

IMPACT PATHWAYS OF LEGUMES: INCREASING BEAN PRODUCTIVITY AND NUTRITIONAL QUALITY OF FAMILY DIETS IN THE WESTERN HIGHLANDS OF GUATEMALA

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GRETCHEN NEISLER is the Director of the Center for Global Connections in Food, Agriculture and Natural Resources (CGC), a boundary-spanning global organization located in the College of Agriculture and Natural Resources at Michigan State University. The CGC provides leadership support to the Legumes Innovation Lab. Dr. Neisler holds a B.S. in Animal Science, an M.S. in Agriculture Extension Education, and a PhD from MSU in Higher Education Administration. Her international portfolio includes work across the Middle East, East Africa, West Africa, and Southeast Asia, building sustainable partnerships within and for academic institutions. Her expertise is in organizational development, conducting translatable research in agriculture, communicating the impact of agriculture science, and learning from our development failures.



ABSTRACT

Despite the fact that the *three sisters of agriculture* (maize, beans, and squash) were domesticated in the Americas and provide a wholesome diet when augmented weekly with animal foods, and despite efforts to increase agricultural production, the indigenous Mayan population of the western highlands of Guatemala remains one of the most undernourished in the world (UNICEF 2013). Government and donor-led efforts have been reporting on the consequences of malnutrition in the Guatemalan population, particularly children of Mayan families located in municipalities with the highest stunting rates. Locally and internationally, this situation has been portrayed as a national shame since many consider that the country is rich enough to have prevented this situation (*The Economist*, 2009). Government-funded hunger and malnutrition relief projects are working in a state of emergency to improve the situation in priority municipalities. Másfrijol is part of the Legume Innovation Lab's unique approaches focused on improving the nutrition of the entire family by promoting a greater consumption of beans.

The Feed the Future Innovation Lab for Collaborative Research on Grain Legumes, branded as the "Legume Innovation Lab (LIL), began in 1980 as the Bean/Cowpea Collaborative Research Support Program (CRSP) (1980–2007). The program supports ten multi-disciplinary collaborative research and institutional capacity strengthening subcontracted projects working in 13 Feed the Future countries in Africa and Central America and the Caribbean involving scientists at 10 US universities, 3 USDA/ARS research centers, and 23 developing country national agriculture research systems and universities. Much of the LIL research portfolio is geared toward producing new technologies, mainly new grain legume varieties. Six of the ten projects are focused on advancing legume productivity; five of these are focused on plant breeding and genetic improvements, while research of the sixth (SO1.B1) focuses on integrated pest management technologies and overcoming other production constraints.

Másfrijol is a new approach within the LIL that situates nutrition education as a major component. The program provides intensive measures to promote dry bean consumption through consumer (particularly women's) training and education. The training is intended to move under-five children's diets from mainly maize consumption toward more diversity and foods with higher nutrient density such as beans. The output from Másfrijol is educated consumers that have a solid platform in which they can make household decisions for the family. The outcome of this approach is comprehensive and sustainable change in production and dietary decisions among a population of people that has otherwise been ignored.

Global development project impact pathways are complex. As a result of this complexity, the pathway from research outputs to impacts must consider several conditions, most of which are beyond the scope of a pure research project. The Másfrijol project made a conscious decision to institutionalize impact assessment focused on improving project outcomes and by connecting with local stakeholders in every aspect of the programming. This approach integrated a culture of impact assessment and generated an awareness among stakeholders about the obstacles that they were facing and ways in which they could overcome them to obtain sustainable change. The project team and its stakeholders were able to visualize how the research fits into development change and to understand constraints to realization of the change needed as indicated by the research.

KEYWORDS

Guatemala, impact assessment, stakeholders, Másfrijol

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in Food, Agriculture, Natural Resources

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The disequilibrium of food, natural resources, and ecological and economic security



- Per capita consumption of animal proteins is 496 calories compared to an average of 1331 in most of the developed countries.
- 13% of the population in Latin America is undernourished.
- Diet variability is due to cultural, environmental and socioeconomic factors.

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MASFRIJOL AT A GLANCE


Project Objective	Indicative Activity	Expected Results
Increase bean productivity in highland systems	Participatory community needs assessments	200 communities (depending on population densities)
	Almacenes Comunitarios	75 Almacenes
	Farmer's with access to improved bean seed varieties	25,000 households with access to improved bean seed varieties improving productivity
Enhance nutritional quality of diets	Improved technologies for household bean grain storage (PGS bag)	20,000 households with access to PGS technology
	Nutrition education and promotion of nutritious bean-based dishes	12,000 households with access to nutrition education, consuming more beans
Total beneficiary households		25,000

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The Success Story of Nutrition and Agriculture Education



Patrocino Garcia, 66
Sows beans after a failed maize crop

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MASFRIJOL and Michigan State University wishes to thank:





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Questions?



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Chair Tobita

Okay, I will call Dr. Gretchen Neisler, the third speaker of this session. Dr. Neisler is the Director of the Center of Global Connections in Food, Agriculture, and Natural Resources located in Michigan State University. She is specialized in education and her expertise is in organizational development. So, today, she will speak about the complexity of impact pathways in global development project with showing an experience in western highlands of Guatemala. Okay, Gretchen, floor is yours.

Dr. Gretchen Neisler

Good morning everyone. It's always a terrible realization when you realize you are the one that's standing in between in you and lunch. This discussion of food and nutrition education in Latin America will attempt to highlight factual challenges we all know the region to be facing and Michigan State University's attempt to critically dissect these challenges and empower consumer decision making. Since Malthus' first debated food and population, basic data on nutrition problems in Latin America, the demographic impact, food production, and the possible future prospects look relatively the same. But what if a new approach, a shifting paradigm, an attention to culture and education changed this trajectory?

All developed countries have per capita caloric availabilities of over 3000 calories a day, compared to an average of 2465 for Latin American as a whole. Only Barbados and Argentina have 3000 calories per day. The daily average per capita protein consumption of 65.7 grams in Latin America is above the 54 gram per day recommended by the Food and Agriculture Organization and WHO.

In Latin America, the average daily per capita consumption from animal protein is 496 calories, compared with the 1331 in the US. The nutrition status of different Latin American countries varies, with minimal caloric intakes of 1880 calories per day to 2170 in some Central American and Caribbean countries. Haiti, the Dominican Republic, Honduras, Ecuador, and Bolivia have frank protein deficits. Within countries, there may be large food gaps between regions, rural and urban populations, and social classes. The FAO estimated that 41 million Latin Americans representing 13% of the population are undernourished. 38% of Guatemalans, Hondurans, and Haitians, 30% of Ecuadoreans, and 23% of Peruvians are believed to be inadequately nourished. The quality of the diet varies widely between the countries and regions because of a multitude of cultural, environmental, and socioeconomic factors.

In general, the diet is heavy in carbohydrates and light on protein. Undernutrition has a characteristic mortality pattern with deaths concentrated in those under 5 years of age and with physical and mental effects that may persist throughout the lifespan. The Latin American population was increasing at 2.3%/year in 1983, representing 9 million new consumers each year. Food production increased by 3.9% a year between 1971 and 1980, but in at least a third of the countries, the rate of increase in food production was exceeded by the population growth rate. The relationship between population and food is complex and is affected by multiple and changing environmental, economic, and social factors directly related to the international economic system. Latin America must augment its food production capacity and focus on basic nutrition education of its population if the issues of malnutrition are to be eradicated.

The Mayan population in Guatemala's western highlands is one of the most undernourished in the world, with children there suffering high rates of stunting. A well-established indicator of early childhood malnutrition, stunting can affect cognitive development and productivity as well as increase the likelihood for heart disease, diabetes, kidney damage and anemia into adulthood.

Despite the fact that the three sisters of agriculture, maize, beans and squash, were domesticated in the Americas and provide a wholesome diet when augmented weekly with animal foods and despite efforts to increase agricultural production, the indigenous population of Guatemala remains one of the most undernourished in the world. Government and donor-led efforts have been reporting on the consequences of malnutrition in the Guatemalan population, particularly children of Mayan families located in municipalities with the highest stunting rates. In 2009, The Economist reported that locally and internationally, this situation has been portrayed as a national shame since many consider that the country is rich enough to have prevented this situation. Government-funded hunger and malnutrition relief projects are working in a state of emergency to improve the situation in priority municipalities.

Beans, a nutrient-dense food with a high percentage of protein, may seem a likely answer to remedy Guatemala's malnutrition problem, but the solution isn't quite that straightforward. As we all know, farmers

don't grow enough beans to meet nutritional needs of the people. Limited access to farmland and elevations greater than 2500 meters above sea level make bean production difficult.

While the three sisters of agriculture are more easily grown in the highlands, they're eaten in disproportionate amounts for proper nutrition. The ratio of maize to bean consumption is 97:3 for most households. A diet this high in corn does not provide the necessary protein and other nutrients to promote healthy growth and development.

To achieve a high-quality protein, equivalent to that of meat, the recommended corn-to-bean consumption ratio should be 70:30, according to Sharon Hoerr, a nutritionist and professor emerita from the Michigan State University. Professor Hoerr goes on to state that a high-quality protein contains the nine essential amino acids that humans must get from food for proper nutrition, health and growth. Beans and maize both contain incomplete proteins; if combined during the same day, however, they form an excellent high-quality protein. Critical problems also lie in the population's limited understanding of the nutritional value of beans, which are often dismissed in favor of processed foods. Consequently, beans are not always consumed when they're available. Instead, farm families frequently sell their beans to purchase less nutritional foods.

Enter Másfrijol. In 2013, Michigan State University, through the support of the Legume Innovation Lab, realized that improving nutrition in the western highlands required the following goals: Increasing bean yields, increasing bean consumption, improving nutrition education, especially about the long-term health benefits of proper nutrition.

The Feed the Future Innovation Lab for Collaborative Research on Grain Legumes, branded as the Legume Innovation Lab, began in 1980 as the Bean/Cowpea Collaborative Research Support Program. The program supports 10 multi-disciplinary collaborative research and institutional capacity strengthening subcontracted projects working in 13 Feed the Future countries in Africa and Central America. Feed the Future is a demarcation of the United States Agency for International Development.

The project involves scientists at 10 US universities, 3 USDA/ARS research centers, and 23 developing country national agriculture research systems and universities. Much of the Legume Innovation Lab research portfolio is geared toward producing new technologies, mainly grain legume varieties; six of the ten projects are focused on advancing legume productivity. Five of these are focused on plant breeding and genetic improvements while research of the sixth focused on integrated pest management technologies and overcoming other production constraints.

Másfrijol is a new approach within the Legume Innovation Lab that situates nutrition education as a major component. The program provides intensive measures to promote dry bean consumption through consumer, particularly women's, training and education. The training is intended to move under-five children's diets from mainly maize consumption toward more diversity and foods with higher nutrient density such as beans. The output from Másfrijol is educated consumers that have a solid platform in which they can make household decisions for the family. The outcome of this approach is comprehensive and sustainable change in production and dietary decisions among a population of people that has otherwise been ignored.

[Audio]

Male Speaker

We are along with mountain range of the Cuchumatanes altitude close to 1600 meters above sea level.

Male Speaker

These are the highlands of Guatemala, and while they are absolutely breathtakingly gorgeous, it's also one of the poorest, least nourished areas in the world.

Male Speaker

It is special for me because I believe that with all the wealth we have in natural resources, it is embarrassing to have very scary malnutrition statistics. We can feed ourselves. With the technology that we are bringing, we can not just have a diverse diet but sufficient for kids not to go through that.

Male Speaker

We are looking here at least 15 to 18 pods per plant. This is an excellent pod formation. This is what we are talking about when we discuss technologies that can help farmers produce more yield per acre.

Male Speaker

This is beautiful. Look at this crop. I see a very intelligent use of this plot to maximize what they can get per square meter and this area here is going to be at least 1.5 quart and I can tell you just by the strength of it and based on our experience, this is a plot that will yield circa 200 pounds per quart. We are talking enough beans for a good four or five months. For a family to have access to protein that is grown in their own soil is very important.

Male Speaker

And so the hope is that kids like this little guy down here will be growing up eating beans and understanding their importance and all of that.

Male Speaker

Absolutely. Our deal, our contract with USAID is to focus on families with children of 5 years and under. We found a lot the importance of the 1000 days of life, the first 1000 days which start from conception through your second birthday. If they don't take enough protein, we know that they will be limited in expanding their full potential, both intellectually and physically. So, they are the main focus of Másfrijol.

Male Speaker

Do you know you are the main focus of Másfrijol?

Child

What?

Male Speaker

Do you know you are the main focus of Másfrijol? C or no?

Child

Yes.

Male Speaker

I think we got a "Si" out of him.

Male Speaker

I think we did.

Male Speaker

That's good. We will take it.

Dr. Gretchen Neisler

Másfrijol began its work by providing 15,000 smallholder farmers each with 5 pounds of high-quality seed of improved, disease-resistant bean varieties adapted to the unique agroecology of the region. These altitude-appropriate varieties were developed by the Institute of Agricultural Science and Technology or ICTA to improve bean yields in the inhospitable, high-altitude elevations of the region.

Through its collaboration with the Guatemalan Ministry of Agriculture, the project also provides farmers training on soil preparation, seed germination and safe bean storage postharvest. The training helps farmers improve their integrated crop management, enabling them to grow more beans on their land and safely store the increased yields long-term. As a result, beans can last up to 6 months after harvest.

By relying on the expertise of established public and private sector agencies and organizations in the region, Másfrijol has been able to extend its impact to reach in greater numbers of farmers and even the most remote areas of the highlands. The partnerships have effectively linked the agriculture and nutrition education activities to ensure that farming families are not only growing more beans but eating the beans they've grown.

To support these lessons and facilitate technology adoption, Másfrijol's training team has developed technical guides and videos that focus on key training messages. Key messages are limited to three to five per topic, so farmers and families can remember to put them into practice at home. We don't want to overwhelm them with too much information but build on the knowledge they have and then lead them to new skills for growing and consuming more beans.

For example, in our training on seed storage, one of 15 training modules offered through Másfrijol, we make sure participants understand exactly how to use special plastic bags to store and preserve their grain for up to 6 to 12 months, and that optimal seed humidity for bean storage is less than 14%. The science behind these principles is interesting, but the farmers don't need to understand such details to use the bags, so training doesn't emphasize them. We focus on practical skills that can be easily applied. Many farmers who had become used to inferior seed quality and assumed that beans were difficult and risky to produce have reported twofold bean yield increases. And most are saving beans for family consumption and the next planting season instead of selling them.

Nutrition Education: Within months of the improved seed distribution and crop management education, Másfrijol, working with the Government of Ministry and Health began establishing nutrition education programs to increase the understanding of the link between regular consumption of beans with maize and improved health.

With its partners, Másfrijol has developed culture-sensitive educational materials that accommodate the literacy and language barriers of the target populations, including a coloring book for children focused on making healthy food choices.

Three years after its formation, Másfrijol reports that families consume more beans at family meals, at least three times a week. Infants and children younger than 5 are being fed more beans on a daily basis instead of a predominantly maize-based diet. Families are learning to measure how many pounds of beans they need per week to meet their food requirements. Although there is more work to do and more people to reach, Másfrijol is succeeding in its project goals. Families are growing and eating more beans and sharing them with neighbors. Másfrijol teams have empowered communities to manage improved varieties on a sustainable basis and implement technologies and practices to grow and consume more beans in the future. Thank you very much.

Chair Tobita

Okay. Thank you very much for introducing Másfrijol, more bean project. The key of success was the education to promote legumes production and consumption. It's almost time but I would like to have one quick question or comment. Yes, please.

Male Questioner

Constraints to produce bean in your country in the field condition...

Dr. Gretchen Neisler

I missed the first part of your question, can you repeat it please?

Male Questioner

What is the constraints, difficulties to produce bean in your country in the field?

Dr. Gretchen Neisler

So, early on before the varieties were established, probably the largest challenge was the altitude which we were trying to grow the beans, and it was also in the preparation of the soils as we were providing those cultivars. I should also say related to your question that through the course of the project, 90 different varieties have now been introduced in the western highlands of Guatemala, 45 of them have been small red beans, and when we went back to do the impact assessment on our sort of mid-term of the project, what we realized is that 67% of the land that was being dedicated to bean growth was now these new small red bean cultivars, which then meant an addition of \$350 million injected into the agricultural economy of Guatemala.

Chair Tobita

It's clear? Okay, Thank you very much Dr. Gretchen. Okay, now I close the session with thanking to all speakers for a kind contribution. So, please give a big hand to the valuable speakers. Thank you very much.