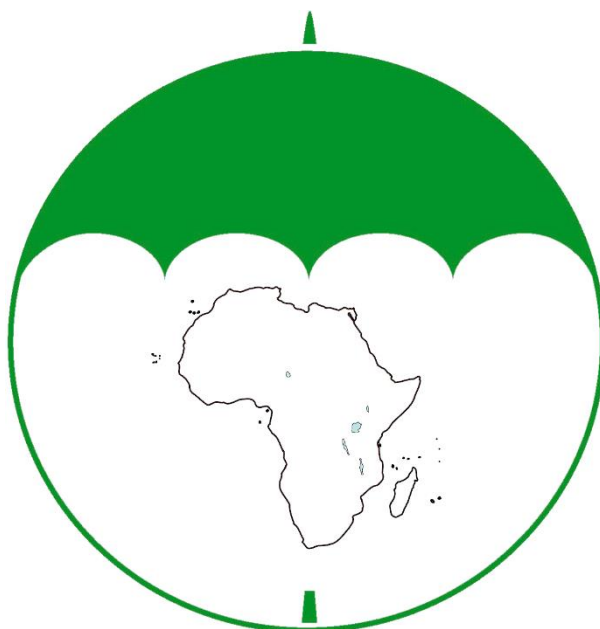


# Terms of Reference



<b>CONTRACTING ORGANIZATION</b>	<b>AFRICAN ORGANISATION FOR STANDARDISATION</b> P. O. Box 57363 - 00200, NAROBİ, KENYA 3rd Floor, International House, Mama Ngina Street Tel: +254 20 2224561/311608 E-mail: arso@arso-organ.org
<b>CONSULTANCY TERMS OF REFERENCE</b>	<b>EDIBLE INSECTS IN AFRICA — IDENTIFICATION, GOOD AGRICULTURAL AND COLLECTION PRACTICES AND VALUE ADDITION FOR HUMAN CONSUMPTION AND COMMERCIALIZATION</b>
<b>CONSULTANT</b>	
	P. O. Box
	Tel:
	Email:
	Duration:
	<b>Total Pay: Financial Proposal</b>

ARSO Central Secretariat  
Nairobi, Kenya  
September 2022

# Edible insects in Africa — Identification, good agricultural and collection practices and value addition for human consumption and commercialization

## 1. Background

The consumption of edible insects started nearly 7000 years ago with more than 1900-2300 species of 18 orders being reported as edible insects, of which 5 orders are with at least 100 records (FAO, 2021; Huis, 2013; Tang *et al.*, 2019; Tiencheu & Womeni, 2017). These insects inhabit in both aquatic and terrestrial environments, the majority of them being harvested from nature though some species are farmed in a large scale.

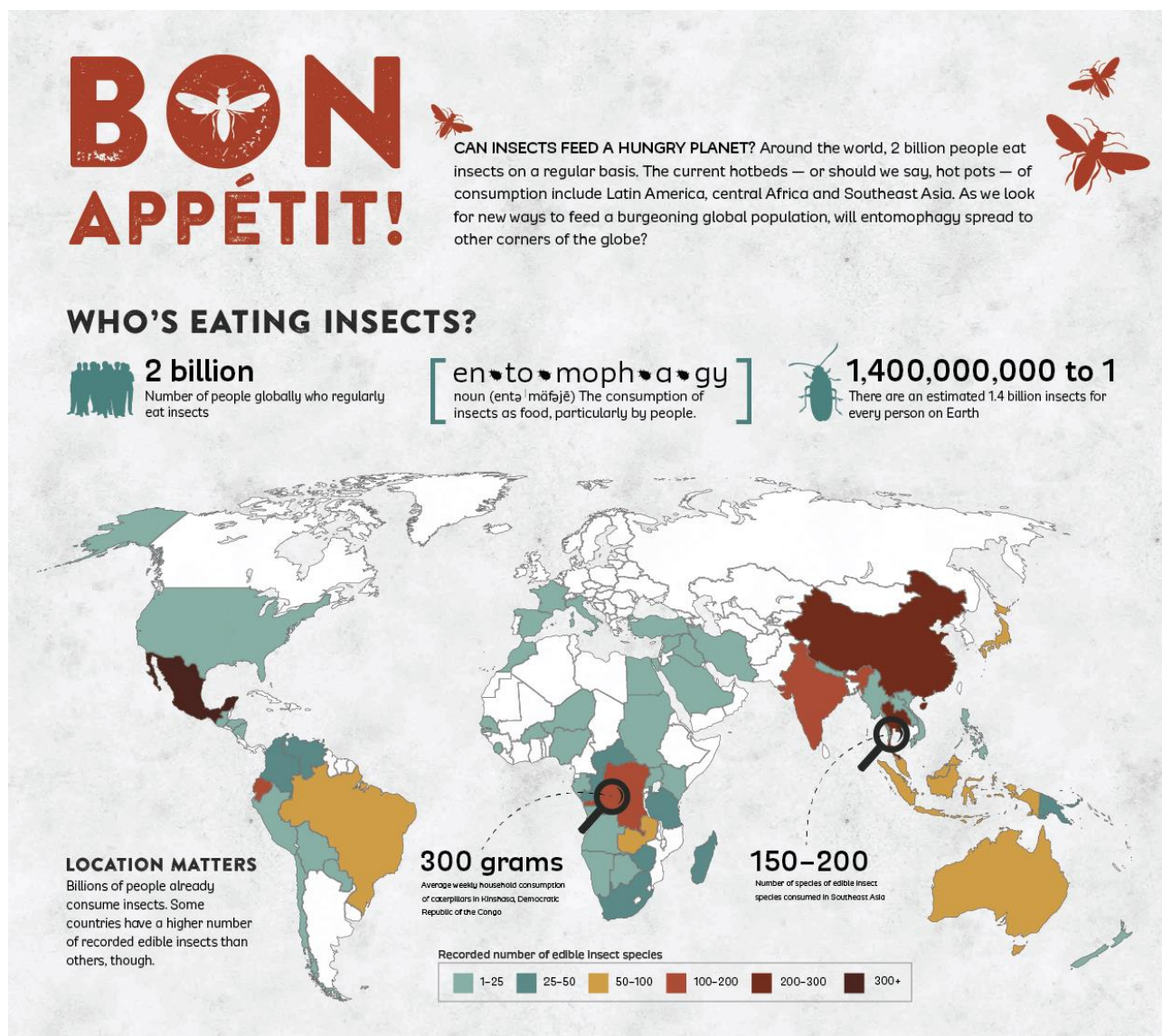
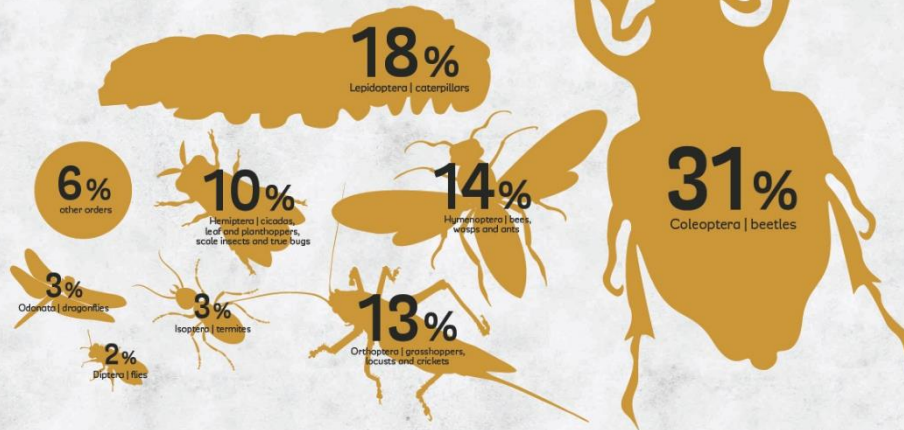


Figure 1: Around the world two billion people eat insects on a regular basis (Sisser *et al.*, 2014)

It is estimated that insects form part of the traditional diets of at least 2 billion people. Globally, the most commonly consumed insects are beetles (Coleoptera) (31 percent), caterpillars (Lepidoptera) (18 percent) and bees, wasps and ants (Hymenoptera) (14 percent). Following these are grasshoppers, locusts and crickets (Orthoptera) (13 percent), cicadas, leafhoppers, planthoppers, scale insects and true bugs (Hemiptera) (10 percent), termites (Isoptera) (3 percent), dragonflies (Odonata) (3 percent), flies (Diptera) (2 percent) and other orders (5 percent) (Huis, 2013).

## WHICH INSECTS ARE WE EATING?

According to the Food and Agriculture Organization of the United Nations, the most commonly consumed insects include:

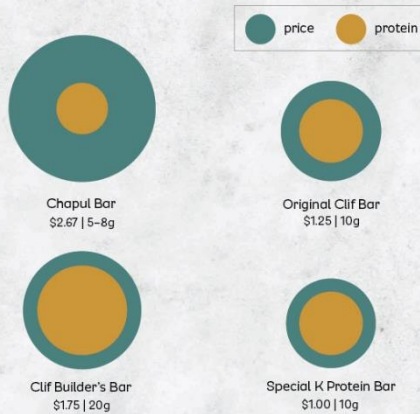


## ARE INSECTS NOURISHING?

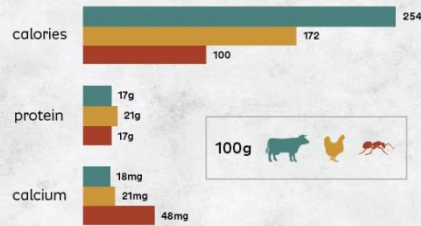
Entrepreneurs at the front lines of introducing insects to Western diets are grinding bugs into flour and adding them to products such as energy bars. How does one product — the Chapul Bar — made from cricket flour stand up to competitors?

**Fe**

Insects provide high-quality protein, nutrients and fatty acids and are also rich in fiber and micronutrients such as copper, iron, magnesium, manganese, phosphorus, selenium and zinc.



Protein content of the mopane caterpillar — a regular part of human diets in Botswana, Namibia, Zimbabwe and South Africa.



## ARE WE ALREADY EATING INSECTS?

According to a recent article in *Scientific American*, "Staples like broccoli, canned tomatoes, and hops readily contain 'insect fragments' — heads, thoraxes, and legs — and even whole insects."

**1,900** The number of edible insect species on Earth

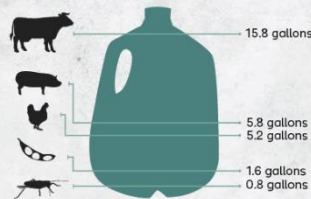
**1kg** The amount per person of flies, maggots and other insects unknowingly consumed by the 5 billion "non-insect-eating" consumers each year.

## WHAT ARE THE ENVIRONMENTAL BENEFITS OF FARMING INSECTS?

Crickets need 1/12 as much feed as cattle, 1/4 as much feed as sheep, and half as much feed as pigs and broiler chickens for the same amount of protein.



How many gallons of water are needed per gram of protein?



**[ 20,000 ]** cricket farmers worldwide

80% of a cricket is edible, compared to 40% of a cow.

**720 million tons** Global animal feed production in 2010. Insects can supplement a portion of traditional feed sources such as soy, corn, grain, and fishmeal.

Crickets lay 1,200-1,500 eggs every 3-4 weeks.



SOURCES: Food and Agriculture Organization of the United Nations, U.S. Department of Agriculture, Smithsonian Institution, *Scientific American*. For more information on entomophagy around the world, visit [fao.org](http://fao.org) and download the report *Edible insects: Future Prospects for Food and Feed Security*. Infographic by Anna Egelhoff | Copy by Todd Reubold | Research by John Sisser

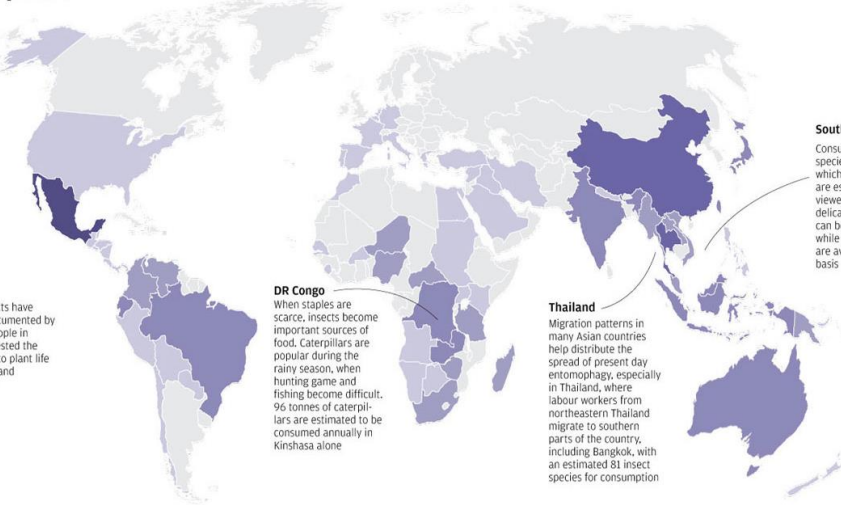
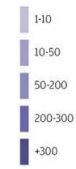
Figure 2: Which insects are we eating? (Sisser *et al.*, 2014)

# Grab some grub

The UN Food and Agriculture Organisation has just published a report on the promotion of entomophagy – the consumption of insects as food. It is a practice that has been around for millennia, Aristotle having waxed lyrical on cicada many a centuries ago. Not only do insects contain great nutritional values, but they have also proven to be more environmentally friendly than raising some livestock. Here we look at some of the more popular insects consumed around the world.

## Edible insects species

Number of species by country



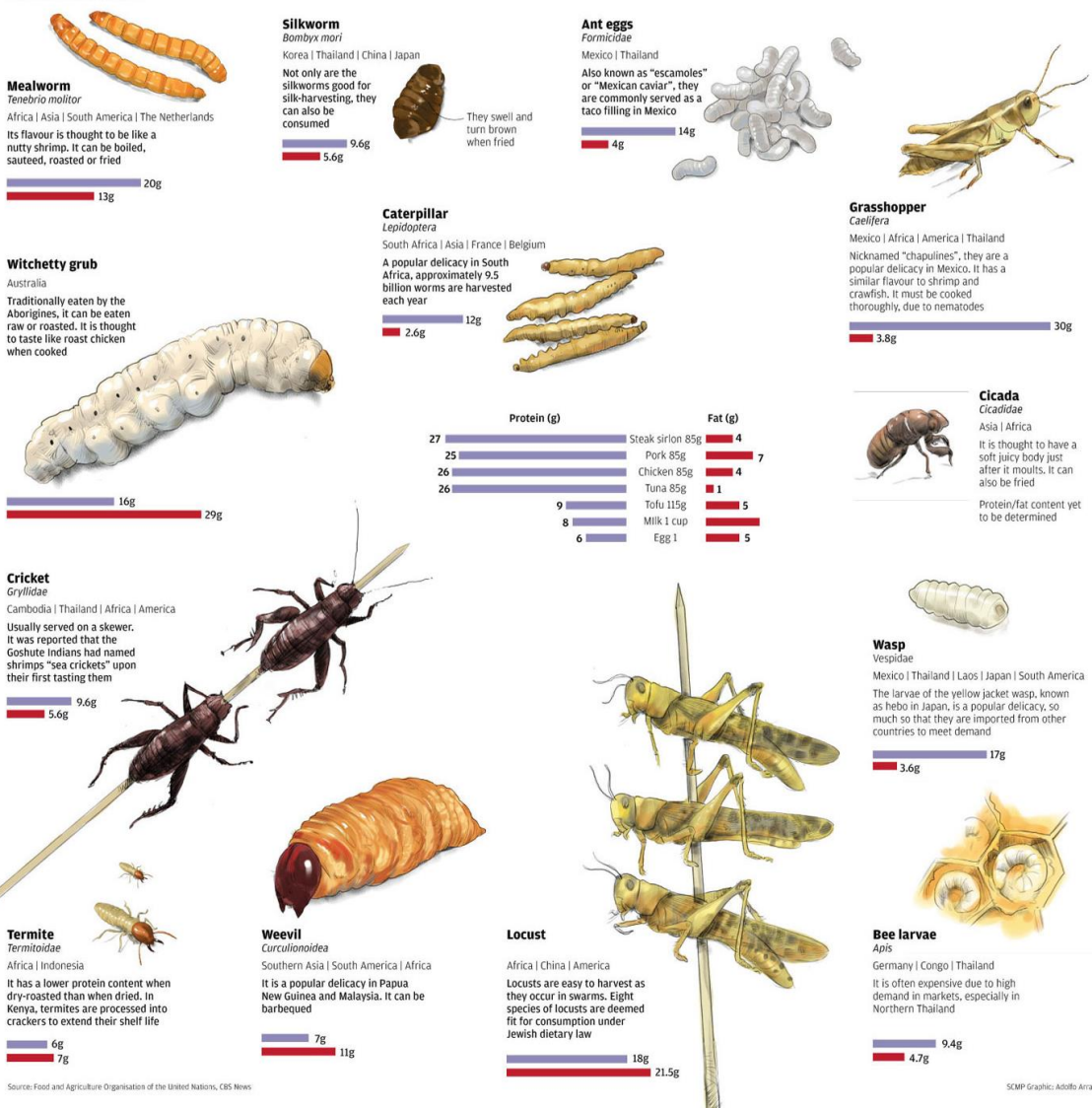
**Latin America**  
Life cycles of insects have long been well documented by the indigenous people in Mexico, who harvested the insects according to plant life and moon cycles, and seasonal changes

**DR Congo**  
When staples are scarce, insects become important sources of food. Caterpillars are popular during the rainy season, when hunting game and fishing become difficult. 96 tonnes of caterpillars are estimated to be consumed annually in Kinshasa alone

**Thailand**  
Migration patterns in many Asian countries help distribute the spread of present day entomophagy, especially in Thailand, where labour workers from northeastern Thailand migrate to southern parts of the country, including Bangkok, with an estimated 81 insect species for consumption

**Southeast Asia**  
Consumes around 150-200 species of edible insects, of which the red palm weevil is especially popular and viewed as a highly prized delicacy. Many aquatic species can be found year-round, while some non-aquatic ones are available on a seasonal basis

Bug's proteins and fat by 100g



Source: Food and Agriculture Organisation of the United Nations, CBS News

SCMP Graphic; Adolfo Aranz

Figure 3: Edible insects & bugs and their nutritional values (Oscar, 2020)

## 2. Strategic Significance of Edible Insects in Africa

Food security is fast becoming a problem for human beings because of booming populations, increase in consumption growth and possible decline in food availability (Gahukar, 2011). Trends towards 2050 predict a steady population increase to 9 billion people, forcing an increased food/feed output from available agro-ecosystems resulting in an even greater pressure on the environment (FAO, 2020). The productivity of agricultural crops is nearly stagnant and chronic malnutrition is rampant in many poor nations. Natural factors such as climate change, energy crisis, decreasing soil fertility, incidence of pests and plant diseases, and man-made situations such as increased food prices, non-availability of foods, lack of purchasing power of consumers, disparity in food distribution, and so on seem to be responsible for food insecurity, while global demand for food will keep increasing for the foreseeable future. Scarcities of agricultural land, water, forest, fishery and biodiversity resources, as well as nutrients and non-renewable energy are foreseen. To effectively respond not just to rapid population growth but also to other pressing challenges, researchers have turned their attention to insects not only because of their abundance, enormous biomass, and high quality protein but also because of the time-honoured practice among many culturally diverse peoples of Africa and Latin America of consuming live, roasted, and fried insects, providing them with a nutritious protein of good quality and high digestibility (Tiencheu & Womeni, 2017).

Edible insects contain high quality protein, vitamins and amino acids for humans (FAO, 2020). Insects have a high food conversion rate, e.g. crickets need six times less feed than cattle, four times less than sheep, and twice less than pigs and broiler chickens to produce the same amount of protein. Besides, they emit less greenhouse gases and ammonia than conventional livestock. Insects can be grown on organic waste. Therefore, insects are a potential source for conventional production (mini-livestock) of protein, either for direct human consumption, or indirectly in recomposed foods (with extracted protein from insects); and as a protein source into feedstock mixtures.

Entomophagy is practised generally for the following reasons (Gahukar, 2011; Huis, 2013):

(1) Insects are found easily in forestland and water resources and can be mass-collected in a short time whenever their populations are abundant.

(2) Insect harvesting/rearing is a low-tech, low-capital investment option that offers entry even to the poorest sections of society, such as women and the landless. Minilivestock offer livelihood opportunities for both urban and rural people. Insect rearing can be low-tech or very sophisticated, depending on the level of investment. Insect rearing is not necessarily a land-based activity and does not require land-clearing to expand production. Feed is the major requirement for land. Insects can be reared and multiplied easily in small spaces and a short period due to their short life cycle and high intrinsic growth rate. Edible insects need not be fed on grains so rearing is more environmentally friendly than traditional livestock. Insects reproduce faster than traditional livestock. For example, the female house cricket *Acheta domesticus* L. (Orthoptera: Gryllidae) can lay from 1200 to 1500 eggs in 3–4 weeks and its water requirement is very low, while for beef, the ratio is four breeding animals for each animal marketed. Further, the efficiency of conversion of ingested food (ECI) is higher (up to 44% in some insects) than for traditional meats. For instance, the house cricket has an ECI twice as efficient as pigs and broiler chickens, four times greater than that of sheep and six times higher than a steer when losses in carcass trim and dressing percentage are accounted for. Because they are cold-blooded, insects are very efficient at converting feed into protein (crickets, for example, need 12 times less feed than cattle, four times less feed than sheep, and half as much feed as pigs and

broiler chickens to produce the same amount of protein). Insects can be fed on organic waste streams.

(3) In low-income areas, only insects are available in the period of food shortage, particularly at the beginning of the rainy season when livestock is lean, new crops have just been sown and the stocks of stored produce from the previous crop season become limited. Consequently, local markets are flooded with insects packed in plastic bags and sold as food articles during the planting season. Similarly, in case of natural disasters (floods, droughts, epidemics of human diseases), ethnic clashes and wars, packets of insects can be easily distributed as an emergency food security measure.

(4) Health: Insects are mostly mixed with, or often consumed as, supplement to predominant diets based on maize, cassava, sorghum, millet, beans and rice, and form an ingredient to produce other food items. Insects are healthy, nutritious alternatives to mainstream staples such as chicken, pork, beef and even fish (from ocean catch). Many insects are rich in protein and good fats and high in calcium, iron and zinc.

(5) Insect preparations include frying, braising, stewing, stewing after frying, boiling and roasting. Eggs to adults are eaten but larvae and pupae are regularly sold in restaurants, and local and retail markets in urban areas (Chen et al., 2009). For example, fried grasshoppers in cans and chocolate-covered ants are sold in Mexico, chocolate chirpy chips or popcorn with roasted crickets and grasshoppers (known as chapulines) in the USA, ants with popcorn in Colombia and maggot cheese in Italy are a local delicacy (Capinera, 2004; Kittler and Sucher, 2008). Some restaurants in the USA are incorporating insects into their recipe books and menus such as stir-fried mealworms and caterpillar crunch (a combination of trail mix and fried caterpillars; Capinera, 2004; Gracer, 2010).

(6) Apart from local markets, export of insects in the form of beetle juice, canned silkworm pupae, caterpillars of hesperid butterflies and immature stages of ants has been initiated by the food industries in developed countries (Ramos-Elorduy, 1998).

(7) Insects already form a traditional part of many regional and national diets. Entomophagy had been used regularly by tribes for centuries as medical treatments and the same practice is being continued in certain countries. It is reported that lake flies (*Chaoborus* spp. (Diptera:Chaoboridae) and *Chironomus* spp. (Diptera: Chironomidae)) are fed to weak children with 'insect biscuits' to gain strength (Ayieko & Oriaro, 2008).

(8) **Environment:** Insects promoted as food emit considerably fewer greenhouse gases (GHGs) than most livestock (methane, for instance, is produced by only a few insect groups, such as termites and cockroaches). The ammonia emissions associated with insect rearing are also far lower than those linked to conventional livestock, such as pigs. A pig produces up to 100 times more GHG compared with mealworms. Emission of ammonia, which causes the acidification and eutrophication of ground water, also appears to be significantly lower. A pig produces 8–12 times more ammonia compared with crickets and up to 50 times more than locusts.

Insects are great resources of vitamins and micronutrients though some studies pointed out these contents can be affected by feeding (Tang *et al.*, 2019). They could provide biochemical substances such as vitamins A, B<sub>1-12</sub>, C, D, E, K, which are needed for normal growth and health. For example, caterpillars are especially rich in B<sub>1</sub>, B<sub>2</sub> and B<sub>6</sub>. Bee brood (pupae) is rich in vitamins A and D. Red palm weevil (*Rhynchophorus ferrugineus*) is a good source of vitamin E. A variety of micronutrients

could be found in edible insects, including iron, magnesium, manganese, phosphorous, potassium, selenium, sodium and zinc.

Until recently edible insects have been collected mainly from the wild but farming insects for human as well as animal consumption is now on the rise (FAO, 2021). Their high fecundity, high feed conversion efficiency, and rapid growth rates make insects viable and attractive candidates for farming. In addition, they can be reared in small, modular spaces, making it feasible to raise them in rural as well as urban farm settings. The low carbon, water and ecological footprints associated with insect production, as compared to those of other livestock species, make them attractive from an environmental sustainability standpoint. In general, edible insects are a good source of protein, fatty acids, vitamins, and minerals, though the nutritional profile is insect species dependent. This makes them a potential food source for healthy human diets. Insects can also be a nutritionally beneficial and sustainable source of feed for animals. These factors make insects a good prospect to help address food insecurity issues related to a rising global population, without simultaneously harming the environment.

### 3. Problem Statement

It was estimated that nearly 842 million people (12% of the global population) were unable to meet their dietary energy requirements in 2010 to 2013 (Kelemu *et al.*, 2015). Africa remains the region with the highest prevalence of undernourishment. Insects as food and feed have the potential to alleviate food, feed and nutrition insecurity in sub-Saharan Africa (SSA) against a backdrop of climate change (Babarinde *et al.*, 2021). Such use has gained unprecedented attention in the past decade and the trend will probably continue due to the species diversity, new discoveries in the nutritional, nutraceutical and medicinal potentials of edible insect species. In order to meet the increasing demand for insects as food and feed, insect farming should complement sustainable wild insect harvesting.

The insects' fauna in Africa is factually rich, with approximately 100,000 species of insects that have been described from SSA (Babarinde *et al.*, 2021). The available data on insect species consumed in Africa show some degrees of variations ranging from 250-320-475-524 edible insects. Such variations could be attributed to the spread of study, method of study, time of study and the targeted respondents (in the case of surveys). Across the globe, however, the leading Orders that have been reported to be consumed by humans are Coleoptera, Lepidoptera, Orthoptera, Hemiptera and Blattodea. The specific genus and species eaten, and their harvesting and processing methods, however, vary from one country/region to the other.

From the foregoing, there is a clear need for the documentation of edible insects in Africa with a view to consolidating the existing knowledge. It is envisioned that this documentation will be updated to cumulatively to create an authoritative inventory of edible insects in Africa.

The areas where entomophagy is widespread are in places where it is generally practiced as a local tradition and it tends not to be overly regulated. In some countries where insects are not usually perceived as human food or animal feed products, legislation tends to refer to insects as impurities or pests that contaminate food. The lack of specific legislation for insects as food or feed products in many high-income nations stems from the fact that the scale of insect production has been quite limited and the sector is still niche in scope. Recently, however, a growing interest in using insects for human and animal consumption as well as other applications is fueling industrial-scale insect farming in different regions. Yet most countries still lack precise and insect-specific legislation,

standards, labelling and other regulatory instruments to govern the production and commercialization of insects in both food and feed supply chains. This lack of a regulatory framework is a major barrier in the way of establishing markets for insects and insect-based products.

This research will contribute towards the development and harmonization of standards for edible insects and their derived products.

#### 4. Objectives for Identification on Edible Insects in Africa and their Value-Added Products and Uses

- (1) Develop an inventory of edible insects in Africa including the countries in which they are commonly consumed as human food, other uses and products commonly derived from the insects in a tabular format as shown in Table 1.

**Table 1: Inventory of Edible Insects in Africa and their Value-Added Products and Uses**

No	Order	Species	Common Name	Countries Reported	Stage/Part	Uses and products
1	Lepidoptera (Caterpillars)	<i>Bunaea alcinoë</i> (Stoll)	Cabbage tree emperor moth	Democratic Republic of Congo (DRC), Zambia, South Africa, Cameroon, Congo, Central African Republic (CA Republic), Zimbabwe, Nigeria, Tanzania		
2	Orthoptera (Grasshoppers, crickets and locusts)	<i>Schistocerca gregaria</i> (Forskål)	Desert locust	Zambia, South Africa, Cameroon, Congo, Botswana, Tanzania, Sudan, Uganda, Ethiopia, Kenya, Sierra Leone, Morocco, Guinea, Lesotho, Mauritania, Somalia, Eritrea, Guinea Bissau		

- (2) Please provide clear illustrations of the edible insects through your own original photographs or copied photographs from other sources which are bibliographically referenced in respect of copyright regulations. Where possible, please indicate the various phases of growth and the stage at which the insects are ready for collection and preparation for human consumption.
- (3) By reference to authoritative, provide the nutritional composition per selected measure of the food product prepared from each edible insect in relation to a substitutable similar food product from other edible animals. Comparison parameters include at least: proteins, fats and essential amino acids in comparison to at least common animal products such as beef, pork and chicken.
- (4) What are their environmental conditions in which the edible insects occur?
- (5) What is the geographical distribution of the edible insect under consideration?

A map showing the geographical distribution of the edible insect from an authoritative source shall be inserted.

- (6) What are the guidelines for their sustainable collection from the wild? What are the good agricultural practices for rearing the edible insects for optimal production?

The collection and agricultural practices may be accompanied by illustrations to promote better understanding.

- (7) What are the value added products, their procedures, hygiene, quality and marketing requirements? What are the food safety, quality and environmental concerns?

This section shall demonstrate the procedures for value added products obtained or potentially obtainable from the various African edible insects. Bearing in mind that the products might be localized and traditionally processed, the consultant shall explore the areas of improvement to achieve hygiene, quality, safety and market compliance of the value-added products.

It is recommended that the consultant combines process charts for product development as aids to understand the process and product pictorials as a means of enhancing comprehension.

- (8) What is the potential for standardization and conformity assessment of the primary and value-added products?

From a selection of the most significant value-added products, the consultant shall establish the criteria for the products to have standards and conformity assessment procedures established to facilitate certification and trade facilitation. If the value-added products are composites, this shall be illustrated clearly.

## **5. Nature of the Compilation**

The consultant shall prepare the compilation in the form of a compendium of monographs with sufficient details and illustrations of high clarity/resolution.

## **6. Value Addition Procedures**

Value addition procedures shall be the core deliverables of the consultancy. The guidance provided in the preceding sections shall be utilized in addition to the best industry practices obtained from authoritative referenced sources. The value addition shall lead to standardization and certification of the products for placing in the market.

## **7. Implementation Methodology and Assignment Duration**

In undertaking the tasks described above, the consultants will employ a combination of desk research, review of research articles and publications and telephone or web interviews with relevant stakeholders.

The consultancy shall be for a period of 6 months and the key deliverables are outlined below:

- Output 1: Inception report outlining the understanding of the task, issues to be addressed, methodology and sources of information; an annotated outline of the study (within 3 weeks after signing the contract)
- Output 2: Draft Compilation (by the end of month 3)
- Output 3: Final Compilation incorporating feedback from the validation workshop (by the end of month 6)
- Output 4: PowerPoint Presentation

## 8. Consultant Qualifications

- At least a Master's degree or equivalent in Agriculture, Zoological Sciences, Entomology, Food Sciences, or related areas.
- Track record of research and publication in the area of scope of this assignment.
- Minimum of 5 years of professional experience working in Agriculture, Zoological Sciences, Entomology, Food Sciences, or related areas.
- Proven working experience on standardization and /or value addition will confer distinct advantage.
- Demonstrated involvement in policy formulation in the agricultural value chains, food security, as well as experience working with governments of the AU Member States and other relevant stakeholders is an asset.
- For this specific job opening fluency in English and/or French is required. Knowledge of the other is an asset.

The application shall be accompanied with a brief outline of the understanding of the consultant on the subject area.

## 9. Application process

Interested and qualified consultants should submit their applications and the application should include the following:

1. A CV and demonstration of accomplishment of similar assignments:
2. A technical proposal for implementing the assignment highlighting the consultant understanding of the scope of the work, methodology of exclusivity and availability for the duration of the assignment.
3. An outline of the compilation
4. Financial proposal for completing the assignment highlighting the cost and its breakdowns.

## 10. Payment Schedules

The total payment shall be paid in two instalments as follows:

40% upon delivery of Draft Compilation (by the end of month 3).

60% upon delivering the Final Compilation and PowerPoint Presentations at the end of six months.

Formal application shall be done latest by **18th November 2022 before 5:00 p.m.**

Applications should be addressed to:

Secretary General  
African Organisation for Standardisation (ARSO) Central Secretariat  
International House 3rd Floor  
P.O. Box 57363-00200 Nairobi-Kenya  
Tel. +254-20-2224561, +254-20-311608

Preferably by e-mail to: [info@arso-oran.org](mailto:info@arso-oran.org), [arso@arso-oran.org](mailto:arso@arso-oran.org) and [arsopit@arso-oran.org](mailto:arsopit@arso-oran.org)



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