Six Legs to Nutrition: A New Old Food Source

Edible insects can significantly improve maternal and child nutrition while offering socioeconomic and environmental benefits

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Key messages

- The high burden of global food insecurity and undernutrition, the increased global emphasis on sustainable food systems, and a growing demand for animal-source protein call for increasing the supply of, and access to, sustainable animal-source foods.
- Edible insects have been a part of traditional diets in many regions in Asia, Africa, and Latin America for millennia and are a highly nutritious food source, rich in macro- and micronutrients.
- Farming insects as "mini-livestock" can help address food and nutrition security challenges in many settings while also generating socioeconomic and environmental benefits, as illustrated by early results emerging in Ghana.

The challenge of scaling up food-based solutions

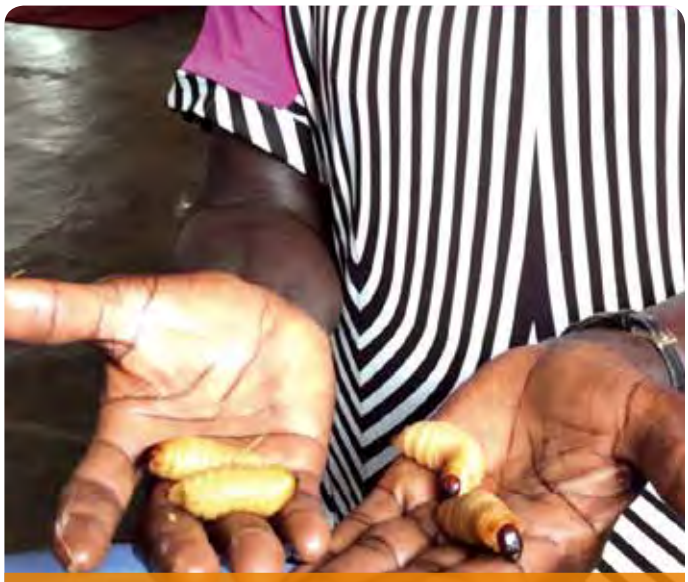
Maternal and child undernutrition is the leading underlying cause of child mortality and morbidity, and is estimated to cause 3.1 million child deaths each year.[1] The associated disease burden – which includes stunting, wasting, and micronutrient deficiencies – must be addressed with innovative and comprehensive solutions aimed specifically at pregnant and lactating women and children under two years of age. While micronutrient deficiencies have been addressed at least in part through supplementation, micronutrient powders, and food fortification, scaling up effective and sustainable food-based solutions has been a challenge.

Animal-source foods are proven sources of the nutrients required to mitigate malnutrition and promote optimal health in these vulnerable populations.[2] However, as the worldwide demand for animal protein is expected to double by 2050, a variety of innovative approaches must be identified.[3] Edible insects have emerged as a promising option to address these needs. The use of these "mini-livestock", where acceptable, could substantially enhance diet quality to meet the high nutritional needs of pregnant and lactating women – along with fast-growing infants and young children (IYC) – while also creating significant socioeconomic benefits for low-income families.

Insects as food

Entomophagy – the consumption of insects as food – has been practiced for millennia by countless cultures in regions that represent the largest burden of malnutrition in today's world. Two billion people in Asia, Africa, and Latin America consume more than 2,000 species of insects – including beetles, caterpillars, grasshoppers, and crickets – as part of their traditional diets.[3] Through the domestication and farming of these typically foraged insects, a consistent source of many essential nutrients can be provided to vulnerable populations.

According to a report from the Food and Agriculture Organization (FAO), the growing global population and increasing



Palm weevil (*Rhychophorus phoenicis*) larva, or *akokono*, an edible insect commonly found in palm trees, offers a promising platform to address maternal and child malnutrition in Ghana.

demand for protein among the middle class is leading to higher costs of animal-source proteins; food and feed insecurity; and rising environmental pressures.[3] Entomophagy offers a new platform for innovation and impact that alleviates burdens in nutrition, food security, economic development, and environmental resource management. Particularly in low-resource settings – where food insecurity and high levels of stunting, wasting, and anemia are persistent – edible insects offer a low-cost and often culturally appropriate source of macronutrients (proteins, fats and carbohydrates), vitamins, and minerals. Insect-based foods can offer complementary sources of animal protein and other nutrients to meet the growing global demand for animal-source foods.

> "Particularly in low-resource settings, edible insects offer a low-cost and often culturally appropriate source of macronutrients, vitamins and minerals"

Health impact

Insects are highly nutritious and many have high protein-to-fat ratios and low cholesterol levels.[4] They are generally rich in minerals including iron, zinc, and phosphorous, as well as many vitamins including riboflavin, pantothenic acid, biotin, folate, and vitamin A.[5,6] In a clinical study conducted in the Democratic Republic of Congo, infants fed a caterpillar-based cereal for twelve months showed higher hemoglobin concentration and lower prevalence of anemia compared with the control group.[7] This caterpillar cereal was also found to be acceptable by both mothers and infants.[8]

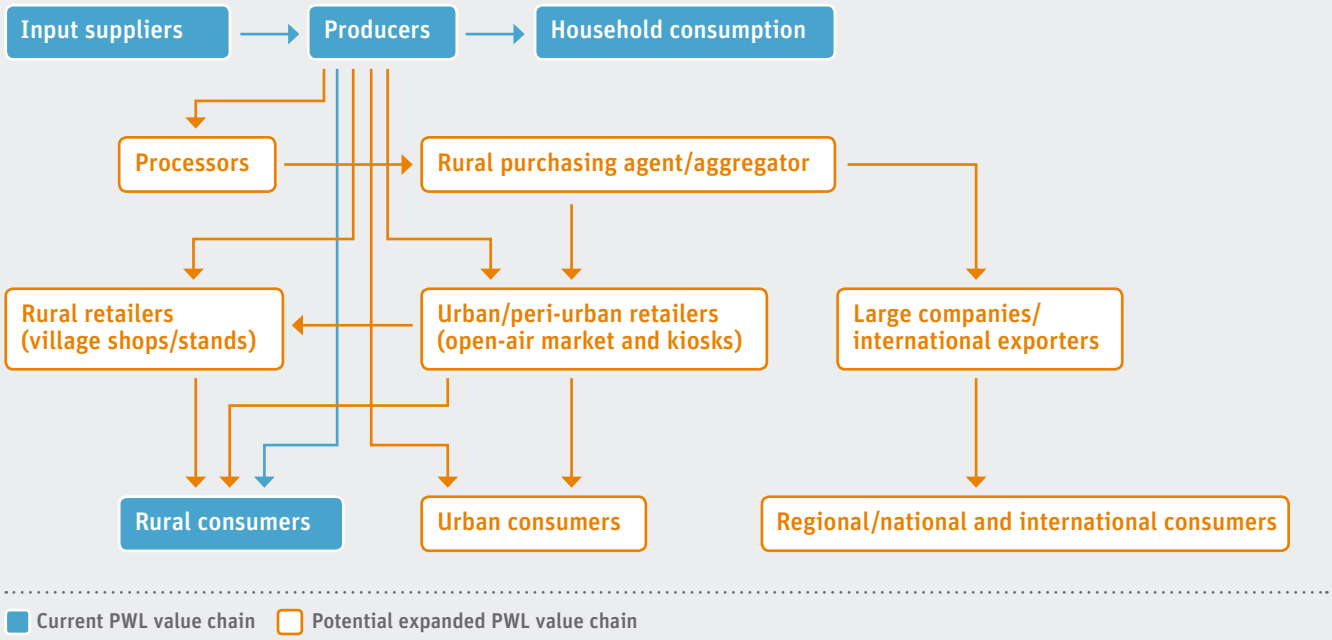
While insects are often consumed whole, they can also be processed into nutrient-rich pastes, powders, or flours. These forms are useful for integrating insects into complementary foods and fortifying local diets with additional nutrients. The combination of micro- and macronutrients found in insects can surpass food fortification by providing a whole, natural, and sustainable food source with the nutrient composition to effectively combat the burden of malnutrition. However, to effectively promote and scale up insect-based foods, higher-quality evidence on the linkage between insect consumption and the reduction of nutrient deficiencies must be generated.

Socioeconomic impact

Edible insects have traditionally been foraged from their natural environment. This practice leaves yields subject to seasonal variation and climate fluctuations. Domestication and farming practices can ensure a continuous and sustainable supply of insects, and successful experiences in Thailand, Laos, and Vietnam highlight the potential for insects as "mini-livestock."[3] Insect farming is a particularly efficient method of providing additional food for individual household consumption and food security. This economic activity can range from micro-farming for household consumption all the way to elaborate value chains that include large-scale farming, processing, and integration into existing food and feed systems to supply domestic and foreign markets.

In Ghana, *akokono* is part of traditional diets and can be prepared using multiple methods.

FIGURE 1: The *akokono* value chain is fairly simple, with linear linkages between input suppliers, producers, and consumers. There is great opportunity to improve and expand this value chain to deliver a significant nutritional and economic impact.



> "Successful experiences in Thailand, Laos, and Vietnam highlight the potential for insects as 'mini-livestock'"

The combination of low up-front investment, small spatial requirements, and physical adjacency to the household presents ample opportunity for low-income populations to engage in insect micro-farming. The short harvest cycles of many insect species can play an important role in supply smoothing and food security.[9] As with other small livestock, the proximity to the household and low physical labor and time requirements could provide significant economic opportunity for women in particular. Additionally, the small spatial requirements may also present an opportunity for urban populations to invest in micro-farming. Overall, insect farming has the potential to provide a consistent, highly nutritious food source and economic empowerment for vulnerable populations.

Environmental impact

Breeding insects requires relatively little water and land. Insects also need only small amounts of food due to their high feed-conversion rates – i.e., how much feed is needed to produce 1 kg of product.[10] Farmed insects can be fed with organic byproducts such as kitchen scraps, compost, and husks and leaves of crops such as corn and cassava.[3] Insects cultivated for animal feed purposes can also be raised on diets of food waste and other organic waste. Consequently, entomophagy could potentially jump-start new markets for agricultural byproducts that would otherwise be discarded. Furthermore, insect farming takes up little space and can be done at home. Families can thus farm insects without sacrificing their current land use: the ability to farm insects alongside produce increases the potential for dietary and economic diversity. Insect farming is therefore an efficient and sustainable venture requiring relatively few resources and producing a low environmental footprint.

Exploring opportunities in edible insects

The best opportunities to accelerate the development and scale-up of entomophagy as a new platform for innovation and impact are those combining favorable geographies and insect species. Geographies should be selected based on criteria such as scale of nutritional gaps, extent of insect consumption by different groups, economic development status, local and regional capabilities, and enabling environment. Species should be selected by matching nutrient profiles against local nutritional priorities, acceptability, and taste preferences. For any combination of geographical scope and species, a core set of activities should be carried out:

- Nutritional analysis of the species, identifying macronutrient and micronutrient profile in terms of content and bioavailability

- Research into harvester/producer/consumer behaviors related to the selected species, particularly among vulnerable groups (entailing a combination of ethnographic research and value chain analysis)
- Human studies on the efficacy, effectiveness, and safety of the species, whether in processed forms or not, to address maternal and child malnutrition
- Development or adaptation of cost-effective farming and processing technologies to enable or expand insect-based value chains, with initial focus on domestic micro-farming in rural and peri-urban areas.

Akokono in Ghana: a promising food source

Malnutrition is a pressing issue in Ghana, particularly for women and children. Almost half (42%) of women of reproductive age and two-thirds (66%) of children under five are anemic. One-fifth (19%) of Ghanaian children under five suffer from stunting and 5% suffer from wasting.[11] Eleven percent of children and 6% of women are underweight.[11]

Considering the high burden of malnutrition in Ghana, the African palm weevil (*Rhychophorus phoenicis*) larva presents a particularly compelling opportunity to improve nutrition. This species is found and consumed as food in its larval stage throughout tropical and equatorial Africa. Palm weevil larvae (PWL) are an excellent source of amino acids, fatty acids, vitamin B_{12}, and minerals such as zinc, potassium and phosphorus.[12] Particularly in Central and Southern Ghana, PWL, locally known as *akokono*, are part of traditional diets and are considered a delicacy. Currently, PWL harvesting is labor-intensive and subject to inconsistent yields, as increased pesticide use decreases availability.

The inputs required for PWL farming are relatively few, and include a bucket, a screened lid, a feed mix, and a few larvae.

During a training session, women take turns preparing *akokono*.

Although the current PWL value chain is relatively simple (see **Figure 1**), there is significant potential to improve and expand it in order to maximize the potential to deliver a substantial nutritional and economic impact in Ghana.

> "Formative research has produced promising results"

Small insects provide big opportunities

Given this opportunity for impact, PATH, Aspire Food Group, Heifer International, the University of Ghana School of Public Health, and Kintampo Health Research Center are working together in the Ashanti and Brong-Ahafo Regions of Ghana to turn this traditional food source into a new avenue for improved nutrition and prosperity among vulnerable groups. By providing starter kits to women to farm PWL at home, this initiative aims to increase consumption of animal protein, dietary diversity, and household income through market sales. Formative research has produced promising results, indicating that caregivers and stakeholders generally perceive PWL to be healthy and appropriate for both adults and children. The low supply and high demand for PWL in local markets make their farming economically attractive. By building social capital, women farmers form socially strong and economically viable community groups that promise the sustainability of PWL farming initiatives.

Conclusion

Our experiences with the PWL in Ghana highlight the potential of edible insects to improve maternal and child nutrition and empower women. The high nutritional content paired with the promising economic potential may provide the necessary conditions to alleviate the burden of malnutrition in many contexts. The nutritional, health, socioeconomic, and environmental benefits of these valuable food sources are yet to be fully tapped.

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