Trash for Some, Treasure to Others

Team Riverside

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The following link will take you to an animated video we created with the help of some animators. The video will help explain the scope of our project and how we plan to take some thing that is considered trash and turn into a treasure for others.

https://drive.google.com/file/d/1xMUX2I3EEjYH5anYP6N4CDiochwIDRil/view?usp=sharing

For the Wilbur-Ellis Innovation Award, we chose to focus on alternative food ingredients as our innovative approach to addresses the prompt of feeding a growing world population. After examining the problem of world hunger, we realized that its less of an issue than malnutrition. While 1 in 10 people are hungry, about 1 in 3 people are malnourished. On a daily basis, about one-third of the world's population are not receiving sufficient amounts of vitamins, minerals, protein, fats, water, and carbohydrates that are needed to maintain an active and healthy lifestyle. So, for this project, we decided to target malnutrition – also known as "hidden hunger." We focused on finding an alternative food ingredient that could alleviate this issue. In doing so, we narrowed our focus on a country where malnutrition was rampant. Our research identified Nigeria as one of the most affected countries in the world, mainly due to the high number of impoverished women and children. Nigeria's population is predicted to exceed that of the US by 2050 making it the third-largest country in the world. We found a commonly eaten porridge called Tom Brown in Nigeria that consists of yellow corn, sorghum, millet, soybeans, and peanuts. The mixture is used as a bridge food for young children (aged 6-59 months), but of course, mothers can eat it too. Since two of our team members are from DePaul University, we learned that Catholic Relief Services, an international humanitarian agency in the US, has a program that sends Tom Brown to countries such as Nigeria. Although Tom Brown is a healthy and nutritious breakfast cereal, it lacks an animal-based protein. Our solution is to include silver carp into the mixture, an invasive and unwanted fish that is overpopulating the Mississippi River and its tributaries. Asian carp were transported to the US in the 1970s as a biological control mechanism to address water quality, but subsequent floods caused them to escape captivity. Decades later, Asian carp dominate Midwest rivers and threaten to enter the Great Lakes, potentially disrupting a multibillion dollar commercial and recreational fishing industry. However, our research found that Asian carp, specifically silver carp, have many nutritional benefits. It's a superfood in disguise. This discovery spawned our innovative approach. If we can

turn silver carp into powder, then it could be added to Tom Brown, thus increasing its nutritional benefits. There is a massive supply of silver carp and low demand in the US since they are considered a trash fish by many people. Therefore, our innovative approach addresses two seemingly unrelated issues – malnutrition in Nigeria and invasive species in the US. Our project focuses on this simple solution. It's a win-win. If successful, we plan to approach Catholic Relief Services, and other humanitarian aid organizations, with this idea so it can be implemented.

World Hunger and Malnutrition Overview

Most everyone is familiar with the term "world hunger" because various organizations have campaigns like "Zero Hunger" and so forth. According to the Food and Agriculture Organization, hunger is defined as "the uncomfortable or painful physical sensation caused by insufficient consumption of dietary energy (calories)." This is a feeling that we are all familiar with. Chronic hunger is when this feeling occurs commonly and most of the time due to things like food insecurity. A population is considered food secure when they have adequate access and availability to safe and nutritious food to maintain a healthy lifestyle. They are considered insecure when these conditions are not met. So, hunger is associated with the lack of food, but these effects often lead to undernourishment or malnutrition. Malnutrition is the larger problem. Nutrition is associated with physical outcomes and quantifiable aspects such as deficiencies in vitamins, minerals, protein, fats, water, and carbohydrates. Lacking these essentials is a threat to living a normal, active, and healthy life. Malnutrition is a more common problem. For example, 1 in 10 people in the world are hungry, but 1 in 3 people are malnourished. Lawrence Haddad, the past Director of Global Alliance for Improved Nutrition (GAIN), said "We need to go beyond Feeding the World to Nourishing the World." This is our focus.

Types of Malnutrition

There are three types of malnutrition: Acute Malnutrition, Moderate Acute Malnutrition (MAM), and Severe Acute Malnutrition (SAM).

Acute malnutrition occurs when there is a below-average proportion of weight to height. This condition is also known as wasting which is caused by nutritional deficiencies from either a poor intake or absorption of nutrients. Wasting is a risk for children during their development and growth stages. This lack of energy while their bodies are trying to conserve energy can lead to low blood sugar, hypothermia, and compromised immune systems.

Moderate Acute Malnutrition (MAM) is the same as above but more severe and is diagnosed when the weight of the child or adult is less than 80% of the median range.

Severe Acute Malnutrition (SAM) is the worst situation. It is diagnosed when a child's or adult's weight for height is less than 70% of the median score. Both moderate and severe malnutrition can lead to higher fatality rates. According to Concern Worldwide US, in 2015 the average fatality rate for children under 5 years of age with MAM was 4%. The number of children under 5 with SAM is 7%.

Effects of Malnutrition

Eating a balanced diet is vital for our well-being and maintaining good health. It provides energy, proteins, and vitamins that are needed to fuel our bodies. However, there are many individuals who do not have or cannot afford necessary nutrients due to their culture or living conditions. Poverty is rampant, worldwide. According to the Global Alliance for Improved Nutrition, poor quality diets and unhealthy environments often cause malnutrition which can lead to several effects: 1) poor child growth such as stunting, wasting, and underweight; and 2) lack of vitamins and minerals leads to nutrient deficiencies

Scale of Malnutrition

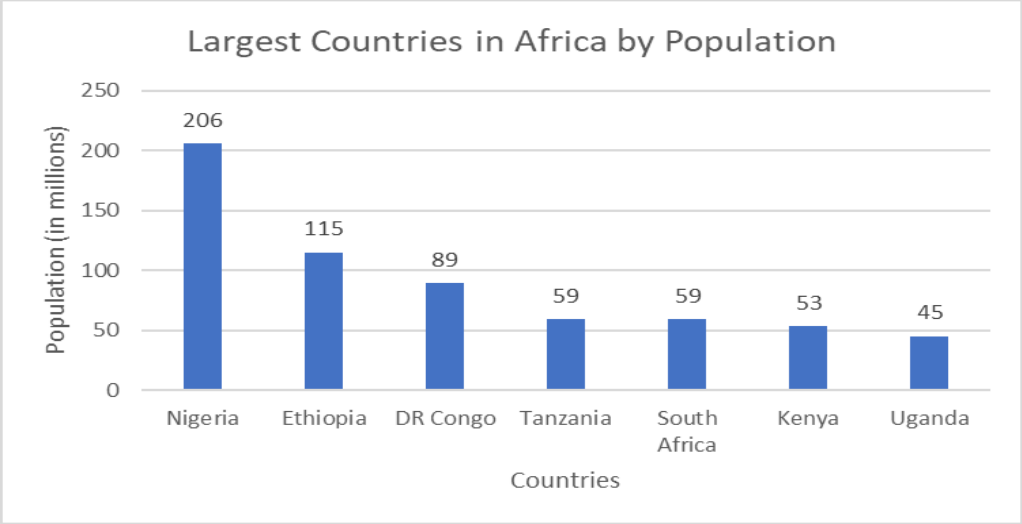
According to Concern Worldwide US, 149.2 million children under the age of 5 were stunted and 45.4 million experienced wasting in 2020. Those figures represent 21.6% and 6.9% of the global child population, respectively. All forms of undernutrition account for half of all the deaths in children under 5.

Malnutrition in Sub-Saharan Africa

According to Statista, the number of undernourished people in the world is 9.9%. Yet, in Sub-Saharan Africa that number is 24.1%. The three main effects are: stunting, wasting and underweight mostly prevalent primarily in East, West, and Central Africa countries like Burundi, Malawi, Niger, Sierra Leone, Nigeria, Democratic Republic of Congo, and Chad.

There are more countries that have high rates of stunting, wasting, and underweight in children but it is most important to target specific populations that have the highest number of children who are experiencing malnutrition. That country is Nigeria (31 million children). It has a stunting rate of 32% meaning that about 10 million children in Nigeria are stunted. Nigeria also happens to be the largest country in Africa by population and according to a report released by the United Nations, Nigeria is the fastest growing country. It is expected to surpass the United States as the third-largest country in the world shortly before 2050.

Population in Sub-Saharan African Countries



World Hunger and Malnutrition Conclusion

We believe that malnutrition, not world hunger, is the real problem. After defining malnutrition, we were able to isolate three primary effects: stunting, wasting, and underweight. Then, we examined where this situation occurs worldwide and who are most affected by these conditions. Our research led us to Africa, specifically Sub-Saharan Africa where malnutrition affects 24% of the population, relative to 9.9% of the world population (and 2.5% in Europe and North America). Within this region, we were able to isolate and focus on Nigeria as the primary target country. It is affected by malnutrition severely and because it has the 7th largest population now with the potential to be the third largest by 2050. Our belief is that by narrowing our scope, we can develop a plan that works in Nigeria and could be expanded elsewhere. We will now proceed with introducing our solution and defining the parameters of our case study.

Tom Brown - A Common African Porridge

A common type of baby food in Nigeria is called Tom Brown. The name originated from a mispronunciation of "turn brown" which has become a local favorite. It's a thick brown porridge that consists of yellow corn, millet, sorghum, soybeans and groundnuts (peanuts). However, we noticed some variation in ingredients and proportions. Tom Brown is a healthy and nutritious food product that is often fed to children, aged 6-59 months old. Although it's considered to be a "bridge food" women also eat it too. The nutritional profile is impressive. Tom Brown contains protein, iron, magnesium, potassium, carbohydrates, vitamin B6, vitamin B12, and many more. In a 100-gram ration of Tom Brown, you can find 20 grams of protein and 13 grams of fat.

The process to make Tom Brown porridge is simple, but time-consuming. To prepare, you must soak soybeans overnight. After de-husking the beans, one must wash and dry them in shade. Next, you roast and mill the ingredients. Tom Brown has a mild flavor, allowing you to sweeten it, to taste. One way to add some flavor to Tom Brown is by adding ginger and date powder.

After combining the powders, simply add a small amount of water and gradually stir until it becomes a thick paste. Then you boil some water and gradually add the paste. The finished product resembles a custard texture. Tom Brown is a local food that is acceptable by many Nigerians and very nutritious.

Tom Brown powder before adding water.

Catholic Relief Services

Catholic Relief Services (CRS) is the international humanitarian agency for Catholics. It has a long history of providing aid and assistance to those in need, including global feeding programs. CRS has a Tom Brown feeding program in Nigeria, designed for children 6-59 months old who suffer from moderate acute malnutrition (MAM). The purpose of this program is to prevent children who suffer from MAM from worsening into severe acute malnutrition (SAM).

CRS trains community members to implement the Tom Brown feeding program. They screen children for MAM and refer those who qualify for assistance. Certain mothers are chosen from the community to work as volunteers for preparing and distributing Tom Brown.

Tom Brown Limitations

Although Tom Brown is a healthy and nutritious food, the porridge has some limitations. First, groundnuts (peanuts) are used as the main source of protein, thus they play a crucial role in nutrition. However, some people are allergic to peanuts and may not realize it until they experience anaphylactic shock. Additionally, peanuts can be affected by aflatoxins produced by certain molds. Despite being uncommon, this fungus is a carcinogen that can result in stunted growth and delayed development. Lastly, Tom Brown lacks an animal-based protein. Crayfish are added to the mixture on occasion, but they produce an offensive smell and taste for many individuals. Yet, protein is an urgent need for malnourished individuals. This limitation becomes our benefit. Since the CRS already has a program surrounding Tom Brown, it will allow us to

implement our innovative solution for creating an even more nutritious dish for malnourished women and children in Nigeria.

Shifting the Focus: The Asian Carp Problem in the U.S.

While Nigeria is struggling to feed its growing human population, the US is battling a biological invasion. Silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Hypophthalmicthys nobilis*), collectively known as Asian carp, were imported from China in the 1970s as a biological control mechanism to improve water quality. However, due to flooding, both species escaped captivity and made their way into the Mississippi River and its tributaries. Their escape and proliferation has become a nightmare for big river systems in the Midwest. Some factors that influence the successful establishment of this fish in its new habitat are its high reproduction rate, ample food, and low number of predators. Asian carp eat from five to twenty percent of their body weight in food each day. In addition to their aggressive diet, Asian carp can reproduce in large numbers. A single fish can produce up to 2 million eggs. They negatively impact native fish such as catfish, paddlefish, and gizzard shad by directly competing for food and space. In just a few decades, the Illinois River has more Asian carp than any place on the planet.

Silver carp (Hypophthalmichthys molitrix) was caught during this project.
This 'ugly-slimy' looking fish has caused lower demand for human consumption.

To date, Asian carp have made their way from the Mississippi River to Chicago, IL. If they enter the Great Lakes they will likely disrupt a multi-billion dollar recreational and commercial fishing industry, not to mention the ecological losses that will occur. This fast-growing fish has also damaged local economies, such as tourism and boating activities in the Mississippi River since silver carp have a tendency to leap from the water when startled, causing bodily injury and much property damage. If that happened, 1.3 million jobs that are supported by the Great Lakes would be at stake, not to mention other multi-billion companies surrounding the

area. To conclude, Asian carp is a **ticking bomb** for both the US ecological water system and the economic well-being of the states if something is not done quickly to address this problem.

Some efforts have been made to block Asian carp from entering the Great Lakes, such as electric current. Although the Army Corps of Engineers might prevent Asian carp from reaching the Great Lakes, however, it does nothing to reduce their population. The supply of fish exceeds the current demand which limits the amount of commercial harvest. Additional markets for Asian carp are needed, but the bone structure and its unfavorable appearance hinders Americans from eating this fish. Asian carp are known as 'trash' fish. One of the reasons is because tons of them get thrown into landfills each year after their removal, showing great desperation to get rid of this fish from the river. Depopulation of this invasive fish should be considered more important, rather than merely preventing them from entering the Great Lakes. A bold step needs to be done to take Asian carp from waterways and reduce its population. However, we have no reason to harvest this fish–*except to throw it into the landfill*–due to its low market demand.

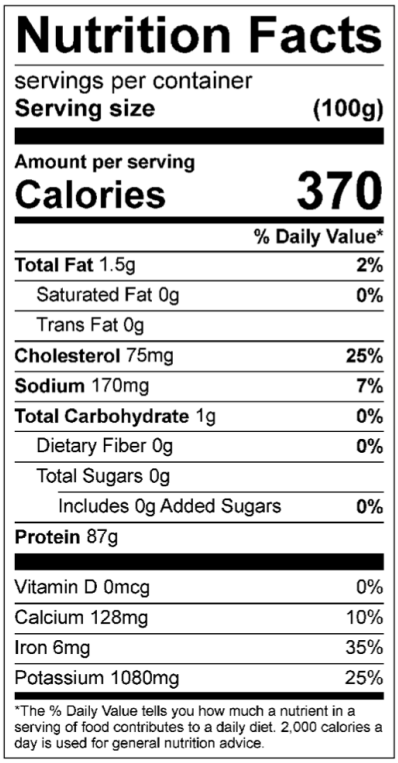
Silver carp requires extra processing due to its bony structure; another reason why people are reluctant to eat this fish. Photo was taken at Sorce Enterprise in Peoria, Illinois during our visit to the fish processing plant.

The bad perception of Asian carp (ugly-looking head and bony structure) has overshadowed its hidden value that is often overlooked. Asian carp are very nutritious as shown by preliminary testing. Silver carp has more than twice as much protein as salmon and tilapia. With this information alone, we can justify taking this fish from the river. This fish has been misinterpreted in the US as *'trash'* where it should be considered *'treasure.'* Its pure gold for those who are lacking macro and micronutrients, especially protein.

Powder Revolution and Benefits

Powdering fish is an approach that can give fish benefits to people developing countries, thus minimizing the struggle with logistics, including shipping, and storing. Although fresh fish is preferred, shipping fresh fish, especially from the United States to Nigeria would result in a much higher cost due to the need for freezing / refrigeration. By powdering the fish, refrigeration is not needed, thus lowering the shipping cost and is also more environmentally friendly. After shipping, the fish would be stored before it is readily consumed. However, most developing and underdeveloped countries often have problems with electricity where they do not have refrigerators to keep their fresh food. Powdered fish has a longer shelf-life due to low moisture content. Another benefit of powdering the fish is that it is versatile and easy to mix with other food ingredients. We are proposing fish powder in order to scale up this project to other countries because the fish powder is easily adaptable to many local foods. WorldFish (WorldFish.org) has proposed the same method to incorporate the fish powder into a meal kit in by working with FedWell Foods, a local social enterprise in Myanmar and has received a $250k grant from the Institute of Food Technologist for doing it. However, WorldFish is using locally grown, small fish. We are proposing to use a nutrient-rich invasive fish instead, addressing two problems at once: *malnutrition* and *aquatic ecology*.

Below is the analysis of the nutrient content of Silver carp in powdered form. Compared to crayfish, which is usually added to Tom Brown mixture, silver carp is much higher in protein conten. While crayfish only has 15% protein, silver carp has 87% protein. Silver carp is also high in calcium, iron, zinc, omega-3 fatty acids, and all nine essential amino acids with low amounts of heavy metals. The heavy metals are lower on the silver carp compared to other carp because it is a mid-water feeder fish, not a bottom feeder. The high amount of iron (35%) is also beneficial for those who suffer from iron-deficiency anemia. It is a package deal to support human health, especially for some countries that are lacking in nutrients. If there is currently no market for this fish, we can start to make one based on this treasure that we found, and more importantly, we can target this to those who need it the most because of its high protein content, such as Nigeria.



Nutrition Facts

servings per container

Serving size **(100g)**

Amount per serving

Calories **370**

	% Daily Value*
Total Fat 1.5g	**2%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Cholesterol 75mg	**25%**
Sodium 170mg	**7%**
Total Carbohydrate 1g	**0%**
Dietary Fiber 0g	**0%**
Total Sugars 0g	
Includes 0g Added Sugars	**0%**
Protein 87g	
Vitamin D 0mcg	0%
Calcium 128mg	10%
Iron 6mg	35%
Potassium 1080mg	25%

*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Nutrition facts of silver carp (flesh only) powder. Analysis was done at Midwest Laboratory.

Adding Silver Carp Powder to Tom Brown

Tom Brown is a healthy local food but becomes better when silver carp is added to the mix, especially for individuals who are suffering from food insecurity. Our innovative idea to fight malnutrition is to create a dry fish powder using silver carp that can be added to Tom Brown. Advantages of this product include high nutrition, relatively low cost, and a long shelf life. This will allow the product to be shipped overseas without the concern of spoilage. When you add Silver carp powder to Tom Brown there is a large increase in the amount of protein as well as Potassium and Iron, in addition to other ingredients.

Tom Brown Taste Test

We have done a preliminary taste test for this product (Tom Brown with and without silver carp) with some Nigerian students at the University of Missouri-Columbia to measure their acceptance of this product using preference, and liking tests, and a group discussion. Although the result could not be generalized to the whole Nigerian population, it is important to get their initial feedback (acceptance before upscaling it). Overall, the students like the product. Interestingly, Tom Brown with silver carp is aligned with the Nigerians' liking of a food product due to the fortification process. During our discussion, the participants mentioned that Nigerians often look for fortified brands when purchasing foods. The addition of silver carp into Tom Brown could simply be considered as fortified Tom Brown (with more nutrients added) which is suitable for

the Nigerians. We also did a taste test on some children (our target) and they described it as a 'Yummy' product. During the discussion, participants were astounded to learn about the protein content of the silver carp. Some preferred the Tom Brown sample with silver carp due to its high protein content. This powdered product aligns well with their need for nutrients, and taste requirements.

Tom Brown with powdered Silver Carp (left), TB, and SC porridge dish (right)

One Solution that Addresses Two Issues

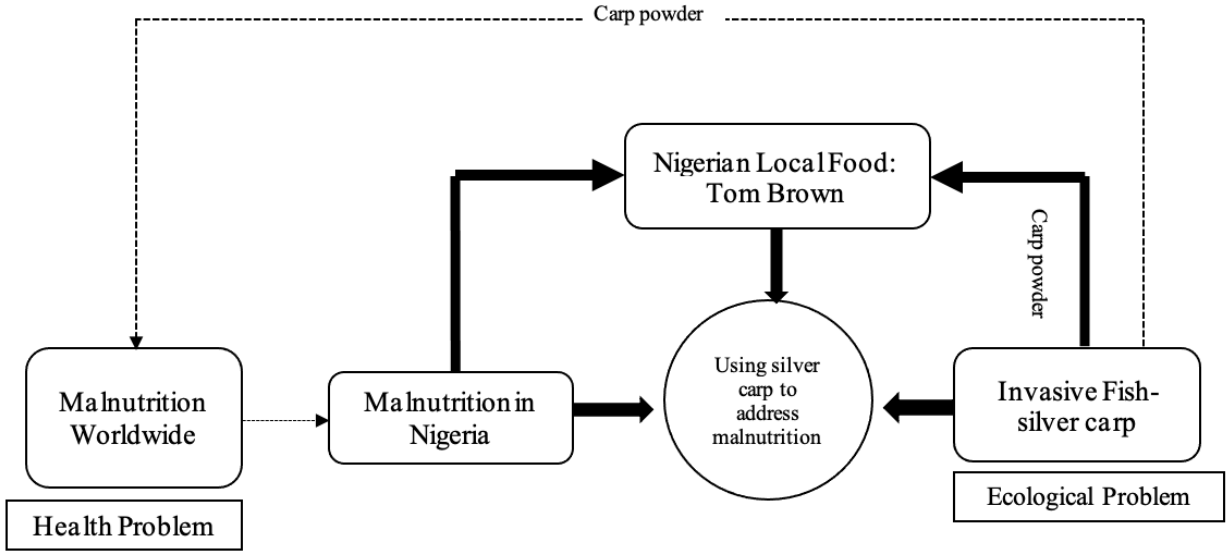
The uniqueness of our approach is that we are addressing two population problems in two different countries: the population of Asian carp in the United States and the human population in Nigeria. Asian carp were growing, still growing, and will grow to reach the Great Lakes and other tributaries **if** there is a lack of effort to remove them from the rivers. According to the World Economic Forum, Nigeria's population is also growing to 400 million people in 2050 and will be the third-largest population in the world. However, this growth rate is threatening since Nigeria is tackling malnutrition and anemia. Nigerian children who suffer from anemia often have irreversible conditions such as stunting and wasting. In other words, these illnesses will persist, likely following them into adulthood, marriage, and reproduction. In other words, malnutrition is like a death sentence due to the stunting and wasting they experienced during their childhood.

Based on these conditions, our purpose is to **solve two problems at once with one solution**: *using the invasive fish - silver carp to alleviate malnutrition in Nigeria*. This approach will benefit both the water ecosystem and human health. It's a win-win solution for both countries. Our solution is in the form of Tom Brown, which is a local food in Nigeria. We are proposing to

combine Tom Brown and Silver carp as a superfood to increase its nutrient value, especially protein. Although the original Tom Brown already has some nutritional benefits and protein, it consists mostly of starch and lacks protein. Adding silver carp will serve the benefits of fish into Tom Brown, such as omega 3 fatty acids which is vital for brain function and cognitive development. As a local food, Tom Brown is culturally-acceptable for Nigerians. We are targeting children and women, especially those of childbearing age because they are prone to malnutrition and anemia. However, other adults can eat it too!

We cannot simply put raw or cooked silver carp into Tom Brown, it must be powdered. Since Tom Brown consist of other powdered ingredients, we are also proposing to powder the silver carp. This powdering process gives a lot of benefits, such as a longer shelf-life and easy mix. Another benefit of powdering silver carp is that we can adapt this project to other countries as well, by simply putting and mixing this invasive fish powder into their own local delicacies.

Figure1. Conceptual Thinking of the Project: Solving two problems with one solution



Fish Processing and Powdering

For this project, we are partnering with a fish processing plant that's on the Illinois River. This location is ground zero for silver carp, making it easily accessible for catching, processing, and transporting the fish. Commercial fishers can catch roughly 5,000 pounds in just a few hours. Fresh fish are sent to the fish processing plant, headed and gutted, and cut into slabs. We are also partnering with a company for powdering the fish. Due to the multiple connections that we have, this project is feasible. We performed some of these tests using silver carp with our partners already.

Economics

First, we should look at the cost of creating a Tom Brown serving with and without silver carp. Second, and more importantly, we'll extrapolate this information to a mass scale to make an estimation of the cost it would take to make a dent in lowering malnutrition across Nigeria.

Cost Breakdown - Bulk Products

The table below indicates the cost of purchasing Tom Brown ingredients at bulk prices in the U.S. This includes tax and shipping costs. These numbers also do not assume any discount (organizations that sell these goods are likely to provide a discounted rate on these products anywhere from 10-50%) that we would likely receive from sponsors, local organizations, and supporters. In addition, if we would buy in larger quantities, the per lb cost would decrease.

Ingredient Bulk Cost			
Product	*Size(lbs)*	*Cost*	*Cost/Per Lb*
Yellow Corn	50	$ 21.99	$ 0.44
Sorghum	50	$ 82.98	$ 1.66
Millet	25	$ 44.90	$ 1.80
Soybeans	50	$104.52	$ 2.09
Powdered Carp	20	$300.00	$ 15.00
Ginger	4	$ 35.88	$ 8.97
Date Dates	30	$133.95	$ 4.47

Cost Breakdown - Per Tom Brown Serving

Looking at the table below we were able to calculate the per serving cost by multiplying the per lb cost of the bulk products from the previous table by the per lb ratio of the serving ingredients. If we assume a discount rate between 10-50% then we can conclude that Tom Brown, by the serving, would cost between 46 and 92 cents.

Ingredient Cost (all ingredients in powdered form)			
Ingredients	*Ratio*	*Lbs*	*Cost*
Yellow Corn	1.5 tbsp.	0.046875	$ 0.02
Sorghum	1 tbsp.	0.03125	$ 0.05
Millet	0.5 tbsp.	0.015625	$ 0.03
Soybeans	0.5 tbsp.	0.03125	$ 0.07
Powdered Carp	0.5 tbsp.	0.046875	$ 0.70
Ginger	0.5 tsp.	0.0028705	$ 0.03
Dates	0.5 tsp.	0.005741	$ 0.03
		Total Cost	$ 0.92
tbsp	Tablespoon		
tsp.	Teaspoon		

Cost Breakdown - Silver Carp

The cost of adding powdered silver carp to Tom Brown is about $0.70, which would likely decrease due to our connections with the fish processing plant in Illinois. Currently, they are focused on monetizing and increasing silver carp demand for domestic use, but they would also be willing to donate excess silver carp to various charities, such as local food banks. We would likely receive discounted or perhaps free silver carp for humanitarian aid, so the cost ranges from $0.70 to as little as 0 cents. We have talked to one organization who has agreed to ship our product for free to certain global destinations.

Cost Breakdown - Silver Carp in Tom Brown vs Other Alternatives like RUTF

These costs might seem high, but it is important to compare them to the current alternatives. Ready-to-use therapeutic food (RUTF) is a popular food that is shipped to places like Nigeria and other countries in Sub-Saharan Africa to wean young children. RUTF ingredients and prices vary but we found data that indicates that one carton of RUTF that is sent to Nigeria costs $53.46. If we level the serving size for both silver carp Tom Brown and RUTF, we get a per serving cost of $.63 cents on the dollar for the RUTF. This is right in the middle between the 46 and 92 cents range for silver carp Tom Brown porridge. However, keep in mind that the nutritional benefits are much greater using the Tom Brown porridge fortified by silver carp. So, depending on our product discounts, you can add a tremendous nutritional value that was previously unavailable. What a bargain!

Extrapolated Cost Breakdown - Nigeria

A cost estimation requires us to first define the population we are targeting. The below table indicates the population size of the total population and the number of children that are 5 years or younger in Nigeria.

Year	2020	2050
Nigeria Population	206,140,000	419,914,596
Children 5 years or younger	31,000,000	63,148,115
Stunted Population	9,920,000	20,207,397
Stunted Rate	32%	32%

There are 31 million children 5 years old or younger in Nigeria, which is 15% of the total population (206 million). Of these children, 32% are stunted, nearly 10 million. The United Nations anticipates an average annual growth rate of 2.4% for Nigeria's population from now until 2050, which means that by 2050 Nigeria's population will double (about 419 million). If the stunting rate remains constant, that means that the population of stunted children will more than double to about 20 million. Therefore, our target is to reduce the stunted rate as the population grows and so we have to target the 9.9 million currently stunted children. We believe

that if we target this population, we can make an impact in improving the nutrition of newborns for generations to come.

The next step is to analyze what it would cost to lower the stunted rate of 32%. To lower the stunted rate from 32% to 31% would require nourishment of about 310,000 children, and assuming each serving would cost 92 cents then the total daily cost would be about $285,200. The annual cost would be $104,098,000.

Children Population	Stunted Population	Stunted Rate%	Stunted Reduction	Cost Per Serving	Total Daily Cost	Total Annual Cost
31,000,000.00	9,920,000.00	0.32	-	$ 0.92	-	
31,000,000.00	9,610,000.00	0.31	310,000.00	$ 0.92	$ 285,200.00	$ 104,098,000.00

Unfortunately, this would only slow the stunted rate growth because the UN predicts that the population will grow by 2.40% meaning that there would be an increase of roughly 250,000 stunted children every year assuming the 32% rate stays the same. However, the stunted population reduction is net positive, meaning the rate would go down over time.

Nigeria Cost Conclusion

In one year, there will be an increase of 250,000 stunted children in Nigeria. However, it would cost a little over $100 million a year to nourish 310,000 children, therefore reducing the stunted rate by 1 percentage point and net a reduction in the stunted population year over year. Keep in mind that these costs could be cut in half assuming a 50% discount rate offered by providers, charities, etc. Although this seems to be expensive, we must also consider the staggering cost of inaction. How is it possible to measure the cost of illiteracy and loss of earnings over a lifetime due to cognitive impairment? We believe this investment, when paired with educational resources to teach local villages about malnutrition, can reduce the stunted population significantly year by year.

We also need to keep in mind that the price for targeting the same population with other products or alternative solutions would cost much more. Although alternatives like RUTF might be cheaper per serving, they lack the protein value that comes from silver carp. And alternatives that have protein cost a lot more due to refrigeration, storage, and transportation costs. Silver carp has none of these costs. So, Tom Brown is not the end-all-be-all, but it is an innovative solution that is creative and cost-efficient.

Powdered Silver Carp in Alternative Foods in Nigeria and Worldwide

Our main takeaway is that powdered silver carp do not just have to be used in Tom Brown or even porridges for that matter. In fact, powdered silver carp can be used in different meals since it can be mixed with other ingredients. So, people other countries who might not eat Tom Brown can mix silver carp powder into their local dishes. For example, India, which also suffers from high malnutrition rates, can mix silver carp powder into their local dishes. Because silver carp

has a mild flavor (we tried it and it tastes like unseasoned white meat), it can be added to any meal to gain the nutritional benefit without needing it to be balanced for taste or texture. Moreover, in a powdered form, silver carp has a long shelf-life. Some developing and underdeveloped countries often have problems with electricity where they cannot keep fresh ingredients. Powdered food that is nutritious will address one of these problems.

So, to feed an ever-growing world population, we can provide an alternative food ingredient (silver carp) to any sort of meal for providing the necessary nutrients to malnourished people. Powdered silver carp is a cost-effective and nutritious alternative that can be scaled widely without a significant increase in price as well as preventing an ecological disaster from occurring in the Great Lakes.

For many years, people have tried to find the best way to feed a growing population. Due to high nutrient-rich food costs, issues with food safety, and transportation many solutions have failed. Most of the success stories feature grains, rice, and cereals which are carbohydrate-rich foods and lack in nutrients. Virtually none of them contain animal protein, due to high cost. However, we believe our solution is the best. We plan to mitigate these risks using nutrient-rich, silver carp which will reduce the population of an invasive species in the US. By powdering fish, we do not need to worry about shelf life. This award will enable us to partner with Catholic Relief Services so we can transport a Tom Brown fortified food product to Nigeria for feeding an ever-growing population, thus turning trash into treasure.

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