

Reports

Addressing malnutrition and food insecurity with breadfruit in a rural, developing country: a case study and lessons learned in Thomassique, Haiti

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Haiti's Central Plateau region suffers from significant malnutrition, economic hardship, and a crisis level of food insecurity. Already the poorest country in the Western Hemisphere in terms of gross domestic product (GDP) per capita, Haiti has pervasively high malnutrition rates, but the Central Plateau is among the most severely affected areas. One in five children of the Central Plateau suffers from malnutrition, and the region exhibits a devastating 30% rate of child stunting. Our US-based team affiliated with Klinik Sen Jozèf, a community-respected medical clinic in the Central Plateau city of Thomassique. We partnered with local Haitian leadership, a local agronomist, and Trees That Feed Foundation to introduce breadfruit (*Artocarpus altilis*) and an innovative development model to combat local malnutrition. Five years into the program, we have partnered with 152 farmers, and we have enhanced our malnutrition program with breadfruit derivatives. This report addresses the lessons we learned to assist others looking to introduce models or crops in a similar manner. Our experience is particularly significant in light of the COVID-19 pandemic, as supply chain disruptions have worsened food insecurity for more than 800 million people in low-income countries.

Malnutrition is a prominent public health concern across the developing world and poses a major threat to Haiti, which has some of the highest reported rates of underweight children across Latin American and Caribbean countries.^{1,2} Within Haiti itself, the Central Plateau is particularly affected by malnutrition. Roughly 20% of children in the region suffer from malnutrition, and the region reports a 30% rate of child stunting, (impaired growth and development due to malnutrition, infection, or other causes³), the highest rate in the country.^{2,4} These issues are rooted in widespread poverty and exacerbated by the limited yields and diversity of local agriculture. With the majority of residents relying on small farm production for income, low yields and poor-quality crops can be devastating. In addition, COVID-19-related supply chain disruptions worsened food insecurity for more than 800 million people in low-income countries.⁵ As the poorest country in the Western Hemisphere, Haiti will likely be among the most seriously affected countries in the world.⁶

Our team of affiliates of the locally known and respected medical clinic, Klinik Sen Jozèf (KSJ) in the Central Plateau city of Thomassique, collaborated with local Haitian leadership and the Trees That Feed Foundation (TTFF) to in-

troduce breadfruit and an innovative community partnership model to the Thomassique area. We refer to the team and their work collectively, but individual team members are named as authors.

Thomassique is located in a remote region of the Central Plateau near the Haitian-Dominican border (Figures 1 and 2). With a population of approximately 65,000, the area is significantly economically depressed, even compared to other regions of Haiti. Medical Missionaries has led medical missions to Thomassique since 1997, and in 2007, the organization established KSJ as a permanent medical center to serve the area. Thanks to strong relationships with the local communities and excellent Haitian leadership, Medical Missionaries and KSJ have been able to successfully introduce many public health programs. In addition, KSJ has established community health committees in the five nearby villages of Barank, Bouloume, Darlegrand, Nan Kwa, and Savan Platte, and these committees carry out many of KSJ's public health initiatives.

The malnutrition described earlier contributes significantly to many of the diseases treated at the clinic, and KSJ has responded through a variety of approaches. These include the Medika Mamba program, a partnership with the

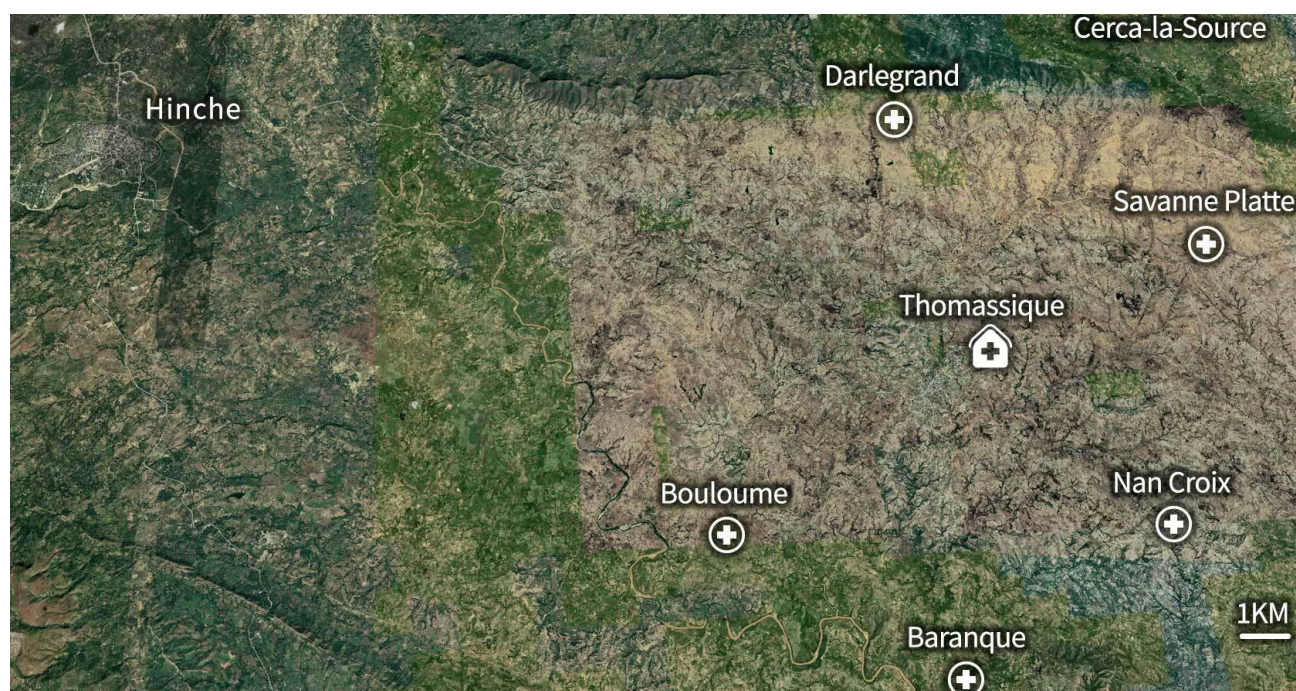


Figure 1. Map of communities surrounding Thomassique, Haiti.

Haitian government and Meds and Foods for Kids, providing a highly nutritious, fortified peanut butter product to supplement the diet of seriously malnourished children.⁷ However, over time, KSJ recognized the need to address malnutrition at its source through a larger, systemic, and sustainable project. We envisioned a trans-disciplinary OneHealth project, focusing on improving not only human, but also animal, plant, and environmental health for the long-term benefit of the interconnected community.⁸

In early 2018, we developed a project charter to introduce breadfruit into Thomassique and its surrounding villages. The charter was founded on three focal, inter-related pillars intended to guide the project: health, education, and economic growth.

1. Health:

- Breadfruit has high levels of essential nutrients.^{9,10} 100 grams of breadfruit provides 25% of the recommended daily allowance for fiber, and 5–10% for protein, magnesium, potassium, phosphorus, thiamine (B1), and niacin (B3),^{11,12} in addition to other nutrients.^{13,14} The fruit's active compounds do not seem to be adversely affected by cooking.¹⁵ Recent studies have demonstrated breadfruit value in combating malnutrition and food insecurity in light of climate change.¹⁶ Accordingly, healthier, breadfruit-infused local diets would ideally result in less malnutrition-related patient visits to KSJ. To this end, our contracts with partner farmers stipulate that community health workers (CHWs) can take a small percentage of fruit for families with children enrolled in malnutrition programs. Perennial crops, like breadfruit, also encourage health by increasing clean air

and reducing erosion. Of particular note, breadfruit trees do not burn well. This protects the trees from being cut down to make charcoal, a common practice in Haiti contributing to widespread deforestation. Accordingly, breadfruit is an excellent candidate for OneHealth-modeled projects.

2. Economic growth:

- Breadfruit is a valuable commodity in the Thomassique area, and introducing it provides our associated farmers with a new cash crop. We aimed to provide a significant number of trees to participating local farmers, believing the economic benefit would provide communities with greater independence to combat malnutrition. The eventual production and sale of breadfruit flour and other breadfruit derivatives will further drive sustainable economic growth.

3. Education:

- The project's success and sustainability depends upon associated farmers learning how to grow breadfruit and care for saplings. In addition, we are working to educate farmers on possible breadfruit derivatives and to foster local entrepreneurship. TTFF has documented many successful and profitable derivatives of breadfruit, ranging from nutritious flour to alcohol. In particular, TTFF cooking schools have increased local demand for and use of breadfruit in other locations.

Our over-arching goal was and is to create a sustainable model that will grow and sponsor offshoots of its own in years to come. Accordingly, our efforts to develop the edu-



Figure 2. Map of Haiti highlighting the Central Plateau.

cation pillar of the project emphasize incentives for creativity and agency.

METHODS

PREPARATION

We first prepared to grow and distribute breadfruit saplings with assistance from TTFF, planning to distribute the first delivery of saplings among five partner villages surrounding Thomassique. Initial fundraising raised slightly over \$5,000, covering projected costs for the pilot program.

Before project implementation, KSJ management and the 2017-2018 Fellows held an introductory meeting with our agronomist and a local stakeholder. We explained our

vision and introduced the “three pillars” model. Afterward, we brainstormed ways to involve the local community in the project. This session was quite valuable. Several suggestions, such as involving the clinic cooking staff in teaching local community cooking sessions, would likely not have been considered otherwise.

IMPLEMENTATION

We constructed a breadfruit nursery in the summer of 2019 and began preparing breadfruit saplings from mature trees ([Figure 3](#)). TTFF has generously supported us in the early stages of the project; they purchase six-inch seedlings for \$3 and donate them back to the clinic for distribution. In



Figure 3. A whole bunch of baby breadfruit trees.

*Photo courtesy of Fellows

In addition, we incentivized our agronomist to produce more seedlings by providing him with \$1 for each seedling sale, as well as a portion of the breadfruit flour produced. To prepare breadfruit flour, we purchased a grinder and built a drying rack. We have now begun distributing some of the breadfruit flour to families in the Clinic's Childhood Malnutrition Program, as planned. In addition, our agronomist provided breadfruit-education trainings for the CHWs. His resources are available upon request.

EXPANSION AND COMMUNITY DISTRIBUTION

Our CHWs first identified farmers interested in participating in the project and created a list for the agronomist, who screened the farms and selected partner farmers. He then conducted breadfruit agronomy training sessions in each village with the farmers. When the breadfruit saplings reached appropriate planting size at the clinic nursery, the agronomist delivered the trees and executed contracts with the farmers. Each contract provides CHWs with approximately 25% of the expected yearly harvest to distribute to members of the Medika Mamba program and other significantly malnourished families.

CURRENT PROGRAM STATUS

During our first distributions of breadfruit seedlings, we provided 273 seedlings to 96 farmers in and near Thomassique; two to five trees were given to each farmer. We expect to soon generate a profit through increased production of breadfruit derivatives (particularly flour). This profit is entirely in the hands of the local Haitian KSJ staff to support the clinic's work.

Additionally, we have reached out to other local organizations with similar values to expand our reach. In particular, we recently held a meeting with SCADD (Solidarite Citoyenne Active Pour Le Development Durable), which conducts agronomy initiatives in nearby Bouloume, to discuss joint ventures.

DISCUSSION

CHALLENGES

1. *Personnel/Staffing*: Our first agronomist was a volunteer from an hour away who came to work once a week, and who had a serious disagreement with a large stakeholder. Simultaneously, reports of other concerns surfaced, making it clear that we would have to part ways with him. We elected to find a local agronomist to replace him and eventually hired Wiscard-Kardin LaPais. LaPais lives in Thomassique and has a special understanding of local farming conditions. We were initially concerned that a local agronomist might be unduly influenced by local politics. However, these worries were outweighed by Kardin's vested interest in the community and reliable attendance (especially during the rainy season, when road conditions make travel difficult). LaPais' leadership has been directly responsible for much of the program's success. Because the paid position was newly created, we had to develop and clarify employee policies along the way, but our patience paid off significantly.
2. *Decision Sharing Between Local and Remote Leadership*: Clear communication between remote and on-the-ground management was essential, as communication failures increased the risk of project failures and poor decisions. While on-the-ground leadership better understands local project challenges, remote leadership could often see greater scope and partnership possibilities. We have been fortunate to have leadership on the ground in Haiti and in the US that is flexible and open to feedback, which has directly contributed to the project's success.
3. *Challenges Specific to Introducing Breadfruit*: TTFF warned us of challenges other groups faced while cultivating breadfruit saplings, and we would not have foreseen some of these issues without their help. Breadfruit saplings die of dehydration easily without a consistent water source. In addition, goats roam widely on many rural Haitian farms and will eat the saplings if they have access to them (we learned this firsthand). Excessive fertilizer can also kill breadfruit saplings. In some rare cases, trees have even been stolen. Further down the line, breadfruit flour must be processed carefully, or it may contain impurities. We believe that strong community involvement and buy-in decrease the likelihood of tree loss or theft, but we continue to work to address these challenges. In addition, studies have suggested that breadfruit monocultures are vulnerable to pests,¹⁷ and research in Hawaii has documented nematode parasites capa-

ble of damaging the plant.¹⁸ However, we do not have evidence of parasites currently affecting our projects, even as we remain vigilant. If we encounter such parasites, we plan to consult the appropriate scientific literature.

LESSONS LEARNED

Since we began our project, it has grown significantly. We share our experiences and lessons learned here, hoping they will prove valuable to others working to introduce crops or systems into communities in developing countries.

1. *Relationships with the local community* – We cannot emphasize enough the importance of having strong relationships with the local community. We were able to leverage preexisting long-term relationships between the clinic and local communities because KSJ has an excellent local reputation, and because many key stakeholders on our team are local leaders. We quickly achieved significant community buy-in, while we expect an outside group starting fresh would encounter more difficulty. On the other hand, we had to be careful not to impinge on established relationships while making room for new approaches. We were held to KSJ's and Medical Missionaries high standard, requiring quality control, flexibility, resilience, and a slow and steady approach over time.
2. *Unified Vision* – During our initial planning, we found that our US-based and Haitian-based leadership teams occasionally had different visions for the project. Accordingly, negotiation experience and skills were far more important to project success than was initially expected. In addition, language barriers should be anticipated, presenting a further challenge. Our work required creative solutions, including video calls and sketched visuals, but thanks to common values, we overcame these difficulties.
3. *Collaboration with Experts* – Outside expertise and partnerships were crucial to our success. TTFF provided the Ma'afala breadfruit and knew novel fruit derivatives. Their expertise was a crucial counterpart to our local knowledge and relationships, contributing hugely to the project. In addition, we held a focus group to brainstorm various aspects of our "three-pillar" model, identifying a number of possible entrepreneurial avenues we would not have otherwise considered. This focus group relied heavily on local knowledge, but it would not have been possible to discuss avenues for breadfruit flour distribution had we been unaware of breadfruit flour itself.
4. *Appropriate Leader Autonomy* – Project leaders need creative freedom and flexibility. In particular, we needed strong leaders with a clear vision, good diplomatic skills, and who were not swayed by local politics and could delegate tasks well. We are fortunate to have these leaders in Saint-Fleur and LaPais.
5. *Appropriate Scope* – As we planned our project, we discussed the possibility of building a large, commercial-scale chicken coop at KSJ, because chicken ma-

nure can make a good fertilizer for breadfruit. We soon realized that starting both projects at the same time was too ambitious and expensive. Instead, we decided to build a small subsistence henhouse to provide manure for fertilizer (and eggs for the clinic). We are now considering building a breadfruit enclosure with free-ranging chickens to provide fertilizer and reduce pests. Looking back, our decision to start small served us well.

6. *Appropriate Staffing* – Initially, we relied upon local volunteers and students to support our agronomist. Although this provided us with a reasonable workforce, school holidays and general reliability presented challenges. When we hired an assistant agronomist to cover holidays, we realized how valuable he was and kept the position. We could have benefitted from a deeper analysis of our projected staffing needs earlier on in our project.

CONCLUSION

Reflecting on our program, we want to emphasize above all else the importance of strong community involvement and buy-in as the most important lesson we learned. This program would not have been possible or successful without the clinic's Haitian leadership. Charles Saint-Fleur and Wiscard-Kardin LaPais oversaw the program's implementation, and Saint-Fleur played a major role in planning it. Without Saint-Fleur, LaPais, and our community health committees, there would have been no project. Our efforts were further enhanced by the clinic's own preexisting years of service to the local community, for which Dr. Lawrence Mercier deserves special thanks. We do not believe a project of this nature and scope can work without key community involvement and local leadership creating and maintaining community trust.

In the short term, we plan to continue expanding the breadfruit project in conjunction with local farmers in Thomassique and its outlying villages. We will continue to host agronomy education sessions, develop breadfruit derivatives, and encourage local farmers to produce more of their own breadfruit seedlings. Ultimately, we hope to donate breadfruit seedlings to other organizations in Haiti and provide educational materials for them in conjunction with TTFF. As our program grows, we will divert surplus profits from breadfruit production to the clinic to fund medications and public health projects.

In the long term, we are considering several new directions. We hope to eventually incorporate several plants into our distribution model, such as papaya and moringa. Although further research is needed to determine which plants will grow most successfully in conjunction with breadfruit, we are considering the possibility of a moringa-breadfruit polyculture. Hopefully, additional research in this area will lead to discovery of a polyculture capable of increasing breadfruit yield and improving the brittle and nutrient-deprived soil so prevalent in Thomassique. We are also considering implementation of arborloo-style latrines to simultaneously enrich the soil and benefit local health.

Ultimately, our goal is to hand over the breadfruit projects in the surrounding villages to the community health committees, providing them with complete autonomy.

Our vision remains tied to the three pillars of developing local health, education, and economy, as we work together toward the common goal of a more economically stable and healthy Central Plateau. Given the projected effect of the pandemic on food security in the immediate future, we believe long-term and community-driven projects like ours are particularly important. While engaged in a literature review, we found very little written about how to plan and implement a program like ours, despite its potential to improve health and economic wellbeing of communities in developing nations. We hope our program's successes and challenges will be useful for others seeking to implement similar programs.

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ACRONYMS AND ORGANIZATIONS

CHW – community health workers (Klinik Sen Jozèf employees who live in partner villages, treating minor injuries

and overseeing local clinic initiatives).

KSJ – Klinik Sen Jozèf (Haitian Kreyol) in Thomassique, Haiti. Also known as Saint Joseph's Clinic (English) and *Clinique St. Joseph* (French).

TTF – Trees That Feed Foundation, an organization focused on planting fruit trees in developing countries.

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AUTHORSHIP CONTRIBUTIONS

All authors contributed to the manuscript.

COMPETING INTERESTS

The authors completed the Unified Competing Interest form at <http://www.icmje.org/disclosure-of-interest/> (available upon request from the corresponding author), and declare no conflicts of interest.

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