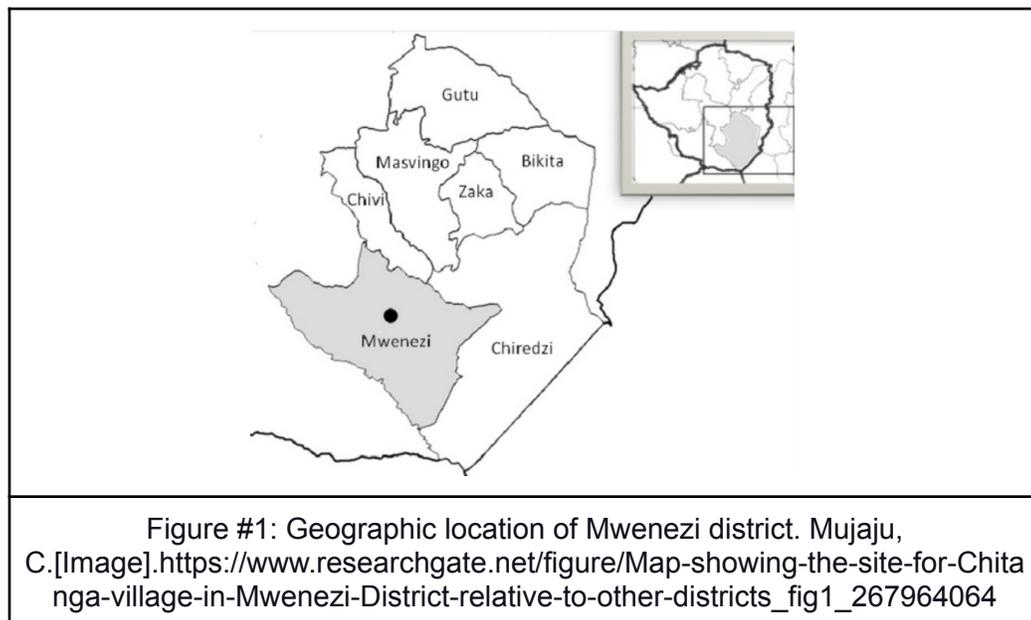


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Zimbabwe, malnutrition

Breeding and consumption of house crickets (*Acheta domesticus*) as an alternative for poor nutrition in Mwenezi, Masvingo, Zimbabwe

Zimbabwe had a population of 14 645 468 inhabitants in 2019, with an average of 4 people per family. From those 14 645 468 inhabitants, half their population suffer food insecurity (UN News, 2019). The food insecurity is aggravated because of the few nutrients that many of your foods have and the little amount that they have, also the extreme climate change that they are suffering due to the climatic phenomenon “El Niño”. This event caused a severe drought in Zimbabwe, more than any other seen in the last 40 years. Three-quarters of Zimbabwe’s population are farming families that base their agriculture on cotton, tobacco, beans, soya beans, and maize, being this last one the staple food. These families were hit by a drought in 2020, reducing the harvest of maize from 2.4 million tons in 2019 (a poor harvest year) to 1.1 million tons in 2020 (WFP, 2020). Zimbabwe’s weather is warm most part of the year, and adding the droughts and few rainy periods, sustainable agriculture is difficult to sustain.

This decline in Zimbabwe's local agriculture made it difficult to stabilize its national currency, which was introduced in 2019 after nearly a decade of using foreign currencies. This is due to the inflation they were passing in 2009, in which they got rid of 12 zeros, inflation estimated at 500 billion percent (Latham, 2021). This recession causes no foreign investment and an increased number of migrant workers.



This is the case of Mwenezi district in Masvingo Province, in which many young people are leaving the place to work in South Africa mines. All these problems have their origin in poor nutrition, which causes health problems, such as the increase of HIV-infected people. Poor nutrition in people causes their immune system to be very weakened by not getting enough nutrients, and the onset of the disease occurs in a couple of months when in Europe it takes around 10 years for the disease to develop (Porrino, 2005).

My proposal consists of cricket breeding and consumption to remedy poor nutrition and stimulate Zimbabwe's economy. This is by using the species of house cricket (*Acheta domesticus*) because of how common it is. Entomophagy is known for being a good alternative to meat consumption and a very friendly solution with the environment, due to its low requirement of water and its facility to grow in many environments. Insects can be a sustainable alternative source of proteins and other nutrients.

Often they are a better source of protein per ounce in comparison with other meat products such as beef, sheep, and chicken. A hundred grams of cricket have a nutritional value of 69 grams of protein (containing 9 essential amino acids), 7 of fiber, 5.5 of fats, 3 milligrams of iron, 75.8 milligrams of calcium, and in other proportions vitamin B12 and potassium. If we compare them with other products, 100 grams of cricket has 69 grams of protein per, while beef only has 27, 2.8 grams of Omega 3 while salmon only has 2.3, and 7 grams of fiber, while broccoli has 2.6 (Invo Pets, 2020).

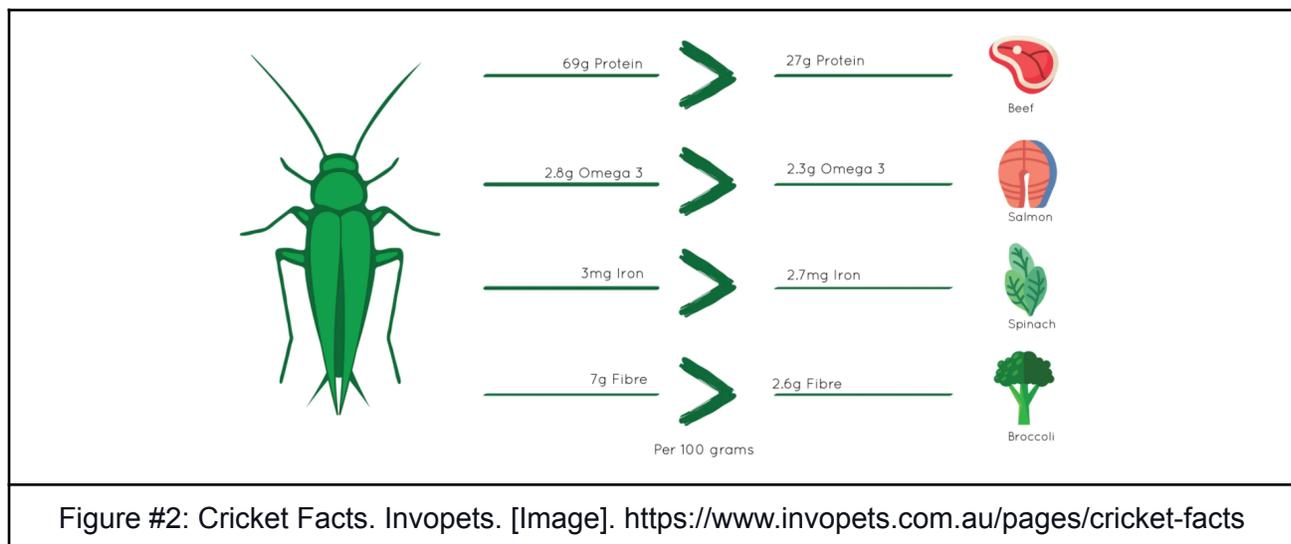


Figure #2: Cricket Facts. Invopets. [Image]. <https://www.invopets.com.au/pages/cricket-facts>

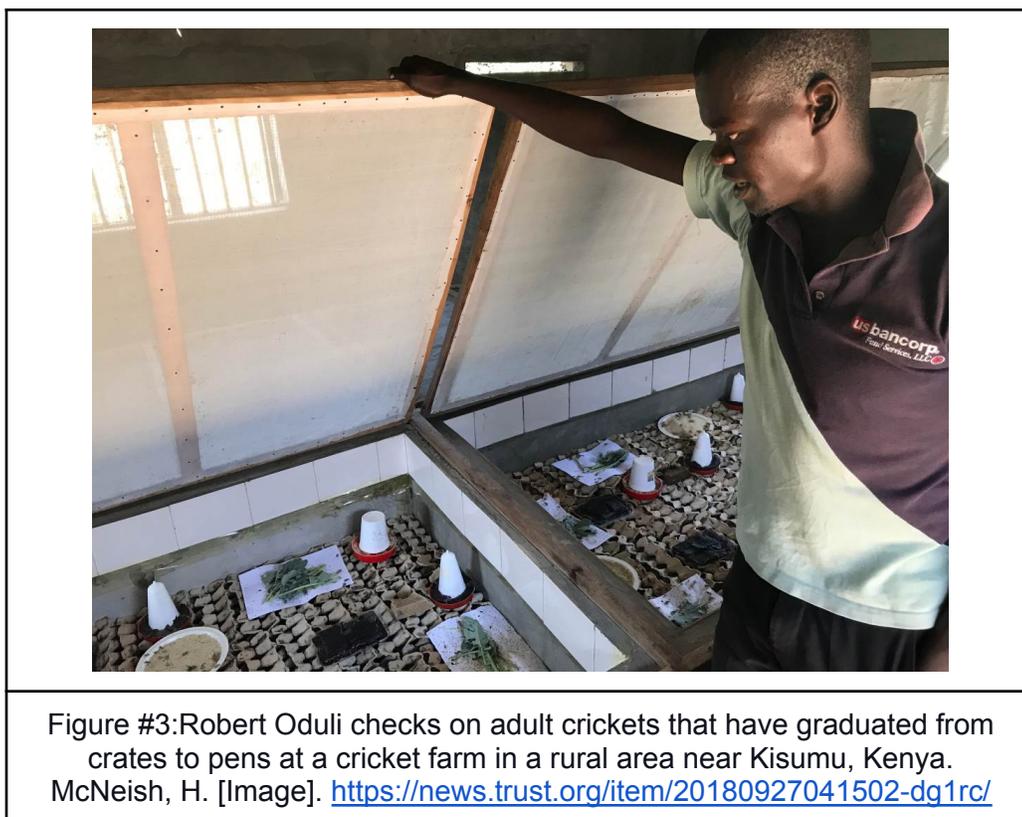
Another benefit of entomology is the impact it has on the environment, for example in comparison with agriculture, in the production of greenhouse gases, entomophagy produces one-tenth the methane and one-three-hundredth of nitrous oxide (Global Citizen, 2018). And the benefit it has over cattle raising is even greater, this industry is known for consuming a lot of water and resources from the land, producing a big part of the greenhouse gases. Producing 1 kilogram of boneless beef consumes 15.400 liters of water, instead, to produce 1 kilogram of cricket you need only 1.5 liters of water.

I chose Mwenezi district because some months ago I saw a news article where it said that Zimbabwe was on alert because half of the population had food insecurity. The news said that in the population, the deaths were overcoming births in the country. From this came out my investigation of why was this happening and from the investigation it turned out that many people do not have enough food or that the food they consume does not give them the necessary nutrients, this causes them to be exposed to many diseases. And also a few months ago I was talking with my mom about a community in Oaxaca, México, where they apply entomophagy, these seemed to me that it could be a great solution if we could apply this to Mwenezi district in Masvingo Province in Zimbabwe.

Mwenezi is a great place to apply my proposal, this is because in Zimbabwean culture eating insects is not something new. There are other kinds of insects that are very normal to consume, for

example the mopane worms (*Gonimbrasia belina*), they are a gastronomic part of this country. For example they are served in restaurants, hotels and in general as a popular dish in homes, this is possible because of the accessibility of getting them in local markets. However this does not mean that these worms could represent a viable solution, the conditions in which these worms can be raised are very particular and how often they can be cultivated represents a long-term solution and is very complicated to introduce in a small community. This is why cricket farming is a more efficient alternative that has been adopted by other countries.

In Kenya, where farmers produce crickets in buckets. In these buckets female adults lay fertilized eggs under wet cotton wool, reaching a single female to lay 200 eggs throughout her life. After one month the eggs hatch into nymphs that feed on vegetables, soy flour, and water up to three months when they reach the adult stage, weighing around 0.5 and 1.5 grams. Then they pass through a process of disinfection where they are emptied into boiling water for 5 minutes and then they are put into cold water to later be dried in the sun, all this with the purpose of reducing the growth of bacteria. This practice was well received by the farmers because this represents a commercial opportunity for a more sustainable option (Katana, 2020). This could be applied in Zimbabwean conditions, and due to the relationship that exists between these countries, accepting their cricket breeding model would not be a problem.



Cricket farming has many ways to be consumed, but many people find it disgusting to eat them in their full form. This is why my proposal includes the fabrication of cricket flour, which is obtained by grinding them to make it more acceptable to many people. In this process, a big part of the proteins of the cricket is lost, but it still remains 36% of protein. This flour has many uses, for example, to make biscuits, cakes, porridge, chapati (a type of flat bread), and mandazi (a type of fried bread). This baked flour also has a very high nutritional value, this is why it also represents a high profit to these people. For all these requirements, I propose the collaboration with the organization "ICIPE", based on his research of insects in African countries and its goal for the conservation and

sustainable use of Africa's rich biological diversity. I consider that their help would be very beneficial.

The methodology that I propose to use for the breeding of insects was taken from the experimentation carried out by Edwin Orlando Portillo Rivera in his work named "Pilot estimation of costs in the cricket flour production and processing (*Acheta domestica*), as a source of protein for human diet, in the Santa Marta farm, Morazán, El Salvador ". This methodology consists of the usage of one cardboard box with the measures 60 x 40 x 40 cm. In which a thousand crickets are placed. In these boxes 4 egg cartons are placed so that the crickets can be placed there, any type of wrinkled cartons could work the same way.

The boxes also include 3 plastic containers, one with water, another with chopped vegetables, leaves or seeds, and the last one for the crickets to place the hatchlings. Crickets can be collected after two months after the mothers lay their eggs. At the beginning the production might be poor depending on the amount of crickets placed, but after some months and the increased production of crickets using more boxes (1000 crickets per box), the production will reach an economic benefit for the farmers.

Table #1: Approximate value of the proposal.				
Description	Category	Amount	Price per unit (USD)	Total (USD)
Acheta Domesticus Crickets	Insects	1000	0.035	35
Cardboard box	Input	2	0.25	0.50
Egg carton	Input	8	0.01	0.08
Water container	Input	2	0.15	0.30
Food container	Input	2	0.15	0.30
Container	Input	1	0.15	0.15
Manual Grain Grinder	Tool	1	37	37
Vermiculite	Substrate	1 kg	5.5	5.5
Foodstuff				
Corn	Food	1 kg	1.2	1.2
Potato	Food	1 kg	0.4	0.4
Wheat	Food	0.5 kg	1.1	1.1
Water	Liquid	1.5 L	1.34	1.34
Total price:				82.87
Orlando, E. (2017). Estimación piloto de los costos en la producción y proceso de harina de grillo (<i>Acheta domestica</i>), como fuente de proteína para dieta humana, en la finca Santa Marta, Morazán, El Salvador. Retrieved August, 2021, from https://bdigital.zamorano.edu/bitstream/11036/6159/1/AGN-2017-024.pdf				

Steps for the methodology:

1. After having all the materials ready, in the cardboard box put the 4 egg cartons.
2. Introduce in the box the two plastic containers, one with water and the other one with the chopped vegetables (corn, potato and wheat).
3. Introduce 1000 crickets and cover the box.
4. After two days of putting the crickets in the boxes, the third container will be prepared. For this it will be filled to the halfway with vermiculite and add water until it is wet (do not need to make a puddle on the top). This container will be covered with a cloth.
5. One day after the third container is put, this container will be removed from the box and passed to the other one.
6. Now in the new box the third container can be discovered, in one container put shredded wheat and wet a piece of paper and put it in the second box so that the crickets can drink water.
7. After some day the hatchlings will grow up and exit from the container, and follow the same process as the first cardboard box.

Breeding stage

8. The crickets in the two boxes will grow up during 2 months and a half. During these two months one person will be in charge of feeding them and putting them water, occasionally they can include a piece of fruit. The container from the second box needs to maintain wet until the eggs hatch.
9. After the two months the crickets from the second box will mature. The crickets from the first box will be collected to produce the flour.
10. The steps 1 - 9 can be repeated to continue the production.

Flour production

11. The crickets collected from the first box will be placed in a pot of boiling water for three minutes.
12. Then they will be taken out from the water and left to dry for several hours.
13. The crickets will be placed in the manual grain grinder to be ground. (the flour won't be ready to consume after the first time in the grinder, it will be necessary to pass it two or three times, adjusting the mill after each pass).
14. After these steps the flour will be ready.

At the beginning, the work of two months will produce between 200 and 150 grams of cricket flour, that in comparison with the price mentioned in the Table #1, flour production is not beneficial. But an important aspect to take into account is that the object that increases the total price is the manual grain grinder, costing 37 dollars approximately, and this tool is an investment that is necessary to make only once. Due to this, the cost of the next productions will be cheaper and adding to this the possibility of adding more boxes to increase the production, the profit that they will get is going to be greater. Viewing the prices of the project I consider that finance will be necessary, and I purpose the organization IFAD. They have a program of "Rural Finance ", quoting a phrase from their web page IFAD recognizes the vast potential of rural finance to improve the livelihoods of rural people, so I consider that this project applies to their rural finance program.

My proposal can be a very viable solution because it attacks the problem of poor nutrition and gives them an alternative to cope with the economic situation in Mwenezi, Masvingo, Zimbabwe, you just have to be careful with the handling of the crickets, so that they do not escape and affect the environment, but apart from that the final product has a moderate price and it is not something momentary, but it can become a job for the community.

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