Completion Report

Watershared: Development, Adaptation, and Mitigation through Watershed Protection in Bolivia (Project No. NCF-C8-0319)

Grantee: GRID-Arendal

Local Partner(s): Fundación Natura Bolivia

Cuencas Sustentables

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1. EXECUTIVE SUMMARY

Natura Bolivia has for almost 15 years developed an incentive-based conservation program, that provides upstream landowners with development project in exchange for forest conservation activities which protect water sources and secure downstream water supplies. These initiatives, although successfully implemented in 80 municipalities in four countries, have two fundamental weaknesses, namely that they:

- Rely on philanthropic start up finance, with users only contributing significant funds after a few years.
- Focus just on conservation and ignore all other water management issues such as the building of dams, pipelines and distribution and purification systems.

Our NCF project thus had two goals:

- *Meta objective 1: find out if we can link conservation (securing green infrastructure) and build the water access system of pipes, dams, taps etc. (grey infrastructure) and achieve both simultaneously for a reasonable price.*
- *Meta objective 2: find out if we can get local authorities to pay for 100% of these linked green-grey infrastructure systems.*

As we tested our plans in the field, we found out that local authorities wanted the concept to work but suggested different formats. For example, our initial idea was to work in large towns with existing water provision institutions which could raise tariffs and thus pay for the green/grey infrastructure over five years. When we presented these ideas, all local authorities we spoke to, had the same message: make the payback time schedule one year, use existing municipal budgets and create new institutions to work in smaller communities. We therefore reset our thinking and took these lessons into account.

For Milestones 1 and 2, we focused on *finding out if we can link conservation and build the water access system of pipes, dams, taps etc. and achieve both simultaneously for a reasonable price.* The clear answer is that we can — and while implementing Milestones 1 and 2 we achieved this in five communities. 464 families in the villages of María del Rosario, Santiago de Chiquitos, Yororobá, Quitunuquiña and La Asunta put 4 118 hectares of their forests into conservation, and each now has clean water piped into their houses.

For Milestone 3 we focused on *Meta Objective 2, getting local authorities to pay for 100% of these linked green-grey infrastructure systems.* We thus worked with six more municipal governments and built eight new water systems in the villages of Quirusillas, Fuerte Rua, Lagunillas, Torrehuaico, Villa Serrano, Picaflor, Florida and Comarapa. These systems included the protection of an 14,842 hectares upstream forests and the provision of water to 4,211 downstream families.

Most importantly we learned how to design and execute contracts in which over the next three years, much of the NCF money invested in building the water systems in these communities, will be paid back into the Watershared Funds, and reinvested in constructing water systems in new communities. In other words, we are well on the way to an innovative new mechanism for upstream conservation and climate change adaptation and mitigation: simultaneously investing in green infrastructure at the same time as investing in grey infrastructure at the start of any water access project, thus building in sustainability from project initiation.

2. ACHIEVEMENT OF RESULTS

2.1 Achievement of outcomes

Expected outcomes	Indicator(s):	Achievement of outcomes
Outcome: 12,000 hectares of water-producing forests are protected, sequestering 84,000 tons of CO2e, returning 8.4 million cubic meters of water to the aquifer, and providing potable water with zero fecal coliforms to 12,000 families		
1.1a: Carbon sequestered: Carbon sequestered by program	84 000 t CO2e	78 410 t CO2e
1.1b: Change in carbon stock		7 841 t CO2e[1]
1.2: Hectares conserved	12 000 ha	18 960 ha
1.3: Number of beneficiaries: clean water downstream, development projects upstream	50 400 people 25 200 women 12 600 girls	51 704 people[2] 25 852 women 12 926 girls
1.4: Number of people with improved livelihood /income generating possibilities	12 000 people 6 000 women 3 000 girls	17 688 people 8 834 women 4 417 girls
1.5: Number of people with increased resilience to climate change	50 400 people 25 200 women 12 600 girls	51 704 people 25 852 women 12 926 girls
1.6: Water returned to aquifer	8.4 million M3	13.27 million M3[3]
2.1: Watershared Fund designed-tested	2 funds	2 funds
2.2: Stakeholder partnerships	12 alliances	12 alliances
2.3: Municipal funds leveraged	New outcome indicator	EUR 217 000

[1] To calculate the additional change in carbon stock (Outcome 1.1b) we multiplied the number of hectares conserved (18 960) (Outcome 1.2) by 0.1 (our estimate of additionality (Botazzi et el 2019), and multiplied that number by an average increase of 2.4t/ha per year in above ground biomass in assumed (IPCC default value for above ground net biomass growth in a tropical dry natural forest). In other words the change in carbon stock = Carbon fraction of tree biomass (0.47)*44/12*watershed conservation area (1,896ha)*change in tree biomass per ha (2.4t/ha)) = 7,841tCO2 per year.

[2] To calculate the number of people with improved livelihoods (Outcome 1.4) we added the number of upstream and mid-watershed families, subtracted any double counting and multiplied by 4 people per family. This summed to 17 688 people, of whom we estimated 50% female and 25% girls. To calculate the number of beneficiaries with clean water and increased resilience to climate change (Outcomes 1.3 and 1.5) we identified the number of people living in the municipalities downstream of the project sites and dependent on the water coming from the projects. These numbers are presented in the column "Downstream Population" and sum to 51 704 people, of whom we estimated 50% female and 25% girls.

Project site	Upstream families	Families mid-watershed	Downstream municipality	Downstream population	Watershed
Quirusillas	25	450	Mairana Quirusila	9 000	Rio Grande
Fuerte Rua	32	32	Tomina	1 500	Rio Grande
Lagunillas Cochabambita	28	253	Trigal	3 500	Rio Grande
Torrehuaico, Angostura	10		Trigal		Rio Grande
Villa Serrano	10	1,450	Villa Serrano	5 000	Rio Grande
Picaflor	22	22	San Ignacio	88	Río Iténez
Florida	54	54	San Ignacio	616	Río Iténez
Comarapa	25	1,950	Comarapa Saipina	12 000	Rio Grande
All Grande H_2O goes to:			Pailon	20 000	Rio Grande

[3] We calculated the volume of water returned to the aquifer (Outcome 1.6) by multiplying the number of hectares conserved (18 960) (Outcome 1.2) by 700 m3/year (estimate from data of Manco 2022)

In general, we achieved almost all of our projected outcomes, exceeding most indicators, apart from 1.1, in which we sequestered slightly less carbon than expected.

Expected outputs	Indicator:	Achievement of outputs:
Output 1.1: Agreements signed to conserve in return for development projects	600 agreements	Agreements signed with 1036 families although most signed at level of community
Output 1.2: Reductions in faecal coliform load	95%	Pre-project monitoring was undertaken, but post project was not, as projects were only completed days before the grant finished, because of Covid related delays. We will use our own funds for post-project monitoring.
Output 1.3: Hectares patrolled	12 000 ha	18 960 ha
Output 1.4: Cases of incompliance sanctioned	100%	100%, although such incompliance was minimal
Output 1.5: Chlorine tanks/water access systems constructed & installed	12 tanks and systems	We completed these two outputs at three sites them, installing chlorine systems in communities where people wanted them.
Output 1.6: Local actors trained in managing system	12 people 6 women	12 people 6 women
Output 1.7.1: Chlorination systems are operating: free chlorine is maintained at a concentration of 0.3-0.5 mg/l	100%	We partially completed these three outputs, but only in the sense that we installed chlorine systems at all the sites where the people wanted them (La Asunta, Yororoba and María del Rosario). However, only these few communities wanted chlorinated systems. In general communities rejected the chlorination component of the project as most people don't like the taste of chlorine.
Output 1.7.2: Water Chlorination systems installed / functioning	12 systems	
Output 1.8: Newly installed systems, fully functioning with correct levels of free chlorine and are being monitored	12 systems	
Output 2.1.1: New financing mechanisms are designed that comply with local norms	2 mechanisms 1 focused on women	2 mechanisms were designed and piloted. The 3-way agreement, exemplified in the Quirusillas agreement, was a negotiation, and finance deal between Cuencas Sustentables SRL, the Municipal Government and the Water Provider. The Water Provider is legally responsible for managing the water access system, but the loan is guaranteed by the government. The 2-way mechanism, as typified by the Villa Serrano agreement, is just between the water provider and Cuencas Sustentables SRL, and focuses on involving women in decision making, with the benefit of providing micro-meters to water users so that water can be better managed across town, making sure that schools/ hospitals are prioritized and leaks quickly fixed.

Output 2.1.2: Financial vehicle created	1 fund focused on women	1 fund focused on women
Output 2.2. % of loans paid back by municipalities	80%	Partially. Contracts that have been signed that stipulates how funds will be repaid. However, no repayments made yet.
Output 2.3. % of funds repaid by municipality that are ready to be re-invested	100%	Partially. Contracts that have been signed that stipulates how funds will be repaid. However, no repayments made yet.
Output 3.1 Strengthened institutions	5 institutions	8 institutions: we built the capacity of water user organizations to manage their projects
Output 3.2. Nine municipalities implement a new user tariff to cover system management and watershed conservation costs	9 municipalities	5 municipal governments: we ended up working in fewer municipalities than expected
Output 3.3. Nine institutions have developed/ strengthened capacities to be self-sustaining	9 institutions	5 institutions: we ended up working in fewer municipalities than expected

2.2 Deviations from the planned outputs and activities

We undertook and achieved almost all the outputs and activities that we had expected. The exceptions were that:

1) Because of COVID related delays, we were unable to complete construction of the water access systems on schedule and did so as the project was closing. We were therefore unable to undertake post-construction monitoring to test the levels of faecal coliforms. We will undertake this monitoring using follow-up funding, secured by Natura Bolivia, from the UK Government's Darwin Initiative.
2) Another result of our inability to complete construction of the water access systems until the end of the project is that the communities did not start the "payback" phase, during which the cost of the materials purchased with co-financing and NCF funds, will be reinvested by the municipalities in new water access projects in other communities. The payback process started after project completion and by mid-2023 was well under way.
3) Most communities rejected the water chlorination component of the project: we learned that the inhabitants of rural communities, accustomed to untreated water tend not to like the taste of chlorine! We hope to be able to persuade communities that chlorination is a necessary part of the water access system, and that its health benefits outweigh the "unpleasant" taste.

We did not undertake any new activities, but we added two new outcome, which we numbered "**1.1b: Change in carbon stock"** to note that we had increased carbon stocks during the project and "**2.3: Municipal funds leveraged"** to quantify how much local funding was leveraged by the project over and above the required co-financing.

Achievement of NCF indicators

NCF core indicator	Results (quantitative)			Clarifications/Means of verification
Number of beneficiaries reached	women		25 852	To calculate the number of beneficiaries with with increased resilience to climate change we identified the number of people living in the municipalities downstream of the project sites and dependent on the water coming from the projects, of whom we estimated 50% are female. To calculate the number of people with improved livelihoods we added the number of upstream and mid-watershed families, subtracted any double counting and multiplied by 4 people per family, of whom we estimate 50% are female
	men		25 852	
	total		51 704	
Number of people with increased resilience to climate change	women		25 852	
	men		25 852	
	total		51 704	
Number of people with improved livelihoods	women		8 834	
	men		8 834	
	total		17 688	
New decent jobs created	full-time	women	0	Although no new decent jobs were created by the project, we provided work opportunities to residents who are now managing and monitoring the water access systems, 4 people per system with a constant focus on gender balance. In addition, because communities now have more secure water supplies, residents now have more opportunities to work on agriculture in their fields. We estimate that almost a quarter of the people living in upstream and mid-stream communities now have these opportunities.
		men	0	
		total	0	
	part-time	women	0	
		men	0	
		total	0	
	seasonal	women	0	
		men	0	
		total	0	

3. CLIMATE CHANGE

- By protecting 18 960 hectares of moist old growth forest and sequestering 78 410 T CO2e, the project has helped mitigate climate change.
- By securing the water supplies for eight, upstream, mid-stream and downstream municipalities the project has helped 51,704 people adapt to climate change.
- By designing and piloting an innovative financing mechanism for integrating green and grey infrastructure investments the project has demonstrated a sustainable long term financing tool for climate change adaption and mitigation.

4. DEVELOPMENT IMPACTS AND CROSS-CUTTING ISSUES

The main project sites – Bolivia's Santa Cruz Valleys and the Chiquitano Forests – are within the tropical Andes biodiversity hotspot. Amboró National Park, on the project's northern border, hosts >900 bird species, almost 10% of the bird species on earth. Many rural communities in the Valleys – as in much of the developing world – depend on streams and rivers for their water supplies. Livestock often defecate in these water sources and are major contributors to contamination and concomitant health problems, especially amongst children. Moreover, extensive cattle grazing is one of the primary threats to global biodiversity and forest cover. Cows enter riverine forests, to drink and graze. They disturb herbs and fungi, consume seedlings of endangered tree species, and disturb the habitat of small animals, thus severely reducing biodiversity. Cows also defecate and urinate in the streams

and compact soil, leading to higher levels of faecal coliforms, increases in flooding and sedimentation, and decreases in dry season water flows and quality.
This project has helped drinking water cooperatives and local governments to provide upstream landowners with economic development projects, such as fruit trees, irrigation pipes and beehives, in exchange for forest conservation. Upstream landowners have thus been able to move away from drought susceptible agriculture, and simultaneously improve hydrological functioning, ensuring water quality and quantity for human consumption.

In addition to resolving communities' lack of access to drinking and irrigation water, the NCF project had a series of other positive spin offs, such as job creation. For example, we created more than a thousand seasonal jobs for community members who – because of more secure water supplies – now have more opportunities to work on agriculture in their fields.

5. ASSESSMENT OF THE RESULTS AND IMPACTS OF THE PROJECT

5.1 Relevance

The project's expected outcomes/objectives and design have responded to beneficiaries', countries, and partners' needs, policies, strategies and priorities.

Bolivia's NBSAPs under the CBD are outlined in the 2019-2030 National Biodiversity Strategy. This project has helped achieve the following within Strategic Line 3: "Maintenance of environmental functions and Living Well in harmony with Mother Earth, by promoting regional, sub-national and local actions for the conservation of ecosystems and species of flora and fauna with a certain degree of threat and in the Transversal Lines: "contributing to ecosystem-based adaptation as a strategy for socio-ecological resilience to climate change in life systems" and "Adjusting regulations, programs, projects and actions to gender equality to ensure the equitable participation of women in Integral Management and Sustainable Biodiversity"

As part of its NDCs under the UNFCCC Bolivia expects to achieve a series of objectives in mitigation and adaptation by 2030. In terms of water, the project will specifically help "increase in a holistic manner the adaptation capacity and systematically reduce the hydric vulnerability in the country" and provide a "Significant improvement of social participation for local water management" and "Increase food production under irrigation.

In terms of forests the project will "increase the capacity of joint adaptation and mitigation through the comprehensive and sustainable management of forests" by "increasing forest areas with integrated and sustainable community management approaches" and "strengthening environmental functions (carbon capture and storage, organic matter, and soil fertility, biodiversity conservation and water availability)".

5.2 Effectiveness

All the project's major expected outcomes were fully met. Indeed, exceeding most indicators, apart from 1.1, in which we sequestered slightly less carbon than expected.

As some examples:

- We expected to have 50,400 beneficiaries with clean water downstream and development projects upstream; we reached 51,704 beneficiaries
- We expected to return 8.4 million M^3 of water to the aquifer; we returned 13.27 million M^3.
- We expected to sign 600 agreements to conserve in return for development projects; we signed agreements with 1036 families

The major factor that helped achieve the outcomes was that the project designers could benefit from the 20 years of field experience of Natura within the project area, and the fact that Natura already knew many of the local actors. Local authorities and stakeholders were therefore able to co-design the project.

The major negative influence on the project was the Covid pandemic. The project was severely delayed and although we achieved the outcomes and outputs listed above (plus many more) we were unable to substantiate our impact through an endline surveys and water quality analyses. In other words, the expected project outcomes were achieved, but the actual impact of achieving these outcomes will only be documented after project completion.

5.3 Efficiency

The Covid pandemic caused severe delays to the project. We were eventually able to complete all tasks but were unable to fully monitor and evaluate our impact. These failures and delays were entirely the result of Covid and are unlikely to be repeated in future projects. The major lessons in terms of cost and operational efficiency are that:

- In a project such as this purchasing a vehicle is an economically feasible alternative to renting.

- Long term budgeting is required to accounts for unexpected price changes. This was especially important with the purchase of chlorination units, for which we budgeted assuming we could use co-financing secured for 2019. With the delay in project implementation, prices went up and so we did not have enough funds for these items. We were fortunate that few communities decided that they wanted the units, so we were able to instead purchase other materials, for which cost had not risen so dramatically.

- Covid-induced delays played havoc with our project and timeline, but we were able to continue, and municipal governments and local stakeholder invested their time and money to work with us, notwithstanding the radically changed circumstances of a post Covid world. This suggests that our model and our innovation are robust.

5.4 Impact

Diarrheal diseases account for 1 in 9 child deaths, making diarrhoea the second leading cause of death among children under five. Extensive cattle grazing is the primary threat to water quality across Latin America. Cows enter riverbank forests to drink and graze, then defecate in streams, and compact soil. Faecal coliform loads increase, and water quality declines. Because many rural communities depend on such streams for their drinking water, forest degradation is a major contributor to gastro-intestinal disease. A meta-analysis of 300,000 children from 35 countries shows that higher tree cover upstream reduces the probability of diarrhoea.

We thus expect that the longer term and broader higher-level effects of our NCF project will be significant. The cleaner water supplies that we have helped deliver – and have demonstrated how others can deliver the same – will likely have significant impact on childhood morbidity and mortality.

The primary project beneficiaries were rural indigenous (Chiquitano) and peasant families. These families live at the margins of Bolivian society practicing small-scale farming of maize, peanuts, beans, potatoes, squash, and yucca, with annual incomes < $2,000. They also have the power to decide if and how watershed protection will take place or not, given that they deforest about 1.5 ha per family per year. Although we were unable to measure income impacts, our experiences elsewhere in Bolivia suggest that by providing economic development projects upstream, we will have helped reduce poverty.

We also focused on increasing gender equality. A transversal objective was that female-led households develop a new culture of sustainable watershed management. By project-end 30 women had ascended to community decision-making positions by building their capacities in leadership, health, and watershed management. The project has also helped build climate resilience, by ensuring that local community members have secure access to clean potable water from their own forests. Our second finance mechanism, that we developed in the town of Villa Serrano, focuses on involving women in decision making, with the benefit of providing micro-meters to water users so that water can be better managed across town, making sure that schools/ hospitals are prioritized and leaks quickly fixed.

In the long term, the potential beneficiaries of our new model for the financing of water provision and conservation systems will be the hundreds of thousands of families in rural Bolivia who have no access to clean water. Our new financing model will ensure that when access to water is provided by their municipal government, it will contain less faecal coliforms because of the healthier upstream ecosystem.

5.5 Sustainability

We expect that positive effects from the project will indeed persist long after the project has been completed. The primary beneficiaries of the project are the upstream beneficiary families who now have cleaner water and have receive development projects. Females have benefited disproportionately from reductions in their daily burden of water collection. Children under five will also benefit disproportionately, as it is they who suffer the most gastro-intestinal diseases from polluted water.

We believe that the project will bring long term sustainability, based on our poverty reduction theory of change, i.e.:

1) Lack of water in quantity and quality has negative impacts on community well-being especially the well-being of young children, who suffer disproportionately from gastro-intestinal diseases from polluted water and women who must spend excess time collecting and carrying water.
2) Enhancing water access will improve well-being, especially of women and children
3) Forest conservation has an opportunity cost for landowners, so this opportunity cost must be at least partially covered to maintain well-being
4) Carefully selection of compensation project types, to focus on income diversification and climate resilience (e.g. projects such as beekeeping and improvements in irrigation) can have a disproportionately positive effect on poverty reduction.
5) By co-designing projects with local communities and helping them think through how best to use the funds that have been authorized to their community by the Popular Participation Law will maximize the probability that community members will be able to engage with the new water infrastructure.

In terms of sustainability of the investments made under the project, we have tried to ensure that they continue to function going forward by:

- Involving local community members in project implementation
- Including several capacity building components in project activities
- Having local institutions jointly finance the investments, so these institutions have a long-term stake in project success.

The partnership formed between the three implementing organisations proved very successful, as we were able to bring different strengths and expertise to the project. However, we do not yet have concrete plans to continue the collaboration, as our organisations' geographic and thematic areas of primary focus are very different.

5.6 Coherence

This project contributed to a formal cooperation agreement with the Bolivian government's "Mother Earth Authority" which committed Natura to provide "Technical and coordination support for the preparation of Bolivia's Nationally Determined Contributions", specifically through the "Technical, logistical and coordination support for the assignment of three municipalities to the Joint Mechanism for Adaption and Mitigation".

Despite this alignment of national policy and the project, some actors remain unconvinced of how and indeed if we can repeat the NCF model. Indeed, the major barrier to scaling the model is that is has never yet been used. It is innovative and new and is requiring a change in thinking for both community members and municipal governments.

6. INNOVATION

The model upon which this project was built, is innovative, being based on behavioural- rather than neoclassical- economic theory (and is thus very different from Payments for Environmental Services, PES). However, the model has two fundamental weaknesses, namely that it:

- Relies on philanthropic start up finance, with users only later contributing significant funds.
- Focuses on conservation and ignores all other water management issues such as the building of dams, pipelines and distribution and purification systems.

Even though Bolivian municipalities invest significant sums in water access projects, there is currently no financial or legal mechanism through which they can simultaneously invest in upstream conservation. Such "access only" water systems are thus destined to provide users with drinking water that is legally unfit for human consumption. On the other hand, philanthropic investment in biodiversity conservation is decreasing, and once local communities realize that their water supplies are contaminated, it is often too late to inexpensively resolve the problem.

The NCF project was designed to evaluate how to resolve these weaknesses and to develop a more effective delivery model that: 1) links conservation (the securing of green infrastructure) with the building of pipes, dams, taps etc. (grey infrastructure), 2) achieves both simultaneously at low cost and 3) demonstrates a road map for local authorities to pay for green-grey infrastructure systems. The project's innovation was to determine a legal pathway by which the public funds being invested in water access projects could also be used to undertake upstream conservation. Such a mechanism would allow governments to simultaneously guarantee clean water supplies and to protect biodiversity in a more efficient and effective way than trying to achieve these goals separately.

The new water management model we developed in the NCF- funded project was thus based on the twin pillars that protecting upstream forests helps maintain potable water supplies, and that water users and local authorities need to contribute to such conservation. The innovation of the NCF project – its real impact – was to chart a legal and financial pathway to help resolve two market failures:

1) Investment in water source protection—building dams and pipes, strengthening institutional capacity, etc.—must be upfront, while water benefits are delayed by 12-24 months.
2) The "grey infrastructure" required to efficiently access potable water is rival and excludable, but the "green infrastructure" (i.e. forests) that capture rainwater is often public.

"Business as usual" for water access projects across the Andes is that investments are made in grey infrastructure without any concern for upstream watershed management. Pipes quickly clog, dams fill with sediment, and drinking water is contaminated with faecal coliforms. Meanwhile, "Business as usual" for environmentalists is to invest donor funds and new water user tariffs to try to recover the situation through upstream restoration.

Our objective was to develop a new "business as usual", which *a priori* melds the civil engineering of grey infrastructure with the protection, maintenance, (and if necessary, restoration) of existing green infrastructure. Such integration will happen before the grey infrastructure is built to 1) ensure that upstream degradation does not prejudice the new investment and 2) "piggyback" the costs of the inexpensive green infrastructure protection onto the far more expensive grey infrastructure construction costs.

7. POTENTIAL FOR SCALING UP AND FOLLOW-UP INVESTMENTS

The potential/likelihood of the project being scaled-up or replicated is high. Given that thousands of rural Bolivian communities lack access to potable water and that protected forested watersheds can help clean water at low cost, we expect that the model will spread rapidly. Natura already works in more than 90 municipalities across Bolivia and have direct access to hundreds of decision makers and thousands of communities where the new model could function.

Thanks to the success of the NCF funded project we have made another step towards large scale impact. In the year post project, Cuencas Sustantables has initiated negotiation of a $280,000 loan from the Interamerican Development Bank (IDB), to build on our NCF results and help make the model self-sustainable.

This loan is still being negotiated, but we are in the final stages of discussion with staff from the Interamerican Development Bank. The IDB will make the loan on a contingent recovery basis, meaning that if our model succeeds, Cuencas will have to pay back the Bank, once the municipalities or water user associations pay back Cuencas. If the model fails, and the municipalities or water user associations do not make the required payments, then loan from the IDB to Cuencas will be forgiven.

8. RISKS

Project risk description	Impact on project	Mitigating measures and responsibility
Further lockdowns resulting from the Covid-19 pandemic	Significant	After the first Covid-19 lockdown we further decentralized project activities/responsibilities of the field team. This meant that that the field team – already based in the project area, not in the city – was far more autonomous and could work even when their own municipality was self-isolating. We thus viewed the probability of this risk as medium.
Project staff get sick from Covid-19	Medium	We took all government-advised bio-security precautions. All Natura and Cuencas staff are vaccinated and have health insurance. We viewed the probability of this risk as minimal/medium.
Water projects are cut from municipal budgets in favour of health projects	Medium	We invested significant field team staff time with communities and authorities to stress the importance of clean water and the project. We viewed the probability of this risk as minimal.

Materialised risks

Project risk description	Impact on project	Mitigating measures and responsibility
Lockdowns resulting from the Covid-19 pandemic prevented project activities	This caused a significant (9-month) delay	The Bolivia field team fully reactivated at the start of 2021 after Covid lockdowns and managed to catch up lost time so that the project was fully completed after the no-cost extension

Political tensions prevented project activities	This caused a 3- month delay	New municipal governments were installed in May 2021. We were fully on track by December 2021
Local authorities rejected our proposed funding mechanism	Minimal	With local authorities we co-created a new, better funding mechanism model that could be implemented quicker and more efficiently
Water quality measuring kits are available from a single source provider in the US, and we were unable to travel to the US to purchase them	This caused a 3- month delay in baseline data collection	Because of systemic Covid related project delays, most systems were only completed in November and December 2022. There was no time, before the end of the project to quantify any differences in water quality. We thus decided not to undertake this activity

9. MONITORING AND EVALUATION

The project has been clearly defined with milestones, deliverables, and indicators. Those has been monitored inside the requirement of an NCF grant.

As part of our monitoring and evaluation program, staff members have also helped two World Bank consultants undertake an evaluation of Natura's work in general and this specific project. The key findings of this evaluation "Leveraging Citizen Action for Water Conservation were that:

- Combining the dual objective of conservation and development goals allows nature and economic needs to be addressed in unison.
- In-kind incentives promote the generation of sustainable livelihoods.
- Upstream communities participate because of a suite of economic and noneconomic motivations, including financial incentives, individuals' social capital, and social norms.
- Because most of the costs of Watershared are paid by local governments and water users, the program does not depend on external funding and is sustainable.

10. LESSONS LEARNT

Our project was designed around two meta-objectives:

1. Find out if we can link conservation (securing green infrastructure) and build the water access system of pipes, dams, taps etc. (grey infrastructure) and achieve both simultaneously for a reasonable price.
2. Find out if we can get local authorities to pay for 100% of these linked green-grey infrastructure systems.

When we wrote the proposal, we had many ideas of how we would achieve these meta-objectives. As we tested our plans in the field, we found that local authorities wanted the concept to work but had different preferred ways of doing so. We therefore reset our thinking.

In late 2019 Bolivia was paralyzed by (effectively) a coup, and there was subsequent political instability for over 18 months after the supposed election date. Given the political instability over the last year, we were however unable to engage with the "lame duck" local authorities.

Municipal governments are more interested that we had expected in getting their water systems built and the required watershed conservation undertaken as quickly as possible. We thus appear to have identified a conservation finance model in which all components of a project, including repayment, can be done within a financial year, using existing municipal finance within the existing national government procurement system. However, because of Covid the related delay, we were only able to finalize construction of the water systems very late in the project timetable, so we were unable to advance as far as we had hope in terms of municipal payback into the Watershared Funds and subsequent re-investment. We expect that this will continue apace in 2023, but the results will unfortunately occur too late to be incorporated into project reporting.

In terms of recommendations and future work, through this project:

1. We designed the technical, legal, and financial pathway to implement a green/grey infrastructure public-private partnership model for water access and sustainable watershed management.

2. Local stakeholders piloted and tested a green/grey infrastructure public-private partnership model for water access and sustainable watershed management.

The short-term primary beneficiaries are upper and middle watershed families with improved access to clean water. In the long term, we expect that females will benefit disproportionately from reductions in their daily burden of water collection. Children under five will also benefit disproportionately, as it is they who suffer the most gastro-intestinal diseases from polluted water.

As we try to expand and scale our experience, potential beneficiaries of the new model will be the hundreds of thousands of families in rural Bolivia who have no access to clean water. The new financing model we have developed with NCF support will ensure that when access to water is provided by their municipal government, it will contain less faecal coliforms because of the healthier upstream ecosystem.

The innovative change that we have created is a public-private financing model for water access and watershed management. This model can disrupt the currently entirely independent financing mechanisms for water access and for conservation. While the financing of upstream conservation remains an independent environmental issue its potential will remain small and subject to donor whims. While the financing of rural water access project remains an independent poverty alleviation measure, it will not attract private capital. Melding these two discrete financing needs into one raises the potential to trigger a significant investment multiplier effect.

If a water access project includes an upstream conservation component, it can provide significant externalities such as biodiversity protection and carbon sequestration. The provision of such public goods can greatly increase the potential for outside interest in investing in such projects. For example, an investor may be interested in earning carbon credits by financing forest conservation. With a proven integrated grey-green infrastructure model, such an investor could gain both the carbon credits and at the same time contribute to the secondary co-benefit of increasing villagers' access to clean water.

11. OUTREACH

To build support for the fusion of grey and green infrastructure into an integrated project (i.e., water access plus watershed protection), our marketing and communication strategy focused on two main messages. The focus of these messages to municipal governments – i.e., the potential new investors and participants in the model – was that:

1) Clean water is a human right, and investment should be in both constructing water distribution systems and in also protecting the forested upstream "Water Factories"

2) Such investments should be structured in the same way as school and hospital construction are financed, through public investments by municipal authorities.

In addition to in person meetings with local authorities in their offices, we produced a series of videos:

- La Asunta
- The Five Steps of Watershared
- Water for the Chiquitania

We also held an international meeting in Santa Cruz, at the UTEPSA University with more than 200 participants, including national, regional and local governments. The meeting was opened by a representative of the State Government of Santa Cruz, and featured speakers from across the Andes and various of the NCF project implementation sites.

This one-day public meeting, held in October 2022, was followed up by a 4-day workshop that discussed the details of the NCF version of the Watershared model. Workshop participants comprised 45 water experts, and municipal technicians from eight countries, including staff from GRID, Natura and Cuencas Sustentables and water professionals from Colombia, Ecuador, Peru and Chile and from across Bolivia. The following workshop participants, agreed to take the lessons of the NCF project and to apply them in Colombia, Peru, and Ecuador:

- The Corporacion Autonoma Valle de Cauca (CVC) is the government entity in charge of managing the renewable natural resources and the environment of the Department (State) of the Valle del Cauca (an area more than 2/3 the size of Belgium). As the highest environmental authority and in alliance with social actors, CVC promotes a healthy environment, contributing to the improvement of the population's quality of life, and competitiveness of the region within the framework of sustainable development. CVC has been implementing Reciprocal Watershed Agreements in 14 municipalities for more than a decade.
- The Instituto del Bien Comun (IBC) is a Peruvian non-profit civil association founded in 1998 that works with rural communities and regional and national government institutions in the Peruvian Amazon to provide greater care for the commons: the resources and spaces held in common such as rivers, lakes, forests, fisheries, natural protected areas, and community territories. These resources and spaces are central to the livelihood of Amazonian peoples, both indigenous and non-indigenous, especially in this age of a changing global climate.
- ETAPA (Empresa de Telecomunicaciones, Agua Potable, Alcantarillado y saneamiento de Cuenca) is a public utilities company owned and operated by the city of Cuenca, Ecuador. The company provides public services, including water to the 500,000 residents of the city. As part of ensuring a clean water supply ETAPA manages the 28,500-hectare Cajas National Park and has been implementing of Reciprocal Watershed Agreements (or "Mutual Water Agreements" as they are known in Cuenca) for more than a decade.

12. FINANCIAL SUMMARY

Table 1. Project financing per partner

Expenditures	NCF	GRID Arendal	Natura Bolivia	Cuencas Sustentables	**Total**
GRID Arendal	62.256	18.134			**80.390**
Natura Bolivia	152.890		202.210		**355.100**
Cuencas Sustentables	160.713			40.8400	**201.558**
Total	**375.859**	**18.134**	**202.210**	**40.8400**	**637.048**

13. CONCLUSIONS AND RECOMMENDATIONS

Lesson learning and scale-up of the conservation of water sources (the "green" infrastructure component of our model) – is well under way across the Andes, building on 20 years of experience of Natura Bolivia, the Corporación Valle de Cauca (CVC) (Colombia) and hundreds of municipal water providers, from Yacuiba on Bolivia's border with Argentina, to Oxapampa in Central Peru, and San Vicente de Chucuri in northern Colombia. The conservation component was improved during the NCF project and has since been improved, refined, and adapted in each of these local contexts (and is now being piloted in Kenya and Comoros).

The municipalities and water providers that are already investing in the conservation of their water sources – some of which have partnered with Natura for almost 20 years – will likely be the first implementers of the new green/grey iteration that we piloted with NCF support. Post-NCF financing we will partially transfer implementation to municipal authorities, and increasingly play the role of facilitator, catalyst, and financer rather than implementer. Evidence to date suggests that *Watershared* is exponentially scalable in terms of both need and available finance. The primary constraint to scalability is the ability of Cuencas and Natura to work at scale. This is a human resource constraint, and we recognize that we will need to find new partners with scaling experience as we advance with the next iteration of the model.

Our iterative, experimental approach worked very well as we tried to chart a pathway in the labyrinth of municipal laws, regulations and procedures. What didn't work as well was when our innovative searching bumped up against municipal government bureaucracy. In terms of project outputs, levels of compliance with the conservation agreements are not as high as we would have expected, and so we are trying to understand why that should be and what we can do about it.

Natura, Cuencas and GRID-Arendal implemented the first pilot of the NCF project in La Asunta community, building the grey infrastructure of 2000 metres of pipes, installing a water tank and chlorination unit, and securing and conserving 1500 hectares of upper watershed forest. The second phase of the NCF project took the innovation one step further, to try and figure out a way to use

municipal public funds for such integrated water systems. What we have undertaken – figuring out how local governments can pay for biodiversity from within water access budgets – will be a quantum leap for conservation financing in Bolivia.

Going forward, we see four challenges to this legacy:

- *High cost of raising capital:* Although we have never raised capital, we are hopeful we will be able to raise scaling capital once we have proven (with an IDB loan over the next two years) that our Minimum Marketable Product (MMP) is viable.
- *Institutional ability to scale:* During the NCF project, Cuencas Sustentables was able to construct 1-2 integrated water access systems at the same time. For the next phase, we will need to build 3-4 systems simultaneously, and then grow accordingly. We thus expect our biggest challenge will be to learn how to build 8-10 integrated water access systems at the same time. We will do this by hiring project managers from the construction sector.
- *Repayment:* in the long term, the model requires that communities and municipalities repay the investments we make. We will need to mitigate this risk by undertaking thorough due diligence of each new community.
- *Climate Change* will affect all water sources. Our civil engineers will need to design capture systems that are robust enough to account for likely reductions in rainfall.

Annex 1: Project completion fact sheet

Project Name:	*Watershared*: Development, Adaptation, and Mitigation through Watershed Protection in Bolivia		
Project no.	NCF-C8-0319		
Country:	Bolivia	**Financing:**	
		EUR	**%**
Nordic Partner:	GRID-Arendal	18.134	3%
Local Partner:	Fundación Natura Bolivia	202.210	31%
Other Partner:	Cuencas Sustentables SRL	40.844	7%
	NCF grant disbursed	375.859	59%
	Total	**637.048**	**100%**
Classification:	Combination		
Project cycle:	Project start date: 18/12/2019 Original closing date: 18/06/2022 Actual closing date: 18/12/2022		
Short project description:	The project had two goals. We firstly wanted to find out if we can link conservation (securing green infrastructure) and build the water access system of pipes, dams, taps etc. (grey infrastructure) and achieve both simultaneously for a reasonable price. We achieved this in five communities. 464 families in the villages of María del Rosario, Santiago de Chiquitos, Yororobá, Quitunuquiña and La Asunta put 4 118 hectares of their forests into conservation, and each now has clean water piped into their houses. We then assessed if it we can get local authorities to pay for 100% of these linked green- grey infrastructure systems. To address this question, we worked with six more municipal governments and built eight new water systems in the villages of Quirusillas, Fuerte Rua, Lagunillas, Torrehuaico, Villa Serrano, Picaflor, Florida and Comarapa. These systems included the protection of an 14,842 hectares upstream forests and the provision of water to 4,211 downstream families. We thus learned how to design and execute contracts in which over the next three years, much of the money invested in building the water systems in these communities, will be paid back into the Watershared Funds, and reinvested in constructing water systems in new communities.		
Project performance:	**Expected Outcomes and Outputs**	**Achieved**	**End-of-project status**
	12,000 hectares of water-producing forests are protected, sequestering 84,000 tons of CO2e, returning 8.4 million cubic meters of water to the aquifer, and providing potable water with zero fecal coliforms to 12,000 families		Achieved
	1.1a: Carbon sequestered: Carbon sequestered by program	78 410 t CO2e	Achieved
	1.1b: Change in carbon stock	7 841 t CO2e	Achieved
	1.2: Hectares conserved	18 960 ha	Achieved
	1.3: Number of beneficiaries: clean water downstream, development projects upstream	51 704 people 25 852 women 12 926 girls	Achieved
	1.4: Number of people with improved livelihood /income generating possibilities	17 688 people 8 834 women 4 417 girls	Achieved
	1.5: Number of people with increased resilience to climate change	51 704 people 25 852 women 12 926 girls	Achieved
	1.6: Water returned to aquifer	13.27 million M3	Achieved
	2.1: Watershared Fund designed-tested	2 funds	Achieved
	2.2: Stakeholder partnerships	12 alliances	Achieved
	2.3: Municipal funds leveraged	EUR 217 000	Achieved
Climate change outcomes and impacts:	By protecting 18 960 hectares of moist old growth forest and sequestering 78 410 T CO2e, the project helped mitigate climate change. By securing water supplies for eight, upstream, mid stream and downstream municipalities the project helped 51,704 people adapt to climate change.		
Development outcomes and impacts:	17 688 people, including 8 834 women were provided with improved livelihood/income generating possibilities**.**		

NCF core indicators	NCF core indicator	Results (quantitative)			Clarifications/Means of verification	
	Number of beneficiaries reached	women	25 852		To calculate the number of beneficiaries with increased resilience to climate change we identified the number of people living in the municipalities downstream of the project sites and dependent on the water coming from the projects, of whom we estimated 50% are female. To calculate the number of people with improved livelihoods we added the number of upstream and mid-watershed families, subtracted any double counting and multiplied by 4 people per family, of whom we estimate 50% are female	
		men	25 852			
		total	51 704			
	Number of people with increased resilience to climate change	women	25 852			
		men	25 852			
		total	51 704			
	Number of people with improved livelihoods	women	8 834			
		men	8 834			
		total	17 688			
	New decent jobs created	full-time	women	0	Although no new decent jobs were created by the project, we provided work opportunities to residents who are now managing and monitoring the water access systems, 4 people per system with a constant focus on gender balance. In addition, because communities now have more secure water supplies, residents now have more opportunities to work on agriculture in their fields. We estimate that almost a quarter of the people living in upstream/mid-stream communities now have these opportunities.	
			men	0		
			total	0		
		part-time	women	0		
			men	0		
			total	0		
		seasonal	women	0		
			men	0		
			total	0		

Annex 2: Results Framework

Expected outcomes	Indicator(s):	Achievement of outcomes
Outcome: 12,000 hectares of water-producing forests are protected, sequestering 84,000 tons of CO2e, returning 8.4 million cubic meters of water to the aquifer, and providing potable water with zero fecal coliforms to 12,000 families		
1.1a: Carbon sequestered: Carbon sequestered by program	84 000 t CO2e	78 410 t CO2e
1.1b: Change in carbon stock		7 841 t CO2e
1.2: Hectares conserved	12 000 ha	18 960 ha
1.3: Number of beneficiaries: clean water downstream, development projects upstream	50 400 people 25 200 women 12 600 girls	51 704 people 25 852 women 12 926 girls
1.4: Number of people with improved livelihood /income generating possibilities	12 000 people 6 000 women 3 000 girls	17 688 people 8 834 women 4 417 girls
1.5: Number of people with increased resilience to climate change	50 400 people 25 200 women 12 600 girls	51 704 people 25 852 women 12 926 girls
1.6: Water returned to aquifer	8.4 million M3	13.27 million M3

Expected outputs	Indicator(s):	Achievement of outputs:
Output 1.1: Agreements signed to conserve in return for development projects	600 agreements	Agreements signed with 1036 families although most signed at level of community
Output 1.2: Reductions in faecal coliform load	95%	Pre-project monitoring was undertaken, but post project was not, as projects were only completed days before the grant finished, because of Covid related delays.
Output 1.3: Hectares patrolled	12 000 ha	18 960 ha
Output 1.4: Cases of incompliance sanctioned	100%	100%, although such incompliance was minimal
Output 1.5: Chlorine tanks/water access systems constructed & installed	12 tanks and systems	We partially completed these two outputs, installing chlorine systems in the communities where people wanted them.
Output 1.6: Local actors trained in managing system	12 people 6 women	12 people 6 women
Output 1.7.1: Chlorination systems are operating: free chlorine is maintained at a concentration of 0.3-0.5 mg/l	100%	We partially completed these three outputs, but only in the sense that we installed chlorine systems at all the sites where the people wanted them (La Asunta, Yororoba and María del Rosario). However, only these few communities wanted chlorination systems. In general communities rejected the chlorination component of the project as most people don't like the taste of chlorine!
Output 1.7.2: Water Chlorination systems are installed and functioning	12 systems	
Output 1.8: Newly installed systems, fully functioning with correct levels of free chlorine and are being monitored	12 systems	
Output 2.1.1: New financing mechanisms are designed that comply with local norms	2 mechanisms 1 focused on women	2 mechanisms were designed and piloted. The 3-way agreement, exemplified in the Quirusillas agreement, was a negotiation, and finance deal between Cuencas Sustentables SRL, the Municipal Government and the Water Provider. The Water Provider is legally responsible for managing the water access system, but the loan is guaranteed by the government. The 2-way mechanism, as typified by the Villa Serrano agreement, is just between the water provider and Cuencas Sustentables SRL, and focuses on involving women in decision making, with the benefit of providing micro-meters to water users so that water can be better managed across town, making sure that schools/ hospitals are prioritized and leaks quickly fixed.
Output 2.1.2: Financial vehicle created	1 fund focused on women	1 fund focused on women

Output 2.2. % of loans paid back by municipalities	80%	Partially: Contracts that have been signed stipulate/describe how funds will be repaid
Output 2.3. % of funds repaid by municipality that are ready to be re-invested	100%	Partially: Contracts have been signed that stipulate/describe how funds will be repaid: the reason this was not achieved within the project period is Covid related delays
Output 3.1 Strengthened institutions	5 institutions	8 institutions: we built capacity of water user organizations to manage projects
Output 3.2. Nine municipalities implement a new user tariff to cover system management and watershed conservation costs	9 municipalities	5 municipal governments: we ended up working in fewer municipalities than expected
Output 3.3. Nine institutions have developed and strengthened their capacities to be self-sustaining	9 institutions	5 institutions: we ended up working in fewer municipalities than expected

Annex 3: Pictures

Picture 1: Delivering the project materials to upstream beneficiaries in Quirusillas (Credit: Cuencas Sustentables)

Picture 2: Project staff at lessons learned workshop (Credit: Cuencas Sustentables)

Picture 3: Participants in the training and capacity building (Credit: Cuencas Sustentables)

Picture 4: Building grey infrastructure in Trigal (Credit: Cuencas Sustentables)

Additional photos and videos are available in this online library.

Annex 4: Other supplementary deliverables/documentation/links

"Leveraging Citizen Action for Water Conservation (https://documentos.bancomundial.org/es/publication/documents-reports/documentdetail/099417306192332086/idu06658fbc60f1620466d0b1830ec00fc674340

Annex 5: Impact story

Diarrheal diseases account for 1 in 9 child deaths, making diarrhoea the second leading cause of death among children under five. Extensive cattle grazing is the primary threat to water quality across Latin America. Cows enter riverbank forests to drink and graze, then defecate in streams, and compact soil. Faecal coliform loads increase, and water quality declines. Because many rural communities depend on such streams for their drinking water, forest degradation is a major contributor to gastro-intestinal disease. A meta-analysis of 300,000 children from 35 countries shows that higher tree cover upstream reduces the probability of diarrhoea.

The 320 km^2 Municipality of Quirusillas nestles between the high Andes mountains and the Amazon in southeastern Bolivia. In the main town, 169 km from the city of Santa Cruz de la Sierra, 450 families have long depended on a system of small dams and pipes that brought drinking water 15 kilometers down the mountain. By 2020 this system was beginning to break down – water was being lost from leaks, broken pipes led to intermittent shut offs, and cows were increasingly polluting the upper watershed.

Even though the system was no longer providing water in quantity and quality, NCF project partner, Cuencas Sustentables, SRL, valued the infrastructure at almost €500,000. With support from grantee GRID-Arendal, Cuencas Sustentables used €35,000 of NCF funds to fix the leaks, replace the old pipes and help recover the water access system. A local conservation group, Natura Bolivia, then negotiated with 10 upstream landowner families, persuading them to sign 20-year conservation agreements to remove the cows and better protect more than a thousand hectares of their watershed forests, in exchange for economic development projects, such as beekeeping, worth €10,000.

The Quirusillas Municipal Government has committed to repay all project costs, allowing project implementers to reinvest the funds in other communities and watersheds.

Figure 5: Newly repaired water system Quirusillas (Credit: Cuencas Sustentables)

This project's innovation is that the project implementers figured out how to legislatively link the financing of "grey" infrastructure (pipes and dams) with investments in "green" infrastructure (biodiversity and carbon-rich forested watersheds). The net result is that 450 downstream families again have clean water, 10 upstream families have economic alternatives to deforestation, and 1105 hectare of forest are better protected and are sequestering an additional 180 tCO2 per year. Even better, the €46,000 invested by NCF is in the process of being repaid by the Quirusillas Municipal Government, ready to be reinvested in another watershed.