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Creating shared value and positive legacies from a transitional working landscape in Panama

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Abstract

This case study documents the early formative steps a private mining and land development firm is taking on its journey to co-create a post-mining vision with stakeholders in Central Panama. The term 'mine closure' is intentionally avoided to shift our planning focus away from liabilities and closure of the mine towards creating opportunities from the continuous transitioning of a landscape. In so doing, creative design energies are redirected to catalysing socio-economic diversification early on and in tandem with mine development. Using a novel application of Systemic Design techniques to the mining context, we demonstrate how the conventional strategic mine planning function for the company has been replaced with a transitional landscape planning approach, placing greater emphasis on progressive rehabilitation and the value it can bring to the community. Nearly every technical and strategic design decision has been influenced by collaborative dialogues with stakeholders over several decades. Corporate expertise in real estate development, mining, energy, and agriculture is being leveraged to develop the Mina Santa Rosa project and other private land holdings as shared spaces from which diverse, long-term socio-economic activity can be incubated. Each 'Shared Space Initiative' will be co-designed with the community and regional partners, with a special emphasis on engaging students from primary school through university in the design, monitoring, and care of these properties. 'Shared Opportunity Ventures' will establish satellite enterprises with local entrepreneurs and regional partners to generate benefits from all extracted materials including waste rock as aggregate, mill fines and rock dust as soil amendments, and paste tailings for a range of industrial applications. Finally, a collaborative research agenda is being drafted to facilitate the effective transitioning of the Mina Santa Rosa mine to a multi-functional and resilient production landscape that will improve food security in the region while supporting native biodiversity. By examining how each corporate decision has been reshaped by stakeholder input, we hope to inspire further debate, inquiry, and co-innovation that will leave a positive legacy long after 'the last ounce is poured.'

Keywords: *shared value; systemic design; post-mining land uses; stakeholder engagement; integrated landscape management; agroecosystems; transitional working landscapes; tropical permaculture*

1 Introduction and project context

In early 2000, the residents of Cañazas in the Veraguas Province of Panama lived an experience not uncommon to mining communities whenever depressed markets or technical failures result in the premature closure of a mine and the departure of a foreign company. In the aftermath of unkept promises, unmet payrolls, limited economic opportunities, and environmental legacies of an abandoned mine at their doorstep, the prospect of reopening the mine understandably agitated old wounds and rekindled community divisions. After riots ensued, fires were set, and mine infrastructure was destroyed, and with memories of past cyanide spills still lingering, fears of history repeating itself understandably resurfaced. When the new owners acquired the property a decade later, the community was naturally suspicious. Public statements by the Mayor of Cañazas in 2012 acknowledged that although some sectors of the district supported mining development, local authorities were not universally supportive of resuming mining activity in the area (La Prensa 2012). It is against this backdrop we document how Veragold Mining Company has worked over several decades to reopen a brownfields project. Through ongoing dialogues with the community, the

company has sought to understand the needs, desires, and fears of its stakeholders, and has allowed each interchange of ideas to reshape the Mina Santa Rosa project.

2 Application of systemic design to the mining context

Past critiques of the minerals sector have duly noted that economic linkages stemming from a mine project tend to focus on building a local economy purpose-built to service mine needs instead of broader-based economic transformation (Weldegiorgis 2021). Additionally, closure planning has generally focused on a 'step change' away from the mine-centric economy that is linked to a future state of closure; a temporal milestone which has the potential to change several times over the life of a project if new resources are discovered or market conditions precipitate temporary or pre-mature closure. We submit Systemic Design (Bistagnino 2011), a practice grounded in the principles of industrial ecology, biomimicry, and cradle-to-cradle thinking at the territorial scale (Ceschin 2019), could prove useful in answering these critiques by redirecting creative energy and resources towards economic diversification in parallel with the development of the mine. The design approach integrates

> *"local socio-economic actors, assets, and resources with the aim to create synergistic linkages among productive agricultural and industrial processes, natural processes, and the surrounding territory" (Ceschin et al. 2019, p. 101).*

The Systemic Design Approach (SDA) has been used to promote rural development (Barbero & Bicocca 2018; Bicocca 2016), link rice and wine value chains in Italy (Fiore et al. 2020) and facilitate Europe's transition towards a circular economy (Barbero 2017). This case study illustrates how the Systemic Design approach can be applied early in mine project planning to conceptualize, identify, and therefore optimize economic linkages during each stage of mine development and after the post-mining vision has been realized. To our knowledge this would be the first application of the Systemic Design method to a mining context.

2.1 Gathering community feedback to inform project design decisions

A discussion about engineering-decision making practices in the minerals sector should be prefaced with a brief detour into the evolution of stakeholder engagement theory. Examinations into the wealth of knowledge developed by practitioners in the extractive industries found that meaningful dialogues are inextricably linked to building constructive stakeholder relationships based on mutual understanding, reciprocal trust, and procedural fairness (Mercer-Mapstone et al. 2017). Other investigations found best practice is contingent upon the intent of the company, resources available, amount of time allocated to and the quality of engagement activities, and community readiness and capacity to participate (Fraser et al. 2019). Other notable findings recognized that (1) the biggest challenge to engagement is earning stakeholder trust and (2) community input to mine design remains limited (Fraser et al. 2019). This case study seeks to add to the literature by illustrating how stakeholder engagement has informed Veragold's project decisions to date, and how ongoing feedback will be weaved into each subsequent mine planning and design iteration.

Dialogues between Veragold Mining Company and residents began in 2008 when the company first acquired the property and mineral concessions. When Veragold learned previous operators had left without honouring final pay checks, the company paid the back wages and severances of former mine workers still living in the area. Those who voluntarily remained to properly close the cyanide heap leach operation were also compensated for their additional time served. Veragold began meeting more frequently with the community which led to the creation of two formal consultation forums. In 2010, a regional, district-level Political Committee was formed which includes elected representatives from the following districts: Cañazas, Cerro de Plata, El Aromillo, El Picador, Las Cruces, Los Valles, San Jose, and San Marcelo. In 2012, a second Community Committee was established to engage political and civic leaders of the town of Cañazas located 1 km north of the mine. This committee includes the mayor of Cañazas, the Cañazas District Representative, the Director of the San Xavier Hospital, the Director of the School Board, the Chief of the Police Department, and three nominated civic members to ensure balanced representation of the different political, social, and economic interests of the town. All social programs currently managed or sponsored by the company were

co-developed with stakeholders to directly address issues raised during committee dialogues. To create an opportunity for views that may not be expressed or represented during regular meetings of the two committees, several open house meetings are hosted at the mine each year.

Formal community surveys were conducted in October of 2012 by a third-party environmental consulting firm as part of the permit approval process for development projects in Panama. Poverty, malnutrition, and limited economic opportunities in the area were listed among the top regional issues identified by survey respondents. Other prominent areas of concern directly related to the mine project itself included (a) fear of potential exposure to cyanide, (b) risk of tailings impoundment failures that might endanger the community and the environment, and (c) the loss of biodiversity from deforestation.

In 2013 during a World Water Day event, conversational field interviews in Cañazas were conducted by a student from McGill University working in partnership with the nonprofit environmental advocacy organization Centro de Incidencia Ambiental Panamá (CIAM) that had recently led a national campaign to ban open pit metal mining in Panama. The researcher returned a month later with a group of 30 students from a field studies course offered by McGill University and the Smithsonian Tropical Research Institute. Random interviews were conducted during a community gathering and both pro- and anti-mining perspectives were expressed by interviewees (Phipps 2013). The researcher acknowledged his association with CIAM may have influenced responses received since interviewees demonstrated a general distrust of apoliticism and expected the researcher to express his opinions first (Phipps 2013). Despite any potential embedded bias, each perspective summarized was considered to have informative value and was included in the compilation of ideas, opinions, and sentiments Veragold has considered in its project planning deliberations to date, especially articulated visions of what development should look like for the region.

2.2 Redesign of mill process

When the CEO first met the community in 2015, concerns about the risks associated with cyanide and tailings dams dominated the conversations. Even though all permit approvals for a heap leach process were in hand, Veragold initiated a new design iteration to evaluate other alternatives that could possibly address these community fears. Once feasibility was confirmed by testing of drill core and existing heap leach material, the ore processing flowsheet was revised to (a) use flotation that would eliminate any outdoor use of cyanide and (b) produce paste tailings instead of conventional tailings. These and other design changes have created new opportunities to generate longer-term benefits from all extracted materials, inclusive of waste rock, paste tailings, and future agricultural output produced sustainably from the regenerated landscape which will be the focus of the Shared Opportunity Ventures presented in Section 4.

2.3 Transitional landscape planning

The term ‘closure’ is used sparingly to reinforce a paradigm that mine projects should be viewed as working landscapes in constant transition. Furthermore, the conventional ‘strategic mine planning’ function has evolved into a ‘transitional landscape planning’ approach to ensure landscape-scale framing of all management decisions. In so doing, additional emphasis is placed on the benefits that progressive land rehabilitation can bring to community stakeholders, as well as project investors who have a long-term vested interest in managing the landscape as an asset that will generate growing shared value after mining.

The desires to reduce regional poverty, improve agricultural productivity, ensure food security, and enhance regional biodiversity are shared by Veragold and the community. Several approaches seeking to balance these goals were explored including integrated landscape management (Scherr et al. 2014), biodiversity conservation efforts on working tropical landscapes (Dulloo et al. 2019; Harvey et al. 2008;) and the practice of permaculture (Holmgren 2020). A preliminary post-mining vision for the Mina Santa Rosa project was compiled from ideas expressed in formal community surveys and ongoing community forums held in recent years (Table 1). A ‘first draft’ Transitional Landscape Plan (TLP) for the Mina Santa Rosa Project supporting different elements of the vision will be shared with the Veragold Advisory Committees and the broader community *before* the current exploration drilling is completed and the next mine design iteration begins.

The purpose of the preliminary vision and TLP is to begin engaging the community more directly in the mine transitioning process, providing an opportunity to invite community feedback and input that can enhance, refine, or possibly reshape Veragold's long-term plans for its private land holdings. The TLP includes proposals for other company lands that, although not directly impacted by the mine activities, have the potential to synergistically catalyse more diverse long-term economic opportunities in the region (See Section 3).

Table 1 Draft vision and transitional landscape planning goals for the Mina Santa Rosa Project, Panama

Vision & Goals	Articulation
Aspiration	The Veraguas province will become a tourist destination and regional hub for sustainable agriculture, artisans, cottage industries, and high-quality intergenerational research supported by a resilient ecosystem.
Design Goal 1	Create a multifunctional landscape that meets the nutritional needs of the region and catalyses a diverse sustainable economy using best practices in tropical permaculture, agroforestry, and silvopasture.
Design Goal 2	Provide infrastructure (physical, financial, educational) to facilitate production of non-perishable products that utilize all crops and agricultural residues with the potential for certification under internationally recognized responsible sourcing initiatives.
Design Goal 3	Develop company assets to serve as tourist destinations and intergenerational working landscape research outposts where visitors, scientists, and practitioners interested in conducting long-term multifunctional landscape field studies will be welcome.
Design Goal 4	Generate interest in ecotourism, agritourism, and geotourism by hosting educational tours for students, scientists, biologists, geologists, journalists, and tourists interested in learning more about central Panama.

2.4 Mine design meets permaculture

A comprehensive comparison of permaculture principles and the nascent scientific discipline of agroecology identified several areas of overlap between these communities of practice and suggest permaculture's central focus on the conscious design of agroecosystems can serve as a viable link between agriculture research, theory, and practice (Krebs & Bach 2018). We posit that permaculture can offer valuable insights on how post-mining landscapes, if designed with proper intent and thoughtful integration with other design elements on the landscape, might yield more diverse long-term benefits than conventional approaches.

A preliminary post-mining layout for company lands using basic permaculture design techniques was prepared to frame future discussions with stakeholders (Figure 1). The design method calls for designating zones according to the frequency and intensity of intended management, emanating outward from areas of highest human use to least frequent use until the boundaries of 'wild' natural habitat are reached. A mixture of habitat trees and agricultural crops are envisioned on each terrace of the rock storage facilities. The paste management facility and rock landforms will be transitioned into grazing lands intermixed with tree species producing nuts, fruits, or palm oil. Slopes would be vegetated with native grasses, herbaceous plants, and tropical flora to support pollinator species and small native fauna. Mine sequencing and production scheduling supports concurrent land rehabilitation so topsoil removed from new disturbance areas can be directly placed on each lift to keep living elements of the soil and existing seed bank viable.

The Mina Santa Rosa project has the potential to be a significant centrally located source of aggregate and construction material which Veragold plans to develop in partnership with the community. Mine planning considers several objectives including strategically sorted placement of rock in landforms and backfilling of some pits to facilitate rehandling for longer-term beneficial use by satellite enterprises. Depending on market demand and startup time needed for these companion enterprises, some terraces may be re-disturbed after

all gold ounces are sold. However, Veragold intends to transition all disturbed hectares as soon as practicable to conduct valuable working landscape research on its private land holdings. Meanwhile, current generations will benefit from the temporarily rehabilitated landscape (e.g., carbon sequestration, crops, wildlife habitat, etc.) until underlying stockpiled rock is rehandled and put to beneficial use.

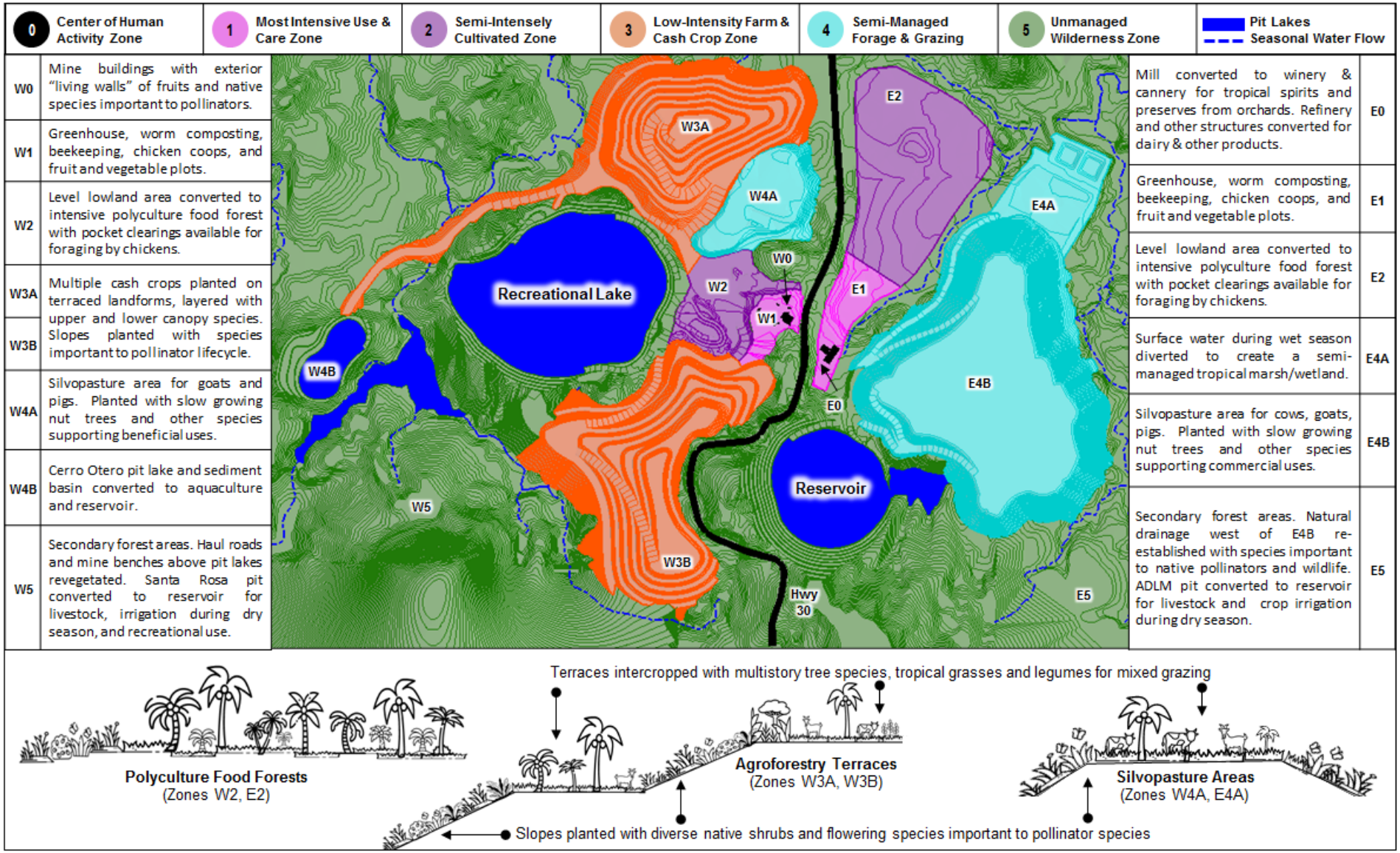


Figure 1 Proposed Cañazas permaculture park and working landscape field laboratory at the Mina Santa Rosa Project in Veraguas Province, Panama

2.5 Infrastructure

In support of the vision and transitional design goals, all mine infrastructure will be leveraged for future use. Administration buildings and ore processing facilities can be converted to support future industries using crops (and their residues) grown on the progressively rehabilitated landscape. A hydro-electric facility 6 km west of the project provides energy to the National Grid. Veragold will connect to the grid and a transformer station will be sized to distribute project power with excess capacity available to share with the community. Similarly, broadband infrastructure installed for the mine will have excess capacity for residents, schools, and businesses. The mine operation will make its ambulance and fire truck available to supplement existing emergency services in the region. Locations are being evaluated for a corporate 'villa' equipped with individual housing units so visiting employees, contractors, university students, and guests can use services and amenities in Cañazas instead of Santiago which is located 30km to the south. This corporate complex would be designed to support future tourism, events, and retreats as the economy transitions over time.

2.6 Mapping system flows

We used Systemic Design mapping techniques to formulate the preliminary TLP for the Mina Santa Rosa project. Visual diagrams depicting envisioned material and socio-economic flows across (a) the regional landscape during gold-silver mining operations (Figure 2) and (b) a conceptual post-mining system (Figure 3) will be presented to stakeholders for feedback and further engagement. In each system diagram, Shared Space Initiatives (highlighted in yellow) represent land holdings owned or rented by Veragold to catalyse near and long-term economic activity. Shared Opportunity Ventures (highlighted in light green) represent future community partnerships that will generate value from all extracted material, including crops and agricultural by-products grown on the continuously changing landscape. The solid arrows represent primary material flows within the system and dashed lines represent by-product material flows within the system. The grey solid block arrows represent financial flows within the system boundary and dashed block arrows represent financial flows across the system boundary. A self-sustaining community fund (highlighted in magenta) will be established using financial flows generated from outside and within the regional system (See Section 4.6).

3 Shared space initiatives

Calls for companies to create 'shared value' for a broader swath of stakeholders have gained prominence in several fora of scholarly debate and professional exchange since its introduction (Porter & Kramer, 2011). Veragold is operationalizing the notion that creating shared value begins with creating shared space and shared opportunity. Veragold has developed six initiatives to serve as shared spaces from which current community needs are addressed and future socio-economic activity can flourish. Two spaces currently serve the community and region, and four other land-use proposals in development are integral to catalysing a broader regional vision that will co-evolve with stakeholders and regional partners as the project advances.

3.1 Community kitchen and farmstead

Beginning in 2010, Veragold was the main donor of the Church Community Kitchen which provided daily meals for school children and occasional evening meals for the elderly. The Kitchen closed in January 2020 after a change in Church leadership and remained closed due to COVID-19 restrictions. During the pandemic lockdowns, Veragold continued to provide supplemental food, medical, and household supplies to families in need within the District of Cañazas and town of Remance. A new property rented from a local business owner was renovated and serves as the Veragold Community Kitchen, or 'Comedor'. The property includes 0.6 hectares of degraded land that Veragold enhanced to demonstrate organic smallholding practices. School children are engaged in the vegetable gardening and tending of the chickens (Figure 4). A small herd of cows graze on Veragold lands to provide milk for the kitchen; goats to produce cheese will be purchased next year.

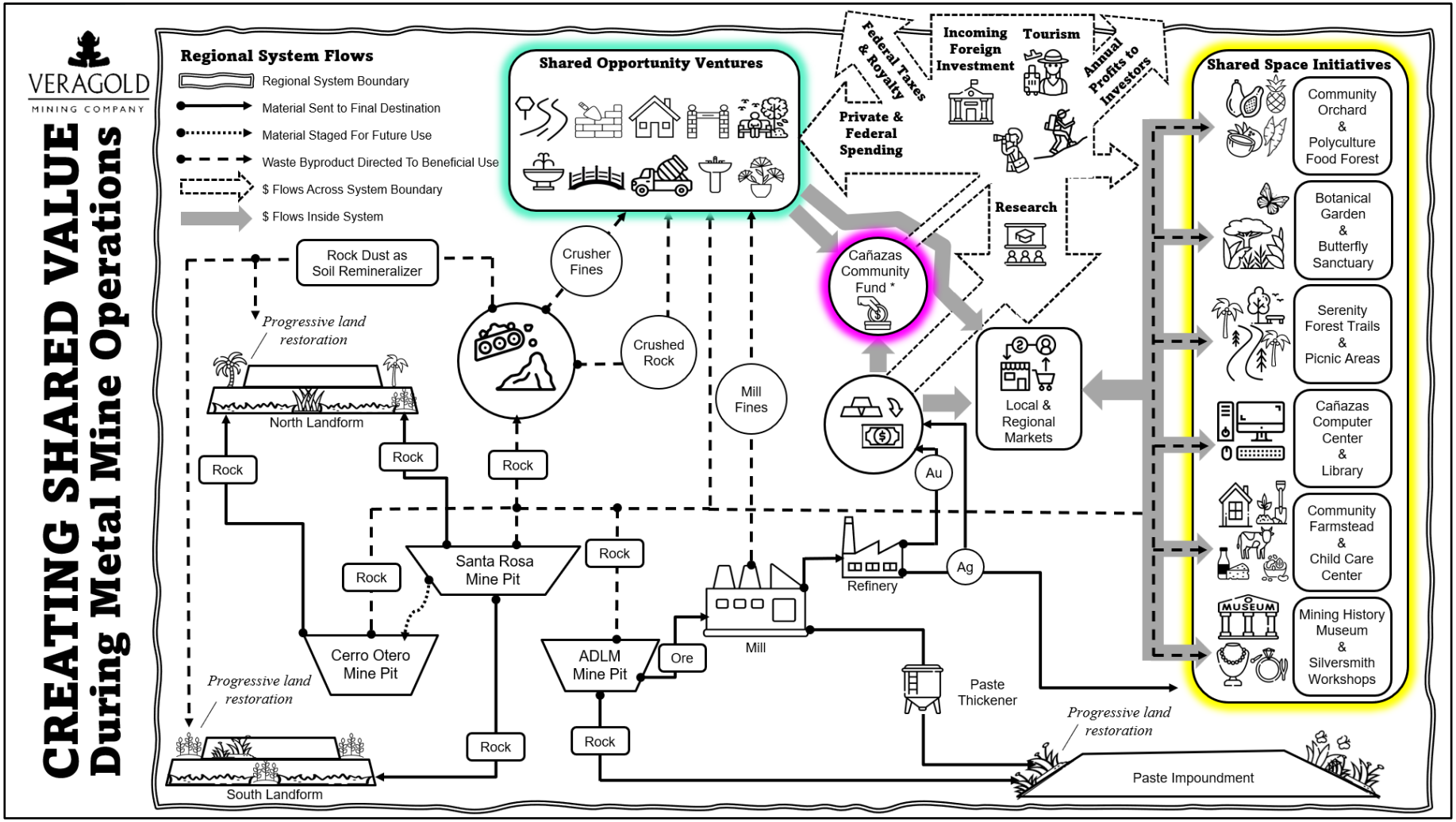


Figure 2 **Systemic design mapping to identify material and financial flows of the Mina Santa Rosa Gold-Silver Project in Panama during operation and progressive transitioning to agricultural use. Veragold's Shared Space Initiatives (highlighted in yellow) will be co-designed with stakeholders to address current community needs and catalyse diverse long-term economic activity. Shared Opportunity Ventures (highlighted in light green) are the enterprises that will be co-developed with community and regional partners to generate value from all extracted material and by-products. A percentage of the original investment capital and annual metal sales proceeds will be directed to the Cañazas Community Fund (highlighted in magenta)**

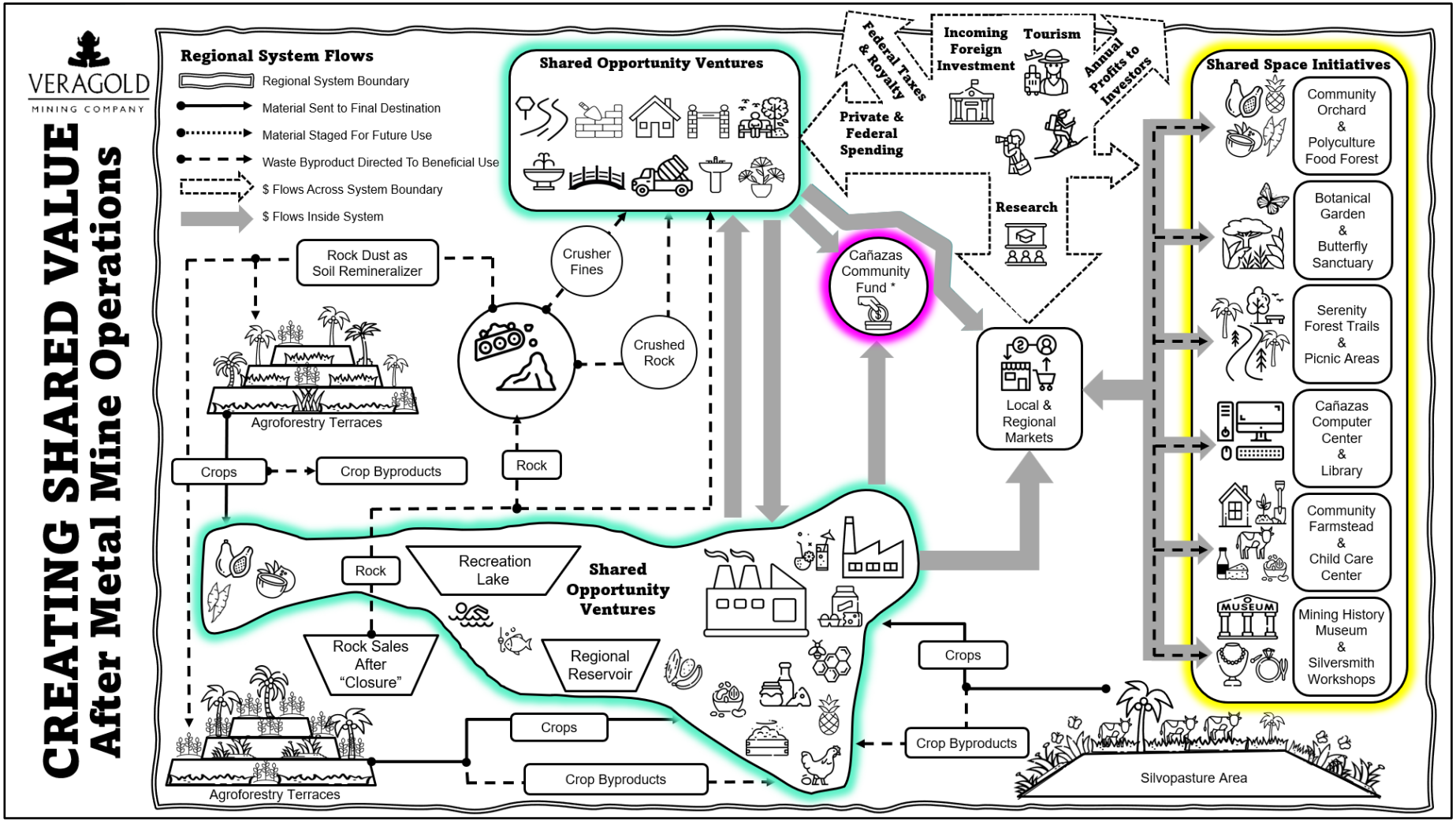


Figure 3 **Systemic design mapping to identify material and financial flows of the Mina Santa Rosa Gold-Silver Project in Panama after metal production ceases and lands have been transitioned to a resilient, multifunctional agroecosystem. Veragold's Shared Space Initiatives (highlighted in yellow) will be co-designed with stakeholders to address current community needs and catalyse diverse long-term economic activity. Shared Opportunity Ventures (highlighted in light green) are the enterprises that will be co-developed with community and regional partners to generate value from all extracted material and by-products. The Cañazas Community Fund (highlighted in magenta) will accrue a sustainable corpus that can continue to grow using additional proceeds contributed by the Shared Opportunity Ventures**

(a) (b) (c)

(d) (e) (f) (g)

Figure 4 **Community kitchen and farmstead. (a) Serving children breakfast before school; (b) Property renovated by Veragold; (c) Meals provided during school vacation; (d) Garden growing salad greens, cucumber, beans, tomatoes, and corn; (e) Veragold cows grazing on mine property; (f) Chicken coup behind the Comedor; (g) Weekly surplus of eggs shared with local families**

3.2 Cañazas Info Plaza

In the fall of 2022, a regional computer center and internet cafe (Figure 5) was established in partnership with the Infoplazas AIP organization to bridge the digital divide in Panama (Infoplazas AIP 2022). Computer stations and printers provide a setting for students to supplement their education. Community members can receive online training, prepare business plans, and work to procure microcredit loans and other financing options. An entertainment center, chess sets, and board games are available for public use. Veragold offers English and art lessons to students and community members in coordination with the primary and secondary schools in the district.

(a) (b) (c) (d)

Figure 5 **Regional Info Plaza for Veraguas Province, a joint project of Veragold and Infoplazas AIP located across the street from the Community Kitchen. (a) Chess sets, board games, and TV available for community use; (b) Property across the street from the Comedor is rented by Veragold to host Info Plaza services; (c) Twelve computer stations with printer and internet access; (d) English lessons offered by Veragold**

3.3 Cañazas mining museum and cultural center

Five recognized eras of exploration and mining activity occurred in Panama, dating from Paleoindian quarrying to Pre-Columbian gold mining to the modern day (Redwood 2020). Indigenous gold mining activity in Panama pre-dates the Spanish conquest of the region by nearly 1400 years, and archaeological evidence suggests gold hammered adornments worn by chieftains rival those of Peru (Redwood 2020). With no mining history museum in Panama, Veragold engaged with stakeholders to explore opportunities to fill this void. A facility has been located that can accommodate exhibits and multiple workshops where silversmiths and artisans can produce traditional Panamanian crafts, jewellery, tableware, and reproductions of pre-Columbian art, known as huacas. Plans to develop the infrastructure and training programs needed for local artisans to safely recycle precious-metals scrap in small-scale workshops are also underway. These initiatives seek to create a tourist draw to Panama's Interior by establishing Cañazas as the Silver City of Panama.

3.4 New regional hospital and wellness areas for Veraguas Province

Veragold donated 5 hectares of land to Panama in 2018 for a new regional hospital in the town of Cañazas. The government completed all land conveyance paperwork in 2021, and an architectural design firm has been engaged. Approximately 17 hectares of company land surrounding this donated parcel is covered with secondary forest canopy that will be left to mature on a natural progression of ecological recovery. The remaining 15 hectares surrounding the future hospital are grasslands which will be enhanced to supplement the nutritional needs of the region, increase native biodiversity, and attract future tourism and intergenerational research activity. The design for the reforested areas will include three zones coordinated with the layout for the future hospital to ensure patients and visitors can benefit from these natural outdoor spaces (Figure 6a). Each project will integrate waste by-products from the mine in the form of pavestone pathways, gabion fencing, and other ornamental landscape architecture features (See Section 4.1 and 4.2).

3.4.1 Community polyculture orchard and food forest

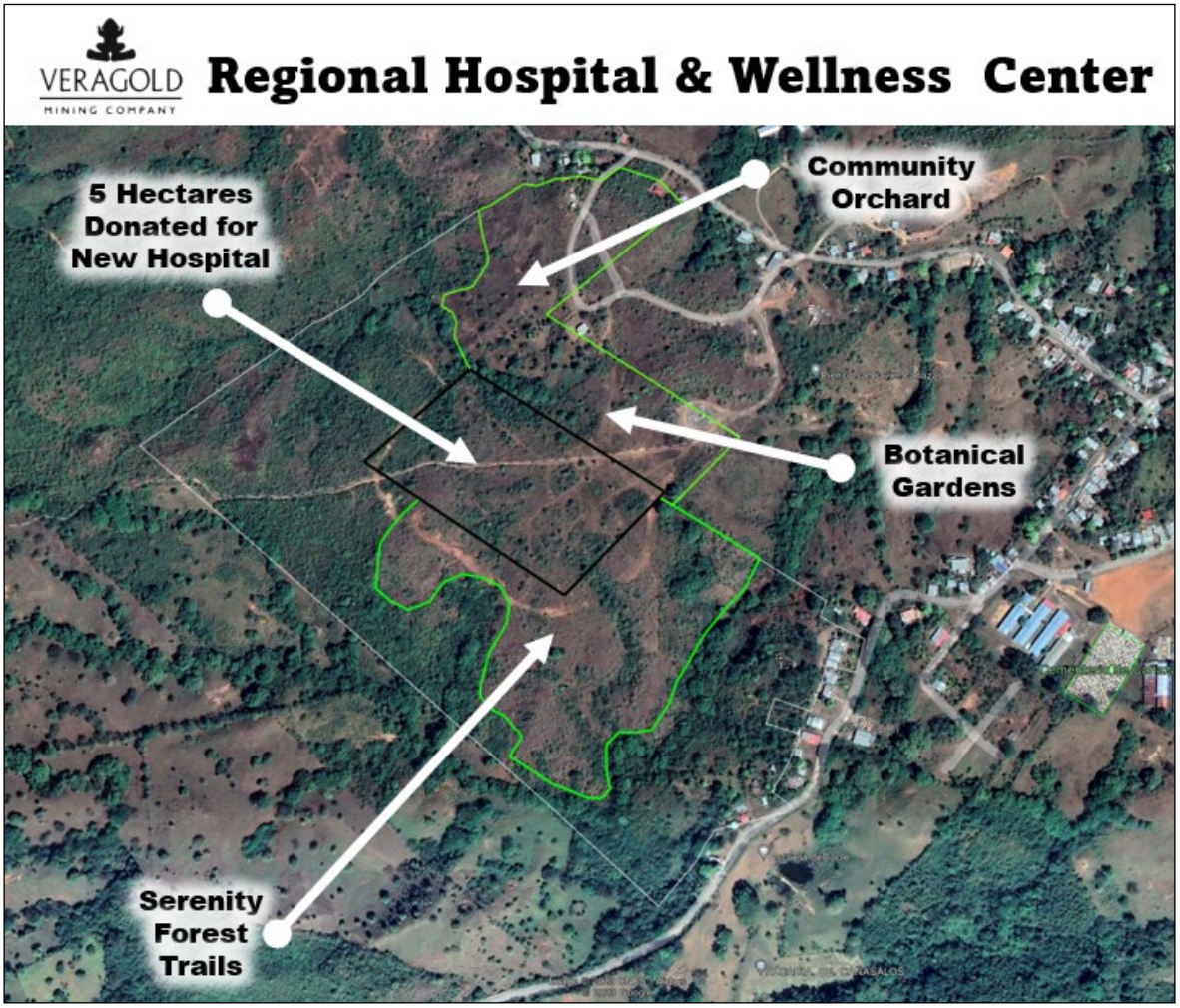
The first proposed zone around the future hospital is envisaged as a polyculture orchard area (Figure 6b) to demonstrate the benefits of perennial intercropping, restoration agriculture, and permaculture techniques that optimize food production. Fruits, nuts, roots, herbs, and legumes will be available for harvest by local families and to provide nutritional variety in the meals served at the Community Kitchen. Crop yields from these lands will also be made available for use in the future hospital cafeteria once that facility is completed.

3.4.2 Cañazas botanical garden and butterfly sanctuary

The second zone surrounding the future hospital is envisioned as a botanical garden focused on the native flora and fauna of the region (Figure 6c). Local environmental clubs, primary schools, secondary vocational programs, and other stakeholders in the region will be invited to participate in the design and maintenance of the gardens which will serve as an outdoor laboratory to supplement existing and future curriculums. Special attention will be given to promoting habitat for migratory species, pollinators, and natural pest control for crops grown in Veraguas province. Community surveys revealed local pride in a nearby waterfall and mountain paths for hiking and biking. If coupled with this existing natural capital, this proposed Shared Space Initiative could draw additional tourism and tropical research activity to Central Panama.

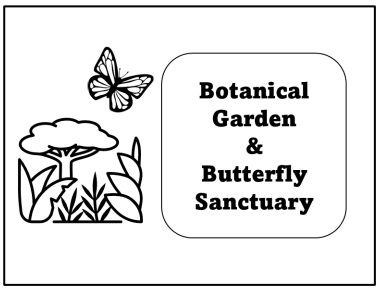
3.4.3 Serenity forest trails

Most of the company parcel surrounding the future hospital will be dedicated to enhancing biodiversity. A network of trails closest to the hospital will be designed through a multi-strata tropical forest where families and patients can spend time away from the hospital in quiet retrospect while receiving care (Figure 6d). Fruits, nuts, and medicinal plants would be accessible from trails constructed with pavestones created from the paste tailings. To enhance species diversity that was lost when the region first underwent conversion to agriculture over the last century, research initiatives under development will include studies to assist the transition of existing secondary forest canopy into more advanced stages of ecological recovery.



(a)

(b)



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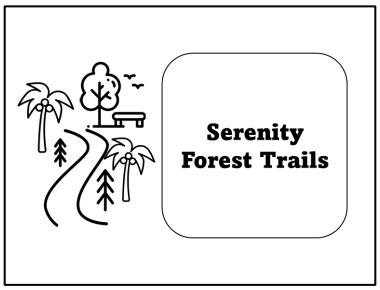

(d)

Figure 6 **Proposed Veragold Shared Space Initiatives in Panama. (a) Company land holdings surrounding future regional hospital in Cañazas will use mine waste by-products in the form of pavestone pathways, gabion fencing, and ornamental landscape architecture features; (b) The Community Orchard and Polyculture Food Forest will demonstrate tropical agriculture techniques that optimize food production; (c) Cañazas Botanical Garden & Butterfly Sanctuary featuring habitat for migratory species, pollinators, and natural predators of pests impacting regional crops; (d) A network of Serenity Forest Trails through a multi-strata tropical forest with fruits, nuts, and medicinal plants accessible from paved trails**

4 Shared opportunity ventures

Veragold is exploring several ways to foster local entrepreneurship and diverse economic opportunity during and after the mine life. Shared Opportunity Ventures, which may manifest as business cooperatives, craft guilds, or even a joint company-community non-profit, will use the locally sourced materials and by-products of the mine discussed in the remainder of this section. Other business incubator programs include the Veragold Sewing Academy that was established in 2012. Sewing machines and boards of fabric are provided to participants during the training program. Veragold will help graduates secure financing and launch businesses to make uniforms for mine workers, core sample bags, burlap bags for nursery plants, tablecloths, linens, and other anticipated needs during the operation of the mine and each Shared Space Initiative.

4.1 Economic use of paste tailings

The particle size of the future paste is amenable for use in a variety of industrial and artistic end-uses. Material testing has confirmed project tailings are suitable for the manufacture of concrete that can be used for roads, cinder blocks, jersey barriers, and other construction uses. The variation in colouring of the different lithological units could also produce attractive coloured concrete mixes for pavestones, tiles, faux stone veneer panels and siding, fountains, garden pots, sinks, countertops, and ornamental “craft concrete.”

4.2 Beneficial use of waste rock

The chemical properties, colouring, and physical textures of the alternating pyroclastic units and laminated sediments observed in the drill core suggest potential for a variety of possible construction and ornamental end-uses. Testing, geologic mapping, and core relogging to characterize each rock type will inform the next mine plan iteration. An architectural design contest with Panamanian Universities is being developed to explore how colourful blasted waste rock might be integrated into sustainable building systems and landscape design elements. Veragold will install demonstration gabion fences and ‘living walls’ around the administration offices that will improve energy efficiency of the buildings and create additional vertical space to grow food and plants important to pollinators.

4.3 Soil remineralization research

Renewed interest in the use of mineral rock dust powders to enhance degraded soils has demonstrated notable productivity gains in Brazilian agroforestry (Manning & Theodoro 2020; Theodoro et al. 2017). Earlier field-trials in several tropical regions with low agricultural productivity investigated the use of quarry rock dust as a soil amendment with promising results (Goreau et al. 2015). Veragold is looking to co-design an interdisciplinary agroforestry, agronomy, and soil science research program using company lands as working landscape research outposts. The first phase will investigate if aggregate fines from the mine are safe and suitable for use as soil amendments to improve nutrient uptake for native species and commercial crops in the region. This will occur at the greenhouse scale using crushed drill core samples from the lithological units encountered at the mine. Next, test plots will evaluate optimum soil composition and replacement depths of native soil to compare with different combinations and application rates of mine- and mill-generated rock dust for a variety of species. Creating ‘place-based’ applied-learning opportunities with the vocational high school in Cañazas that features an agriculture curriculum, as well as other educational institutions in Panama, is a foundational pillar of Veragold’s overall engagement strategy.

4.4 Agriculture and conservation partnerships

Other Shared Opportunity Ventures seek to improve food security and biodiversity in Veraguas province. Veragold recently met with federal agencies and agricultural experts in Panama to discuss crop suitability experiments and soil research plans for the Mina Santa Rosa project. Partnerships to grow crops for community use from seed donated by agribusiness companies are being investigated. Veragold is also identifying lands to fulfill its voluntary commitment to enhance and reforest 10 hectares of land for each hectare impacted by its operations, which exceeds the government-mandated mitigation ratio of 3 to 1.

Recent reports addressing global food system security have noted that rescuing fruit and vegetable biodiversity must be an integral part of progressing towards the Global Sustainable Development Goals and ensuring that nutrient-dense foods are accessible and affordable to consumers and rural forest communities (Jansen et al. 2020; van Zonneveld et al. 2021). Scholars have noted that a structured and managed global rescue plan to strengthen and fill gaps in existing networks of seedbanks will be required to preserve heirloom species with cultural value (Cochrane 2017; Dwiveldi et al. 2019) and ensure sufficient genetic variations are available to maintain diversity and climate-adaptability in new cultivated varieties (Cochrane 2017; Kilian et al. 2021). Veragold is seeking partners to establish a regional network of greenhouses and seed storage sites to ensure adequate seed is available for company reforestation projects and surrounding landowners in the event of crop failures related to severe weather, disease, infestations, wildfire, or other natural disasters.

4.5 Veragold employee cooperative credit union

Early planning efforts are underway to establish an Employee Credit Union. The goal of this initiative is to provide financial planning education in regions of Panama where few residents set aside money for emergency savings, higher education, and retirement. This program will allow members to benefit from interest accrued over time that can support future education and retirement goals. Furthermore, members can lend money to other members wishing to establish businesses that will germinate and flourish during and after the mine has transitioned to its next use. This will be an employee-run organization with employees sitting on the governing board that will make financial decisions for the credit union.

4.6 Cañazas community fund

Management has set aside a portion of its project startup capital to make an inaugural contribution to the Cañazas Community Fund. Supplemental annual contributions sourced from a percentage of future project proceeds will establish a sizeable corpus capable of generating interest revenue to benefit the community on a sustainable basis. The corpus will be sufficient to continue operating the Shared Space Initiatives currently managed by Veragold and other programs developed by the community. Charitable giving campaigns are being designed to encourage employee and local business contributions to the fund that would be supplemented by a Veragold match. In the early years, the fund will be jointly managed by the company and the community. After a proper governance structure is put in place, management and administration of the fund will be turned over to a democratically selected board of trustees to oversee how best to leverage and distribute the value generated by the mine to the shared benefit of the community.

5 Summary

Although all technical decisions about mine design and ore processing for the Mina Santa Rosa Project have been made by the company, this study illustrates how community feedback has influenced project decisions to date as well as Veragold's plans to co-develop a transitional landscape plan with the community. We show how Systemic Design methods facilitate the identification of synergistic linkages across a transitional mine-influenced landscape that can be leveraged to catalyse a resilient post-mining economy by developing company and community assets in an integrated fashion. The mine project will undergo several design iterations as new information becomes available, but the firm has laid the groundwork to engage the community and other partners to collaboratively advance and reshape the ideas presented here.

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