WATER GUARDIAN PROJECT

Sponsors

Execution

Partners

Santa Cruz do Sul

2016

1. Introduction

The "Water Guardian" project is carried out in the sub-basin of Andréas Brook – Drainage Basin of the Pardo River (Rio Grande do Sul, Brazil). This waterway is extremely important for the city of Vera Cruz, which has an estimated population of 23,983 inhabitants, according to data from the Brazilian Institute of Geography and Statistics (IBGE, 2010). The water for approximately 60% of this population comes from Andréas Brook.

The Water Guardian project poses the following question: how can water sources be preserved, improving quality and flow, while also providing better living conditions for the rural riverside population, which often needs development?

In this regard, the economic instrument *Payment for Environmental Services (PES)* is noteworthy for its potential to not only support the protection and sustainable use of natural resources, but to enhance the quality of life of small rural farmers. It recognizes the economic value of protection of ecosystems and sustainable use, in addition to providing a financial incentive to "providers" of environmental services.

The goal of the Water Guardian project is to protect water resources through Payment for Environmental Services (PES) to small farmers. Launched in 2011, it is scheduled to continue until December 2015. It is sponsored by the Altadis Foundation – a nonprofit organization belonging to the Imperial Tobacco Group – and Universal Leaf Tabacos. It is executed by the University of Santa Cruz do Sul (UNISC), with support from the Vera Cruz City Hall, Pardo Committee, Tobacco Industry Union (Sinditabaco) and the Brazilian Tobacco Growers Association (Afubra). To fund the project for five years, UNISC – the institution that implements the activities – is allotted a yearly payment.

In 2012, the Water Guardian project received accreditation from the Water Producer Program of the National Water Agency (ANA), which enables it, through the local City Hall, to register additional projects to compete for federal funding in technical, material and financial terms, to expand water resource protection initiatives in the Andréas Brook basin.

Due to the good results of the project, in 2015 the government of Vera Cruz showed interest to take it over after the initial the five-year period. In our assessment, this is an opportunity for the project to become a broad and permanent program, assuming

characteristics of public policy. In this way, the partners resolved to extend and to adjust the finish date of this partnership to December 31st 2016. Therefore, during 2016, the partners of the Water Guardian will work on a plan action to transfer knowledge, processes and technologies of the project to the city of Vera Cruz and ensure the continued protection and environmental preservation of the area covered by the project.

Andreas Brook – Vera Cruz – Rio Grande do Sul - Brazil

2. Water Guardian Project - Overview

What

The Water Guardian Project is a pioneering initiative in Southern Brazil, which objective is the development of water resources recovery and protection actions through the Payment for Environmental Services (PES) to small scale farmers, characterizing them as “Water Protector Agents”.

Where

The project shall cover the entire Andréas Brook Hydrographic Sub-Basin, in Vera Cruz (Rio Grande do Sul, Brazil), on which all the water springs are to be identified and preserved.

How

Once the water springs have been identified and the holding has been surveyed, diagnoses are made and action plans for the recovery and/or protection of water springs are established. The farmers adhere voluntarily and take part in the entire process.

When

Scheduled for a five-year period (2010-2015), the project encourages the farmers to adopt water and soil conservation practices in their lands, while remunerating them for water production services rendered.

In 2015, the government of Vera Cruz showed interest to take over this project beyond the five-year period. In this way, the partners resolved to extend and to adjust the finish date of this partnership to December 31st, 2016. Therefore, during 2016, the partners will work on a plan action to transfer knowledge, processes and technologies of the project to the city of Vera Cruz and ensure the continued protection and environmental preservation of the area covered by the project.

2.1 Partnerships

The project is sponsored by Fundación Altadis - a nonprofit organization that belongs to Imperial Tobacco Group

The conception and implementation of the project is by Universal Leaf Tabacos (ULTL)

The technical responsibility is provided by a partnership with the University of Santa Cruz do Sul (UNISC).

The project is also supported by the Administration Board of Vera Cruz Municipality, Pardo Committee, SindiTabaco and AFUBRA.

Municipality of Vera Cruz in the downtown area.

2.2 Objectives of the Project

Implement water recovery and protection actions through systematized stages and monitoring, as follows:

- Identification and characterization of the water springs;
- Diagnosis and plan for the recovery and protection of degraded areas;
- Periodical monitoring of the evolution of water quality and streamflow;
- Guidance and supply of the material resources for the recovering and protection of the springs.
- Implement Payment for Environmental Services (PES), in accordance to criteria established by the Water Guardian Project;
- Draw the attention of the partners and their communities to the fact that best environmental practices and conservation-oriented management, along with improvements in the native forest coverage, may turn the farmers into "Water Producers" and attract benefits to the whole community, either directly or indirectly.

Pictures of some properties that belong to the area of the Water Guardian Project.

2.3 Criteria for Payment of Environmental Services (PES)

- The valuation methodology used to estimate the payments made to farmers is the opportunity cost method, which represents the cost associated with a particular choice, best measured in terms of the lost opportunity.
- The concept of opportunity cost is directly related to the economic principle that resources are scarce, or are insufficient to satisfy all our needs. Thus, whenever a decision is made to use a resource to meet a particular need, you lose the opportunity to use it to meet other needs.

CROP	INCOME (R$/ha)	OPPORTUNITY COST (R$/ha)
Tobaco	10,000.00	2.000,00
Corn	1,500.00	300.00
Rice	2,250.00	450.00

The project considered corn as the reference crop for PES value calculations.

- Every grower is entitled to an annual value of R$ 325.00 per protected hectare, plus R$ 200.00 for their adhesion to the program. Costs related to area demarcation, seedling planting, spring water protection are also covered by the program.
- The PES values were negotiated with the producers, and the final value was depended on the size of the area included in the environmental services project. The plan is to be effective until 2016 and comprises five annual payments.

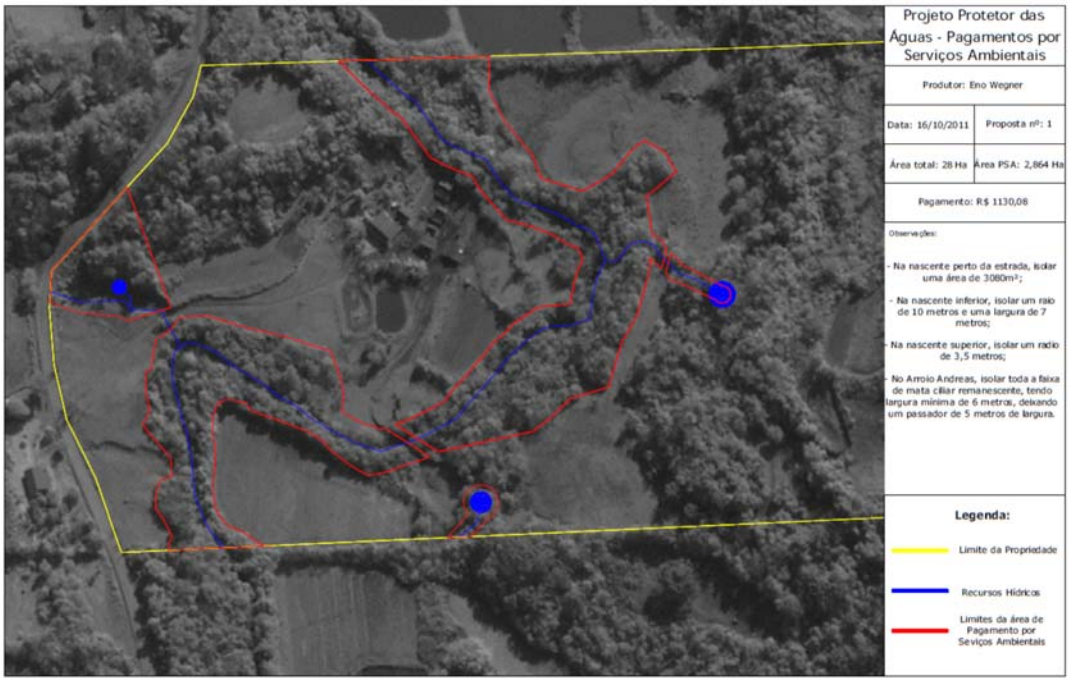
2.4 Investments

- The financial investment for the execution of this project corresponds to 505,000 Euros (Five hundred and five Thousand Euros).
- The amount deposited annually by Altadis Foundation was as follows:

Year	Euros
2011	140,000 Euros
2012	70,000 Euros
2013	150,000 Euros
2014	115,000 Euros
2015	30,000 Euros
Total	**505,000 Euros**

2.5 Negotiation with farmers

A layout of each property was made as from satellite images to limit the area to be preserved and to receive the PES. The delimitation of the area to be preserved in each property was made in common agreement with each farmer.



An area of the Water Guardian Project: 2,864 ha / PSE: R$ 1,130.09

Pictures of a property that belongs to the area of the Water Guardian Project.

2.6 Demarcation and Fencing

The monitoring of water quality has demonstrated, since the onset of the project, the need to prevent animals from accessing the springs and riparian areas, in order to improve the water quality indicators. So, the fencing activities in the project are to prevent cattle from entering the areas where the springs and/or riparian vegetation of the basin are located. The installation of fencing has been underway since 2012.

To date, 43 of the 67 farms participating in the Water Guardian Project have fencing needs, totaling 21,153 linear meters.

Fences that protect the area from animal interference.

Picture of the fences that were installed to protect the area to be preserved

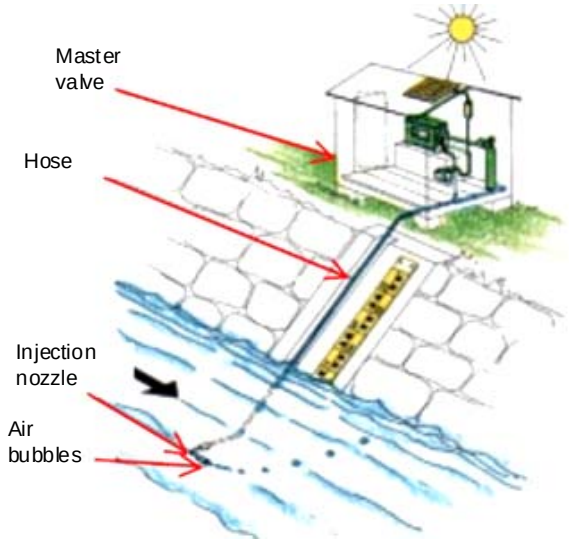
2.7 Monitoring of the water flow and quality

After the farmers adopted the described actions on each negotiated plan, the technical team started monitoring the areas that are being preserved.

The focus of the monitoring is to register the progress and the benefits of every step of the project. This activity is scheduled to happen as follows:

- Water flow and quality monitoring (in 20 sites, samples are collected every month). In the selected 20 sites we collected samples in order to evaluate physical, chemical, and microbiological characteristics of the water.

- Besides the springs monitoring, the project monitors also the Arroyo Andreas water flow and quality. To that end, the team built a hydrological measurement unit that counts with proper equipment to perform the monitoring.



Plan of the water flow measuring station

Professor Lobo analyzing water sample from Arroyo Andreas.

Water analysis applied methods at the Water Guardian project.

Water Guardian technician collecting water from a natural spring for analysis.

2.8 Hydrological Station

In planning and managing the use of water resources, it is necessary to know the flow rates, in order to assess availability and demand over time. Hydrological cycle measurements, from a quantitative point of view, are taken along waterways, creating time series that are extremely useful for different studies and projects, basically to answer typical questions such as: where is the water, how much water is there over a length of time and what are the risks of supply failures in a certain flow at a point along the waterway? Besides being able to predict future flows in coming weeks or months, another extremely important use of hydrological data is to estimate the frequency of future events that can hinder water resource management, such as low flow rates, which can affect supply, and flooding, which can damage infrastructure. Therefore, the detection of trends in flow series is important for water resource management.

Therefore, to contribute with historical rainfall and flow data of Andréas Brook, the Water Guardian project installed an automatic hydrometric station to measure precipitation and flow. The station is located 17.8 km from the source of Andréas Brook and, until June 2014, readings were taken every 12 hours. With the improvements, its services were expanded and 48 daily measurements, at 30-minute intervals, started being taken.

On the left, the data logger with an additional battery housed in a hermetic box. In the middle photo, the PVC pipe wrapped in a geotextile which contains the level sensor. On the right, the pole with photovoltaic panel and rain gauge.

All the data from the station has been systematically collected. Monthly reports are sent to the Municipal Water and Sewage Service (SEMAE) of Vera Cruz. As a result of this initiative, the Water Guardian project is generating a reliable database for the Vera

Cruz City Hall, thereby contributing to increasingly efficient management of the water resources in the Andréas Brook sub-basin.

2.9 Works to Protect Springs on Farms

Taking into account the results of the water analysis performed monthly, the technical team of the Water Guardian Project identified five water springs used for human consumption located near the farms, and of which the exposure status was contributing to the poor quality of the water indicators. Thus, the technical team performed a diagnosis and recommended to protect such springs, what has been approved by the Steering Committee of the project. The selection criteria took into account technical and health aspects since the chosen springs, besides impacting negatively the quality indicators of the water basin, were not proper for human consumption.

The improvement works in the aforementioned sources of supply started in May 2012. The five items are among the twenty ones that are being monitored with regard to physical, chemical and biological parameters through the collection of water samples, which are taken monthly from the beginning of the project. The table below lists five monitored springs and identifies the stage of improvement and protection activities.

Identification of the springs selected for improvement.

	Owner	UTM coordinate	Status
1	Alberto João Pritsch	350227 E, 6717475 S	Completed
2	Albino Niedermayer	348478 E, 6724492 S	Completed
3	Anselmo Eifert	349886 E, 6717483 S	Completed
4	Claudenir Kuhn	350251 E, 6718108 S	Completed
5	Rodrigo Keller	349750 E, 6721136 S	Completed

Retrofitted spring of Mr. Alberto João Pritsch.

2.10 Works Performed on Environmental Education

The technical team of the project develops several environmental education actions that aim at developing and strengthening the environmental awareness in the community involved so that the achievements during the project life may continue forever. One of the environmental education actions focus on the children of farmers living in the neighborhood of the Andréas brook and thus, the public elementary school that serves that community has become an active partner of Water Guardian project.

The community is also highly satisfied with the Water Guardian Project. And the young generation is interested in learning on how to preserve and improve the monitoring and sustainability of their water resources.

Students learning about the importance of reforestation of the Arroyo Andreas surrounding areas.

Students visit Andréas Brook and collect water samples

Analysis of the samples collected from the field in the school's lab

2.11 Academic Papers Generated through the Water Guardian Project

The sharing of knowledge derived from the involvement in the Water Guardian project, especially by academics from different fields of knowledge, has generated lasting results that extend beyond the dissemination of the project. Some papers have resulted in improvements that have optimized the performance of our project. One such example occurred in 2014, when an Environmental Engineering student, Felipe Berti Previdi, who held a scholarship from the Water Guardian project, wrote his final course paper which was entitled "**Acquisition and Interpretation of Hydrological Data from the Andréas Brook Sub-Basin**". The paper addressed the optimization and calibration of the project's hydrological monitoring station, in order to obtain a time series for rainfall, suspended sediments and water level of Andréas Brook in Vera Cruz (Rio Grande do Sul).

From the data collected, it was possible to interpolate these three parameters and determine the hydrograph and typical behavior of the drainage system. For the 15 recorded rainfalls, the following mean values (hh:mm) were obtained: 4:03, 8:24, 13:58, 41:25, 49:42 and 54:00 for peak, rise, retardation, concentration, recession and base times,

respectively. A direct relationship was also found between the head of the water resources and the amount of suspended sediments in the water. It was also possible to establish a mathematical relationship between the amount of rainfall and expected level of increase of the stream.

Based on the conclusions of this paper, adjustments were made to the Hydrological Station, which until June 2014 had taken readings every 12 hours. With the adjustments recommended in the academic paper, the station expanded its output and started taking 48 daily measurements, at 30-minute intervals.

2.12 Seminar of the Water Guardian Project

Among the scheduled activities of the Water Guardian Project, the annual seminars are opportunities where the participants may get together to evaluate the progress of the project, suggest adjustments and consolidate successful experiences. An example was the seminar at the end of the fourth year of the Water Guardian Project held in the Santa Tereza Community Hall, in Vera Cruz. It was attended by rural residents from the Andréas Brook sub-basin, project participants, partners, supporters, students and different organizations interested in the subject.

Project´s fourth anniversary and environmental services payment ceremony

In addition to presenting the results from the four years of the project, a participation certificate was given to each farmer in the Water Guardian project.

Water Guardians attending the event

3 Results

3.1 Water Quality Monitoring

Water quality condition refers to the "quality provided by a body of water, at a given time, in terms of possible uses with appropriate safety, based on Quality Classes," where each quality class represents a "set of water quality conditions and standards necessary for complying with predominant uses, whether current or future," as per CONAMA Resolution No. 357, of March 17, 2005 (CONAMA, 2005, p. 2) [1].

Along the Andréas Brook sub-basin, 20 collection points, located on farms participating in the Water Guardian project, were selected for water quality monitoring studies.

Water samples have been collected monthly at the 20 selected points since December 2011, in order to perform analyses of physical, chemical and microbiological variables.

The results of the water quality assessment, were based on the classes of water use according to CONAMA´s Resolution 357/2005, at the 20 collection points distributed along the Andréas Brook sub-basin.

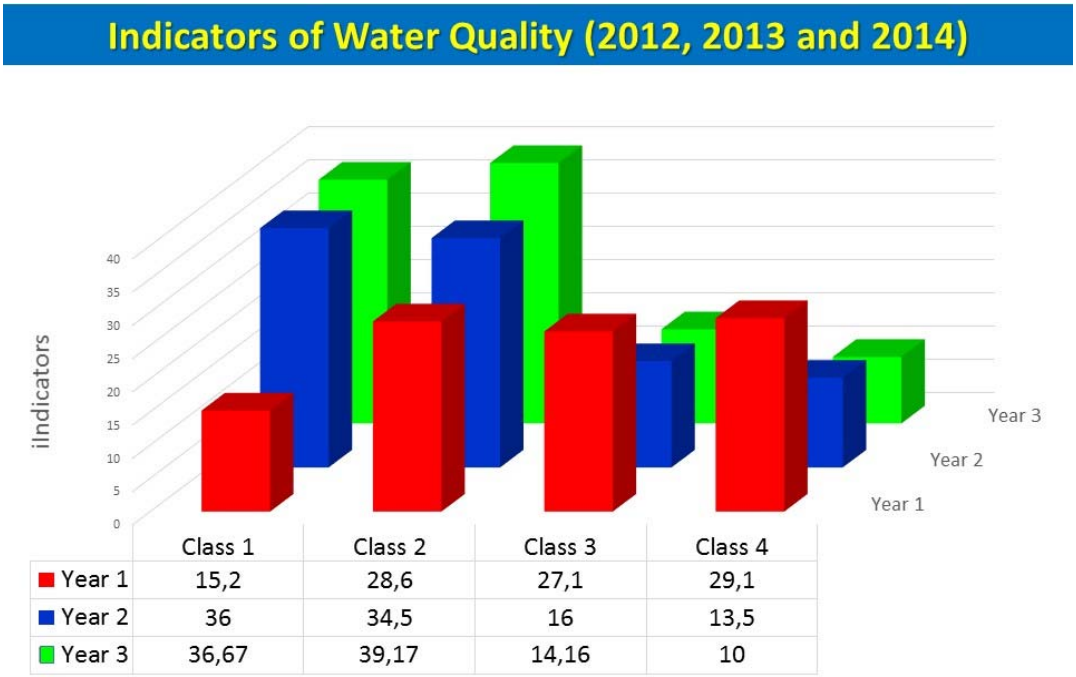
The sample points classified as belonging to Class of Use 1 of CONAMA are characterized as having good quality water, suitable for human consumption after simple treatment, for protection of aquatic communities and for primary contact recreation (swimming), among its main characteristics.

In turn, the sample points classified as belonging to Class of Use 2 also correspond to good quality water, where the main difference in relation to Class of Use 1 is that, in this case, after conventional treatment, the water can be used for human consumption.

The sample points belonging to Class of Use 3 have much more restrictions for use than Class 2. Only after conventional or advanced treatment can this water be used for human consumption, secondary recreation contact and drinking water for animals, among

its main characteristics. Thus, higher uses such as for human consumption, protection of aquatic communities and primary contact recreation (swimming) are not permitted.

Finally, the sample points classified as belonging to Class of Use 4 correspond to the worst quality class, intended only for navigation and harmony of landscape.



	Class 1	Class 2	Class 3	Class 4
Year 1	15,2	28,6	27,1	29,1
Year 2	36	34,5	16	13,5
Year 3	36,67	39,17	14,16	10

- Indicators show a meaningful increase in the higher status Classes 1 and 2, and a reduction in the lower Classes 3 and 4.

Comparison of the water quality analysis results in the periods 2012, 2013 and 2014 at 20 collection points of the project, in the Andréas Brook sub-basin

These results confirm the working hypothesis of the Water Guardian project, since, as a result of the conservation actions taken with these springs and riparian areas, water quality improved significantly, as demonstrated by the fact that the classes of use 1 and 2 of CONAMA´s Resolution, corresponding to good quality water classes, increased substantially, from 43.8% in 2012 to 70.5% in 2013 and 75.84% in 2014. In the case of the lower status classes 3 and 4, their presence accounted for 56% at the beginning of the project, but was reduced to 24.16% in 2014, after most of the planned protection measures of the project had been implemented.

The results of this monitoring until 2014 demonstrate the success of the Water Guardian project. The results confirm the effectiveness of the Payment for Environmental Services (PES) strategy for the preservation of water resources on family farms. Improving the water quality of the springs and riparian areas on the farms was an important factor for raising awareness in the municipal government which, in turn, started promoting public policies to supplement the benefits to farmers who effectively comply with the environmental protection provisions on their farms, as can be seen in the next section of this report.

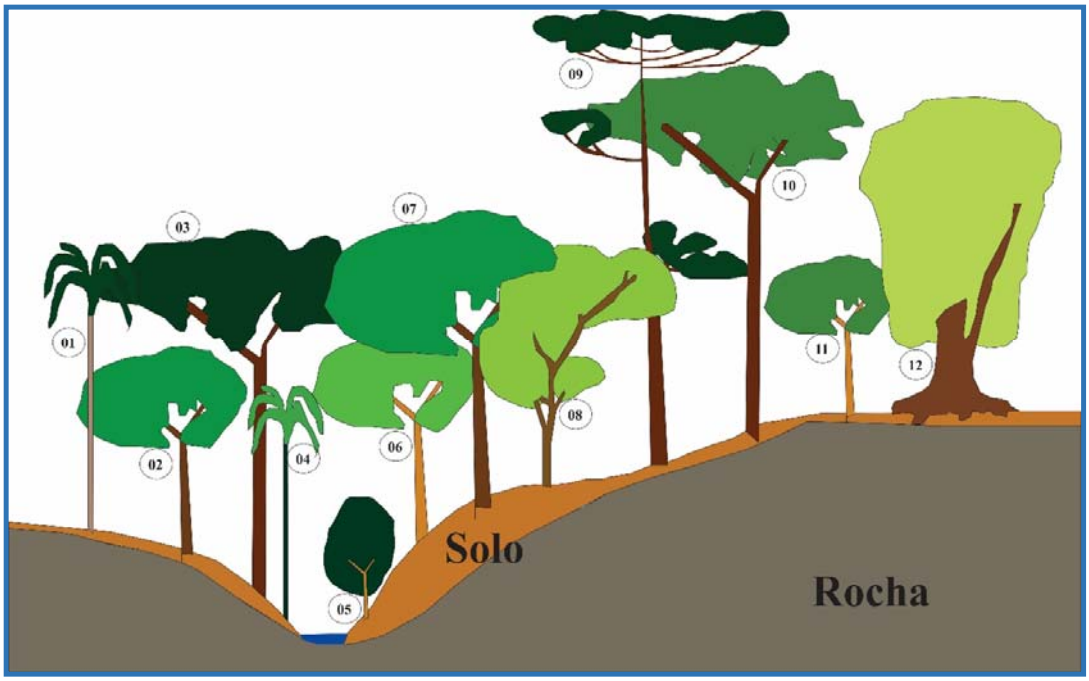
3.2 Vegetation Monitoring

Riparian vegetation is a natural protection against siltation. Without it, erosion will wash the river banks away and the suspended solids in the river water will cause damage, water treatment will be difficult, clog pipes and cause siltation. The erosion process is accentuated especially when floods occur during rainy seasons. Therefore, the preservation of these areas is essential due to their role in avoiding siltation on the banks of waterways and also serving as filters that prevent water quality from being impaired. It can be quite diversified in terms of botanical species and provides a way for wildlife to find food and water. This work was carried out to study the of riparian vegetation associated with PES preserved areas of Andréas Brook.

The floristic composition on the fragments studied in the Andréas Brook sub-basin is complex and variable, characterized by typical species of the Atlantic Forest biome, as well as species associated with riparian vegetation. The fragments can be classified as in the mid stage of ecological succession, characterized by a gradual spatial and temporal increase in the diversity of species. Different groups of species can be oberved, with different locations within the fragments: those located on the edge of waterways, which depend on the fluvial dynamics of the bed (fluctuations in water levels, humidity, etc.); the species found inside the fragment, which basically depend on synergistic interactions of the ecosystem, where the humidity factor is not significantly present; and the species found on the edge of the fragment, which are pioneer species typical of more drained areas.

Overall, pioneer and early secondary species stood out in the results, with the highest Importance Value Indices (IVI) at most collection points, constituting a set of species that are preparing to evolve to the next stage, but are initially colonizing the abandoned land around the springs. Camboatás and chal-chal are the most common species at these points, especially because they are spread by birds.

Morphological details of some species found: 1) *Cupania vernalis* (camboatá vermelho); 2) *Allophylus edulis* (chal chal); 3) *Inga marginata* (ingá feijão); 4) *Nectandra megapotamica* (canela preta); 5) *Casearia silvestris* (chá de bugre); 6) *Matayba elaeagnoides* (camboatá branco).



Schematic profile of the vegetation in the Andréas Brook sub-basin: 1) *Syagrus romanzoffiana* (gerivá); 2) *Inga marginata* (ingá feijão); 3) *Nectandra megapotamica* (canela preta); 4) *Euterpe edulis* (palmito); 5) *Actinostemon concolor* (laranjeira do mato); 6) *Cupania vernalis* (camboatá vermelho); 7) *Matayba elaeagnoides* (camboatá branco); 8) *Allophylus edulis* (chal chal); 9) *Araucaria angustifolia* (pinheiro do Paraná); 10) *Erythrina falcata* (corticeira da serra); 11) *Casearia silvestris* (chá de bugre); 12) *Phytolacca dioica* (umbuzeiro).

This work represents an outstanding study of the vegetation in spring and riparian preservation areas. The results showed that the preservation of these strategic areas turned out to be the key for forest conservation, considering that in the short term there will be decreased loss of soil washed into the rivers and consequent increased likelihood of aquifers being replenished, which will help to normalize the hydrological cycle and ultimately, increase water availability. The preservation of riparian areas and springs, besides helping to improve water quality, also contributes to maintaining the gene flow between species, thereby protecting the biodiversity of the site.

Water production, as mentioned earlier, is related to drainage protection, where forests provide certain environmental services such as regulation of the water cycle, i.e., maintenance of the flow during the dry season and control to minimize flooding, good

water quality by reducing the level of carried sediments, erosion and siltation control and preservation of aquatic habitats, among others.

Therefore, the adoption of Payment for Environmental Services (PES) to farmers protecting the springs and riparian areas located on their farms represents a highly efficient action in terms of sustainability. The results of this research confirm the possibility of a gradual increase in the spatial and temporal diversity of tree/arborescent species from the representative vegetation of the water source areas, classified as in the mid stage of ecological succession. Thus, as demonstrated by the results, the use of PES as a policy tool for the sustainable development of rural areas by public agencies is a promising alternative in terms of public management.

3.3 Approval of Bill No. 067/2015 for Water Tax Exemption for Water Guardians

On June 16, 2015, a bill submitted by the Vera Cruz Municipality exempting farmers registered with the Water Guardian project from paying the montly water bill was approved by the City Council of Vera Cruz. This measure was taken to encourage and compensate the environmental services in order to preserve the springs of the Andréas Brook and from Dona Josefa region, resulting in annual savings of around 414 Brazilian Reais to the farmers who now will have to pay only for the excess of consumption, when applicable. Besides these benefited farmers, this law will offer the same incentive to the owners of properties which have wells, water tanks and pressure pumps from Semae (local water and sewage service) on their properties.

In the mayor’s point of view, the water tax exemption represents a strategic form of ensuring the continuity of the successful experience of the Water Guardian project, implemented in 2011.

4 Final Considerations

This report shows that after the implementation of the springs protection measures by our Water Guardian Project, there was an increase of 30% on the good water supply, classes 1 and 2, as per the classification of CONAMA, from 2012 to 2013 (it raised from 43.8% in 2012, to 70.5% in 2013).

The analyses of 2014 showed an increase of around 5% in these classes, raising from 70.5% in 2013 to 75.84% in 2014, what demonstrates the project has already achieved a level of stability in terms of actions and results. This scenario shows also that the five year duration period planned initially for the project was adequate, and its methodology can be considered as validated.

We may conclude, therefore, that the actions implemented by the project have now moved into the maintenance stage. The relationship between the partners have also progressed, and the government of Vera Cruz is interested to take over this project, with a greater involvement of the team responsible for the Water Treatment Plant (WTP). In this way, the management of the Water Guardian Project and the technicians of the WTP will prepare an action plan during 2016 to transfer knowledge, processes and technologies of the project to the city of Vera Cruz, to ensure the continued protection and environmental preservation of the area covered by the project.

In our assessment, this is an opportunity for the project to become a broader and permanent program, assuming characteristics of public policy.