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Bushmeat and The Future of Protein in West Africa

CONTENTS

Editorial	1
Bushmeat – Trends and Prospects	2
Grasscutter Farming: The Future of Bushmeat in West Africa	6
Edible Insects: The Future of Protein	8

The purpose of this newsletter is to monitor trends across the West Africa region for policy makers, researchers and other decision makers in the international community.

Disclaimer: *The views expressed in this newsletter do not represent those of the Rockefeller Foundation.*

Introduction

Malnutrition is a major concern in Africa. The lack of protein in particular is of special concern because access is limited and starchy diets predominate. For generations, the lack of protein has stunted the physical and mental development of millions of children on the continent, limiting their overall potential. In fact, one cannot fully understand the underdevelopment of Africa's human capital without grasping the hidden, yet lifelong effects of protein deficiency. Although overall nutrition and protein consumption in Africa has improved in the past two decades, the challenge of sufficient protein consumption remains, especially among the poor.

This issue explores the animal protein challenge in West Africa, and highlights how consuming wildlife as a source of protein threatens the ecosystem. Demand for bushmeat has created a vibrant trade, which is endangering the existence of wildlife and destroying forests and grasslands, as hunters employ crude hunting methods like bush burning. Our first article examines some of the challenges of bushmeat consumption, while the second explores the potential for domesticating grasscutters (cane rats) as a way to meet rising demand. The third article looks at edible insects and their potential as a viable source of dietary protein.

Editorial

Locally produced animal protein is scarce in the West Africa region. This is fundamentally because the region's geography is prone to tsetse fly infestation, a problem that has made it uninhabitable for domestic livestock, restricting cattle rearing to the Sahel belt. The result is that traditionally and historically, the meat of wild animals (commonly called bushmeat) has been the primary source of animal protein for most communities. As a result, people have developed a preferred taste for bushmeat, such that it now fetches a premium over beef and other meats. And as populations have grown and become more affluent, the demand for bushmeat has become unsustainable, as its rate of consumption is endangering the ecosystems of the region, with some animals threatened by extinction.

One way to solve the crisis of bushmeat is to encourage conventional protein. However, this is resource-intensive in land, water, and other resources. Some 30% of the land on Earth is used for pasture and growing feed for livestock (mainly maize and soy). In fact, livestock and humans are already competing for food. The fact that the taste for bushmeat is well developed means that demand for it exists irrespective of the presence of conventional meats. Additionally, bushmeat is central to the livelihood of many poor rural dwellers who consume and trade in it, therefore encouraging conventional protein will be a difficult-sell.

Innovative solutions are needed to meet animal protein demand. One emerging solution is the commercial farming of small wildlife. Since small animals requires little resources in terms of time, feed, and space, the poor can easily participate in rearing them. This is happening with encouraging results in grass cutter breeding. A highly desired meat across the region with over 80 million hunted annually, the potential for grasscutter farming to reduce poverty is strong. For example, a stock family of five grasscutter (one male and four females) can generate enough revenue to educate two children. Some of the more successful farmers can make up to US\$1,400 annually, underscoring its poverty-reducing potential additional to providing needed dietary protein.

However, there is still some ways to go before grasscutter farming skills are widely diffused and the necessary support and financing infrastructure is developed. Benin's successful commercial grasscutter farming industry is a

good example for the region. And Ghana is leveraging Benin's experience with good results. Benin's efforts have relied on government and development partners working together. However, other models like those in Nigeria, where private sector entrepreneurs/farmers are promote grasscutter farming through consultancy is also effective.

There is also a growing realization that insects can meet the protein challenge of the region. Insects not only have higher nutritional quality than animal protein, but they can also be produced more sustainably and with a much smaller ecological footprint than animal protein. Prospects for promoting insect eating are good, as insects are traditionally consumed in many communities in the region and considered a delicacy. One challenging demographic to capture may be the middle class, as with modernization, the educated have tended to shun eating insects.

Insect eating has the potential to support many rural dwellers and street traders in urban areas, where insects are traditionally popular. This is already happening on Southern Africa with mopane worms (caterpillar). It is estimated as an US\$85 million regional trade, supporting livelihoods of the poor in both rural and urban settings. However, like any wildlife, growth in trade raises issue of sustainability as uncontrolled harvesting can deplete stocks. For this reason, technological developments for commercial insect farming are critical to growth in this sector. Thailand provides a good example of this.

Considering that many may shun eating insects, an indirect way of utilizing insect protein is by using them as animal feed. A number of initiatives using this approach are being incubated in the region and elsewhere.

As interest in commercializing wildlife and insects as a source of protein grows, more attention will need to be paid to food safety. There have been cases of communities being sickened by consuming insects in Nigeria, and even deaths in Kenya due to improper bushmeat handling. Zoonotic diseases are always a lurking danger when humans come in contact with animals. Education and strong regulation is imperative for the growth of this sector. With proper regulation and support, wildlife and insect farming can be an important contributor to the quest for protein in the region.

Bushmeat – Trends and Prospects

The term bushmeat is frequently used to describe the meat from any wild animal that is killed for subsistence or commercial purposes. Species range in size from large mammals, such as primates and antelope, to small animals like frogs, snakes, rodents, bats, insects, and termites. By some estimates, bushmeat contributes between 20% and 90% of the animal protein eaten in many regions of Africa. Bushmeat consumption is especially widespread in Central and West Africa.

Drivers of Bushmeat Consumption

Livelihood and consumer preferences are the main drivers of bushmeat consumption. Many poor people in marginal areas depend on bushmeat for their animal protein supply because they have no other source or cannot afford alternatives. And for many poor people, bushmeat is an important component of their livelihood. For poor farmers,

bushmeat is particularly important in lean agricultural periods. For example, the bushmeat harvest enables cocoa farmers in Ghana to reduce their meat and fish expenditures while maintaining protein consumption levels during the lean season. Moreover, when income shortages are highest, bushmeat sales increase, stalling income poverty. Indeed, it is often among the poorer households that bushmeat comprises the largest share of household income, and protein consumption.

Overfishing along the West Africa coast is another driver of bushmeat consumption. Practiced mainly by subsidized European Union fishing vessels, overfishing has lowered fish catch, and as a consequence, bushmeat demand has risen.

In urban areas, bushmeat is a delicacy and many are willing to pay a premium for it. A survey found that bushmeat is more expensive than conventional meat in seven countries: Burkina Faso, Cote d'Ivoire, Ghana, Niger, Senegal, Sierra Leone, and Togo. With the exception of Senegal, people in West African countries prefer to eat bushmeat over domesticated meat. This preference is attributed to several factors. Bushmeat is perceived to be healthier and tastier than conventional meats. There is also a belief that it has medicinal benefits, and cultural traditions of eating bushmeat are also an important factor in explaining the preference.

The demand and price premium creates a market for bushmeat, thus linking rural hunters to the urban market. And a noticeable trade in bushmeat is conducted throughout the region. According to the Ghana Wild Life Division, the bushmeat sector employs about 300,000 people, either directly or indirectly, and the local consumption and export of bushmeat generates a total of US\$300 million (though this data is a bit dated). Indeed some estimates see bushmeat as a bigger industry than Ghana's gold mining.

Bushmeat trade is fairly well balanced with rural hunters making good margins. A bushmeat value chain study in Ghana found no one group has overall control of the trade. While urban restaurants sell the most bushmeat to consumers, rural hunters appear to make the most profit, indicating that the bushmeat trade is an important component of the rural economy. At the same time, revenue accrued from the trade is also an important source of income for women in urban areas who are at the market end of the bushmeat value chain.

Good estimates of the bushmeat economy are hard to determine as most of the meat is consumed in homes and

Table 1: Bushmeat Consumption Patterns in West Africa

Benin	Bushmeat is commonly sold in markets and is preferred to meat of conventional livestock. Grasscutter is the favorite species for most people.
Ghana	A wide range of wild animal species are accepted as a food resource. It is estimated that 70% of Ghanaians eat bushmeat, with it constituting the main source of animal protein for rural communities. Recent surveys of meat consumption indicate that bushmeat is still popular. Over 90% of people interviewed said they would eat bushmeat if it were available.
Liberia	Popular bushmeat includes antelope and various monkeys. A dated survey estimated that three quarters of the country's meat production comes from wild animals. By some estimates, as much as 80% to 90% of the population consumes bushmeat.
Nigeria	Bushmeat is popular with both urban and city dwellers and provides 20% of animal protein in southern Nigeria. Most commonly consumed are small mammals including squirrels, grasscutters, giant rats, brush-tailed porcupines, and bats.
Senegal	A survey in the Sine region estimated consumption among the Sereer as 12.9 g per person per day, as compared with 24 g of conventional domesticated meat per person per day. The most commonly consumed species are birds, with children consuming the greatest quantities.
Sierra Leone	Bushmeat was once a staple food in many Sierra Leonean's diets. Despite the increasing scarcity of wildlife throughout the country, bushmeat is still available in most rural and urban markets, constituting 55% of household consumption.

Source: <http://www.fao.org/docrep/w7540e/w7540e04.htm>

much of the trade is unrecorded. For example a study focusing on alternative commodity chains estimated that a minimum of 128,000 fruit bats are sold each year in Ghana through a commodity chain stretching up to 400 km. More knowledge is needed, as previous studies have largely missed the nuances of bushmeat trade.

Although the bushmeat trade is illegal in most countries, its growth has triggered more sophisticated weapons and traps, and cruder hunting practices like the use of poisons, and burning forests to evict animals. Strong demand has also strengthened links between hunters and traders so that some urban traders even pre-finance hunting by providing hunters with supplies such as shotgun cartridges. These hunting practices are unsustainable for wild animal populations

Throughout the region, the marketplace is witnessing a decrease in large animals and an increase in small animals, signifying a depletion of the larger, slow moving and slowly multiplying animals. Indeed some animals such as the pigmy hippopotamus (*Choeropsis liberiansis*) in Liberia, and manatee (*Trichechus senegalensis*) in Ghana are in danger of extinction due to hunting. The pigmy hippopotamus for example, once lived in Nigeria, but is now believed to be extinct as there have been no sightings for decades.

Logging has also contributed to the rise in bushmeat consumption. Logging companies frequently provide the infrastructure to facilitate hunting in areas which were previously hard to access by humans. Further, the employees of these companies often hunt wildlife for their personal needs.

Impact

Bushmeat hunting can have destructive impacts on the environment and on humans. Wild animals play an integral role in their ecosystems. For instance, fruit bats are important pollinators and their demise creates a significant gap in the ecosystem. Forest burning is also environmentally destructive. Beyond destroying animal habitats, these fires at times burn out of control and threaten farms. Hunting with poisons is also destructive and dangerous. They kill animals indiscriminately and have the potential to get into the human food system.

Beyond the need to preserve ecosystems, bushmeat hunting poses important human health risks due to exposure to zoonotic diseases. A study in Sierra Leone found women involved in the bushmeat trade are at a greater risk of exposure to potential zoonotic pathogens through

accidental self-cutting, as women tend to be the ones who conduct the actual trade in meat.

In order to conserve biodiversity and at the same time protect human health, bushmeat consumption and trade should be regulated. However, this can be problematic for the critical role that bushmeat consumption and trade plays in the livelihoods of poor people. This underscores the need for interventions that regulate bushmeat consumption and diversify the sources of income available to those communities that depend on bushmeat. Such interventions would need to focus on the agricultural lean season to help relieve the dependencies on bushmeat as a safety net.

Interventions

Unraveling the commodity chain from capture to consumption for each species of bushmeat is vital to understanding how best to manage the trade, and mitigate its potentially deleterious effects. The Zoology Society of London (ZSL) is conducting research to better understand patterns driving bushmeat hunting and trade in West Africa, and are developing models to predict future trends and impacts of management actions. The objective is to assist both policymakers and project managers to develop effective methods of regulation and management for sustainability. In the region the project includes:

- Studying long-term off take and market surveys in Sierra Leone and Ghana to understand patterns of use over time and impacts on hunted species
- Studying the role logging plays in bushmeat use in Cameroon, Gabon, and Ghana
- Taking a spatially-explicit approach to studying bushmeat supply and demand in Nigeria
- Researching public health risks from hunting, butchering, trading, and consuming bushmeat, focusing on bats in Ghana and the trade to Europe

Proposals have also been made to make logging companies comply with codes of conduct to ensure the effective protection of wildlife in their concession areas.

Other key means that have been proposed to tackle the wild meat crisis include the institution of protected areas, as well as quotas or complete bans on the harvesting and trade of certain species. For instance, the Ghana Wildlife Division bans hunting from August 1st to December 1st every year. Labeled as the “closed season”, this enables wildlife to reproduce, wean their young, and prepare them for maturation. However, due to poor implementation, hunters openly defy the rule.

Perhaps combining modern and traditional interventions may be more fruitful. Traditionally, wildlife was managed at the community level using a system of protected areas and species. Hunters required the permission of the chief before hunting, and had to give part of the animal to the chief. Tribes commonly associated a species with their ancestral heritage and prohibited the killing of such totems. For instance, the Boabeng-Fiema Monkey Sanctuary in Ghana, where ancient beliefs associated with the local monkeys have conserved the species and its habitat, has become a well-known tourist attraction. There are numerous sacred sites throughout the region that can be leveraged to protect wildlife and concurrently develop tourism, thereby providing alternative livelihoods for the poor.

Studies to better understand the risk perception among bushmeat hunters and traders is needed, and would pair well with public health-based education programs to minimize zoonotic disease transmission. One such study has collected preliminary information in Sierra Leone in what could be a starting point.

Perhaps the most fruitful approach to tackling the bushmeat challenge – one that addresses both the demand for the meat and accommodates livelihood needs – is commercial bushmeat rearing. Mini-livestock--the breeding and farming of small wildlife species (e.g. rodents like cane rats, giant rats, and porcupines)--has been particularly promising as these are short-cycle livestock species that are adaptable to a range of habitats and diets, and require little resources.

Awareness and scientific understanding of mini-livestock is increasing and the development of this sector is sustainable because it not only fulfills nutritional and income-generating requirements, but it also protects the environment (see next story).

Notwithstanding the above interventions, there is no simple solution for achieving the twin goals of feeding the human population and conserving wildlife. The key will likely rest in long-term integrated efforts.



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Grasscutter Farming: The Future of Bushmeat in West Africa

Bushmeat use has transformed from subsistence consumption to a significant trade. The threat it poses to some species highlights opportunities for commercial farming. Most countries in the region have some experience with wildlife domestication, however there is no commonly used management system.

Among commercially reared wildlife, grasscutter shows the greatest prospects due to the popularity of its meat. Approximately 80 million cane rats are hunted per year in West Africa. Consumer acceptance trials in Ghana indicate that grasscutter meat is far more popular than beef and goat (49.7%, compared to 28.9% and 21.5% respectively). Part of the popularity is due to perceived superior nutritional value of the grasscutter, which has some basis as Table 2 shows.

The relatively low fat and cholesterol content makes grasscutter a choice meat for an emerging health conscious middle class in the region. The steady growth of this class is an indication that demand is likely to increase rapidly in the future.

Grasscutter is a good choice for domestication not only because the meat is highly desired and culturally accepted, but the animal also requires few external inputs in terms of feed, time, and space:

- As its name implies, it feeds on grasses, which farmers can grow or harvest from the wild at no cost.
- Each animal only requires about 10 minutes of care each day.
- Grasscutter farming requires little space and can be easily integrated into an existing farm.
- Grasscutter farming can easily be done in urban areas as well (outdoors or indoors)

These factors make grasscutter farming a viable income generating opportunity for landless individuals as well as the growing unemployed youths in urban areas.

Feasibility reports on grasscutter farming ventures indicate that the long-term profitability is comparable to that of poultry farming, and is higher than cattle ranching. Thus, grasscutter farming is a good opportunity for rural poor who depend on hunting for livelihood.

Currently only about 0.2% of grasscutter meat is provided by domesticated grasscutter, underscoring the potential for growth. However, would-be farmers continue to face some challenges. High initial capital, stock procurement, and limited technical expertise (how to house, feed, and breed the animals and getting veterinary assistance), are common inhibitors. This has hampered backyard grasscutter farming by rural households as well as large-scale commercial ventures.

Interventions

A number of programs help would-be farmers acquire skills for grasscutter farming. Under the Project Benino - Allemand d'Aulacodiculture (PBAA), the Republic of Benin initiated the first serious study on grasscutter domestication. The aim of the project was to select improved grasscutter stocks genetically adapted to life in captivity, and to promote breeding in rural and sub-urban environments by smallscale farmers. To support the fledgling industry, the government has created a sub-sector under the Ministry of Agriculture with specialized veterinary officers in charge of grasscutter care. It has also developed programs to assist prospective grasscutter farmers with grants and loans at 2% interest. As a result of these interventions, Benin is now the leading producer of grasscutter in the world, with some very successful farmers able to house 7,000 animals, compared to 150 for the most successful farmers in Ghana.

Learning from the success of Benin, governments and development partners are actively supporting grasscutter farming in the region. Some examples include:

- The German Development Cooperation's program that is networking within the sub-region to help other countries leverage Benin's experience. The activities of the project include developing training concepts for farmers and artisans, training and backstopping master trainers, assisting farmers to acquire breeding stock, introducing participatory research with government and private partners, and facilitating business development assistance (business plans, bank financing packages, etc).

Table 2: Approximate Composition (%) and Mineral Content of Grasscutter Meat in Relation to Other Domestic Animal Meat

Meat	Moisture	Ash	Protein	Fat	Fe	Ca	P
Beef	73.8	1.0	19.6	6.6	5.1	3.9	57
Mutton	78.5	1.0	17.2	2.9	3.1	9.0	80
Pork	64.8	0.8	19.4	13.4	1.0	3.0	72
Grasscutter	72.3	0.9	22.7	4.2	2.8	8.3	111

- Heifer International's grasscutter program in Ghana, which was inspired by the Benin Project's success (eg. a shipment of 300 grasscutters for Heifer Ghana's grasscutter program were from the Republic of Benin)
- The Skills Development Fund (SDF), supported by the Government of Ghana, the World Bank, and the African Development Bank (ADB) supports skills development for grasscutter farming. Targeted skills include reproduction and reproductive management, nutrition and feeding, handling techniques, cage construction, mating techniques, and health management.

The private sector is also very active in promoting grasscutter farming, with a number of farms and consultants offering technical expertise and supplying breeding stock to those entering the industry.

- Zandala Farms in Nigeria has written a grasscutter farming manual entitled "Modern Grasscutter Breeding Guide".
- Jovana Farms, also in Nigeria, offers regular hands-on training programs on its farms for grasscutter breeding.

Looking Ahead

Grasscutter farming has good potential to improve livelihoods. Experiences with grasscutter farming indicate that one grasscutter family, consisting of one male and four females, can provide school fees for two children.

There have been promising results where interventions have been implemented:

- In one district in Ghana intervention through the German Development Cooperation has seen 20 poor farmers increase the stock from 5 to 15 within two years, with women constituting about 30% of the farmers trained.
- One of Heifer's Project's most successful grasscutter farmers makes at least US\$1,400 per year from his grasscutter operation alone, which is about double the average annual income of other Ghanaians.
- Bushfires in Ghana's Brong Ahafo region have reduced drastically after efforts to promote captive grasscutter breeding.

The prospects for grasscutter farming look good. The market for both fresh and smoked grasscutter meat is effectively unlimited. However, research to develop cheaper ways of production needs investment in addition to extension services for appropriate technology transfers to smallscale farmers. Benin provides good examples of how to go about this. Emerging private sector initiatives also need support and strengthening as an alternative model.

With all this, there is strong potential for grasscutter farming to alleviate poverty, and at the same time protect the environment.

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Edible Insects: The Future of Protein?

“...It is a “supreme irony” that “all over the world billions are spent every year to save crops that contain no more than 14% of plant protein by killing another food source (insects) that may contain up to 75% of high-quality animal protein...”

<http://www.co2science.org/articles/V15/N22/EDIT.php>

The potential for insects to supply protein needs for human populations is a seldom-researched topic in the area of food security. Though insect consumption may sound strange to some, it is not unusual at all. Entomophagy (insect eating) is in fact widespread in West Africa and many other regions around the world (see Figure 1). A recent report by the Food and Agriculture Organization (FAO) points out that there are more than 1,900 edible insect species on earth, and about two billion people eat a wide variety of insects regularly.

Commonly eaten insect groups include ants, beetles, bees, caterpillars, wasps, grasshoppers, locusts, crickets, cicadas, leaf and planthoppers, scale insects and true bugs, termites, dragonflies and flies. The most commonly consumed insect in Africa is the cricket. However, preferences vary by region. For example, in Nigeria caterpillar is the most widely marketed edible insect and sells for about twice the price of beef. Table 3 shows some species of insects eaten around the region.

Prospects for Insect Eating

Due to a number of advantages that insects provide as a protein source, there is a growing air of optimism that insect-based food products can realistically become an important part of the future food supply:

Species Eaten	Countries
Beetles/Beetle Larvae	Ghana, Ivory Coast, Liberia, Nigeria, Senegal
Bee Larvae	Sierra Leone
Termites	Burkina Faso, Ghana, Guinea, Ivory Coast, Mali, Nigeria
Caterpillars	Ivory Coast, Mali, Nigeria
Giant Silkworm Moths	Burkina Faso, Ivory Coast, Mali, Nigeria
Dragon Fly	Nigeria
Grasshoppers	Nigeria
Crickets	Burkina Faso, Nigeria

Source http://www.food-insects.com/book7_31/Chapter%2020%20West%20and%20North%20Africa.htm

- Insects are particularly high in protein, with levels comparable to beef. For example, 100 grams of grasshopper meat contains 20g of protein, which is only 7g less than an equivalent portion of beef, while 100g of the common house cricket contain four times more protein than the same amount of chicken. Caterpillars have a higher proportion of protein and fat than beef and fish, with a high-energy value as well.

Fig 1: Insect Eating Patterns



<http://www.kickstarter.com/projects/exoprotein/exo-protein-bars-made-from-cricket-flour>

- Insects are also particularly rich in fat, and can thus supply a high caloric contribution to the human diet, particularly in famine-stricken areas of the world. Moreover, like fish, insect fatty acids are unsaturated and are thus healthier.
- Insects also provide many minerals. 100 grams of cricket contains, 12.9 g of protein, 5.5 g fat, 5.1 g carbohydrates, 75.8 mg calcium, 9.5 mg iron, 3.10 mg niacin, 1.09 mg riboflavin, 185.3 mg phosphorous, and 0.36 mg thiamine. Red ants, small grasshoppers and some water beetles contain iron, magnesium, phosphorous, selenium, and zinc. Research shows that 100 grams of insects provide more than 100% of the daily requirements of these respective minerals and vitamins. (See Table 4 for comparison with other meats.)

Insects are also healthier than beef. For instance, 100 grams of ground beef contains 288.2 calories, which is almost three times the amount of 100 g of crickets; and 21.2 g of fat, which is almost four times the amount of crickets. Furthermore, compared with other animal foods, insects also have higher fiber content.

Beyond nutritional content, insects have a better value proposition.

- On average, insects can convert 2 kg of feed into 1 kg of edible meat. In comparison, cattle require 8 kg of feed to produce 1 kg of meat. Factoring in their astounding reproduction rates, and shorter life spans, the actual food conversion efficiency of insects may be 20 times that of cattle. And insects feed on a far wider range of plants than conventional livestock.

Table 4: Mineral Content (mg/100g) of Silkworm Pupae and Conventional Meats

Component	Pupae	Beef	Pork	Chicken
Phosphorus	175	191.50	160.00	No data
Iron	7.0	1.67	0.80	No data
Calcium	24.0	6.50	8.00	8.00
Zinc	2.10	3.41	1.60	1.26
Copper	0.45	0.05	0.13	0.06
Magnesium	54.0	19.25	17.0	26.00
Manganese	0.69	No data	No data	No data

Source: <http://onlinelibrary.wiley.com/doi/10.1111/1541-4337.12014/full#crf312014-bib-0078>

- Collecting edible insects can also be highly labor-efficient. According to one study in Utah, USA, collecting locusts (*Melanoplus sanguinipes*) yielded an average return of 273,000 calories per labor hour.
- Insect farms are also known to play a vital role in breaking down natural waste products. Beetle larvae, flies, ants, and termites clean up dead plant matter. The mineral and nutrient by-products of the dead organisms then become reabsorbed into the soil for future plant life.
- Insects can consume agricultural waste or plants that humans and traditional livestock cannot. By converting biomass that is not consumable by humans into edible insect mass, insects don't compete with the human food supply, whereas cows and chickens primarily fed on grains, which humans also eat. Additionally, insects also use much less water than conventional livestock.
- Insects are easy to farm in large quantities using very little space.
- Farming insects may also require minimal market introduction efforts, as insects already form part of some local food cultures. Researchers in Thailand have shown that people consume insects not because they are environmentally friendly, or nutritious, or cheap compared to meat or poultry, but simply because they prefer the taste.

However, there are a number of challenges to promoting insect eating:

- With modernization, insect eating has been declining. The more educated are more reluctant to eat insects, even when it is their cultural heritage. This leaves the practice to rural and marginalized people who cannot afford the more conventional forms of protein, and stigmatizes insect eating to a practice of the poor.
- Some insects (e.g. termites) are seasonal, making it hard to develop stable markets.
- Logging is destroying habitat for some insects, thereby removing them from diets.
- Modern farming views insects as pests rather than food, and application of pesticides has reduced insect populations and made eating them hazardous. In Mali for instance, where children traditionally eat insects, the pesticides used on cotton crops has exposed children to pesticide poisoning. This has prompted the community to discourage insect consumption altogether.

Interventions

The potential benefits of insect farming and consumption is being appreciated, and a number of interventions are taking place in the region.

Rather than relying on natural populations, developing mass-breeding methods is one key to unlocking the value of insects. Some of the initiatives addressing this challenge in the region are:

- A 4-year European Union project entitled “Insects as a sustainable source of animal protein for Africa” is conducting research on simple cultivation methods and establishing small scale insect farms for human consumption. The initial focus of the study is Central Africa. Wageningen University is leading this project.
- The Bugs for Life group at Imperial College London has an initiative to understand the potential of edible insects as an environmentally friendly solution to malnutrition in impoverished regions. The group will work in the Wama community in Benin to better understand how they traditionally gather, sell, cook, and consume insects. In addition, the research will explore methods

for insect breeding that can be applied locally in order to counter the risk of over-exploiting natural stocks.

- A group of students from the University of Montana used a holistic approach to research alternative protein sources in the Sanambele village in Mali, after fears of pesticide poisoning prompted mothers to discourage their children from eating grasshoppers, a traditional snack). Using local knowledge, their intervention proposed the idea of alternative insect farming focusing on the house cricket. Borrowing from Thailand where cricket farming is widespread, they were able to construct simple structures to support cricket breeding with good success.

Another area that is getting attention is product development. The Nigerian Stored Products Research Institute is examining how edible insects, especially those common in a locality, could be used to fortify grains like sorghum as a way to counter protein-energy malnutrition in children. In light of this, calls have been made for Nigerian entomologists, in tandem with agricultural extension agents, nutritionists, and health workers to make a comprehensive list of all edible insects in the country and adjoining countries.

Fig 2: Woman Selling Mopane Worms in Zambia



Source: <http://www.ipsnews.net/2013/12/food-security-can-come-tiny-wiggly-packages-2/>

An area that does not receive enough attention is health impact. Though insects have been part of the diets of many people in the region, consumption of insects does pose some health hazards. A study in Nigeria identified the consumption of pupae of the African silkworm as the cause of a seasonal ataxia and impaired consciousness in a region where this insect was widely consumed. The study pointed to the necessity of thorough heat treatment for the detoxification of the African silkworm to make it a safe source of high-quality protein. In Kenya and Namibia, there have been recorded cases of deaths from botulism due to improper handling, storage, and transportation of termites and caterpillars.

Therefore, in conjunction with promoting insect as food, issues of food safety across the whole value chain must be given a high priority.

Insects as Animal Feed

Using insects as an animal feed is another approach to insect farming. In Uganda, farmers use termites for feeding fish by either collecting the termites directly, or purchasing them from collectors at a cost of US\$0.27/kg. On average, a termite hill yields approximately 50 kg per year. Using insects as animal feed is more acceptable in regions where insect eating is shunned.

Animal feed consumes significant land resources, and diverts food from humans; therefore alternative feed sources are welcome. A study in Nigeria evaluated the replacement of fishmeal with maggot meal and found that diets in which 25% of fishmeal was replaced with maggot meal were most efficient in terms of average weekly weight gains and protein efficiency rates. It concluded that maggot meal is an inexpensive partial substitute for fishmeal in broiler-chick feeding. Likewise, in Togo chickens are fed with maggots.

Commercial Insect Farming Taking Off Around the World

Edible insects are increasingly being farmed commercially in Northeast Thailand, expanding an industry that started in 1999. Entomologists and agricultural extension agents at Khon Kaen University have developed low-cost, cricket farming techniques and offer training to local residents. Currently, 4,500 families in Khon Kaen Province raise crickets, as do nearly 15,000 others elsewhere throughout Thailand. A single family can manage cricket farming as a sideline activity without outside help, needing only a few hundred square feet of land. The 400 families in just two local villages produce roughly 10 metric tons of crickets in the summer peak yield period, translating to between US\$130 and US\$ 1,600 of extra income per month, per family. Most of the farmed crickets go to big city markets, like outdoor stalls in Bangkok. However, some are exported to neighboring cricket-consuming nations, such as Laos and Cambodia. Thai families also farm ants, another popular edible insect. And Khon Kaen University experts have also developed new techniques for farming grasshoppers and the giant water bug, which is a Thai favorite.

There is now growing interest across the globe to commercialize insect farming.

- The FAO is trying to replicate Thailand's success in insect farming in Laos. Its edible insects project (which ended in April 2013) looked at boosting insect production and harvest for consumption. The objective was to provide poor households with an affordable, culturally acceptable, protein-rich food complement. It has trained 120 farmers to breed house crickets, weaver ants, and palm weevils, as well as mealworms. Weaver ants are semi-bred on trees before they are fed additional food, while the other insects are bred inside special containers at the National University of Laos in the capital city, Vientiane.
- A team of McGill University MBA students has won the US\$1 million Hult Social Entrepreneurship Prize for a project that aims to improve the availability of nutritious food to slum dwellers around the world by providing them with insect-infused flour. The money will help them grow Aspire Food Group, an organization that will produce nutritious insect-based food products that will be accessible year-round to some of the world's poorest city dwellers. The '*Power flour*' can be used to bake bread, make tortillas, and enhance stews and soups.
- Exo, another startup, aims to create an organic food bar made through combining cricket flour (slow roasted and milled crickets) with organic and all-natural ingredients such as raw cacao, dates, almond butter, and coconut. They claim to have created a bar that is high in protein, low in sugar, incredibly nutritionally dense, and packed with omega 3 fatty acids, iron, and calcium. The bars are free of unnatural sugars, gluten, grains, dairy, soy, artificial preservatives, and anything processed. The target market is health conscious Western consumers rather than traditional markets of insect eating communities.

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There is renewed effort to develop a commercial insect-based feed industry. Some include:

- A European Union-funded project, PROteINSECT, investigating how flies can contribute to the growing demand for protein in livestock and farmed fish feeds. PROteINSECT is focusing its research efforts on flies not only for their ability to grow rapidly on a range of organic wastes, but also because there is already considerable expertise in their breeding in countries such as Ghana and Mali. The University of Sterling and Fish for Africa-Ghana (FfA), a commercial tilapia farm in Ghana will be conducting these insect-based feed trials. Fly-breeding and maggot production systems will also be developed in Mali as part of the project. Target animal feeds are for poultry. Additionally, PROteINSECT will focus on the use and recycling of waste materials for scaling up the production of fly larvae.
- Agriprotein, a South African fly factory that recently won a US\$100,000 UN innovation prize for animal feed. The factory found a way to raise edible insects by feeding them discarded food, manure, and meat by-products.
- Currently, a fly factory is up and running near Cape Town and is selling its magmeal to South African salmon and chicken farms. Agriprotein is also exploring innovative ways of funding small entrepreneurs to manage human waste generated by growing slums. Entrepreneurs will employ their technology to degrade the human waste to compost and grow flies for animal feed at the same time. A pilot project is currently underway in the Kibera slums in Nairobi.

Way Forward

Developing a vibrant insect food sector can bring significant benefits. Some of the poorest members of society, such as women and landless dwellers in urban and rural areas, can easily become involved in insect gathering, cultivation, processing, and sale. These activities can directly improve their own diets and provide cash income by selling excess production as street foods. For instance, in southern Africa the mopane worm (caterpillar) has a trading value of US\$85 million, supporting the livelihoods of many rural poor and urban street vendors.

Thinking about Insects as Feeds

Black Soldier Flies – The Perfect Insect for Feed

Black soldier flies (*Hermetia illucens*; Diptera: Stratiomyidae) have been touted as the perfect insect for feed. Black soldier flies are found in abundance and naturally occur around the manure piles of large poultry, pigs, and cattle. They can be used commercially to solve a number of environmental problems associated with manure and other organic waste, such as reducing manure mass, moisture content, and offensive odors. At the same time, they provide high-value feedstuff for cattle, pig, poultry, and fish. Moreover, the adult black soldier fly is not attracted to human habitats or foods and for that reason, it is not considered a nuisance.

The high crude fat content of black soldier flies can also be converted to biodiesel; 1,000 larvae growing on 1 kg of cattle manure, pig manure, and chicken manure produce 36g, 58g, and 91g of biodiesel respectively.

See more at: <http://www.thefishsite.com/articles/1683/insects-as-animal-feeds#sthash.on24N6oW.dpuf>

GREEINSECT – A Comprehensive Approach to Insect Farming

A project about to start in Kenya demonstrates the right approach to bringing insect to the formal food supply system. GREEINSECT is a consortium of public and private institutions that aims to investigate how insects can be utilized as novel and supplementary sources of protein in the food and feed sectors by means of mass production in small- to large-scale industries in Kenya. GREEINSECT is organized through work packages addressing:

- Technological development, adoption, and adaption capabilities of insects for feed and food, and investigation of operational and implementable business models;
- Institutional framework development for managing the risk of disease in the reared insects, humans and animals related to mass breeding systems, and international trade and food security standards;
- Modeling and assessing contribution of insect production systems to green economic growth and nutrition security, and exploring economic and political incentives for the development of climate-friendly food and feed sectors
- Capacity building of Kenyan research institutions and knowledge dissemination
- Developing a Kenya-based knowledge platform involving public and private sectors.

Furthermore, international partners from southeast Asia will advance the progress of the project through their experiences within the edible insect sector. International knowledge dissemination will be supported by FAO.

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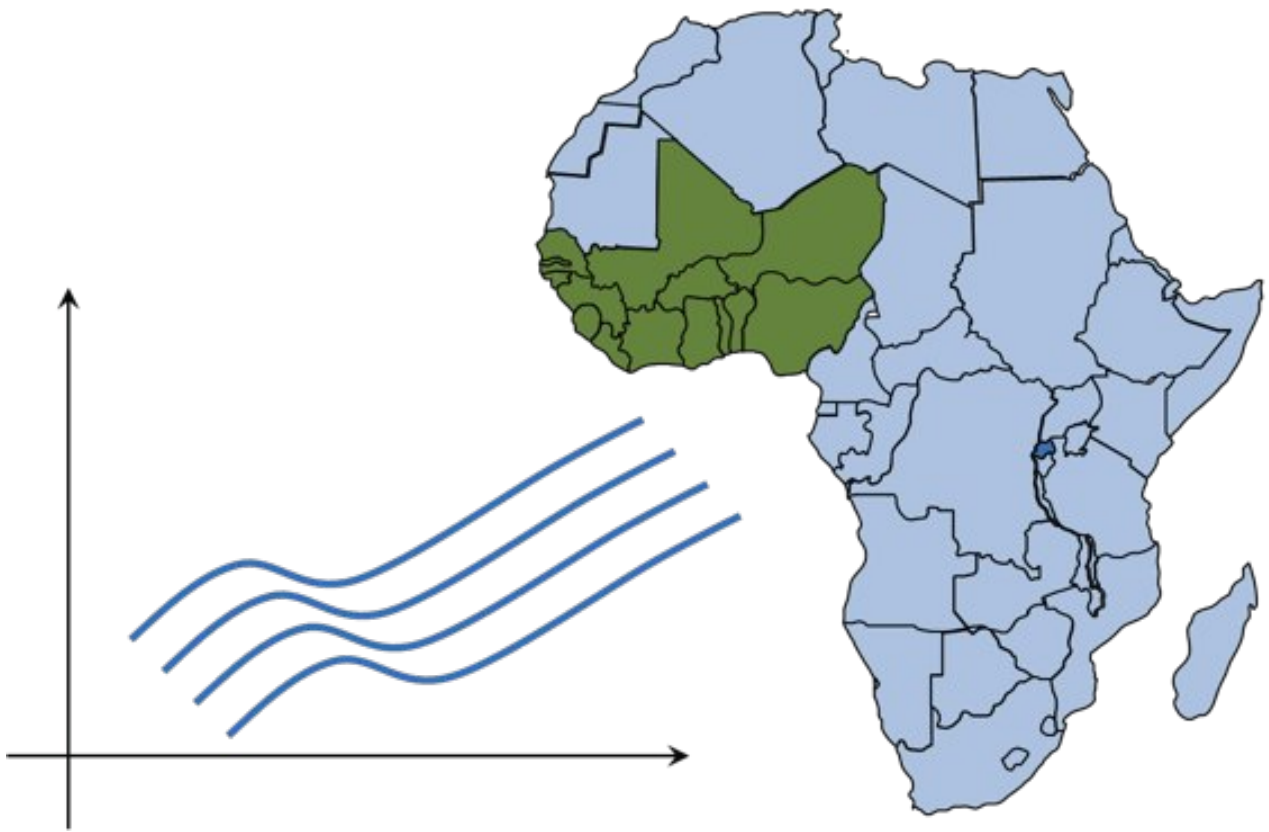
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Insects can be a key component in the fight against malnutrition and poverty. However, buy-in for this will require a change in mindsets for many.

Perhaps intervention that will re-orient the mindsets of policymakers and agriculturalist in particular will be the critical intervention that will unlock the value of insects as protein and a source of prosperity.

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