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Traditional knowledge on wild edible vegetables consumed by communities around Serengeti ecosystem, northern Tanzania

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Globally traditional knowledge on wild edible vegetables (WEVs) exists in most communities, but this information is limited and incomplete in the Serengeti ecosystem. This study employed face to face interviews using semi-structured questionnaires to about 180 households to acquire the required information on the WEVs species they consume in their area. After analysis of the collected data, the results indicated that a total of 10 WEVs species mostly herbaceous plants belonging to 10 genera and 9 families were used mainly for domestic (92.8%) and partly commercial (7.2%) purposes. Women (50.8%) were more knowledgeable on the WEVs they use than men in their area. Also, households with lower income (n = 161) represented more of women who were more knowledgeable on the WEVs they consume because they are the ones who most frequently harvested and cooked them. Additionally, majority of the households (86.6%) reported that the WEVs were decreasing in supply and difficult in accessing them and again were aware that WEVs were improving their livelihood and healthy status in the area. Therefore, we call for urgent measures to protect and conserve WEVs in Serengeti ecosystem.

Key words: Wild edible vegetables, traditional knowledge, communities, ethnobotany, Serengeti ecosystem.

INTRODUCTION

Wild edible vegetables (WEVs) are defined as those plants with edible parts that grow naturally on farm land, and on fallow or uncultivated land (Khakurel et al., 2021). They are the fresh and edible parts of herbaceous plants (Satter et al., 2016). According to Satter et al. (2016), WEVs may include roots, stems, leaves, fruits or seeds of the plants that can be eaten as raw and/or cooked form. They have played a significant role in different geographical regions of the world throughout human history (Duguma, 2020). They are a major part of daily food intake by humans with their main dishes all over the world and the cheapest and most readily available source

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of foods that can contribute significantly to human nutrition and health in rural as well as in urban areas, especially among the poor and marginalized communities (Satter et al., 2016; Duguma, 2020).

Globally, it is estimated that species of higher plants range between 300,000 and 500,000, of which at least 250,000 have been identified and documented, 30,000 edible and 7000 collected or cultivated at some point for human consumption (Bvenura and Sivakumar, 2017). About 30 major crops feed the world, providing 95% of dietary energy/calories or protein, while minor and underutilized species including wild fruits and vegetables play a key and significant role both nutritionally and culturally in many societies. Moreover, according to Naik et al. (2017), there are 45,000 species of wild plants out of which 9, 500 species are ethno-botanically important species. Among these, 7,500 species are in medicinal use for indigenous health practices and 3,900 plant species are used as tribal food; out of which, 145 species comprise root and tuber as food, and all totaled, there are 521 species of WEVs (Naik et al., 2017). Therefore, the consumption of wild plants persists in many communities, especially among indigenous people for whom wild food plants are part of their traditional food systems (Nath, 2015; Berihun and Molla, 2017; Punchay et al., 2020). Indigenous people often experience food insecurity and malnutrition, yet local communities often possess traditional knowledge that can help them to alleviate these problems through harvesting, hunting, and gathering of wild plants (Punchay et al., 2020). It has previously been found that the collection and consumption of WEVs has been a way of life to supplement dietary requirements for many rural populations (Berihun and Molla, 2017; Naik et al., 2017). In addition, previous studies have shown that humans have a tremendous influence on WEVs, even before civilization because of their high nutritional value as well as medicinal importance (Berihun and Molla, 2017; Naik et al., 2017). These plants play an important role in the livelihoods of rural households and forest inhabitants and provide an integral part of the subsistence strategy of people in many developing countries (Powell et al., 2014; Berihun and Molla, 2017; Naik et al., 2017). Therefore, the history of gathering WEVs for food from the wild, not only in Africa but the world at large, cannot be overemphasized. In Africa, for example according to Bvenura and Sivakumar (2017), this history can be back to the pre-Bantu migration era and can be found on the rock art of the Sahara and southern parts of the continent. It has been found that till today, women and children usually predominate the practice of gathering these essential foods (Bvenura and Sivakumar, 2017). However, Bvenura and Sivakumar (2017) pointed out that this tradition has drastically declined over time due to several factors such as forest degradation, agriculture, and urbanization.

Nonetheless, WEVs are still widely consumed in the daily diet of the local people and also serve as a source of income. However, they have received little attention in research studies concerning their biodiversity conservation and sustainable management; and many are largely ignored, remain unexplored or undocumented, especially those found in the Serengeti ecosystem. Therefore, the present study was carried out to document traditional knowledge on wild edible vegetables consumed by communities around the Serengeti ecosystem, northern Tanzania. Firstly, we hypothesized that women would have more knowledge on WEV's identity and their usage than men in the Serengeti ecosystem because they are the ones who most frequently harvested and cooked them. Secondly, that local people with lower income would be more knowledgeable of WEVs they use than those with higher income because they are the ones who most frequently use them in the area. Thirdly, more herbaceous than woody WEVs species would be used by the people because they are abundant and mostly frequently encountered in the area.

MATERIALS AND METHODS

Study area

The Serengeti ecosystem is approximately 25,000 km^2, centered on Serengeti National Park (SNP) (14,763 km^2) which is a World Heritage Site, Biosphere Reserve, and forms the heart of the Serengeti Maasai-Mara Migratory Ecosystem of north-western Tanzania and south-western Kenya (Mfunda and Røskaft, 2011) (Figure 1) and lies between 1° and 2°S; 34° and 36°E. The park itself is situated on the north western edge of Lake Victoria and up to the border with Masai Mara national reserve (Bugwesa et al., 2009). It borders the Ngorongoro Conservation Area, a multiple land use area, Ikorongo, Grumeti and Maswa Game Reserves, Ikona Wildlife Management Area (WMA) and Loliondo Game Controlled Area (Roskaft et al., 2012). The national park contains high diversity and concentrations of ungulates, large carnivores, and birds (Sinclair and Arcese, 1995). Also, the Serengeti ecosystem supports the largest herds of migratory species including wildebeest (*Connochaetes taurinus*), zebra (*Equus burchelli*) and Thomson gazelle (*Gazella thomsoni*) (Sinclair and Arcese, 1995; Thirgood et al., 2004). The land use type consists of a wildlife conservation area, human settlements, and agricultural and grazing lands. Topography of the area is characterized by a series of hills and valleys extending to an extensive gentle and flat area. Altitudes vary from 1280 to 2540 m above sea level, and the climate is described as having annual rainfall ranges from 600 to 1,200 mm and an average temperature of 26°C (Herlocker, 1974). The annual migration of over a million wildebeest defines the ecosystem (Schmitt, 2010) following seasonal variations in rainfall and the availability of grazing across the ecosystem (Walelign et al., 2019). According to Schmitt (2010), the ecosystem has more than a hundred villages located along the outside of the game reserves and park and within the game controlled area, or the NCA. These villages are home to over two million people inhabiting seven districts (Walelign et al., 2019). Many people in the ecosystem have been around since before the parks inception in 1959, having their

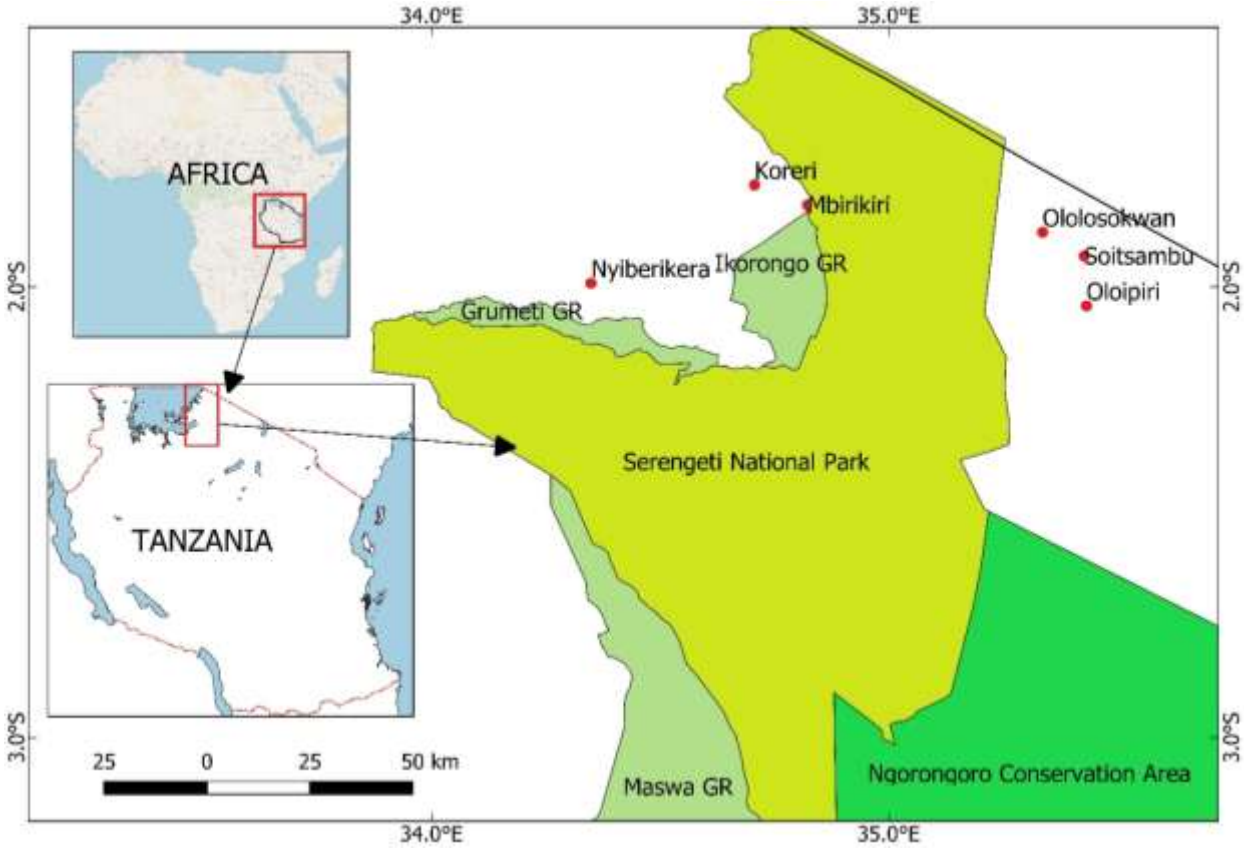

Figure 1. Map of Serengeti Ecosystem showing the study villages in red dots.
Source: Authors

traditional grazing lands taken away by the establishment of the park (Schmitt, 2010). However, immigration into the area is common and thus many people and groups are new to the ecosystem (Schmitt, 2010). However, the western side of Serengeti is mainly inhabited by multi-ethnic agro-pastoral communities mostly engaged in peasant agriculture (Mfunda and Røskaft, 2011). The ethnic communities in this part include the Kurya, Isenye, Natta and Sukuma, who mainly grow cotton, sorghum, millet, maize and cassava as dual crops and sell forest products such as fuel wood and building poles (Mfunda and Røskaft, 2011). On the contrary, the region East of SNP is inhabited by the Maasai pastoralists and Sonjo agro-pastoralists (Mfunda and Røskaft, 2011). The Sonjo are agro pastoralists who have specialized more in agriculture than the Maasai, and they mainly grow maize, beans, sorghum and millet. Maasai are mainly pastoralists, with livestock being central to their way of life, a style viewed as being compatible with sustainable conservation (McCabe, 2003).

Data collection

The data for this study were collected between January and May, 2018 because it was the time when the budget for the field work was available. Our survey encompassed 180 households who were chosen purposively, that is, 30 respondents from six randomly selected villages using a lottery method. The villages were Ololosokwani, Soitsambu, Oloipiri from Ngrongoro district and Mbirikiri, Koreri, Nyiberekera from Serengeti district. This criterion was used to understand and obtain maximum information as possible on WEVs available in each area. In each village, 30 households were purposively selected for the interview because based on the literature, a sample of at least 30 households is enough for statistical analysis (Acharya et al., 2013). No prior notice was given to the interviewees to reduce possible misrepresentations during the data collection process, although the village chairman was first informed about the study purposes; and his permission was secured to carry out interviews in the area. The respondents were chosen based on their ages (15 - 95 years) and gender (male, female). Then, the face-to-face interview using a semi-structured questionnaire was administered by the researchers with the help of the translator to acquire the required information. The method employed in this study was designed for collecting baseline information on the diversity and usage of WEVs by communities of the Serengeti ecosystem. The questions were prepared in English but asked in ‘’Swahili’’ language and then translated to the respective languages by the help of a tribe translator. From this method, we were able to record the required information on the uses of WEVs from each respondent in the area. Data collected included: village name, age of the respondent, age class (youth, adults, elders), gender (males, females), GPS location of the respondent household, education level (no education, primary, secondary), level of income (small, large), accessibility of

Table 1. The WEV species and their frequency of use by local communities among different families in the Serengeti ecosystem.

Species	Family	Frequency	Percent
Gynadropsis gynandra	Capparaceae	68	37.6
Amaranthus hybridus	Amaranthaceae	38	21.0
Solanum nigrum	Solanaceae	13	7.2
Corchorus tridens	Tiliaceae	32	17.7
Oxygonum sinuatum	Polygonaceae	2	1.1
Brassica oleracea var. *acephala*	Brassicaceae	1	0.6
Vigna unguiculata	Fabaceae	5	2.8
Agaricus bisporus	Agaricaceae	1	0.6
Portulaca quadrifolia	Portulacaceae	19	10.5
Capparis tumentosa	Capparaceae	2	1.1
Total		181	100.0

Source: Authors

WEVs (easy, moderate, difficult), WEVs availability (deceasing, increasing, stable), harvesting area (open area, game controlled area, game reserve, national park) and whether WEVs have contributed to improve their livelihood in the area.

Data analysis

Statistical Package for Social Science (SPSS, version 16.0) software was used for analyzing the data (http://www.spss.com) (Kirkpatrick and Feeney, 2010). The data were analyzed using descriptive statistics to determine the frequencies among different variables and the Pearson's Chi-square goodness-of-fit test using Exact Tests with Monte Carlo confidence level (two-sided significance). The Exact Tests enabled us to make reliable inferences because our data were small, sparse, heavily tied, or unbalanced and poorly distributed. Also, Exact Tests enabled us to obtain an accurate p value without relying on assumptions that may not be met by our data. Therefore, Pearson's Chi-square goodness-of-fit test using Exact Tests with Monte Carlo confidence level (two-sided sig.) were used to determine whether the distribution of cases (e.g., wild edible vegetable species) in a single categorical variable. These variables included the following: Gender (consisting of two groups: men and women), Income category (consisting of two groups: small income and large income), Taxonomic category of WEV group (consisting of two groups: family and genus), Frequency of the WEVs use (consisting of four groups: daily, weekly, monthly and annually, Accessibility of WEVs (consisting of three groups: easy, moderate and difficult), WEVs availability (consisting of three groups: deceasing, increasing and stable), Harvesting area (consisting of four groups: open area, game controlled area, game reserve and national park), and Whether WEVs have contributed to improve their livelihood in the area (consisting of two groups: “Yes” and ”No”).

In addition, a linear regression analysis was used with response to the question “Which WEVs species are you using in your area?” as the dependent variable; and the following independent variables: age classes (youth, adults, elders), gender (men, women), education level (no education, primary, secondary education), income level (small, large), frequency of use (daily, weekly, monthly, annually), reasons for use (domestic, commercial), harvesting location (open area, game controlled area, game reserve, national park), availability status (stable, decreasing, increasing) and WEVs forms (herb, shrub). This method was used to determine which independent variables or factors explained the existing variation in traditional knowledge of WEVs use among the communities in the area. Since all the independent variables used were all continuous, therefore no assumptions about their distributions were made. For all tests, $p \leq 0.05$ was considered significant.

RESULTS

In the present study, a total of 10 WEV species belonging to 10 genera and 9 families (Table 1) were documented and used mainly for domestic (92.8%, diet) and partly commercial purposes (7.2%, source of income). Of these species, 179 were herbs (98.9 %) while others were shrubs (1.1 %). Among these, the most represented were Capparaceae (38.1%), Amaranthaceae (21.5%) and Tiliaceae (17.7%); exemplified by the following species: *Gynadropsis gynandra* (37.6%), *Amaranthus hybridus* (21.0%), and *Corchorus tridens* (17.7%), respectively (Table 1).

Traditional knowledge about WEVs differed significantly among villages (χ^2 = 58.98, df = 11, P < 0.001). Households from Koreri (21.5%), Mosongo (21.0%) and Maburi (17.7%) villages were more knowledgeable on WEVS they use than other villages such as Nyiberekera (3.3%), Nyamirama (2.8%), Mbirikiri (3.9%), Ololosokwani (6.1%), Oloipiri (1.7%), Enguserosambu (3.3%), Maaloni (9.9%), Losoito (2.2%), and Digodigo (7.2%). Those households reported that they use more *G. gynadra* (n = 68), *A. hybridus* (n = 38) and *C. tridens* (n = 32) compared to other WEVs species in the area.

Traditional knowledge on WEVs differed significantly among households’ ages as well as age classes (p <0.001), with more youths (n = 65, 35.9%) and elders (n

Table 2. Differences between men and women in terms of knowledge about WEV uses in the Serengeti ecosystem.

WEV Species	Men		Women		Total	
	n	%	n	%	N	%
Gynadropsis gynandra	39	57.4	29	42.6	68	100.0
Amaranthus hybridus	27	71.1	11	28.9	38	100.0
Solanum nigrum	10	76.9	3	23.1	13	100.0
Corchorus tridens	7	21.9	25	78.1	32	100.0
Oxygonum sinuatum	2	100.0	0	0.0	2	100.0
Brassica oleraceae var. *acephala*	1	100.0	0	0.0	1	100.0
Vigna unguiculata	1	20.0	4	80.0	5	100.0
Agaricus bisporus	1	100.0	0	0.0	1	100.0
Portulaca quadrifolia	1	5.3	18	94.7	19	100.0
Capparis tumentosa	0	0.0	2	100.0	2	100.0
Total	89	49.2	92	50.8	181	100.0

Source: Authors

= 62, 34.3%) who expressed more knowledge on WEVs than adults (n = 54, 29.8%) in the area. Moreover, traditional knowledge on WEVs differed significantly among education levels (χ^2 = 33.45, df = 18, P = 0.015) with households with primary education (60.2%) being more knowledgeable than those without any education (23.2%) and those with secondary education (16.6%) in the area.

Also, WEVs were found to differ significantly from where they were found (P < 0.001). A majority of the households reported that more WEVs were found in open areas (n = 149, 82.3%) and game controlled areas (n = 19, 10.5%) than in a National parks (n = 9, 5.0%) or in Open areas and Game controlled areas (n = 3, 1.7%) and open areas and national parks (n = 1, 0.5%) within the area.

Most of the respondents mentioned that the frequency of the WEV's use was mostly annually (30.6%), daily (27.4%), weekly (25.5%) and monthly (16.6%), respectively. Some of which were often collected from open areas, game controlled areas or a national park. Herbaceous plants made up the highest proportion of edible plants and leaves were the dominant edible parts consumed through cooked food.

Moreover, women (n = 92, 50.8%) possessed more traditional knowledge on WEVs identity and usage than men did (n = 89, 49.2%) (χ^2 = 45.1, df = 9, P < 0.001; Table 2) with the 99% confidence interval for p = (0.001, 0.001). The Monte Carlo estimate of 0.000 for the exact p value was based on 10,000 random samples from the reference set, using a starting seed of 475,497,203. Also, youths (35.9%) and elders (34.3%) were more knowledgeable on identifying WEV's use than adults (29.8%) in their area, and this difference is statistically significant (χ^2 = 70.495, df = 18, P < 0.001, Table 3) with the 99% confidence interval for p = (0.001, 0.001). The Monte Carlo estimate of 0.000 for the exact p value was based on 10,000 random samples from the reference set, using a starting seed of 624,387,341. Women elders (n = 41, 44.3%) were more knowledgeable on the WEVs they use in their area especially on using *Portulaca quadrifolia* (n = 18, 94.7%) and *C. tridens* (n = 25, 78.1%) compared to adult men (n = 19, 20.7%) and youths (n = 32, 34.8%), as well as to their counterpart men elders (n = 21, 23.6%), adults (n = 35, 39.3%) and youths (n = 33, 37.1%) who reported mostly specifically *A. hybridus* (n = 27, 71.1%) and *G. gynandra* (n = 39, 57.4%) and their differences were statistically significant (χ^2 = 45.07, df = 9, P < 0.001) with the 99% confidence interval for p = (0.001, 0.001). The Monte Carlo estimate of 0.000 for the exact p value was based on 10,000 random samples from the reference set, using a starting seed of 2,000,000. Whereas, there were also statistically significant differences with level of household income (n = 161, small income) and (n = 20, large income) regarding the traditional knowledge on WEV uses (χ^2 = 2.42, df = 9, P < 0.001; Table 4) the former being more knowledgeable than the latter in the area, with the 99% confidence interval for p = (0.001, 0.001). The Monte Carlo estimate of 0.000 for the exact p value was based on 10,000 random samples from the reference set, using a starting seed of 2,000,000. Women (n = 82, 50.9%) had lower income compared to men (n = 79, 49.1%); though their differences were not statistically significant (P = 0.937).

In addition, majority of the local household (86.6%) reported that the WEVs decreased more in supply than either increasing (7.8%) or remaining stable (5.6%) and their differences were statistically significant (χ^2 = 16.72, df = 2, P < 0.001) with the 99% confidence interval for p =

Table 3. Differences between household's age classes in terms of WEV use knowledge in the Serengeti ecosystem.

Species name	Age Classes			Total
	Youths	Adults	Elders	
Gynadropsis gynandra	26 (38.2)	28 (41.2)	14 (20.6)	68 (100.0)
Amaranthus hybridus	19 (50.0)	13 (34.2)	6 (15.8)	38 (100.0)
Solanum nigrum	7 (53.8)	0 (0.0)	6 (46.2)	13 (100.0)
Corchorus tridens	6 (18.8)	10 (31.2)	16 (50.0)	32 (100.0)
Oxygonum sinuatum	2 (100.0)	0 (0.0)	0 (0.0)	2 (100.0)
Brassica oleracea var. *acephala*	1 (100.0)	0 (0.0)	0 (0.0)	1 (100.0)
Vigna unguiculata	4 (80.0)	1 (20.0)	0 (0.0)	5 (100.0)
Agaricus bisporus	0 (0.0)	1 (100.0)	0 (0.0)	1 (100.0)
Portulaca quadrifolia	0 (0.0)	1 (5.3)	18 (94.7)	19 (100.0)
Capparis tumentosa	0 (0.0)	0 (0.0)	2 (100.0)	2 (100.0)
Total	65 (35.9)	54 (29.8)	62 (34.3)	181 (100.0)

Source: Authors

Table 4. Differences between households with different levels of income in terms of knowledge about WEV uses in the Serengeti ecosystem.

Species name	Level of income		Total
	Small income	Large income	
Gynadropsis gynandra	52 (76.5)	16 (23.5)	68 (100.0)
Amaranthus hybridus	38 (100.0)	0 (0.0%)	38 (100.0)
Solanum nigrum	9 (69.2)	4 (30.8)	13 (100.0)
Corchorus tridens	32 (100.0)	0 (0.0)	32 (100.0)
Oxygonum sinuatum	2 (100.0)	0 (0.0)	2 (100.0)
Brassica oleracea var. *acephala*	1 (100.0)	0 (0.0)	1 (100.0)
Vigna unguiculata	5 (100.0)	0 (0.0)	5 (100.0)
Agaricus bisporus	1 (100.0)	0 (0.0)	1 (100.0)
Portulaca quadrifolia	19 (100.0)	0 (0.0)	19 (100.0)
Capparis tumentosa	2 (100.0)	0 (0.0)	2 (100.0)
Total	161 (89.0)	20 (11.0)	181 (100.0)

Source: Authors

(0.001, 0.001). The Monte Carlo estimate of 0.000 for the exact p value was based on 10,000 random samples from the reference set, using a starting seed of 2,110,151,063; and also, there was more difficulty in accessing them (42.0%). Also, a majority of the households (n = 181, 100%) agreed that the WEVs were improving their livelihood in the area.

Furthermore, a linear regression analysis where the dependent variable was "which WEVs species are you using in your area" and independent variables as: age classes, gender, education level, income level, frequency of use, reasons for use, harvesting location, availability status and WEVs, with the method entered being significant ($F = 9.1$, $r^2 = 0.389$, $P < 0.001$). Here, the slope coefficients of the regression line for age classes ($B = 1.09$, $t_1 = 4.85$, $P < 0.001$), gender ($B = 1.46$, $t_1 = 4.17$, $P < 0.001$), income levels ($B = 2.69$, $t_1 = 4.86$, $P < 0.001$) and WEV's form ($B = 5.26$, $t_1 = 3.12$, $P = 0.002$) explained the variation significantly; while the education level, frequency of use, reasons for use, harvesting location, and availability status did not.

DISCUSSION

The present study revealed that a total of 10 WEV species of herbaceous plants, belonging to 10 genera and 9 families, were known and used by the majority of

the households mainly for domestic and partly commercial purposes in the area. Our findings support reports that Wild Edible Vegetables (WEVs) are an important component of traditional food systems with higher nutritional values around the world (Powell et al., 2014; Konsam et al., 2016; Khakurel et al., 2021). This is because they have used WEVs from time immemorial to contribute to their food security and health as well as having nutrient value (Thakur et al., 2017). In addition, WEVs are also important to communities of the area, probably because they are a source of vitamins, fibers, minerals, fatty acids and sometimes they have medicinal values (Duguma, 2020). In most cases, communities consumed those plants or plant parts after either boiling or frying or preparing curry or chutneys or raw vegetables. Also, a study by Duguma (2020) revealed that WEVs are relevant to household food security and nutrition in some rural areas and are relied on to supplement the staple food, to fill seasonal food shortages, and to serve as emergency food during famine. Again, communities around the Serengeti ecosystem use these WEVs such as *G. gynandra*, *A. hybridus* and *C. tridens* as an accompaniment for their staple cereal-based diets food crops that include maize (*Zea mays*), rice (*Oryza sativa*), wheat (*Triticum aestivum*), potato (*Solanum tuberosum*), soybean (*Glycine max*), and cassava (*Manihot esculenta*). These are grown in their areas to add diversity to their diets; thus, making their diets healthier and more interesting. In addition, Konsam et al. (2016) reported that the use of wild plants as food is an integral part of the culture and tradition of many indigenous communities around the world. Similarly, Devarkar et al. (2010) revealed that although nowadays, human vegetable consumption is based on rather very limited number of crops (12-15 species); however, in many parts of the world, the use of wild plants is very common. Moreover, previous studies also revealed that a large section of the rural population, such as those of the Serengeti ecosystem, meets their nutritional requirement through unconventional means, by consuming various wild plants and animal resources (Konsam et al., 2016).

However, besides nutritional value obtained from the WEVs in the Serengeti ecosystem, some of the communities used WEVs partly for commercial purposes. This corroborates with the finding of Duguma (2020) who reported that benefits such as income and employment can be obtained from the sale of WEVs. This is in support of the study by Konsam et al. (2016) who reported that millions of people, mostly in developing countries, derive a substantial part of their subsistence and income from wild plant products. In addition, although WEVs provide staple food for indigenous people and serve as complementary food for non-indigenous people, they also offer an alternative source of income (Konsam et al., 2016).

The finding also revealed that *Agaricus bisporus* was among the WEVs used by people in the area. This plant is an edible basidiomycete mushroom native to grasslands in Europe and North America. However, it was found to be used by the people of the Serengeti area because during the rainy season, wild edible mushrooms such as *A. bisporus* grow naturally in most parts of Tanzania and members of various communities, especially women and children, gather mushrooms to be used as relish (Mamiro et al., 2010). Additionally, the wild edible mushrooms are reported to be seasonal and the seasonality is determined by moisture availability (Mamiro et al., 2010). According to Mamiro et al. (2010) their availability is controlled by moisture availability in particularly that found in the Serengeti ecosystem.

The findings also showed that elder women households in the Serengeti ecosystem possessed more traditional knowledge on WEVs, including their identity and usage, because probably they predominately use the practice of gathering and cooking of these essential foods (Bvenura and Sivakumar, 2017); and therefore this supports our first predisposition. In addition, it is because knowledge of WEVs is part of their traditional knowledge, which is usually transmitted by elders to young ones and also by participation of individuals in collection of vegetable plants (Devarkar et al., 2010). Also, the study by Konsam et al. (2016) observed that women (>40 years old) of a household possessed more traditional knowledge about leafy vegetables, including the identity of the species, as well as the usage and mode of preparation. This could be due to their association with household chores, such as cooking, marketing, and their home nurturing qualities (Konsam et al., 2016). This is in support of the finding from the study by Powell et al. (2014) who claimed that everywhere, women had very clear knowledge about specific preparation practices needed to make different species palatable. In addition, Powell et al. (2014) pointed out that some women claimed that people prefer WEVs to cultivated/imported vegetables because they taste better and/or have medicinal properties.

The finding also revealed that traditional knowledge on WEVs differed significantly between education levels and those households that have been to school are more knowledgeable than those who have not in the area. This is because, according to Gartaula et al. (2020), those who have been to school have already experienced the interface between formal knowledge at school and informal knowledge at home with respect to their own food and nutrition and therefore are self-motivated to learn from both knowledge systems. Moreover, it had been found that a food literacy that is predominantly shaped by both informal and formal food knowledge in most communities to enhance the overall food literacy and community food security of current and future

generations because those that have been to school have the potential to enhance their food literacy in the schools through experiential learning (Gartaula et al., 2020).

However, majority of the local household reported that the WEVs were decreasing in supply and difficult in accessing them probably because of increased land use change (expansion of agricultural lands), developmental activities (road construction and urbanization), habitat destruction (timber harvest, fuelwood collection, and wildfire), drought, overharvesting and overgrazing (Bvenura and Sivakumar, 2017; Duguma, 2020). Also, according to Powell et al. (2014), decreased availability of WEVs is probably due to biodiversity loss and changes in agricultural practice, government and development policies that ignore WEVs; loss of knowledge needed for gathering and preparation; and a general loss of cultural value for WEVs.

In this study it was found that households with lower income were more knowledgeable on WEVs they use than those with higher income in the area. This is in support of our second prediction and the finding by Duguma (2020) who reported that WEVs have played a significant role in supplying food and nutritional requirements and increasing the health status of poor communities in many rural parts of the world. In addition, according to Duguma (2020), WEVs have always been an essential and widespread food source for food-insecure families living in poverty in developing countries. Moreover, WEVs are also important for many communities in rural villages and even those in urban areas, especially among the poor and marginalized (Duguma, 2020).

The finding also indicated that youths and elders households possessed more traditional knowledge on WEVs species they use than adults in their area. This finding is consistent with a study by Konsam et al. (2016), which revealed that traditional knowledge of WEVs should be transmitted to future generations to obtain inexpensive food resource and improve their healthy status as previously had been reported that WEVs knowledge is gained early in life and increases with age.

Again, majority of the local households reported that the WEVs improved their livelihood in the area. This is because WEVs are known to make important contributions to food baskets and livelihoods in the smallholder and subsistence farming communities of sub-Saharan Africa (Shumsky et al., 2014). Also, this finding supports the findings of Ju et al. (2013) who reported that locally harvested wild edible plants (WEPs) provide food as well as cash income for indigenous people, and are of great importance in ensuring global food security and they improve the nutrition in the diets of many people in developing countries. Additionally, some also play a significant role in maintaining the productivity and stability of traditional agro-ecosystems (Ju et al., 2013).

CONCLUSION AND RECOMMENDATIONS

This study concludes that majority of the households were knowledgeable on the WEVs species they use in their area. Most of the WEVs species used were herbaceous plants and were used mostly for domestic and partly commercial purposes. Elder women were more knowledgeable than men of all ages on the WEVs they use in their area. Households with lower income more represented by women were more knowledgeable on the WEVs they consume because they are the ones who most frequently harvested and cooked them. Additionally, majority of the households were aware that the WEVs were decreasing in supply and difficult in accessing them probably because of their over harvesting as well as improving their livelihood and healthy status in the area. We therefore call for further research into WEVs nutritional components to understand their potential as a source of future food and nutritional security as well as for urgent measures to protect and conserve WEVs in Serengeti ecosystem.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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