



Semilla Nueva Standard Report Second Semester July – December 2023

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LETTER FROM THE DIRECTOR

We say this every year, and it's true every time—Semilla Nueva is entering our most exciting phase yet. We have always known that the key to scaling biofortified maize seeds would come down to two main drivers:

- 1) Make it cheap to make any seed biofortified,**
- 2) Get governments to pay for effective seed subsidies.**

In 2023, we laid the groundwork to begin working on both of these strategies.

To advance our work in seed development, we signed a collaborative agreement with the University of Wisconsin to begin our first gene editing project to improve the nutrition of maize seeds. This is only the beginning of what will be a multi-year endeavor, but it's the first step to radically reduce the cost and time to make any seed biofortified. We are now working with the world's cutting-edge technology and leading scientists, three to five years earlier than we thought possible.

We're also hopeful about setting up our first government-managed subsidy in the very near future. We are close to launching a three year project with USAID to build a trust fund in a Guatemalan bank, managed by seed company partners and the Guatemalan government to implement our seed subsidy program. We are combining this effort with the launch of a new seed brand that will cover all companies' biofortified seeds, and efforts to bring Guatemalan congresspeople to see farmers in their districts who benefit from the subsidy.

Other exciting results include:

- 1) We increased the number of farmers using our seed from 20,505 in 2022 to 24,678 in 2023
- 2) Close to a million people in Guatemala are eating our nutritious maize
- 3) Our two impact studies showed farmers making \$123 and \$212 more in farm profit (a 34% and 115% increase, respectively)
- 4) Our first randomized controlled trial (RCT) on the impact of our maize on the biological status of children and women has shown positive initial results
- 5) We have nutritious seeds in development that will be able to compete with the best seeds in the local market
- 6) Thanks to a grant from USAID-DIV, we are launching two RCTs: one testing the nutritional impact of our maize, the other determining the most cost-effective subsidy model to scale with farmers in Guatemala.

We also faced some big challenges. We doubled in staff size over the last 24 months and it's been a challenge to build out middle-management. Our most important partner seed company lost half its production in a heat wave. The Salvadoran government dropped a seed handout program that has lasted for decades, requiring us to adapt our strategy. It's in moments like this, with big opportunities and real challenges, that we can't be more thankful to the partners, advisers, and supporters who make our work possible.

Thank you
-Curt Bowen



EXECUTIVE SUMMARY

Subsidized Seed Sales

- Overall sales increased 6% from 2022 to 2023.
- Over 2,500 bags of seed production were lost due to an El Niño influenced heat wave.
- In 2023, 6% of the seed sold in Guatemala was Semilla Nueva's biofortified hybrid F5, which was launched only two years ago.
- Sales in 2024 are set to double compared to 2023, with three new companies producing biofortified seed.
- We finalized our new brand for all subsidized biofortified maize seeds: *Maiz de Poder*, (corn of power). The brand includes nutrition messaging for the first time. Both our sales and partner sales will include the logo. Semilla Nueva will begin to promote this brand instead of our own seed brand starting this year.

Institutionalizing the Subsidy

- In Guatemala, Semilla Nueva and USAID are in the final co-creation phase of a grant which would fund a third-party program to design, oversee, and finance a national seed subsidy for biofortified seeds. The award may be signed by March or April 2024.
- In El Salvador, government tests on F5 have shown it to be comparable in terms of yields to the current seed they provide farmers, and the seed is now registered with the Salvadoran government for production and sales. Due to changes in their seed subsidy program, Semilla Nueva is working to develop a new strategy similar to our approach in Guatemala.
- In Honduras, the government and partners have begun the registration process, allowing for commercial production and sales by 2025.

Developing Better Seeds

- Several of Semilla Nueva's biofortified hybrids in development continue to show competitive yields compared to some high segment seeds. One hybrid is slated for initial promotion in 2024 and sales of 2,000 bags in 2025. Four others are slated for initial promotion in 2025 and sales in 2026.
- Semilla Nueva's work to discover the genes that increase zinc reached a second important milestone, with Bayer discovering 3-5 genetic regions related to zinc expression.
- Semilla Nueva has finalized a contract with University of Wisconsin to test new gene editing (CRISPR) approaches to biofortification. 13 genes will be tested for their ability to increase nutrition in maize. A test gene edit will be made in a new open pollinated variety for the Guatemalan highlands that the government plans to launch this year.
- A new industrial dryer will allow us to increase our seed conversion speed by 50%.
- The NGO One Acre Fund is sending us the most important seeds they've already launched in Africa and plan to launch in the coming years so that we can convert them to be biofortified.

Impact

- Semilla Nueva reached 24,578 families in 2023, 20% more than in 2022.
- We estimate 825,921 people consumed our nutritious maize in 2023, a 39% increase from 2022.



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- Sales led our growth due to a decrease in farmers receiving donated seed. Farmers who gave away biofortified seed to their families and neighbors allowed us to reach 34% more families through sales although average planting size decreased.
 - Our biofortified seeds increased farmer net incomes by \$238 per hectare, resulting in an extra \$123 for the average farmer purchasing our seed (a 34% increase). Farmers who received free seed increased their incomes by \$212 on average (a 115% increase).
 - Climate resilience contributed to higher incomes. Biofortified seed lost 54% fewer plants and ears to winds and rot associated with storms and droughts.
 - Initial results from our first nutrition RCT with Cornell University show an improvement in zinc biomarkers for mothers and children eating biofortified maize.
 - Through a \$1.2M project from USAID-DIV and support from Light a Single Candle, Semilla Nueva and partners J-PAL, DIL and PSE will lead various studies on the nutritional and economic impact of subsidies for biofortified maize, including three randomized controlled trials (RCTs).

Funding and Administration

- Through renewals, new grants, and individual donations, Semilla Nueva received \$4.5M in funding from January through December 2023.
- We expanded our 2023 budget from US\$2.9 to US\$3.3M and set our 2024 budget at \$4.7M.
- Cash-on-hand, committed funding, and likely renewals will cover operations for the next nine months.
- Our financial statements are now in compliance with US-GAAP for nonprofits. Our 2023 External Audit will be available by mid-March 2024.
- We hired 11 new employees in 2023, and opened six new positions in 2024 to support the expansion of our activities.



CONTEXT AND KEY TERMS

Semilla Nueva's Strategy

Malnutrition is decreasing worldwide, but for the 1.2B people who eat maize three times a day, the number of malnourished children is increasing. This population is fed by 53M poor smallholder farmers in Sub-Saharan Africa and Mesoamerica. Most are extremely poor and do not use improved maize seeds, let alone more nutritious, biofortified maize seeds.

Three market failures prevent farmers from adopting higher-yielding biofortified seeds at scale:

- 1) Consumers and farmers won't pay more for nutritious maize, preventing seed development.
- 2) Without subsidies, most poor farmers cannot afford any new, high yielding seeds.
- 3) Without a strong market, local seed companies don't develop and market new, higher yielding or biofortified seeds.

Semilla Nueva's solution is to:

- 1) Pilot subsidies for companies selling new, high-yielding biofortified seeds at affordable prices.
- 2) Work with governments to institutionalize these subsidies.
- 3) Develop high-yielding, more nutritious biofortified seeds, and techniques to make it cheap for all seed companies, including larger transnationals and governments to develop their own.

Maize market

Throughout this report, we use terms to describe the Guatemalan maize market and our goals in breeding new biofortified seeds. Some context can make this report easier to understand. In Guatemala, our goal is for more than half of the maize consumed to be biofortified. We plan to reach this goal by getting more farmers to use our seed and increasing their yields so they produce more of the maize consumed in Guatemala. The table and descriptions below provide an overview of the structure of the maize market in Guatemala, the types of farmers, and their contribution to annual maize consumption, in order to contextualize the number and type of farmers who will need to use our seed to reach this goal.

Table 1: Semilla Nueva estimate of Guatemala's maize market and maize farmer structure

Farmer Segment/Source	Hectares	Farmers	Average Yield (mt/ha)	Total Annual Production (mt)	% of Annual Consumption
Non-hybrid high elevation	157,990	320,000	2.6	410,364	19.2%
Non-hybrid low-mid elevation	315,000	550,000	2.3	715,909	33.5%
Low-segment hybrid	56,000	80,000	3.6	200,000	9.4%
Mid-segment hybrid	28,000	40,000	3.9	109,091	5.1%
High-segment hybrid	56,000	40,000	5.2	290,909	13.6%
Imported illegally from Mexico	0			409,091	19.2%
Total	612,990	1,030,000		2,135,364	100.0%



Non-hybrid farmers do not purchase seed annually, but instead save and replant seeds saved from their previous harvests. These farmers typically use a limited amount of chemical fertilizer, herbicides, and seed treatment, which they purchase each year. Most only grow enough maize for home consumption, but some have large enough land holdings to produce enough maize to sell to the market. We estimate the 870,000 farmers who do not purchase seed produce 53% of the maize consumed in Guatemala¹. Our current seeds are suitable for farmers in the low and mid-elevations (0-1,800 MASL), but seeds have not yet been developed for higher elevation regions in Guatemala.

Low-segment farmers purchase cheap but low-yielding hybrid seeds produced by local companies. The seeds cost ~US\$45 per 20kg bag and provide farmers with only slightly higher yields than non-hybrid seeds. We estimate 80,000 low-segment farmers produce 9% of Guatemala's maize.

Mid-segment farmers use moderately priced seeds produced and sold by national Guatemalan companies. The seeds cost ~US\$71 per 20kg bag but only provide moderate yields. We estimate 40,000 mid-segment farmers produce 5% of the maize consumed in Guatemala.

High-segment farmers purchase the most expensive hybrid seeds from transnational seed companies every year. The seeds cost ~US\$150 per 20kg bag but provide farmers with high yields. We estimate 40,000 high-segment farmers produce 14% of Guatemala's maize consumption.

Breeding terms

Pure lines: Pure lines are seeds bred to be genetically homogeneous. They have specific traits (yield, nutrition, disease resistance, etc.) and are similar from generation to generation.

Hybrids: Most commercial maize seeds are hybrids. They result from pollinating one pure line with another. Commercial hybrids² generally have been bred for excellent yields and other positive traits. If a farmer buys a hybrid and saves seed from the grain produced, desired traits, such as yield, become less pronounced with each generation. Depending on a farmer's economic and agroecological context, it can be highly advantageous to buy hybrid seed every year (or every few years). Hybrids are not synonymous with GMO. The seeds used to produce hybrids commercially are normally called parental seeds.

Seed conversion: We use the term seed conversion to refer to backcrossing, a process to convert a pure line to have a new trait while maintaining as much of the genetics and desirable performance of the original line as possible. Imagine creating a golden retriever with poodle hair by crossing a golden retriever and a poodle, finding the puppies that are the most like golden retrievers but with full poodle hair. In the next generation, you cross those puppies with a golden retriever and pick the puppies that are even more like golden retrievers but still have poodle hair, etc. After several generations, you may have a few golden retrievers with poodle hair. Semilla Nueva backcrosses (or converts) the lines of high yielding hybrids to have improved nutritional traits while maintaining their yield.

¹ In 2020, the Guatemalan government estimated 20% of maize is imported illegally from Mexico. In our model we estimate 17%.

² If a (simple) hybrid is itself crossed with another line or another hybrid, it forms a triple or double hybrid. Most commercial seeds in Sub-saharan Africa and Mesoamerica are triple or double hybrids.



SUBSIDIZED SEED SALES

Doer at Scale

Summary

- Overall sales increased 6% from 2022 to 2023. While mid-year sales had increased 50% from the same time the previous year, Semilla Nueva and other seed companies fully sold out of seeds and were without inventory for the second sales season.
- Over 2,500 bags of seed were lost when partner seed company, Valle Verde, lost mid-year seed production due to an El Niño influenced heat wave.
- In 2023, 6% of the seed sold in Guatemala was Semilla Nueva’s biofortified hybrid F5, which was launched only two years ago. This shows that our model works not only to scale biofortified seed, but also addresses a critical market failure that prevents new, higher yielding hybrids from reaching farmers.
- Sales in 2024 are set to double from 2023 numbers, with three new companies producing biofortified seed. 81% of the necessary production is already planted, with the remaining 19% scheduled for April.
- We finalized our new brand for all subsidized biofortified maize seeds: *Maíz de Poder*, (Corn of Power). The brand includes nutrition messaging for the first time. Both Semilla Nueva and partner sales will include the logo. Semilla Nueva will begin to promote this brand instead of our own seed brand starting this year.

While sales of biofortified seed increased 50% compared to mid-year 2022, they only increased 6% year over year due to failed seed production due to unusually high temperatures during the second seed production cycle

Table 2: Past and projected sales of biofortified seed (20 kg bags)

20kg bags sold by	2021	June 2022	Total 2022	June 2023	Total 2023	2024*	2025*
Semilla Nueva	3,637	4,092	5,213	5,552	5,688	8,500	9,000
Other seed growers	1,129	800	2,005	1,783	1,993	6,700	11,000
Valle Verde	1,129	800	2,005	1,504	1,627	5,000	6,000
Semillas del Trópico				279	279	1,000	2,000
Other seed growers (2)					87	700	3,000
TOTAL	4,766	4,892	7,218	7,335	7,681	15,200	20,000

*estimates

Year over year, total sales of biofortified seed grew by 6%, compared to our target of 40%. By mid-2023, Semilla Nueva and Valle Verde had both fully sold out. Semilla Nueva took the decision to not produce more seed for the second sales season to let Valle Verde’s sales absorb all second season demand. It was a big moment for our model—we deliberately limited our own sales to make space for our partners. Valle Verde began production of an additional 2,500 bags in June 2023. Unfortunately, an El Niño influenced heat wave led to some of the highest temperatures on record (over 35°C/95°F). Male plants failed to produce sufficient pollen and Valle Verde only harvested 200 bags.



There are three important takeaways from this experience. First, Semilla Nueva and partner seed companies should prioritize seed production of our F5 hybrid during the main production season, due to cooler temperatures. Second, there is sufficient demand for both Semilla Nueva and partner seed companies to increase seed production to have more inventory on hand for the second planting season. Third, while our hybrids have great heat tolerance, we need to optimize breeding for heat tolerance for parental seeds as well. While one may think that heat tolerant hybrids always have heat tolerant parents, this isn't always the case. One of our primary focuses going forward will be to develop seeds that are as cost-effective as possible for seed companies to produce and that will involve climate resilience in the parental seeds as well as the hybrid they sell to farmers.

Three new seed companies joined the subsidy program, bringing the total to five. 2024 sales are posed to increase 99%, with 82% of seed already in production

The increased demand from farmers and retailers led to significant increases in interest from other seed companies to participate in our subsidy program. Our longstanding partners, Valle Verde and Semillas del Trópico agreed to plant enough seed to more than double their sales in 2024 (see Table 3 below). Valle Verde is planning to plant their remaining area for 2,500 bags in late March or early April to prevent a repeat of their losses in mid-2023. Valle Verde also invested in seed drying infrastructure to allow them to harvest earlier (while there are still rains).

Table 3: Current and planned seed production (hectares and 20 kg bags)

Seed company	Already planted (ha)		Planned planting (ha, April 2024)		TOTAL planned sales (bags)	
	F5	F7	F5	F7	F5	F7
Semilla Nueva	16	52			2,500	6,000
Other seed growers	23	5	21		3,200	3,500
Valle Verde	18		18		2,500	2,500
Semillas del Trópico	4		3		600	400
Agropher (new)		4				500
Meseta (new)	1	1			100	100
TOTAL	96		21		15,200	

Agropher began as an agricultural input distributor in Northern Guatemala. The company serves a large number of non-hybrid maize farmers with inputs and has been looking to expand into seed production and sales. They operate in southwestern Petén, northern Alta Verapaz, and northern Quiché—a region with some of the world's highest malnutrition and poverty rates. It is also the biggest maize producing regions in the country, and has one of the lowest rates of hybrid seed use. Semilla Nueva's new production team is assisting Agropher to produce seed for the first time to sell through their existing distribution network.

Meseta is a local Guatemalan company associated with Starker Biotechnologies. They have focused on developing maize hybrids for the Guatemalan highlands and sell to 5-10,000 small scale farmers/year. They have found farmers in these regions prefer to purchase smaller quantities of seed and generally



sell 1 kg plastic containers of seed. Semilla Nueva is working with Meseta to biofortify their existing hybrids for the Guatemalan highlands and to produce and sell our F5 seed for middle elevations.

PASFESA (Productos Agrícolas San Fernando S.A.) is a potential new seed producer. PASFESA is an agrochemical distributor with a strong and well-developed market in eastern Guatemala, which was originally responsible for most of Semilla Nueva’s seed sales in 2018-2022. Semilla Nueva began working with smaller, regional distributors in 2022 in order to reach more subsistence farmers, but continued the relationship with PASFESA. With support from Semilla Nueva’s seed production team, PASFESA believes they could eventually sell 3,000 bags a year, a volume similar to the Fortaleza biofortified seeds they sold in 2022.

Maíz de Poder – a brand for Guatemalan biofortified maize seeds – is ready to launch

Semilla Nueva has prepared our new umbrella brand, “Maíz de Poder” (Corn of Power). The brand will allow us to communicate about all subsidized biofortified seeds in a single campaign or program, and make it easier for farmers to identify biofortified seeds in the market.

The brand was developed based on three studies led by our marketing team and a contracted company that involved 511 surveys and six focus groups. 93% of farmers liked everything about the concept and 6 out of 10 farmers (who normally don’t buy seed) said they would try biofortified seeds after listening to the *Maíz de Poder* presentation. We also tested the willingness of farmers to advocate for a subsidy program through a pilot project with support from Rippleworks which involved 1,499 farmers in 67 communities in nine departments.

The *Maíz de Poder* concept is built on three pillars of value to our farmers: higher yields (*milpa más productiva*), affordable price (*semilla subsidiada*), and nutrition (*más nutritivo*). Nutrition and subsidy messaging are new marketing focuses for Semilla Nueva. Both have risks, which is why studying farmers’ receptivity was a high priority in 2023.



Figure 1: Logo for Maíz de Poder



Our studies showed that male and female heads of household in farming families have a basic understanding of the concept of nutrition and associate it with being well fed and having overall health. Concepts such as vitamins, nutrients, protein, and calcium were all mentioned spontaneously during our research. Most importantly, nutrition did not generate any negative associations when linked to maize seeds. Our work in 2016-18 with Appleseed, a social marketing company, warned of possible negative reactions to nutrition promotion. As a result, we maintained a policy of not promoting these benefits to farmers. Our recent studies tested promotion of a high-yielding seed that also happens to be more nutritious. 100% of interviewed OPV farmers and 87% of hybrid farmers reported a willingness to try the seed after learning about *Maíz de Poder's* combination of yield, price, and nutrition.

This year, instead of promoting our original seed brand, Fortaleza, Semilla Nueva will now promote *Maíz de Poder* in materials at agrodealers, in mass media, and during field days and other activities. Stickers and promotional materials are being prepared to allow each company selling biofortified seeds to place a *Maíz de Poder* logo on their bags and other promotional materials and take advantage of Semilla Nueva's marketing materials.

In 2023, we redesigned our demonstration parcels and field days to begin this transition. We used Fortaleza (our seed company) branding, but began to explain to farmers that other companies sold these seeds under different brands.

In 2024, demonstration parcels will feature *Maíz de Poder* branding and grow Semilla Nueva's Fortaleza brand alongside biofortified seed from other seed companies like Valle Verde with their promotional materials. The idea is for Semilla Nueva's demo parcels to fully transition from promoting our seed brand to promoting the multiple subsidized, biofortified seeds on the market—and the program that allows companies to sell them at an affordable price. This change will be accompanied by an increase in the geographical regions where promotion takes place, adding additional field days and goals for farmers' participation.

Table 4: Historic and planned field days and farmer participation

	2022	2023	2024
Field Days	49	64	100
Farmers	1,737	2,104	2,650

We expanded from one to two seed production coordinators, seven to ten field technicians, and are adding additional support staff for project and process management

Over the course of 2023 Semilla Nueva and our partner seed companies suffered production losses due to lack of technical assistance. We've hired a new seed production coordinator to ensure we can provide better service to our partner seed companies in Guatemala and El Salvador. Our field technicians are responsible for seed promotion and collecting much of our impact data. With a combination of our new *Maíz de Poder* promotional strategy and new, more extensive impact studies planned, we also decided to expand the team, with new hires focused on locations with many non-hybrid farmers that do not yet use commercial seeds. Finally, with these new projects expanding, we re-organized the operations department and are currently hiring two new deputy positions that will focus on data/processes and project management.



INSTITUTIONALIZING THE SUBSIDY

Payer at Scale

Summary

- In Guatemala, Semilla Nueva and USAID are in the final co-creation phase of a grant which would fund a third-party program to design, oversee and finance a national seed subsidy for biofortified seeds. The award may be signed by March or April 2024.
- In El Salvador, government tests on F5 have shown it to be comparable to the current seed they provide farmers, and the seed is now registered with the Salvadoran government for production and sales. As of February 2024, with the re-election of the president, the Salvadoran government is planning to change their seed handout program to a voucher program. Semilla Nueva is working to develop a new strategy similar to our approach in Guatemala.
- In Honduras, the government and partners have begun the seed registration process, allowing for commercial production and sales by 2025.

Guatemala: Co-creation of a USAID award is in the final stages; the program would move our subsidy to third-party implementation with the Guatemalan government

Semilla Nueva's strategy for institutionalizing our subsidy program in Guatemala involves: a) piloting the program ourselves, b) transitioning the program to one overseen by a third party and paid directly by philanthropy, in a way that can be later used by the Guatemalan government, and c) achieving a long-term funding commitment from the Guatemalan government. This USAID award currently in negotiation allows our best opportunity to move into the second phase of this plan.

Over the second half of 2023, Semilla Nueva completed negotiations on project milestones, the project description overview, and risk assessments and mitigation plans focused on gender, indigenous people, and the environment. USAID is currently preparing the final request for application which will lead to a final application and then contract negotiations.

The Guatemalan Institute of Agricultural Science and Technologies (ICTA) and the Ministry of Agriculture participated in the creation of this unsolicited proposal to USAID in 2021 to fund an expanded pilot of our biofortified seed subsidy program. Ultimately the proposal was approved by ICTA, as well as several local partners and submitted to USAID. The Ministry of Agriculture continues to review the proposal through its various committees. While less than 1% of unsolicited proposals are accepted by USAID, our program made it through initial due diligence and is now in co-creation, with a possible US\$4.5M, three-year, fixed amount award in the final stages of negotiation. This award would support the creation of a third-party technical committee to refine our existing subsidy program, oversee its annual implementation, and use a legal instrument within a Guatemalan bank to pay seed companies based on the technical committee's approval of their sales. Instead of Semilla Nueva negotiating directly with seed companies, reviewing their results, and paying them for successful sales of biofortified seeds at reduced prices, this committee (of which Semilla Nueva would be a member) would lead these efforts. If successful, this committee would receive three years of funding from USAID to test the concept and more than double the number of farmers accessing subsidized seed.

Critically, with leadership from ICTA, the program would be a public-private partnership and would facilitate subsequent institutionalization through long-term Guatemalan governmental funding. This



plan was co-designed with ICTA and several of Semilla Nueva’s board members, including two experts on Guatemalan legislation and advocacy. We held several meetings with the World Bank and explored the current subsidy impact data we’ve collected. The World Bank has significant experience in creating and improving agricultural input subsidy programs in Central America and the Caribbean and is exploring the possibility of participating in the technical committee.

This approach has several risks. Moving to a third-party committee to oversee the subsidy will decrease Semilla Nueva’s control of the program. The challenges of moving from an NGO being the payer and doer of a program to a third party is one of the most common barriers to scale. Our strategy for confronting these challenges is to maximize strategic alignment and long-term pressure. We are negotiating the USAID award to allow payment only if the subsidy program is created and implemented annually in such a way as to maximize its positive impact on farmer livelihoods and nutritional outcomes. We’ve chosen allies to create the committee that have proven track records of success in policy change and sound technical recommendations in other third-party programs. We have included partners such as the government’s semi-autonomous Institute of Agricultural Sciences and Technologies (ICTA) which could add legitimacy to the results of the pilot and advocate for long-term budget allocations if the program is successful. We’re tying in third-party impact evaluation from partners such as DIL and JPAL, who would create far more credible impact data than Semilla Nueva’s internal reports. We’re building a marketing plan (explained in our subsidized seed section above), which will include policy makers in events to promote biofortified seeds to farmers, creating political awareness and pressure. Lastly, If the USAID grant is not successfully negotiated, Semilla Nueva will seek other funders to allow this transition, albeit at a slower pace.

Our goal is not to have a set deadline by which we project the subsidy will be fully paid by the Guatemalan government, but rather to build a system that will continually maximize pressure until a political opportunity arises and allows for such a move.

There is an additional risk that deserves mention. Semilla Nueva is currently the biggest producer and seller of biofortified seeds in Guatemala. To allow for a long-term role as a leader of the subsidy program we are designing, Semilla Nueva will need to continue to accelerate our transition from producing and selling seeds, to supporting other seed companies to do so. This adds pressure to our existing plans to limit our sales while creating more demand for other seed companies, and eventually for a potential spin off or sale of Semilla Nueva’s brand to another seed company. Semilla Nueva has begun conversations with potential partners on this topic.

El Salvador changes from seed handouts to vouchers. We will need to shift strategies

El Salvador was the perfect country to expand to. They already provide free hybrid maize seed to nearly all of their farmers, and our seeds seem to be on par or better than what they provide. We spent 2022 and 2023 running dozens of test sites with the government, meeting with top officials, and registering our biofortified seeds in the government’s name. With results being positive, we prepared a plan to hand out seed to between 2,000 and 3,000 farmers and to launch a study in conjunction with our research partners in mid-2024 to evaluate impact. Officials at the national agricultural research system (CENTA) were working with us to design the study and the seed is currently in production. In early February 2024, we learned that after several decades of existence, the seed handout program will be canceled. Instead farmers will receive a voucher allowing them to purchase any agricultural inputs at retailers throughout the country. We will be working with the government to evaluate other options,



hopefully piloting a supply-side subsidy program similar to our current model in Guatemala, but hopefully designed with the government from the beginning.

Honduras: initial conversations and testing in late 2023

Semilla Nueva met with the Honduran government's Department for Agricultural Sciences and Technologies (DICTA) in March and May 2023 and began creating a plan to test our new biofortified seeds. The Honduran market is different from Guatemala and El Salvador's in that there are three primary groups of farmers: 1) A small group of ~40,000 relatively large farmers who purchase high segment GMO seeds from Corteva and Bayer and use industrial agricultural techniques, 2) ~100-200,000 small farmers who receive free, low-yielding seeds from the government, and 3) ~400,000 small scale farmers who do not use improved seed varieties.

Based on our conversations with the government, Semilla Nueva will begin registering our new biofortified seeds with the Honduran government (allowing the seeds to be considered a Honduran variety), test production with the local seed companies who currently provide seed to the government, and generate a testing strategy to see how using newer biofortified seeds could increase farmer incomes and justify their incorporation in an improved subsidy system. After a lengthy process, Semilla Nueva received permission to import seed and conduct the trials which should be underway by the end of February 2024.



DEVELOPING BETTER SEEDS

Making farmers and seed companies more money—and the subsidy cheaper

Summary

- Several of Semilla Nueva's biofortified hybrids in development continue to show competitive yields against some high segment seeds. They are currently in the registration process, with one slated for initial promotion in 2024 and sales of 2,000 bags in 2025. Four others are slated for initial promotion in 2025 and sales in 2026.
- Semilla Nueva's work to discover the genes that increase zinc reached a second important milestone, with Bayer discovering 3-5 genetic regions related to zinc expression. Additional tests are underway or in planning for 2024.
- Semilla Nueva has finalized a contract with the University of Wisconsin to test new gene editing (CRISPR) approaches to biofortification. 13 genes will be tested for their ability to increase zinc, iron, and protein quality without negative consequences such as lower yields. Additionally, Semilla Nueva's favorite non-biofortified lines will be sequenced in preparation for later gene editing efforts, and a test gene edit will be made in a new open pollinated variety for the Guatemalan highlands that the government plans to launch this year.
- A new industrial dryer will allow us to finally get to our long sought after goal of three backcross cycles per year at our research farm, increasing our seed conversion speed by 50%.
- One Acre Fund is sending us the most important seeds they've already launched in Africa and plan to launch in the coming years so that we can convert them to be biofortified. We hope advances in gene markers (and hopefully, gene editing) will significantly decrease the time required to return biofortified versions of these seeds to One Acre Fund for them to use in their programs.

Better biofortified seeds entering registration

Test results in the main growing season confirmed that Semilla Nueva has several already biofortified seeds with higher yields than our best F5 and F7 seeds, and several seeds that we are converting to be biofortified have yields competitive with the best seeds from the private sector. Semilla Nueva will launch a new seed with ~10% higher yield than F5 in 2024 with sales beginning in 2025. A second seed will launch in 2025 with sales in 2026. We hope to have a seed with yields comparable to the best seeds in Central America launching in 2026 with sales in 2027. For all of these seeds, Semilla Nueva is beginning to build systems to more deeply evaluate seed producibility (how much commercial seed a seed company can produce on a given unit of land) at the same time that we are testing their performance for farmers. Higher producibility will lead to less need for a subsidy in the future and more seed companies being interested in our seeds.

The two Figures below show the results of yield trials at two different stages of the breeding process. The first is a smaller set of seeds, tested in nine sites in Guatemala. The second consists of several hundred new seeds tested in only three locations. Black bars represent the most important commercial seeds in Guatemala. DK390 and NK102 are the highest yielding seeds from Bayer and Syngenta in the high segment. JC24 and JC21 from Valle Verde lead the mid-segment. HB83 is the low segment standard, and B15 is one of the most popular seeds given away by the Guatemalan government. The red bars represent Semilla Nueva current commercial seeds. Yellow represents Semilla Nueva seeds that are in conversion to improve their nutrition. Blue bars are Semilla Nueva seeds in registration with the government and under evaluation for launch.

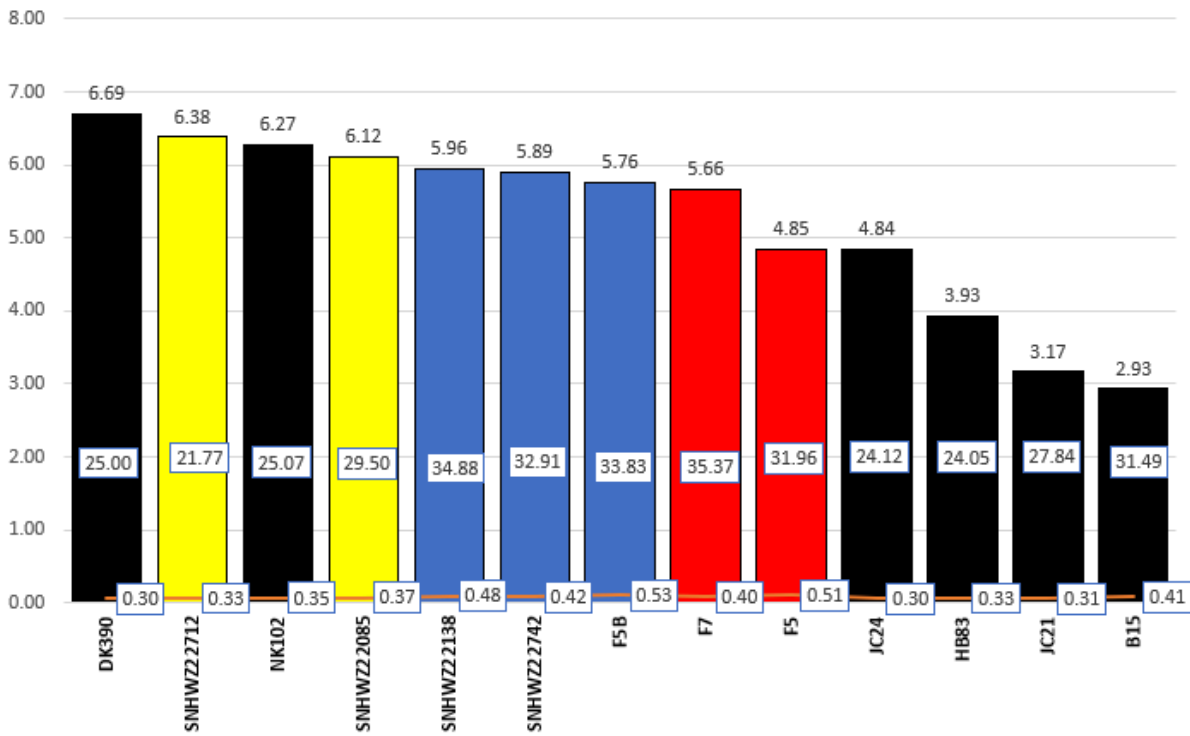


Figure 2: Yield (left axis, mt/ha), zinc levels (middle boxes, PPM), and lysine (lower boxes, % of protein) of Semilla Nueva's current new generation of seeds, 9 locations, main season.

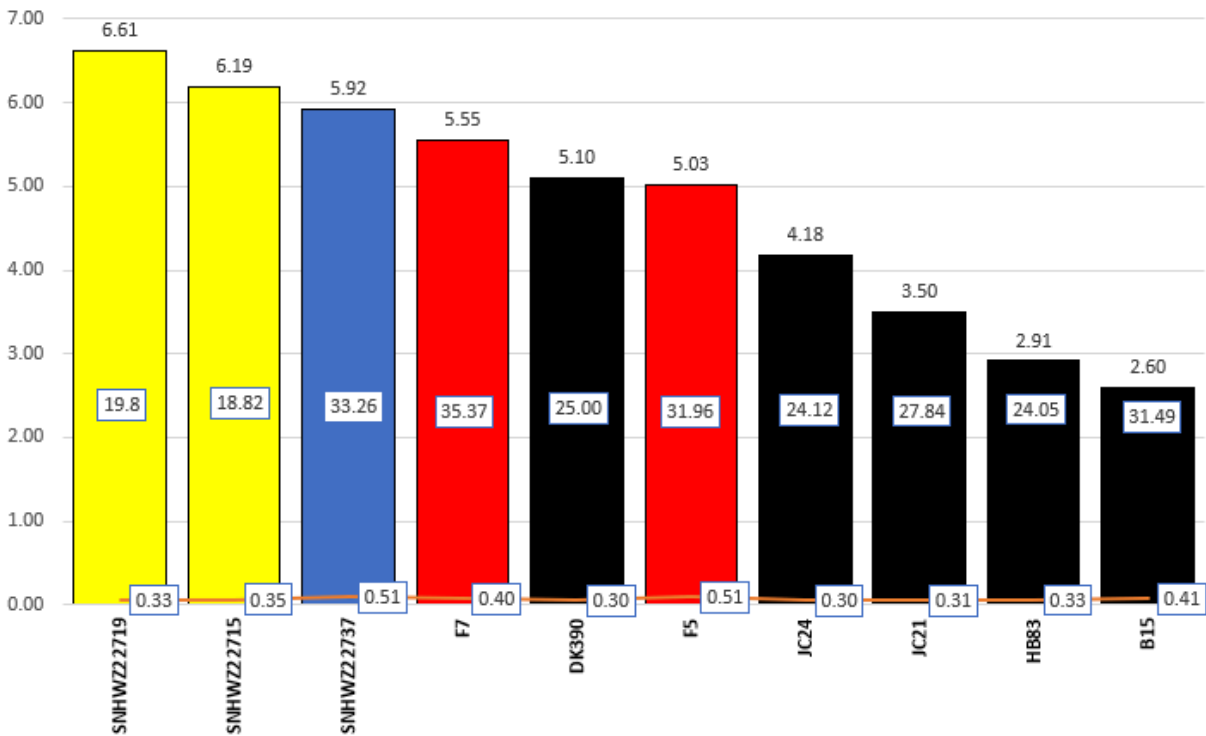


Figure 3: Yield (left axis, mt/ha), zinc levels (middle boxes, PPM), and lysine (lower boxes, % of protein) of Semilla Nueva's newest experimental seeds, 3 locations, main season, Guatemala



The two graphs above show that we have seeds in registration (blue bars) that have similar or higher levels of nutrition than our two current commercial seeds F5 and F7, with yields that are 5-20% higher. Yields are especially higher than F5, which will be our leading biofortified seed in the next two years given higher costs to produce F7. One of these seeds will be in promotion in 2024 with sales beginning in 2025. The other other promising seeds can enter promotion in 2025 with sales in 2026. Statistical significant data can be found in our footnotes.³

The seeds represented by the yellow bars have even more potential. These hybrids have lines that are currently being converted to be more nutritious, while maintaining yield. They compete and sometimes beat the best seeds in the market. We hope to have our first seed of these in promotion by 2026. This result, however, also shows why Semilla Nueva is so laser focused on converting seeds to be more nutritious. There are currently seeds available for free license by international seed banks that are as good as the best seeds produced by the transnational companies in Central America and in parts of Africa. If we can make it inexpensive and fast to make these seeds nutritious, it will dramatically increase the attractiveness of our subsidy model to seed companies and the climate resilience and income results we can bring to small farmers.

Progress to identify markers for zinc continues

Identification of the genes for zinc and iron is one of the most important steps to significantly decrease the cost and time required to convert a conventional high-yielding seed to be biofortified. Semilla Nueva identified three potential genetic regions for zinc in our maize in early 2023. The team is now working on creating new families of seed to test these genes (and others) by mid-2024. Our collaborator Bayer reported that they are in the final stages of analysis and have identified three to five potential regions that contribute to zinc levels in our maize populations. After final results are available, there may be interest in a continued project to assist Semilla Nueva in implementing these markers or exploring gene editing options.

Semilla Nueva launches gene editing project – the potential holy grail of biofortification

Originally, Semilla Nueva had planned to gain proficiency in the use of genetic markers (see above) and then from knowledge of these genes, work towards gene editing (inserting or activating the genes directly in new seeds). Semilla Nueva's breeding director believed that there was sufficient data and studies available to justify trying 13 genes that had already been identified as highly correlated to zinc, iron, and protein quality. The potential of the technology is difficult to overstate. If a simple gene editing approach that significantly increases nutrition without impacts to yield is discovered, it could allow us to take any high yielding seed in the world and make it biofortified in less than a year and for a minimal cost. Further, if the genes are naturally occurring in maize, this would not be considered GMO in the vast majority of countries. Even the famously cautious EU just passed an approval of gene editing as non-GMO in early 2024, as several countries in Latin America and Africa already have. With support from Light a Single Candle and potential support from USAID, Semilla Nueva designed history's most extensive gene editing project for maize (don't give us too much credit, it's a new technology!).

³ 9 locations, trial seeds: Fisher, alpha=0.1, LSD = 0.381. Groups: DK390 (A), SNHWZ22712 (AB), NK102 (BC), SNHWZ22085 (BCD), SNHWZ22138 (CDEF), SNHWZ22742 (CDEFG), F5B (DEFGH), F7 (FGHI), F5 (K), JC24 (K), HB83 (M), JC21 (N), B15 (N)

3 locations, experimental seeds: Fisher, alpha=0.1, LSD = 0.963. Groups: SNHWZ22719 (A), SNHWZ22715 (ABCD), SNHWZ22737 (ABCDE), F7 (BCDEFG), DK390 (EFGH), F5 (EFGH), JC24 (HI), JC21 (IJ), HB83 (J), B15 (J).



After conversations with nearly all major companies and academic centers with gene editing experience in maize, Semilla Nueva decided to work with the leading public sector center at the University of Wisconsin. After several months of negotiation and planning with our advisory board, a final proposal was approved by both organizations and signed on February 14, 2024.

The project will test 13 genes which have already been shown to increase nutrition levels in maize. These genes will be tested in the standard test seed the University of Wisconsin (UW) works with, which will make it easy to evaluate their potential negative consequences, such as decreasing yield. Simultaneously, UW will test gene editing technologies with a well known gene in two of Semilla Nueva's favorite non-biofortified lines and a non-biofortified line used by One Acre Fund in Africa for their programs in Africa. Current gene editing approaches have to be adapted to new genetics, and maize seeds from the tropics can be very different from maize seeds from temperate regions like the midwestern United States. At the same time, the Guatemalan government has provided the newest open-pollinated seed that they plan to launch in the Guatemalan highlands. UW will also test a gene editing strategy on this OPV, which could open up a new application of the technology. We hope to have indicative results within the first 18 months of the project. We estimate that if 3-6 of these 13 genes generate enough additional nutrition, we would be able to pick hybrids from both Africa and Central America to begin a gene editing process—with potential for field testing around 24 months later.

A new industrial dryer will allow us to finally get to our long sought after goal of three backcross cycles per year at our research farm

Semilla Nueva's process of converting new seeds to be biofortified requires planting, growing, pollinating, harvesting, and testing tens of thousands of maize plants a year. Unfortunately, due to weather constraints, we are only able to grow 2-2.5 cycles of corn per year. With a new industrial seed dryer, we will be able to harvest early, dry our seeds, and test them—cutting our total cycle time to less than four months and enabling three cycles of backcrossing per year. The dryer will also allow us to grow seeds during times when they would normally rot before harvest, since we can harvest early and dry them ourselves instead of leaving them to dry in the field. Having our own laboratory and research farm with irrigation was the first achievement that enabled our goal of three cycles per year. With the dryer, we should be able to increase the speed of our breeding process by 50%.

One Acre Fund has sent their lines for the seeds they've already launched and are interested in launching in Rwanda

After extensive conversations with One Acre Fund's new seed center program in Rwanda, an agreement was reached to send Semilla Nueva the lines from the seeds they are promoting with seed companies in Rwanda and the seeds they may launch with those companies over the next several years. Semilla Nueva already possessed several of these lines, which are over a year into the conversion process already. We hope to receive the rest and begin converting them to be biofortified by May. With markers, we may be able to cut down the time required to develop new seeds, but we estimate the first seed could be ready to send back to One Acre fund for testing in 18-24 months.



IMPACT

Summary

- Semilla Nueva reached 24,578 families in 2023, 20% more than in 2022. Semilla Nueva increased the number of families reached through sales by 14% from 2022, while other seed companies sold seed to 41% more families.
- We estimate that 825,921 people consumed our nutritious maize, a 39% increase from 2022.
- Sales led our growth, and we provided less donated seed this year.
- Our biofortified seeds increased farmer net incomes by \$238 per hectare, resulting in an extra \$123 for the average purchasing farmer household (a 34% increase). Farmers who received free seed increased their incomes by \$212 on average (a 115% increase).
- Climate resilience contributed to higher incomes. Compared to conventional seeds, biofortified seeds lost 54% fewer plants and ears to winds and rot associated with storms and droughts.
- Initial results from our first nutrition RCT with Cornell University show an improvement in zinc biomarkers for mothers and children eating biofortified maize.
- A \$1.2M USAID-DIV award will allow us to lead four academically-backed studies on the nutritional and economic impact of biofortified maize between 2024 and 2026, and allow us to complete an interactive ex-ante model. This model will allow policymakers to understand and predict the cost-effectiveness of different subsidy designs and scenarios.
- With funding from Light a Single Candle, Semilla Nueva, J-PAL, DIL and PSE are leading a second subsidy RCT based on a voucher distribution program, to evaluate if additional discounts beyond our current subsidized price drive adoption.

Semilla Nueva reached 20% more families in 2023 compared to 2022. Sales led the growth due a decrease in farmers receiving donated seed.

In 2023, we reached 24,578 families with biofortified seed, a 20% increase from 20,505 families in 2022. While our original goal was 30,000 families, three major barriers got in the way. First, both seed companies and Semilla Nueva didn't produce as much F7 as expected. Second, a heat wave destroyed most of Valle Verde's seed production during the summer. Lastly, low production led us to put extra effort into seed processing, and we significantly reduced the amount of seed we had originally planned to provide to NGOs.

We were happy, however, that the biggest contributor to the growth in farmers using seed was our subsidy model, which allowed 14,738 farmers to purchase the seed at subsidized prices from their local retailers. Semilla Nueva increased the number of families reached through sales by 14%, while other seed companies increased this number by 41%. These farmers, on average, had higher yields and planted larger areas than in previous years, helping us grow the total number of consumers of biofortified maize to an estimated 825,921, a 39% increase from 2022.

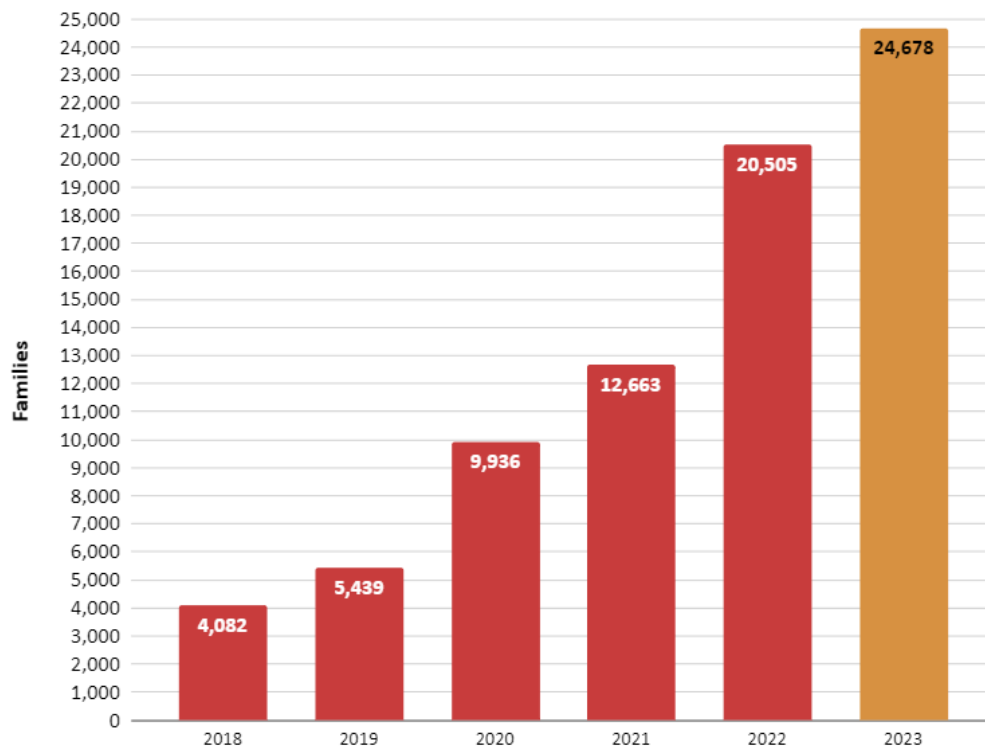


Figure 4: Families that planted Semilla Nueva biofortified maize seed (2018 - 2023)

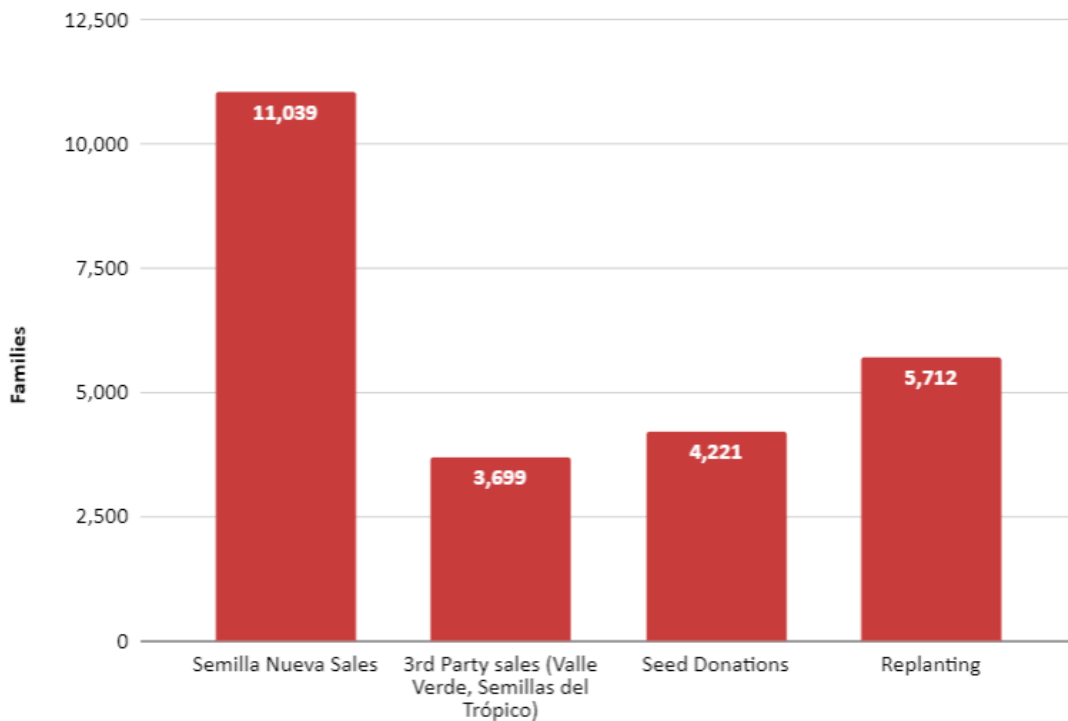


Figure 5: Breakdown of families planting biofortified maize in 2023 by source of seed

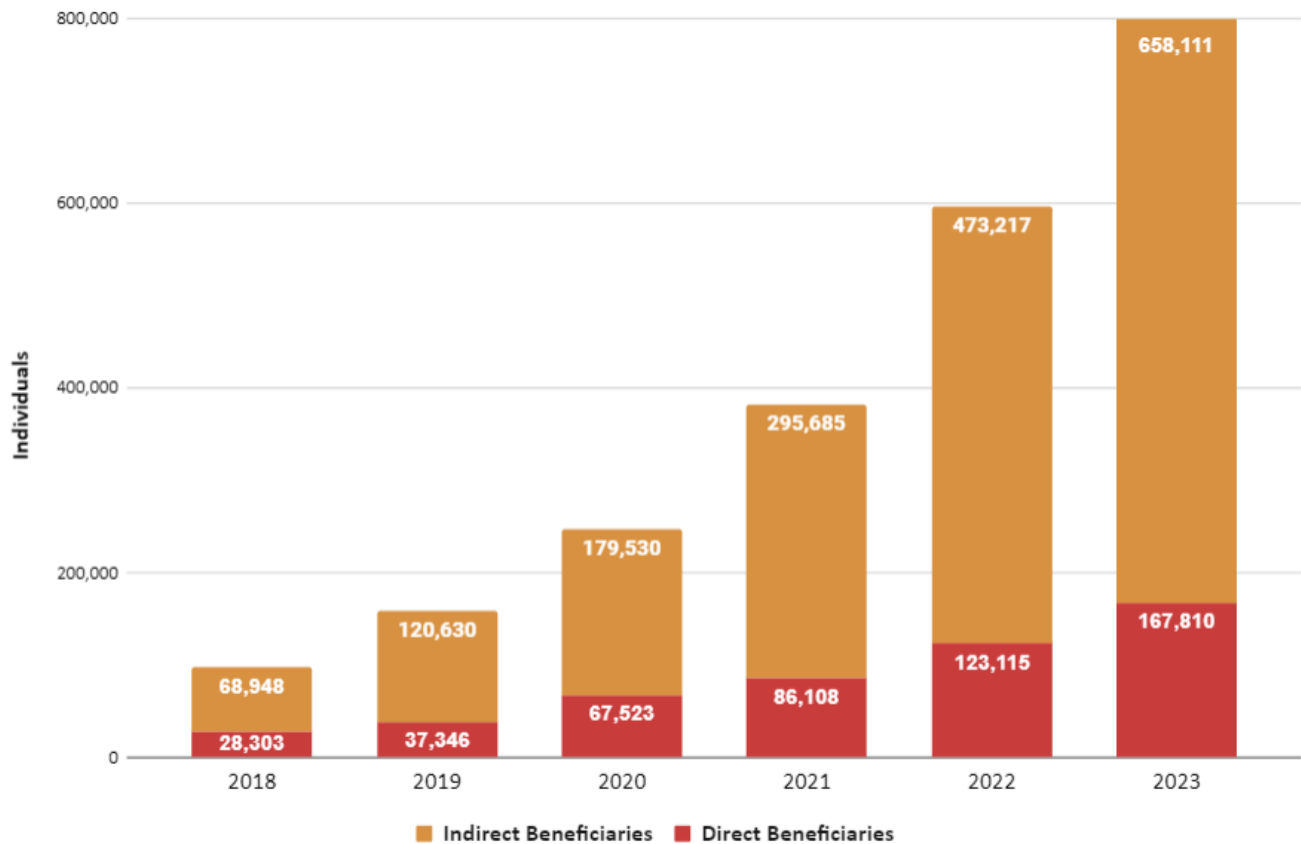


Figure 6: Number of direct⁴ and indirect⁵ beneficiaries per year

Farmers buy seed for their friends and family. We reached 34% more families through sales

An anecdote that we commonly heard from farmers was that they purchased some seed, and then gave some away to their neighbors and family members. This year, we worked to quantify this practice and found that 34% of purchased seed is being shared instead of planted. The average amount shared was 7.5lbs, which is about enough for a family to produce all of the corn they eat during a year. We’re now including these families in our estimates for purchasing farmers.

We tested a new impact evaluation methodology with the University of Chicago’s Development Innovation Lab. Purchasing farmers earned \$123 more with biofortified seeds

This year, with support from Michael Kremer’s Development Innovation Lab at University of Chicago, Semilla Nueva tested a new monitoring and evaluation strategy. Semilla Nueva previously used a system to evaluate economic and climate impact on our farmers through naturally occurring side by side parcels. We would find farmers who had purchased and planted our seed and their normal seed side by side, and provided both parcels the same management. We then would evaluate harvests, profit, drought and storm damage, and other indicators to determine the impact our seed would have

⁴ Direct beneficiaries are the farmers who planted biofortified seed and their families.

⁵ Indirect beneficiaries are the estimated number of individuals who consumed biofortified maize by buying excess production from the market.



on that segment of farmer. The advantage of this method is that it allows for statistical significance with a much smaller sample size. The disadvantage is that we don't know if those farmers who plant two seeds are truly representative of the farmers in their segment.

In 2023 we worked to try a new methodology. We identified random farmers from each group that interested us, and then followed them throughout the year. This methodology required a much larger sample size, so we decided to a) double the number of farmers we planned to work with and b) reduce the segments we'd evaluate. We settled on finding 20 farmers each in six groups:

1. Grew maize without hybrid seeds in 2022 and did so again in 2023
2. Grew maize without hybrid seed in 2022 and then purchased biofortified seeds in 2023
3. Bought low-segment hybrids in 2022 and continued in 2023
4. Bought low-segment hybrids in 2022 and then tried our biofortified seeds in 2023
5. Bought mid-segment hybrids in 2022 and continued in 2023
6. Bought mid-segment hybrids in 2022 and then tried our biofortified seeds in 2023

Given that nearly all maize farmers purchase some inputs, and by selecting agrodealers in all low- and mid-elevation regions of the country (where farmers use our seed), we theorized we could get a more representative sample of maize farmers and see the differences in those purchasing our seeds. As in past years, we paid agrodealers to collect names of farmers purchasing our seed, other hybrid seeds, or maize farmers who bought inputs for their maize but not seeds. We identified a total of 2,847 farmers. 782 farmers qualified to take part in our study. 124 of these farmers were selected, agreed to participate, and allowed data collection and harvest of their field in late 2023.

Table 5: Yield and profits by farmers segment for purchasing farmers

	OPV	Low Segment	Mid-segment	Biofortified (F5/F7)
Yield (mt/ha)	2.78	3.74	3.81	3.98
Income (\$/ha)	1,526	1,988	1,976	2,160
Costs (\$/ha)	868	1,138	1,231	1,171
Profits (\$/ha)	658	850	742	988

On average, farmer income was \$238 per hectare higher with biofortified seeds than for those farmers who normally don't purchase seeds or those who buy the lower or mid-priced seeds on the market. These groups represent 96% of maize farmers in Guatemala. Adjusting to the average farmer, who purchased 22.7 lbs to plant on 0.52 hectares, we can estimate that farmers who switched to our biofortified seeds earned on average \$123 more than their peers who remained with their traditional seeds.



Table 6: Yield and profit, adjusted to average farmer planting size (0.52 hectares)

	OPV	Low Segment	Mid-segment	Biofortified (F5/F7)
Yield (mt)	1.43	1.93	1.97	2.05
Income (\$)	787	1,026	1,020	1,114
Costs (\$)	448	587	635	604
Profits (\$)	340	439	383	510

There are certain limitations to the study design, however. Only the difference between biofortified seed yields and profits and those of OPV farmers was statistically significant. The other two groupings were far from significant. Given the variation in the data, to reach statistical significance for all three pairs of farmers would require a survey of close to 1,000 farmers. Semilla Nueva's operations team invested approximately 40% of their time in 2023 into this study (worth around \$300,000). Scaling our survey eight-fold in order to reach statistical significance for each group simply isn't practical on a yearly basis. With new seeds launching every two years, our impact studies need to be constant. Semilla Nueva is still evaluating whether, in 2024, to return to our previous side-by-side parcel methodology. Regardless, results from 2023 are similar to those from 2022 and demonstrate the economic impact that is driving farmer adoption of our seeds in Guatemala.

Ultimately the data collected from this study will not be sufficient to publish in an academic journal. The methodologies and skills we have developed, however, will be critical for the studies we do hope to publish which we will be working on in 2024.

One of the major reasons for higher incomes was climate resilience. On average biofortified seeds lost 54% fewer plants and ears to winds and rot associated with storms and droughts.

In each of our trials we measured how many plants were lost to winds and how many ears were lost to rot (which strongly correlates to drought and storm damage). Analyzing all farmers we studied showed a 54% reduction in lost crops. Farmers planting low-segment, mid-segment, and OPV seed lost an average of 22% of their plants and ears to winds and rot, whereas those using our biofortified seeds only lost 12%. We're working on sub-analyses for drought-affected farmers and should have them shortly.

Farmers who received seed for free planted on average 0.48 hectares and earned \$212 more

Semilla Nueva co-harvested with 10 farmers who received free seed as part of one of our studies. For farmers who planted 16 pounds of biofortified seed, yields increased by 36%. Farmers in this group did not use additional inputs on their biofortified seeds. Their only difference in cost was due to the value of the biofortified seed which we have included. It's important to note that while yields increased modestly, given that costs remained the same, farmer profit more than doubled. We see this data as being highly illustrative of why even small increases in yield can be so critical for farmers—and why we are investing so much in our breeding program.



Table 7: Yield and profit for farmers who received free seed

	OPV	Donated Biofortified seed
Yield (mt)	1.22	1.66
Income (\$)	677	900
Costs (\$)	492	504
Profits (\$)	184	396

We have initial results from our first nutrition Randomized Controlled Trial (RCT), paving the way for a larger, more statistically significant trial

Semilla Nueva’s first nutrition RCT was developed with Cornell University and the Institute of Nutrition of Central America and Panama (INCAP). The study’s goal is to: 1) test the use of novel zinc biomarkers to better predict zinc status, and 2) use these new biomarkers and traditional biomarkers for iron, to evaluate the impact of consuming biofortified maize on zinc and iron status for young children. The study will also link these biomarkers to the results of much easier to use survey tools (24 hour recall and food frequency questionnaires), potentially allowing a less expensive and time consuming methodology to predict nutritional outcomes in the future. While the study faced significant challenges and attrition from 53 to 30 families (please see our previous two reports), the initial results show an improvement in the new zinc biomarker in mothers and children eating biofortified maize compared to those eating conventional maize. Results are still in process for iron.

Having positive results is a massive win for the organization. To date there hasn’t been a reliable biomarker for zinc status. While this biomarker is in its initial stages, we can show that there is a difference between the levels detected in mothers and children, and between the groups based on the amount of zinc they are consuming from biofortified maize. Semilla Nueva is working with INCAP and Cornell to prepare a much larger study which would allow for more statistically significant results and potentially begin to set standards for how to use the new biomarker to quantify deficiency levels.

USAID Development Innovation Ventures’ (USAID-DIV) US\$1.2M award allows for four new studies to answer the most critical questions to convince policy makers and allies of our work

After our initial submission in early 2022, USAID-DIV and Semilla Nueva co-designed a revised proposal in 2023. This updated proposal focused on gathering essential evidence that policymakers and technical experts need to understand the cost-effectiveness and impact of biofortified maize. The award, signed in September 2023, allows us to conduct four studies between 2024 and 2026, evaluating the potential nutritional and economic benefits of biofortified maize and biofortified maize seed subsidies. The data collected from these studies will be used to develop rigorous, interactive impact models and cost-effectiveness scenarios. These models and scenarios will be reviewed and utilized by relevant academic and policy institutions in Central America. The studies include:



Study 1 – Bioavailability RCT.

To be undertaken in 2024, this study will allow us to measure how much zinc and iron is absorbed by children who eat biofortified tortillas vs. conventional tortillas. Similar studies on the bioavailability of zinc in biofortified maize have been conducted in Zambia, but differences in maize milling and cooking practices between Central America and Sub-Saharan Africa can affect phytates and nutritional content in maize flour. Due to this difference, predicting the nutritional impact of biofortified maize in Mesoamerica will require its own bioavailability study, which will be methodologically similar to previous bioavailability studies. This study will enroll up to 56 children, aged 10-14, from the Guatemalan highlands, and use stable isotopes to measure the quantity of zinc and iron absorbed by children consuming biofortified tortillas vs. conventional tortillas. Semilla Nueva will provide the maize for this study, which will be implemented by the Institute of Nutrition of Central America and Panama (INCAP), overseen by Manolo Mazariegos, with technical oversight from UC Denver, who have prior experience leading similar studies in Guatemala.

Study 2 – Subsidy RCT.

With a pilot in 2024 and a higher powered study in 2025, this research will help determine the best subsidy model to scale the adoption of biofortified maize seeds in Guatemala. The study will measure 1) how different subsidy models (vouchers, agrodealer incentives, supply-side seed company subsidy) and subsidy amounts affect initial adoption and continued purchase of biofortified seeds among impoverished, smallholder farmers and 2) impacts on the livelihoods, food security, and climate resilience of participating farmers, allowing us to produce cost-benefit ratios for each subsidy type. Field work for this study will be led by Semilla Nueva, with the design, oversight, and publishing of results from the Paris School of Economics (facilitated by the Abdul Latif Jameel Poverty Action Lab (J-PAL) and University of Chicago's Development Innovation Lab (DIL).

Study 3 – Market Survey

This study will estimate the total number of maize farmers in Guatemala and their likelihood to use biofortified seeds at different price points. Using similar models to the national census, Semilla Nueva will hire a surveyor to sample national maize farmers about basic family demographics, maize growing practices, yield, pest damages, seed purchasing history, and barriers and motivators for purchasing seed. A subset of farmers will be selected for crop cuts (yield harvests) to determine the correlation between their estimated and actual yields. Data collected will allow us to rank seed preferences regarding yield, price, and agronomic performance, and estimate how changes to the subsidy structure or seed characteristics increase the number of farmers who may purchase biofortified seeds in the future.

Study 4 – Ex-Ante Model

As the three previous studies provide data, their results will be used to build an ex-ante/ex-post impact and cost-effectiveness model which will estimate the nutritional and economic impacts of different adoption scenarios, as well as the government costs to implement subsidies that would lead to these scenarios. The ex-ante impact model will provide estimates of zinc, iron, and quality protein intake and deficiencies of the national population, and then, using results of our bioavailability study, calculate how these deficiencies change based on increases in the number of farmers utilizing new biofortified maize seeds, as well as increases in farmer income. Results of the subsidy RCT and market survey will allow us to estimate the number of farmers likely to use biofortified maize seeds depending on subsidy designs and levels of financial support. The overall goal of the study is to create a rigorous



impact estimation tool that can help policy makers and policy influencers easily understand the costs and benefits of different biofortified seed subsidy policies.

Progress continues on Semilla Nueva’s first subsidy design RCT with J-PAL, PSE, and DIL.

Complementing the subsidy RCT that we illustrate above, Semilla Nueva also completed the first year of an additional RCT on subsidy design. With funding from Light a Single Candle, we provided 3,000 farmers with 25 lbs of seed in 2023. The idea is for them to use the seed for a year, see the impacts, and then be provided vouchers of different amounts to encourage them to purchase the seed for themselves at local agrodealers. The study will evaluate if additional discounts beyond our current subsidized price drive adoption. We’ll also evaluate if farmers buy more often if they live closer to agrodealers. Voucher design was approved with PSE and DIL and the second phase of the study will begin in early 2024.



FUNDING AND ADMINISTRATION

Summary

- Through renewals, new grants, and individual donations, Semilla Nueva received \$4.5M in funding from January through December 2023. Seven of our larger funders renewed their support for a total of US\$847,307/year. Six funders increased their support from US\$735,000 annually in 2022 to a total of US\$1,507,993 in 2023. Eight new funders and individual major donors granted a total of US\$2,438,818, with the largest being Rippleworks with a US\$1.5M donation of unrestricted funds.
- USAID Development Innovation Ventures (USAID-DIV) has approved a US\$1.2M award to be disbursed from 2024 to 2026. Semilla Nueva and USAID Guatemala continue the co-creation process for a US\$4.5M award to fund our subsidy pilot and breeding efforts.
- We expanded our 2023 budget from US\$2.9 to US\$3.3M and set our 2024 budget at \$4.7M.
- Cash-on-hand and committed funding cover 93% of the 2024 budget, providing cash flow for nine months.
- Our financial statements are now in compliance with US-GAAP for nonprofits. Our 2023 External Audit will be available by mid-March 2024.
- We hired 11 new employees in 2023 to support the expansion of our activities, and ended the year with 45 full-time employees. Six additional positions were opened in early 2024, Three were already filled by February 15th.

Table 8: Institutional and Major Donor Support (>\$10k/yr) in 2023 (US\$)

	Funders previous annual gift in 2022	Funding received in 2023 ⁶
Five Funders who expanded support	735,000	1,507,993
New Funders	-	2,438,818
Six Funders who renewed support	847,307	847,307
TOTAL	1,582,307	4,794,118

New funding allowed Semilla Nueva to increase our budget from US\$2M in 2022 to US\$3.3M in 2023 and US\$4.7M in 2024. We believe we can sustain these higher budget levels

Semilla Nueva’s funding from Vitol, Dovetail, Eric Martin, John Trone, the Pulte Family Charitable Foundation, and Light a Single Candle expanded from US\$735k in 2022 to US\$1,507,993 over the course of 2023. We received US\$847,307 in renewed or continued funding from Cartier, Mulago, Rotary, The Innocent Foundation, Dave Smith, the Arvy Foundation and the International Foundation. Finally, we received US\$2,438,818 in new funding from Rippleworks, Shockwave, Focus Central America, Praxis, USDA-CRIA, Kirke Lathrop, and other individual major donors. The largest new donor, Rippleworks, provided a one time, US\$1.5M grant to catalyze Semilla Nueva’s growth. As a result of this grant, we increased our 2023 budget from US\$2.9M to US\$3.3M, and our 2024 budget to US\$4.7M.

Much of this funding comes in recognition of our progress in transitioning from a seed company selling biofortified seed to an integrated model dedicated to decreasing the costs of developing new biofortified seeds, scaling subsidy pilots with seed companies, and institutionalizing these subsidies.

⁶ Includes full sum committed by donors in grant agreements, including one-time, multi-year grants and sub-contracts to third-parties that are not reflected in Semilla Nueva’s 2023 cash flow projections (Table 9)



Funders prioritize different impacts (nutrition, livelihoods, climate resilience, for example), but each is betting on a scalable solution that contributes to the solution of one or more of these challenges.

Given current likely and committed funding (excluding our pending large USAID grant), we currently have sufficient funding to operate until October 2024, with 93% of the 2024 budget covered. The increased burn rate will require significant increases in fundraising in future years, especially considering the Rippleworks funding is a one-time award. We believe increased fundraising is feasible given our projected growth in impacts, development of partnerships to create third-party impact studies, potential funding from USAID, and new professional fundraising staff.

USAID Development Innovation Ventures (USAID-DIV) confirmed a US\$1.2M award; Semilla Nueva and USAID-Guatemala are in final stages of negotiation of a \$4.5M grant

After our initial submission in early 2022, USAID-DIV and Semilla Nueva co-designed a new proposal in 2023. This new proposal focused on collecting the most valuable evidence policymakers and technical experts need to understand the cost-effectiveness and impact of biofortified maize. Dr. Erick Boy, head of nutrition at HarvestPlus and member of our Board of Directors, assisted in designing the proposal strategy based on his professional knowledge and global demand for evidence on biofortified maize. The final contract was signed in September 2023. An overview of its four studies is available in the *Impact Evaluation* section above.

As mentioned in the *Institutionalizing the Subsidy* section, USAID Guatemala and Semilla Nueva are in the final stage of co-creating a US\$4.5M, fixed amount award to be implemented by Semilla Nueva. Semilla Nueva and USAID have finished key steps in the process including designing the award amount, milestones, project description, and risk assessments and mitigation efforts for environmental and social impacts. After USAID finalizes a Request for Application (RFA) and Semilla Nueva synthesizes the previous documents into a final application, the last step involves negotiating and signing the final contract.

It's important to note that this is a fixed amount award, which involves payment against deliverables and significantly minimizes the amount of financial and administrative reporting that USAID grants normally entail. This award was made possible by Semilla Nueva's successful completion of two smaller USAID subcontracts in 2020-2022. Competent completion of the award could pave the way for future large grants from USAID, especially as Semilla Nueva expands to new countries.

Semilla Nueva executed 97% of our 2023 budget. The 2024 budget increases 49% to \$4.74M

As of December 31, Semilla Nueva executed 97% of the total budget approved (US\$3.28M). As shown in Figure 7, we spent more than anticipated on Seed Development (R&D) due to increased need of daily wages, costly licenses, and the purchase of an industrial seed dryer to expedite the backcrossing process. We also spent more on administration mainly due to the move to much more adequate new office space in Guatemala City.

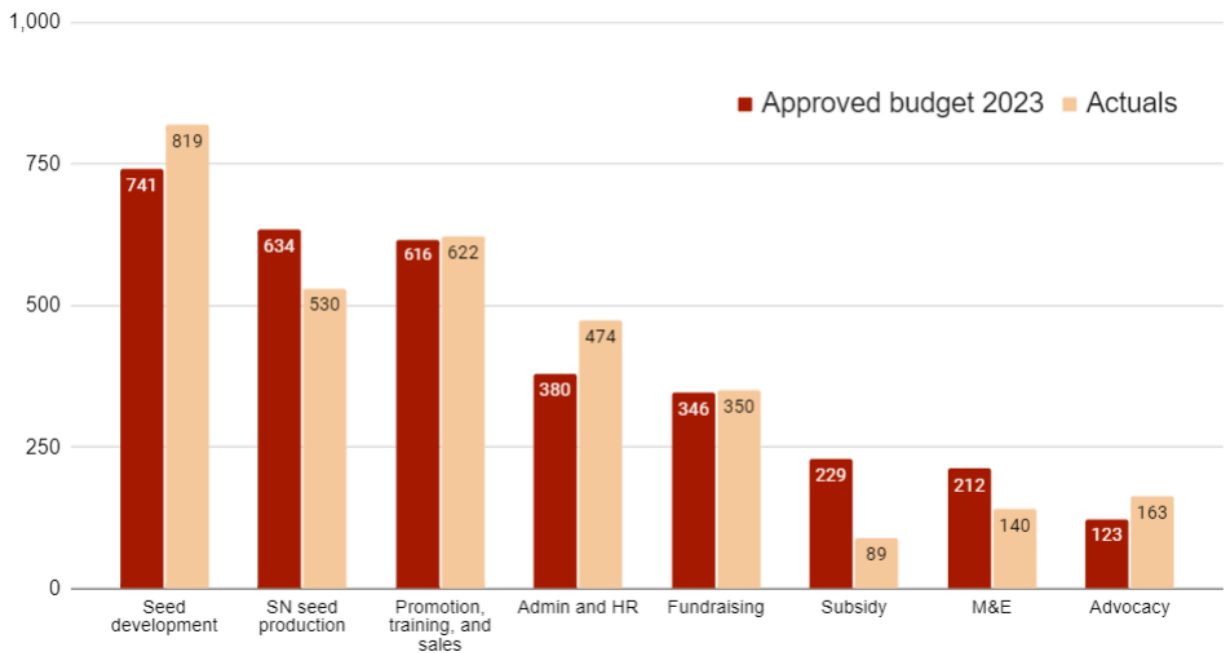


Figure 7: Semilla Nueva 2023 budget vs. expenditures (US\$1,000s)

After an organization-wide, participative and hands-on budgeting process, Semilla Nueva’s budget for 2024 was set at US\$4.74M, representing a 49% increase vs 2023 actual execution. As mentioned in our previous report, we have updated our budget categories according to our strategic focuses: subsidy, seed company support, advocacy, seed development, etc. Table 9 shows our historical financial data and forecast for the next three years.



Table 9: Semilla Nueva Financial history and projections (US\$ 1,000s)

Financial history and projections							
Costs (\$)	2022	2023*	2023 actuals	Execution %	2024	2025	2026
SN seed production	393	585	490	84%	703	787	669
Seed company support					89	99	111
International expansion					174	194	218
Promotion, training, and sales	397	568	574	101%	830	930	1,041
Subsidy to other seed companies	70	212	82	39%	246	521	617
Advocacy and partnerships	194	114	151	133%	195	218	244
Seed development	573	684	756	111%	1,032	1,136	1,249
Impact evaluation/M&E	65	195	129	66%	679	726	777
Admin and HR	310	350	438	125%	417	467	523
Development	191	320	323	101%	377	422	472
TOTAL EXPENSES	2,193	3,028	2,943	97%	4,740	5,500	5,922
FUNDING SOURCES							
Bilaterals and multilaterals	0	100	0	0%	1,025	833	607
Foundations	1,772	3,755	4,470	119%	3,200	3,900	4,300
Individual donors	155	182	180	99%	600	1,000	1,400
OTHER INCOME SOURCES							
Net sales income	102	119	138	117%	207	219	195
Exchange rate gain	109	0	-14		0	0	0
Bank interest/other	1	54	47	87%	84	96	108
TOTAL INCOME	2,139	4,209	4,822	115%	5,116	6,048	6,609
Surplus or deficit	-54	1,181	1,879	159%	376	548	687

* 2023 budget decreased from US\$3,280M to US\$3,028M due to currency restatement from 7.2 to 7.8 quetzales per dollar.

Cash and commitments for 2024 covers nine months of operating expenses

As shown in Table 10, we started 2024 with cash availability of US\$1.4M and confirmed funding of almost US\$3M from the continued support from Cartier (US\$400K), Dovetail (US\$350K), Vitol (US\$200K), USAID DIV (US\$700K), CRIA (US\$200K), Rippleworks (US\$800K donation made in 2023, but which we reserved until 2024), and individual donations (US\$276K), resulting in a 7% funding gap (US\$314K).

Furthermore, risk adjusted potential funding represents an additional 2.4 months of cash. The Board designated reserve balance is US\$845K, representing 2.1 months of operating expenses if required.



Table 10: Projected cash-flow and funding gap 2023-2024 (US\$ 1,000s)

Financial projections 2024 (US\$ 1,000s)		
Cash beginning balance*	\$1.378	31%
Confirmed funding	\$2.926	66%
Interest gain	\$121	3%
Total cash available	\$4.426	100%
Expenses projections 2024	\$4.740	
Funding gap	-\$314	7%
Cash availability in months	9	months
Other leverage sources		
Risk adjusted potential funding	\$955	2.4 months
Board designated reserves balance	\$845	2.1 months

Financial statements are in compliance with US-GAAP for nonprofits; 2023 External Audit is underway

Semilla Nueva’s 2023 financial statements are now in compliance with US-GAAP for nonprofits. The main change in terms of presentation was the classification of grants, which now separates restricted donations from unrestricted donations. Our external audit for the 2023 financial year is being conducted by Manuel Cervantes y Asociados, partners of LEA Global. Their report will include an assessment on compliance with US-GAAP for nonprofits. The audit report is expected to be available by mid-March.

11 new hires in 2023, six planned in 2024 to support increased activities

In 2023 we hired and onboarded 11 new staff members to fill new positions (six for Operations, two for Research and Development, two for Finance, and one for Monitoring and Evaluation), resulting in 32% increase in headcount. We ended the year with 45 full time employees (43 located in Guatemala, one in Argentina, and one in the US).

For 2024, we plan to hire six additional new positions. By February 2024, three of these positions have already been filled (two in Operations and one in Development), and three are still pending (one in Finance/Admin, one in Monitoring and Evaluation, and one in Research and Development). If USAID funding is approved, we would potentially hire two more to lead the projects.

December organizational culture survey showed important decrease in all dimensions in the last six months of the year

Our end of year anonymous survey based on the *Great Place to Work*® methodology dropped in average 21% compared to December 2022 results, and a 19% compared to mid-2023 results across all dimensions:

- general appreciation of the workplace
- camaraderie between teams
- credibility related to communication and decision making process



- impartiality and fairness in employee’s compensation
- pride in the organization and sense of belonging, and
- respect for the employee development and work-life balance (Figure 7).

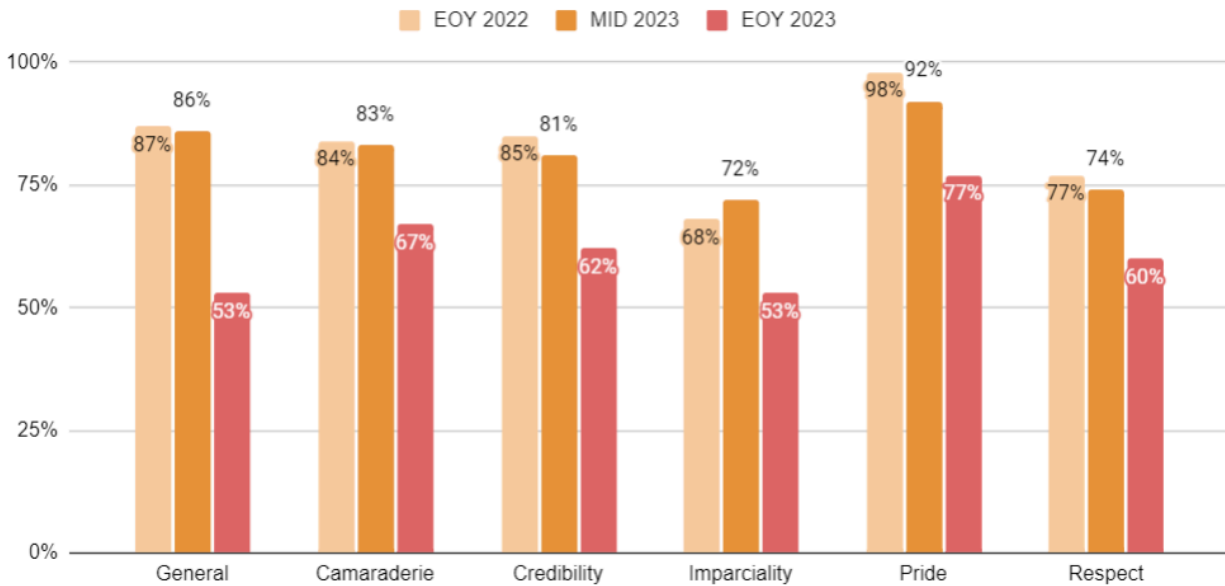


Figure 7: Semilla Nueva Great Place to Work results by dimension 2022 vs 2023

As we explored the data, we found one very interesting trend. As shown below in Figure 8, the group that was most dissatisfied was middle management. As Semilla Nueva has doubled in size in the last two years, we began to build middle management for the first time. Most of these employees had either been hired in the last year, or began to manage other staff for the first time within the last year.

In December, the Leadership Team brought all of the middle managers into a half-day meeting to discuss the results. Common observation from this group included a lack of participation in organizational and strategic planning, miscommunications regarding changes to plans, lack of understanding of the responsibilities of other groups in the organization, and the implementation of new initiatives that affected daily operations.

Some of these results stem from a lack of support from the leadership team to this group, some comes from new difficult projects we have taken on in the last year or the full restructuring of our breeding program that took place mid-year. But there were other internal factors that were also important. One is that Semilla Nueva has a tendency to do annual planning with broad project objectives and outcomes. Sometimes by mid-year we realize that we planned too many things in the same month or didn't think through the details of what would be necessary to execute on an objective. Sometimes mid-year we are busy with ongoing projects and don't have the time to fully develop the new projects for the second half of the year. We decided we needed to find a way to plan more in advance, more in depth, and in a participatory, more inter-departmental way.

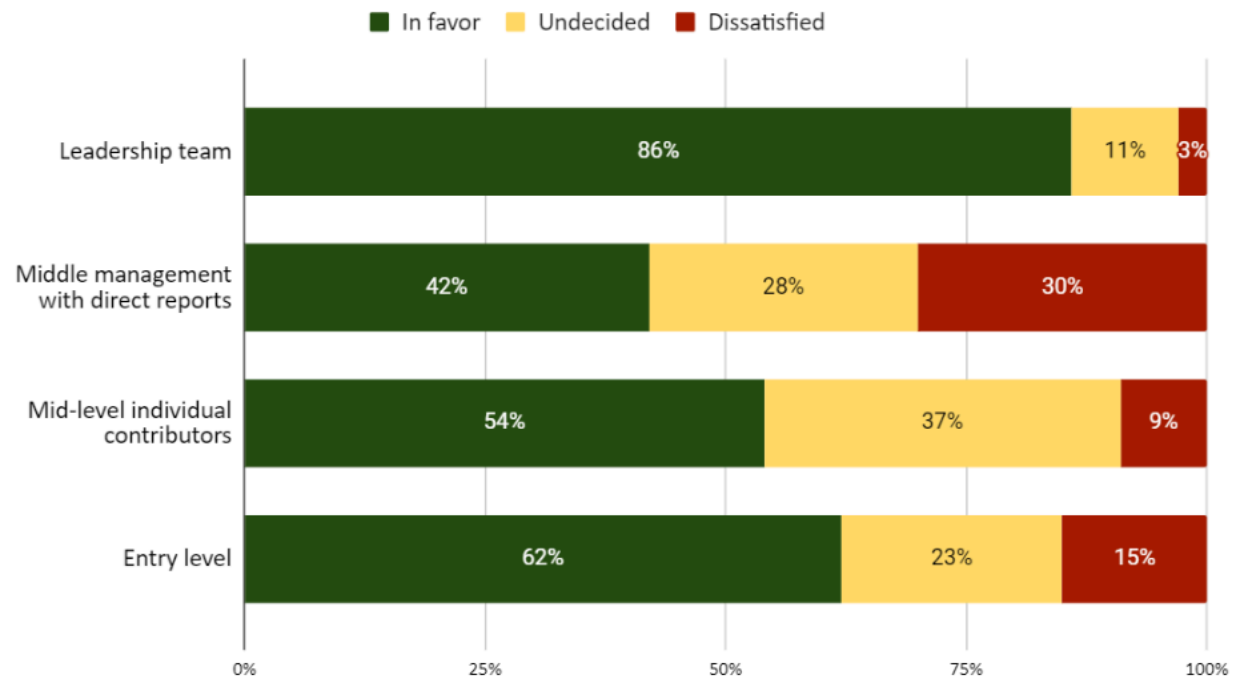


Figure 8: General satisfaction, December 2023 *Great Place to Work* survey by employee segment

In late December and early January, we took the following steps:

1. We changed the format of our team retreat to ensure a full day to explore the organization's strategy and spent four hours discussing strategic questions and exploring ideas.
2. We formed an Expanded Leadership Team (ELT) comprised of 14 middle-management employees. The ELT now meets once a quarter to review planning and results. Members also receive an update from the leadership team on a weekly basis.
3. The extended leadership team helped lead the 2024 annual planning process. Department leads worked with their middle managers to build annual plans and budget requests for their department. After an initial revision, the plans were presented to the entire leadership team and extended leadership team and revised as an organization. This process took several days, but it allowed everyone who manages a team to know the essential activities of everyone else who is managing a team.
4. We paid for a survey of salaries and benefits offered to employees in Guatemala. We identified the employees who were farthest from the market mean and prioritized their salaries in 2024. Other employees received a 6.6% salary increase, with the exception of the Leadership Team who's salaries stayed the same as in 2023.
5. We will hire new positions to help ensure better work-life balance. To provide a healthier work environment and avoid a higher employee turnover, we plan to hire six new positions in 2024 to provide the bench strength needed to allow staff to utilize planned time off and leverage the ½-day-off per month benefit we offer as part of our health and wellness initiative, without affecting operations.