ORIGINAL RESEARCH ARTICLE

UTILIZATION OF ALATE TERMITES (*Macroterme Spp*) TO IMPROVE NUTRITIONAL SECURITY AMONG HOUSEHOLDS IN VIHIGA COUNTY-KENYA.

[1]Samantha Anyuor, [2]Monica Ayieko and [3]Amulen Deborah
[1]Department of Agricultural Economics, Agribusiness Management and Agricultural Extension-Chuka University
[2]Department of Plant, Animal and Food Sciences, Jaramogi Oginga Odinga University of Science and Technology
[3]Department of Livestock Industrial Resources, Makerere University
Corresponding email: anyuorsamantha@gmail.com

ABSTRACT
Among key food nutritional concerns all over the globe is the rising demand for high-value protein, which is projected to double by 2050 due to the rapidly growing population in developing economies, such as Kenya. To meet the new demand, conventional livestock may prove expensive as the current production system remains unsustainable. Research on alternative sources of protein calls for affordable and environmentally acceptable protein sources. Hence entomophagy is gaining attention with approximately 1,900 insect species consumed worldwide including the Alate termites. However, information on utilization and abundance is largely anecdotal and disjointed due to the limited knowledge of sustained off-season production, appropriate processing technology and packaging for all end-user market segments. The objective of this study was to fill this knowledge gap by assessing the capacity of farmers on the current harvesting and utilization of the alate termite. The research involved a cross-sectional descriptive survey design that informed data collection from a target population of 64,752 households. A Semi-structured questionnaire was used to collect data from a sample of 204 households obtained through a multistage sampling procedure within Vihiga County Western Kenya. Descriptive and exploratory statistics was applied in summarizing the results while chi-square statistic was used to test for association between attitude, knowledge and utilization of alate termites and the socio-demographic variables

The key findings revealed a strong association between the respondents' socio-economic status and' capacity, including attitude on consumption, methods and forms of utilization of alates. Where the categorical variables socioeconomic characteristics, influenced the choice of preferred forms as either fried or blanched termites ($p<0.001$). Additionally, there was a strong association of termite availability and their role in alleviating hunger through household diet diversification and food security. The utilization of alate termites assessed was recorded to have 65% of the respondents utilize the alate termites for health reasons while 81% consume alate termites as either side dish or staple. The main factors determining abundance and utilization of alate termites (figure 2) include seasonality and weather (63.2%), type of soil in the locality. The termites may be exploited to provide high-quality diets for households especially in developing countries while promoting awareness of the nutritional potential.

Key words: Alate termites, Food security, edible insects, Livelihood

1.0 INTRODUCTION

The entire globe is faced with food insecurity especially in countries in Sub Saharan Africa. Threats of malnutrition and stunting pose a greater challenge with fears to feed the doubling population projected by the year 2050 (FAO, 2013). Kenya as one of the affected economies has made substantive strides in reducing the prevalence of malnutrition, stunting and food insecurity, through several policy interventions which contributed to the fall in the cases of malnutrition from

35% in 2008 to 26% in 2014. (KNBS et al. 2015; ICF Macro, 2010). Additionally, there have been coordinated National Nutritional strategies and initiatives committed to eradicating hunger and attaining a food-secure nation, included in the National development blueprint, the vision 2030, and aligned as part of the broader medium-term development plans.

Regardless of the efforts, Kenya continues to experience severe food insecurity with 3.4 million people in 2007 suffering from acute food insecurity, (USAID, 2017a). Recently, there is modelling and research on the effects of the COVID-19 pandemic on the state of household food security and malnutrition, which is displayed to have affected livelihoods and in turn household diets. These are attributed to persistent drought, devastating floods as a result of climate change, high cost of domestic food production, and low purchasing power. Therefore, to achieve the goal of environmental sustainability while meeting the increasing demand for protein calls for scaling up intervention research on sustainable solutions to guarantee access to affordable and accessible nutritious food. To meet the demand, animal protein has proven expensive and unavailable due to challenges on production systems, pressure on agricultural land as well as effects of Green House gas emissions (GHGs) (Steinfeld H, et.al.,2006; Oonincx D.G., et.al., 2010).

Among the alternative food sources are the high-value edible insects that are being used to supplement animal-based protein. Entomophagy, the collection and consumption of insects could be a possible solution as a food supply chain for developing countries, Kenya included (van Huis, 2013). Edible insects have proved potential and significant by research for future food and feed alternatives with high nutritional value and a lesser ecological footprint. (FAO, 2013). Therefore, there is a focus on the supply side to establish and optimize insect production and develop a functional edible insect value chain. Nevertheless, different studies have shown that entomophagy contributes positively to nutrition, health, environmental sustainability and household livelihood for those involved in the edible insect value chain (van Huis, 2013), of which alate termites are among the edible insects that have gained substantial attention in terms of collection, marketing and consumption (Huis, 2012; Anankware et al., 2016).

Currently, over 1,900 insect species are consumed (Van Huis, 2013), depending on their stage in the life cycle. Anankware et al., (2015) reported consumption of some edible insect species including termites in Asia, South Africa (SA), North America (NA), Africa and Australia with SA, NA and Asia being high on the ranking. Entomophagy has been reported in Africa (Van Huis, 2013) mainly collected from harvesting from the wild for either livestock feed or food. The most commonly consumed insect species include caterpillars (Lepidoptera) 18%, bees, wasps and ants (Hymenoptera) (14%), grasshoppers, locusts and crickets (Orthoptera) (13%), cicadas, leafhoppers, planthoppers, scale insects and true bugs (Hemiptera) (10%), termites (Isoptera) (3%), dragonflies (Odonata) (3%), flies (Diptera) (2 %) and other orders (5%) (FAO, 2013; (Arnold van Huis, 2013). More than 2.5 billion people eat insects in Africa and Asia as part of their diet and sale for income generation in rural and urban areas. (FAO, 2010). Insects are a potential source of protein (amino acids), fats, minerals and essential vitamins including vitamin A, B complex and C (Johnson, 2010). They pose low risks of zoonosis (Ayieko et al., 2011) with high entrepreneurial

opportunities for the population worldwide.

In Kenya, different insect species including the alate termites, grasshoppers, locusts, lake flies and crickets have been embraced as important parts of the diet (Ayieko, 2013; Kinyuru et al., 2012). These insects have received a boost due to increased research on their potentiality. The consumption of the soldier termites of the Macrotermes spp has been reported in Zimbabwe as well as parts of Sub-Saharan Africa and SA by Van Huis, (2003). Termite collection and consumption has been reported by Ayieko et al. (2010) in greater parts of Western Kenya that forms the study region, with alate termites being the most commonly harvested at the onset of the first rains following a dry season.

According to a report by GoK (2013), Vihiga County is depicted to be characterized by small scale crop and livestock production which predisposes the population to dangers of food insecurity and malnutrition. Additionally, a report by the county development plan of (2018-2022) indicates that the county faces a challenge of malnutrition resulting in stunting, wasting and underweight of approximately 21% of children population under the age of five. Therefore, diversification of food resources and promotion of value chain activities of the available food resources would promote employment to contribute to household cushioning techniques against poverty, hunger and promote food security. Harvesting, commercialization and consumption of alate termites in Vihiga County are experienced mostly during the long rainy season depicted by the high quantity of the harvested alate termites that supplements household diets through both the direct and indirect livelihood pathways.

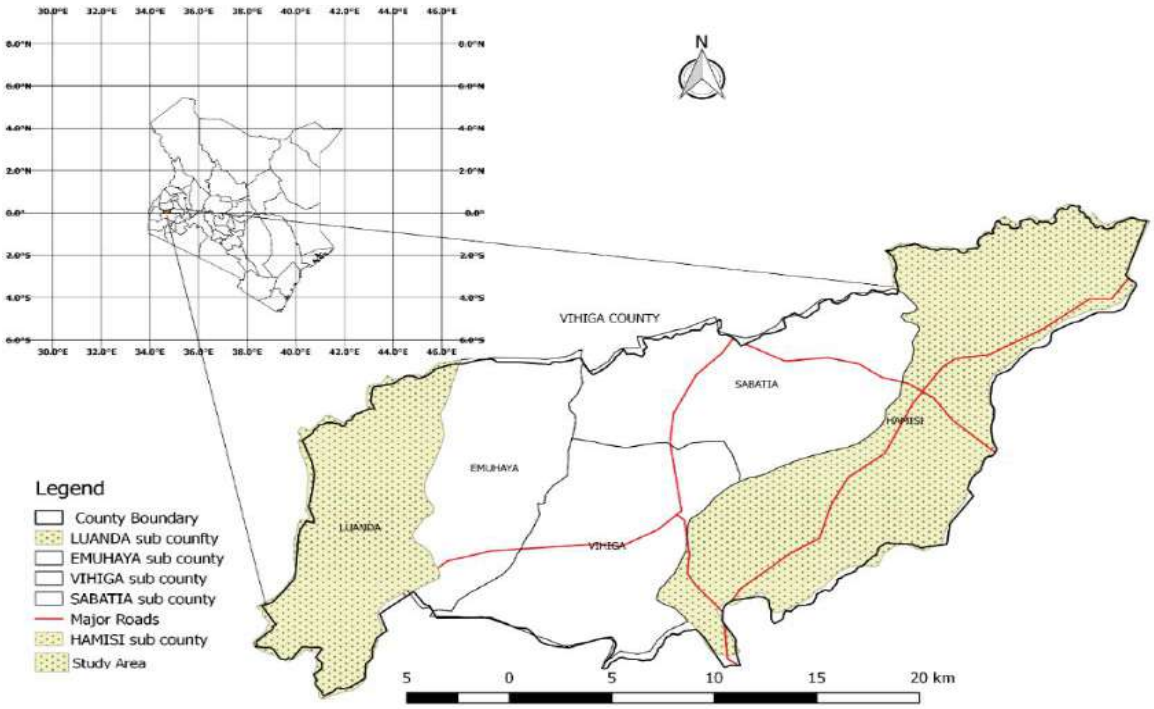
Termites are sold in whole after frying or in processed products such as Crackers, muffins, sausages and meatloaf this shows its potential for food security and source of household livelihoods. (Ayieko et al., 2010). From literature, it is evident that termites and termite products are accepted by the greater population in the lake region of Kenya, therefore, there is a need to explore their economic and nutritional potentiality by assessing the households already benefiting from the utilization of the termites. Studies have been done on cases of acceptance of insects and willingness to buy them (Ayieko et al., 2010), however, facts on potentials of termites to contribute to household food security and benefits of utilization to a household in terms of economic aspects remains an unexplored area of research. Thus, this study focused on how utilization of alate termites contributes to household livelihood dietary diversification to make recommendations on its potentiality as an enterprise by promoting residents' capacity.

2.0 Materials and Methods

2.1 Study area

The study was conducted in two sub-counties within Vihiga County Kenya that is Luanda and Hamisi sub-counties as a sample representation of urban and rural households respectively as in figure 1. The study area was purposively selected due to data concentration looking into the emergence of termite commercialization and the population density within the county.

Cross-sectional survey design was used to obtain the extent of harvesting, commercialization and consumption of alate termites. According to KNBS (2019), Hamisi sub-county recorded the highest number of households of 37,982 selected to represent the rural residents, while Luanda sub-county recorded 26,766 which was a representation of the urban residents that forms the largest known termites' commercialization Centre within Vihiga County.



Source: GIS (Feb 2020)

Figure 1: Map of Vihiga County

2.2 Study and sampling design

The target population was obtained through multistage sampling procedures, where for the first and second stages, purposive sampling was employed to select Vihiga County as the area of study. The county has a total population frame of 64,752 households from which Luanda and Hamisi sub-counties were selected. These two represented the urban and rural populations respectively due to the emergence of harvesting and commercialization of alate termites.

In the third stage, random sampling was employed to obtain two wards per sub-county. This enhanced good representation data of which, from Luanda sub-county, Luanda south and Luanda Township were selected whereas, from Hamisi sub-county, Tambua and Gisambai wards were selected.

The sampling procedure was guided by information obtained from sub-county agricultural offices. The fourth stage comprised the use of a simple random sampling procedure to obtain 120 and 84 respondents from Hamisi and Luanda sub-counties giving a total of 204 respondents for the study including harvesters, marketers and consumers.

Data was collected through face-to-face interviews using a semi-structured questionnaire from selected Households as well as from the open market places to interview the harvesters, marketers and consumers. The questionnaire was administered in the two sub-counties within Vihiga County by the trained research assistants using the online data kit (ODK collect). The application of the ODK was to ensure efficiency, convenience, cost-effectiveness and as well aid reduction of human errors that would be committed during data entry.

The questionnaire was organized into four sections containing information on respondents' demographic characteristics, farmers' capacity on collection and utilization of alate termites, termite collection and household income and food security.

Data collected were assembled, grouped into categories, coded and entered into an MS Excel sheet. Qualitative data was organized into distinct categories, patterns and themes identified and further evaluated and analyzed to determine its adequacy and usefulness to the objectives of the study. All the analysis was done using R version 4.0.2 (RCore Team, 2020).

2.3 Analytical framework

Statistical methods, Chi-square tests

A chi-square statistic was used to evaluate whether the distribution of categorical variables differs from one another. The procedure compares the tallies or counts of categorical responses between two independent groups. The null hypothesis assumes that there is no association between two variables whereas the alternative hypothesis assumes that there is independence as it is for other tests like ANOVA, where a test statistic is computed and compared to a critical value. The critical value for chi-square statistic is determined by the level of significance (0.05 in this study) and the degrees of freedom. The degrees of freedom for chi-square were calculated using the formula;

Equation 1 $$df = \frac{r-1}{c-1}$$

Where r is the number of rows and c is the number of columns. If the observed chi-square test statistic is greater than the critical value, the null hypothesis can be rejected. The chi-square test statistic is provided by;

Equation 2 $$x^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Where $O_{is}$are observed frequencies and $E_{is}$are the expected frequencies, and x^2 is the chi-square test of independence.

The key indicators of farmers' capacity for collection and utilization of termites were: attitude, knowledge and practices pertaining to preference and consumption. These indicators were measured on a five-point Likert scale (with 5 being strongly agreed). The respondents were asked to indicate the extent of their agreement on each statement (indicator).

Descriptive statistics such as frequencies, percentages and charts were then used to describe the data. Furthermore, Chi-Square statistic was then employed to determine the association between the indicator variables and the sociodemographic variables (e.g. age, gender, education level, occupation, etc.). The Chi-Square model was specified as follows:

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Where:

χ^2 – is the Chi-Square test statistic for association between attitude, knowledge and utilization of alate termites and the socio-demographic variables

O_i – are the observed values (frequencies); i = 1,2,…,n

E_i – are the expected values (frequencies); i = 1,2,…,n

This is tested at 5% level of significance with a degree of freedom:

$$\mathrm{df} = (r-1) \times (c-1)$$

where r = number of rows and c = number of columns.

3.0 RESULTS AND DISCUSSIONS

This survey sought to assess the attitude of respondents on preference for termite products, level of awareness, knowledge/skills on methods of utilization and harvesting of alates. There was an inclusion criterion (table 1) of which only respondents that participated in either consumption, harvesting and commercialization of alate termites were interviewed. The respondents from the two strata were treated as a single unit during the analysis.

The age of respondents was between the ranges of 15 to over 65, with 60% of respondents being female. About 58.1% within the age of 15-44, and the least representation of 7.7% of the respondents of age 65 and above. A significant proportion of (about 93%) of the respondents were educated, however, there was a direct correlation between involvement in alate termite consumption and education level of the respondents (p=0.029), with 38% of the respondents who rely solely in farming as the source of livelihood.

3.1 Consumption of alate termites

Frequency distribution revealed that 81% of the respondents consume alate termite attributing to the higher rate of commercialization of alate termites (Macrotemes spp.). In Vihiga County. The rate and reason for consumption was linked to a number factor. Ranging from individuals' attitude, preference and knowledge of benefits. Respondents of all ages consume the workers, this coincides with the findings of Nyeko and Olubayo, (2005) that both male and female of all ages consume soldiers, alates and workers in Uganda. However, two other termite species were also mentioned to be harvested for other purposes in Vihiga county, including the subterranean and Kalotermitidae, (Boafo, H.A, Afledzie-Obresi, S., 2019), collected for chicken feeding in Ghana. The consumption rate in Vihiga was higher regardless of the age of respondent, this concurs with a study by Sere et al., (2018), that the consumption rate is distributed among the various age categories.

Table 1: Respondents Involvement rate in frequencies.

Parameter	Variable	Frequency	Percentages
Consumption of alate termites.	Yes	164	81%
	No	40	19%
Harvesting of alate termites	Yes	64	31%
	No	140	69%
Commercialization of alate termites.	Yes	32	50%
	No	32	50%

Consumer preference on forms of alate termites

Results of this survey in Table 1 reveals a greater percentage of respondents consumes raw (straight from the mound) and fried alate termites (AT), this is attributed to the taste. The raw termites are preferred as compared to blanched and sundried termites which are mostly utilized for preservation purposes (Van Huis et. al., 2013). Chi-square statistics on the categorical variables

socio-economic characteristics and their influence on the choice of alate termites revealed a statistical significance ($p<0.001$) between occupation and consumption of blanched alates, ($p=0.029$) level of education on the consumption of raw alates and ($p=0.018, 0.036, 0.05$) between marital status and consumption of blanched, sundried and raw alates respectively.

In general, 81% of the respondents alluded to be consuming alate termites. However, there was no statistical correlation between persons' gender and consumption of either form of alate termites. Meaning preference for either blanched, fried or raw termites was influenced by individual reasons. The consumption rate was dependent on consumers' attitude alluded by respondents as either being easy to prepare, tasty or nutritious.

Table 2: Correlation between consumers' preference on the form of utilization and selected demographic variable.

	Fried		Blanched		Sundried		Raw	
Variable	Freq	p-value	Freq	p-value	Freq	p-value	Freq	p-value
Occupation								
Farmer	67		33		65		55	
Educationist	31	0.421	7	0.023*	20	0.772	18	0.712
Casual labourer	29		16		28		24	
Other	48		36		48		39	
Education								
Non-formal	12		6		13		10	
Primary	54	0.082	34	0.111	52	0.651	49	0.029*
Secondary	58		28		57		48	
Tertiary	41		24		39		29	
Marital status								
Married	104		62		102		82	
Single	34	0.065	17	0.018*	32	0.036*	28	0.05*
Divorced	3		1		2		3	
Widow/er	24		12		25		23	

Note; * shows the level of significance. At 95% C.I

$\chi 2$- Was used to determine the relationship between the categorical demographic variables and consumers preferred forms of alate termite preparation.

3.2 Awareness of methods of alate termite utilization

Alate termite utilization within the study area was determined by considering respondents' opinion on the varied purposes of alate termite utilization. First, the results showed a proportion of the respondents to be using alates as chicken feed (53%). 70% of the respondents were female who collected alate termites as feed for chicken. These findings concur with the study of Boafo, H.A, et.al. (2019) who reported that only 11% of the respondents indicated that they do not

provide termites to their poultry in Ghana. However, a chi-square test provided a p> 0.05 depicting that gender had no significant influence of the respondents' opinion on utilization as chicken feed. On the other hand, education level played vital role with a total of 104(51%) who agreed out of which 74 (71%) represented respondents in primary and secondary education level, even though respondents with tertiary education disagreed alluding that there are more health benefits associated with alate termites as food other than as feed.

More importantly, statistical association was realized between the use of late termites as chicken feed and respondents' level of education at p<0.001 thus, positively significant. This probably because farmers with higher education have industrial or semi-industrial poultry farms and these are less suitable for the use of termites as the main source of protein. These farmers tend to stock a larger number of birds under intensive or semi-intensive systems and would require larger amounts of termites to feed their birds.

Likewise, occupation of the respondents had a scientific significance as a proportion of 47(45%) out of total respondents were farmers who agreed to the opinion to use alate termites for feed especially during peak seasons.

65% of the respondents utilized the alate termites for health reasons, based on the nutritional proportions which are important for curbing malnutrition. This has been reported by studies in Kenya and other parts of the world like Nigeria (Ijeomah, H. M., Oyebade, B.A.and Mazi, E.C., 2015; Ayieko, et al., 2012). The nutritional potential of alate termites has been related to crayfish which is presumed to have high protein content thus considered healthy for children growth.

Respondents' occupation was statistically significant with a p-value <0.0011, with 32% of the occupation category being farmers who mentioned they utilize alate termites for health reasons. Farmers attended a number of trainings on INFOODs project thus aware on the nutritional potential. Likewise, respondents' marital status influenced the decision for the method of utilization where X2 =26.59 (P=0.0322) with the married (41%) who tend to agree, this could be because the married are more concerned with the health status of the family. Even though, education status of respondents had no significance p>0.05, since respondents within primary (24%) and secondary (20%) are the greatly involved in collection of the alate termites. Results on the utilization of alate termites in figure 3 shows only 6.8% agreed to use of alate termites for poverty reasons. Gender and marital status of respondents had no correlation p>0.05. However, education level (X2 =27.314, p=0.026) and occupation (X2 =35.94, p=0.0017) of respondents were statistically significant. Occupation influences individuals' income level thus some collect for poverty having a majority of respondents in the primary and secondary level of education with low economic status are greatly involved in termite collection and consumption. This indicates the potentiality of alate termites for food, this is also depicted by a study on the potential of insects for food and feed (Van Huis, 2015)

3.3 Harvesting of alate termites.

In this study, 62(30%) of the respondents participated in alate termite collection, with a greater percentage being female. This concurs with the study of Josiah Taru & Bernard Chazovachii (2015) who reported that females and children continue to dominate the process of trapping termites in most cases. Higher quantities of alate termites are harvested soon after the first rainfall during the long rains season between March to June 26(42%), and short rains season around November to December 28 (45%) with the least quantities during drought periods. Respondents (57%) indicated that the best harvesting time for termites to be afternoon and morning hours. This

contradicts the findings by Boafo, H.A, et.al, (2019) who reported that macrotermes are harvested throughout the year in some parts of Ghana, though this could be due to varying ecological conditions and the subspecies.

Harvesting is dominated by respondents of all ages, the knowledge of the species to be harvested is based on indigenous knowledge which involves looking at the size of the termite and the type of wings, this somewhat contradicts the results by Netshifhefhe, et al., (2017) reporting that the harvesters used size, taste and color of termites as well as the mound type and size to identify the species in Limpopo South Africa. The missing links between the findings would be mainly because in Limpopo there is the harvesting of both the alates and the soldier termites.

Common harvesting methods within the study area involved the use of the source of light to attract the alate termites which are then collected into containers. A similar harvesting method was reported in Zimbabwe by Chavunduka (1975). However, new emerging techniques include the use of a bucket placed upside down over an emergence hole/mound. This technique was used by (60%) of the respondents. This technique is similar to those reported in Limpopo SA where the termite hole is covered with sticks and leaves of either banana (*Musa paradisiaca Linnaeus* and *M. sapientum Linnaeus*) or *Peltophorum africanum*, while in Ghana Fresh branches with leaves from any plant are used (Netshifhefhe, et.al, 2017; Boafo, H.A, et.al., 2019). In Vihiga the banana leaves are used with grass or plant debris which provided good shade for the alates and as they fly to the bottom of the hole where they are trapped and harvested.

Some harvesters do not own the mounds (individual land) therefore, have to travel on averagely less than 4 km while many others walk 6-10KM to harvest. The harvested quantities in case of surplus are preserved through sun drying (50%), pan-frying (41.66%) and refrigeration (8.33%). Even though, larger quantities are sold raw (direct from the mound).

Factors influencing the abundance of alate termites.
The respondents who had stayed in the area for more than 20 years (49.7%) alluded that there is variation in termite abundance over years. About 65% of the harvesters did not own mounds thus could cover an average distance of less than 1KM while a majority would cover a distance of 6-10 KM to the mounds. This could have contributed to low quantities of harvest since the alates could emerge and be attracted by other sources of illumination as they swarm. In Imo states Nigeria, higher quantities of alates are harvested directly from the mounds with low quantities harvested in areas away from mounds, (Ijeomah, H. M., et.al, 2015). This, however, contradicts results from this study, since respondents mentioned they could use other sources of illumination to attract the alates away from holes of emergence. Season simulation is also applicable with a created microenvironment that stimulates the alates to emerge and swarm from wet grounds away from the mounds.

Of importance, a chi-square test of association showed that respondents with formal education agreed that there is variation in abundance based on soil type, season and continuous agrochemical utilization ($p=0.034$, $p=0.003$, 0.008 respectively). This implies that formal education is positively significant as the education process contributed to the knowledge on the reduction in quantities of alate species per harvest in a specific area. On the other hand, respondents' who had no formal education, indicated that they use traditional knowledge and skills but were able to note the change in quantities with limited knowledge on the contributing factors.

Additionally, gender showed statistical significance in association to season influence on termite abundance (p=0.002). This is because females (61%) are more involved in harvesting than males. More importantly, there was a statistical significance between occupation and awareness p=0.025, with farmers (31%) who tend to agree alluding that availability is influenced by the type of soil and continuous use of agrochemicals that contributes to change in soil properties and mound characteristics. However, the study revealed that variation in termite abundance based on agro-ecological conditions (35.8%) influenced by the amount of rainfall and microclimate in an area

The abundance of alate termites influences the extent of utilization, this was assessed by looking at respondents' information level. The respondents who had stayed in the area for more than 20 years (49.7%) alluded that there is variation in termite abundance over years. Most of the harvesters did not own mounds thus low harvest quantities was depending on regions, and could cover an averagely of less than 1KM while a majority would cover 6-10 KM to the mounds, this contributed to low quantities since the alates could emerge and be attracted by other sources of illumination as they swarm. Supported by a study in Imo states Nigeria, statistically showed low quantities of alate harvested in areas away from mounds, (Ijeomah, H. M., et.al., 2015). This, however, contradicts results from this study which revealed alates could swarm from wet grounds away from the mounds.

A chi-square test was run to determine the association between respondents' socioeconomic characteristics and awareness of factors determining the abundance of alate termites. Results obtained showed that respondents with formal education agreed with the fact that there is variation in abundance based on soil type, season and agrochemical utilization (p=0.034, p=0.003, 0.008 respectively). Implying that through the formal education process they were able to learn as well as observe a reduction in quantities of alate species per harvest in a specific area. This influences the abundance of the alates. On the other hand, respondents' who had no formal education, mentioned that they use inherited knowledge and skills but can note the change in quantities with limited ideas on the facilitating forces.

However, there is a negative correlation between, marital status and awareness on factors limiting abundance although gender showed statistical significance in association to season influence (p=0.002), as females (61%) being more involved in harvesting than males. More importantly, there was a statistical significance between occupation and awareness p=0.025, with farmers (31%) who tend to agree most alluding that availability is influenced by the type of soil and continuous use of agrochemicals that contributes to change in soil properties and mound characteristics. However, variance based on agro-ecological conditions (35.8%) was also mentioned where the amount of rainfall and microclimate in an area influences abundance and swarming of the alate termites

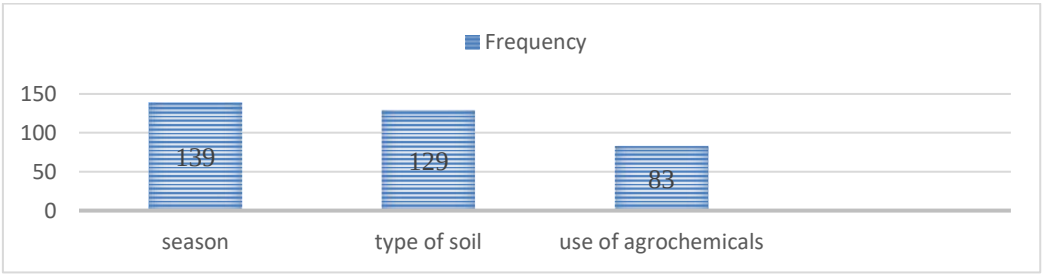


Figure 2: Factors influencing abundance of late termites

Therefore, the major factors determining abundance and utilization of alate termites (figure 3) include seasonality and weather (63.2%), type of soil in the locality and the continuous use of agrochemicals. This partly coincides with results by Ijeomah et al. (2015) in selected communities in Nigeria that season is a major factor which determines its abundance. This is because during the rainy season the alates goes for the 'nuptial flight'.

The study also revealed that there is influence of continuous use of agrochemicals in the fields contributing to the reduced availability of the alate termites and abundance.

4.0 CONCLUSION

Considering facts as obtained in the data, quite many households have explored the options of livelihood diversification by benefiting from the collection and utilization of alate termites. As proof of the potentiality of the alate termites, most respondents supported the fact that alate termites are key in enhancing household diet diversification which in turn contributes to household food security. The two pathways of household food security were depicted by, a greater percentage of respondents who uses the termites as food directly either, raw, blanched, sun-dried or fried in own oil as well as commercialization to obtain income used to attain other household needs including, quality education, health care and maternity care. Farmers consider termites as very important because they are an easily available protein and play an important role in improving options of food consumed among rural and urban households when it is available. However, the species utilization is decreasing among the younger generations and urban dwellers even though it serves as a cheap substitute for conventional protein in the diets of many rural dwellers. It is good for children and women who require nutritious food and a high-calorie diet. Its prices and high relative protein content can be harnessed to improve the nutrition of lactating women. It can as well be used as an inexpensive and rich dietary supplement for households. The consumption of alate termites should thus be encouraged among city dwellers. The main challenge is on the collection of termites because their availability varies with season and weather, excessive use of agrochemicals as well as type of soil and, in some cases, farmers must walk long distances to obtain them. Therefore, trapping techniques should be promoted and the existing methods should be improved. In regions where trapping is uncommon, Research should also be conducted on methods to effectively preserve the species to make it available during the off-season as well as improve processing technologies for the farmers to ensure a continuous supply in the diets.

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