



Ethno-Zoological uses of Edible Insects among Rural Communities in Southeastern Nigeria

*¹Duruigbo, Stanley O. ²Nwankwo, Emmanuel C. & ³I.E. Duruanyim

^{1,2}Department of Forestry and Environmental Management, Michael Okpara University of Agriculture, Umudike, Nigeria; ³Department of forestry and wildlife technology, Federal University of Technology Owerri *Correspondent Author: stannovico12@hotmail.com

ABSTRACT

The recent emphasis on food security and biodiversity conservation has brought to light the importance of combining knowledge systems between conventional scientists and indigenous people. The present study was conducted to evaluate the ethno-zoological uses of edible insects in different communities of southeast Nigeria. The specific objectives of the study were to; assess the consumption pattern and perceptions of edible insects in southeast Nigeria using a structured questionnaire, describe the socio-economic characteristics of the respondents in the study area, identify the ethno-cultural beliefs of some edible insect species consumed in different communities of southeast Nigeria. Four states and eight Local Government Areas (LGAs) were purposively selected based on the vegetation types. The study used questionnaires and oral interviews to gather information on the ethno-zoological uses of edible insect species in different communities of southeast Nigeria. Out of the 240 questionnaires distributed across the survey locations, 235 individuals responded, out of which 54% were female, and 46% were male. 74% of the respondents were married, 20% were single, and 6 were widowed. The results obtained were presented using descriptive statistics. The result showed that 19 insect species across five orders and 10 families were consumed. The highest abundance was recorded in Ebonyi State, while the least was in Imo State. Among those who had not eaten insects, the most common reasons were the appearance and odour of the insects. Ethno-cultural beliefs on some edible insects were also documented. Conclusion, the study highlights the importance of insect consumption in Southeast Nigeria as a significant traditional practice that supports the rural population's livelihood. The study recommended that edible insects should be prioritised in communities of low economic status where malnutrition and poverty are prevalent.

Keywords: Abundance, Edible Insects, Species, southeast Nigeria, ethno-zoological

INTRODUCTION

Food security and safety, coupled with malnutrition, has been a challenging area and cause of concern for economic growth and the welfare of humans globally. Feeding an expected global population of 9 billion by 2050 is a daunting task that engages researchers, technical experts and leaders worldwide (FAO, 2017). The population of Africa is estimated to reach 2.53 billion by 2050 (Statista, 2023). This increase in population has led to a rise in demand for animal-based protein sources, as a result of globalization, urbanization and population expansion (Babarinde, Mvumi, Manditsera, Akande, and Adepoju, 2021; Ismail, Senaratne-Lenagala, Stube, and Brackenridge, 2020). In recent years, there has been an increasing interest in insects and insect-derived products as a food source in Africa. This alternative is being advocated as a viable long-term replacement for traditional animal and other protein sources. Studies have shown that insect and insect-derived products

can be a suitable substitute for conventional protein sources, such as soy, egg, maize, grains, and fishmeal (Kouřimská and Adámková, 2016; Musundire, Ngonyama, Chemura, Ngadze, Jackson, Matanda, Terakihi, Langton, and Chiwona, 2021).

For many years, edible insects have been a traditional component of African cuisine, with insects serving as supplementary food in 90% African diets (Kelemu, Niassy, Torto, Fiaboe, Affognon, Tonnang, Maniania, and Ekesi, 2015; Muya, Mutiaka, Bindelle, Francis, and Megido, 2022). Globally, approximately 2,100 edible insect species are consumed by millions of people as an alternative protein source (Van Huis, 2020). In Africa, there are approximately 500 edible insects including beetles, termites, caterpillars, grasshoppers, crickets, bees, and maggots have been recorded (Hlongwane, Slotow, and Munyai, 2020a). Among these, 256 species are consumed in the Central African region, 164 in Southern Africa, 100

species in Eastern Africa, 91 in Western Africa, and 8 species in Northern Africa (Kelemu *et al.*, 2015). With a rich biodiversity of insect species, Africa has long recognized the value of incorporating insects into its culinary traditions and diets (Mariod, 2020a), as well as utilization of insects as medicine (Siddiqui, Li, Aidoo, Fernando, Haddad, Pereira, Blinov, Golik, and Câmara, 2023a).

In Nigeria, each of the six geopolitical zones, consumes over 30 insect species, predominantly sourced from the wild (Ibitoye, Ebenebe, Amobi, Oyediji, Ogundele, and Arabani, 2021). The most commonly consumed insects are larvae and adults of beetles (coleopteran) larvae of the Saturniid caterpillar (*Cirinaforda*); *Bunaea alcinoe* (Lepidoptera) Winged termites (Isoptera), and grasshoppers (Orthoptera) (Serivastava *et al.*, 2009; Banjo, Lawal, and Songonuga, 2006; Adeoye *et al.*, 2014). Insect consumption is indigenous to southeast Nigeria, but intentional consumption to improve nutrition is limited by many composite factors. Edible insects constitute an important part of the daily diet of a large proportion in Southeast Nigeria (Okore, Awaaja and Nwana 2014). The inadequacy of food supply and the poor quality of the available foods in Africa have led to persistent hunger and malnutrition, particularly affecting vulnerable groups such as children, pregnant women, and the elderly. Statistics from 2020 revealed that 21% of the African population experienced undernourishment (Bahar *et al.*, 2020; FAO, ECA, and AUC, 2021). In a continent where malnutrition and food insecurity are persistent challenges, edible insects could offer a convenient and cost-effective nutritional solution, especially for vulnerable populations.

The use and application of tradition zoological knowledge systems can promote environmental conservation and aid in the management of disasters in terms of disaster prevention, mitigation, recovery, prediction, early warning, preparedness, response, and rehabilitation

(Mwaura 2008). However, much of this valuable traditional knowledge remains undocumented. Wall (2006) observes that traditional knowledge is gradually disappearing in most Africa countries including Nigeria with little action taken to preserve it. The lack of documented ethno-zoological information on edible insects eaten in southeast Nigeria poses a risk to their continued use. Hence, there is a necessity to document the ethno-zoological practices related to edible insect species across various communities in southeast Nigeria. Thus, the present study focused on the following general and specific objectives. (1) Identify the ethno-cultural beliefs of some edible insect species in different communities of Southeast Nigeria through the use of a structured questionnaire, (ii) evaluate the consumption pattern and perceptions of edible insects in Southeast Nigeria using a structured questionnaire, and (iii) describe the socioeconomic characteristics of the respondents in the study area.

METHODOLOGY: Study area : The survey was carried out in four selected states (Abia, Anambra, Ebonyi and Imo) of Southeast Nigeria. Southeast Nigeria lies between latitudes 4° 20' to 7° 10'N and longitudes 6°35' to 8° 25' E (Akukwe, Krhoda, and Oluoko, 2018). The zone is bounded in the East by Cross River State, in the West by Delta and parts of Kogi States. In the South Akwa Ibom States; and the North by Kogi and Benue States (Umeh, 2018). According to Anon (1978), the vegetation zones span from the Enugu-Ebonyi axis to Abia-Imo axis of the southeastern region of Nigeria (Figure 3.1). The climate between the two zones varies slightly, but average high and low day temperature records range from 33°C to 23°C respectively. Average humidity and wind speed are 82% and 8km/h respectively with the average annual rainfall is within 2000mm (NIMET 2016). According to the National Population Commission, the population of the entire five southeast states of Nigeria in 2016 was projected to be over 20million people (NBS, 2018).

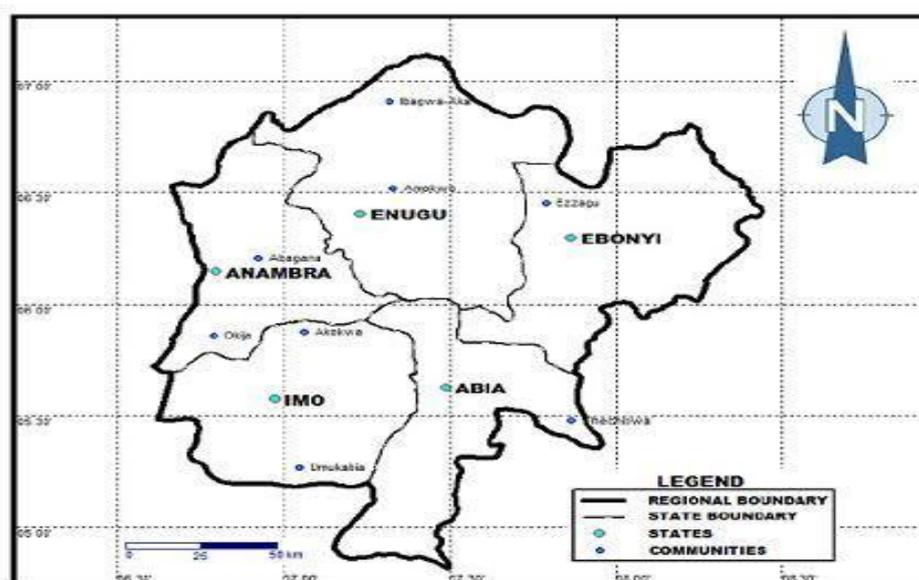
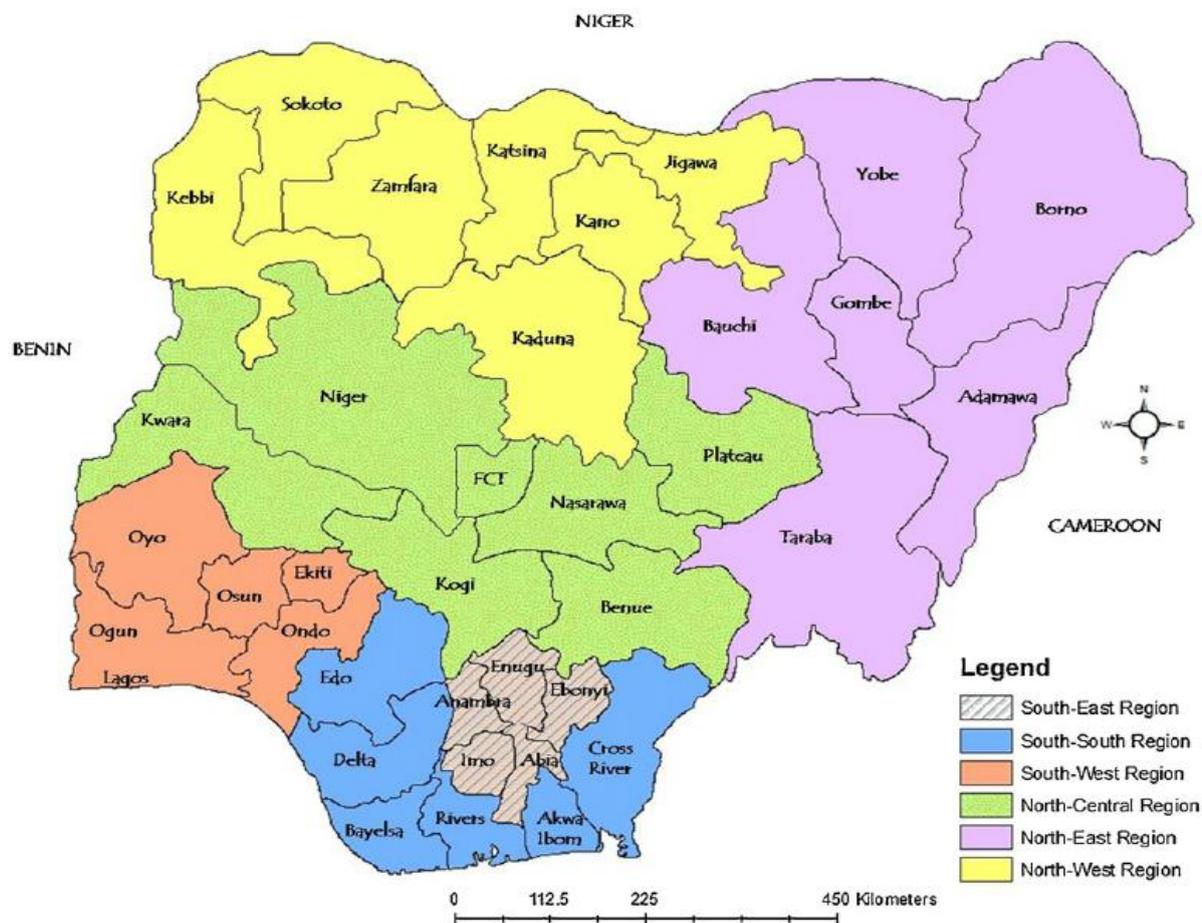


Fig 3.1: Map of Nigeria showing the study area

Source: Adapted from National Boundary Commission (2020)

Ethno-Zoological uses of Edible Insects among Rural Communities in Southeastern Nigeria

Sampling and selection of respondents A total of 240 respondents were selected based on the main objectives set. The respondents therefore included adults, women and men over 18 years old and from all social classes. A well-structured questionnaire/oral interviews was used on an individual basis to ensure better information and to minimize external influences on the respondent's side. **Questionnaire administration** Structured questionnaires were employed to obtain information on ethno-zoological uses of edible insect species in all selected rural communities of southeast Nigeria. The questionnaire was structured into four (4) sections. In the first section, information about the respondents was collected. The second section contained questions about consumer perceptions and harvesting methods. Section three dealt with consumption pattern. The fourth section included questions related to cultural perspective and medicinal uses associated in consuming insects. The enumerators translated the questions into the local dialect to enhance understanding of respondents. Furthermore, respondents were provided with pictures and real samples of various edible insects identified from literature and internet were used to help respondent identify the species consumed, or previously consumed, in their villages. Questions were in Imo State (Figure A1).

conducted from September - December 2021 with respondents selected randomly by approaching them.

Oral interview: The questionnaire by virtue of its nature may not have allowed for exhaustive and in-depth answers to the research questions, therefore, oral interview was also conducted. This face-to-face interview was used to supplement other sources of information. **Data Analysis:** From the responses obtained in the questionnaire survey, simple percentages were used to examine the data gathered from the administered questionnaire.

RESULTS AND DISCUSSION: Information from the questionnaire survey reveals that a total of 19 insect species belonging to 10 families and five orders were identified to be consumed in the habitats and locations of Abia, Anambra, Ebonyi and Imo States. Most edible insect species belong to the order Orthoptera and Coleoptera and the families Acrididae, Saturniidae and Scarabaeidae. The insect species from the order Orthoptera and Saturniidae family were the most abundant, followed by the order Hymenoptera and the Acrididae family, but least in the order Hymenoptera and the Dynastidae family. Abundance of the surveyed insect species was highest in Ebonyi but least

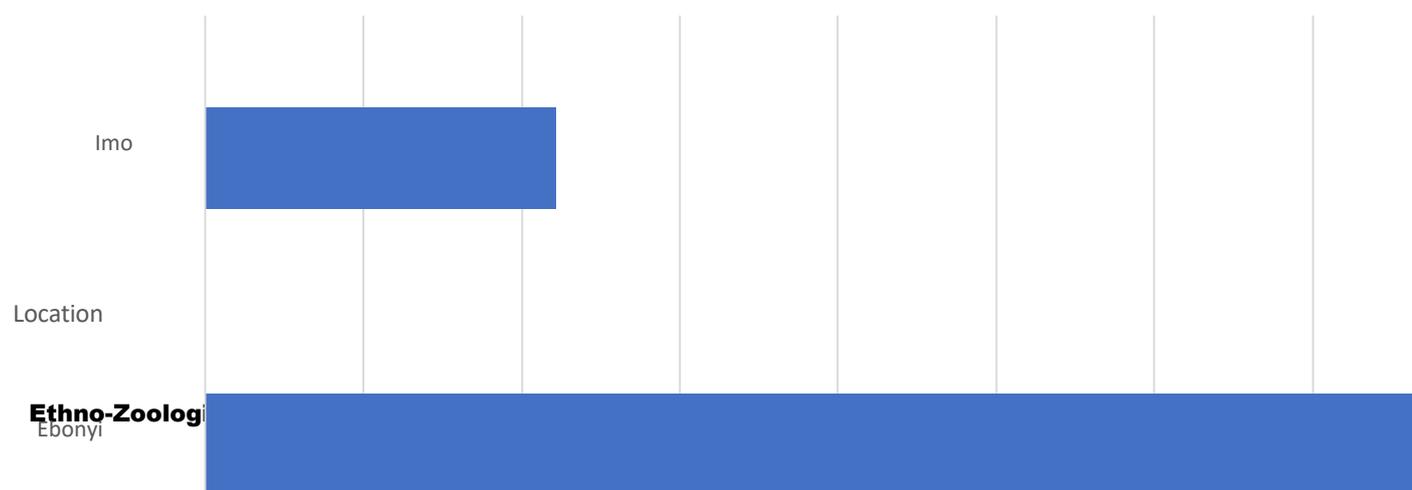


Figure A1. The differences in insect abundance among the survey locatio

SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENTS.:

Of the 240 questionnaires distributed across the survey locations, 235 individuals responded. The respondents were between 18 and 70 years old, of which 54% were female, and 46% were male across the survey locations (Figure A2 a). 74% of the respondents were married, 20% were single, and 6 were widowed

(Figure A2 b). 21% of the respondents had formal education to primary school level, 21% had secondary level education, 55% had secondary level education, 13% had tertiary level education, and 11% had informal education (Figure A2 c). Most respondents were farmers (63%), 15% were civil servants, and 22% were self-employed (Figure A2 d).

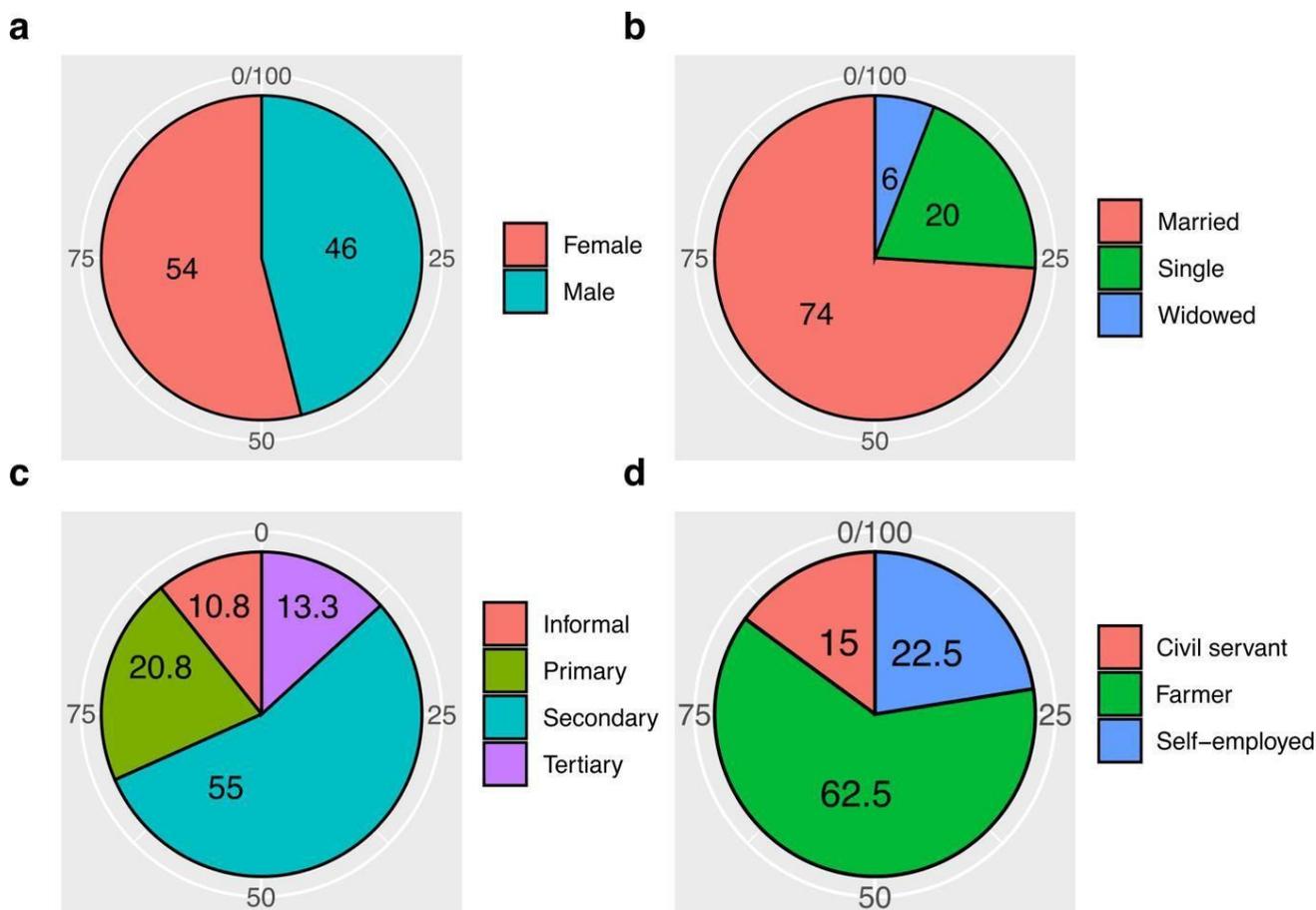


Figure A2. Demography of the respondents

PERCEPTION TOWARDS INSECT CONSUMPTION AND COLLECTION METHOD

Most respondents' perceived insects as non-beneficial (91%), 5% considered insects beneficial, 3% as both beneficial and non-beneficial, and 1% expressed no clear perception

of insects. A greater number of the respondents indicated they could identify insects (97%), while 3% indicated they could not identify insect species. The majority (78%) of the respondents indicated they had had insects as part of their meal, while 22% had never tasted insects as part of their meal (Figure A4 a).

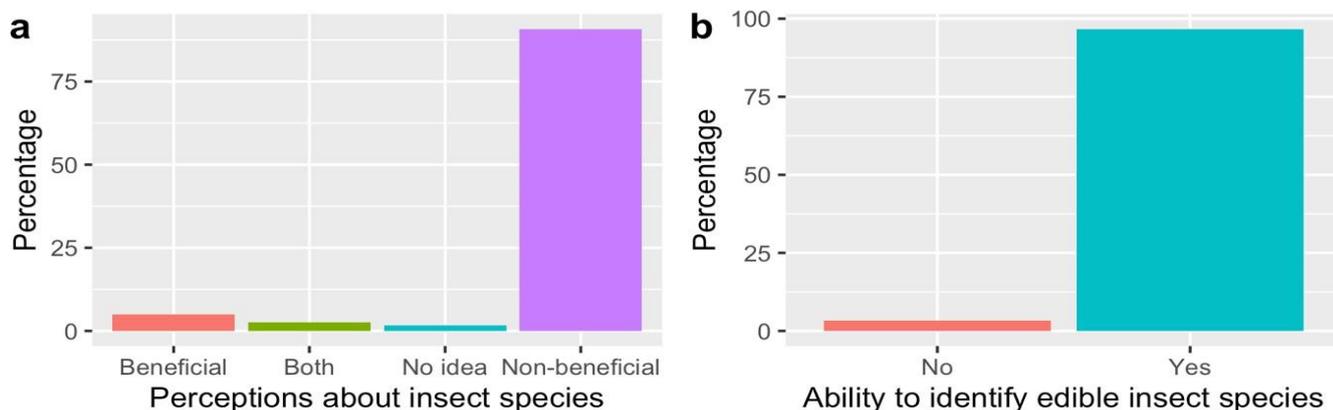


Figure A3. Responses on the perceptions of insect species and the ability to recognize edible insect

Among those who had not eaten insects as part of their meal, the most common reason for not eating insects was appearance, with 52.5% of the respondents choosing this option. The second most common reason was odour, with 26.7% of the respondents selecting this option. The third most common reason was taste, with 12.5% of the respondents picking this option. The least common reasons were cultural and religious beliefs, with 3.3% and 5% of respondents choosing these options (Figure A4 b). For those who have had insects as part of their meal, most respondents (71.7%) obtained their insect species from the wild (Figure A4 c). This means that they either collected the insects themselves or bought them from someone who did. The second most common source of insect species was the market, with 24.2% of the respondents buying their insects from

a vendor or a shop. Family and friends were the least common source of insect species, with only 4.2% of the respondents receiving their insects as a gift or a recommendation from someone they know (Figure A4 c). Among those who would love to have insects as part of their meal, the most popular method of collecting insects from the bush was handpicking, with 74.2% of the respondents choosing this option (Figure A4 d). This means they would use their hands or a tool to pick the insects from the plants, the ground, or the air. The second most popular method of collecting insects from the bush was traps, with 24.2% of the respondents selecting this option (Figure A4 d). The least popular method of collecting insects from the bush was other methods, with only 1.7% of the respondents picking this option (Figure A4 d).

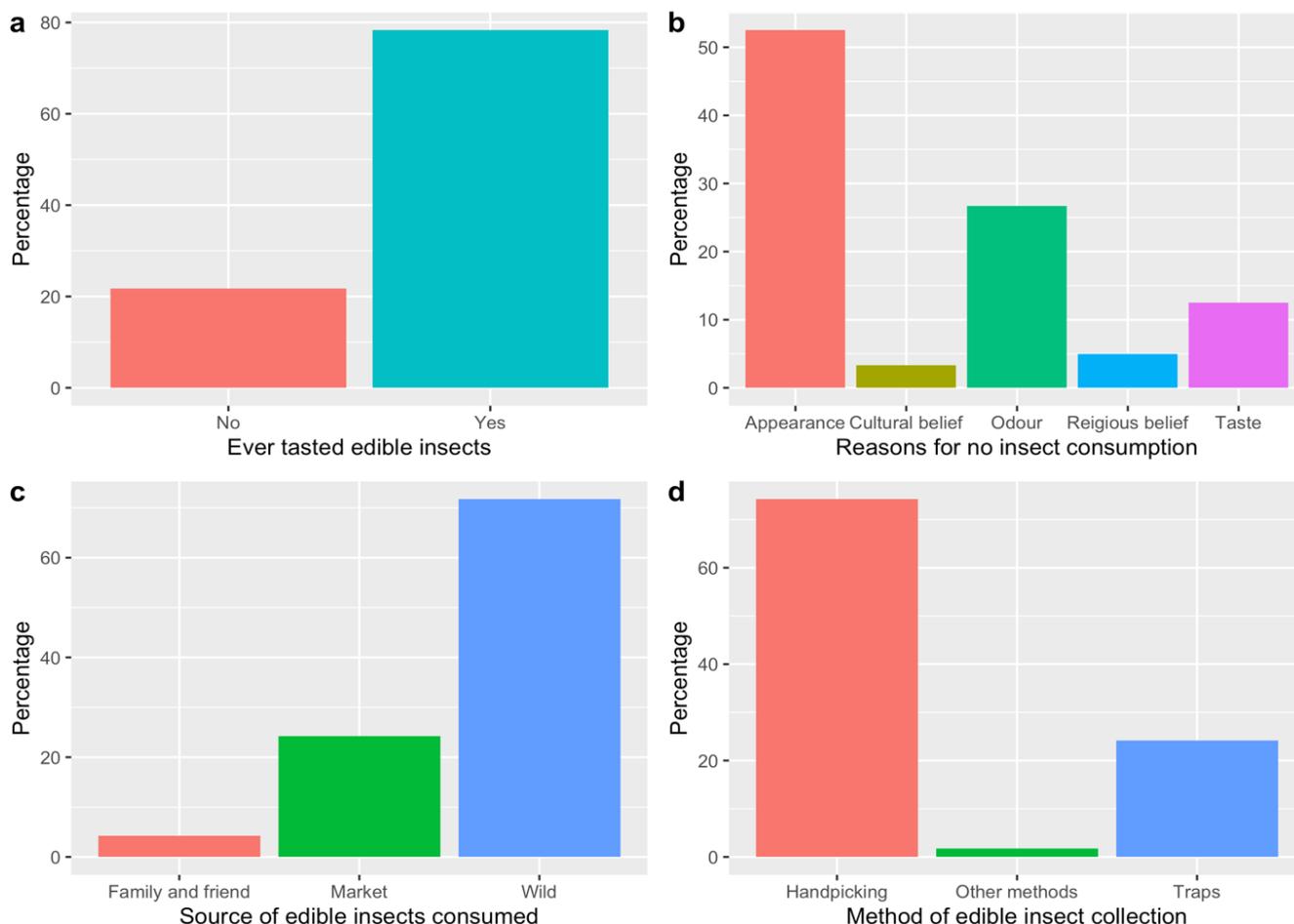


Figure A4. Responses on the consumption of edible insect, reasons for not having insect as part of diet, sources of the edible insects and the methods of collection

EDIBLE INSECTS CONSUMPTION PATTERN

The most common method of preparing the insects for consumption was frying, with 55% of the respondents choosing this option. This means they cook the insects in hot oil or fat until they are crispy and golden (Figure A5 a). The second most common method of preparing the insects for consumption was roasting, with 35.8% of the respondents selecting this option. The least common methods of preparing the insects for consumption were boiling and raw, with 6.7% and 2.5% of the respondents picking these options, respectively. This means that they would either cook the insects in boiling water until they are soft and tender or eat them without cooking (Figure A5 a). The result to the question “Do you think insect species have contributed immensely to the nutritional need of those around you,” shows that the majority of the respondents (73.3%) answered yes, indicating that they believe that insect species have a positive impact on the nutritional status of

their community (Figure A5 b). The minority of the respondents (26.7%) answered no, suggesting that they do not think that insect species have a significant role in meeting the nutritional needs of their community (Figure A5 b).

The most common nutrient the respondents got from insects was protein, with 70% of them choosing this option (Figure A5 c). The second most common nutrient the respondents got from insects was fat and oil, with 25% of them selecting this option. This means that they acknowledge that insects contain fat and oil, which are important for providing energy, absorbing vitamins, and maintaining cell membrane function. The least common nutrient the respondents got from insects was vitamins, with only 5% of them picking this option. The respondents either do not know or do not appreciate that insects also provide vitamins, which are vital for regulating metabolism, growth, and development.

The result of the responses to the question (Q10) “If given the opportunity for those that have not

eaten insect, would you attempt consuming it as part of your diet?" shows that the vast majority of the respondents (94.2%) answered no, indicating that they are not willing to try insect as part of their diet (Figure A5 d). The minority of the respondents

(5.8%) answered yes, suggesting they are open to eating insects as part of their diet. They are curious or interested in insect consumption, which could be motivated by various factors such as nutrition, environment, novelty, or adventure

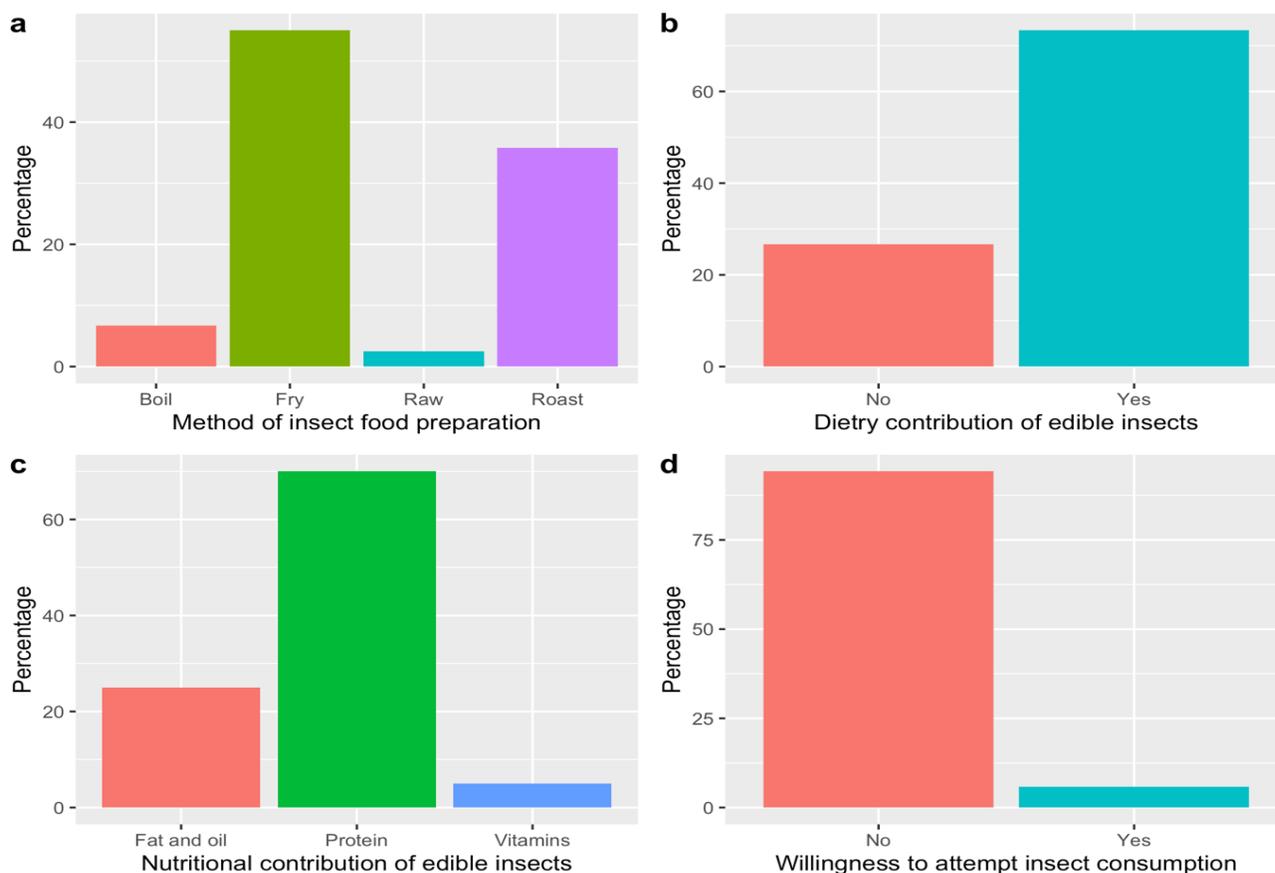


Figure A5. The result of the survey investigating attitudes towards consuming insects, exploring food preparation, dietary considerations, and willingness to try insect-based foods.

The most common reason for eating insects among the respondents was poverty, which accounted for 69.2% of the answers (Figure A6 a). The second most common reason was common practice, representing 24.2% of the responses. The third most common reason was curiosity, which accounted for 4.2% of the answers. The least common reason was ethno-medicine, representing only 2.5% of the responses. This means that very few people ate insects because they believed they had some medicinal or therapeutic value. The most preferred insect species among the respondents was termite, which accounted for 70.8% of the answers. The second most preferred insect species was cricket, representing 17.5% of the responses. The third most preferred insect species was palm weevil, which accounted for 9.2% of

the answers. The least preferred insect species was the palm beetle, which represented only 2.5% of the responses (Figure A6 b). Most respondents (60%) answered that they have some cultural perspective or taboo associated with eating certain insect species in their community (Figure A6 c). The second largest group of respondents (36.7%) answered no, saying they do not have any cultural perspective or taboo associated with eating any insect species in their community. The smallest group of respondents (3.3%) answered no idea that they did not know whether there were any cultural perspectives or taboos associated with eating any insect species in their community or not. Most respondents (88.3%) indicated they did not know why edible insect species were no longer eaten in their communities (Figure A6 d). The minority of respondents (11.7%) indicated

they could not eat edible insect species because

they were unavailable in their village.

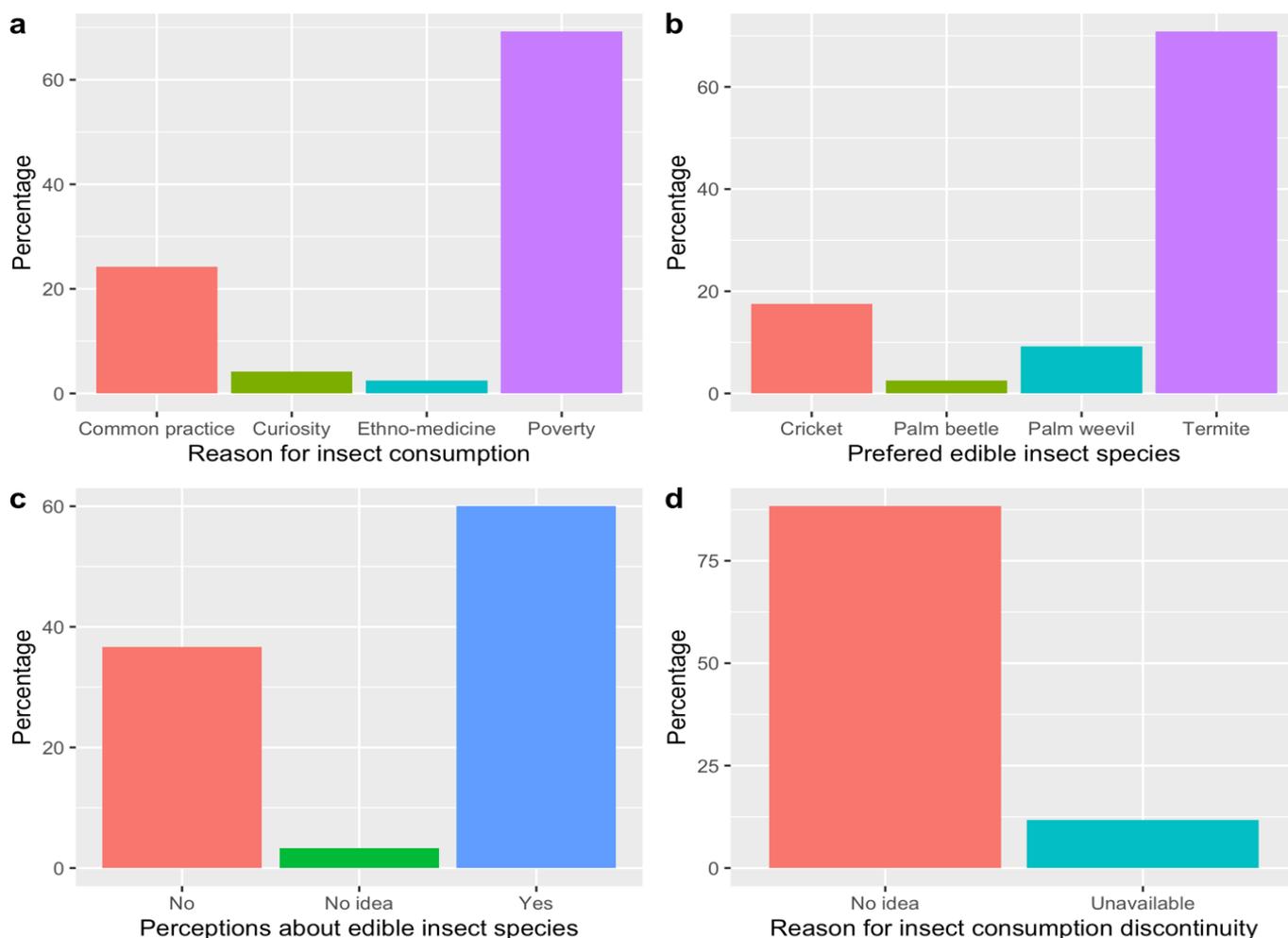


Figure A6. Responses on the reasons for insect consumption, preferred edible insect species, perceptions about edible insect species and the reasons why individuals in communities no longer consume insect as part of their diet.

ETHNO CULTURAL BELIEF OF SOME RECORDED EDIBLE INSECT IN THE STUDY AREA

The survey conducted in the study areas revealed that people of different cultural groups used a diverse range of edible insects. Interestingly, some of these insects were used in unique ways based on the cultural beliefs of the people. For instance, the people of Nkume in Njaba LGA, Imo state believe that a year of Nwaigu (*Gonimbrasia spp*) invasion is a good omen that promotes good health throughout the land. In Nkume Njaba Local Government Imo State; one of the

most strongly held convictions among the locals is that the Abuzu (*Brachytrupes membraceus*) is meant exclusively for the elderly, especially those caught during egwuonwa (moon light). As per their tradition, if children consume Abuzu, it will cause rainfall whenever they engage in farming activities. Children hunt Abuzu for the elderly, who reward them with a female chicken after collecting a certain number.

The people of Abia State believe that the spread of Aku (*Macrotermes bellicosus*) often helps in the regeneration of depleted soils. The termite hill is also used to make large village-owned mound shrines

Ethno-Zoological uses of Edible Insects among Rural Communities in Southeastern Nigeria

dedicated to the fertility of village wives in Anambra State. In Nkume, children are not allowed to hunt or eat Aku (*Macrotermes bellicosus*) at night. This is because there is a species of this insect locally known as Nkposhinti that is not edible and can cause deafness if eaten accidentally according to their belief. The *Zonocerus variegatus*, a type of insect commonly referred to as the devilish insect or Ukpana Mmuo by the locals, is found in the Umuowa region of the Orlu Local Government Area in Imo state. The people of Umuowa in Orlu local government area in Imo state believe that consuming this insect can bring about misfortune, particularly for the younger generation. The insect itself is unique in appearance, with its strikingly colorful body and distinctive features. Despite its alluring appearance, it is best avoided to avoid any negative consequences.

Bees are stinging winged insects which uses pollen and nectar to produce honey. They are typically found in hollow trees; their presence has also been associated with superstitions and beliefs in some cultures. For example, in southeast Nigeria, a swarm of bees near a residential area is seen as a bad omen, indicating that someone in the family will pass away soon after. In rare cases, people have even attempted to use magic to lure bees into an enemy's home in hopes of having them inflict fatal stings Ebenebe *et al.*, (2017). Despite these superstitions, bees remain a vital component of our ecosystem and a magnificent wonder of the natural world. The respondents lamented that the original significance of these cultural values seems more less or lost in some cases. The respondents also yielded information on the edible insects used by the traditional healers in the treatment of ailment in southeast Nigeria. The results showed that four (4) edible insect species were used in traditional medicine in these communities' termites, *Apis mellifera* honey, cricket, (*Brachytrupes membraceus*) palm weevil larvae (*Rhychphorus phonecis*). It was also observed that a total of 6 ailments were treated by the traditional herbalists in the study areas these ailments includes cough, wounds/sores infertility, rashes. Ulcers and burns.

Oil extract from palm weevil with specific plant species are used in treatment of women's infertility in Umuowa Orlu and Nkume Njaba in Imo State It also used in treatment of rashes and wounds in the same

area. In all the four eastern state surveyed the belief that consumption of African palm weevil (*Rhychphorus phonecis*) enhances blood supply in infants. Ebenebe *et al.*, (2017) reported that African palm weevil (*Rhychphorus phonecis*) is used in treatment of anaemia in southeast Nigeria. Cricket mixed with oil is also used in treatment of cough and wounds in Anambra and Abia State. Honey is used in treatment of cough, septic wounds, ulcers, and, bed sores in the four southeast state surveyed. Study by Chakravorty *et al.*, (2013) indicated the therapeutic uses of edible insects in some communities in India. According to them, four species of insects from order of Hemiptera are used for the therapeutic values. The traditional practitioners claimed that the rural populace is used to traditional medicine and would only consider the orthodox medicine as a last resort. This is because traditional medicines are affordable and accessible to rural populace relative high cost of orthodox medicines and lack of access by rural people to hospital facilities.

DISCUSSIONS: The current study identified 19 insect species across five orders and 10 families that are consumed in various locations within Abia, Anambra, Ebonyi, and Imo States. The majority of these edible insects belong to the orders Orthoptera and Coleoptera, and the families Acrididae, Saturniidae, and Scarabaeidae (Alamu, Amao, Nwokedi, Oke, and Lawa 2013; Ibitoye *et al.*, 2021; Banjo *et al.*, 2006; Ebenebe, Amobi, Udegbala, Ufele, and Nweze, 2017) had reported significant Entomophagy in Nigeria. This finding is supported by the work of Okere *et al.*, (2014) who recorded 20 edible insect species in Niger delta region of Nigeria. This result is slightly different from the study of Ebenebe *et al.*, (2017) who recorded 17 edible insect species in southeast Nigeria. The abundance of these insects varied across locations and seasons. For instance, the highest abundance was recorded in Ebonyi State, while the least was in Imo State. The majority of respondents were farmers most had secondary level of education Farmers are more involved in edible insects harvesting. This was due to the ease with which most farmers could access the insects' habitat while engaged in other farm activities which allow them to harvest a greater quantity of it. Educated people, with secondary school level

revealed higher level of knowledge, thus being more aware of nutritional and other benefit of edible insect species. This finding is consistent with a study by Alamu *et al.*, (2017b) which reported that consumer education and knowledge of the insects-based foods can shape perception and shift their consumption behaviour. Among those who had not eaten insects, the most common reasons were the appearance and odour of the insects. This aligns with research indicating that the ‘yuck factor or individual psychology plays a significant role in the reluctance to consume insects Jonas-house (2016).

The reasons for not eating insects are largely related to their physical characteristics rather than cultural or religious beliefs. This suggests that strategies to promote the consumption of insects may need to address these sensory perceptions. Additionally, the reliance on wild sources for insects indicates a potential area for development in terms of insect farming and commercialization (Ibitoye, *et al.*, 2021 and Babarinde *et al.*, 2021). The willingness to consume insects seems to be low among those who haven’t tried them before. This could be due to a variety of factors, including cultural perceptions and personal preferences. However, with the right awareness and education about the nutritional benefits of insects, this could potentially change over time. The majority of respondents cited poverty as the main reason for eating insects. This aligns with research indicating that insect-eating in Nigeria is often linked with poverty, primitivism, and lack of food for people in rural communities (Ibitoye *et al.*, 2020),

CONCLUSION: The study highlights the importance of insect consumption in Southeast Nigeria as a significant traditional practice that supports the rural population's livelihood.

To further encourage and promote this practice,

RECOMMENDATIONS: To further encourage and promote this practice, the study recommends that edible insects should be prioritised in communities of low economic status where malnutrition and poverty are prevalent. The seasonal nature of edible insects means that they are only available during certain

periods, leading to restricted access when they are not in season. This has a detrimental impact on both traders and consumers who rely on edible insects for dietary supplementation and as a source of income. Therefore, it is crucial to engage in insect farming to ensure a consistent and increased availability of edible insects throughout the year.

REFERENCE

- Akukwe, T. I., Krhoda G.O. and Oluoko, O.A. (2018). A Principal component analysis of the effects of flooding on food security in agrarian communities of South Eastern Nigeria. *International Journal of Hydrology*, 2 (2):
- Alamu, O. T., Amao, A. O., Lawa, I. O., Nwokedi, C. I. and Oke, O. A. (2013). Diversity and Nutritional status of edible insects in Nigeria. *International Journal of Biodiversity and Conservation*, 5(4): 215-222.
- —
- Anon. (1978). The National atlas of the federal republic of Nigeria. Government Printer, Lagos. First edition. p.136.
- Babarinde, S.A., Mvumi, B.M., Babarinde, G.O., Manditsera, T.A., Akande, T.O. and Adepoju, A.A. (2021). *International Journal of Tropical Insect Science*, 41, 1923-1951.
- Bahar, N.H.A., Lo, M., Sanjaya, M., Van Vianen Alexander, P., Ickowitz, A. and Sunderland, T., (2020). Meeting the food security challenge for nine billion people in 2050: what impact on forests? *Global Environmental Change* 62: 102 -156.
- Banjo, A.D., Lawal, O.A .and Songonuga, E.A. (2006).The nutritional value of fourteen species of edible insects in south-western Nigeria. *African Journal of Biotechnology*, 5:298 - 301.
- Chakravorty, J., Ghosh, S. and Meyer-Rochow, B. (2013). Comparative survey of entomophagy and entotherapeutic practises in six tribes of Eastern Arunchal Pradesh (India). *Journal of Ethnobiology and Ethnomedicine*, 9: 50. <https://doi.org/10.1186/1746-4269-9-50>
- Ebenebe, C.I., Amobi, M.I., Udeguala, C., Ufele, A. N. and Nweze, B. O. (2017). Survey of Edible Insect Consumption in the South-Eastern Nigeria; *Journal of Insects as Food and Feed*. 3 (4): 241-252.
- FAO, (2017). The future of food and agriculture – trends and challenges. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.
- FAO, ECA and AUC. (2021). Africa – regional overview of food security and nutrition 2021: Statistics and trends. Available at:

- <https://www.fao.org/3/cb7496en/cb7496en.pdf>. Accessed 20 August 2022.
- Ibitoye, O., Ebenebe, C., Amobi, M., Oyediji, T., Ogundele, O. and Arabani, I. (2021). Edible insects for food and feed in Nigeria: *Exploring the roles of Extension Services*, 41, 2287-2996
- Ibitoye, S.O., Oyetunji, P. and Oleyo, T (2020). Patterns of consumption of edible insects among young people in three Local Government Areas in Oyo State, Nigeria. *International Journal of Tropical Insect Science*, 41 (2) 185-218.
- Ismail, B.P., Senaratne-Lenagala, L., Stube, A. and Brackenridge, A., (2020). Protein demand: review of plant and animal proteins used in alternative protein product development and production. *Animal Frontiers* 10: 53-63.
- Jonas, H. (2016). It's not just the yulk factor that put people off eating insects. The Conservsation Academic Tigour Journalistic Flair.
- Kelemu, S., Niassy,S., Torto, B., Fiaboe, K., Affognon, H., Tonnang, H., Maniania, N.K. and Ekesi, S., (2015). African edible insects for food and feed: inventory, diversity, commonalities and contribution to food security. *Journal of Insects as Food and Feed* 1:103-119.
- Kouřimská, L. and Adámková, A. (2016). Nutritional and sensory quality of edible insects. *NFS Journal* 4: 22-26.
- Mariod, A.A. (2020a). African edible insects as alternative source of food, oil, protein and bioactive components. Springer,Cham,Switzerland.
- Musundire, R., Chidewe, C., Samende, B.K., Chemura, A., Bangira, C., Andika, O.A., and Chiwona, K. L. (2021a) Soil characteristics and nutritional traits of *Macrotermes natalensis* (Isoptera: Macrotermitinae) as indicators of nutritional quality in Zimbabwe. *International Journal of Tropical Insect Sci.* 6: 102-11.
- Muya, G.M.N., Mutiaka, B.K., Bindelle, J., Francis, F. and Megido, R.C., (2022). Human consumption of insects in Sub-Saharan Africa: Lepidoptera and potential species for breeding. *Insects* 13: 886-891.
- Mwaura, P. (2008). Indigenous knowledge in disaster management in Africa. United nations Environment Programme, Nairobi.
- National Boundary Commission NBC (2020). Annual report. Retrieved from <https://www.nbs.org.kh/download>
- NBS (2018). 2017 Demographic Statistics Bulletin. National Bureau of Statistics. Online at: <https://nigeriastat.gov.ng>. accessed: 3rd august, 2019.
- NIMET (2016). 2016 Seasonal rainfall prediction (SRP). Nigeria Meteorological Agency, US. Available at: <https://nimet.gov.ng> p.58
- Okore, O., Avaaja D. and Nwana I. (2014). Edible Insects of the Niger Delta Area in Nigeria. *Journal of Natural Sciences Research.* 4 (5): 1-9. www.iiste.org
- Siddiqui, S.A., Li, C., Aidoo, O.F., Fernando, I., Haddad, M.A., Pereira, J.A. M., Blinov, A., Golik, A. and Câmara, J.S. (2023a). Unravelling the potential of insects for medicinal purposes – a comprehensive review. *Heliyon* 9: 1265-1283.
- Statista, (2023). Forecast of the total population of Africa from 2020 to 2050. Statista Research Department. Available at: <https://www.statista.com/statistics/1224205/forecast-of-the-total-population-of-africa/>.Accessed25May2023.
- Umeh, C.I. (2018). Evaluation of participation of rural youths in agriculture/rural development programmes in southeast Nigeria. Unpublished Ph.D disertation in the department of rural sociology and extension, Micheal Okpara University of Agriculture, Umudike, Abia state Nigeria , pp.70-72.
- Van Huis, A. (2020). Importance of insects as food in Africa. In: Mariod, A.A. (ed.) African edible insects as alternative source of food, oil, protein and bioactive components. Springer,Cham, Switzerland,Pp.1-17.
- Wall, S. (2006). An Autoethnography on learning about auto ethnography. *International Journal of Qualitative Methods* 5(2): <https://doi.org>.