes to improving livelihoods and health remains uncertain. On a national scale, honey production is believed to still be largely untapped, with only 1 percent of an estimated potential 500 000 tonnes of honey harvested per year (Amulen *et al*., 2017). Like many NWFPs, challenges to sustainable and viable commercialization remain a major issue for these products, especially in the Northern part of the country.

While demand for both edible insects and honey is said to outstrip supply (Odogno *et al*., 2018; Amulen *et al.*, 2017) prospects of fully-fledged "ento-economies" that can make significant contributions to livelihoods and nutrition/health in rural areas, particularly in the West-Nile sub-region, is under-researched. Only a handful of studies examine commercialization prospects of insects, and most are concentrated in more urban and semi-urban areas such as around Lake Victoria Basin where *Ruspolia differens* was found to be the most commercialized edible insect (Odongo *et al*., 2018). Analysis of honey value chains has been subject to greater study, although value chain studies in the West-Nile sub-region are limited. This section examines insect-based consumption, demand and collection practices in the West-Nile region of Northern Uganda (namely honey and grasshoppers) to try to quantify contributions to livelihoods and nutrition/health, and assess associated prospects and opportunities. It also attempts to preliminarily appraise key bottlenecks to developing the sectors, and threats to sustainability.

Findings from the household surveys and focus groups in Yumbe and Arua reflect national tendencies with regards to main insects consumed: grasshoppers and termites are the most consumed and in demand edible insects in the sub-region, both featuring among the top 10 NWFPs consumed. Honey ranks first as the most important product. Households consume up to 28 kg of termites and13 kg of grasshoppers annually, and collectors gather up to 10

sacks/day (330 kg) to sell in rural markets. However, little value addition exists and rarely is there processing to prolong shelflife; distant markets and fluctuating harvests (mainly due to habitat loss) combine to create significant impediments for fully-fledged ento-economies in rural Uganda. Findings moreover reveal that although barriers to consumption do not exist (there is a strong cultural tradition of consumption and there is indeed high demand), the availability of the insects concentrated in just a few months limits their ability to make a substantial contribution to improved nutrition and livelihoods. Instead they are among a large basket of wild foods that do however contribute aggregately to improved nutrition. Domestication and nutrition-smart processing and packaging and organization of collectors into cooperatives could however improve prospects for commercialization. Greater sensitization on the nutritional benefits could also result in increased consumption among collectors and their families, who tend to sell most of their harvest (focus group discussions, 2019).

3.3.2 Background: sustainable and viable commercialization of NWFPs

During their “honeymoon period” and in particular after the United Nations Conference on Environment and Development (UNCED) in Rio de Janiero (1992), NWFP commercialization was viewed as a simple solution for conservation and improving local livelihoods (Belcher & Schrekenberg, 2007). Over the years, critics were quick to highlight the risks of NWFP commercialization, including dispersed, poorly developed, diverse and “faddish” markets, long product development, limited scope and value of markets, high barriers to entry e.g. sophisticated technology, market and certification requirements, intellectual property rights issues, intensive harvesting and consequent resource depletion, (Shanley et al, 2002; Belcher & Schrekenberg, 2007). Homma (2012, 2014) describes the susceptibility of extractive resources as having “boom and bust cycles” (Homma 2012 and 2014). Put simply, the natural trajectory for NWFPs tends to be a steady increase in demand and consequently harvest, followed by a decline in the resource base.

NWFP commercialization has undoubtedly resulted in unintended consequences. Indeed, many NWFPs do experience “boom” cycles and run the risk of overexploitation, inadvertently becoming a threat to the conservation of the resource base (Homma, 2014). Moreover, overharvesting often results in ad-hoc or “reactive” policymaking (Laird 2011) – which is not conducive to effective management and conservation of NWFPs in the long-run. Increased incomes may also have a negative impact on nutrition in poor rural households, as it is now well-established that rising incomes tends to lead to more unhealthy diets and increased consumption of fats, oils, sugar, animal-based products and processed foods (Guyomard *et al.*, 2012). Additionally, commercialization has been shown to “trade away important traditions” and adding value much higher up in the supply chain at the processing stage and thus excluding smallholders, especially women, from benefits (Wynberg *et al.* 2012).

Opinions on improving the odds of successful NWFP commercialization are mixed. On the one side, there is the argument that domestication, intensive management or the discovery of synthetic substitutes is the only path for extractive products of significant economic importance (Homma, 2012). Others are less sceptical, positing that although there are no “magic bullet products”: conducive national policies, product differentiation, a better understanding of and access to markets and improvements in product quality are all opportunities for encouraging NWFP commercialization (Belcher & Schrekenberg, 2007). Undoubtedly, the limited perceived value of NWFPs coupled with lack of economic and

nutritional information (and in turn, low demand) has contributed to associated market failures common to various NWFPs (DeCaluwe, 2012).

Lessons from the past three decades suggest there is no one-size-fits all strategy for marketing and commercialization of NWFPs. Marketing pathways typically can be summarized as follows: through mass-production (e.g. cork), niche-products with high value addition (e.g. “super foods” such as acai or moringa) and increasingly, NWFPs as “bundles” or complementary products or services marketed as part of larger forest packages (Pettenella et al; 2007; Juang et al, 2017). In a study by Spake *et al.* 2017, surveyed certification bodies (organizations in charge of auditing forest operations), organizations that support forest owners interested in certification, and forest owners themselves saw potential in certifying NWFPs and cultural ecotourism as a “bundle”, based on complementary aspects of the management of the ecosystems that generate both of them, and the existing skills and experience of certified forest managers and their support networks (Juang *et al.* in FAO, 2017). Marketing NWFPs as complementary products and services, for example through territorial marketing, has been a relatively successful strategy in Central and Southern Europe where NWFPs such as mushrooms, truffles and chestnuts have been marketed as part of a broader “forest package” (EU Innovation project, 2019; Pettenella, 2007). On the other hand, product differentiation and specialized NWFPs and services oriented towards niche markets, including high-end niche consumers, offer alternative opportunities to improve livelihoods of NWFP collectors. Acai products from Amazonia are just one example; natural honey from Zambia and Uganda might also fit within this domain. In Europe, interest in wild products is re-emerging with products of “nature-oriented” management systems increasingly being sold as nature or wilderness products in niche product markets (Wiersum, 2017). Lessons and experiences from countries regardless of development status suggest that there is no ideal model for NWFP commercialization particularly because of the vast array and end uses of products. With the exception of some mass-produced products like cork or bamboo, most NWFPs might realistically be viewed as part of broader livelihood and nutritional diversification strategies.

This section focuses on insect-based NWFP value chains, understood as the full range of activities required to bring a product or service from conception, through the different phases of production through delivery to final consumers (Kapinsky & Morris, 2000), to try to obtain a realistic picture of the degree to which selected products are contributing to livelihoods in the study area and prospects for commercialization. In most developing countries, not least Uganda, agriculture and food tends to represent the largest part of the economy particularly because of the number of people deriving an income from it and food value chains are thus strategically important in national and global politics (FAO, 2014). According to FAO (2014), a sustainable *food* value chain is one that (1) is profitable throughout all of its stages (economic sustainability); (2) broad-based benefits for society (social sustainability); and (3) has a positive or neutral impact on the natural environment (environmental sustainability). For reasons mentioned in section one of this thesis, most NWFPs fall under the category of underutilized species, which according to Gruere (2006) require three necessary conditions for successful commercialization: demand expansion, increased efficiency of supply and marketing channels and a supply control mechanism (i.e. differentiation from substitutes, which as aforementioned have historically been responsible for numerous NWFP market failures). Given that this reasearch it is one part of a larger study going beyond value chains, a “rapid” value chain analysis was carried out and results are presented in this section.

3.3.3 Honey and bee-product value chains in the West-Nile sub-region

Honey and other relevant apiculture-related value chains in the West-Nile sub-region are described and analysed below.

a. Description, ecology and distribution

The West-Nile agro-ecological zone is the largest honey producing zone of Uganda (Figure 14). It is estimated that some 84 320 kg are produced annually in the region (Amulen *et al*., 2017). Common crops grown are finger millet, maize, sesame, cassava, sorghum, tobacco, soya beans, pigeon peas and cow peas, in addition to tobacco which is the major cash crop and livelihood for most of the population in the district (UBOS, 2017; FAO & OPM, 2018; Amulen *et al.* 2018). Farming these crops, especially tobacco, has exposed apiaries to pesticide contamination, which is relatively unregulated in Uganda (Amulen *et al.* 2018). This poses challenges to marketing honey and beeswax as organic – with recent studies detecting at least 20 pesticides in honey and beeswax samples, particularly in proximity of citrus and tobacco farms. There is growing demand for domestic consumers (mostly a growing middle-class in urban areas) as well as international demand for “clean” honey, which presents opportunities for Ugandan beekeepers, providing they have access to information on national and international quality standards and associated best practices (Bradbear, 2019, personal communication; Kilmo Trust, 2012).

Another threat to apiculture is large scale land-use that can reduce floral abundance and species richness and negatively affect bee species populations through nutritional shortage in both quantity and quality of resources (Vaudo *et al.*, 2015). It is estimated that some 80 percent of indigenous flowering plants in Africa benefit from honeybee pollination, with approximately one-third of all food produced a result of commercial honey bee pollination (BBC, 2019). The current massive loss of vegetation in northern Uganda (FAO & UNHCR, 2017; FAO & World Bank, 2018) could potentially affect honey production in the medium to long-term if the trend is not reversed.

Figure 14. Honey producing areas in Uganda

Source: Kilimo Trust, 2012.

b. Health benefits

Honey is sometimes referred to as a "nutraceutical" because of its nutritive and therapeutic benefits. Yet health benefits of honey vary vastly and largely depend on agro-ecological zone, bee forage (nectar and pollen nutritional quality varies among host plant species) and even species (nutritional requirements may vary) (Vaudo *et al.*, 2015). Honey is typically composed of mostly sugars and water, several vitamins, amino acids, antibiotic-rich inhibine, proteins, antioxidants and micronutrients (in small quantities). It can also be a source of calcium, copper, iron, magnesium, manganese, phosphorus, potassium and zinc. It has been suggested that feeding honey to infants can improve memory, growth and reduce anxiety; honey also has recorded medicinal properties, beneficial for people suffering from aneamia; positive metabolic health and cardiovascular effects, antiseptic properties, and anti-microbial activity (Ajibola *et al.,* 2012). In Uganda, honey is consumed for its medicinal value, as a substitute for sugar and in some communities as an ingredient in porridge (enturire); it is also a delicacy at wedding ceremonies in rural communities (Kilmo Trust, 2012). Findings from this study confirm the main motivation for honey consumption is medicinal/health.

c. Overview of honey use in the study area

Honey ranked second among the top NWFPs consumed by surveyed households in Yumbe, and first in the focus group discussions, suggesting it is among the most important products harvested. Similarly, findings from focus groups (n=159) in neighbouring Arua and Moyo conducted in an ICRAF/FAO study found honey ranked first among the top 10 important wild products (ICRAF & FAO, 2019). 63 percent of all households reported consumption of honey in Yumbe, with 50 percent directly involved in beekeeping activities. The average

quantity of honey collected among these is 8.5 liters (≈8.5 kg) annually, typically harvested during the seasons of January/February, May/June and September. This is still far below potential productivity levels of 15kg, 26 kg and 60 kg per hive per season for traditional, Kenyan Top Bar and Langstroth hives respectively (Kilmo Trust, 2012). 16 percent of all households surveyed reported selling honey harvested, mostly in raw form (combs, typically unfiltered, including bee brood) all within the sub-region. Key informants reveal that, contrary to other honey producing countries in Africa like Zambia which exports much of its honey to the European Union, there is high domestic demand for honey in the country, supported by Uganda's burgeoning middle class (Bradbear, personal communication, 2019).

Traditionally in the West-Nile sub-region, the hollow bark of the *Borassus* palm is used for honey production; it can be seen in wide use throughout Yumbe and Arua Districts. Woven grass hives are also used, but less frequently. Some beekeepers in the study area have organized into cooperatives, through which they receive access to equipment such as top-bar hives, but this has not come without challenges. Beekeepers from a cooperative in Maroba village, Kululu sub-county, for instance, describe that equipment is sometimes delivered through NGOs or larger organizations, but often it comes without training or protective gear and smokers. There are also mixed opinions about the sustainability of the different hives. The general messaging from many NGOs, some international organizations and bigger honey producers is that local log hives can be unsustainable because of damage imparted to trees. Key informants (TUNADO, Bees for Development) contend that KTB and the Langstroth hives used in western beekeeping, however, can in certain contexts be even more unsustainable, with questionable sourcing and without the use of local labour hence with no or limited impacts for local economies (Bradbear, personal communication, 2019). Undoubtedly there are advantages and disadvantages to using traditional (Picture 4), KTB and Langstroth hives, which range from affordability to yields and management (Table 12).

Table 12. Advantages and disadvantages of traditional, KTB and Langstrogth hives

	Traditional Hive (borrassus palm, woven grass hives)	Kenyan Tob Bar (KTB)	Langstroth
Advantages	• Made from inexpensive and locally available equipment, thus potentially room for more hives production • Local manpower employed in construction of hives • Low skill set needed for management • Can easily own dozens of hives (sometimes in the hundreds)	• Fair yield (up to 26kg/hive) • Local manpower employed in construction of hives • Easy inspection and bee-friendly management	• Typically higher yielding (up to 60kg/hive) • Easier hive inspection and management • Contains queen excluder (simplifies extraction of "clean" honey • More durable
Disadvantages	• Low yields (maximum 15 kg/hive) • Shorter life span of hive • Difficult to inspect and manage hive	• Can be expensive • Combs have a tendency to break • Tendency for bees to abscond	• Both hive and extraction material is expensive • Sourcing of wood used to make hives not necessarily legal or sustainable • Often not produced in loco (poor local capacity for modern hive construction)

			• High rates of bees absconding • High skill set needed • Rarely makes economic sense in poor settings, often creating debt

Source: Adapted from Kilmo Trust, 2012.

Picture 4. Borrassus palm beehives in Romogi sub-county. © Giulia Muir

d. Valorization and markets for bee products.

On a national scale, different forms of honey are marketed and sold. These range from crude honey (including brood and dead bees), semi-refined (liquid honey which may contain particles of wax or debris), refined (strained), chunk honey (pieces of whole combs of capped honey, often sold together with liquid honey) and comb honey (honeycombs with white capping) (Kilmo Trust, 2012). Most of the honey observed in the area was crude or semi-refined; variants of chunk honey were also on sale (Picture 5).

Picture 5. “Chunk honey” on sale at Arua market for UGX 2000. © Giulia Muir

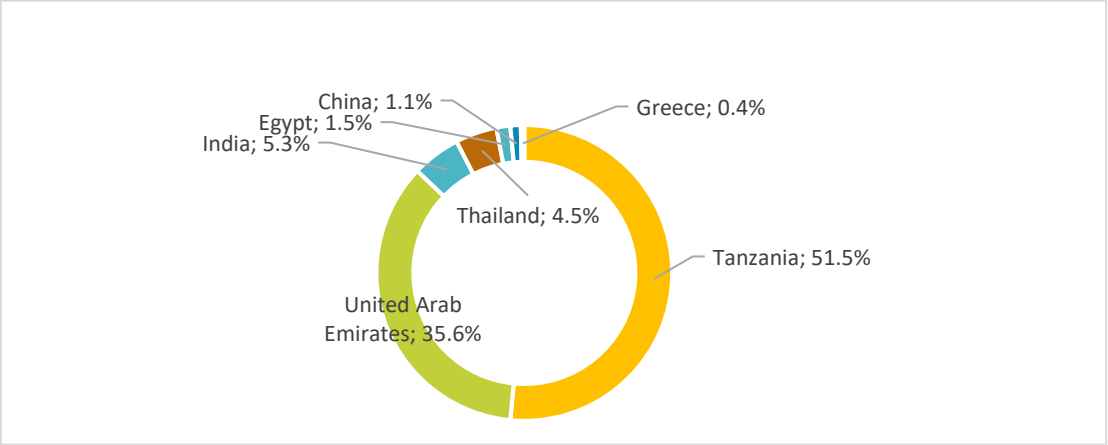
Other apiculture products sold on a national scale include propolis, beeswax, honey wine and to a lesser extent pollen and bee venom (the latter boasting particularly high profit margins, but never observed on sale or consumed in the study area). The main bee products observed in the study area were different forms of honey and beeswax (the latter only at processing facilities and never at the household level). One of the main processors of apiculture products in the West Nile sub-region, Bee Natural Products, reported production of beeswax mainly for baiting hives (picture 6); beeswax production was not reported by households sampled or beekeepers profiled during focus groups neither in Yumbe or Arua, suggesting this is a major untapped income opportunity.

Picture 6. Beeswax production at Bee Natural Products, Arua district (credit: Bee Natural Products)

Uganda is one of the five countries in sub-Saharan Africa (together with Zambia, Tanzania, South Africa and Kenya) licensed to export to the highly competitive EU market (Amulen *et al.* 2017). Demand and price are dependent on country of origin, level of processing and nectar sources (Bees for Development, 2016). Low domestic productivity and beekeeping adoption rates means Uganda exports only an estimated 5 percent of its honey, with the domestic market consuming the most of honey produced locally (Kilmo Trust, 2012). Key informants reveal that, contrary to other honey producing countries in Africa like Zambia that exports a large portion of its honey to the European Union, there is high domestic demand

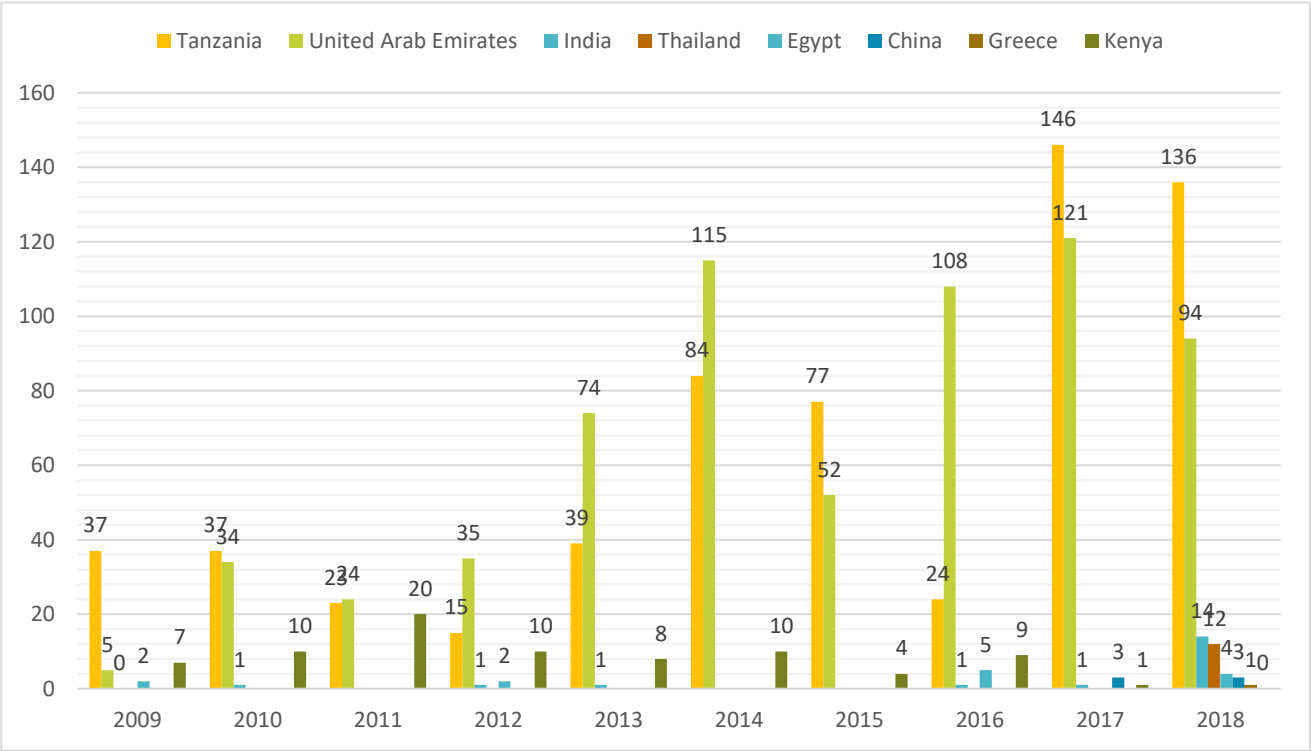
for honey in the country. This is confirmed by experts at Bee Natural Products, which claims to have halted honey exports due to high demand in the country (ICRAF & FAO, 2019). Interviews with local processors in Yumbe district confirm that honey is imported into the region from the Democratic Republic of Congo and Sudan to meet local demand. At present, most of the honey targeting middle and high income population is imported; this is largely because high income consumers prefer to purchase imported honey because it is not as "messy" and better packaged (Kilmo Trust, 2012). This factor, coupled with low production, has resulted in Uganda importing honey from countries as around the globe (Figures 15, 16 and 17). The main countries exporting honey into Uganda are Tanzania (136 tons/year) followed by the United Arab Emirates (94 tons/year), India (14 tons/year), Thailand (12 tons/year) and Egypt (4 tons/year) (ITC, 2019). According to expert interviews, there is huge potential to support local honey producers in view of Uganda's growing middle class by improving adherence to standards, packaging and processing methods (see more details within the session on SWOT analysis below) (Bradbear, personal communication, 2019).

Figure 15. Natural honey imports by Uganda: import quantity share by country of origin (2018)



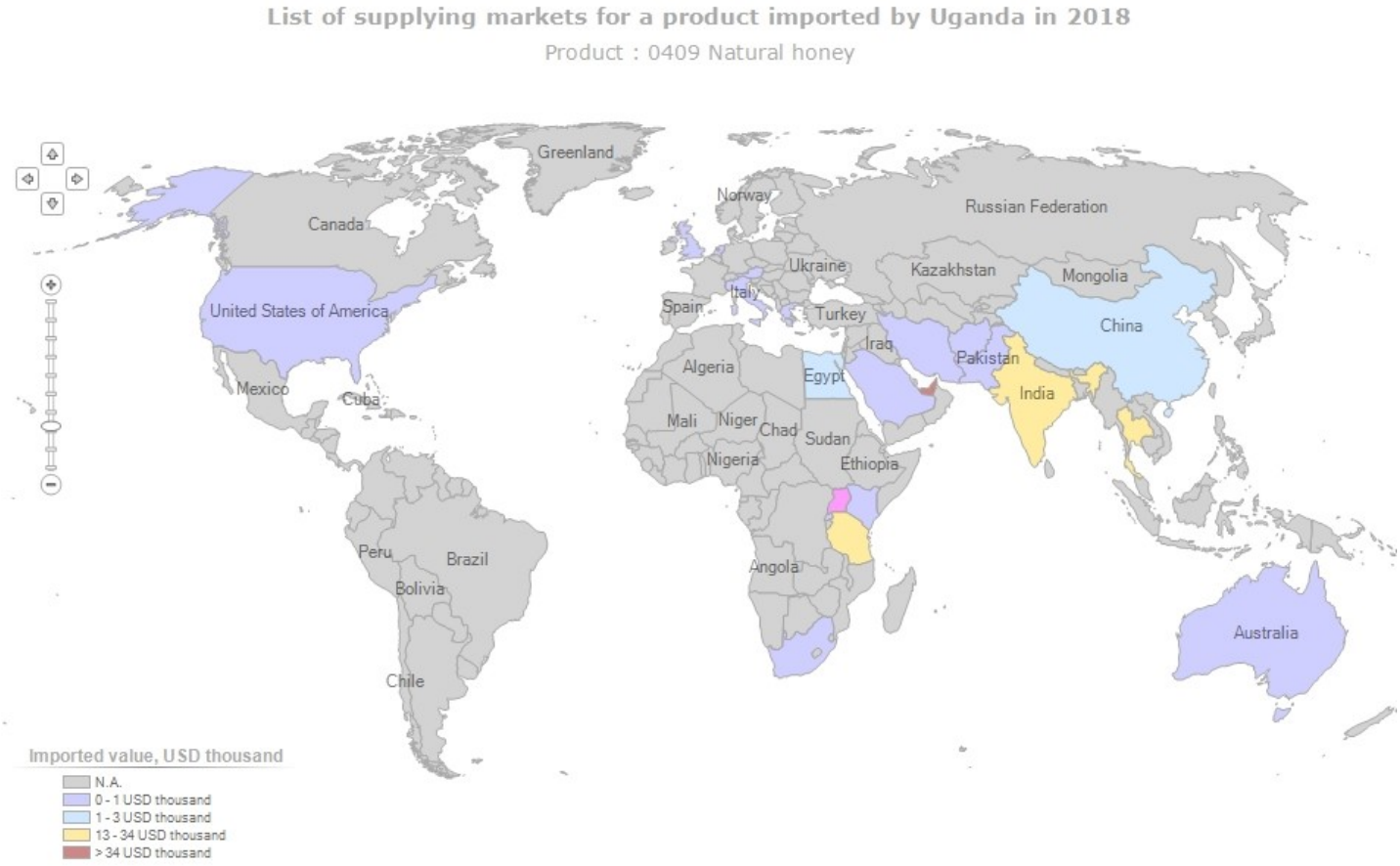
Source: Data extracted from ITC, 2019.

Figure 16. Natural honey imports by Uganda: import quantity (tons) by country of origin (2018)



Source: Data extracted from ITC, 2019

Figure 17. Countries exporting natural honey to Uganda



Source: Data extracted from ITC, 2019.

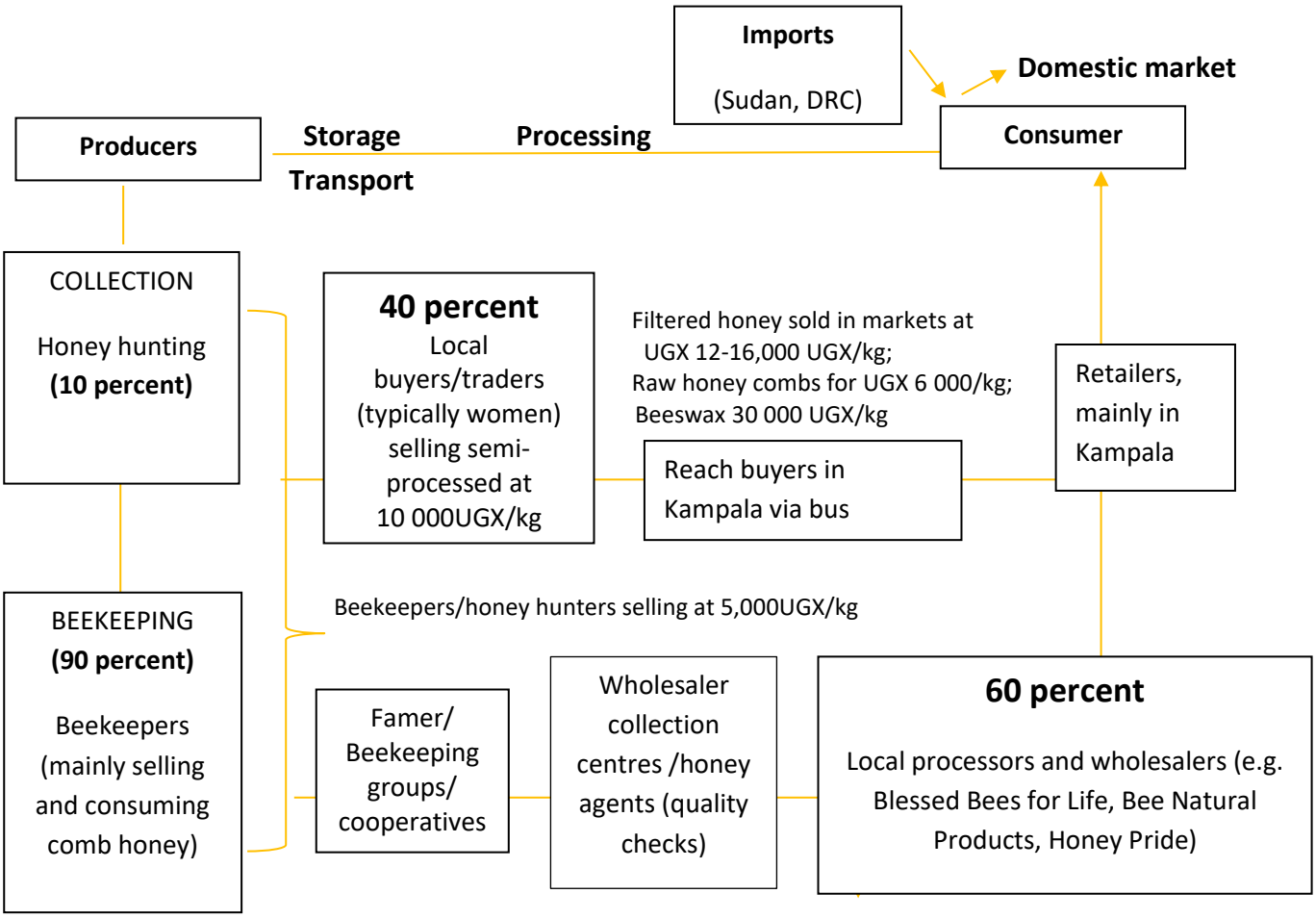
With regards the production to consumption system (Figure 18), information was collected from the main players in the area (Bee Natural Products, Blessed Bees for Life, Honey Pride) and TUNADO, the national umbrella organization which also collects information on beekeepers and processors throughout the country. The value chain seems to be formed mainly of beekeepers (occupying 90 percent of production), with wild honey collection representing only 10 percent of honey produced in the entire West-Nile region (TUNADO, personal communication, 2019). Of this production, about 60 percent goes to processors and the remainder to buyers/traders who sell the honey at local markets or to other traders in Kampala via the local bus service.

Bee Natural Products report that they purchase honey from local cooperatives and individual beekeepers (with whom they support with training, hive baiting and bee management) who drop off honey at collection centres throughout the West Nile (FAO & ICRAF, 2019). The first quality checks are performed at the collection centres and again at the wholesale head office where processing, batching, packaging and wholesale takes place. Due to long distances between processing units and hives (between 12-45 km according to focus groups) some processors send agents to the field to collect the honey.

Smaller but established processors also exist, including Blessed Bees for Life operating in Yumbe. The enterprise operates in a similar way, providing training in beekeeping for honey production as well as wax and propolis, largely untapped in the country. Honey is purchased directly from beekeepers, through the Kakwa beekeeping cooperative operating in the district, or via Yumbe District Farmers' Association, which also mobilizes farmers to participate training and diversifying income with beekeeping and building hive equipment. The enterprise also offers other "biodiversity friendly" services such as tree planting and waste management (i.e. use of sawdust from hive construction as bio-fuel to reduce pressure on forests). The beekeeping enterprise reported production of some 17 000 kg of honey in 2013 (Blessed Bees for Life, 2017).

Honey Pride, the third key processor in the Yumbe/Arua district areas, operates in a similar manner starting with quality checking for impurities such as dung and smoke, sorting light and dark combs, pressing, filtering and letting the honey settle for 30-60 days (but up to four months as a result of excessive smoking). Honey Pride typically offers a flat rate of up to 7000 UGX/kg to beekeepers and sells the processed and filtered liquid honey on local markets at about 20 000 UGX/kg. Beeswax production remains low (between 800-900 kg per year) as only about 15 percent of beekeepers harvest the wax (Honey Pride, personal communication, 2019).

Figure 18. Apiculture production-to-consumption system in the West-Nile sub-region



Source: Adapted from Belcher & Schrekenberg, 2007.

Like other animal-based NWFPs (edible insects, bushmeat), honey trade on local markets in Yumbe appeared more lucrative than the sale of raw plant material. Honey fetches for some 80 000 UGX per 5 litre container, corresponding to UGX 12 000-16 000 (USD 3.18-4.24) per litre. Honey combs (*anu horokoto)* can be found on sale for roughly half the price UGX 6 000 (USD1.59/kg). Beekeepers appear to make between 5 000-7 000 UGX per kg of comb honey, with buyers selling to other buyers at about 10 000 UGX, or to consumers directly at between 12 000 and 16 000 UGX after some degree of processing, accounting for up to three times more than what beekeepers receive.

Beekeeping tends to be a male dominated activity in Uganda, including Yumbe and Arua, although women are often involved in sales. Male beekeepers interviewed noted that beekeeping is “dangerous” for women. Beeswax, a high-potential bee product, was not easily found in local markets. A very small number of vendors in Arua reported having small stores of beeswax for sale, which they sell to large international companies who send agents to the area and collect the wax in bulk at between UGX 25 000-30 000/kg. Beeswax is in high demand in international markets for the cosmetic industry in particular and is sold at 4-5 times the price (raw) on the international market, but it does not have a local market, largely due to lack of knowledge and skills on harvesting beeswax and poor market access.

Many strengths and opportunities, but weaknesses and threats remain. In Uganda, there is strong institutional support for the honey and beekeeping sector. Uganda boasts a National Apiculture Development Strategy and has a national body – the Uganda National Apiculture Development Organization (TUNADO) – which supports information and awareness raising on the benefits of bee products and apiculture, research and development and bringing together relevant stakeholders to improve performance (Bees for Development, 2019). The Government of Uganda also has two statutory instrutments on apiculture: the Declaration of Bees as Animals Instrument (2004, No.72) and the Animal Diseases Instrument (2004, No. 73) on controlling Bee Diseases (Tunado, 2017). Important to note that different countries have different quality standards, but Uganda's National Residue Monitoring Plan for honey and bee products (NRMP), developed in 2005, has been instrumental in allowing producers/processors to export honey and beeswax to the EU, the United States, Japan and South Africa (Tunado, 2017; Kilmo Trust, 2012; ITC, 2019). Notwithstanding, production is well below potential, and only five percent of honey is currently exported.

There are also evident bottlenecks undermining the sector on a national scale which range from a decline in bee forage to poor uptake of beekeeping to hive management and processing weaknesses. Key bottlenecks emerging from focus groups in the study area (Table 13) included lack of adequate equipment and training, bees absconding or bee death from wildfires, inadequate storage facilities (re-used plastic containers, often not food-grade) and distance to markets – the latter was particularly evident in parts of Ariwa and Romogi sub-counties in Yumbe. A handful of beekeepers associated with the cooperative in Romogi sub-county were able to reach urban centers in Yumbe, where they reportedly dropped off their honey in appropriate storage equipment (e.g. buckets) provided by larger companies in the area. According to harvesters, awareness of market prices via mobile technology has improved income from sales, but only for the "lucky few" with facilitated access to urban markets via the local bus service; most engaged in roadside sales with frequent reports of honey fermentation. Several factors limit production, including access to market information, equipment, skills, bee diseases and forage availability. Poorly regulated pesticide use, particularly in proximity to cash crop farming, limits the potential of marketing Ugandan honey as organic. Uganda's export opportunity is said to lie in its potential to supply niche markets such as fair trade and organic where there are premiums of 10-30 percent above conventional honey prices (Tunado, 2017). There are also prospects for domestic market, as growing body of high-income Ugandans still tend to prefer imported honey which is deemed "superior" and "cleaner" (Kilmo Trust, 2012).

All beekeepers interviewed in Yumbe noted a decline in honey production in the past year, which was attributed to climatic conditions, pests and agro-chemical contaminants (e.g. insecticides, fungicides). Interestingly, focus groups in the neighbouring Arua districts found a reported increase in honey production by beekeepers. This was attributed to an increase in the number of hives available over the past five years, as previously most honey was collected through "honey hunting" (wild hives). The extent to which production has been affected by a reduction in availability of bee forage as a result of degradation of the natural ecosystem (FAO & OPM, 2017) is unknown but worthy of further investigation.

Table 13 reports the results of the SWOT analysis conducted with reference to bee products value chain in Yumbe District.

Table 13. SWOT Analysis of the bee products value chain in Yumbe District

Strengths	**Weaknesses**
• Institutional support for honey and beekeeping sector (Uganda National Apiculture Development Organization-TUNADO; National Apiculture Development Strategy; National Honey Export Strategy) • High domestic and regional demand • Widespread traditional knowledge of beekeeping using local hives • Good availability of bee forage • Low application of medicine and chemicals to treat bees, resulting in "cleaner" honey most honey available on the international market (particularly from the EU, North America) • Health/medicinal properties • High success as a livelihood diversification strategy	• Inadequate/rudimentary processing and storage methods • Lack of equipment and access to training (e.g. beeswax extraction, skill building in entrepreneurship, marketing) and inputs and services (e.g. financial support) • Poor organization of beekeepers (i.e. into cooperatives) • Distance to markets • Instable supply of honey due to bees absconding or inadequate skills particularly with modern beehives
Opportunities	**Threats**

• Improved incomes through:
  • Labelling/certification in line with Ugandan Bureau of Standards, among others (facilitated through TUNADO)
  • Organization of harvesters/producers for better access to markets
  • Marketing and trade of beeswax, currently untapped (and with fewer quality controls than the food industry).
  • Untapped propolis production.
  • Access to market information (e.g. prices) via mobile technology
• Incentive to conserve forests (increased value of standing forest)
• Improved health (e.g. antiseptic, anti-microbial activity)
• Interest in development/international community in beekeeping projects
• Modern beekeeping techniques perceived as "less dangerous" and increasingly seeing the involvement of women and disadvantaged segments of society
• High biodiversity (potential bee forage)
• Indirect benefits for food production from pollination
	• Possible forest degradation in the Yumbe area due to agricultural policies oriented towards cash crop farming and refugee influx might affect availability of bee forage in the long-run
	• Persistence of wildfires
	• High barriers to market entry (e.g. difficulty adhering to standards, strict quality controls)
	• Erosion of local and sustainable beekeeping methods due to the "push" for modern beekeeping
	• Insecure tenure (keeping bees requires access to use/ownership of land)
	• Lack of enabling environment and conducive policies in support of beekeeping

Source: author's own elaboration

3.3.4 Grasshopper *(Ruspolia differens)* value chains

a. **Description, physiology and distribution.**

The edible grasshopper *Ruspolia differens* is a slender grasshopper (30-42mm), with a slanted face and a longer than wide cone narrowing from base to apex. It may be solitary or forming high-density seasonal flying swarms in May and November-December in Eastern Africa, during peaks of rainy seasons following dry seasons (Nyeko, 2018; Ng'ang'a *et al.* 2018). It is common in open grassland habitats, on the edge of forests and at road sides (Malinga *et al.*, 2018).

b. **Health benefits.**

Ruspolia differens are known to be rich in protein (37 percent), fat (48.2 percent) as well as several minerals (Potassium, the most abundant), as well as phosphorus, calcium, iron (the most abundant trace mineral) and zinc. Its oil also has high amongs of polyunsaturated fatty acids (Ssepuuya *et al.*, 2017). Microbiological data of edible insects including *R. differens,* particularly along the value chain, however, is lacking (EFSA Scientific Committee, 2015) and a key impediment to export, in addition to seasonality and perishability issues (Nonaka, 2009). One study in Tanzania found high microbial counts in raw samples of *R. Differens,* but a statistically significant reduction in all cuonts after processing (Ng'ang'a *et al.* 2018). The same study did not detect almonellae, *Listeria monocytogenes*, and *Escherichia coli* after processing.

c. Overview of grasshopper use in the study area.

Household survey results indicate that edible insects such as termites (*Macrotermes sp.),* also referred to as “white ants”, and grasshoppers (*Ruspolia differens*) are by 84 percent of households. Grasshoppers specifically were consumed by 66 percent of households. Collection and consumption of edible insects appears to be concentrated in May and June (termites) and November and December (grasshoppers). Other types of insects are also collected (e.g. crickets), but less frequently. On average, households collect 28 kg and 13kg of termites and grasshoppers respectively each year. Although termites were the top insect consumed in the study area, the value chain analysis focuses on grasshoppers because termite collection, is predominantly for home consumption; sale is mostly as a snack street food, often sold directly by collectors or family members; and that other uses such as medicinal, construction and feed were not observed in the study area and include domains which are beyond the scope of this study. Grasshoppers moreover appear to have greater market potential due to the volumes being collected, promising rearing attempts (Odongo *et al.*, 2017) and successful value addition experiences (e.g. into flours). *Ruspolia differens* is typically consumed either boiled, raw, sun-dried, deep-fried, toasted, smoked and flavoured with onions, or used to make a soup, and is considered a tasty and nutritive delicacy (Odongo *et al.,* 2017; Ng'ang'a *et al.* 2018). It is consumed both as a snack or cooked together with other vegetables such as peas and beans.

d. **Valorization and markets for grasshoppers.**

The global market of food products containing insects range from snacks (e.g. protein bars), to sauces and seasoning, bakery, alcoholic beverages to confectionery, most often in the form of powder/flour, and extracts, but also available whole, dehydrated and dry (Government of Canada, 2018). According to the agriculture department of Canada, 103

insect-containing products were launched around the world between 2004 and 2018 (Government of Canada, 2018). Snacks constitute almost half of these products, with sauces and seasoning being the second most popular category. Most relevant insect ingredients were crickets and cricket flour – used mainly for snacks, cereal and energy bars – and grasshoppers and silkworms, used for protein snacks. The growth of the cricket market is primarily due to its high nutritional value, ease of processing and farming, and ease of integration into food recipes and products (Government of Canada, 2018; Reuters, 2018).

Official global statistics on edible insect production are unavailable, as most insects are traded informally. Thailand is the only country that has detailed customs codes on edible insects, likely because its long history of consumption and collection and its established cricket farming industry. Updated values for Thailand imports of prepared insects are available through the Thai customs department, which provides volume and value for house crickets, grasshoppers, bamboo caterpillars and other insects. It has been reported that about 800 tonnes of edible insects are annually imported from Cambodia, Myanmar, Lao PDR and China to Rong Kluea market (Ratanachan, 2009.). The top five imported insects are silkworm pupae, ground crickets, leaf-eating grasshoppers, mole crickets and giant water bugs (FAO, 2013). Declared imports for prepared insects in 2018 reached USD 812 000, with the value of the entire import market estimated at over USD one million in 2014 alone.

Unsurprisingly, official statistics on edible insect production/trade from Uganda are unavailable, yet a number of studies exist demonstrating the high market value and domestic demand for grasshoppers in particular (Odongo et al., 2018; Okia et al, 2017; Van Huis, 2017; FAO, 2013). Odongo *et al* 2018 report that the large majority of traders in the Lake Victoria Basin area (42 percent) sell harvest with no form of processing; 26 percent sun dry harvest; this is followed by salting (12 percent) and roasting (9 percent). Refrigeration was only practiced by 7.8 percent. Most of the harvest observed in the study area was also limited to primary forms of processing (washing, removing appendages), although most of the produce observed was sold raw.

In the study area, grasshoppers have traditionally been collected and sold by women and children, but men have gained interest due to the market value. Men often are responsible for transporting surplus after home consumption to more urban centres (e.g. Arua) where demand and prices are higher, particularly for value added processing such as drying, roasting, salting and storage; this was also confirmed elsewhere in Uganda (Odongo *et al.* 2018). Expanding access to artificial light sources has made it possible to collect the grasshoppers at night with relative ease (FAO, 2013; Ng'ang'a *et al.* 2018; personal communication, 2018). Key informants revealed that men have developed a technique of connecting bright lights and are able to collect grasshoppers in large amounts. Most of those surveyed in the study area, however, collected for home use; excess harvest is sold in the area along roadsides or smaller markets, and typically in raw form. More established wholesalers and retailers do exist in other parts of Uganda (e.g. Lake Victoria Basin), as documented by Odongo *et al.* (2018), however the value chain observed in Yumbe appeared short and rudimentary. Consumption and marketing have remained largely local and traditional in nature using conventional methods (deep frying, toasting and smoking), with minimal value addition (limited to washing and plucking of appendages, as observed in markets in Arua). Some collectors reported frying and extending shelf life up to two months using soda ash, but only for home consumption.

High demand and potential particularly for niche, high-end consumers, but production in Yumbe is still rudimentary. *R. differens* is known as the most marked edible insect in Uganda, yet commercialization and marketing processes are not well documented (Odongo *et al.* 2018). In the Lake Victoria Basin area, one kg can sell for USD 3, comparable to prices of beef (USD 3.50) and fish (USD 1.95) (Odongo et al. 2018). The same study found retailers earning USD 690 and wholesalers USD 2 633 per season from trade in edible insects alone. Most of the edible insects were traded as fresh with minimal processing and packaging. Value addition can be done through preservation to prolong shelf life, but this occurs rarely. Due to high perishability, harvest is sold on domestic markets in Uganda (Picure 7). 1 kg of fresh grasshoppers can fetch prices at local markets that are 40 percent higher than 1 kg of beef (FAO, 2013; Agea *et al.* 2008). Fish and meat vendors reported a decline in sales, moreover, during peak grasshopper season.

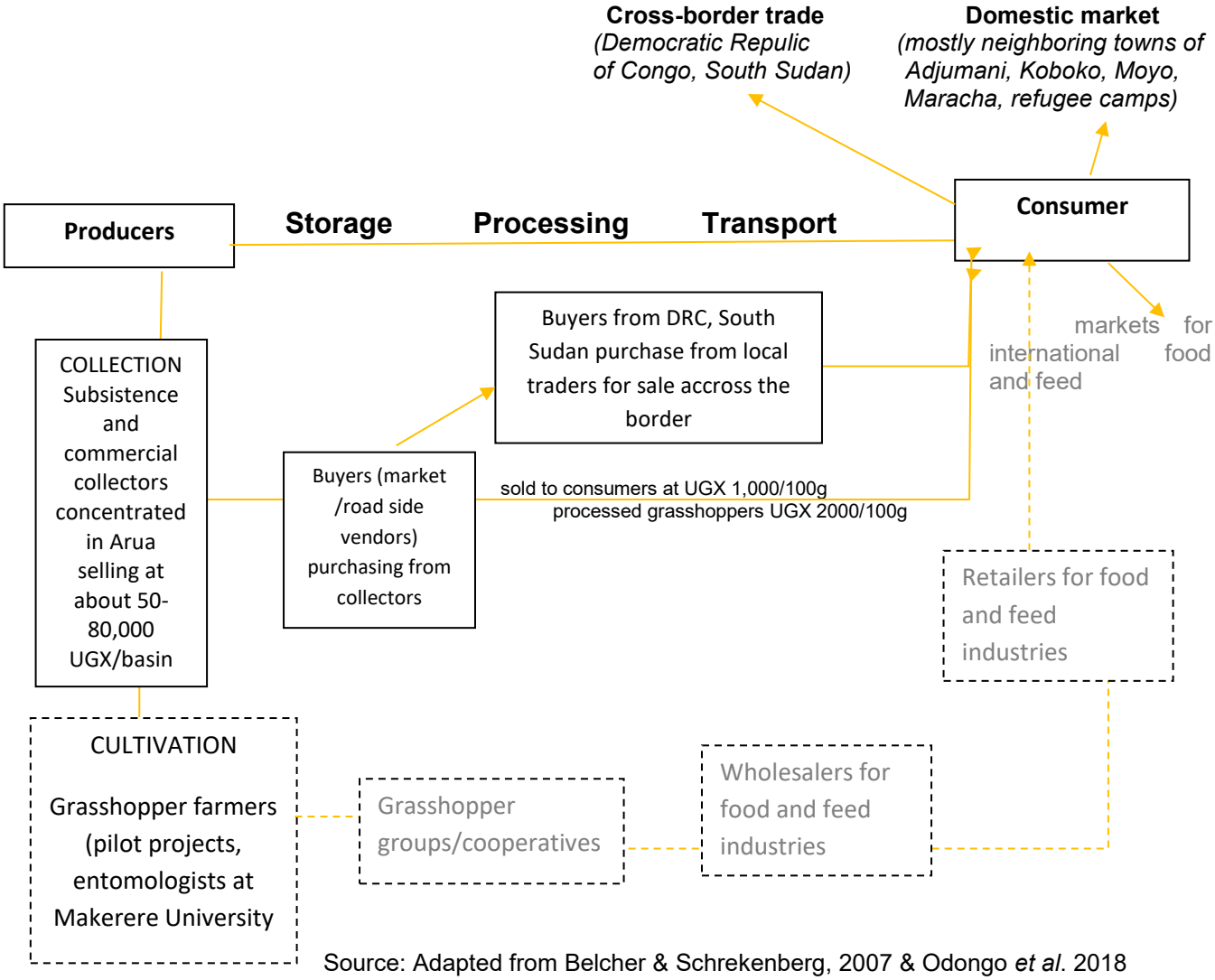
Picture 7. Grasshoppers on sale in Arua market. ©Giulia Muir

Findings from this study suggest that, when collected in large quantities, grasshoppers can be sold for a good price; 0.5 kg can to fetch up to 10 000 UGX (USD 2.65) at the beginning of the season. Grasshoppers and termites appeared to be among the most profitable among wild foods. Prices at local markets were around 1 000 UGX (USD 0.27) per cup (100 g) if processed (i.e. washed, insect legs and wings removed), UGX 2 000 (USD 0.53) unprocessed, for both termites and grasshoppers. Collectors revealed that during the month of November, at the peak of the grasshopper season, a single collector can harvest and sell up to ten sacks (330 kg) of grasshoppers in a single night. Commercial collectors in the Lake Victoria basin reported collection of up to 70 bags (100 kg each) durking peak swarming season, suggesting collection might be below potential in the study area (Odongo *et al* 2018; Okia *et al.* 2017), although the latter studies also showing the lack of guidance or practices on sustainable harvesting. Additionally, crickets can also be found in markets from April to December but at lower prices – roughly UGX 500 (USD 0.13)/cup (100g).

Figure 19 provides an overview of the grasshopper production-to-consumption system in Yumbe. Collectors who sell excess harvest often are engaged in sales directly (or through family members, often women). Harvest is also sold to middlemen at collection centres, who then travel to more urban centres to sell produce. Discussions with experts from Makerere University, district entomologists and collectors revealed that commercial harvesters are concentrated in Arua district. It is unclear, even among experts, if production is concentrated in Arua because collectors have developed methods to attract the swarms (through metal sheets and bright lights) or if there are issues related to vegetation that influence productivity in the area. Collectors who sell excess harvest often are engaged in sales directly (or

through family members, often women). Harvest is also sold to middlemen at collection centres, who then travel to more urban centres to sell produce.

Figure 19. Grasshopper production-to-consumption system in West Nile sub-region



Source: Adapted from Belcher & Schrekenberg, 2007 & Odongo *et al*. 2018

Men, women and children participate in harvest and sales in what is still a short value chain. Grasshoppers are usually collected and sold by women and children but men have gained interest due to the market value, and who often transport the grasshoppers from rural areas in Yumbe to more urban centres (e.g. Arua) where demand and prices are higher, particularly for value added processing such as drying, roasting, salting and storage; this was also confirmed elsewhere in Uganda (Odongo *et al.,* 2018). Key informants revealed that men have developed a technique of connecting bright lights and are able to collect grasshoppers in large amounts (Picture 8) . Most of those surveyed in the study area, however, collected for home use; excess harvest is sold in the area along roadsides or smaller markets, and typically in raw form. More established wholesalers and retailers do exist in other parts of Uganda (e.g. Lake Victoria Basin), which is well documented by Odongo *et a*l. (2018), however the value chain observed in Yumbe and Arua appeared short and rudimentary.

Picture 8. Young boy colects grasshoppers in Arua. ©Giulia Muir

Sustainability of harvest. Risks related to overharvesting of edible insects are well documented (FAO, 2013; Okia *et al.,* 2017; De Foliart & Paoletti, 2005). Other factors associated with a decline in populations are related to habitat changes, environmental or climatic conditions and contamination (Van Huis *et al.*, 2017). Similar to honeybees, wide use of pesticides in the study area in proximity of tobacco farms could be another factor influencing the perceived decline in insect populations (Amulen *et al.,* 2017). Interviews with key informants suggest there are no basic practices on "sustainable" wild harvesting on grasshopper populations in the study area, although these exist in other contexts. This is confirmed by other studies in the country (Odongo *et al.,* 2018; Okia *et al.* 2017).

Securing grasshopper populations requires a mix of approaches which range from sustainable harvesting methods to enhancing wild populations, sustainably managing insect habitats to developing rearing methods (FAO, 2013, DeFoliart and Paoletti, 2005; Hanboonsong et al., 2001). While concerted efforts to ensure sustainable harvesting were not observed in Uganda, there are cases of conserving or even enhancing the availability of edible insects in the wild in other parts of the world. Hanboonsong *et al.,* 2003 describe how in Asia, bamboo caterpillars are now harvested by cutting rectangular holes at the internodes of the host plant rather than cutting down the whole plant (the traditional method). Van Itterbeeck and Van Huis (2012) describe how to enhance the availability of wild insect populations of palm weevils and caterpillars in Mexico by providing egg-laying sites and manipulating host trees (Van Huis, 2012). Enhancing wild populations is not a practice distinct to insects and is also common with other wild resources, for example by spreading rhizomes, seeds or seedlings (Chamberlain *et al.,* 2018; Dounias, 2016). A concerted research effort is underway in Uganda to explore mass-rearing techniques for *R. differens* (Malinga *et al*., 2019; Opoke *et al.* 2019 ; Opoke *et al.* 2019 ; Rutaro *et al.* 2018 ; Valtonen *et al.,* 2018). Efforts are now being piloted with select farmers for small-scale rearing (Nyeko, personal communication, 2019). Farming insects coupled with improved processing to prolong shelf-life as well as the conservation of grasslands where the grasshoppers breed could all guarantee a more stable supply of nutrition and income in the study area.

Table 14 reports the results of the SWOT analysis conducted with reference to grasshopper value chain in Yumbe and Arua Districts.

Table 14. SWOT Analysis of the grasshopper value chain in Yumbe and Arua

Strengths	**Weaknesses**
• High demand particularly in urban centres for high-end consumers • Widespread knowledge and tradition of consumption in the study area • Nutritional benefits (particularly in the absence of other protein sources) • Livelihood diversification strategy	• rudimentary processing and storage methods • Short shelf life (no more than 4 days) • Collectors are not organized • Distance to markets • Instable supply • Insufficient evidence on nutritional composition and bioavailability, as well well as microbial threats and contaminants • Lack of safe harvesting technologies (bright lights used reported to affect eyesight) • Fatigue associated with collection which typically occurs during the night • Contamination of catch with non-palatable insects or soil and grass • Lack of electricity • Erratic weather patterns and uncertainty regarding swarming origin and behaviour • Use of pesticides in farming and bush burning
Opportunities	**Threats**

• Improved incomes through:
  • Organization of harvesters/producers for better access to markets
  • Improving processing techniques and value addition, particularly geared towards prolonging of shelf life
• Incentive to conserve wild ecosystems (including grasslands where the grasshoppers breed)
• sustainable and accessible source of protein, micronutrients
• demonstrated potential for grasshopper rearing
• growing middle class with purchasing power
	• Environmental degradation to put grasshopper habitats at risk
	• Lack of regulation on pesticide use on agricultural farms
	• Unsustainable harvesting
	• Lack of enabling environment and conducive policies in support of grasshopper value chains
	• Lack of standards for quality control, food hygiene and safety, etc.

3.3.5 Recommendations for improving bee product and grasshopper value chains.

Existing literature suggests that globalised and neo-liberal model of based on vertical integration has driven value chain development in the past, but has done very little to benefit

the environment, nutrition or local livelihoods; it has only been capable of achieving substantial economic gains with a selection of products, and for small pockets of society (Secco *et al.*, 2009). In the context of most NWFPs, there are many "middle ground" products that fall in between internationally traded commodities and famine foods with demand grounded in cultural traditions and produced on a gradient from wild harvested to forest farmed (Sills, 2016). A great number of these products are a part of a so-called "net system approach" premised upon several integrated small and medium-scale rural-based enterprises supplying relatively limited quantities of high quality products, oriented to niche markets (Secco *et al.*, 2009). This model has not only proven more economically viable but also more equitable in distribution of benefits, it has been more effective in stimulating the local economy as a whole, integrated system based on NWFPs and related to other environmental services (Secco *et al.,* 2009). These products are closely linked to local communities and associated with natural food production and traditional food systems. At the same time, vertical integration can facilitate export to a larger market, potentially higher prices e.g. for "special honeys" and foreign exchange earnings (Bees for Development, 2006). The advantages of selling locally include lower marketing and transaction costs, less stringent quality criteria and small volumes are acceptable.

In the context of the West-Nile's insect-based value chains, both bee and grasshopper products show enormous prospects for development, but at present they *contribute* to household incomes by diversifying livelihoods in the study area for most communities, contributing at best to 10 percent of household income (focus group discussions); they do not form the *basis* of livelihoods. While some more established entities (e.g. Bee Natural Products and Blessed Bees for Life) demonstrate prospects for developing "forest honey" for international appeal and, enhancing wild grasshopper populations and mass grasshopper rearing for the feed and food industries could provide significant opportunities for trading grasshoppers regionally and internationally, with appropriate standards and processing, prospects for insect-based products to make more immediate and significant contributions to rural and local livelihoods include:

- More **horizontal and equitable integration** based on the net-chain concept (FAO, 2014), including collective organization of harvesters and producers to share processing costs, for instance, particularly associated with expensive equipment (i.e. beekeeping, storage) and transport, marketing information, skills and increase volume and quality of production for greater market access. This should include expanding access particularly with regards to the beekeeping sector to women, as apicultural activities were found to be largely male dominated in the study area.

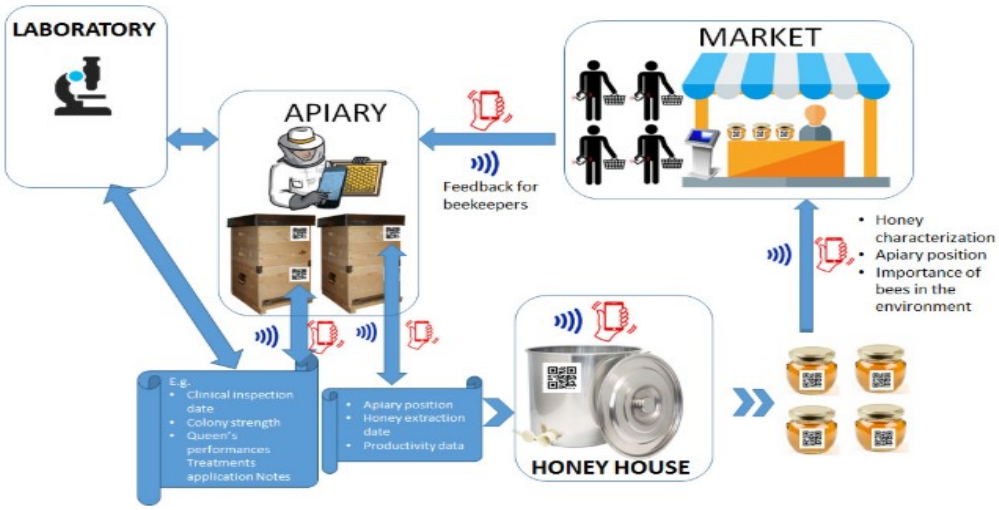
- **Improving processing (especially storage) techniques, value addition and adherence to standards for food safety** including for underutilized products (e.g. beeswax, propolis). While bee products require little further processing if handled carefully, and thus beekeepers should capture more of the end value of the final product (Bees for Development, 2006), several elements could significantly improve prospects for bee product-based livelihoods. Improved processing particularly with regards to storage and avoiding spoilage for instance, is largely the largest bottleneck observed in the study area. Additionally, training to ensure harvesting takes place in accordance with national and international quality standards could also significantly improve prospects (i.e. honey is often harvested "raw" and although this is sometimes perceived as the cleanest honey, residual parts of bees and brood do not easily conform to international honey standards). Finally, harvesting other products, namely beeswax and propolis, is still largely untapped, despite

having huge prospects particularly for regional and international cosmetic/health markets and less stringent standards than food industry.

For grasshoppers, there is tremendous potential in view of projections that eating insects will become a billion dollar industry (Fortune, 2019). The market for processed products (snacks, protein bars, bakery/flour) is growing on the international scale, with insect ingredients already appearing in large grocery chains across the United Kingdom, Canada and the United States. Regulatory openings (e.g. EU Novel Food Regulation) have facilitated the launch of insect-based products for human consumption in Europe and North America in particular. Tapping into these markets can be possible through training on processing grasshoppers particularly as snack foods and flour, which could be facilitated through "back-yard rearing" techniques much like those well-established in Thailand (FAO, 2013; FAO, forthcoming) to ensure supply. Adherence to standards and food safety protocols are equally vital to making this possible, although more research is needed on bioavailability and microbial safety of insects, particularly harvesting from the wild.

- **Improved and more innovative marketing and traceability.** Labelling and certification via the Ugandan Bureau of Standards and international certification bodies can also improve prospects for insect-based products, including innovative certification and marketing techniques based on forest "packages and bundles" either through territorial marketing (e.g. "West-Nile" or "forest honey"), marketing as complementary products through established wood-based certification schemes or through nutritional/health properties as "nutraceuticals"/"cosmeceuticals". Both "traditional" honey and beeswax in bulk based on product standardization and vertical integration and export of high-value niche speciality honey (e.g. of specific floral or geographic origin) which could be marketed to consumers who are willing to pay more, for instance in the European Union (Bees for Development, 2006) offer prospects for improved livelihoods. The use of mobile technology to trace honey back to the hive through QR codes, currently being explored by the Italian *Istituto Zooprofilattico Sperimentale del Lazion e della Toscana*, could also greatly improve prospects for national and international marketing given national and international demand for quality honey (Figure 20).

Figure 20. Innovative traceability systems for honey



Source: *Istituto Zooprofilattico Sperimentale del Lazion e della Toscana, 2019.*

- **From gathering to farming?** Related to this, while honey hunting and wild insect gathering to diversify incomes and diets has demonstrated benefits, as documented in this thesis, there are also opportunities for increasing these benefits with greater volumes and a more stable supply, particularly through improved hive management, the collection of beeswax (only practiced by a small proportion of beekeepers) as well as grasshopper rearing. For honey these practices are well established, and more technical training (in both traditional and modern beekeeping) to improve production could greatly improve prospects for livelihoods. For grasshoppers, although rearing is still in its infancy in Uganda, research is well underway to improve farming techniques of *Ruspolia differens* (Malinga *et al.,* 2019, Ooke *et al*., 2019; Rutaro *et al*., 2018; Nyeko *et al*., 2018). South-South exchanges with backyard cricket farmers in Thailand, where small-scale cricket farming is an established practice (FAO, 2013; FAO; forthcoming) could also be explored further.

- **Improved normative frameworks and research developments.** Institutional and regulatory support for apiculture in Uganda is relatively well established thanks to the presence of TUNADO that works to provide a national platform for stakeholders to promote and develop the apiculture industry through capacity development in basic good practices in beekeeping and beeswax extraction, marketing and business skills and by facilitating local and international networking. Despite the trainings and periodic updates on market prices through TUNADO's newsletter "Api-price watch", interviews with processors revealed a general dissatisfaction with market data and information about quality standards. Grasshopper collection on the contrary is entirely informal. Although most districts have entomologists, they generally deal with insects as agricultural pests and there is little knowledge about consumption, market prices and food safety measures. While scientific interest in edible insects has increased in recent years win Uganda, with significant advances on nutritional attributes and rearing potential of grasshoppers (Odongo, 2018; Nyeko, 2018; Rutaro, 2018; Malinga, 2018), the practice requires more research, legislation and regulation and business incubation (Niassey *et al*., 2018).

4. CONCLUSIONS AND FUTURE PROSPECTS FOR NWFPS

This final section seeks to pull together key findings, limitations and future research recommendations in the field.

4.1 Key findings (Research Objective 1)

The research undertaken began by reviewing non-wood terms and definitions, which have long been tangled, as a first attempt towards improved quantification and visibility of NWFPs. In brief, this was done first by (1) clarifying boundaries between agricultural and forest products, so forest products currently under agriculture can be "reclaimed"; (2) drawing on lessons from the fisheries sector with regards to distinguishing between wild catch and farmed fish, and associated activities by classifying NWFPs under the different gradients from wild to farmed from which they derive (e.g. wild, managed and cultivated products); (3) moving beyond *product* classification systems towards *activity* classifications *(International Standard Industrial Classification of all Economic activities)* to capture gathering of NWFPs that may not be accounted for under crops nor under forest products, given that they may be harvested outside of these boundaries (e.g. "bush", non-forest land). In doing so, clarity is provided on the time old terminology debate that has contributed to the well-acknowledged data gap on NWFPs. The objectives of this exercise was twofold: (1) providing the scientific community and in particular, official statisticians, with a means to closing in on the NWFP data gap to get a better understanding of the contributions of NWFPs and wild gathering to lives and livelihoods; (2) the second objective was to provide the basis of the field work undertaken, which focused on edible products that are wild gathered, in order to pilot a means to obtaining useful information on NWFPs in low-resource settings. Combined, these efforts are aimed at improving the visibility of NWFPs to support policy and decision making.

The review concluded that semantic confusion on NWFPs should come as no surprise, given that NWFPs refer to a broad range of species from all over the world with extremely different ecologies and livelihood roles, and equally diverse market chains, end products and consumers (Laird *et al*., 2011; Wong *et al*., 2001, Shackleton & Pandey (2014). Nevertheless, since the term was coined, there has been wide acknowledgement that the proliferation of terms in use has created a lot of confusion among scientists, statisticians and decision makers, inhibiting understanding and progress in research and development, communication and reporting (Belcher, 2003). The plethora of terms and definitions in particular has made it impossible to collect globally comparable data through time. As a result, information on NWFPs is patchy and incomparable across countries.

Undoubtedly, the sheer number of products and different end uses coupled with challenges surrounding non-standard units of measurement and terminology issues all make NWFP quantification problematic. The availability of global data on production, consumption and trade, coupled with resource quantification, could give way to valuation of NWFPs, including economic quantification and a potential taxation system that could support land-use planning.This could provide the needed incentive for systematic data collection, including inventorying on NWFPs.

Cultural and contextual differences regarding how these products are perceived in different countries/regions and by different entities will however likely mean that they will continue to be referred to colloquially with varied terms and definitions. Differing national legal connotations equally suggest a single universal term is highly unlikely. However, statistical

gathering need not necessarily adhere to botanical or cultural standards; these classifications often require compromises for the purposes of collecting official data. The aforementioned proposals will hence not satisfy all NWFP practitioners, yet they provide clarity on what the different terms mean including practical steps that, if taken on board by statistical entities (e.g. international statistical agencies, national statistical offices and/or forestry ministries) can help paint a more accurate picture of NWFP contributions to economies, livelihoods and diets, and ultimately better inform policy, land-use decisions and nutrition interventions, where these products remain under or un-represented largely because there is very little data to "make a case".

In short, important but not impossible further steps could be taken to make NWFPs more visible in official statistics by (1) amending the current FRA definition to include products from **other wooded land**, as well as forest products from plantations (e.g. pine nuts, chestnuts, brazil nuts) if they adhere to FRA's definition of land use and criteria for height and canopy cover for forests and other wooded land to "reclaim" forest products currently under agriculture; (2) related to this, providing countries/statistical entities with improved guidance on including both wild and managed forest products in official forest statistics (as described in section 3.1.5); and (3) capturing NWFP contributions through the *activity* of gathering in and outside of forests.

Further complementary steps are still needed to make NWFPs more visible, particularly to capture products collected and consumed informally or for subsistence use. These include integrating questions about NWFPs and gathering practices into livelihood, agricultural and dietary surveys; building statistical capacity to collect information on these products and practices (guidance and clarity on terms and definitions is a good first step); and integrating NWFPs in forest inventories as a complement to global data that is typically captured through international statistical classification systems and associated databases.

4.2 Key findings (Research Objectives 2 and 3)

The clarifications on terms and definitions provided the basis for carrying out the field work, which focused on the activity of gathering and consumption of wild gathered ("untended") foods, hereon referred to as wild foods or products. **The main finding from this work was that contrary to popular belief, wild gathering and consumption are not synonymous with hunger. Wild food use contributes to dietary diversity, seasonal evenness, as well as household and nutritional resilience, similarly to findings in other countries in recent years (Powell *et al.,* 2017).**

Through the lens of collection, it was possible, by inquiring about gathering *activities*, to ascertain that 100 percent of households collect wild products, mainly for home consumption, but also for sale. Related to this, on average, it was found that households consume about eight types of wild products each year. The most commonly consumed categories of products include wild fruits (95 percent of households), wild vegetables (88 percent), edible insects (84 percent), MAPs (82 percent), honey (63 percent), wild terrestrial meat (61 percent) and wild nuts and seeds (49 percent). Findings indicate that the most consumed wild foods are *Termites alates* followed by honey and *Abelmoschus esculentus* (a wild, leafy green vegetable) consumed by 76 percent, 62 percent and 61 percent of households respectively. Two species of insects (*Termites alates and Ruspolia differens*) feature in the top 10 as well as two types of wild caught fish (nile tilapia and mudfish).

Assessments of *relative* contribution to diets confirm that wild foods diversify diets, with some wild food groups such as fruits, fish and in some cases vegetables boasting consumption comparable to farmed varieties. Moreover, termites and grasshoppers, when collected, contribute up to 62.5% and 35% of the RDA of protein respectively, particularly significant considering that minimal amounts of protein were found available in the study area. Similarly, *B. Agyptiaca* and *T.indica* contribute important amounts of potassium, zinc, vitamins and dietary fibre, with tamarind contributing up to 58 % of RDA for Zinc. The obvious limitation here is that supply is not constant and these contributions are limited to short periods of the year when the foods are in season.

Not all NWFPs and wild foods are equal; most are not "famine foods". No positive correlation moreover was found between lean seasons and wild food use; consumption is cyclical and associated with seasonal availability. The main motivation for consumption was traditional/culinary. Hunger was cited more consistently as a motivation for consumption for only a handful of species, and sometimes not at all. Findings also confirmed that **there is year-round availability of wild food**. Food frequency questionnaires and seasonal calendars suggest wild products contribute to diets year-round, providing important micro- and macro-nutrients.

Perceptions regarding availability in the wild show some worrisome trends. Depletion in the wild is mainly due to environmental and climatic reasons. Some species such as Vitellaria fruits are regarded to be on the decline because the wood is valued for charcoal production; sometimes this is attributed to the influx of refugees. Other factors cited include climatic factors (e.g. drought) and environmental degradation (i.e. agricultural expansion, wood fuel collection by hosts/local communities).

For most products, wild gathering also makes economic sense due to the potential returns from sales, particular in view of the time actually spent collecting which ranges from one to two hours on average. However, with the exception of some foods such as grasshoppers and some leafy greens, typically low volumes , seasonality issues and limited sales of harvest means that, on average, no single product forms the basis of livelihoods or diets but aggregately, gathering (from forest, other wooded land and other land) **plays an important livelihood and diet diversification role.**

Key bottlenecks to commercialization of single NWFPs remain and typically include lack of basic equipment, such as for processing (most is performed by hand and is time consuming and laborious e.g. extracting oil from nuts of *Vitellaria* or *Balanites*), organization, credit and training. In turn, at present, insect-based NWFPs contribute to livelihoods and health by diversifying livelihoods and diets, yet production remains untapped. Average honey collection (8.5 kg) is still far below potential productivity levels of 15kg, 26 kg and 60 kg per hive per season for traditional, KTB and Langstroth gives respectively (Kilmo Trust, 2012). In the same way, while grasshopper harvest is potentially lucrative in neighboring districts such as Arua, most of the harvest in Yumbe is still consumed directly in households due to difficulties accessing markets and consumers with high purchasing power. Supply also remains a challenge, as collection is concentrated in just two months of the year and there is no processing observed at present that significantly prolongs shelf-life.

Although there is high demand and potential particularly for niche, high-end consumers, low adherence to standards remains another major bottleneck to reaching Uganda's growing middle class with higher purchasing power, as well a international markets, in addition to basic transport challenges. Little attention is paid to washing and storing grasshoppers

under hygenic conditions, for instance; cases of diarrhea and vomitting were commonly cited by collectors and consumers of grasshoppers during focus groups. There appears to generally be better knowledge about honey production standards, but discussions with processors who purchase from harvesters (Honey Pride in Arua, Blessed Bees in Yumbe) indicate that it is not uncommon for them to turn the honey delivered down because it is contaminated with grass, manure (used to make traditional grass hives) and smoke. Greater access to information on basic quality standards is vital to improving market access and incomes of collectors. Other common bottlenecks related to both insect value chains include: environmental degradation (i.e. decline in bee forage and insect habitats) and little value addition (particularly storage challenges).

Creating markets, innovating value-chains and greater inclusion of NWFPs in land-use planning and associated biodiversity restoration activities are all recommended as ways forward. Wild and semi-wild NWFPs are fundamental to the functioning of healthy forests (Chamerberlain *et al.,* 2018). While NWFP management is highly complex and often comes with large spatiotemporal variation, experience shows that measures to include NWFP users in management can increase the incentive for responsibly managing forests and wild ecosystems. NWFP users are also highly knowledgeable about sustainable harvesting practices and methods to replace, expand or even extend wild populations (e.g. by planting seeds, roots, rhizome pieces, seedlings) (Chamberlain *et al*. 2018). Wild populations "managed" by knowledgeable harvesters have shown high growth rates under high harvest pressure, while populations of the same species managed by other less knowledgeable have declined under much lower levels of harvest (Chamberlain *et al.* 2018); this knowledge should be taken into consideration in associated land use planning and management to maintain wild populations and their associated ecosystems.

This is also true for insect habitats. Creating markets for insects, by preserving insect habitats and rearing insects where possible could also contribute to alleviating pressure on wildlife. While forest management has historically viewed insects as pests, edible insects advocates argue that creating a wider market for food insects could provide an economic incentive for conserving insect habitats (FAO, 2013) and in turn, contribute to the sustainable management of forest habitats. Other recommendations to ensure sustainable edible insect supply include: maintaining reserves, maintaining as much landscape heterogeneity as possible; reducing the contrast between remnant forest patches and neighbouring disturbed habitats; promoting the concept of land sparing outside reserves; simulating natural conditions and natural disturbance; and connecting similar patches of quality habitat with protected corridors (Samways, 2007). These same principles can be applied to other products like honey to ensure bee forage, and gathering activities in general.

Specific interventions can take the form of participatory monitoring with NWFP community users, multi-species plantations and associated complementary harvesting strategies. This might be complemented by the development of sustainable harvesting guidelines including access rights. Moreover, participatory domestication of priority species should be done where suitable, possible and appropriate; more research is needed to determine available supply and priority species for domestication. Information on supply in particular is the very basis for sustainable value chains. Opportunities to assess wild food resources systematically through participatory monitoring should be explored.

Other recommendations include: more horizontal integration and equitable participation of both men and women in value chains, improved and more innovative marketing and traceability (including nutrition labelling and certification for speciality products or "forest

packages" as part of territorial marketing); improving skills including related to rearing as appropriate (improved hive management and backyard grasshopper farming). Finally, nutrition composition analyses on high potential NWFPs is recommended, where this information is insufficient, to increase demand for nutritious NWFPs and to link producers of nutritious NWFPs to local public procurement policies and programmes. Examples of where NWFPs could be integrated include school feeding and international organizations' procurement policies e.g. fortified blended foods with edible insects, honey, shea or balanites oil for cooking, or integration of wild fruits and vegetables, in line with "planetary health" recommendations of (Willett *et al.*, 2019).

4.3 Concluding remarks

This research contributes to the growing body of knowledge on the importance of biodiversity and uncultivated ecosystems for food and nutrition security, particularly from the point of view of livelihood and nutritional diversification and resilience-building. Findings suggest that NWFPs are not "famine foods"; consumption and gathering is largely motivated by availability and accessibility. Moreover, their contributions particularly from the point of view of fruit and vegetable intake are often comparable to domesticated varieites, thereby adding vital micro-nutrients to diets. As such, edible NWFPS in particular and "wild biodiversity" in general should be given due weight in decisions about land-use planning, forest management and nutrition interventions.

The main limitation of the research is that the field-work was concentrated in a small area in the West-Nile Region, Uganda. The findings would bear greater weight if the same inquiry were conducted in multiple districts or even better, different countries to allow comparison of results. The section on quantifying the nutritional contributions was also limited by lack of information on food composition of NWFPs and wild foods in general. Notwithstanding, the methods provide proof on concept and demonstrate "scaleability" in other contexts and countries. Additional research is recommended to apply the same methods in different countries, with the possibiltiy of running the rapid food frequency in at least two seasons to cross-check results and improve data accuracy. Quantification of the volume of all products collected, moreover, proved problematic due to the time-consuming nature of collecting this information using non-standard units of measurement; as such, quantities were collected for only a selection of products.

In summary, the study herewith provides recommendations on how to translate this research into practice. This begins with (1) improving data and in turn, visibility, resource monitoring and product development potential specifically in the realm of production and trade statistics as well as consumption and nutritional composition data on uncultivated parts of diets. Efforts are also needed to (2) improve use, management and availability of NWFPs. This can be done through both supply- and demand-side measures ranging from domestication and expansion of protected areas – so-called "re-wilding" (Annex 1), improvements in processing, especially storage and standards along NWFP value chains, nutrition education and documenting local and indigenous knowledge on NWFP use. Together, these efforts could contribute to "reorienting" food systems towards producing more healthy foods and at the same time enhancing biodiversity, in line with the Lancet (2019) recommendations towards a "planetary health diet".

Future research needs should focus on (1) improving data on *resource* availablity of NWFPs particularly in view of climatic changes; (2) measuring the nutritional productivity of forest

and wild ecosystems compared to agricultural production systems (Charrondiere *et al.*, 2017) to continue to better inform policy and decisions about sustainable food systems; (3) continue to improve the nutrition composition data on NWFPs for product development and greater possibility for inclusion in public procurement (i.e. school feeding); (4) understanding what a "re-wilding" conservation approach to food systems would look like in developing country contexts.

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Annex 1. NWFPs as part of "re-wilding"

This section was a part of research objective 1 on disentangling "wild" definitions, which entered into the domain of definitions on wilderness and recent literature on re-wilding. While beyond the direct remit of this thesis, some of the key findings of this desk review are presented here given that one of the final concluding remarks suggests further research on NWFPs in the context of re-wilding as a conservation approach,

Rewilding is an approach to nature conservation introduced in the late 20th century, specifically the 1980s, in reference to The Wildlands Project which aimed to create "core wilderness" areas without human activity and connected by corridors in North America (1998 Soule and Noss; Svenning *et al.,* 2015; Lorimer *et al.*, 2015; Jorgesen, 2015). There is no consensus about what rewilding is, and different opinions on the degree of "wildness" and conversely, human intervention that constitutes rewilding. The only agreement among authors appears to be that there is still much confusion surrounding the concept, so much so that several caution about the lack of ecological foundations of such an approach (Nogues-Bravo *et al.*, 2016; Jorgesen (2015). What is clear from literature is that the model is an emerging trend in conservation – associated with key words such as "new", "innovative", "experiment", "progressive" and "novel"; its definition is in continuous evolution, and various interpretations exist arguably based on differing ends and objectives of respective authors and entities. Three primary schools of thought emerge, but with several adaptations even within these sub-groups (Svenning *et al.*, 2016; Jepson, 2016); looking at two decades of rewilding literature, Jorgesen (2015) finds six different meanings for rewilding in different geographies (see Table 3).

Table 1. Rewilding variants

Term	Definition	Source
"Original"/First school of thought (restoring "wilderness")		
Rewilding	Restoring big and well-connected wilderness areas based on the regulatory roles of large predators; based on "3 Cs approach" (Core areas, Corridors and Carnivores)	Soule & Noss, 1998; Nogues-Bravo, 2016; Lorimer *et al.,* 2015; Jorgesen, 2015; Gross, 2014
Pleicistone rewilding	Aims to restore some of the evolutionary and ecological potential that was lost 13,000 years ago" (introducing relatives or functional equivalents of extinct taxa)	Donlan *et al.,* 2005 in Nogues-Bravo *et al.,* 2016
Passive rewilding	Passive management of ecological succession with the goal of restoring natural ecosystem processes and reducing human control of landscapes	Nogues-Bravo *et al*., 2016; Corez Avizanda, 2015
Second school of thought (restoration of "traditional" agriculture)		
European Rewilding	Stems from an interest in ecological networks and naturalistic grazing as a means to preserve and develop particular kinds of landscapes (rewilding without predators). Differs from Pleicistone rewilding as it refers to mid-Holocene as a reference frame, in support of the original landscape of Europe as mix wood-pasture as opposed to closed canopy forest.	Vera, 2000; Zeller, *et al*. 2017; Nogues-Bravo *et al.*, 2016; Corez Avizanda, 2015; Lorimer *et al.,* 2015.
Transhumant rewilding	Species reintroduction with managed herding of wild ungulates for the ecological restoration and	Root-Bernstein, 2016

	sustainability of food production in (silvo)-pastoral systems.	
"Back to nature" re-wilding	Rewilding as a process of re-introducing properties from wild relatives of crops based on modern biotechnology techniques.	Anderson *et al.,* 2015
	Rewilding as furnishing crops with lost properties that their ancestors once possessed to tolerate adverse environmental conditions with molecular techniques.	Palmgren *et al.,* 2014
Third school of thought (restoring severed human/nature relationship)		
Rewilding as "acculturization"	Re-connecting people with nature, re-introducing "naturalistic" forms of food production. Aims to increase the experiential value of forests in respect of forest food gathering.	Wiersum, 2016.

Source: adapted from Nogues-Bravo et al., 2016.

In Europe, rewilding is seen as an opportunity to recover "*native biodiversity and ecological processes and provide a range of ecosystem services*" on Less-Favoured Areas – LFA - (e.g. marginal land, mountainous areas) (Cramer *et al*., 2008 in Corez Avizanda, 2015; Merckx and Pereira, 2015). Rewilding programmes in fact can, in a roundabout way, access funds through the European Commission (EC) agri-environment schemes – a key means by which the EC integrates environmental concerns into the Common Agriculture Policy (CAP) - providing payments to farmers to preserve the environment and maintain the countryside (e.g. EC Regulation 1698/2005). According to the EC, these schemes play a critical role in meeting society's demand for environmental outcomes provided by agriculture. Kleijn and Sutherland (2003) in Jepson (2015) argue that these schemes are now integral to the financing of conservation management in Europe. The paradox is that EU agricultural policies themselves are the cause of the disappearance of many species of wild plants and animals and form a threat for many others, explains Vera (2000). Notwithstanding, re-wilding, understood as the re-introduction of ""naturalistic forms" of food production, including forest food gathering (Wiersum, 2016) could be viewed as a means to conserve NWFPs, including associated gathering which occurs in forests and other wooded land (and on other land).

"Going back to nature" in Europe does not mean restoring a landscape of closed canopy forest, argues Vera (2000); European landscapes are not a result of "natural" processes but have evolved as a result of the introduction of agriculture. Vera (2000) proposes that the pre-Neolithic landscape of northern Europe was in fact dominated by more open environments with herds of herbivores (kept in check by wolves and lynxes) as key ecological drivers and rooted within distinct cultural traditions (Vera, 2000; Jepson, 2015). Contrary to Southern African ecosystems which evolved millions of years ago, European ecosystems have been shaped by humans, with cultural grasslands emerging as a result of intensifying agriculture, explain Zeller *at al.* (2017).

Re-wilding in a broad sense is also not limited to Europe and North America. For example, in central Chile, "transhumant re-wilding", understood as species reintroduction with managed herding of wild ungulates, is an approach being used for the ecological restoration and sustainability of food production in (silvo) pastoral systems (Root-Bernstein *et al.*, 2016). The authors consider the relative ecosystem service advantages and costs of the transhumant rewilding scenario compared to other restoration and agricultural development scenarios for central Chile and conclude that transhumant rewilding has the potential to be

a useful model for rewilding-in-spired land management in cultural landscapes and can contribute to food security and sustainable agricultural production.

What does this mean for the prospect of “re-wilding” food systems on a global scale? Paradoxically, rewilding and agriculture (i.e. domestication) appear to be intrinsically antithetical, at least against the North American rewilding roots because, in essence, domestication is at the opposite end of the spectrum from wild, and hence cannot be considered natural. In the same way, foraging is perceived as antithetic to farming (Dounias, 2016). Domesticated forms are in fact the result of anthropogenic influence on biodiversity (Zeller *et al.*, 2017). Yet wild and domesticated resources can and already do exist. In Japan, for instance, isolated rice terraces have been found to be unexpected hot spots of biodiversity; many rare plants and insects have coexisted with Japanese farming for millennia, including the sunflower relative (the “*yaburegasamodoki*”) (Normille, 2016). The problem is that biodiversity is declining as traditional practices and farmers disappear (Normile, 2016). Many indigenous food systems are equally rich in biodiversity, but are also at risk due to land-use changes and globalisation (FAO, 2013; FAO, 2010).

In this vein, re-wilding in practice becomes an approach that could involve re-introducing wild plants and animals (i.e. wild biodiversity, including NWFPs) into food systems by upgrading existing reserves and harmonizing them with the needs and aspirations of their constituencies, which has enormous potential for biodiversity conservation (Pringle, 2017). This could include the re-introduction of traditional forms of biodiversity-friendly agricultural practices and systems, including associated knowledge of both domestication and wild plant gathering, as well as countering the well-established practice of land-use changes in favour of domestication. Expanding nature reserves would also increase the availability of land for for wild gathering. There is also a socio-biological component, which Wiersum (2016) describes as a relatively new and multidimensional phenomenon, which involves both the biological process of “de-domestication” and new forms of culturally-embedded interactions between people and nature. He adds that this involves the reintroduction of more “naturalistic” forms of food production, with the aim to increase the experiential value of forests in respect of forest food gathering (2016). In practice, re-wilding could be equally useful as a framework and approach both towards conservation and towards “re-orienting agricultural priorities” to produce diverse foods that both provide nutrients and support environmental sustainability by enhancing biodiversity (Willett *et al.*, 2019).

Annex 2. Household Questionnaire

Quantifying consumption and collection of NWFPs

This survey is being administered to understand the contribution of non-wood forest products/wild forest products like mushrooms, wild fruits and vegetables, nuts and seeds, honey, roots, insects and other wild game, medicinal plants, construction materials, fodder and fibres from forests or trees to diets and to livelihoods more broadly. This survey will ask you some questions about your consumption habits and gathering practices, and should take approximately 30 minutes to complete.

I have received verbal consent from respondent to conduct interview _____

1. Household and interview particulars				
1.1 Household ID				
1.2 Task	Date	Time	By whom?	Status, ok. If not, please comment (*including motivation for refusal to answer survey)*
1.2.1 Interview				
1.2.2 Checking questionnaire				
1.2.3 Entering data				
1.2.4 Checking & approving data entry				

2. Household composition and characteristics						
PID	**2.1 Name (optional)**	**2.2 Age** *(years)*	**2.3 Relation to qualified respondent** *Qualified respondent...01* *Spouse……02* *Own Child……..03* *Step Child……04* *Adopted Child……05* *Grand Child……06* *Brother/Sister……07* *Cousin……08* *Niece/Nephew……09* *Son/Daughter-In-Law 10* *Brother/Sister-In Law.11* *Parent……12* *Parent-In-Law……13* *Other Relative……14* *Maid/Nanny/HouseServant..15* *Non-Relative……16*	**2.4 Gender** *Male = 1* *Female = 2*	**2.5 current status** *IDP=1;* *Refugee==2;* *Returnee=3;* *Host=4*	**2.6 Were you born in this village? (if yes skip to section 3)** *Yes=1; No=2*
1			1			
2						
3						
4						
5						
6						
7						
8						
9						
10						

2.7 When did you arrive? *(date mm/yyyy)*	**2.8 Where are you from?** *(country)*	**2.9 What's your ethnic group?**	**2.10 What's your religion?**

3. Access to agricultural and forest land					
Plot ID	**3.1 Please list fields/plots that are yours/you have access to** *1 - annual crops* *2 - perennial crops* *3 - fallows* *4 - agro-forests* *5 - grazing land* *6 - gardens* *7 - woodlots* *8 - forest* *9 – other*	**3.2 Plot size** *(m2)*	**3.3 Distance from your home (km)**	**3.4 Which activity best describes your use of the field/plot?** *Gathering (free access) =1; Regulated (permit-based)=2; Cultivated =3; Other (specify) = 4*	**3.5 Cultivated products (including tree crops)** see codes A

4. Sources of Income		
4.1 What are your primary sources of income (please express as percentage of 100%) *(if 1 >0 skip to section 5)* *from gathering/hunting in forest/agroforestry/woodlot=1* *from agricultural products/food=2* *from the sale of fuelwood=3* *from other_____ =4*		**4.2 In your view, what are the five most important NWFPs/wild products harvested/gathered for cash?**
source	percentage	
		1
		2
		3
		4
		5

5. Assets		
5. 1 What is the main type of housing material of the walls of your home? *1 = Minimum (made of light materials, e.g., bamboo, paddy straw, jute stick, leaves, mud, etc.)-;* *2 = Low (made of light materials plus wood or galvanized metal);* *3- Medium (combination of wood and galvanized metal);* *4 = High (made concrete materials and galvanized roof)*	**5.2 Do you own livestock? If so, please list type and number of units.**	
	Type	**number of units**

6. General consumption/use and collection of wild products	
	6.1 Did you consume/use or collect (pick) any of these products during the last year? *Consume/use=1; Collect=2; Both=3; Neither consumption nor collection=4*
1. wild mushrooms *If consumed and/or collected, proceed to section 6.2*	
2. wild vegetables (including tubers, yams and roots) *If consumed and/or collected, proceed to section 6.3*	
3. wild fruits *If consumed and/or collected, proceed to section 6.4*	
4. wild nuts or seeds *If consumed and/or collected, proceed to section 6.5*	
5. wild terrestrial meat (large/small mammals, reptiles, amphibians, birds, snails, other) *If consumed and/or collected, proceed to section 6.6*	
6. wild aquatic meat (e.g. fish, crabs) *If consumed and/or collected, proceed to section 6.7*	
7. insects *If consumed and/or collected, proceed to section 6.8*	
8. medicinal or aromatic plants *If consumed and/or collected, proceed to section 6.9*	
9. honey or associated products (e.g. combs, propolis) *If consumed and/or collected, proceed to section 6.10*	
10. fodder *If consumed and/or collected, proceed to section 6.11*	
11. Other (saps, resins, bark, bamboo, rattan, thatch grass, palm leaves or other construction materials or fibres) etc. *If consumed and/or collected, please proceed to section 6.12*	

6.2 Mushrooms									
6.2.1 List the main species consumed		**6.2.2 Why did you choose to consume this species?** *widely available ("free access")=1; hunger/food shortage=2; culinary/ traditional/ cultural motivations= 3; medicinal/ health=4; Other (e.g. donation; please specify) =5*	**6.2.3 Where do you usually obtain the species from?** *forest= 1; agroforestry =2; cropland=3; non-forest natural system=4; purchased at the market/shop =5; barter=6; other (specify)=7*	**6.2.4 During which months does harvesting typically occur?** *Jan = 1 Feb = 2 Mar= 3 April = 4 May = 5 June = 6 July = 7 Aug = 8 Sept = 9 Oct = 10 Nov = 11 Dec = 12*	**6.2.5 How many times do members of your household collect these items during the season in which gathering typically occurs? Unit:** *Times per month*	**6.2.6 How many hours daily did you spend collecting the products** *1= 0-2 hrs; 2 = 2-4 hrs; 3 = 4-6 hrs; 4 = 6-8 hrs; 5 = more than 8 hrs*	**6.2.7 Average daily quantity collected Kg** *(see codes B)*	**6.2.8 What do you usually do with the species?** *1 = consume 2 = sell 3 = barter 4 = other (specify) multiple answers OK*	**6.2.9 In your view, has the availability of the resource declined, increased, or remained stable in the last year?** *Declined=1; increased=2; remained stable =3*
1									
2									
3									
4									
5									

6.3 Wild vegetables (including tubers, yams and roots)									
6.3.1 List the main products consumed		**6.3.2 Why did you choose to consume this species?** *widely available ("free access)=1; hunger/food shortage=2; culinary/ traditional/ cultural motivations= 3; medicinal/health=4; Other (e.g. donation; please specify) =5*	**6.3.3 Where do you usually obtain the species from?** *forest= 1; agroforestry =2; cropland=3; non-forest natural system=4; purchased at the market/shop =5; barter=6; other (specify)=7*	**6.3.4 During which months does harvesting typically occur?** *Jan = 1 Feb = 2 Mar= 3 April = 4 May = 5 June = 6 July = 7 Aug = 8 Sept = 9 Oct = 10 Nov = 11 Dec = 12*	**6.3.5 How many times do members of your household collect these items during the season in which gathering typically occurs? Unit:** *Times per month*	**6.3.6 How many hours daily did you spend collecting the products** *1= 0-2 hrs; 2 = 2-4 hrs; 3 = 4-6 hrs; 4 = 6-8 hrs; 5 = more than 8 hrs*	**6.3.7 Average daily quantity collected Kg** *(see codes B)*	**6.3.8 What do you usually do with the species?** *1 = consume 2 = sell 3 = barter 4 = other (specify) multiple answers OK*	**6.3.9 In your view, has the availability of the resource declined, increased, or remained stable in the last year?** *Declined=1; increased=2; remained stable =3*
1									
2									
3									
4									
5									

6.4 Wild fruits									
6.4.1 List the main products consumed		**6.4.2 Why did you choose to consume this species?** *widely available ("free access") = 1; hunger/food shortage=2; culinary/ traditional/ cultural motivations= 3; medicinal/health=4; Other (e.g. donation; please specify) =5*	**6.4.3 Where do you usually obtain the species from?** *forest= 1; agroforestry =2; cropland=3; non-forest natural system=4; purchased at the market/shop =5; barter=6; other (specify)=7*	**6.4.4 During which months does harvesting typically occur?** *Jan = 1 Feb = 2 Mar= 3 April = 4 May = 5 June = 6 July = 7 Aug = 8 Sept = 9 Oct = 10 Nov = 11 Dec = 12*	**6.4.5 How many times do members of your household collect these items during the season in which gathering typically occurs? Unit:** *Times per month*	**6.4.6 How many hours daily did you spend collecting the products** *1= 0-2 hrs; 2 = 2-4 hrs; 3 = 4-6 hrs; 4 = 6-8 hrs; 5 = more than 8 hrs*	**6.4.7 Average daily quantity collected Kg** *(see codes B)*	**6.4.8 What do you usually do with the species?** *1 = consume 2 = sell 3 = barter 4 = other (specify) multiple answers OK*	**6.4.9 In your view, has the availability of the resource declined, increased, or remained stable in the last year?** *Declined=1; increased=2; remained stable =3*
1									
2									
3									
4									
5									

6.5 Wild nuts or seeds									
6.5.1 List the main products consumed		**6.5.2 Why did you choose to consume this species?** *widely available ("free access)=1; hunger/food shortage=2; culinary/ traditional/ cultural motivations= 3; medicinal/health=4; Other (e.g. donation; please specify) =5*	**6.5.3 Where do you usually obtain the species from?** *forest= 1; agroforestry =2; cropland=3; non-forest natural system=4; purchased at the market/shop =5; barter=6; other (specify)=7*	**6.5.4 During which months does harvesting typically occur?** *Jan = 1 Feb = 2 Mar= 3 April = 4 May = 5 June = 6 July = 7 Aug = 8 Sept = 9 Oct = 10 Nov = 11 Dec = 12*	**6.5.5 How many times do members of your household collect these items during the season in which gathering typically occurs? Unit:** *Times per month*	**6.5.6 How many hours daily did you spend collecting the products** *1= 0-2 hrs; 2 = 2-4 hrs; 3 = 4-6 hrs; 4 = 6-8 hrs; 5 = more than 8 hrs*	**6.5.7 Average daily quantity collected Kg** *(see codes B)*	**6.5.8 What do you usually do with the species?** *1 = consume 2 = sell 3 = barter 4 = other (specify) multiple answers OK*	**6.5.9 In your view, has the availability of the resource declined, increased, or remained stable in the last year?** *Declined=1; increased=2; remained stable =3*
1									
2									
3									
4									
5									

6.6 Wild terrestrial meat (large/small mammals, reptiles, amphibians, birds, snails, other)									
6.6.1 List the main products consumed		**6.6.2 Why did you choose to consume this species?** *widely available ("free access)=1; hunger/food shortage=2; culinary/ traditional/ cultural motivations= 3; medicinal/health=4; Other (e.g. donation; please specify) =5*	**6.6.3 Where do you usually obtain the species from?** *forest= 1; agroforestry =2; cropland=3; non-forest natural system=4; purchased at the market/shop =5; barter=6; other (specify)=7*	**6.6.4 During which months does harvesting typically occur?** *Jan = 1 Feb = 2 Mar= 3 April = 4 May = 5 June = 6 July = 7 Aug = 8 Sept = 9 Oct = 10 Nov = 11 Dec = 12*	**6.6.5 How many times do members of your household collect these items during the season in which gathering typically occurs?** **Unit:** *Times per month*	**6.6.6 How many hours daily did you spend collecting the products** *1= 0-2 hrs; 2 = 2-4 hrs; 3 = 4-6 hrs; 4 = 6-8 hrs; 5 = more than 8 hrs*	**6.6.7 Average daily quantity collected Kg** *(see codes B)*	**6.6.8 What do you usually do with the species?** *1 = consume 2 = sell 3 = barter 4 = other (specify) multiple answers OK*	**6.6.9 In your view, has the availability of the resource declined, increased, or remained stable in the last year?** *Declined=1; increased=2; remained stable =3*
1									
2									
3									
4									
5									

6.7 Wild aquatic meat									
6.7.1 List the main products consumed		**6.7.2 Why did you choose to consume this species?** *widely available ("free access)=1; hunger/food shortage=2; culinary/ traditional/ cultural motivations= 3; medicinal/health=4; Other (e.g. donation; please specify) =5*	**6.7.3 Where do you usually obtain the species from?** *forest= 1; agroforestry =2; cropland=3; non-forest natural system=4; purchased at the market/shop =5; barter=6; other (specify)=7*	**6.7.4 During which months does harvesting typically occur?** *Jan = 1 Feb = 2 Mar= 3 April = 4 May = 5 June = 6 July = 7 Aug = 8 Sept = 9 Oct = 10 Nov = 11 Dec = 12*	**6.7.5 How many times do members of your household collect these items during the season in which gathering typically occurs? Unit:** *Times per month*	**6.7.6 How many hours daily did you spend collecting the products** *1= 0-2 hrs; 2 = 2-4 hrs; 3 = 4-6 hrs; 4 = 6-8 hrs; 5 = more than 8 hrs*	**6.7.7 Average daily quantity collected Kg** *(see codes B)*	**6.7.8 What do you usually do with the species?** *1 = consume 2 = sell 3 = barter 4 = other (specify) multiple answers OK*	**6.7.9 In your view, has the availability of the resource declined, increased, or remained stable in the last year?** *Declined=1; increased=2; remained stable =3*
1									
2									
3									
4									
5									

6.8 Insects									
6.8.1 List the main products consumed		**6.8.2 Why did you choose to consume this species?** *widely available ("free access)=1; hunger/food shortage=2; culinary/ traditional/ cultural motivations= 3; medicinal/health=4; Other (e.g. donation; please specify) =5*	**6.8.3 Where do you usually obtain the species from?** *forest= 1; agroforestry =2; cropland=3; non-forest natural system=4; purchased at the market/shop =5; barter=6; other (specify)=7*	**6.8.4 During which months does harvesting typically occur?** *Jan = 1 Feb = 2 Mar= 3 April = 4 May = 5 June = 6 July = 7 Aug = 8 Sept = 9 Oct = 10 Nov = 11 Dec = 12*	**6.8.5 How many times do members of your household collect these items during the season in which gathering typically occurs?** **Unit:** *Times per month*	**6.8.6 How many hours daily did you spend collecting the products** *1= 0-2 hrs; 2 = 2-4 hrs; 3 = 4-6 hrs; 4 = 6-8 hrs; 5 = more than 8 hrs*	**6.8.7 Average daily quantity collected Kg** *(see codes B)*	**6.8.8 What do you usually do with the species?** *1 = consume 2 = sell 3 = barter 4 = other (specify) multiple answers OK*	**6.8.9 In your view, has the availability of the resource declined, increased, or remained stable in the last year?** *Declined=1; increased=2; remained stable =3*
1									
2									
3									
4									
5									

6.9 Medicinal and aromatic plants									
6.9.1 List the main products consumed		**6.9.2 Why did you choose to consume this species?** *widely available ("free access)=1; hunger/food shortage=2; culinary/ traditional/ cultural motivations= 3; medicinal/health=4; Other (e.g. donation; please specify) =5*	**6.9.3 Where do you usually obtain the species from?** *forest= 1; agroforestry =2; cropland=3; non-forest natural system=4; purchased at the market/shop =5; barter=6; other (specify)=7*	**6.9.4 During which months does harvesting typically occur?** *Jan = 1 Feb = 2 Mar= 3 April = 4 May = 5 June = 6 July = 7 Aug = 8 Sept = 9 Oct = 10 Nov = 11 Dec = 12*	**6.9.5 How many times do members of your household collect these items during the season in which gathering typically occurs? Unit:** *Times per month*	**6.9.6 How many hours daily did you spend collecting the products** *1= 0-2 hrs; 2 = 2-4 hrs; 3 = 4-6 hrs; 4 = 6-8 hrs; 5 = more than 8 hrs*	**6.9.7 Average daily quantity collected Kg** *(see codes B)*	**6.9.8 What do you usually do with the species?** *1 = consume 2 = sell 3 = barter 4 = other (specify) multiple answers OK*	**6.9.9 In your view, has the availability of the resource declined, increased, or remained stable in the last year?** *Declined=1; increased=2; remained stable =3*
1									
2									
3									
4									
5									

6.10 Honey or associated products									
6.10.1 List the main products consumed		**6.10.2 Why did you choose to consume this species?** *widely available ("free access)=1; hunger/food shortage=2; culinary/ traditional/ cultural motivations= 3; medicinal/health=4; Other (e.g. donation; please specify) =5*	**6.10.3 Where do you usually obtain the species from?** *forest= 1; agroforestry =2; cropland=3; non-forest natural system=4; purchased at the market/shop =5; barter=6; other (specify)=7*	**6.10.4 During which months does harvesting typically occur?** *Jan = 1 Feb = 2 Mar= 3 April = 4 May = 5 June = 6 July = 7 Aug = 8 Sept = 9 Oct = 10 Nov = 11 Dec = 12*	**6.10.5 How many times do members of your household collect these items during the season in which gathering typically occurs? Unit:** *Times per month*	**6.10.6 How many hours daily did you spend collecting the products** *1= 0-2 hrs; 2 = 2-4 hrs; 3 = 4-6 hrs; 4 = 6-8 hrs; 5 = more than 8 hrs*	**6.10.7 Average daily quantity collected Kg** *(see codes B)*	**6.10.8 What do you usually do with the species?** *1 = consume 2 = sell 3 = barter 4 = other (specify) multiple answers OK*	**6.10.9 In your view, has the availability of the resource declined, increased, or remained stable in the last year?** *Declined=1; increased=2; remained stable =3*
1									
2									
3									
4									
5									
6.10.10 Do you have previous beekeeping skills? Yes = 1; No = 2									

6.11 Fodder									
6.11.1 List the main products consumed		**6.11.2 Why did you choose to consume this species?** *widely available ("free access)=1; hunger/food shortage=2; culinary/ traditional/ cultural motivations= 3; medicinal/health=4; Other (e.g. donation; please specify) =5*	**6.11.3 Where do you usually obtain the species from?** *forest= 1; agroforestry =2; cropland=3; non-forest natural system=4; purchased at the market/shop =5; barter=6; other (specify)=7*	**6.11.4 During which months does harvesting typically occur?** *Jan = 1 Feb = 2 Mar= 3 April = 4 May = 5 June = 6 July = 7 Aug = 8 Sept = 9 Oct = 10 Nov = 11 Dec = 12*	**6.11.5 How many times do members of your household collect these items during the season in which gathering typically occurs? Unit:** *Times per month*	**6.11.6 How many hours daily did you spend collecting the products** *1= 0-2 hrs; 2 = 2-4 hrs; 3 = 4-6 hrs; 4 = 6-8 hrs; 5 = more than 8 hrs*	**6.11.7 Average daily quantity collected Kg** *(see codes B)*	**6.11.8 What do you usually do with the species?** *1 = consume 2 = sell 3 = barter 4 = other (specify) multiple answers OK*	**6.11.9 In your view, has the availability of the resource declined, increased, or remained stable in the last year?** *Declined=1; increased=2; remained stable =3*
1									
2									
3									
4									
5									

6.12 Other (saps, resins, bark, bamboo, rattan, thatch grass, palm leaves or other construction materials or fibres) etc. If consumed and/or collected, please specify in section									
6.12.1 List the main products consumed		**6.12.2 Why did you choose to consume this species?** *widely available ("free access)=1; hunger/food shortage=2; culinary/ traditional/ cultural motivations= 3; medicinal/health=4; Other (e.g. donation; please specify) =5*	**6.12.3 Where do you usually obtain the species from?** *forest= 1; agroforestry =2; cropland=3; non-forest natural system=4; purchased at the market/shop =5; barter=6; other (specify)=7*	**6.12.4 During which months does harvesting typically occur?** *Jan = 1 Feb = 2 Mar= 3 April = 4 May = 5 June = 6 July = 7 Aug = 8 Sept = 9 Oct = 10 Nov = 11 Dec = 12*	**6.12.5 How many times do members of your household collect these items during the season in which gathering typically occurs?** **Unit:** *Times per month*	**6.12.6 How many hours daily did you spend collecting the products** *1= 0-2 hrs; 2 = 2-4 hrs; 3 = 4-6 hrs; 4 = 6-8 hrs; 5 = more than 8 hrs*	**6.12.7 Average daily quantity collected Kg** *(see codes B)*	**6.12.8 What do you usually do with the species?** *1 = consume 2 = sell 3 = barter 4 = other (specify)* *multiple answers OK*	**6.12.9 In your view, has the availability of the resource declined, increased, or remained stable in the last year?** *Declined=1; increased=2; remained stable =3*
1									
2									
3									
4									
5									

7. Food Frequency

Relation to qualified respondent: _____
qualified respondent...01; Spouse.....02; Own Child.....03; Step Child.....04; Adopted Child.....05; Grand Child.....06; Brother/Sister.....07; Cousin.....08; Niece/Nephew.....09; Son/Daughter-In-Law 10
Brother/Sister-In Law.11; Parent.....12; Parent-In-Law.....13; Other Relative.....14; Maid/Nanny/HouseServant15; Non-Relative.....16

NON-FOREST FOODS **Food group, items, varieties consumed**	**Never (or less than once per month)**	**1-3 per month**	**1-2 per week**	**3-4 per week**	**daily**	**Food source** *1 = market/ 2= farmed* *3=wild* *4 = other*
Grains Maize [flour]/posho,rice, millet flour, sorghum, wheat flour, bread, chapati (wheat rolls)						
White roots and tubers and plantains Cassava flour or roots (dry or fermented), sweet potato (white, yellow, orange), irish potato, bananas (green)						
Pulses and legumes beans, peas, lentils, cowpea, soy beans, pigeon peas						
Nuts and seeds groundnut (whole, powder), bambara groudnut, pumpkin seeds, sesame seeds (simsim),						
Dairy (milk, yogurt)						
Eggs						
Meat - pork, chicken, goat, beef						
Fish Nile perch (Empuuta), Singidia tilapia (Engege), Nile tilapia, Catfish (Semutundu), Silver fish (Mukene), Lungfish (Emmamba), Eels (Ensonzi), Sprat (Enkejje), Clarias locally known as "Emalle"						
Other vegetables onion [leaves], tomato, garlic, baby marrow, garden eggplant, [Chinese] cabbage, cultivated okra, carrots, spinach (dodo), green peppers						
Other fruits Banana, apple, mango, avocado, papaya, watermelon, guava, exotic (grape, strawberry, mulberry, peach) , citrus (orange, tangerine, lemon), jackfruit, paw paw						
Cooking oil sunflower						
Other beverages and foods Fermented beer,						

FOREST FOODS **Food group, items, varieties consumed**	**Never (or less than once per month)**	**1-3 per month**	**1-2 per week**	**3-4 per week**	**daily**	**Food source** *1 = market/ 2= farmed* *3=wild* *4 = other*
Mushrooms						
wild fruits - wild custard apple, tamarind, desert date, fan palm fruit, fig, gardenia, abyssinian jujube, large sourplum, black plum, palm tree)						
forest/wild vegetables, leaves and shoots - moringa, fig, black plum leaves, gardenia						
insects and other small protein foods caterpillars, grasshoppers, termites, bee larvae, palm weevils						
wild meat rodents, monkey, guinea fowl, small deer, bats, hares, birds)						
medicinal or aromatic plants (okra, ginge, jumping seed tree)						
forest honey (jarred, combs, propolis)						
nuts and seeds (shea, niam seeds,and/or derived oils)						
Other foods or beverages gathered in the wild ***Specify:***						

INTERVIEW END: (TIME) _____

Annex 3. Focus group guiding questions

1. DATE, DURATION AND FACILITATOR PARTICULARS	
Date	
Time start	
Time end	
Group Facilitator	
Note-takers and interpreters (names and contact info)	

2. AREA IDENTIFICATION CHARACTERISTICS	
Settlement/Village	
Region - forested (1)/non-forested (2)	
Land use/vegetation type	
GPS coordinates	Latitude _____ / Longitude _____

3. GROUP CHARACTERISTICS	
Number of people *Note: separate groups for men and women recommended; no more than 12 people per focus group*	Men: Women:
Number of participants per age group	1.___below 16 2. ___16-35 3. ___above 35
Main livelihood activity	1. ___ Nomadic 2. ___ Hunter and gatherer 3. ___ Farmer 4. ___ Pastoralist 5. ___ Fishermen 6. ___ Logging 7. ___Handicrafts 8. ___Product processing or industrial 9. ___Trade related 10. ___Services (incl. government, tourism, health care…) 11. ___Mining 12. ___ Other, specify_____
Ugandan nationals or residents from other countries	__ Ugandan Nationals __ List other nationalities present:

4. LIST FOODS TYPICALLY CONSUMED (Forest and non-forest)	
1.	**2.**
3.	**4.**
5.	**6.**
7.	**8.**
9.	**10.**
11.	**12.**
13.	**14.**
15.	**16.**
17.	**18.**
19.	**20.**
21.	**22.**
23.	**24.**
25.	**26.**
27.	**28.**
29.	**30.**

5. LIST MAIN FOREST FOODS CONSUMED
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

6. LIST MAIN FOREST PRODUCTS COLLECTED (IF ANY) AND MAIN SPECIES (IF AVAILABLE)
1.
2.
3.
4.
5.

7. CALENDAR OF AVAILABILITY OF PRODUCTS COLLECTED					
JANUARY	**FEBRUARY**	**MARCH**	**APRIL**	**MAY**	**JUNE**

JULY	**AUGUST**	**SEPTEMBER**	**OCTOBER**	**NOVEMBER**	**DECEMBER**

7. FREQUENCY OF COLLECTION AND QUANTITIES COLLECTED		
MAIN PRODUCTS	HOW MANY TIMES DO YOU COLLECT THE PRODUCT EACH SEASON (e.g. 10 time/month)	HOW MUCH DO YOU COLLECT DAILY? Units: 1 full, ½ or ¼ maize sack Bowl(s) - 100g Litres
1.		
2.		
3.		
4.		
5.		

8. HAS THE AVAILABILITY OF THE MAIN PRODUCTS COLLECTED (QUESTION 6) CHANGED IN THE LAST FIVE YEARS?			
PRODUCT	INCREASE	DECLINE	NO CHANGE
1.			
2.			
3.			
4.			
5.			

9. FOOD AND NUTRITION SECURITY & MOTIVATIONS BEHIND GATHERING	
What are the most food-insecure times of the year?	
What is the main motivation behind gathering?	Hunger/food shortage, abundance/free access, cultural/traditional reasons, medicinal, other?
Are there any forest products and foods that are particularly important for you/your households?	
Are there forest foods that only men, women or children consume?	

10. GENDER DISTRIBUTION OF LABOUR and USE OF HARVESTED PRODUCTS		
Who typically collects the main products listed? Please list main products collected by men and women in order of importance.	Men 1. 2. 3. 4. 5.	Women 1. 2. 3. 4. 5.
Do children participate in collection activities?	Yes	No
Who participates in processing of products? Please list which products are processed by men/women respectively.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.
What is the end use of the products? Home-consumption or sale (or both)?	HOME-CONSUMPTION 1. 2. 3. 4. 5.	SALE 1. 2. 3. 4. 5.

11. FOREST ACCESS & CONFLICT	
Do you have access to forest/wooded area for collecting wild forest products/NWFPs?	
Do you need a permit?	
What is the average distance to the area?	Distance _____
What is the average time required to reach the area?	Time _____
Have you experienced conflict for the collection of NWFPs in the last year? With whom?	

12. KNOWLEDGE, SKILLS and RESOURCES	
Where did you receive knowledge or skills on harvesting forest products?	
In your view, what is necessary to increase the benefits (home use or sale) from NWFPs? Please rank in order of importance	1. Better access 2. Better skills and knowledge 3. Better protection/regulation of the forest product 4. Better access to markets 5. More investment in planting/domestication 6. Better organization into user groups 7. Other_____

OTHER NOTES:

Annex 4. Market Survey

1. DATE, DURATION AND ADMINISTRATION PARTICULARS	
Date	
Time start	
Time end	
Survey administrator	
Interpreter	

2. AREA CHARACTERISTICS	
Settlement/Village	
Name of market if applicable	
GPS coordinates	Latitude _____ / Longitude _____

3. FOREST PRODUCTS SOLD, PRICE & WEIGHT				
PRODUCT (Local name)	Common or scientific name, if available	PRICE	WEIGHT	PEAK SEASON
WILD FRUITS/NUTS				
1. Kumoro	Shea nut/*Vitellaria P.*			
2. Iti	*Tamarindus indica*			
3. Lugba	*Balanites a.*			
4. Ichuki/Ochiki	*Ximenia Americana c.*			
5. Lipa	Wild custard apple			
6. Wiki	*Borassus aethiopium*			
7.	Wild passion fruit			
8.	Mango			
9. Odoo	*Vitex doniana*			
10. Batunda				
11.				
12.				
13.				
WILD VEGETABLES				
14.	*Moringa o.*			
15. Kiliwiri				
16. Dodo (wild)				
17. Ejiribiri				
18. Aroa-Asubi				
19. Luguruku				
20. Mundrokolo				
21. Sebika				
22.				
23.				
24.				
25.				
INSECTS				
26.	Crickets			

27.	Onya			
28.				
29.				
HONEY OR DERIVED PRODUCTS				
30.	Honey			
31.	Honey combs			
MUSHROOMS				
32. Lidu mushroom				
33.	Anthill mushroom			
34. Idiliri mushroom				
35. Kanue mushroom				
36. Lobini				
37.				
38.				
39.				
40.				
MEDICINAL PLANTS				
41. Pilopilo				
42. Sambia				
43. Kakwa				
44. Bulikibuli				
45. Izekize				
46. Aji-rija				
47. Layu				
48.				
49.				
50.				
51.				
BUSHMEAT				
52.				
53.				
54.				
55.				
FISH				
56.				
57.				
58.				
59.				
OTHER				
60.				
61.				
62.				
63.				

4. ANNUAL TRENDS, CHANGES IN SUPPLY & DEMAND			
What are the most important forest products sold?	What has been the demand trend in the past five years? *(1) Increased* *(2) Declined* *(3) No change*	What has been the supply trend in the last five years? *(1) Increased* *(2) Declined* *(3) No change*	What has been the trend in market price in the past five years? *(1) Increased* *(2) Declined* *(3) No change*
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

ADDITIONAL NOTES: