

P22 ON



SÃO PAULO SCHOOL OF
BUSINESS ADMINISTRATION
Center for Sustainability
Studies

DECEMBER | 2017

Nature-based Solutions

IN PARTNERSHIP WITH:



FUNDAÇÃO GRUPO BOTICÁRIO
DE PROTEÇÃO À NATUREZA





FUNDAÇÃO GRUPO BOTICÁRIO
DE PROTEÇÃO À NATUREZA



Promover e realizar ações de conservação da natureza é mais do que nosso trabalho. É nossa missão.

Nosso compromisso é traduzido em números tão expressivos quanto a biodiversidade brasileira.

 Mais de 1500 iniciativas apoiadas

 2 Reservas Naturais, com quase 11 mil hectares de áreas naturais protegidas

 Mais de 160 espécies descobertas

 505 proprietários beneficiados pela iniciativa de Pagamento por Serviços Ambientais

 496 Unidades de Conservação beneficiadas

Saiba mais em: www.fundacaogrupoboticario.org.br

P22ON

DECEMBER | 2017

FGV | SÃO PAULO SCHOOL OF BUSINESS ADMINISTRATION
Center for Sustainability Studies

Coordinator
Mario Monzoni

Vice-Coordinator
Paulo Durval Branco

Editor
Amália Safatle

GVces Researchers
Mariana Nicolletti, Natalia Lutti, Thaís Camolesi Guimarães

Communications Coordinator
Amália Safatle

Production Manager
Bel Brunharo

Text
Amália Safatle, Bruno Toledo, Cíntya Feitosa, Magali Cabral

Copy Editor
José Genulino Moura Ribeiro

Website
Amália Safatle and Oscar Freitas Neto (in collaboration)

Design
José Roosevelt Junior

Acknowledgements
To the team at Trends in Ecosystem Services Business Initiative (TeSE)

Editorial Board
Annelise Vendramini, Aron Belinky, Daniela Gomes Pinto, Fernanda Carreira, Guarany Ipê do Sol Osório, Livia Menezes Pagotto, Mariana Nicolletti, Mario Monzoni, Mauricio Jerozolimski, Paulo Durval Branco

Cover
Photo: Fundação Grupo Boticário

22
Página

P22_ON is a product of Page22.

WHAT ARE NATURE-BASED SOLUTIONS?

Nature has evolved over 3.8 billion years to develop and harmonise all existent life forms on earth.

We humans are a relatively recent species within this small, delicate and beautiful blue planet.

Yuval Noah Harari, author of *Sapiens, A Brief History of Humankind*, says that if it were possible to go on a hike in East Africa 2 million years ago, we would have encountered human figures in familiar groups completely adapted to nature, just like chimpanzees, elephants and baboons. But that was still Pre-History.

Only 70,000 years ago did the *Homo sapiens* form more elaborate cultures and begin to write History proper.

During those 70 millennia, hu-

mans and nature lived side by side without major environmental disturbance. That is, environmental degradation has always occurred through contemporary History, but in doses that allowed for the natural replenishment of extracted resources.

However, in the last 60 years, we have begun to alter the natural environment as never before in the History of our planet.

We have put our own existence at risk.

Over time, we realised that we were closing our eyes to the billions of years of nature's accumulated experience.

The last decade saw the emergence of the first projects using human intervention based on the functions of healthy ecosystems to tackle pressing challenges.

These interventions are called Nature-based Solutions (NbS), and help deal with problems such as: sea level rise; water scarcity, which overlaps in areas where there was previously an abundance of water; floods; the disappearance of biodiversity on land, sea, etc.

Since our emergence, we have depended on the resources we extract from nature. That dependency will continue.

As such, by protecting the environment, NbS are also protecting the local economy and wellbeing of people.

In practice, it works like this: Imagine a marine environment which the fishing industry has exploited to its final consequences. The disappearance of biodiversity would, in this case, affect the quality of life of local fishermen.

A Nature-based Solution which can restore this marine ecosystem - by, for example, building artificial reefs - would benefit the region environmentally, socially and economically.

The International Union for Conservation of Nature (IUCN), the organization which coined the term, has established seven basic principles for a NbS:

- To deliver an effective solution to a global challenge using nature;
- To provide the benefits of biodiversity through the good management of diversity and ecosystems;
- To present the best cost-effectiveness when compared to other solutions;
- Can be communicated in a simple and effective manner;
- Can be measured, verified and replicated;
- To respect and strengthen community rights over natural resources;

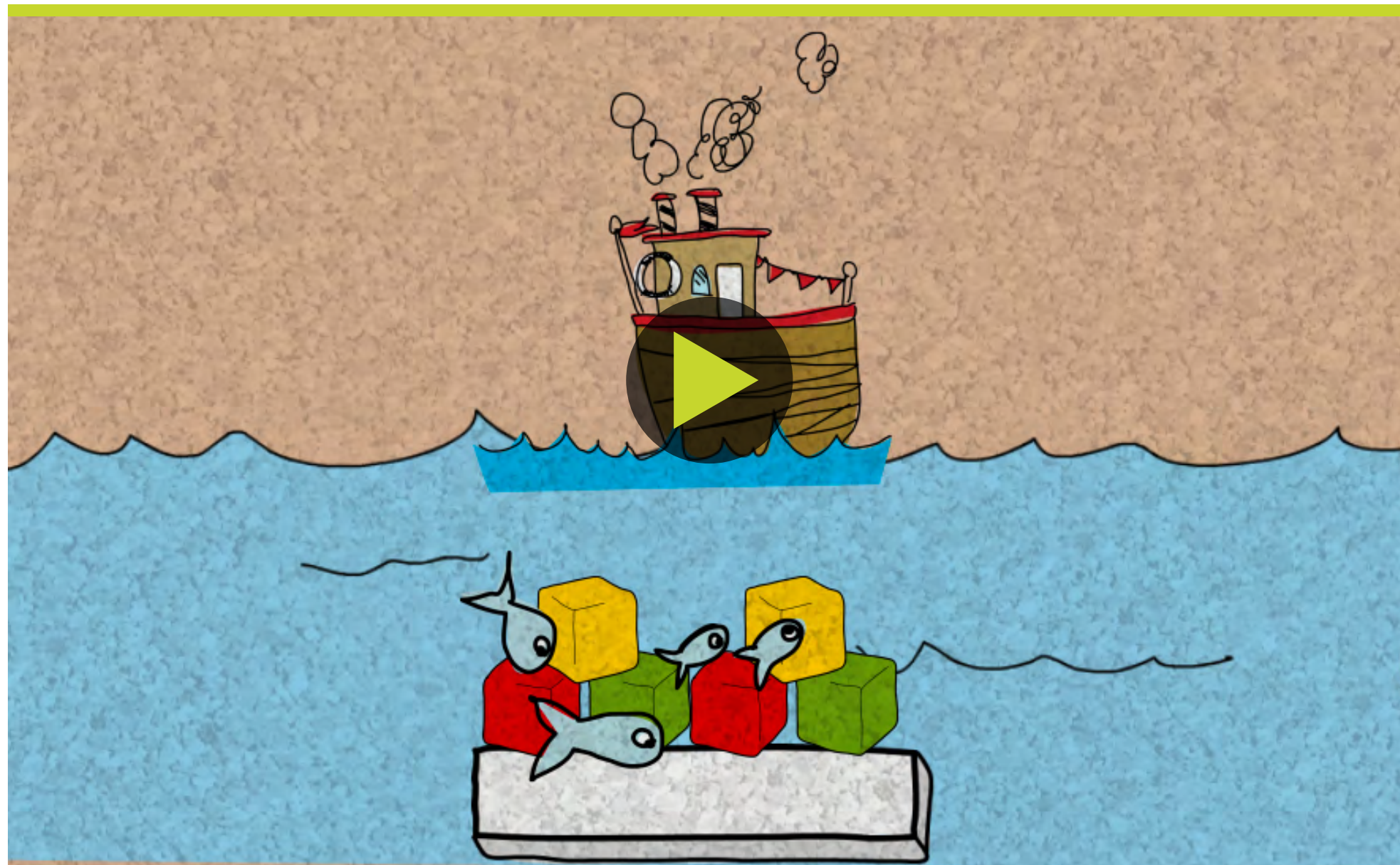
- To link sources of public and private funding;

Here in Brazil, the Fundação Grupo Boticário (Boticário Group Foundation), in affiliation with the IUCN, has taken action to disseminate these concepts and practices.

This edition of P22_ON presents the results of the first call for NbS cases made in Brazil, by initiative of the Foundation. The objective is to identify and recognise projects which demonstrate how nature can be part of the solution to the various demands of society.

The reports and statements produced should help deepen the reader's knowledge about the concept of NbS and get to know in detail 15 selected cases from the call - organized by types of solution for societal demands: water supply, municipal management, quality of water and marine environments.

Happy reading!





NATURE'S ANSWERS TO HUMAN PROBLEMS

"In nature there are no rewards or punishments; there are consequences."
James Abbott McNeill Whistler, American painter and artist.

As much as the human mind has become ingenious in its short and recent period in Earth's timeline, it has no comparison with the **3.8 billion years** of evolution of nature. If there is a place where the human being can find most of the answers and solutions relating to quality of life, it is within this formidable open-air laboratory, which is constantly being designed and re-designed.

Human intelligence doesn't seem so brilliant when, instead of drawing inspiration from the accumulated expertise of nature, it modifies and alters the services it provides, to the point of endangering its very own existence. According to the *Millennium Ecosystem Assessment* (2005), we humans have changed the natural environment more rapidly in the last 60 years than ever before in the planet's history.

The result is a corrosion of the environment's foundations, which support not only economic activity but also the wellbeing of people and life of all species. Happily, there is a growing perception that it is possible to find answers in **Nature-based Solutions** - a term coined between 2009 and 2010 by the International Union for Conservation of Nature (IUCN).

But what exactly are Nature-based Solutions? According to the IUCN, they are interventions which use nature and the natural functions of healthy ecosystems to address the most pressing demands of our time. It is a type of solution which helps protect the environment, as well as providing numerous economic and social benefits.

This is the definition which the

Boticário Group Foundation, in affiliation with the IUCN, has adopted for use in its initiatives for disseminating NbS concepts and practices in Brazil - among them, the call for cases which is the subject of this edition, in which the Boticário Group Foundation in partnership with the Centre for Sustainability Studies at FGV-Eaesop and the Ministry of the Environment selected proposals from various regions of the country.

NbS uses the attributes and processes of the complex system of nature, such as its ability to store carbon and regulate water flow, with the aim of attaining certain results, e.g. reducing the risk of disasters, improving human wellbeing and promoting a green and socially inclusive economy. By doing so, it can transform environmental and social challenges into innovative opportunities, transforming **natural capital** into a source of prosperity.

Abroad, the concept and appli-

cation of NbS has been more strongly disseminated by the European Commission, which has adapted it to its own development outlook. But what about in Brazil, a recognised environmental power with profound economic and socio-environmental problems?

"There is little available information on the subject, and most of it is international, which makes it difficult to apply to Brazilian reality", says Maria de Lourdes (Malu) Nunes, executive director of the Boticário Group Foundation. "Through this initiative, we are showing that it is possible to face the various problems that exist in our society using nature as part of the solution."

The greatest advantage NbS has, is its broad approach. Solutions draw on a range of actions in several fields, such as restoration, infrastructure, management and protection to face social challenges - among them access to clean water, food, income generation and



climate balance - with the aim of providing human wellbeing, at the same time as generating benefits for conservation.

"NbS helps us reach the objectives of the UN conventions on Climate Change, Biodiversity and Desertification", says André Ferretti, biodiversity economics manager at Boticário Group Foundation.

They also contribute to achieving the **Sustainable Development Goals (SDGs)** and the fulfilment of the Brazilian National Adaptation Plan (NAP). Launched by the government in 2016, one of the plan's principles is **Ecosystem-based Adaptation (EbA)**. EbA, in turn, is a form of Nature-based Solution.

According to Malu Nunes, inclusion of the EbA in the National Adaptation Plan opens up an important space for the strategic use of Nature-based Solutions, as NAP guidelines are passed on to local government and companies of various sectors.

The National Adaptation Plan (NAP), a National Policy on Climate Change instrument, rec-

ognises the role ecosystem services play in reducing human vulnerability, and has among its guiding principles the prioritization of Ecosystem-based Adaptation (EbA) measures for adaptation to climate change in the country.

"The concepts of EbA and NbS are so similar and synergistic that they blend together. It can be said that EbA measures are Nature-based Solutions focused on the challenges of climate change", says Mariana Egler, environmental analyst at the Ministry of the Environment.

Egler points out that, among the selected projects in this case call, around seven could equally be considered Ecosystem-based Adaptation solutions, as they are based on the recovery of ecosystems seeking the provision of ecosystem services which reduce vulnerability to climate change.

These are: projects related to the conservation and supply of water (proposed by WRI, IAV Vale Environmental Institute, The Bioatlântica Institute and Prefecture of Catende); those focused on the reduction of

urban flooding (Prefecture of Campinas); and those pertinent to the reduction of coastal vulnerability through the recovery of sandbanks (Fluminense Federal University) and the improvement of water quality (PhytoRestore).

"The development of studies for monitoring the results of these initiatives in the long term could provide technical and scientific subsidies for consolidating those actions, in comparison to grey initiatives, especially if we consider the multiple benefits of AbE measures and their long-term financial viability" says Egler.

SOCIETY'S PERCEPTION

Society often does not realise that the benefits it is receiving come from ecosystem services, such as access to clean water and food. "The concept of Nature-based Solutions is a way of raising people's awareness about the services nature provides, and in the process attaining the Sustainable Development Goals (SDGs)", says Matheus Couto, an analyst of the cooperation between the United Nations Environment

Program (UNEP) and the World Conservation Monitoring Centre (WCMC).

However, Couto thinks that it is necessary to assess, case by case, when solutions should be sought in nature, in engineering, or in hybrid models, which mix the two. Those based on nature are not always both more effective and more accessible in financial terms (affordables). Sometimes, paths which integrate NbS with engineering can be better, from this point of view.

This is shown in the *Resilience to Extreme Weather* report, published in 2014 by The Royal Society Science Policy Centre, regarding impact reduction of extreme events, such as heat waves, tidal waves, floods and droughts (see figure 12 of the [study](#)).

In any case, for Couto, there is the need for different solutions as a form of increasing the conservation of biodiversity and natural systems. This is because of the fact that of the 17 SDGs, there are four which are related to the biosphere, and form the basis

of everything: life on earth (SDG 15, life under water (14), clean water and sanitation (6) and the fight against climate change (13). This approach, which proposes a new understanding of the SDGs, was presented in June last year by Stockholm Resilience Center director Johan Rockström, and Pavan Sukhdev who is on the board of the Center.

As the 'wedding cake' image shows, the four SDGs which form part of the base support the eight social goals, among them the eradication of poverty, gender equality and quality education. From there, it is possible to reach the four economic goals, such as decent employment, growth and responsible consumption. Running across them all is the 17th goal, which is the partnerships needed to achieve these goals. [Watch the video](#) explaining the diagram.

In short, Rockström and Sukhdev's message is that the economy must serve society in order for it to evolve within the planet's safe operational space. Such an approach, however, has not gained traction with the United Nations, for whom

it could inadvertently create a hierarchy among SDGs, instead of viewing them transversally.

For André Ferretti, the wedding cake diagram helps reinforce the understanding that the other goals cannot be reached if the natural foundation is not well preserved. According to Ferretti, as well as serving as a pillar, nature, and those solutions based on nature, end up generating additional benefits, contributing to the attainment of other goals.

When restoring a forest area, for example, the gains for climate and water quality and supply are linked to food, human wellbeing and income generation benefits if fruit plants are used among the species.

Another example: in containing a hillside susceptible to landslides, if a nature-based restoration is carried out instead of a conventional retaining wall, there will also be associated gains - in terms of landscape, microclimate and ecosystem recomposition.

By encouraging NbS, the Boticário Group Foundation has

repositioned its action strategy, seeking to amplify the effects of its performance/operations/actions. According to Ferretti, the Foundation, which has worked in conservation since 1990, had focused its activity on the conservation of protected areas and supporting projects through grants.

The Foundation eventually decided to go beyond philanthropy, acting on a par with the private sector via Payment for Environmental Services (PES), a system of remuneration through which the agent promoting the environmental benefit is rewarded and the beneficiary must pay the relevant economic cost.

It took a further leap from there to stronger action related to water, climate adaptation and mitigation.

"Since 2015, we have had more contact with EbA and NbS, which has to do with our institution, which is a business foundation", says Ferretti. This is because NbS can be a part of private investments, generating profit while promoting conservation.

The call for cases is a result of this new front of action. "We hope this material will inspire other companies, universities and governments to help their regions benefit by using nature as a solution", says Malu Nunes.

[Find out](#) how proposals were selected.

PRINCIPLES OF NbS

- Delivers an effective solution to a global challenge using nature
- Supplies biodiversity benefits in terms of well-managed diversity and ecosystems
- Better cost-effectiveness in relation to other solutions
- Can be communicated in a simple and convincing manner
- Can be measured, verified and replicated
- Respects and reinforces the rights of communities over natural resources
- Links public and private sources of finance

Source: IUCN. 2012. *The IUCN Programme 2013-2016*

WHY NOW? – REASONS FOR IMPLEMENTING NbS

- Raising awareness and interest in managing and maintaining biodiversity and ecosystem services as a means of reducing economic risks by guaranteeing the continued supply of essential resources.
- Demonstrable financial advantages through the reduction of initial capital expenditures and operational costs.
- It is an umbrella term which promotes our dependency on biodiversity to increase the resistance and resilience of socio-ecological services in relation to global changes and unforeseeable extreme events, as well as providing ecosystem services which positively contribute to human health and wellbeing.

Source: *European Commission, 2015. Nature-based Solutions and Re-Naturing Cities*

Azote Images for Stockholm Resilience Centre



STEP BY STEP: CASE SELECTION

Launched on 12th July this year, the “Call for Nature-based Solutions” is the first record of cases using NbS developed for private and public sector decision-makers in Brazil. Its objective is to identify and recognize initiatives which demonstrate how nature can be a part of the solution for many of society’s demands.

Initially, the call received 91 responses from interested parties, with 40 proposals being effectively registered - 15 of which came from the private sector, 12 from the Third Sector, 7 from the academic community and 6 from the public sector.

Following from this, a pre-committee formed by the Boticário Group and the Boticário Group Foundation carried out an initial screening, to verify whether proposals met the minimum eligibility criteria: clarity and relevance of the demand to be solved through Nature-based Solutions (NbS); clarity in the presentation and argumentation for the proposed NbS; aspects of biodiversity conserva-

tion respected and driven by the initiative.

There were 21 proposals which went through to the second stage of assessment, submitted to a Specialist Committee formed by the FGV Eaesp Centre for Sustainability Studies, the Boticário Group Foundation and the Ministry of the Environment, represented by the Secretariat of Biodiversity, Forests and Climate Change. The pre-screened proposals were read and given a score by at least three professionals from the different institutions.

For assigning a score, evaluators used the following rule: 0 - not met or not applicable; 1 - the criteria is insufficiently explored by the proposal; 3 - the proposal clearly meets the criteria; or 5 - the proposal meets the criteria in exemplary fashion. The following criteria was used, with the first three considered to be essential (a score of 0 was not permissible):

- Clarity and relevance of the demand to be solved through a Nature-based Solution (NbS);

- Clarity in the presentation and argumentation of the proposed NbS;

- Aspects of the conservation of biodiversity respected and driven by the initiative;

- Identification of potential beneficiaries of the solution;

- Comparison of the NbS with the possible use of grey infrastructure for solving the identified demand/problem;

- Clarity in the analysis of investments *versus* benefits generated;

- Indication of how the proposed solution contributes to increasing local resilience to climate change;

- Indication of results with their contribution to reaching global or national targets;

- Demonstration of viability of scale or replicability;

- Indication of benefits to society, as well as those directly related to a demand to be solved.

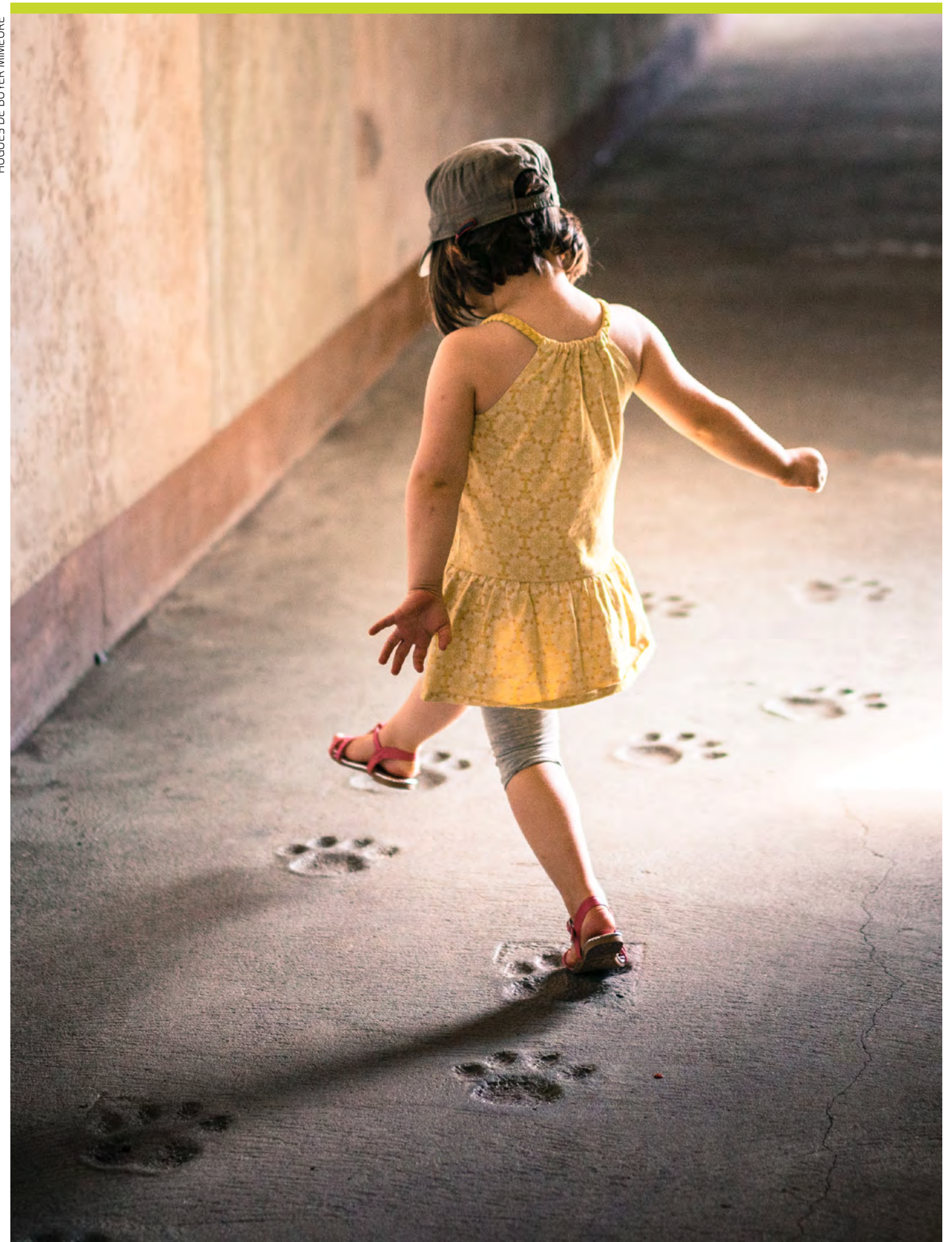
After individual analysis, an alignment and consensus meeting was held, in which 15 cases were selected - presented in this NbS edition of P22_ON. Five belong to the Third Sector, four to the private sector, four to academia and two to the public sector.

The following reports present the cases organized into types of solution by societal demand: water supply, municipal management, production chains, water quality and marine environments.

Proposals may in their history be linked to some of the institutions involved in this initiative, however, selection by three different parties ensures they are exempt from the selective process.

All selected proposals refer to the major objectives of the National Plan for Adapting to Climate Change and UN Sustainable Development Goals.

HUGUES DE BUYER MIMÉURE



THE ROLE OF FORESTS IN WATERCOURSES

Many of the residents of the Southeast Region of Brazil have felt or are feeling the effects of the water crisis which has taken place in recent years in rural and urban areas. Among the measures taken by water supply companies, 'grey infrastructure' works were much talked about, such as building new reservoirs or transposing water from one basin to another.

Although they may be necessary, these works do not forgo initiatives for restoring the natural environment as the crisis may be related to forest degradation and the unsustainable exploitation of water resources. It should be added, of course, that climate change has been altering rainfall regimes all over the planet. What few people know is that Nature-based Solution (NbS) projects aimed

at increasing the supply of water resources are underway.

In a public call, the Boticário Group Foundation selected four SbN cases from this segment, among which the World Resources Institute (WRI) case should be highlighted, which proposes **green infrastructure** as a complementary solution to conventional measures to improve water production in the Cantareira System, which supplies water to nearly 9 million people in the Metropolitan Region of São Paulo (RMSP).

"We understand that forests can bring further advantages to conventional structures. It is our job to try to assess the cost and benefit of planting forests in priority areas", says WRI biologist and economist Rafael Feltran-Barbieri.

Given the high costs of works

in this sector, the economic objective of the project, entitled *Natural Infrastructure for Water in Brazil: Restoration as a Public Sanitation Strategy*, is important. The implementation of a forest is not cheap, hence the relevance of calculating cost-effectiveness. Barbieri explains that there is already a good theoretical basis for the services provided by a forest, particularly the retention of sediment.

Sediment, which is carried by watercourses, is the main cause of turbidity. Supplying clean water to a population involves high expenditure on chemical products, power and the workforce of the public utility company. When the presence of a forest impedes **leaching of the soil**, sedimentation is greatly reduced and creates a positive impact on the cost of water treatment.

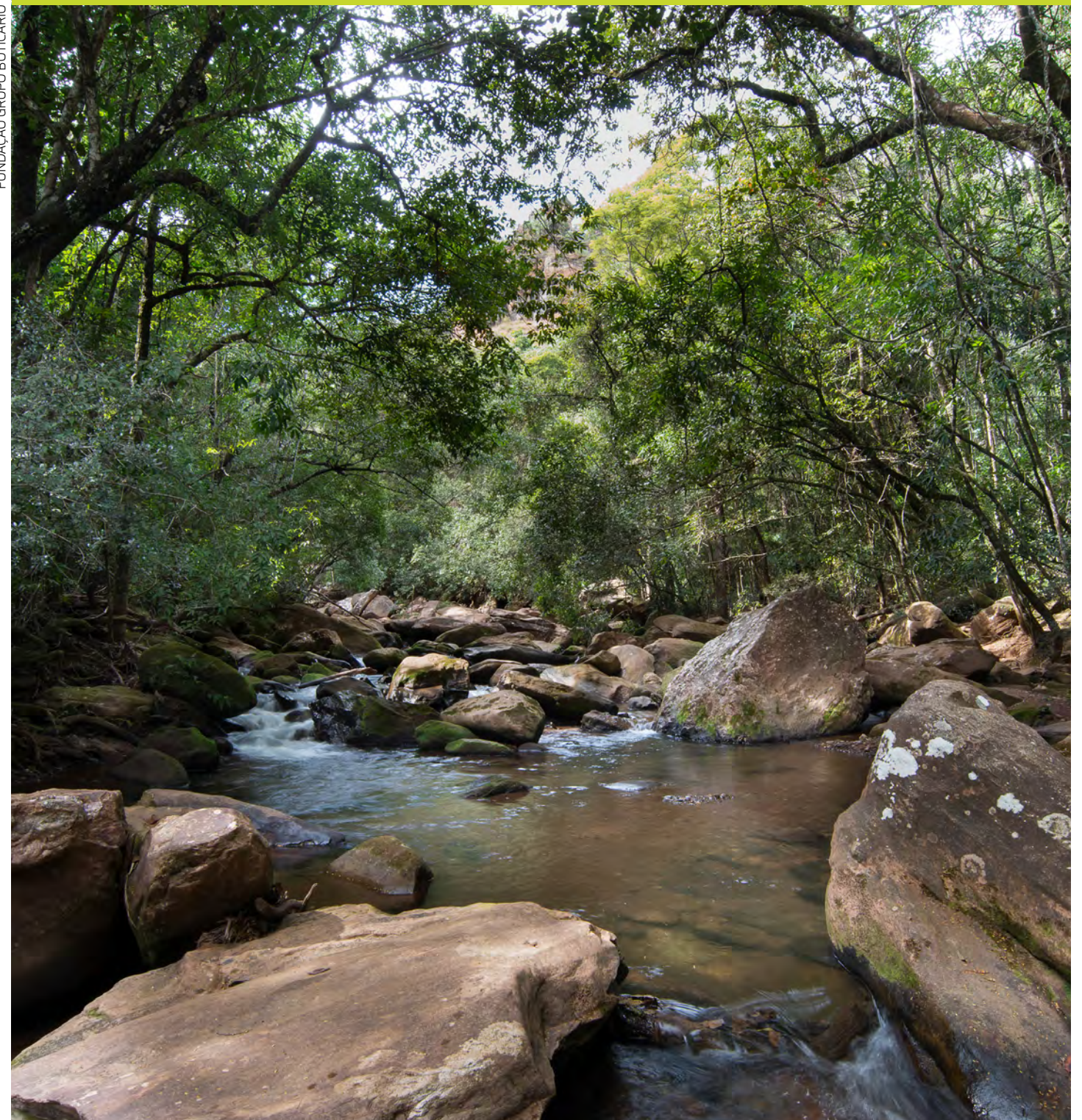
As calculations gave positive

results for the economic benefits of forest restoration, native seedlings have been planted on 4,000 hectares of areas providing water resources and in bad conservation status in RMSP - a task undertaken by non-governmental organization The Nature Conservancy (TNC), in partnership with 'Projeto Nascentes', of the Department of the Environment of the State of São Paulo.

According to the WRI, direct benefits outweigh costs by up to 16.54%, excluding positive externalities generated by other eventual ecosystem services, such as carbon sequestration, pollination, microclimatic thermal comfort, biodiversity protection, etc.

Even at the high **discount rate** of 15.46% (12% + **Average Brazil Risk** of the last 5 years + **standard deviation** of Average Risk), benefits would be only slightly

FUNDAÇÃO GRUPO BOTICÁRIO



lower than costs (-5.68%), which indicates that the restoration can practically be paid for with the savings generated by avoiding water treatment.

It is expected that 132,000 tonnes of sediment per year will not be carried, equal to an

approximate reduction of 72% of the current load. The net benefit (in present value) could reach R\$30 million, or R\$1 million per year - the project has a 30 year duration. As such the water treatment company will cut power, water and chemical product costs by R\$ 138 million.

In addition to improving water quality, restoring forests in aquifer recharge areas increases soil capacity for rainwater absorption. "The more quality water in aquifers, the lower the need for building new reservoirs", says Barbieri, noting that demand for

water from the Cantareira basin will grow by 10% over the next 20 years. Plantation of forests will be monitored for 3 years.

The eventual purchase of lands whose vegetation needs to be restored is also factored into

calculations in the economic model applied by WRI. Barbieri recalls that there is an alternative to the acquisition of lands where the proprietor is in debt with the Forest Code. "The landowner could receive an incentive to carry out the restoration, or lease it out". The model also allows for the possibility of Payment for Environmental Services to owners who have legal forest.

This same project is being replicated in Espírito Santo, in the Jucu River Basin, which supplies Grande Vitória, and in Rio de Janeiro, in the River Guandu Basin. Barbieri says these are different cases.

While the Cantareira System is formed of six reservoirs (the quantity of sediment which reaches the water treatment system in these circumstances is lower, as a large part is retained in the reservoir), in Guandu, the water is captured directly from the river and is therefore more sensitive to sediment. "When the river is very cloudy, the cost of treatment skyrockets", says Barbieri. In Vitória, water is also captured directly from the Jucu river, although a reservoir will be inaugurated in 2018.

BITTER SWEET

Another classic NbS project selected by the Boticário Group Foundation, which is also focused on water supply, is the *Environmental Compliance of Rural Properties in the Barra Seca Basin and Foz do Rio Doce*, created and administered by Instituto BioAtlântica (Ibio).

The Region of Espírito Santo faces a serious water scarcity situation. The objective of the proposal is to increase the

scale of forest restoration and ensure water availability. To this end, an institutional arrangement was formed with actors from several sectors: private (Leão Alimentos / Coca-Cola), Third Sector (TNC), Government of the State of Espírito Santo (Reflorestar Program) and the Barra Seca River and Foz do Rio Doce basin committee.

51 rural properties with up to 150 hectares of priority areas to be recovered over five years were identified. By agreeing to participate in the initiative, farmers gained advantage from the forest restoration process itself and increased water availability in the region, as well as the Rural Environmental Registry (CAR) and Payment for Environmental Services (PES). Additional benefits include basic rural sanitation and environmental compliance of the property.

Water scarcity in the Rio Doce basin is not recent. Specifically in Barra Seca, in the municipality of Linhares, the crisis was further aggravated by a conflict over water use (the Samarco disaster caused by the rupture of the Fundão Dam two years ago did not reach these tributaries).

As a big coffee producer, the region makes intensive use of soil. The geographer and Ibio project coordinator Thiago Belote Silva says there is no more water for coffee plantations or factories. "There is no water in the Conservation Units (Sooretama Biological Reserve, managed by the Chico Mendes Institute for Biodiversity Conservation (ICMBio), and Vale Nature Reserve)."

According to Belote, last year, when the water crisis intensi-

fied and Ibio started the project, there were many reports of animals from the two biological reserves, which are located in the Cupido and Pau river basins respectively, leaving the Conservation Units in search of water. "We even heard reports of animals which had died of thirst inside the reserves".

The NbS initiative in Barra Seca is also complementary to grey infrastructure. "We know that the forest regulates water cycles and holds more water in the territory, but we see grey infrastructure as an important strategy in regions with water crises, where there has been less frequent rainfall", says Belote.

But the message is that grey infrastructure should not be solely relied on. "Investing in forests means saving a lot on grey infrastructure", says Belote, citing the emblematic example of New York, where conservation work carried out in the mountains during the 90s helped avoid the construction of a new treatment plant to ensure supply for the population.

Another point in favour of NbS is to be found on the property of a local farmer known as Chico da Mata. "In the middle of the water crisis, Chico was giving 10 tankers per day to supply Sooretama and Vila Valério, cities in the Foz do Rio Doce basin. "The water sprang inside a forest which he preserved. His farm is like a showcase for the program".

With funds collected for water use, Ibio has used them to complement works: "We think not only about the forest part, but about the productive aspect and the environmental quality of the property - rural sewage, sanitation, rural waste trans-

formation, rural roads".

Country roads play a significant role in the production of sediment - they are generally badly made, poorly managed and leach in the rain, silting watercourses. "The project was conceived of taking all possible additionalities into account", says Belote.

THE FUTURE IN THE REARVIEW MIRROR

Back to the Cantareira System, this time with a NbS with a long title: Compensation for Greenhouse Gas Emissions from Companies, Products and Processes via Ecological Restoration for the Increase of Green Infrastructure in the Cantareira System, Main Water Source for São Paulo.

In this project, The Green Initiative (TGI) proposes to increase the resilience of the water supply service during the dry season by planting native Atlantic Forest in rural areas in Extrema (MG), along the tributaries of the Jaguari River, which is greatly responsible for replenishing the Cantareira System.

The water crisis of 2014 and the available climate forecasts of Brazil point to the necessity of creating a natural infrastructure (forests) for São Paulo to transition more easily from season to season. "We understand the Nature-based Solution as a path for adapting to a future with a more extreme climate, with possible droughts such as 2014", says the geographer and director of TGI, Lucas Pereira. "We propose to reduce the 70% deficit of riparian forest identified in the region of the Cantareira System, according to studies by SOS Mata Atlântica

DIVULGAÇÃO



and Greenpeace", he says.

If there is not much new in the fact that forests contribute to the water recovery of a region, the same can't be said of how TGI captures funding. In 2005, it developed the Carbon Free Program, whose mission is to promote voluntary projects for the compensation of greenhouse gas emissions in Brazilian biomes.

Financing comes from companies interested in measuring and compensating for emissions from their activity. At the other end, the investment is applied to recovering fragments of degraded forest, with priority for Permanent Preservation Areas on private property for environmental compliance or in Conservation Units. "We view the program as an innovative tool for financing restoration, which can easily be replicated" says Lucas Pereira.

TGI has developed projects along these lines in nearly 40

municipalities of Brazil. "In 12 years, we have worked with nearly 500 companies and financing at all scales. The organization enables compensation from a company, product or event. It calculates emissions and proposes compensation for an area of forest which will absorb the equivalent of the carbon emitted", he explains. In Extrema, Leroy Merlin and Caixa Seguradora are among the main funders.

R\$30,000 are needed to make viable one hectare of forest, with all stages included, from transaction costs to plantation, maintenance for two years and monitoring. Between 2015 and 2016, 40 hectares were planted, and this year TGI will plant another 20 hectares. The municipality of Extrema will plant another 100 hectares of forest in 2017.

Natural infrastructure cannot compete with grey infrastructure, but it can significantly reduce the need for engineer-

ing works (slope containment, macrodrainage, dams, adduction, silt removal, etc.). The first to benefit, according to Lucas Pereira, are the local population - who will enjoy the environmental services provided by the forest in its various aspects - and, later, users of the Cantareira System.

COURSES INTERRUPTED

The state of Espírito Santo is going through one of the biggest water crises in history, which has led rural landowners to take some drastic measures, such as building dams and drilling illegal wells. These measures intensify the problem and hinder environmental processes.

The same water crisis mentioned above, in the Barra Seca project, is affecting the Vale Environmental Institute (IAV), a non-profit organization which is responsible for the financial and administrative management of the Vale Nature Reserve (RNV),

located within the region. There are 23,000 hectares of Atlantic Forest tableland at risk, with 3,000 plant species and over 2,000 animal species. Surrounded by coffee plantations, water is disappearing from the area.

IAV developed a NbS for forest restoration to which 31 properties from around the reserve adhered to. It is called the *River Pau Atravessado Forest Restoration Project: Protecting Springs and Riparian Forests*, and aims to donate 104,000 native seedlings for restoring 68 hectares (6 of them in Permanent Preservation Areas) in the Pau Atravessado River micro-basin.

IAV biologist Rayany Soeiro Batista, who is responsible for field visits, explains that the disappearance of water from the reserve is due to the numerous irregular dams and artesian wells made by surrounding farms to guarantee their supply of the water. "They are cheating the



Ecological restoration in the Cantareira System

LUCAS PEREIRA/ INICIATIVA VERDE

law, but our proposal is to help them ecologically. We have to be very clear, from the first visit, that we are not here to audit", says Rayany Batista.

However, fear drives away most farmers. "We've met with some resistance. Of the 97 properties with dams we found, we did only 31 projects" she says. After the first contact, if the farmer agrees to participate, the area is measured and species which will best adapt to the location are identified. IAV then prepares a formal proposal explaining to the landowner what needs to be done to ensure increased water production.

Throughout this process, biologists from the reserve bring environmental education to the field, demonstrating how reforestation is essential for protecting the river bed from erosion and silting, and improving infiltration during the rainy season which can secure a stock for months of drought. Other additionalities are the prevention of environmental disasters by reinforcing dam areas and preventing breaks, as well as creating an ecological corridor for animals to return to their habitat within the reserve.

From the moment the proprietor removes their seedlings from the nursery of the Re-

serve, IAV lends initial technical assistance and later provides a technical follow-up every six months.

Rayany Batista says that, given the first results, the teams will try again to engage with 46 rural producers who initially were not interested in participating, despite their dams needing maintenance (the 31 projects are budgeted at around R\$ 240,000 and 20 of the 97 properties are in a good state of conservation). Among the main beneficiaries of the NbS are the civil population surrounding the reserve and residents of Sooretama.

Batista recalls that, in 2016, Sooretama even issued a state of alert due to the lack of water. Supply was provided by tankers on alternate days of the week, she says. Other important beneficiaries will be the reserve's flora and fauna. "Without water, the forest is more susceptible to fires, and fauna more vulnerable to hunting", says Batista.

X-RAY OF PROPOSALS

PROPOSAL: "NATURAL INFRASTRUCTURE FOR WATER IN BRAZIL: RESTORATION AS A STRATEGY FOR PUBLIC SANITATION"

Proponent: Rafael Feltran-Barbieri – World Resources Institute (WRI)
Sector: Third Sector
Location: São Paulo, SP

Problem: Deforestation in areas of springs causes sediment transport to watercourses and consequently to the Cantareira System (a network of dams which supplies almost 9 million people in the São Paulo Metropolitan Region). Cleaning the water before it reaches the population requires high expenditure on chemical products, power and workforce. Projections indicate that demand will increase by up to 10% over the next 20 years, with the probability of heat, drought and torrential rain further aggravating the problem of water turbidity.

Solution: The proposal points out the positive impact on water treatment costs provided by forest restoration in areas of springs in RMSP. The forest reduces leaching of upstream soil and reduces the volume of sediment reaching the dams. The direct benefits of planting forests outweigh the costs borne by the supply company by up to 16.54%, without factoring in the positive externalities generated by other ecosystem services, such as carbon sequestration, pollination, micro-climatic thermal comfort, protection of biodiversity etc.

PROPOSAL: "ENVIRONMENTAL COMPLIANCE OF RURAL PROPERTIES IN THE BARRA SECA AND FOZ DO RIO DOCE BASIN"

Proponent: Thiago Belote Silva – Instituto BioAtlântica
Sector: Third Sector
Location: Rio de Janeiro, RJ

Problem: The water scarcity of the Rio Doce basin is not recent and, in Barra Seca, in the municipality of Linhares, the crisis has worsened due to conflict over water use. As the region is a large coffee producer it makes intensive use of the soil. There is no more water for the production process of coffee plantations or other industry. There is also no water left inside the Conservation Units [Sooretama Biological Reserve, managed by the Chico Mendes Institute for Biodiversity Conservation (ICMbio), and the Vale Nature Reserve] located in the region. There are reports of animals dying of thirst.

Solution: The objective of the proposal is to increase the scale of forest restoration and guarantee the availability of water. 51 rural properties with 150 hectares of priority areas for recovery over 5 years have been identified. An institutional arrangement has been formed with actors from various sectors: private (Leão Alimentos/ Coca-Cola), Third Setor (TNC), the government of the state of Espírito Santo (Reflorestar Program) and the Barra Seca and Foz do Rio Doce Basin Committee.

PROPOSAL: "COMPENSATION FOR GREENHOUSE GAS EMISSIONS FROM COMPANIES, PRODUCTS, AND PROCESSES VIA ECOLOGICAL RESTORATION FOR THE INCREASE OF GREEN INFRASTRUCTURE IN THE CANTAREIRA SYSTEM, MAIN WATER SOURCE FOR SÃO PAULO"

Proponent: Lucas Pereira – The Green Initiative
Sector: Third Sector
Location: São Paulo, SP

Problem: The water crisis of 2014 and the available climate forecasts for Brazil point to the necessity of creating natural infrastructure (forests) for São Paulo to transition more easily through the seasons. It is estimated that the system will require the restoration of over 30 million native trees, with many areas of the region having a low potential for natural regeneration. Despite projections indicating an increase in rainfall average it is still extremely important to increase green infrastructure in municipalities geographically responsible for replenishing the sources which make up the system. This is needed for it to maintain its balance and resilience against irregularities in the rainfall pattern.

Solution: To increase the resilience of the water supply service in times of drought, through planting native Atlantic Forest in rural areas of Extrema (MG), along the banks of tributaries of the Jaguari River, which is greatly responsible for replenishing the Cantareira System - a network of dams which supplies nearly 9 million people in the Metropolitan Region of São Paulo. The project seeks financing through the Carbon Free Program, whose mission is to promote voluntary projects to offset greenhouse gas emissions for the benefit of Brazilian biomes. On the one side are companies interested in measuring and offsetting emissions from their activity and, on the other, programs for recovering fragments of degraded forest.

PROPOSAL: "RIVER PAU ATRAVESSADO FOREST RESTORATION PROJECT: PROTECTING SPRINGS AND RIPARIAN FORESTS"

Proponent: Rayany Soeiro Batista – Vale Environmental Institute
Sector: Third Sector
Location: Nova Lima, MG

Problem: The state of Espírito Santo is going through one of the biggest water crises in history, which has led rural landowners (coffee growers) in the Barra Seca region, in Linhares, to take drastic measures, such as building dams and drilling illegal wells. This is the site of the largest remaining Tableland Forest in the state, a forest complex with approximately 50,000 hectares, encompassing the Vale Nature Reserve, Rebio Sooretama and the Private Reserves of National Patrimony (RPPN) Mutum Preto and Recanto das Antas. This area is highly relevant for the conservation of the Atlantic Forest, as it is home to various endemic species under threat, and is dependent on the health of its water resources. The disappearance of water from its reserve is due to the numerous irregular dams and artesian wells built by the surrounding farmers to ensure their supply of the remaining water.

Solution: The project aims to donate 104,000 native seedlings to restore 68 hectares of forests (of which 6 are in Permanent Preservation Areas) in the micro-basin of the Pau Atravessado River. The 37 springs located in the surrounding areas were earmarked as starting points for implementation of environmental recovery projects.



BOB PETERSON/FICKR CREATIVE COMMONS

IN THE RIVER AND THE SEA, OPPORTUNITIES FOR GENERATING INCOME AND PRESERVING NATURAL RESOURCES

While contributing to restoring ecosystems and conserving natural resources, Nature-based Solutions (NbS) can at the same time provide wellbeing, generating economic and social benefits for the people involved.

To those who depend on nature for their subsistence, solutions such as these can be a big opportunity for increasing their income and improving their quality of life, without implying a depletion of natural stocks and flows.

This is a sensitive issue for important economic activities in Brazil, such as fish farming. A frequent problem of the sector is overfishing, which puts pressure on natural fish stocks and can lead to extinction of species. To avoid risks, fishing is forbidden during the 'piracema' or breeding season, so as to ensure the natural renewal of stocks.

The piracema period, however, is of enormous economic cost for fishermen, as they are prevented from carrying out their traditional economic activity. Initiatives such as insurance, which provides fishermen with a guaranteed minimum income during the period, helps alleviate the problem, but are still limited in scope and suffer problems of transparency and corruption.

In most cases, fishermen without access to external help such as insurance end up supplementing their income with other economic activity during the piracema. In the Amazon, they often turn to cattle-ranching - which can result in intensified deforestation.

FISH-FARMING AGAINST DEFORESTATION

In recent years, the resumption of the rate of destruction of the Amazon Forest in Brazil has been directly related to the increase of small-scale deforestation - that is, carried out on small stretches of forest.

"Deforestation on small stretches is linked to settlements and small rural properties", explains Yago Cavalcante, of the fund manager Kaeté Investimentos. "This type of deforestation, which we call 'fish-bone', is much harder to control with traditional tools."

In small rural properties in the region of Acre, deforestation came about due to the restriction of fishing activity (arising from governmental prohibition as well as unavailability of fish), which forced fishermen to clear forest for extensive livestock farming.

Economic needs and the resultant degradation of forest are what motivated the structure of Peixes da Amazônia's business model, one of the NbS cases selected for this edition of P22_ON. Created in 2011, this **social enterprise** aims to support sustainable fishing in the region, enabling local fishermen to generate higher income in exchange for the conservation of native forest on their properties.

"Peixes da Amazônia reconciles social impact, income generation for small producers and **positive environmental externalities**, such as the containment of deforestation and the possibility of restoration of degraded areas", says Cavalcante. Since 2014, Kaeté has been one

of the main investors in Peixes da Amazonia and supports the management and strengthening of the business model.

Currently, Peixes da Amazonia has an annual productive capacity of 20,000 tonnes of fish, 40,000 tonnes of animal feed, and 10 million fingerlings. The company is responsible for the production of fingerlings, feed, and refrigeration for the processing of fish meat. Fattening is carried out by fish farmers.

Producers which are integrated into the chain receive the fingerlings and the feed for fattening the fish, as well as technical assistance to support the production process. Once fattened, the fish are resold to the refrigerator.

During visits, technicians providing assistance from Peixes da Amazônia take the opportunity to monitor the situation of the forest area of each property, to verify whether producers are fulfilling their responsibility of conserving the native forest and, where possible, restoring degraded areas.

In addition to Kaeté, the Business Agency of the State of Acre and local businesses also have a stake in Peixes da Amazônia. However, the great innovation of the business model lies in the structuring of a public-private-community partnership, that is, the local community is added to the management of the organization. As such, fish farmers, organized as a cooperative, are also encouraged to undertake and participate in the management and development of the company, improving remuneration.

Today, Peixes da Amazônia

brings together 500 producers in Acre, with a protected forest area which totals 55,000 hectares. The goal is to increase the number of integrated fish farmers five-fold over the next five years.

The economic results for local producers are important. Their average income before integrating the Peixes da Amazônia chain was around R\$ 980, obtained mainly from agricultural activities. After integration, fish farming alone yields an average of R\$ 1,800 to producers, with lower environmental impact.

The business model seeks to address two important challenges in the Amazon: deforestation, and the lack of socio-economic opportunities in a historically deprived region. "Peixes da Amazonia seeks to generate value from a native product, directing income to the region itself and reducing incentives for small rural landowners to clear forest", says Cavalcante.

INTEGRATED CULTIVATION OF ALGAE

The difficulties faced by traditional fishing are not limited to the Amazon. In all basins along the coast, fishing has run into problems which directly threaten the subsistence of thousands of families and reduces the supply of sea produce.

To meet demand as well as the needs of workers, aquaculture - the cultivation of aquatic organisms usually in a controlled and confined space - has been gaining ground in recent years, including on the coast (mariculture).

As such, in addition to fish, aquiculturists or mariculturists can



Integrated algae mariculture

DIVULGAÇÃO

breed other animals, such as mussels and oysters. However, an increase in this type of activity can cause the accumulation of harmful nutrients within bodies of water, leading to **eutrophication**, a process in which pathogens develop and can cause the death of animals and plants.

A path to reducing the environmental impact of mariculture has been opened by the laboratories at the Institute of Biosciences at the University of São Paulo (USP). The project, called *Integrated Algae Mariculture: Eco-efficient and Socio-economically Sustainable Services*, a NbS selected in the call for cases, seeks to bring the necessary knowledge and technology for the production of **gracilaroid algae** (algiculture) to the mariculturists of the North Coast of São Paulo.

When cultivated in an integrated manner with fish and mussels, these algae are able to maintain

a balanced ecosystem, without water contamination by detritus. The objective is to increase productivity in the area of cultivation, diversify production and improve the incomes of coastal communities while decreasing the environmental impact of mariculture production.

Based on Integrated Marine Multi-trophic Aquaculture (IMTA), the premise of the project lies in the capacity of algae for reusing the waste from fish and mussel production, reducing levels of acidity in bodies of water, and diversifying the production of mariculture, as gracilaroids are among the most cultivated and consumed species of algae in the world.

Instead of cultivating a single species, IMTA tries to imitate a natural ecosystem, combining the cultivation of several species with complementary ecosystem functions, so that a food type which is not consumed, such as

residue, nutrients and by-products can be re-used and converted into nutrients, food and energy for other cultures.

“Our idea is to help mariculturists develop eco-efficient production methods, enabling productive activity with social and economic benefits, which also mitigates the environmental impact of eutrophication as well as carbon sequestration through algae photosynthesis”, explains Fanly Fungyl Chow Ho, professor of the Institute of Biosciences at USP and coordinator of the project. “This aquaculture strategy is based on aquatic production under the concepts of recycling and reuse,” she explains.

The project is now being applied together with a partner mariculturist in the city of Ubatuba (SP). In addition to technical training for algiculture, the initiative also seeks to carry out

environmental monitoring in the region, so as to estimate the impact of algae cultivation on the surrounding area. This will facilitate the diagnosis of activity on the North Coast of São Paulo and the possible effects of its intensification.

The project shows a path for mariculture in Brazil to reduce the environmental impact of its activity, diversify production and improve quality, productivity and income. “Even in terms

of seasonality, algae can serve as an income source when production of mussels or fish is reduced, allowing the mariculturist to maintain productivity while the environmental impact of operations are mitigated”, says Chow Ho.

The project is still in its implementation phase. The first laboratory tests with gracilaroid algae were carried out in 2016. In recent months, USP researchers started field tests,

taking the algae to a commercial mussel cultivator in Ubatuba. The first sea test results should be processed by the end of this year.

“Scientific research should not be limited to laboratories and classrooms. The idea behind this project is precisely to take our knowledge and technology to people out there, to help them face their problems and create an impact on society and the environment”, concludes Chow Ho.

X-RAY OF PROPOSALS

PROPOSAL: “PEIXES DA AMAZÔNIA”

Proponent: Yago Oliveira Cavalcante – Peixes da Amazônia

Sector: Private

Location: São Paulo, SP

Problem: In recent years, the resumption of the rate of destruction of the Amazon Forest in Brazil has been directly related to the increase of deforestation carried out in small stretches of forest. – linked to settlements and small rural properties, and much harder to control with traditional tools. In the Acre region, forest clearing has come about through restrictions on fishing activity (arising from governmental prohibition as well as unavailability of fish), which has forced fishermen to clear forest for extensive livestock farming.

Solution: Peixes da Amazônia allows local fishermen to obtain a higher income in exchange for the conservation of native forest on their properties. The fund manager Kaeté Investments, the Acre State Business Agency and local businesses also have a stake in the company. Via a public-private-community partnership, fish-farmers organized as a cooperative are encouraged to participate in the management and development of the company, with improved remuneration.

PROPOSAL: “INTEGRATED ALGAE MARICULTURE: ECO-EFFICIENT AND SOCIO-ECONOMICALLY SUSTAINABLE SERVICES”

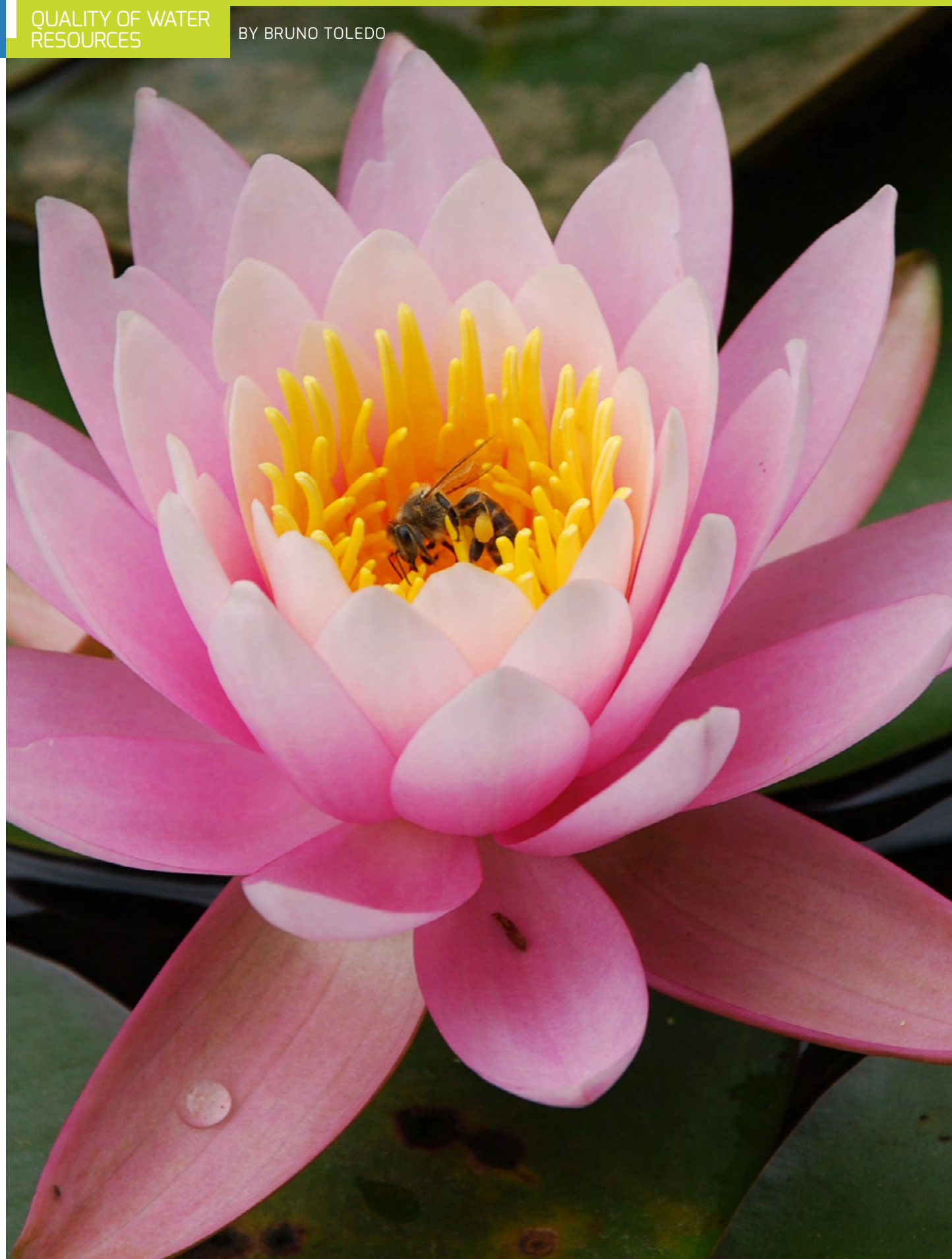
Proponent: Fanly Fungyl Chow Ho – Institute of Biosciences at USP

Sector: University

Location: São Paulo, SP

Problem: Aquaculture – the cultivation of aquatic organisms, usually in a controlled and confined space - has become increasingly important in recent years, including on the coast (mariculture). As well as fish, aquaculturists or mariculturists are able to breed other animals, such as mussels and oysters. However, an increase in this type of activity can cause the accumulation of harmful nutrients within bodies of water, leading to eutrophication, the process in which pathogens develop and can cause the death of animals and plants.

Solution: The project seeks to bring the necessary knowledge and technology for the production of gracilaroid algae (algiculture) to the mariculturists of the North Coast of São Paulo. When cultivated in an integrated manner with fish and mussels, these algae are able to maintain a balanced ecosystem. The project relies on the capacity of algae to reuse the waste by-products of fish and mussels, reducing the level of acidity in bodies of water, as well as diversifying mariculture production. Instead of cultivating a single species, the idea is to imitate a natural ecosystem, combining the cultivation of several species with complementary ecosystem functions, so that a food type that is not consumed, such as residue, nutrients and by-products, can be re-used and converted into nutrients, food and energy for other crops.



MAURO GUANDI/FLICKR CREATE COMMONS

MORE NATURE, BETTER QUALITY OF WATER

January 2015. The peak of the water crisis in the Southeast. In São Paulo, millions of people are suffering restrictions to their water supply at the height of summer. The summer rain, so badly needed to break the drought which set in since the previous year, has not returned. The Cantareira System, which supplies large part of the residents of Greater São Paulo, survives through the use of its technical reserve, popularly known as the 'dead volume'.

The situation at the dried reservoirs was bleak. However, only a few kilometres away, within the city of São Paulo, the main reservoir in the region was still full, as if the lack of rain for months had never happened. Despite not fully compensating for the loss of the Cantareira System, the Billings reservoir could have alleviated difficulties in the most critical period of the drought. And yet this was never even imagined, not for lack of will - but because it was practically unfeasible.

The water in the Billings reservoir is extremely polluted. Contaminated with sewage, it is not fit for any type of human

consumption. To do so, high investment in treatment would be required, which would be a costly and lengthy process.

One does not have to go too far to see how surreal the lack of water is in a region as irrigated by rivers as Greater São Paulo is. The rivers Tietê and Pinheiros, important for the capital's development since the 16th century, can also help to alleviate the water problem, but the dismal quality of their waters, also contaminated by raw sewage, precludes any form of human consumption.

NATURE AS A WATER FILTER

In an essay published in 1974, the economist Edmar Bacha coined a term which sums up the abysmal inequality which mars Brazil: *Belíndia*, a mix between the minuscule and affluent Belgium, and India, gigantic and miserable. If the term itself did not survive in the field of economics (India today is an emerging country in frank economic development after all), it remains strong in the realm of social reality.

Half of the population of Brazil does not have its sewage treat-

ed. Of the 100 largest Brazilian cities, only 10 treat over 80% of their sewage. In the North, in which most of the water wealth of Brazil is concentrated, only 16.4% of sewage is treated. This means that the bulk of liquid waste flows to the rivers and streams of the region's cities, contaminating watercourses - and rendering them useless for human use ([read more in the Página22 edition on sanitation](#)).

The challenge of basic sanitation in Brazil is as big that of 'belindian' India, but innovative and simple solutions are beginning to appear and produce results. Once again, nature is an important element to their effectiveness and value for money.

Two Nature-based Solutions (NbS) selected for this edition of P22_ON consist of tools which are being implemented to solve the *effluent* problem in Brazil. Bringing together natural processes, scientific knowledge, technology, creativity and persistence, they show some of the paths to expanding sewage treatment, whether in large cities or in the countryside.

The first - *Filtering Gardens*,



Sewage treatment via root zones

DIVULGAÇÃO

Water Factories – leverages natural processes to create more efficient and sustainable systems for the treatment of sanitary and industrial effluents. Based on phytoremediation (decontamination of aquatic and terrestrial herbal environments), Phytorestore Brazil proposes an innovative model for treating sewage - instead of traditional treatment stations, which are costly and generate strong odours and sludge, beautiful gardens ensure efficient, odourless decontamination at a low operational cost.

The filtering gardens project was developed by the French researcher Thierry Jacquet in the 1990s, based on studies of

phytoremediation processes. In 2004, Jacquet founded the Phytorestore in France, which was brought to Brazil six years later. Since then, the company has been developing projects for the treatment of effluents based on a solution which involves technology, nature, landscaping and efficiency.

“If trees are known as the lungs of the world, filtering gardens are like the livers of the landscape”, says Lilian Hengle de Gregori, general director of Phytorestore Brazil. The great differential of filtering gardens, in addition to their landscape solution, is that the process of decontamination does not generate sludge of any type, the main ‘villain’ of effluent treatment.

The process of effluent purification is carried out by the roots of **macrophytes**, installed in gardens designed according to the volume of effluent to be treated. The main characteristic of these plants is that they don’t cause so-called bio-contamination - that is, contaminated material does not rise above the plant’s green mass, which allows filtering gardens to be visitable spaces with no contamination risk.

The treatment process happens in four stages. Firstly, the effluent goes through an aeration tank, where a blower keeps organic matter in movement, to avoid sedimentation (and consequently the formation of sludge) and to ‘break’

gasses which produce odour.

Following this is the aerobic treatment stage (elimination of viruses and bacteria which die in the presence of oxygen), with the organic material being filtered through a first set of plants directly rooted in the gravel. In this first filtering, the effluent enters vertically through the garden, so as to pass through more quickly (about two hours). At the end of this stage, 85% of pollution has been removed from the effluent, especially solid pollutants, which serve as plant food.

The effluent then passes through a second filtering garden, where anaerobic treatment is applied (eliminating pathogens, which die in the absence

of oxygen). Here, the material enters horizontally, so as to pass more slowly and carry out the process of de-nitrification of liquid pollutants. Finally, the effluent undergoes a further reduction of its organic load (11%).

The water coming from this second filter meets the technical requirements of Resolution no. 430 of the National Environmental Council (Conama) for release into bodies of water, such as streams and rivers. However, to oxygenate the water, it goes through a fourth stage, of the ‘planted pond’: here, lillies planted at the bottom of the pond oxygenate the water before its release into nature.

“We haven’t invented anything.

The entire process we implement is a replica of what exists in nature”, says Gregori. “The difference with our technique is in the scale: we take advantage of natural processes and apply them tailored to each situation. We know the exact size of garden needed for a particular volume of effluent, for a particular type of pollution and contamination.”

Among the filtering garden projects implemented by Phytorestore in Brazil, a highlight is the L’Oréal unit on the island of Fundão, in Rio de Janeiro. The garden treats waste generated on the complex and captures rainwater for reuse. Inaugurated in October 2017, the garden was awarded the Green Solutions Awards 2017 prize in the category of Sustainable Infrastructure, held in the German city of Bonn, during the 23rd Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 23).

SANITATION IN RURAL AREAS

The second NbS for sewage treatment in root zones has been implemented in the small city of Campos Novos (SC) as result of the partnership between Santa Catarina State University (Udesc), local government and the administration of a small school in the rural area of the city. The proposal is called *Sewage Treatment Via Root Zones*.

As in many places in the interior of Brazil, the rural district of Campos Novos does not have a system for collecting and treating sewage. Waste is deposited in septic tanks for natural decomposition. However, during the rainy season, sewage of-

ten ends up running along the ground, bringing the risk of infection and illness to rural schoolchildren.

To avoid this problem, professor Eduardo Bello Rodrigues, at the time a Master’s degree student in Sanitary Engineering at Udesc, sought out the local public administration and school director in 2009 with a project for treating sewage in root zones, with a process similar to that developed by Phytorestore.

With support from the authorities, he built a treatment zone using macrophytic plants, where raw sewage from a tank enters and is horizontally distributed. The plants remove the nitrogen and phosphorous, as well as decomposing the organic matter.

“The differential of this model is the cost, which is much lower than that of any treatment system, such as activated sludge, because it only uses the force of gravity, with no electricity consumption”, explains Renan Schlegel, a researcher at Udesc. “The system operates itself, with simple periodic checks.”

In addition to the sewage treatment system, the project is also promoting educational and awareness campaigns with students, teachers and collaborators of the beneficiary school.

Projects such as these can be important for making sewage treatment systems feasible in the interior, especially in sparsely populated areas. “In the interior, it is easier to implement such systems, as there is land available”, says Schlegel. “Although in the interior it is difficult to make collection net-

works, as there are few houses. It’s easier to build a system of this type for each residence. 10 square metres (*the average space occupied by a root zone treatment system*) is practically nothing in the countryside.”

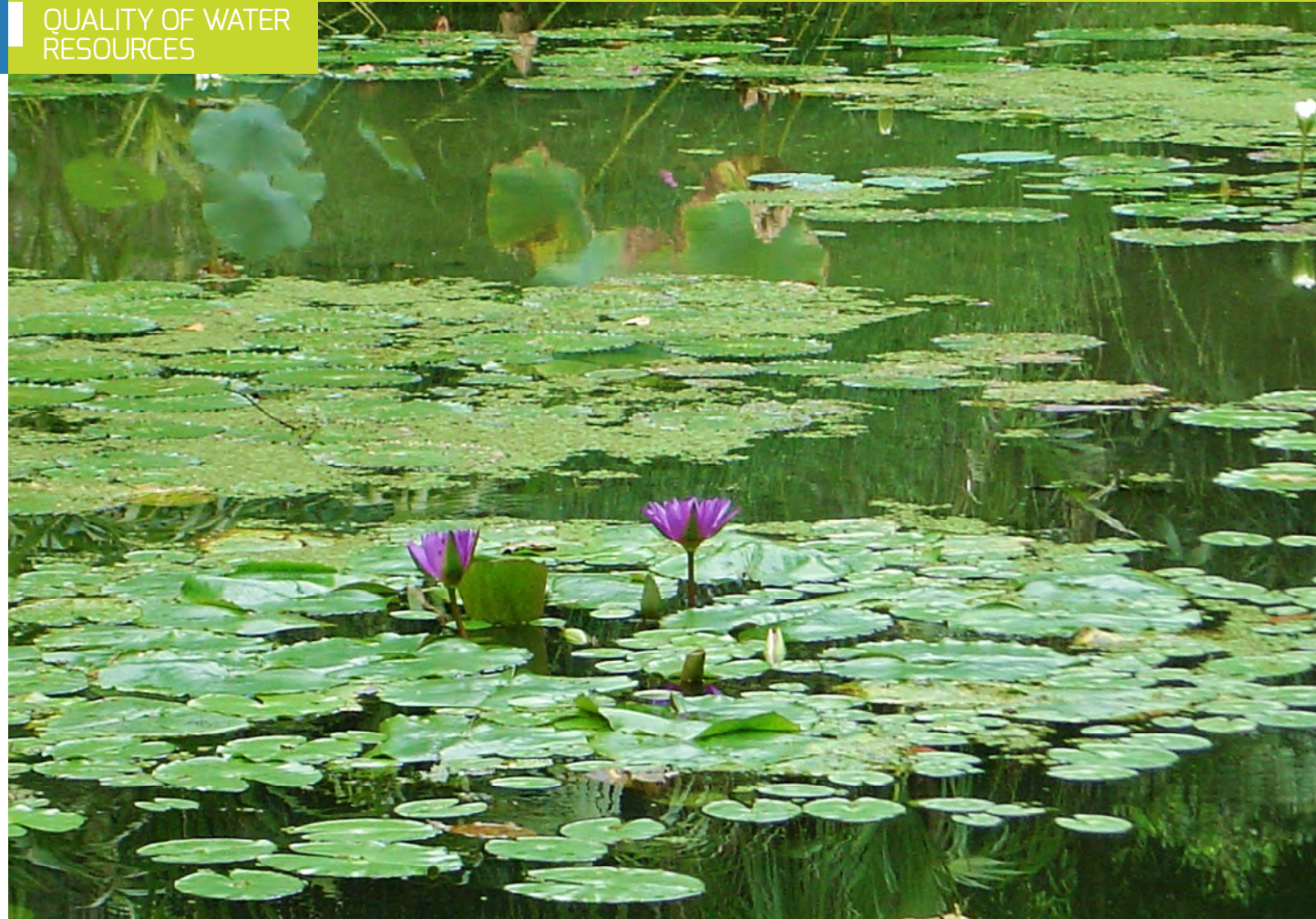
The initiative for the school in Campos Novos opened the way for the structuring of a large rural sanitary environmental project, once again under the coordination of Udesc researchers in partnership with the city’s local government. In this new program, started in March this year, the objective is to take sanitation technology to other state schools in the region of Campos Novos, especially in rural areas.

INNOVATION FOR THE ECONOMICIZING OF WATER

Sanitation helps to solve a later problem of the water issue: the contamination of bodies of water by sanitary and industrial effluents. However, there is an equally important question which precedes this discussion: before the effluent becomes effluent, it is water. Water often becomes effluent not because of effective use, but because it is wasted.

The excessive use of water is a chronic problem for water management. Fed by abusive consumption practices, waste can compromise water availability, threatening supply in critical situations - such as the situation in the Brazilian Southeast between 2014 and 2015, and which has been ongoing in the Federal District for almost two years, not to mention the Northeast region.

An important part of this waste happens in industry, which is a



ZAIDA MACHADO/FLICKR CREATIVE COMMONS

large water consumer in production processes. This is a striking reality of the cleaning products industry. Over 95% of products sold on the market are composed of water. That is to say, the active cleaning agent is practically diluted in litres and litres of water to reduce strength and create greater volume.

The excessive use of water triggers a series of wastages which is fed by the sector: greenhouse gas is emitted to transport tons and tons of cleaning products from factories to supermarkets, in addition to the plastic and cardboard packaging.

To change this, one of the NbS cases selected for this edition of P22_ON seeks to make use of nature's own assets to cre-

ate cleaning products without excessive water use and transparency in its relation with consumers. Launched this year by Marcelo Ebert, YVY is a cleaning product brand which uses **ingredients of natural origin**, without the need for petrochemicals, chlorine and phosphates.

"This brand is the result of 10 years of developing cleaning solutions for companies and industry", says Ebert. "We propose to show that it is possible to really clean using ingredients from nature, without the need for an excessive quantity of products".

The ingredients of YVY are based on terpene, composed of seeds, flowers, leaves, roots and plant wood. In nature, terpene is responsible for asepsis and the chemical balance of the environ-

ment. With the use of technology developed by YVY, bactericidal blends can be extracted, as well as blends specialized in dissolving and neutralizing odours. Essential oils are mixed in to add fragrance to the products.

"As YVY products are formulated using only ingredients of natural origin, the chance of intoxication or having an allergic reaction during use is significantly lower", argues Ebert. "Also, we avoid polluting water and contaminating aquatic organisms with petrochemical substances".

In addition to a natural chemical composition, YVY products do not needlessly consume water and other resources, since the packaging, which is in the form of recyclable capsules and non-disposable sprays, contains the pre-

cise amount of the super-concentrated product.

The YVY business model is also innovative for the sector. Via a subscription system, customers receive around 1kg of cleaning products, including disinfectants and detergents, among others, which would be the equivalent to purchasing 15kg of conventional products.

X-RAY OF PROPOSALS

PROPOSAL: "FILTERING GARDENS, WATER FACTORIES"

Proponent: Lilian Hengle de Gregori – Phytorestore Brasil

Sector: Private

Location: São Paulo, SP

Problem: Half of the population of Brazil does not have sewage treatment. Of the 100 largest Brazilian cities, only 10% treat over 80% of their sewage. In the North, in which most of the water wealth of Brazil is concentrated, only 16.4% of sewage is treated. This means that the bulk of liquid waste flows to the rivers and streams of the region's cities, contaminating watercourses - and rendering them useless for human use. Traditional treatment stations are costly and generate strong odours and sludge.

Solution: The process of sewage purification is carried out by the roots of macrophytes, installed in gardens designed according to the volume of effluent to be treated. The main characteristics of these plants is that they don't cause bio-contamination - that is, contaminated material does not rise above the plant's green mass, This allows filtering gardens to be visitable spaces with no contamination risk, and still offer 'landscape value'. The decontamination process does not generate sludge of any type, which is the main 'villain' of effluent treatment.

PROPOSAL: "SEWAGE TREATMENT VIA ROOT ZONES"

Proponent: Renan Marlon Schlegel – Santa Catarina State University (Udesc)

Sector: University

Location: Ibirama, SC

Problem: Like many places in the interior of Brazil, the rural district of Campos Novos does not have a system for collecting and treating sewage. Waste is deposited in septic tanks for natural decomposition. However, during the rainy season, sewage often ends up running along the ground, bringing the risk of infection and illness to rural schoolchildren.

Solution: With support from local government, Udesc researchers built a treatment zone using macrophytic plants, where raw sewage from a tank enters and is horizontally distributed. The plants remove the nitrogen and phosphorous, as well as decomposing organic matter. The differential of this model is the cost, which is much lower than that of any treatment system, such as activated sludge, because it only uses the force of gravity, with no electricity consumption.

PROPOSAL: "YVY, CLEANING PRODUCTS WHICH PLAY CLEAN WITH YOU AND THE ENVIRONMENT"

Proponent: Marcelo Ebert – TerpenOil

Sector: Private

Location: Jundiaí, SP

Problem: Most cleaning products use raw material chemical compounds which pollute bodies of water and contaminate aquatic organisms with petrochemical substances. In addition, over 95% of products sold on the market are composed of water. That is to say, the active cleaning agent is diluted in litres and litres of water to reduce strength and create greater volume. The excessive use of water increases greenhouse gas emissions when transporting tons of cleaning products from factories to supermarkets, in addition to requiring more plastic and cardboard packaging.

Solution: YVY products are formulated with ingredients of natural origin, without the use of petrochemicals, chlorine or phosphates. The ingredients are based on terpene, composed of seeds, flowers, leaves, roots and plant wood. In nature, terpene is responsible for asepsis and the chemical balance of the environment. As well as having a natural chemical composition, the products do not needlessly consume water and other resources, since the packaging, which is in the form of recyclable capsules and non-disposable sprays, contain the precise amount of the super-concentrated product.



ACTING IN THE PRESENT, REDUCING RISK IN THE FUTURE

To avoid the aggravation of risk of floods, water scarcity or erosion of slopes, a lot of local authorities and municipal bodies opt for works of infrastructure costing millions. Channelling rivers, drainage pools, reservoirs, dams, river and sand transposition, among others are not the only choice when it comes to reducing the **vulnerability** of a region.

Future climate scenarios - considering not only the historical series but also projected effects of climate change according to climate models - show that Brazil will have both extreme drought and rain events, depending on the region.

In recent years, water scarcity and large floods have shown how dependent we are on good planning and effective solutions

to increase **resilience**, mainly in urban areas which today are home to over 80% of the Brazilian population, according to the Brazilian Institute of Geography and Statistics (IBGE).

An additional challenge to cities, which lie within the scope of municipal management, are a large portion of the priority agendas contained in the National Adaptation Plan, such as health, food security, disaster risk management, infrastructure, coastal zones, among others. Adaptation management requires robust governance as well as financing, two features which local authorities in Brazilian generally lack, particularly in the midst of the crisis.

Some municipalities have begun to regard Nature-based Solutions as an option for prevent-

ing the more drastic effects of climate change, especially those related to extremes of rain and drought.

Among the alternatives for dealing with these risks are, for example, increasing green coverage in cities, native forest and vegetation restoration in areas of springs and coastal zones.

In fact, there is not yet a basis for cost comparison between these solutions and conventional ones, known as **grey infrastructure** - construction of dams, channelling rivers, among others. But managers who believe in Nature-based Solutions understand that the direct and indirect costs avoided are greater than the resources which would be allocated to conventional works and actions.

Creating parks, for example, provides additional health benefits, as it improves air quality through increased afforestation, reducing public health costs. At the same time, it enables the installation of sport and leisure equipment, encouraging the practice of physical activity. There are also health gains in relation to sanitation, as it will be difficult for a river which is used for leisure and is part of the economy to become a point for illegal waste and litter disposal.

Such is the case of Campinas, which, through its Municipal Green Plan, in 2016, aims to create linear parks in the revision of the Green Areas and Conservation Units System (SAV-UC). According to Gabriel Dias Neves, from the Green, Environmental and Sustainable Development Secretariat of the city, 49 sections of parks have been mapped out for implementation to reduce the deficit of social green areas in Campinas, over a 20-year horizon, accounting for the increase of the population.

This NbS proposal, selected for the case call of this edition, is titled *Implementation of Linear Parks in the Municipality of Campinas*. It is expected that the parks will improve the medium to long term availability of water in the region, as well as reducing the vulnerability to flooding through increased rainwater infiltration and creating a natural barrier along the rivers.

"In Brazil, solutions to issues related to bodies of water have always been about concreting - channelling and diverting watercourses", says Neves. "With these other solutions, we stop hiding rivers and start using

them, returning those spaces to the city." With the inclusion of rivers in the daily lives of the population, Neves is also hoping that the population itself will become controllers of maintaining the quality of the water and parks, avoiding acts of vandalism and pollution.

The plan is still in its initial implementation phase, and its execution does not only depend on the local authority. Some areas are located on allotments, and the implementation of parks by the entrepreneur does carry financial considerations. Two are already in execution by the municipal agency via the Growth Acceleration Program (PAC) of the Federal Government.

There have been recent studies in 43 other parks on the current situation of Permanent Protection Areas in the stretch and the efforts required for their restoration, illegal waste disposal, availability of sport and leisure equipment, including possible demand from the population - for example, whether a skate park or equipment for physical activity of the elderly would be more appropriate. As the projects become ready, municipal management will seek the funds to make them viable.

To analyse the distribution of Green Areas with Social Function, the Index of Social Green Areas per Basic Territorial Unit was developed, which also ties it to the number of inhabitants. Accessibility to each of the areas was also considered, based on the methodology developed by the English Nature organization and European Environment Agency. These tools help to assess the physical distance of the population from

green areas.

When defining the Priority Areas for the Implementation of Green Areas with a Social Function, a *deficit* map was created, identifying areas with the greatest needs. The Municipal Plan estimates that the entire project will be delivered by 2026. As there will be two more municipal elections before then, the idea is to establish the project through municipal decrees. "It would then follow its course regardless of government change", says Neves. "But we still need to assess whether this management model works, or if it needs to be changed to increase the likelihood of success", he says.

A SOLUTION FOR WATER SCARCITY, WITH SOCIAL GAINS

At this time of economic crisis, many municipal management initiatives are stuck awaiting resources. As they are about current or near-future issues, they depend on stable partners and permanent policies, so as to not get lost in the change of government.

In Catende, located in Zona da Mata, Pernambuco, an ambitious project to consolidate Private Natural Heritage Reserves (RPPN) with social gains seeks partnerships to be executed. It is called *Local Environmental Integration: RPPNs, Settlements and Public Authorities for Water Security in the Municipality of Catende*.

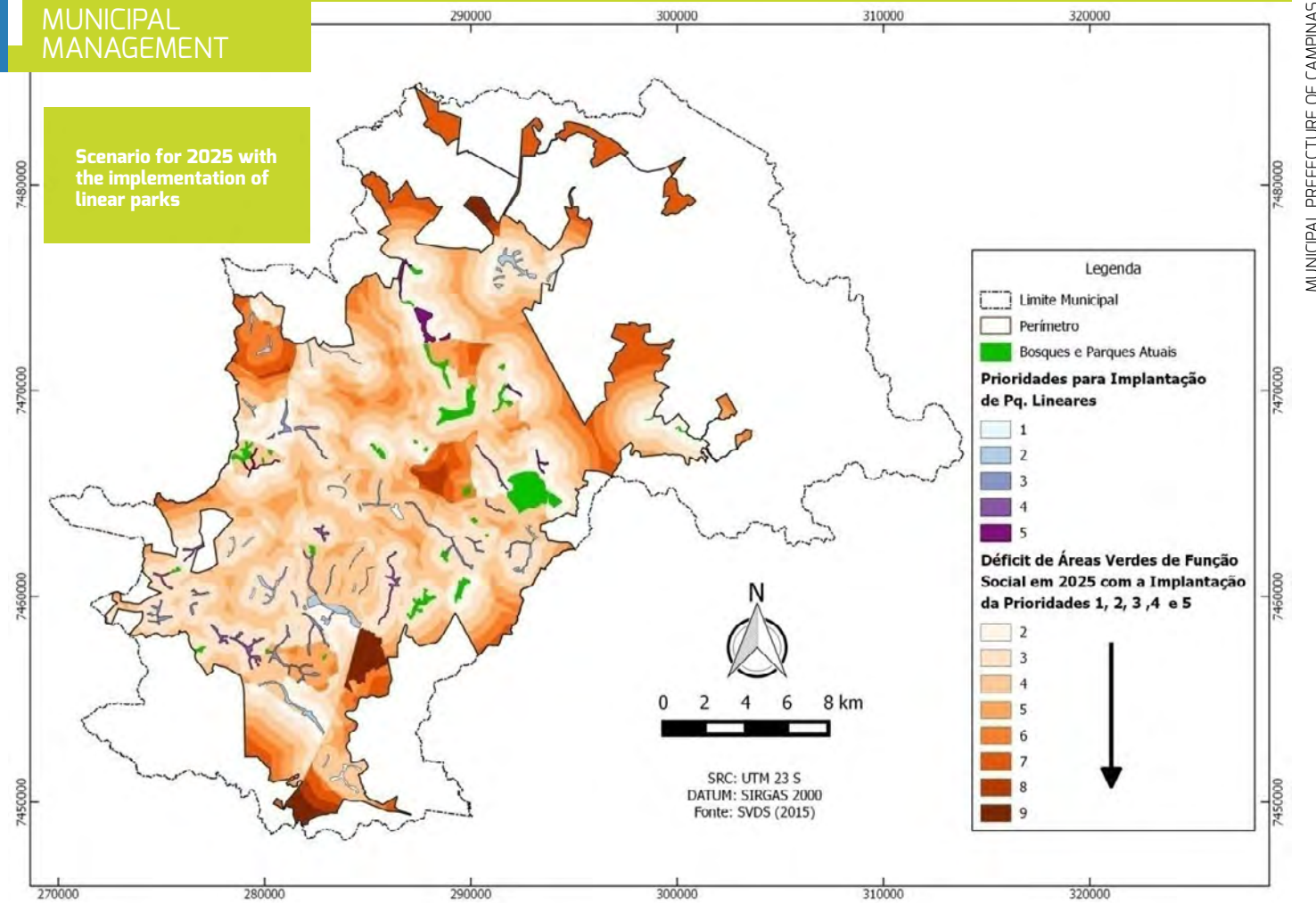
In an integrated action, with an eye on future climate change scenarios, the objective is to ensure the water security of the municipality of Catende, by means of forest restoration on

the banks and replenishment areas of the Santa Rita reservoir, benefiting a population of 37,000 inhabitants. "The conventional solution is to capture water from other reservoirs or build pipelines, says João Batista de Oliveira Júnior, of Catende City hall. "But that is just taking water from one place to another, while what we need is a more perennial solution".

Project managers are looking at water resource management, although tangentially aim to contribute to environmental compliance of sections of the Miguel Arraes Rural Settlement Project, with the restoration of Permanent Preservation Areas (APP) and Legal Reserves (RL). It is expected this will support a change in settlement production, with the implementation of agroforestry systems to assist in preservation and sustainable land use, and ensure production and food security for 15 families.

Once production areas have been established, settlers can sell food to the municipal administration itself, which is used for school meals. Finally, the project will also make possible the setting up of a seedling nursery and encourage environmental education through school visits and training families living in the settlements, as well as eco-tourism.

The idea is to complete the project in five years, with the first three being the most critical and 'hands-on', consisting of restoration and research for defining areas for forest restoration, identification and distribution of seeds of native species, planting and maintenance of seedlings, mapping of areas for development of agro-ecological agricul-



MUNICIPAL PREFECTURE OF CAMPINAS



MUNICIPALITY OF CATENDE

ture and areas of mature forest. During this period the aim is to offer training and select the project workforce and technical support, with settlers as the target audience.

Talks for the implementation of the project have already started with the Federal Institute of Pernambuco (IFPE) and with private initiatives. The local authority has stated that at this time it is not able to begin the project, and only provide technical staff. "We will only be able to properly execute it when we find a patron interested in linking its brand to the environmental issue", says João Batista Júnior.

FLOOD PREVENTION AND IMPROVED WATER QUALITY

In the Santa Catarina municipal-

ity of São Bento do Sul, in the mountain region, the problem is the opposite: future climate scenarios are indicating an increase in rainfall and greater risk of flooding in urban areas, particularly the Banhados and Negrinho river basins. The increase in frequency of heavy rain has also hit the municipality's urban water supply system by increasing turbidity and suspended solids in the water, as well as accelerating the process of silting in the region's rivers and reservoirs.

Municipal management hired consultants Aquaflorea Meio Ambiente to assess how the implementation of forest and wetland conservation and recovery actions in strategic areas could mitigate the effects of torrential rains by increasing infiltra-

tion and slowing down the flood pulse in the region.

The study, which is still in progress, and the proposal, called *Prioritization, Modelling and Valuation of Ecosystem Services in the Basins of the River Vermelho*, will investigate the role of natural infrastructure in regulating the rainfall regime in the main hydrographic basins of the region, as well as in the maintenance of water quality, accounting for climate forecasts and possible changes in environmental governance.

The final result will be an estimate of the potential impact of Ecosystem-based Adaptation (AbE) actions on mitigating the effects of extreme weather events, and also on the recovery of ecosystem services. "We

will assess if, in conserving remaining areas and recovering the basin in strategic areas, we can improve the quality of water", explains João Guimarães, from Aquiflora Meio Ambiente. According to Guimarães, strategic areas can be defined as being critical, either due to the possibility of degradation, or due to their importance in the supply of water resources in the region.

The consultants have assessed that the restoration and conservation of some of those areas also favours the infiltration of rainwater, which benefits the entire hydrological cycle and contributes to the replenishment of deeper aquifers. "This helps improve flow in times of drought, because the water that infiltrates, as well as being fil-

tered, reaches the river later. It is the main source which feeds the river in times of drought", says Guimarães.

Once identified, areas which are a priority for the recovery and maintenance of ecosystem services are incorporated to maps of alternative land use. With analysis of the rain and temperature variables in accordance with climate scenarios for the region, gains and losses will be assessed in terms of the provision of ecosystem services between current and alternative scenarios, from both the environmental and economic point of view.

The study should also estimate other socio-economic benefits related to the conservation and recovery of natural infrastruc-

ture, such as carbon capture for eventual trading in the form of certified credits in the voluntary market.

A NATURAL BARRIER AGAINST EROSION AND THE ADVANCE OF THE SEA

In Cabo Frio, located in the Lakes Region of the State of Rio de Janeiro, the future climate scenarios are causing as much concern as already familiar events such as erosion, swells and strong winds. The idea of a peaceful life next to the sea has become a constant headache with the reduction of the sand band.

In recent decades, housing has set up along the entire coast of the region, disregarding the risk of intensification of the population near the beach. The result

is a reduction of the natural protective barrier of those regions, such as restinga forest, a transitional type of vegetation. "Many people consider it 'ugly' vegetation, and so don't see the importance of preserving it", says Rosemary Vieira, professor at the Institute of Geosciences at the Fluminense Federal University.

Fortunately, between one condominium and another, restinga is reappearing between the houses and the beach, in a northward direction, from the area of the Radio Direction-Finding Navy Station of Campos Novos, known as the Navy Reserve, which today is home to a large area of preserved restinga.

True to the 'Brazilian way', plan-

ning and management become more agile when risks are already impending. However, in this region, UFF researchers have obtained a degree of support from allotment managers to reconstitute and manage the natural restinga ecosystem in an extension of approximately 7 hectares. This forms a 'belt' of continuous vegetation cover, spanning at least 4 condominiums.

Via UFF extension projects with support from the Navy, researchers have worked on retrieving exotic species, fencing and opening paths through the vegetation, as well as building a seedling nursery with matrices of native species collected from the Navy Reserve. Species which no longer exist in the allotments, due to poorly planned



DIVULGAÇÃO

occupation, may be found there.

However, the *Recovery and Management of Restinga Vegetation in the Tamoios District, Cabo Frio* project depends on the individual will of researchers and volunteers in the region. “There is no financing. With partnerships the task could be accelerated. It really is a labour of love. We’ve made requests to the local authority and local trade to put up signposts. The work is done entirely on our own initiative” says Vieira.

The idea is that from this ‘pilot area’, conditions can be created for the expansion of vegetation to local neighbourhoods to

the north of the region, where vegetation cover is fragmented and featureless. Actions can be summed up as the removal of species. “It is not that residents and the administration of the condominiums are 100% backing the restoration, because many think it is just bush”, says Vieira. “But, as the sea’s advance over the sand band is very visible, there is awareness of the problem, and they are sharing information with each other in areas closer to the erosion.”

The main contribution of this initiative is to reduce the displacement of sand from the beach, avoiding large waves from

reaching paths, pavements and buildings located closer to the sea. Without restinga vegetation, according to Vieira, the solution would be for a lorry to remove sand from the lanes almost daily. “It would be ‘drying ice’ [an exercise in futility], as well as expensive. The natural vegetation option even provides other benefits, such as thermal comfort and lower wind impact.”

X-RAY OF PROPOSALS

PROPOSAL: “IMPLEMENTATION OF LINEAR PARKS IN THE MUNICIPALITY OF CAMPINAS”

Proponent: Gabriel Dias Mangolini Neves – Municipal Government of Campinas
Sector: Government
Location: Campinas, SP

Problem: The Brazilian climate scenario is moving towards a greater incidence of extreme events, related to both droughts and rainfall, requiring a robust management response for adaptation from municipalities as well as financing. A large portion of the priority agendas contained in the National Adaptation Plan lie within the scope of municipal management, such as health, food security, disaster risk management, infrastructure, coastal zones, among others. Even while being hit hard by the crisis, many municipalities and their agencies still opt for infrastructure projects costing millions to avoid the risk of floods, lack of water, or the worsening of coastal erosion.

Solution: Through understanding that the direct and indirect costs avoided are greater than the resources which would be allocated to conventional works and actions, Campinas included the creation of linear parks in its revision of the Green Areas and Conservation Units System. 49 sections of parks were mapped out for implementation to reduce the deficit of social green areas over a 20-year horizon. In addition to increasing resilience to climate change, it also provides health benefits, by improving air quality through afforestation, thus reducing public health costs.

PROPOSAL: “LOCAL ENVIRONMENTAL INTEGRATION: RPPNS, SETTLEMENTS AND PUBLIC AUTHORITIES FOR WATER SECURITY IN THE MUNICIPALITY OF CATENDE”

Proponent: João Batista de Oliveira Júnior – Catende Prefecture
Sector: Government
Location: Catende, PE

Problem: Future climate scenarios are indicating a water security problem in the municipality of Catende. The conventional solution, which is to capture water from other reservoirs or build pipelines, does not permanently address the problem, as it means simply taking water from one place to another. At the same time, stretches of the Miguel Arraes Rural Settlement Project are not environmentally compliant, and need to restore Permanent Preservation Areas (APP) and Legal Reserve (RL) areas.

Solution: To ensure water security, the local authorities have a forest restoration project for the banks and replenishment areas of the Santa Rita reservoir, benefiting a population of 37,000 inhabitants. In restoring APPs and RLs, it is expected this will support change in settlement production, with the implementation of agroforestry systems to assist in preservation and sustainable land use, and ensure the production and food security for 15 families. Once production areas have been established, settlers can sell food to the municipal administration itself, which is used in school meals. Finally, the project will also make possible the setting up of a seedling nursery and encourage environmental education through school visits and training families, as well as eco-tourism. Without resources, but providing technical staff, the municipality is seeking partners to implement the project.

PROPOSAL: “PRIORITIZATION, MOD-ELLING AND VALUATION OF ECOSYSTEM SERVICES IN THE BASINS OF THE RIVER VERMELHO (SÃO BENTO DO SUL-SC).”

Proponent: Paulo Schwirkowski – Municipal Autonomous Water and Sewage Service (Samae)
Sector: Government
Location: São Bento do Sul, SC

Problem: Future climate scenarios are indicating an increase in rainfall and greater risk of flooding in urban areas, particularly the Banhados and Negrinho river basins. The increase in frequency of heavy rain has also hit the municipality’s urban water supply system by increasing turbidity and suspended solids in the water, as well as accelerating the process of silting in rivers and reservoirs in the region.

Solution: The study, which is still running, will investigate the role of natural infrastructure in regulating the rainfall regime in the main hydrographic basins of the region, as well as in the maintenance of water quality. With behavioural analysis of the variables rain and temperature in accordance with climate scenarios for the region, gains and losses will be assessed in terms of the provision of ecosystem services between current and alternative scenarios, from both the environmental and economic point of view. The study should also estimate other socio-economic benefits related to the conservation and recovery of natural infrastructure, such as carbon capture for eventual trading in the form of certified credits in the voluntary market.

PROPOSAL: “RECOVERY AND MANAGEMENT OF RESTINGA VEGETATION IN THE TAMOIOS DISTRICT, CABO FRIO”

Proponent: Rosemary Vieira – Fluminense Federal University
Sector: University
Location: Cabo Frio, RJ

Problem: Cabo Frio, located in the Lakes Region of the State of Rio de Janeiro, is already familiar with events such as erosion, swells and strong winds. In recent decades, housing has set up along the entire coast of the region without regard for the risk of intensification of the population near the beach. The result is a reduction of the natural protective barrier of those regions, such as restinga forest, a transitional type of vegetation.

Solution: To reconstruct and manage the natural restinga ecosystem in an extension of approximately 7 hectares. Researchers working voluntarily have retrieved exotic species, put up fences and opened paths through the vegetation, as well as building a seedling nursery with matrices of native species collected from the Navy Reserve. The idea is that from this ‘pilot area’, conditions can be created for the expansion of the vegetation to local neighbourhoods in the north of the region, where vegetation cover is fragmented and featureless. The project is seeking to accelerate its work through partnerships.

WHAT EYES CANNOT SEE

A fishing boat sails in the waters of the Paraná sea. Seen from afar, it is a fine maritime picture. From close up, it is not. The vessel is a deep sea trawler, which devastates the seabed. Nobody sees a trace of the 'land' flattened below the surface. At least half of the species captured are of no use to the industry. They get thrown away. A day's worth of trawling brings in what a local prawn fisherman would take a month or more to catch.

The depiction above has been occurring for many years, until the loss of marine biodiversity on the coast of Paraná became severe and became a social

problem. The over 4,000 small local fishermen, despite going quite far from the coast, would return home with nothing.

Then, in 2010, a Nature-based Solution (NbS) emerged involving artificial reefs, developed by the MarBrasil Association, in partnership with the Federal University of Paraná Foundation (Funpar).

The proposal of the *Marine Biodiversity Recovery Program (Rebimar)*, selected in the public call by the Boticário Group Foundation in the rubric of solutions for the marine environment, consisted in using the reefs for larval recruitment (a

type of 'banquet' for fish) to attract animals back to the region and thus colonize the new habitat and its surroundings.

Paraná has the second smallest coastline of the country, with nearly 100 kilometres in a straight line (it is longer only than the coast of Piauí, which is 66km). However, considering the perimeter of the three large bays which enter the Serra do Mar (Paranaguá, Guaraqueçaba and Guaratuba), the coastal area of the state grows to around 1,500 km, according to calculations by agronomist engineer Juliano Dobis Carneiro, coordinator of Rebimar. "These bays are important for marine biodiversi-

ty because of their ecosystems (mangroves and rocky shores). Despite being small, the coast of Paraná is very rich and diverse", he says.

In theory, fishing should basically be artisan. But in practise, large ships from São Paulo and Santa Catarina invade the narrow strip of Paraná sea, from North and South respectively, to poach fish, says Carneiro. "This type of fishing is highly degrading to the marine environment", he says, also pointing out the failures of the state: "as with the rest of Brazil, basic sanitation in Paraná is deficient, and there are also issues with the port in Paranaguá, which has problems with

waste, oil spillages, etc. This all worsens contamination in the area."

The artificial reefs built by the program accelerate recovery. They give living conditions to the larvae, which serve as food, and shelter for the new groups of young animals which will consequently be attracted to the coast. The pigfish was one of the first to arrive, says Juliano Carneiro. The location which was chosen for the installation was the mouth of Paranaguá Bay, in front of the Pontal do Paraná, and is strategic in helping accelerate recovery. "The reefs are also a physical barrier to industrial fishing.

We ended up protecting an area of 15,000 hectares from large fishing vessels, which now find it difficult to carry out trawling manoeuvres."

Rebimar was created by professor Frederico Brandini of the Biological Oceanography Department at the Oceanography Institute of the University of São Paulo (IOUSP), and biologist Ariel Scheffer da Silva, president of the MarBrasil Association Council. The had already sunk two old vessels on the coast of Paraná (shipwrecks also serve as shelters for animals), with the purpose of researching the recovery of marine biodiversity in the area.

Initially, the objective of Rebimar was to recover biodiversity, but the fishing issue came about due to two reasons, as Carneiro explains: "First, the project would automatically end up helping to recover fishery resources of commercial value; secondly, because one of the conditions for Ibama to grant an environmental license for installing the reefs was to have a public hearing with local fishermen, as they are the main users of the area."

The reefs were installed in a parallel line to the coast, at a distance of 5 km. There are 10 points, each with 350 blocks made of cement and a pH neu-

tralizing product (pictured). Between the points there is a distance of 1.2 km, which totals a 12km extension of barrier. In all, 3500 reefs were installed. Each is 50cm long by 40cm high and 40 cm wide. There is a clover-shaped hole in the middle, to increase the surface area for attachment of marine organisms. Each piece weighs 120 kg. From Carneiro's description, they collectively resemble a series of small mountains on the seabed.

Although it was of interest to the project to understand how the reefs would function underwater, the monitoring of the reefs was another condition set by Ibama, which feared the



PAULA KASTEN

reefs would be buried. On a first check, Rebimar noticed that the reefs had sunken slightly, but not enough to stop the reefs functioning as a natural rock.

In terms of monitoring fishery results, in addition to the return of the pigfish to the vicinity of the barrier, the physical impediment of trawler fishing and the fact that fishermen did not need to go so far from the coast, a diversification of activity could be seen: instead of catching prawns, many fishermen began to rent out their vessels for sport. They take tourists and holiday-makers fishing near the reefs. "Line fishing is an excellent alternative activity as it is not aggressive to the environment", says Carneiro.

Two or three weeks after their installation, the reefs were colonized by algae. Four years later, where there was previously only sand, animals could be observed migrating from one area to another. "There is now an environment with large biodiver-

sity, which is even comparable to Ilhas dos Currais, a national marine park. We have found the Mero fish [a species under threat of extinction], morays, octopuses, turtles. This means that the rock imitation has worked", says Juliano Carneiro.

In 2012, Rebimar was awarded the ODM Brasil Prize from the federal government (as encouragement for reaching the UN Millennium Development Goals), with one of the criteria being the replicability of the project. The reefs designed by Rebimar can be installed anywhere on the coast, but Carneiro has a warning: "We do not advocate throwing artificial reefs all over the place, because it is an alteration of nature. On the coast of Paraná, which has few islands, we found that an artificial reef would be a good NbS".

The project, financed by the Socio-environmental Petrobras Program, cost R\$ 5 million, a negligible amount given the environmental, social and eco-

nomics results which have been attained.

MIMICRY IN THE SEA

Forecasts indicate that the sea level in the region of Santos (SP) could rise by 18cm by 2050, due to climate change, and would result in water advancing over urbanized areas of the city. The city already faces big problems with sea swell and erosion. The building of breakwaters (concrete barriers in the sea) is one solution for reducing the risk of flooding. But is traditional engineering prepared to carry out this work with the lowest possible impact on marine biodiversity?

As can be seen in other coastal cities, when seaside promenades and roads are built, the structures usually have smooth walls, and certainly do not resemble the rocky shores of the Brazilian coast, its crevices and recesses a habitat for various species of marine animals.

A project called *Ecological Engi-*

neering as a Solution for Coastal Biodiversity Maintenance in the Face of Impact from Urbanization and Climate Change, which is also a marine environment NbS selected by the Boticário Group Foundation, proposes an engineering methodology which makes constructions more similar to rocks. This mimicry of nature in human interventions at sea is called 'blue engineering'.

According to professor Ronaldo Christofolletti from the Sea Institute at the Federal University of São Paulo (Unifesp), who is responsible for the project, the fact that in many urbanized areas the recovery of nature is almost never possible means it is necessary to develop a formula which can guarantee the maintenance of local biodiversity - and, consequently, of ecosystem services - in regions where interventions are necessary, as is the case of Santos. "Planting mangroves on the coast of a city like Santos to contain the sea's advance, for example, is

no longer possible. So we can use grey engineering, but in an ecological way", says Christofolletti.

The NbS project itself consists in making a geomorphological survey of the marine environment along the entire coast of Santos, in order to verify the structure of its rocky walls - its slopes, types of slots and holes, porousness, roughness, among other characteristics - in order to provide the subsidies for turning grey engineering into blue engineering. Christofolletti believes this will make possible the preservation of marine diversity through human intervention.

In other words, when building

promenades, barriers or any construction in the sea, structures must have a rocky appearance, so that the various species can find refuge, including predators. "When a predator no longer exists in an environment, some other species will develop more than they should, forming a vicious circle until natural diversity is lost", says Christofolletti, according to whom a similar methodology has been used in the United Kingdom, Australia and the United States, where ceramic pots were fixed onto artificial walls to create a habitat.

Carrying out the survey in Santos does not mean the data cannot be used for any other region of the country, given

that, according to Christofolletti, rock formations have the same characteristics on a scale of hundreds of kilometres - between Espírito Santo and Santa Catarina. As it is still in an initial phase, there are no results yet to assess the proposal's efficiency.

The idea, as soon as there are comparable items, is to compare the natural coast with the existing artificial structures. "We are beginning an initial survey of where the artificial structures are, what they are like and what biodiversity exists around them. Following this, we will carry out a general survey of the entire coast of Santos. When we look at the artificial and natural substrata, we will

be able to compare the biodiversity in each structure", says Christofolletti.

The survey will cost R\$ 5 million and will be financed by the Research Support Foundation of the State of São Paulo (Fapesp) and the National Council for Scientific and Technological Development (CNPq), according to Christofolletti. Talks have also been held with the local authority of Santos for eventual participation.

X-RAY OF PROPOSALS

PROPOSAL: "MARINE BIODIVERSITY RECOVERY PROGRAM - REBIMAR"

Proponent: Juliano José Dobis Carneiro – MarBrasil Association

Sector: Third Sector
Location: Paranaguá, Gua-
raqueçaba and Guaratuba
Bays, PR

Problem: Large fishing boats from other states invade the strip of Paraná sea to catch prawns. Industrial trawler fishing has, over the years, destroyed the sediment structure of the entire biological community of the local marine ecosystem, compromising the habitat

of hundreds of species of socio-economic and ecological importance. The local fishermen of Paraná have begun to sail further and further from the coast, yet without success.

Solution: The proposal was to build artificial reefs to accelerate the recovery of the marine environment in the bays of Paraná, which thousands of local prawn fishermen depend on. The reefs, which are made of concrete, are able to sustain larvae that serve as food, as well as providing shelter to new groups of young animals which will consequently be attracted to the coast.

PROPOSAL: "ECOLOGICAL ENGINEERING AS A SOLUTION FOR COASTAL BIODIVERSITY MAINTENANCE IN THE FACE OF IMPACT FROM URBANIZATION AND CLIMATE CHANGE"

Proponent: Ronaldo Christofolletti – Federal University of São Paulo (Unifesp)
Sector: University
Location: Santos, SP

Problem: Forecasts indicate that the sea level in the region of Santos (SP) could rise by 18cm by 2050, due to climate change, and would result in water advancing over urbanized areas of the city. The city is already facing problems with sea swell and erosion.

Solution: The building of breakwaters (concrete barriers in the sea) is one solution for reducing the risk of flooding. The proposal is that the engineering project for these barriers, as that of any construction in the sea, must respect the geomorphology of the marine environment. In other words, the constructions must copy the form of the local rocky coasts - its slopes, types of slots and holes, porousness, roughness, among other characteristics - with the purpose of attracting biodiversity. The project aims to create a survey of these characteristics in order to subsidize future engineering works.



PAUL CROSS/ FLICKR CREATIVE COMMONS



Malu Nunes, Executive Director of the Boticário Group Foundation, explains why Nature-based Solutions should be encouraged as a conservation strategy.



Everton Lucero, Secretary of the Ministry of Environment, stresses the importance of Ecosystem-based Adaptation (EbA).



The Secretary of Biodiversity of the Ministry of the Environment, José Pedro de Oliveira Costa, emphasizes the importance of the call for Nature-based Solutions cases.



Mario Monzoni, Coordinator of the Center for Sustainability Studies at FGV Eaes (GVces), talks about the forefront of knowledge in the valuation of ecosystem services and EbA.

COMPILED BY AMÁLIA SAFATLE



WAQAS MUSTAFEEZ/FLICKR CREATIVE COMMONS

DICTIONARY, SUGGESTED READING AND VIDEOS

> Dictionary: Get to know the terminology used in this issue

Adaptation – Initiatives and measures to reduce the vulnerability of natural and human systems against current or expected climate change effects. The transfer of populations from low coastal zones to higher zones is an example of adaptation to rising sea levels. Unlike **mitigation**, adaptation involves action and policies which are planned to encompass other objectives and involve multiple sectors. As such, they imply a conceptual and thematic complexity, represented in the classic global problem of different scales of decision-making, characterized by a large diversity of actors, multiple factors of stress and varied timescales.

Aquatic Macrophytes – Aquatic vegetation which can live in swamps as well as totally submerged environments. It has cer-

tain features proper to terrestrial vegetation and is greatly capable of adapting to different types of environment, which makes its occurrence widespread. They can be emerged (e.g. **taboa**, **reeds**), floating (**orelha-de-rato**, **aguapé**), floating leaves (vitória-régia, **lírio-d'água**), rooted and submerged (**cabomba**) and freely submerged (utricularia) inhabit them.

Biomimicry – In simplified terms, means imitation (*mimesis*) of life (*bios*). This area of science observes nature and seeks to reproduce phenomena similar to those found in biological systems, seeking innovative solutions for design, technology, product launches, wellbeing and even management processes, among others. Its exponent is the American writer Janine Benyus, who in 1997 published *Biomimicry – Innovation Inspired by Nature* (more in [this report](#) and [Página22 interview](#))

Brazil Risk (Risco Brasil) – Meas-

ure for classifying the general risk of a country. The Emerging Markets Bond Index Plus (EMBI+) is the most widely used index for expressing risk level.

Discount Rate – Cost of capital used in a financial return analysis, which can be calculated using the Weighted Average Capital Cost (WACC), which indicates the minimum level of investment attractiveness, i.e. the expected return on other investments.

Ecosystem – A dynamic complex of plants, animals, micro-organisms and their non-living environment interacting as a functional unit. Examples of a non-living environment are the mineral fraction of the soil, relief, rainfall, temperature, rivers and lakes – regardless of the species that

Ecosystem-based Adaptation (Eba) – According to the United Nations Environment Program (Unep), it means the use of biodiversity and ecosystem servic-

es as part of an overall **adaptation** strategy to help people and communities adapt to the negative effects of climate change at local, national, regional and global levels. An example of an EbA is mangroves functioning as barriers to stop the advance of the sea over islands and land.

Ecosystem Services – According to The Economics of Ecosystems and Biodiversity (TEEB) initiative, ecosystem services are direct and indirect contributions made by ecosystems to human wellbeing. Examples of services provided by nature are the growth of vegetation which removes carbon from the atmosphere, maintains soil quality and prevents erosion, or which puts slopes, housing and river flow at risk. More on ecosystem services [in this issue of P22_ON](#).

Effluents – Waste from industry, sewage, and rainwater networks which are disposed of in the environment, in liquid or gas form.

Eutrophication – Process through which a body of water is enriched with high levels of nutrients, especially phosphates and nitrates, causing the accumulation of decomposing organic matter.

Gracilarioid Algae – Belong to the *Gracilaria* red algae genus, from which the agar biopolymer can be extracted. It is largely used in the food and pharmaceutical industry as a gelling and stabilising agent.

Green Infrastructure – A method which aims to preserve biodiversity via actions which strengthen the resilience of ecosystems, simultaneously facilitating adaptation to climate change and reducing vulnerability to natural disasters. The concept was introduced by the European

Commission's White Paper on Adaptation to Climate Change (2009). According to the [document](#), green infrastructure is "essential for mitigating fragmentation and non-sustainable land use, and ecologically maintaining and restoring ecosystem services."

Grey Infrastructure – Conventional civil engineering projects, such as motorways, buildings, dams. Grey refers to the concrete used in urbanization.

Leaching – With the extraction of natural vegetation, soil is exposed to the sun, wind and rain. Leaching is the process where rainwater drains away the soil's minerals, leading to erosion, fertility loss and the silting of watercourses (accumulation of sediment in river channels).

Life Cycle Thinking – A mode of thinking which considers implications from 'cradle to grave', that is, the entire product life cycle. The life cycle is the set of stages necessary for a product to fulfil its function – from obtaining natural resources to its final destination, after fulfilling its purpose.

Mitigation – Actions aimed at reducing greenhouse gas emissions in order to limit the effects of climate change, including rising sea levels, hurricanes and extreme temperatures. An example of an action of mitigation is the change from petroleum-based energy sources to renewable sources.

Natural Capital – Can be defined as the "stock or reserve provided by nature (biotic or abiotic) which produces a valuable future flow of natural resources or services", according to authors Herman Daly and Joshua Farley. An example of "stock"

is ecosystems, while ecosystem services are an example of "flow".

Nature-based Solutions (NbS) – Defined by the International Union for Conservation of Nature (IUCN), as interventions which are inspired or based on nature for solving problems faced by various sectors of society in a sustainable way. This type of solution helps protect the environment, providing economic and social benefits.

Nymphaea (Water Lily) – Botanical genus which includes various species of aquatic **macrophytes**.

Positive or Negative Externality – Positive or negative reflections of an activity felt by those who have done little or nothing to generate them.

Present Value – The value of a certain sum of money at a certain future date, taking into account the interest earned by that sum. It can also be understood as the value of a future resource or cost stream in terms of its current value. The **discount rate** is used to determine this value.

Standard deviation – A measure representing how much the values from which the mean was extracted are near or far from the average itself.

Social Enterprise – An organization which mixes features of the Second and Third Sector, which has become what is known as Sector 2.5 (two point five). The social enterprise seeks to associate the expertise of the world of business with the social expertise of non-profit organizations.

Sustainable Development Goals (SDGs) – A global agenda set during the UN Summit on Sustainable Development in Septem-

ber 2015 consisting of 17 goals and 169 targets, to be achieved by 2030. Subjects can be divided into four main dimensions:

- **Social:** related to human needs, health, education, quality of life and justice.
- **Environmental:** about the preservation and conservation of the environment, with actions ranging from reversing deforestation, protecting forests and biodiversity, fighting desertification, sustainable use of oceans and marine resources, up to adopting effective measures against climate change.
- **Economic:** addresses the use and depletion of natural resources, waste production, energy consumption, among others.
- **Institutional:** about the capacity of putting SDGs in practice.

The SDGs were built as part of a global negotiation which began in 2013, with Brazil's participation in the discussions and definitions of its agenda. Brazil has expressed firm support for contemplating the eradication of poverty as a priority among initiatives focused on sustainable development. Source: [estrategiaods.org.br/](#)

Resilience – In physics, is the capacity of a determined system for recovering its balance after having been disturbed. In the climate context, it is the capacity social, economic and environmental systems have for coping with climate impact, re-organizing themselves so as to maintain their essential function, identity and structure, while still being able to adapt, learn and transform.

Vulnerability – Degree to which a system is susceptible and in-

capable of dealing with the adverse effects of climate change. Vulnerability can be economic, social, environmental and/or physical. Coastal areas, for example, are physically vulnerable to the rising of sea levels, though many are socially and economically capable of adapting to that problem. The Brazilian Northeast and African Sub-Sahara are vulnerable to the intensification of droughts in environmental as well as social and economic terms.

Wellbeing – Represents a set of the basic elements for a good life: freedom of choice, health, good physical condition, good social relations, security, peace of mind and a spiritual life..

> Further reading, videos, blogs and sites

• **Concept: What are we talking about?**

Do you want to know more about the concept of NbS? Access [this page](#) for the International Union for Conservation of Nature (IUCN).

• **NbS, a large umbrella**

Some concepts, such as Natural Capital and Ecosystem Services, come under the umbrella of Nature-based Solutions.

In the field of Natural Capital, the current standard reference is the [Natural Capital Protocol](#). To know more, visit the [Natural Capital Coalition](#) website, a global collaborative network which brings together initiatives and organizations.

On the subject of Ecosystem Services - remember [this edition of P22_ON](#)? Worth a visit or revisit.



Another point of reference on the subject is the [Trends in Ecosystem Services \(TeSE\)](#) initiative, by GVCes. Its objective is to facilitate the insertion of ecosystem services in corporate decision-making, using tools for valuation. To this end, it develops simple, low cost methods based on easily available data, generating information to support project analysis and performance indicators. See its practical application in these [business cases](#).

Internationally, the [TEEB Project](#) (The Economics of Ecosystems and Biodiversity) seeks to make clear the contingent relation between natural capital and the economy to society and decision-makers, such that this relation is reflected in the planning and elaboration of public and corporate policy. In Brazil, the [EbA: Opportunities for Regional-Local TEEB Project](#) is a project of the Brazilian Government, coordinated by the Ministry of the Environment (MMA), in partnership with the National Confederation of Industry (CNI) within the context of Brazil-Germany Bilateral Cooperation for Sustainable Development.

Biomimetic initiatives which contribute to biodiversity conservation and human wellbeing can also be considered Nature-based Solutions. [Ask Nature](#) is a biomimetic platform in which researchers, engineers, biologists, architects, designers and others can connect, share information and collaborate.

• **NbS and SDGs**

[Watch the video](#) in which Johan Rockström and Pavan Sukhdev, from the Stockholm Resilience Centre, propose a new view on the **Sustainable Development Goals (SDGs)** - with four of them forming the environmental base for the rest - and showing how they are interrelated when the issue of food is the common link.



Also on SDGs, the United Nations Environment Program (UNEP) published [this brochure](#) on the integrated focus of the 2030 Agenda, which addresses the environmental issues in each of the goals.

• **NbS and Adaptation**

What do Nature-based Solutions have to do with **adaptation** to climate change? A lot!

The [EbA: Opportunities for Public Policy on Climate Change](#) study uses the concept of Ecosystem-based Adaptation (EbA), as well as presenting nearly 100 types of EbA practice in Brazil and the world. Based on the results of the study, objective recommendations are made for the inclusion of EbA strategies in public policy for adaptation to climate change, with a focus on the National Adaptation Plan - conducted by the Department on Climate Change and Environmental Quality of the Ministry of the Environment, launched in May 2016. The expectation of the Grupo Boticário Foundation is that the study will contribute to the construction of a national adaptation strategy, taking biodiver-

sity conservation into account.

This [TNC publication](#) shows how to use nature to minimize climate and natural disaster risk.

This is a [further example](#) of adaptation which shows the role of mangroves in protecting the coast. Storm waves occur when strong winds and low atmospheric pressure raises water levels on the coast, causing seawater to encroach on the land. The biggest storm waves are caused by tropical cyclones, which can result in extensive flooding, death and property damage - and are a phenomenon intensified by climate change. Under these circumstances, mangroves reduce the water flow when there are storms, thereby reducing surface waves and protecting coastal areas and their inhabitants.

• Water Supply and Quality

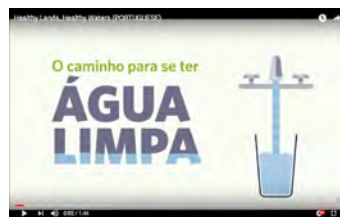
Cases of practical applications of natural infrastructure in facing water problems and floods have been collected in [this publication](#).

[This blog](#) by the World Resources Institute (WRI) drew attention in 2016 to problems with water supply and quality in Brazil, which went through a historical drought in São Paulo in 2014, and was preparing to receive Olympic athletes in the polluted waters of Guanabara Bay in Rio de Janeiro. The text uses these 'hooks' to show how natural infrastructure can help solve a water crisis.

Following this, the WRI recommended reading [this document](#) regarding a tool for economic analysis to aid decision-makers in comparing potential investments in natural and conventional infrastructure. The tool helps assess costs and benefits for each investment

vis-a-vis challenges relating to water, food and energy.

The Nature Conservancy, via this [video](#), shows how to improve water security with Nature-based Solutions. The organization is part of the [Water Funds Alliance in Latin America](#).



TNC presents some worrying information in its analysis, published in [this study](#), of hydrographic basins and springs which supply over 4,000 of the world's large cities: the degradation index is greater than 70% in the springs of the Metropolitan Region of São Paulo.

Some initiatives, however, bring hope. One of them is the restoration of the forest in the Guandu River Basin. The Guandu Water Producer Project, launched in November 2008, charges user fees downstream which are used to compensate farmers for reforesting their lands and conserving forests. This has resulted in cleaner water and less carbon released into the atmosphere. Watch [this video](#).



• Projects for the Marine Environment

In the United Kingdom, a green engineering project was awarded this year for restoring marine life, as shown in [this video](#). Doctoral

student of Environmental Science Kathryn O'Shaughnessy received the Innovation Award from the Crown Estate's Seabed Fund for her project 'Green Engineering of Coastal Infrastructure: A Design for Life'.



In Seattle, in the United States, [this project](#) allows light to penetrate waters through piers and promenades, benefiting the marine

environment and the reproduction of salmon on the urbanized coast. Few plants can grow in the shadows of seaside structures, but the passage of light means that coastal and marine plants can develop, gathering zooplankton and other invertebrates in their surroundings, which salmon feed off. Plans for creating riparian zones include planting trees and bushes along slopes, which will also contribute to reducing coastal erosion, improving water quality, and making the coast of Seattle more beautiful.

• And more:

[Read here](#) about how and why Research and Innovation policies in the European Union are driving the public agenda for Nature-based Solutions and the concept of Re-naturing Cities.

The [publication](#) entitled *Green Infrastructure: Engineering to Benefit Business and Biodiversity – Living Solutions to Environmental Challenges on Corporate Lands* presents case studies of green infrastructure projects implemented by companies in their own facilities.

P22ON

If you are interested in associating your organization with high quality content on strategic sustainability issues, support this and coming editions of P22_ON.

For more information, contact
belbrunharo@pagina22.com.br.