Semilla Nueva Standard Report
July – December 2019

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EXECUTIVE SUMMARY

In 2018, we launched sales of the world's first high protein quality and high zinc commercial maize seed. Our approach was different. Where existing programs had reached a roadblock trying to get Guatemala's poorest to prioritize scarce resources to improve their diets, we would provide farmers with a seed that provided them higher yields of their staple food—but now with higher levels of their most important missing nutrients.

In our second year we significantly improved the nutrition of over 5,000 families in Guatemala. We achieved some big successes. We reacted to beginner's mistakes from our first year. We honed our model and developed systems, strategies, and people that will be critical to scale. Our sights are set on improving the nutrition of millions of the world's poorest people, and thanks to the support of those reading this report, we're finding surer footing. Thank you

Sales and Marketing: In 2018, we sold 1,234 bags of our Fortaleza F3 seed. This past year we increased sales by 77%, selling 2,183 bags of seed. While this growth is significant, we missed our ambitious sales goals. We incorrectly targeted wealthier farmers who buy only more expensive, higher yielding seed, and we learned that farmers in some regions received lower prices for grain produced from our seed. To correct, we made large changes in our sales team as well as our community and regional targeting strategies. We launched new campaigns built on the fact that farmers, their families, and tortilla shops universally love our grain for its tasty tortillas. As a result of the adjustments, we hope to nearly double sales again in 2020. Among all surveyed farmers, our brand Fortaleza was the second most loved, and among the poorer and smaller farmers we are targeting, it was number 1.

Production: We established a long-term seed storage facility to allow for seed to be kept year-round, improved quality control, and will have over 4,100 bags of seed ready for 2020 sales.

Research and Development: Scaling sales and policy will both depend on improved, higher-yielding biofortified seeds. Two new seeds have passed a rigorous screening process and could be launched commercially in 2022. Pending funding currently under review, our breeding program will launch seeds with yields 20-35% higher than our current seed for field testing in 2022. We began a partnership with INCAP, Central America's leading nutrition institution, to create a nutrition testing lab capable of screening thousands of seeds at a fraction of the price which will make future R&D efforts possible and improve our quality control efforts.

Impact Evaluation: Our studies show that farmers in our target market are increasing yields and incomes. We identified the source of our lower than expected amino acid levels and are implementing a solution. Most excitingly, we launched our first ex-ante model. It concludes that large scale adoption of biofortified seeds can make significant national impacts on nutrition. The next version of this model will help us determine how best to focus our efforts to get there.

Development: Semilla Nueva received new and expanded renewals from several of our most important donors. Funding was also obtained from Open Road Alliance to compensate for the US administration's decision to cut funding to Guatemala programs. Several large foundations are currently reviewing renewals, and we are close to a fully funded, expanded 2020 budget with the right investments in seed development, policy, M&E, and marketing.

SEED PRODUCTION

Summary:

- **Over 4,100 bags of F3 seed will be available for 2020.** This includes 966 bags of seed produced in late 2019 and 3,100 bags from seed production expected in February – April.
- **A new warehouse and cold room were established to maintain seed stock over several years.**
- **Semilla Nueva undertook a rigorous certification and training program on proper use of agricultural inputs—critical for future work with USAID**.

Semilla Nueva began seed production for the 2020 season

Six production farmers who previously produced seed successfully planted 17 hectares from the beginning of October through the end of November. The staggered planting plan was developed to accommodate for an atypically rainy October and early November which delayed planting slightly. Twelve hectares were planted in the department of Chiquimula in eastern Guatemala and five in the department of Retalhuleu on the southern coast. With quality control measures in place, harvest is on track and expected in early March through early April, 2020.

Table 1: Seed inventory and production by hybrid

	F3	F17
	Bags	Bags
2019 Inventory	966	507
2020 Eastern Production	2350	0
2020 Southern Production	800	0
Total	4116	507

New warehouse

Immediately after finishing the main 2019 sales season, Semilla Nueva relocated additional inventory to a newly outfitted warehouse an hour outside Guatemala City. The new warehouse includes a small cold room with controlled conditions for parental seed and a larger storage area for commercial seed. Given the high elevation and cool temperature of the site, commercial seed should maintain high viability from one year to the next, allowing a constant inventory while only producing seed during the much more reliable Guatemalan dry season.

Environmental training

To comply with rigorous USAID environmental requirements, Semilla Nueva's staff underwent two USAID approved trainings. Six production farmers and 15 staff were certified in usage of agricultural inputs and 13 staff members as registered trainers for safe agrochemical usage. The program certifies Semilla Nueva's seed-producing farmers and staff in global best practice standards for agricultural input usage and will streamline future work with USAID and other US bilateral programs.

MARKETING

Summary:

- **Farmers like Fortaleza more this year:** among surveyed farmers, Semilla Nueva's net promoter score increased in 2019 vs. 2018. Among the farmers surveyed, we maintained our status as the second most recommended seed brand overall (second to Monsanto's brand Dekalb), and became the most recommended seed among low and mid-segment farmers.
- **Penalties for biofortified grain**: as mentioned in the January-June 2019 report, in the regions of the southern coast and northern Guatemala, some grain buyers are penalizing farmers for the slightly smaller grain size and slightly darker color of grain produced from our seed. Semilla Nueva is shifting its targeting to regions and farmers who deal less with these intermediaries, while developing new campaigns to counter the problem.
- **New tortilla campaign**: Semilla Nueva launched a new campaign to highlight the taste and texture of the tortillas produced from our seed. The campaign is being featured in field days and agrodealers across the country to boost sales. It improves the targeting of low and mid-segment farmers and changes the narrative to make our grain more desirable.
- **Following agrodealers biggest recommendation for F3—more seed per bag:** Agrodealers' main recommendation after the 2019 season was for Semilla Nueva to begin selling seed in 20kg bags instead of in bags of 60,000 seeds. This small change will make the price per pound for small farmers almost as inexpensive as the cheapest low-segment seed, where we are most competitive.

Semilla Nueva improved our Net Promoter Score (NPS)

For the second year, Semilla Nueva completed Net Promoter Score (NPS) surveys in all major sales regions. NPS surveys provide information on brand satisfaction and how likely a consumer is to recommend a brand. A third party surveyor called 200 farmers. 167 farmers were reached (83%) and confirmed planting maize during the 2019 main corn season. The completed surveys found that 130 (or 78%) of farmers recognize the Fortaleza brand.

Of those 130 farmers, 29% (38 farmers) did not grow Fortaleza, with 17 farmers citing lower yields than top performing seed as the primary reason. This data is in line with the findings of our previous report that Fortaleza F3 is not competitive in the high-segment market and that farmer targeting still must be improved. Compared with 2018, the total 2019 NPS score for the Fortaleza brand improved 11 points (Figures 1 and 2). Fortaleza was perceived more positively in the Guatemalan Highlands (Fortaleza NPS = 73, N=11) and eastern Guatemala (Fortaleza NPS = 7, N=41), compared to the southern coast (Fortaleza NPS = 0, N=57) and northern Guatemala (Fortaleza NPS = -14, N=17).

Figure 1: Guatemala seed brand Net Promoter Score 2018

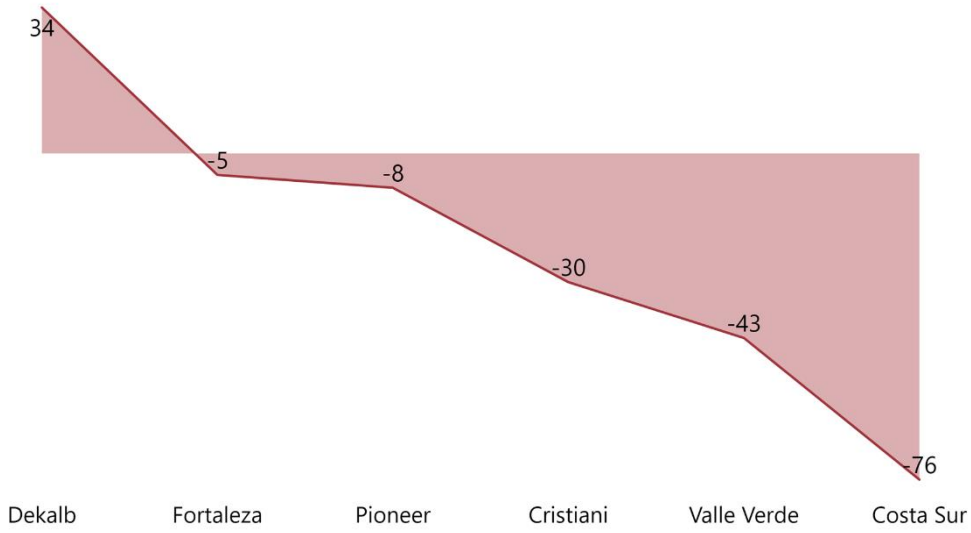
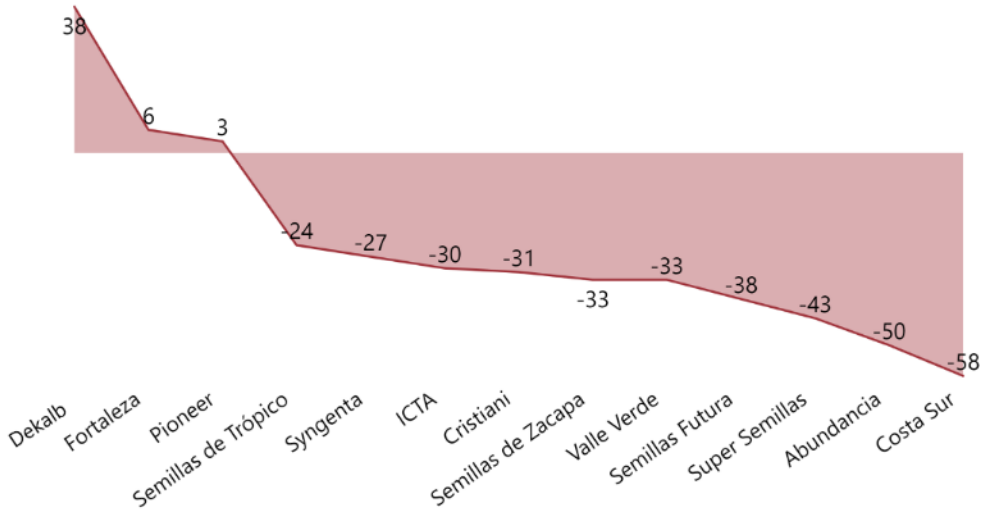


Figure 2: Guatemala seed brand Net Promoter Score 2019



This year, Semilla Nueva also reanalyzed NPS data looking only at farmers who normally purchase low and mid-segment seeds. In this group of target farmers, the NPS score for Fortaleza brand was 46 points, recognizing Fortaleza as the best brand in those segments, above even Monsanto's Dekalb brand. Farmers primarily cited good yields as Fortaleza's primary benefit over other seeds.

Figure 3: Net Promoter Score for mid and low-segment farmers

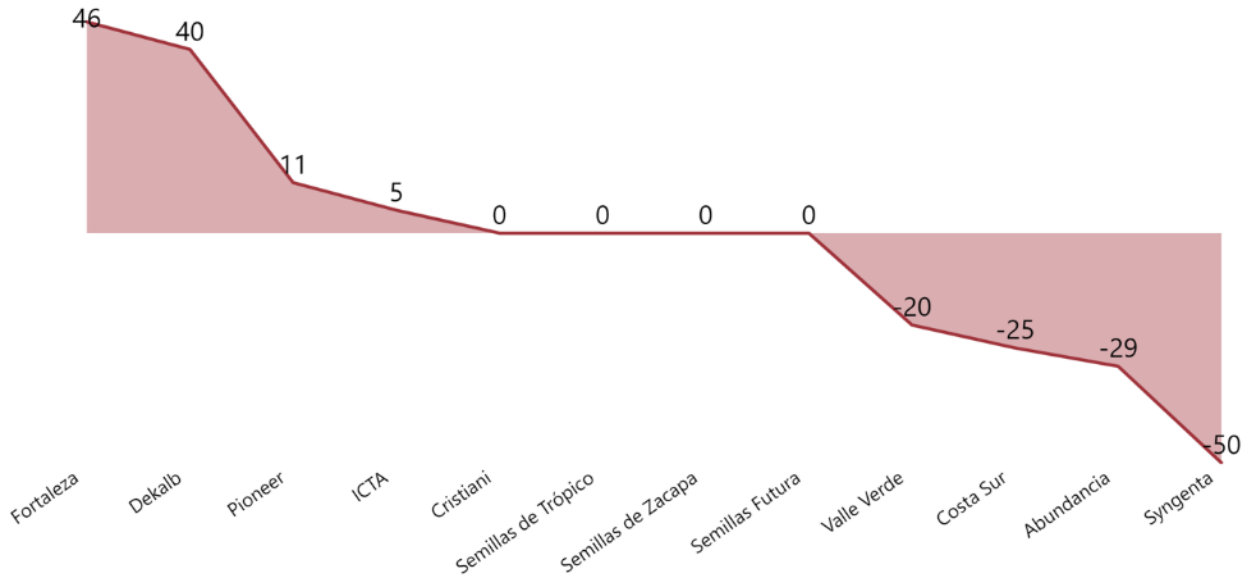
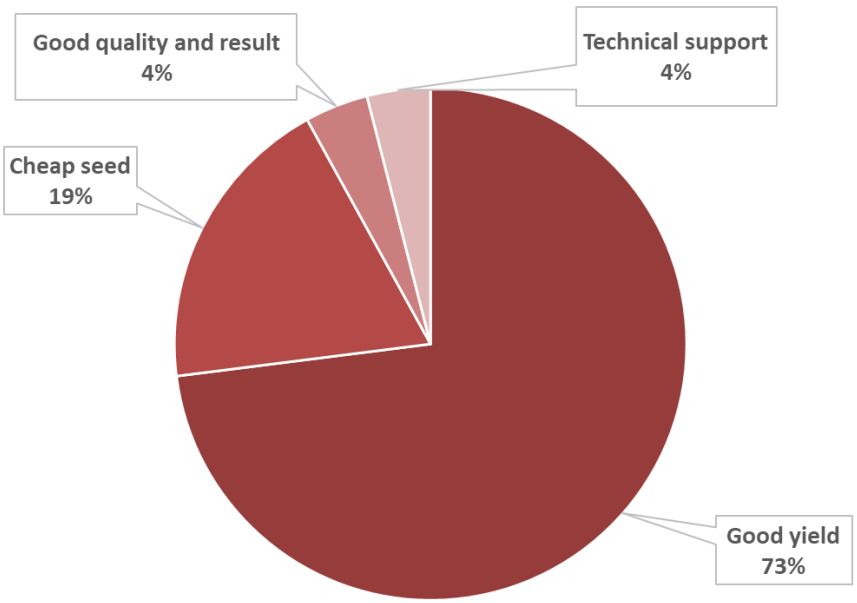


Figure 4: Primary benefits of Fortaleza seeds by low and mid-segment farmers



Penalization of grain size and color continues to be a major problem in certain regions
As discussed in depth in our January-June 2019 Standard Report, many farmers in northern Guatemala and the southern coast received lower prices from grain buyers. This problem has continued. As previously described, penalties of 4-5% ($0.67 of the $12-17 farmers are paid per 100lb sack) continue to affect farmers who sell in some of the major commercial regions during the peak periods of grain harvest. Given the excess supply at this time, intermediaries will use even small cosmetic issues to penalize farmers, even though these issues don't affect their wholesale sales later. Penalties are far less common for farmers selling their grain in local markets, tortilla shops, or during the off seasons.

Even with penalties, farmers in the low-segment may increase their incomes with F3, but for farmers in the mid-segment, the penalties can decrease profits enough to make purchase of another seed economically advantageous. While this issue does not affect sales in all of Semilla Nueva's geographies, it must be addressed with new solutions to prevent slowing potential growth. While Semilla Nueva's strategy to date has been to simply sell F3 as a normal maize seed, the organization will need to develop new strategies including those described below to compensate for this problem.

Semilla Nueva launched the "Best Tortilla" campaign to boost public perception of the Fortaleza tortilla's taste and texture
Semilla Nueva's sales team spent part of 2019 visiting farmers who had purchased in 2018 but hadn't purchased again in 2019. Farmers often fit the following profile:

1) They wished F3 yielded as much as the high segment seeds they normally purchased, and/or
2) They faced discouraging penalties from intermediaries, but
3) They universally wished they still had some Fortaleza grain, because their family missed the texture and taste of the tortillas.

Semilla Nueva's new sales coordinator seized this insight, and within a month of starting his post launched a new campaign, "Mejor Tortilla" (best tortilla). In the short-term, the campaign focused on reminding farmers across all segments that their family deserves the tortillas that taste the best. The campaign continued to highlight the economic benefits for low and mid-segment farmers, while encouraging high-segment farmers to plant a small amount of their field with F3—enough for their family's home consumption. The campaign featured events with blind taste tests with Fortaleza tortillas vs. traditional tortillas and involved both farming families as well as the staff of the leading community tortilla shops. In these public blind taste tests, many during farmer field days, 100% of consumers polled preferred F3, citing its superior taste, texture, and softness as the primary reasons for preference. Tortilla shops also found F3 dough to be easier to manage and produce more tortillas per pound of maize. Promotional materials were designed and launched at agrodealers throughout Guatemala, and new fliers and banners were launched at field days.

While it is too early to correlate the campaign with improved sales, some variant of the "best tortilla" may provide a base to move Fortaleza seeds from a product that intermediaries penalize to a product that consumers universally prefer—driving wider adoption through consumer preference rather than nutrition-based, behavior change.

Photo: Flyers used for the "Better Tortilla" Campaign.

From 60,000 seed bags to 20kg bags

Semilla Nueva's leadership and sales teams visited agrodealers throughout 2019. After the main sales season, one recommendation was constant. F3 is a small and light seed. We sell in bags of 60,000 seeds which is standard for international seed companies. As our previous standard report found, most of F3's customers (and most low-segment farmers in general), purchase seed by the pound. Our bags of seed are price competitive, but they only weigh 16-18kg, compared to 20kg for most low-segment seeds. While one bag of our seed will plant the same area as a bag of a similarly priced low-segment seed, the price per pound for seed is 30-50% higher, depending on the agrodealer. By selling seed in 20kg bags instead of 60,000 seed bags, we will drop our per pound price to within 10% of the average low-segment seed, making ourselves far more competitive among Guatemala's smallest and poorest commercial hybrid maize farmers. The leadership team has decided to follow the recommendation, and new 20kg seed bags will be launched in 2020 with a campaign targeting low-segment farmers specifically.

SALES

Summary:

- **Sales increased 77% in Semilla Nueva's second year**. We sold 2,195 bags in 2019 vs. 1,234 sold in 2018. This was a substantial increase, but short of our goal of 2,500 bags.
- **Targeting of the correct farmer segments was improved in late 2019**. These changes required changing sales staff in some regions and hiring a more experienced coordinator to lead the department.

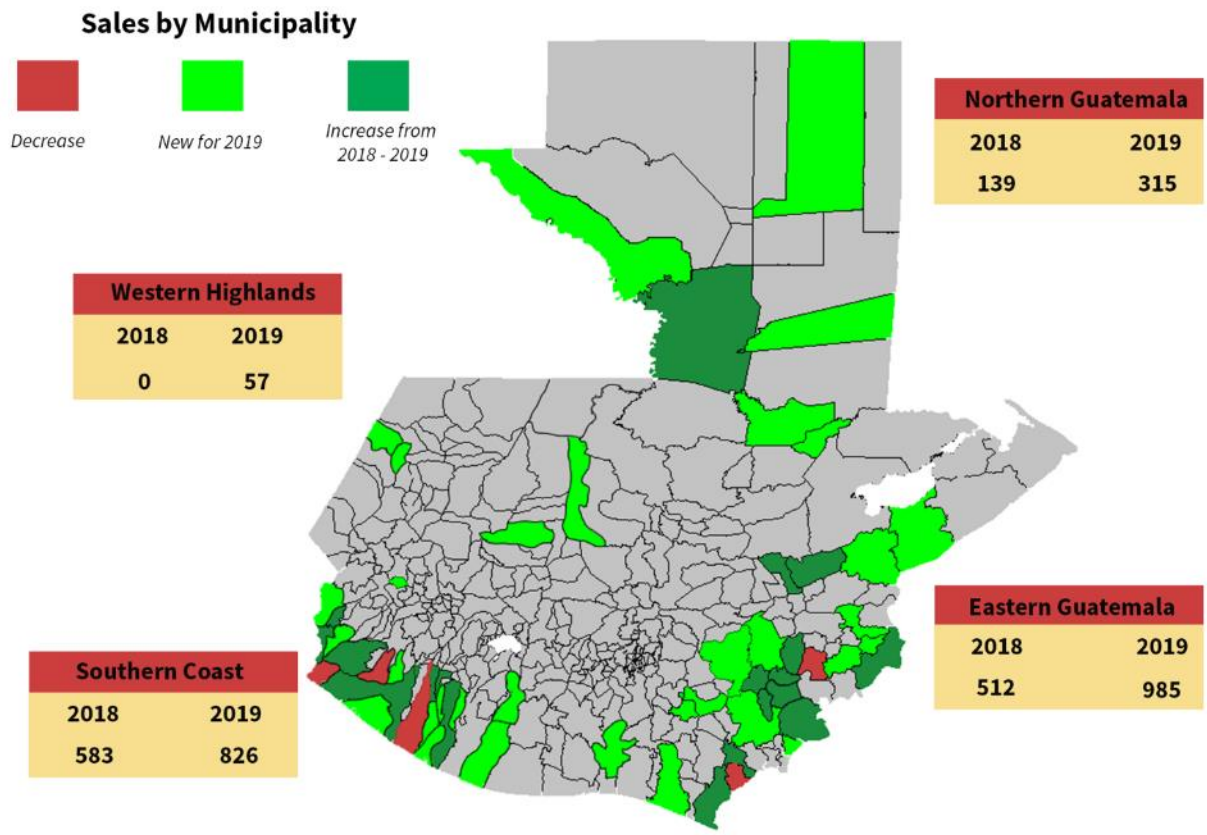
2019 Sales Results

In our second year of sales, Semilla Nueva sold 2,195 bags (2,057 bags of F3 and 138 bags of F17), representing a 77% sales increase compared to 2018. Many farmers bought F3 seed for a second time, mainly in eastern Guatemala where the seed has high performance and grain size and color were not penalized. In the southern coast and northern Guatemala, most sales were the result of farmers purchasing seed for the first time. As mentioned previously, in our first year of sales, 2018, the sales team largely targeted high-segment farmers who didn't purchase again in 2019. 2019 was also the first year of promotion and sales in the Guatemalan highlands, in partnership with the USAID Feed the Future program and the implementing organization Popoyan.

Table 2: Fortaleza seed sold from distributors to agrodealers by region 2019

	2017	2018	2019	2018 vs 2019
	Total	Total	Total	Sales increase
Southern Coast	34	583	826	42%
Eastern Guatemala	0	512	985	92%
Northern Guatemala	3	139	315	127%
Guatemalan Highlands	0	0	57	
Total	37	1234	2183	77%

Figure 5: Semilla Nueva sales (in bags) 2018 vs 2019 by region with change in sales by municipality

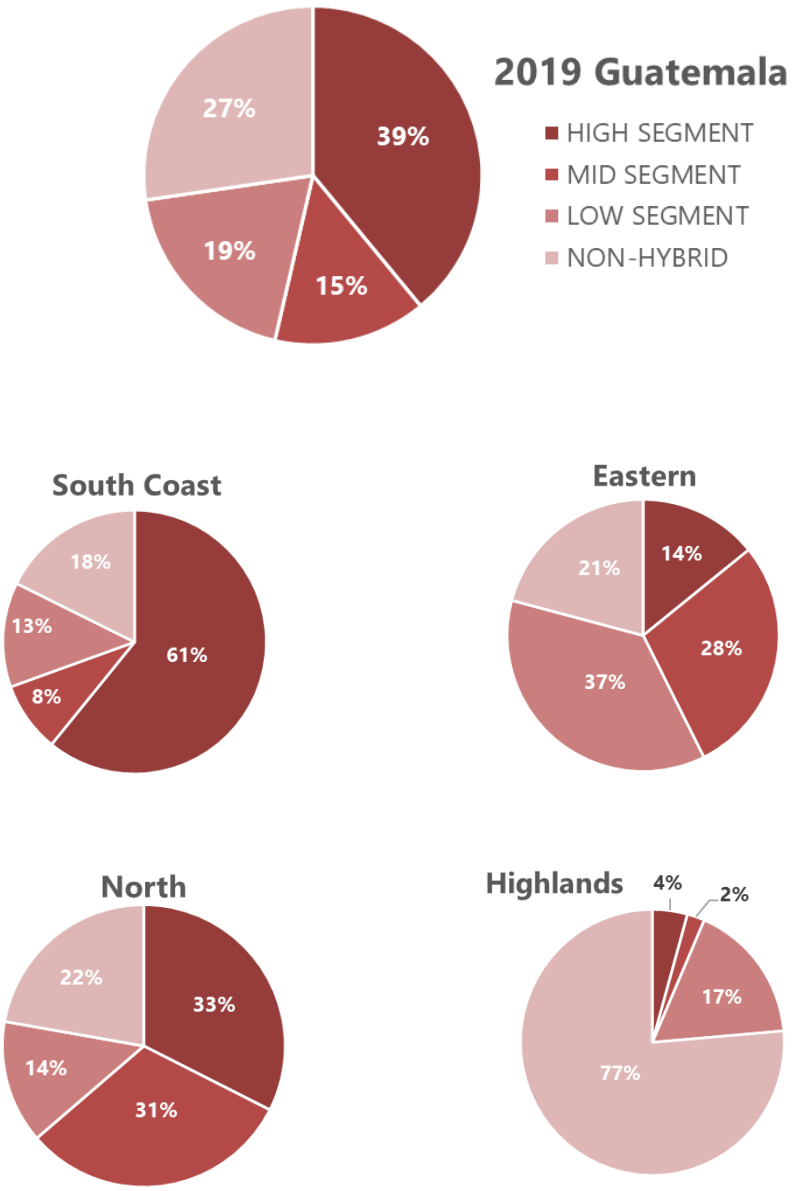


Semilla Nueva's increased sales were due partially to an increase of retail locations. In 2018, 58 agrodealers sold Fortaleza seeds. This increased to 128 in 2019. The sales team established 42 demonstration parcels and led 98 events involving 2,563 people —including 72 field days, 8 farmer meetings, 13 agrodealer trainings, 4 agricultural input trainings, and 1 tortilla shop event.

Improved farmer targeting and changes in the sales team

While sales did increase 77%, we missed our sales goals for 2019. Semilla Nueva's operations team conducted a rigorous performance evaluation to determine the causes. Ultimately, the conclusions lined up with the analysis of farmer targeting provided in the last standard report, which covers 2019's primary sales season. As mentioned in that report, and highlighted throughout this one, Semilla Nueva's primary operational challenge was targeting the farmers in the low and mid-segment where Semilla Nueva's seed provides the highest returns. While farmer targeting improved in 2019, there were major opportunities for improvement which weren't implemented. As shown below, 34% of farmers attending field days were still high-segment farmers. In the region where Semilla Nueva invested the most, the southern coast, over 60% of farmers attending promotional events, and the majority of farmers hosting demonstration parcels, were high-segment farmers.

Figure 6: 2019 Farmer attendance in Semilla Nueva events by segment in each region



Recognizing the need for improved sales leadership, Semilla Nueva in October hired a new sales coordinator with over 20 years of field experience and a proven history of success leading maize seed sales in Guatemala. Augmenting this position, Semilla Nueva contracted an M&E and marketing analyst who is improving the collection and speed of evaluation of economic and demographic data as well as market surveys.

Semilla Nueva's new sales coordinator completed his on-boarding and is leading the team restructuring and capacity building processes required to meet 2020 sales goals. The sales coordinator spent three months traveling throughout the country to assess individual sales technician performance and worked with the operations director to restructure the team accordingly. Moving forward, the sales team will be composed of five field technicians and one sales technician, all six reporting to the new sales coordinator. The field technicians will be responsible for creating the field demand and "pulling" seed from the agrostores to farmers. They will visit farmers, establish demonstration plots, organize field days, and collect data regarding yields and cost benefits of F3 and competitors. The sales technician, a new role, will be responsible for establishing a relationship with the distribution channel by "pushing" seed from the distributor to agrodealers, and the agrodealers to farmers. This new role was necessary due to the challenges faced with distributors in 2019 regarding on-time seed availability and agrostore inventory management. In 2020, Semilla Nueva will pilot this new position in eastern and northern Guatemala, with plans to extend to the rest of the country after further evaluation. This new sales structure involved replacing one field technician in the southern coast and moving a field technician position from the southern coast to eastern Guatemala, where we have more sales opportunities. In preparation for 2020 sales, the sales coordinator will focus on improving market segmentation, farmer relationships, quality control for demonstration plots, and inventory management – the key performance areas identified for improvement during the previous season. He and the operations director will work closely together to leverage the ongoing and improved marketing data to continue to refine team structure and capacity to meet consumer needs.

RESEARCH AND DEVELOPMENT

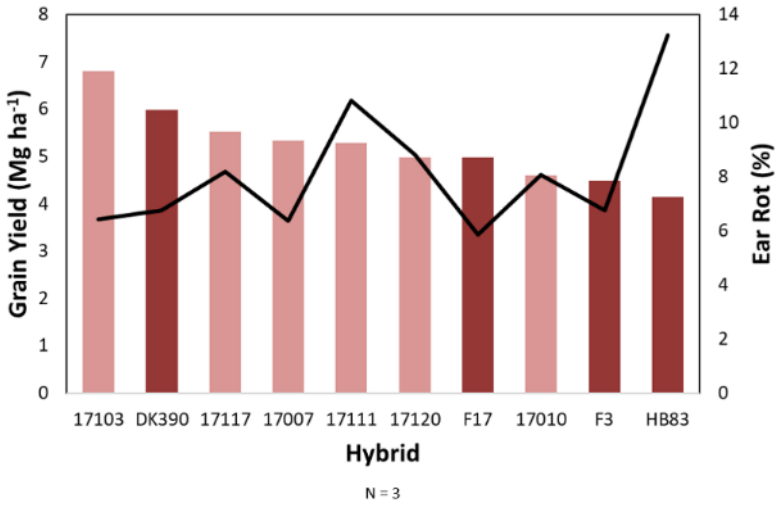
Summary

- **Two new higher yielding seeds identified.** Semilla Nueva established a more rigorous seed evaluation program. Two potential seeds were discarded. Two other, high-yielding, biofortified seeds were selected for continued testing (potential commercial launch in 2022).
- **Semilla Nueva's backcross breeding program is halfway through its first cycle. Seeds with 20-35% higher yields could be ready for testing in 2022.** This program will enable a continuous flow of new, improved biofortified seeds and allow seeds to be developed for other countries. Its first major proof of concept will be nutritional testing of 10-16,000 new seed lines in summer 2020.
- **Semilla Nueva's nutrition lab is set to launch in February**. Using technology from the USDA, Semilla Nueva is establishing a lab with INCAP, Central America's leading nutritional think tank and research group. The lab is set to launch in February and begin its first testing in March. The lab will greatly improve Semilla Nueva's quality control and M&E programs.

Semilla Nueva's new seed evaluation program

Semilla Nueva's operations director ran a regional seed evaluation program for an international seed company before coming to Semilla Nueva. Under her supervision, Semilla Nueva's program was revamped. Two potential seeds which had been previously identified were discarded due to problems with ear rot and disease susceptibility. Based on a new agreement signed with the International Maize and Wheat Improvement Center (CIMMYT), mentioned in the January-June 2019 standard report, additional new seeds were identified for testing. After trials in May – November 2019, two seeds passed the initial screening, and a second round of trials began in December 2019. These two promising hybrids, (code 17103 and 17117 in Figure 7) showed far higher yields than low-segment seed HB83 or our F3; the yields are close to the most popular high-segment seed, DK390. It is important to note that 17117 is a biofortified seed with higher levels of protein quality and zinc, while 17103 only has higher levels of zinc. Both seeds will be analyzed for nutritional content in early 2020. Farmer trials may begin in 2021 and an initial commercial pilot in 2022.

Figure 7: Guatemala Validation Trials – Main Season 2019. Bars correspond to yield, line to ear rot.



Maize Breeding Backcross Program

Semilla Nueva's research partner, CIMMYT, has developed hybrid maize seeds with yields 20-35% higher than F3. Unfortunately, these seeds aren't biofortified and don't have higher nutrition levels. In July 2019, Semilla Nueva launched its new backcross breeding program. Backcrossing involves taking seeds with traits that are desirable, such as yield, and uses conventional breeding techniques to introduce another desired trait, like nutrition. Our backcross involves a high-yielding "recurrent parent" line with good agronomic potential and a biofortified QPM/zinc "donor" line, which has the nutritional components that we seek, but isn't as high yielding. Through this process Semilla Nueva will develop new seeds which keep the good agronomic and yield characteristics of the original recurrent parent while adding the nutritional qualities of the donor line. Semilla Nueva's backcross plan involves planting, pollinating, and harvesting six generations of seeds before forming experimental hybrids to test. The third and sixth generation involve nutritional analysis on thousands of experimental lines. Semilla Nueva is currently backcrossing four high-yielding hybrids, each with 20-35% higher yields than F3 and other positive traits such as disease resistance.

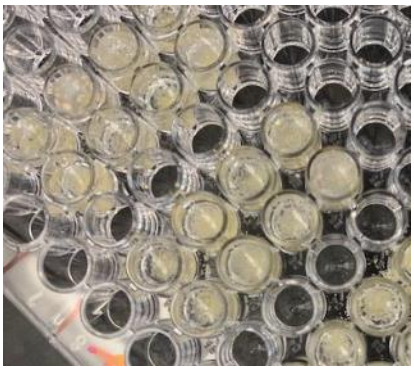
The first generation was planted in July 2019, and the second followed in November 2019. This second generation will be harvested at the end of February 2020 and immediately replanted. The third generation will consist of 10-16,000 plants, each with a unique set of genes. Of these, 90% will be discarded after harvest using light tables, and the remaining 10% will be tested in our new lab. Of these, we expect approximately 16-30 seeds will be selected that maintained all the nutritional traits, but also now possess 75% of the genetics of their original recurrent parents. Reaching these final seeds is the first major milestone of the Semilla Nueva breeding program. This full process would be repeated once more before forming new hybrid seeds ready for testing in Guatemala.



Photos: controlled pollination of 2nd generation, January 2020

Launch of Semilla Nueva nutrition lab

Semilla Nueva's senior research consultant began work in July 2019 and focused on establishing a lab for 2020's anticipated nutritional testing. Semilla Nueva had already identified a methodology for testing protein quality with Dr. Paul Scott at the USDA-ARS research station in Ames, Iowa. Semilla Nueva's research consultant completed an in-depth study of the lab protocol, machinery, and methodology and visited the lab in Iowa in July and September.


Photos: USDA-ARS amino acid lab, Ames, Iowa, USA

After understanding the laboratory requirements, it was determined that the Semilla Nueva office could not host the lab without significant renovations and hiring new staff. Semilla Nueva instead approached the Institute for Nutrition for Central America and Panama (INCAP), Central America's leading nutrition think tank, laboratory, and policy advocate. Semilla Nueva proposed to provide startup funding, all equipment, and pay at cost for staff time and utilities related to analyzing Semilla Nueva samples, with priority treatment during Semilla Nueva's highest evaluation periods. INCAP, located in Guatemala City, will use the equipment to provide services to other organizations at a profit the rest of the year. After three months of equipment review, protocol development, and costing, the agreement is set to be signed in February.

In February, the lab will be calibrated with existing maize samples with known amino acid levels. In March a pilot sample of backcrossed maize lines will be run. Processes will be streamlined so that in July, we will be ready to process between 2000-4000 samples. Using third party providers, these samples could cost up to $225,000, but using the new methodology it will cost $10-15,000. Additional funds are being sought to incorporate zinc analysis as well as hire a full-time breeder to scale the program.


Photos: Semilla Nueva lab preliminary setup at INCAP, Guatemala City

Ultimately, Semilla Nueva's current seed, F3, may be able to reach up to 20,000 families in Guatemala (up from more than 4,000 in 2019). Reaching a significant portion of the other

130,000 Guatemalan families who buy seed, reaching enough to change the national nutritional intake of the population, will require better seeds. While Semilla Nueva will continue to grow in the coming years with its current seeds and new ones coming from partners, continued growth, getting other companies to adopt, and policy change will all require high the ability to quickly convert attractive not-biofortified seeds, to become attractive biofortified seeds. This will quickly become one of Semilla Nueva's critical core competencies.

COLLABORATIONS

Summary

- **Three cooperatives produced and sold 704 bags of biofortified seed this year, reaching 70% of their goals**.
- **Growth will require additional resources for promotion and higher yielding seeds.**
- **The cooperatives will focus in 2020 on lower yielding but cheaper to produce open-pollinated biofortified seeds**, in order to complement offerings from Semilla Nueva.

Table 3: Production, Sales, Remaining Inventory by Cooperative

Bags (60,000 seeds)	ATESACATEL	APALH	ASOPRAE	Total
ICTA HB-18 production goal	400	400	200	1,000
ICTA HB-18 production achieved	547	317	116	979
ICTA HB-18 sales goal	400	400	200	1,000
ICTA HB-18 sales	308	317	82	704
ICTA HB-18 inventory remaining	240	0	34	274

ATESCATEL and APALH have set goals to sell approximately 1,200 bags of seed in 2020. ASOPRAE may continue sales, but had significant challenges in seed production in their zone, and may sell seeds in their area produced by ATESCATEL and APALH. The cooperatives decided internally that given Semilla Nueva's strong sales presence in the area, they would focus on lower yielding open-pollinated varieties, ICTA B-9 and ICTA B-15, which have 10-20% lower yields than F3/HB-18, but are far easier to produce and would grant them a niche in the market not covered by Semilla Nueva. Both organizations valued having a unique product over selling the same seed as Semilla Nueva under a different name. They cited that previous generic seeds were launched only after gaining larger market acceptance and large campaigns by the Guatemalan government—and neither cooperative possesses the resources, experience, or infrastructure to brand a seed themselves. They also requested that instead of technical assistance from Semilla Nueva in production and sales, that funds be sought to help them build their own seed promotion capacities, which Semilla Nueva has prioritized in grants being pursued currently.

As mentioned in the previous standard report, new and higher yielding biofortified seeds were recognized by both cooperatives as critical to further expanding their sales. They are interested in participating in Semilla Nueva's R&D program and testing and launching new seeds as they become available.

IMPACT EVALUATION

Summary

- **Yield data from farmers verifies our controlled tests**: F3 has higher yields on average than currently available low and mid-segment seeds, but economic impact was diluted by farmers planting smaller areas than expected.
- **Can Semilla Nueva seed become a tool for livelihoods interventions with subsistence farmers?** Initial data show that subsistence farmers who switch from traditional non-hybrid seeds to F3 can double their net incomes. 27% of the farmers who participated in our 2019 field days fit this demographic—and we have yet to study their adoption.
- **We reached a conclusion why F3 has lower protein quality than expected, and we are working on a fix**. In our last report we informed that while zinc and iron levels were higher in F3 than expected, protein quality was lower. We have now identified the source of the lower levels and are working to increase them again.
- **Version 1 of our ex-ante model focuses on decreasing zinc deficiency and commercial farmers.** If all farmers using commercial seeds adopt F3, 40% of total zinc deficiency among Guatemala's children under five would be eliminated. Version 2 of this model will expand to impacts of adoption of commercial farmers of biofortified seed on iron and protein deficiencies. In addition, it will begin to look at the nutritional impacts of different levels of biofortified seed adoption by Guatemala's 600,000 subsistence maize farmers.

F3 economic impact for farmers

In Semilla Nueva's controlled yield trials, we confirmed that F3 yields less than expensive high-segment seeds, but on average provides better returns than the mid and low-segment seeds that 60% of farmers purchase. In 2019, we surveyed farmers who planted seeds from the mid and low-segment, as well as F3. To qualify for the survey, both plots had to have received the same inputs, be on similar quality land, be planted the same date, and Semilla Nueva field technicians had to be present for harvest.

Economic impacts were then calculated based on farmers planting 0.49 bags of seed (the amount reported in our January-June 2019 Standard Report based on surveys of agrodealers). This is far less than Semilla Nueva's original estimates. Originally we assumed families would buy approximately one bag. Now we know our sales are reaching slightly more than double the number of farm families we originally estimated. While this means that the same number of bags sold is improving the nutrition of far more farming families, it also means these families are planting less area and earning less additional money each than anticipated. Correlating this data with sales prices, seed prices, and the average amount of F3 seed that farmers are buying and planting nationally indicated that on average, farmers in the low-segment earned $33.26 more with F3, and farmers in the mid-segment made $72.06 more with F3. These numbers should increase as farmers plant more of their land with the seed. A breakdown of this data comparing F3 to each competing seed is provided below.

Table 4: Economic benefits of F3 compared to mid-segment, low-segment, and non-hybrid seed assuming 0.49 bags purchased

Segment	Non-biofortified seed	Savings on seed ($)	Additional maize produced ($)	Net economic benefit ($)
Mid	HS-23	8.3	51	59.0
Mid	JC-24	6.0	-52	-46.4
Mid	Tropical Max	9.2	-28	-19.0
Mid	HR-245	11.5	179	190.2
Low	HB-83 Bonanza	-3.3	28	24.9
Low	HB-83 Pujanza	-4.2	54	49.9
Non-hybrid	"Cargill"	-20.8	584	563.7
Non-hybrid	"Chimbo Amarillo"	-20.8	767	746.6

Results above on the impact of farmers using non-hybrid seeds should be taken with caution. These are the first side-by-side trials under farmer conditions we have done, and are based on only 3 locations. We estimate that future field results may be closer to $200/family, which may still double subsistence farmer agricultural income. Converting subsistence farmers to hybrid use will not be an easy task, and Semilla Nueva will explore alliances to effectively reach this farmer demographic without ourselves creating the significant and expensive organizational structure to convert farmers to hybrids.

Lastly, it is important to note that penalties from intermediaries also represent a threat to the economic impact of our model. Over 2020, we intend to significantly increase the number of farmers surveyed and begin to develop regional and national estimate for the impact this problem is having on farmers using F3 seed.

Nutritional quality—why were amino acids levels lower than we thought?
As mentioned in our previous standard report, Semilla Nueva ran into our first quality control issue in 2019, when amino acid levels were lower than expected in the grain that farmers harvested. Zinc levels were higher than expected, and Semilla Nueva also discovered that our seed produces grain with higher levels of iron, which hadn't been reported before. Amino acids, however, were still higher than normal maize, and our scientific partners have explained that the observed levels still qualify F3 as a Quality Protein Maize, but they are lower than Semilla Nueva expected.

After a rigorous review, these lower amino acid levels were found in Semilla Nueva's original parental seed, in new parental seed recently sent from our technical partner CIMMYT, as well as in their stock of parental seed. This implies that amino acids may have lowered between the higher amino acid seed CIMMYT originally sent us to test before we launched our F3 program (seed received 2015-6 and tested in 2017), and the parental seed they sent us to begin the commercial program (seed received in 2017, tested in 2018, and results received in 2019). CIMMYT explained that this could have happened because donor focus has been on micronutrients like zinc, but not on protein quality—meaning their internal quality control efforts weren't focused on this nutrient during their seed production processes.

Working with CIMMYT, we came up with a plan to attempt to raise the amino acid levels to the original levels. Given that our testing showed that the seed originally had higher amino acids, our populations of seed may have some grains with lower levels, and other seeds with the original higher levels. The genetic contamination that reduces amino acid levels often correlates with seed opaqueness and can be detected with a light table, so Semilla Nueva constructed several light tables and began a project to clean our parental seed and then produce a new purer population for testing and production. The process is ongoing, and initial results will be reported in 2020.

Photo: Cleaning seed with a light table involves examining each seed for the desired opaqueness

Our most important take away is that Semilla Nueva needs to develop its own nutritional testing capacities and test seed at every stage of seed evaluation and seed development. Semilla Nueva's new nutrition lab in collaboration with the INCAP, mentioned in the R&D section, will provide the ability to continuously test all our seeds in evaluation and production at 5-10% of the cost of our previous testing. Also testing will be done in a matter of weeks, instead of the 3-6 months it has taken us to send samples to Mexico and get results.

Ex-ante model—to what point can we improve Guatemala's national nutrition?
Semilla Nueva's program was founded on a strong body of scientific research showing that farming families who grow and eat biofortified maize reduce stunting levels among their children. Then, we started to get more ambitious. Maize Is the staple of Guatemala's poorest populations, and most of the poorest of the poor are landless and buy the majority of the maize they consume. This maize Is produced by the small commercial farmers our program serves.

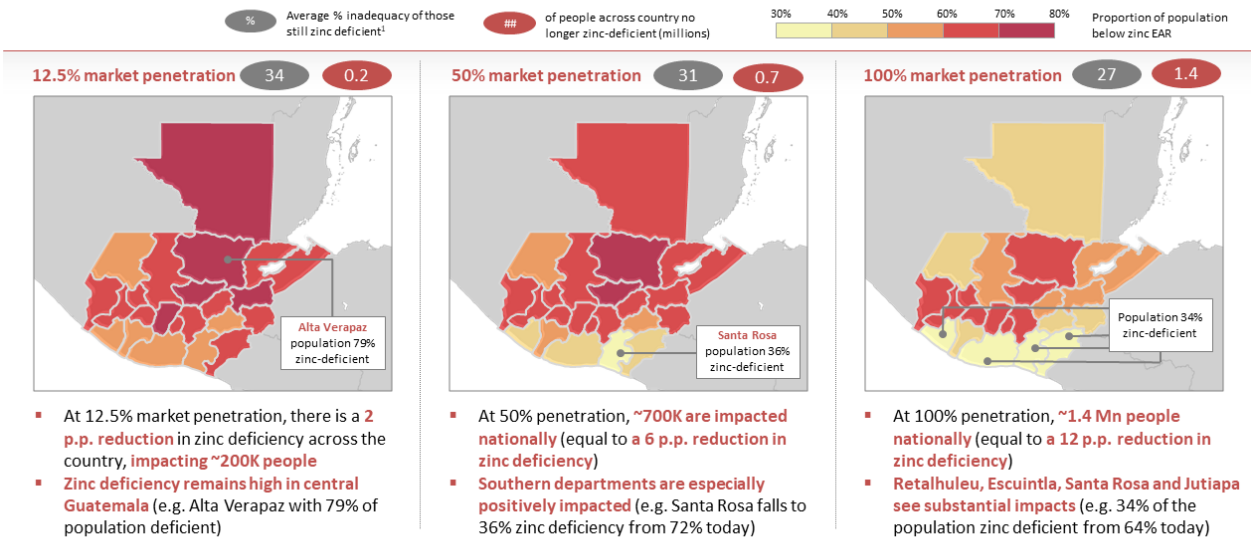
While improving farming family nutrition is great, Semilla Nueva worked throughout 2019 to answer a really big question: —*how many farmers* have to sell *how much biofortified grain* which gets eaten by *how many malnourished people* before our seeds start to improve the nutrition of the Guatemalan population as a whole?

Semilla Nueva worked with Dr. Jack Fiedler, who pioneered this modeling for biofortified crops at the International Food Policy Research Institute (IFPRI) and Harvest Plus. Under his guidance, our M&E coordinator worked with the Guatemalan government and INCAP to access Guatemala's Home Consumption and Expenditure Surveys. These representative national surveys of over 10,000 households provide a geographically representative database of the foods that families are growing, selling, buying and eating. The first version of our model used this data to model the Guatemalan diet, zinc deficiency in different areas and demographics, and then maize production, sales and purchase throughout the Guatemalan population. Then using geographic and demographic data, we developed a likely adopter model which determined which of these farming families are purchasing seeds currently, and which would be the first, and the last, to adopt our seed. Integrating these models together provides a detailed analysis of the current deficiency of zinc and the impacts that different levels of commercial farmer adoption would have on farming families and consumers throughout the country.

Version 1 of the ex-ante model is a preliminary proof of concept. It only focuses on one nutrient, only focuses on the improved zinc levels in our current seed, doesn't take into account higher yields for F3 farmers or future seeds SN plans to launch, and only looks at adoption for farmers who already purchase seed. As such it is a highly conservative. The second version will expand to model the impacts of enhanced protein quality and iron, begin to examine the impacts of higher yields, and look at the national nutritional impacts of different adoption levels by subsistence farmers.

Ultimately an ex-ante model is a strategic tool. It will let us know what degree reduction in population wide nutritional deficiencies can come from varying levels of commercial adoption or varying levels of subsistence farmer adoption. By knowing this data, we can decide where to concentrate our policy efforts. It can also help guide us on seed development, optimizing between concentrating on developing seeds that are more nutritious than F3 (depth of impact) vs. seeds that will be more widely adopted (breadth of impact). Instead of devolving into philosophical conversations on values, we can plug the numbers into the model to see the nutritional results of different options and scenarios, allowing us to shape our strategy in the most evidence based way possible. With that said, the maps below represent our preliminary findings of our initial first version of the model:

Figure 8: Ex-ante V1 overview, impacts of biofortified adoption on zinc deficiency



The above graphic represents the basic findings of the model to date. Increasing levels of marketshare will move large segments of the Guatemalan population from zinc deficiency to sufficiency and decrease the zinc gap for populations that are still deficient. At 12.5% market penetration (the equivalent of 18,000 bags sold), 200,000 people will move out of zinc deficiency, while the population that is still zinc deficient will see a 6% reduction in their dietary zinc gap. If 100% of Guatemala's commercial seed becomes zinc biofortified, 1.4 million people will become zinc sufficient, the 44% of children under five years who are currently zinc deficient will drop to 34%, and the gap of those still deficient children will decrease from 32% to 22%. Combining the impact of children leaving deficiency with the reduction of the zinc gap in children still deficient leads to a 40% total decrease in the zinc deficiency among Guatemala's children under five.

Can Semilla Nueva's first seed, F3, end chronic malnutrition in Guatemala based on its high zinc levels? The answer is no. Semilla Nueva has never sold our program as the only answer to chronic malnutrition. Chronic malnutrition is one of the most challenging problems in international development because it is multicausal. Major advances must be made in both filling nutritional gaps in the diet of marginalized populations as well as improving hygiene, access to clean water and other causes of childhood infection. The strength of this ex-ante analysis, however, is that it allows us to: 1) provide a ballpark estimate to determine if our solution is worth continued development, 2) begin to tweak our model and goals from the outset in order to optimize our outcomes, and 3) develop a framework with which to compare this solution with other alternatives.

From the above analysis, we draw the following conclusions:

1. Large scale adoption of biofortified seed with higher zinc levels is a worthwhile goal. Our team, policy advisers and nutrition experts are unaware of any other major intervention which could achieve similar reductions in zinc gaps among Guatemala's poorest

populations at so large a scale. Ultimately zinc-biofortified maize can't be the only solution, but it may be the best currently available solution--and the most cost-effective.

2. Public policy change is warranted. Semilla Nueva will never reach 100% market penetration, but public policy can move the broader seed industry in this direction. This model both shows the necessity and justification for policy change.

3. We need to improve the ex-ante model. Neighboring El Salvador has converted nearly all of its subsistence farmers to hybrid seed through training and publicly-funded seed distribution programs, and has maintained this program for over a decade. If Guatemala launched similar policies, but did so with biofortified seed, what would be the impact? What additional reductions of nutrients gaps could be had by 10%, 20% or more of subsistence farmers being provided improved biofortified seeds?

Semilla Nueva Is continuing to develop the model, and over the course of 2020 hopes to answer these questions, and others. We will begin analysis on iron and protein quality, subsistence farmers, higher yields, and other factors. Ultimately our M&E program will provide much of the data that will feed this model and sharpen its accuracy. We also hope to work with our staff and the local and International experts who have helped develop the model to publish it, and lead events in Guatemala to promote its findings.

Figure 9: Estimated numbers of families planting biofortified maize provided by Semilla Nueva and its collaborators

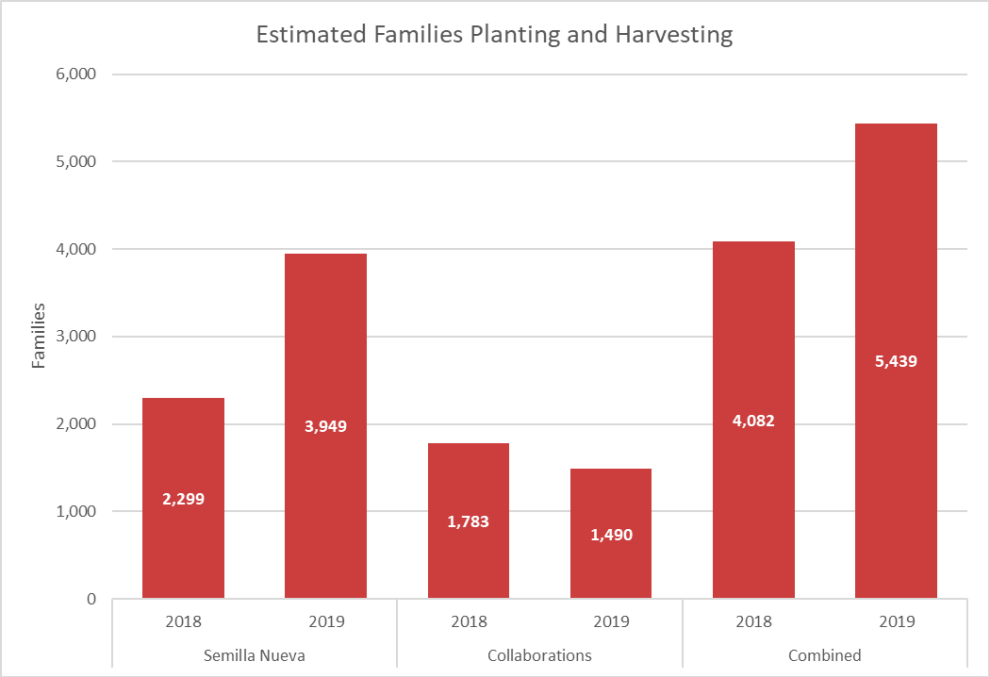
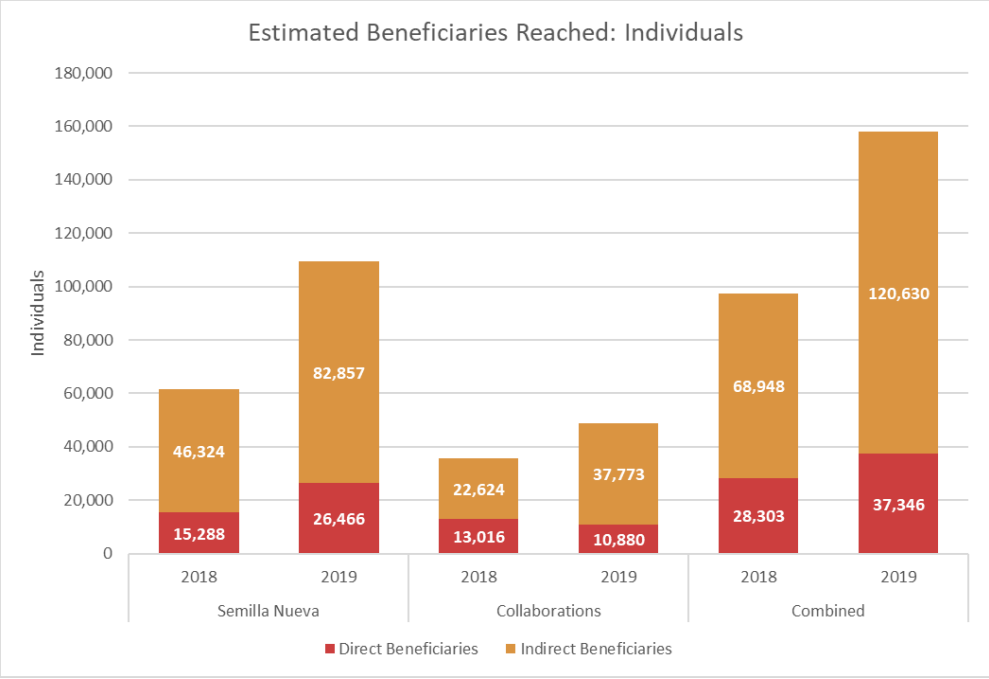


Figure 10: Estimated numbers of beneficiaries reached with more nutritious maize grain produced with seed sold by Semilla Nueva and its collaborators



DEVELOPMENT

Semilla Nueva hired a new program and development manager in August, 2019. She joined the team after five years at Last Mile Health where she managed advocacy and policy, including bilateral and multilateral engagement. She is prioritizing new award management, reporting systems, and an improved partner engagement strategy for 2020.

Over $590,000 in funding was secured in the past 6 months including 1 new partner, 4 renewals, and end of year grassroots support.

Semilla Nueva received renewals from:

- The Harbourton Foundation - A long standing partner supporting Semilla Nueva's operational growth, the Harbourton Foundation provided critical bridge funding to compensate for the unexpected elimination of US government funding for Guatemala.

- Conservation Food and Health - Providing its largest award to date in its partnership with Semilla Nueva, The Conservation Food and Health Foundation is supporting core operations, with a focus on seed production, sales and marketing.

- Swiss Re - The Swiss Re Foundation provided a two-year renewal, with funds specifically allocated to strengthen Semilla Nueva's capacity for sales, monitoring and evaluation, seed evaluation, and business planning to decrease long-term philanthropic needs.

- Miracles in Action - One of Semilla Nueva's longest funding and thought partners in Guatemala, Miracles in Action provided critical end of year funding which will support hiring for key positions in sales and leadership.

Open Road Alliance: The US administration cut all funding to Guatemala in April 2019 and four projects in various stages of development were canceled. In addition, one contract had its current funding reduced and could be ended prematurely. Semilla Nueva was awarded complementary, emergency funding from Open Road Alliance, a high impact foundation that provides immediate funding to organizations facing unexpected roadblocks. We are grateful for Open Road Alliance's agile and critical support.

Field Visits: Semilla Nueva was grateful to host field visits for two partners. Representatives of its long-standing partner, The Inter-American Foundation visited production farmers in November and learned about their experiences working with Semilla Nueva to produce seed needed for the upcoming sales season. Semilla Nueva hosted the Light a Single Candle Foundation in December. The team was able to visit the experimental farm and farmers in the Southern Coast to explore support for Research and Development opportunities.

GLG: Curt Bowen was awarded the GLG Social Impact Fellowship in recognition of Semilla Nueva's leadership in the social entrepreneurship space. The fellowship provides pro-bono access to GLG's consulting platform and offers Semilla Nueva the opportunity to speak with a large number of top experts across diverse fields from seed breeding to fundraising. Semilla Nueva is using this opportunity to improve research programs, administrative policies, and strategic planning decisions.

Upcoming: Semilla Nueva will attend the events surrounding Skoll World Forum in March 2020. This is a key opportunity to connect with existing and potential partners. Semilla Nueva welcomes connections and opportunities to be made at Skoll. Please email kateylinskey@semillanueva.org if you'd like to connect at Skoll or have suggestions for our engagement.

This second semester report mentions only the new funding received between July and December 2019. However, Semilla Nueva is grateful for all our supporters and partners who have helped create new programs and grow the organization to where it is today.

FINANCE / ADMINISTRATION

Summary

- **USAID partnerships have led to far more robust financial and administrative controls**, creating a need for increasing the department staff over the course of 2019.
- **Semilla Nueva passed an in-depth external audit.** We're preparing for a second audit geared towards international donors, and we enrolled with Guatemala's Superintendence of Banks.
- **Significant progress has been made in creating Semilla Nueva as a hybrid organization, with a non-profit owning a subsidiary for-profit organization**. We hope to finish this transition in 2020, but there are challenges due to changing and complicated Guatemalan laws, as well as donors who only want to support their specific activities in only one of the two entities.
- **2019 expenditures were 100.04% of 2019's budget**. We apologize for the discrepancy.

USAID Partnerships

Semilla Nueva signed two USAID-funded projects in the first quarter of 2019.

- **Feed the Future Partnering for Innovation – FINTRAC:** This two-year partnership required detailed new financial and administrative tracking systems and detailed quarterly accounting of leverage. All systems have been implemented successfully with no report modifications or post-facto negotiations necessary. This project includes funding for implementation of an integrated inventory and accounting system, which will be implemented in 2020. The new system will represent a critical investment to improve departmental efficiency and decrease reporting time.

- **Feed the Future – PRO-INNOVA – Popoyan:** This partnership has required significantly more resources, including tracking of all staff time by the hour corresponding to detailed reports on outputs and project contribution per person. Each quarterly report has undergone significant reviews of 4-6 weeks with multiple rounds of questions and renegotiations. Semilla Nueva's staff created a 32-page MOU to clarify all accounting calcuations. Overall two new positions were hired to meet increased administrative requirements. While this process has proved challenging, the investment will create the systems to prepare Semilla Nueva for larger partnerships with bilateral funders in the future.

External audits and certifications

Our partnership with the Inter-American Foundation started in 2014 and includes external, third party audits every 1-2 years. Last November, we received an audit for the period February 2018 to July 2019. We are very glad to share the outcome with zero findings. Results from the IAF's audits have led to IAF staff commenting on our administrative and financial controls as exemplary for organizations of our size.

Semilla Nueva is also preparing for a second third-party audit. The Inter-American Foundation audit normally focuses exclusively on Guatemalan law and best practices. Our next audit will amplify the scope and prepare a report for all our international donors.

Lastly, based on previous recommendations from the Inter-American Foundation, Semilla Nueva's Guatemala-based NGO enrolled in the Guatemalan Superintendence of Banks under their program with the Financial Action Task Force. Enrollment protects Semilla Nueva from

long-term legal liabilities related to money laundering and terrorism. The process required a compliance manual and risk assessment process, as well as restructuring of administrative and operational processes. New systems will also require Semilla Nueva to provide due diligence forms to new donors providing funding to the Guatemalan NGO directly in order to prevent money laundering and terrorism financing.

From NGO to hybrid

Semilla Nueva made significant process in building our hybrid structure. Semilla Nueva launched a subsidiary for-profit company owned 99.999% by our non-profit (Guatemalan law requires companies to have more than one owner, and a former board member holds 1 share). This move was necessitated both by Guatemalan legal requirements as well as donors who would only support for-profit social enterprises. The subsidiary company was launched in February. Seven sales, marketing, and administrative positions were moved to the new organization between May and August, a new budgeting and accounting system was introduced which separates all planned and executed costs, organizational guidelines were established in the accounting department to prevent mixing funds, and staff were trained in new requirements.

Challenges remain. Several donors have both strong preferences and policies which only allow their funding to be spent within an NGO or a for-profit structure. Reconciling donor requirements with creating a clean and logical break between the two organizations has proved difficult and prevented consolidating the new structure fully. Semilla Nueva is expanding procedures that govern the relationship between the nonprofit and seed company entities as they currently operate, while simultaneously preparing to move remaining relevant personnel and activities to the seed company. A timeline is also being prepared with Guatemalan legal counsel for how to manage the ongoing process in accordance with Guatemalan law and guidelines, including provisions.

We want to give special thanks to the Mulago Foundation for connecting us with other leading social enterprises which have dealt with similar issues and provided very useful insights. We also owe a thanks to GLG, for sponsoring a number of legal and financial experts in Guatemala to create a thorough and clear division and relationship between the organizations.

Budget vs Actual 2019

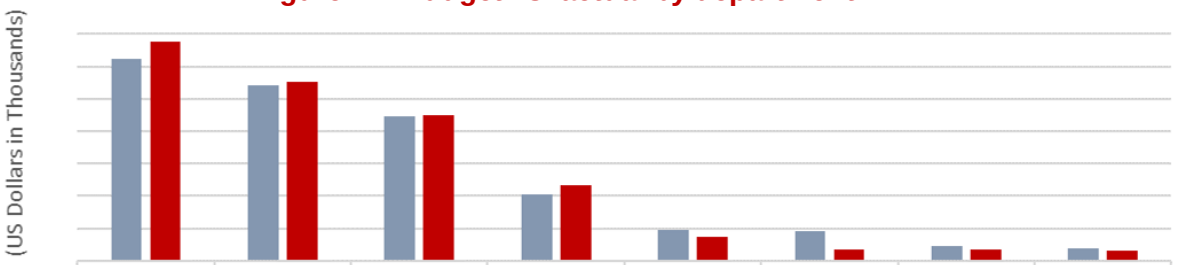
Budget execution continued to closely follow Semilla Nueva's overall budget, with 100.04% execution and minimal variance at the departmental level.

Table 5: Historic budget vs. actual

SEMILLA NUEVA BUDGET VS ACTUAL (IN US$)

Year	Budget	Actual	% of Execution
2016	376,953	392,602	104%
2017	599,674	586,371	98%
2018	784,273	759,033	97%
2019	1,042,847	1,043,239	100%

Figure 11: Budget vs. actual by department



	Production	Sales	Administration	Development	Monitoring & Evaluation	Collaborations	Marketing	Experimental Farm
Budget	312	270	223	103	48	46	22	19
Expenditure	338	277	226	116	36	17	17	16

Figure 12: Semilla Nueva Organizational Chart, Dec 2019