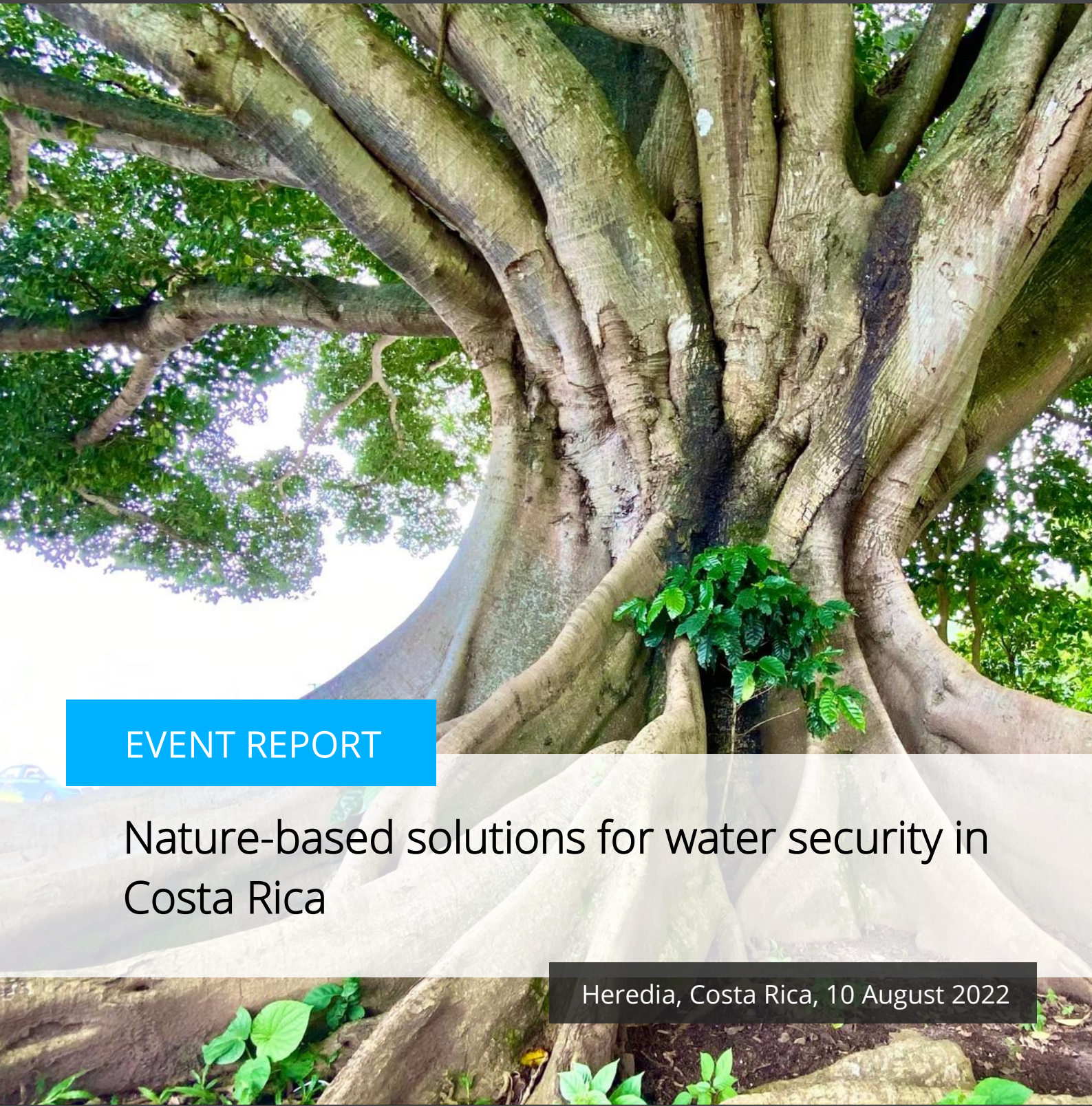




Innovative Groundwater Solutions



EVENT REPORT

Nature-based solutions for water security in Costa Rica

Heredia, Costa Rica, 10 August 2022



TECHNISCHE
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DRESDEN

EVENT REPORT

Workshop

Nature-based solutions for water security in Costa Rica

Co-organized by:

Water Research and Management Division, National Service of Groundwater, Irrigation and Drainage (SENARA)

Water Resources Center for Central America and the Caribbean (HIDROCEC), Mesoamerican Center of Sustainable Development of the Dry Tropics (CEMEDE), Laboratory of Waste Management of School of Chemistry - National University of Costa Rica (UNA)

Research Group INOWAS at the Department of Hydrosociences of the Technische Universität Dresden (TUD), Germany

Heredia, Costa Rica
10 August 2022

About this report

This document contains the report of the workshop entitled “Nature-based solutions for water security in Costa Rica” organized in Heredia, Costa Rica, on 10 August 2022. The workshop represented the closing event of the bilateral German - Costa Rican project “Facilitation of green adaptation techniques for reduction of seasonal water scarcity in Costa Rica”.

Photo cover: Higuerón tree (*Ficus goldmanii*), UNA campus (photo: Catalin Stefan)

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Heredia, August 2022

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Welcome addresses

Dr. Martin Parada Gómez, Vice Rector
National University of Costa Rica (UNA)

Good morning, dear community, guests from public institutions, Master Luis Fernando Coto Picado, director of SENARA, Master Roberto Ramírez Chavarría, director of research and water management of SENARA, Dr. Catalin Stefan, director of the research group INOWAS TUD, Master Catalina Zapata, INOWAS TUD researcher, Dr. Pavel Batista Solís from CEMEDE of the National University based in the Chorotega region, Dr. Andrea Suárez Serrano, who coordinates the HIDORCEC institute of the UNA in the Chorotega region, but in Liberia. I was also very pleased to see our former vice rector for research at this university, Luisa Castillo, whom I also welcome on behalf of our rector and our deputy rector, Francisco González Alvarado and Marianela Rojas Garbanzo.

Fundamentally, this welcome to the international seminar "Nature-based solutions for water security", developed in the framework of the GREAT project, facilitating the adaptation of green technologies for the seasonal reduction of water scarcity in Costa Rica, with the joint collaboration between public universities, the National University, the National Technical University and the State Distance University, the Water Resources Centre for Central America and the Caribbean, the Centre for Sustainable Development of the Dry Tropics and the Waste Management Laboratory. In the case of the Technical University of Dresden, which has an important research group which is INOWAS, as well as key public bodies for the National Service for Groundwater, Irrigation and Drainage, which is SENARA.

I would say that from the point of view of the water problem we should point out some elements, probably in the diagnosis you have already identified them, and that is that around the world 2.3 billion people lack access to basic sanitation and almost 800 million people lack access to drinking water and, therefore, in the 2030 Agenda or the Sustainable Development Goals this has been taken into consideration. But in the case of Costa Rica, water resources have also been extremely deteriorated by the presence of pesticides in agriculture, in intensive and extensive banana and pineapple production and, of course, there is an excessive presence of plastics and other solid waste in watersheds, which added to the deforestation of wooded areas near rivers where agricultural activities are carried out. But it is also interesting to note that more than 40% of the water generated by domestic operators, I should say, such as the water supply company of Heredia or AyA itself and others, is water that is not accounted for due to leaks, deteriorated or obsolete meters, among other reasons.

But also the ASADAS, that is, these small micro-enterprises, with serious limitations in terms of water resource management, and I believe that as a model they are exemplary, but they face multiple difficulties in achieving adequate financial sustainability. And finally, the establishment, I think, of a water tariff that, compared to the costs of other goods such as the sport drinks that many of us use, is marginally recognised by society. An example is that any sport drinks for exercise costs 2 USD and a 1m³ of water costs 1.3 USD, which we families pay, illusory that so many litres of water cost so little for society, and therefore the problem is complex and more than justifies analysis by the academic community, professionals involved with the sector and the political class,

among others.

So from the perspective of the public university's contribution, the emphasis should be on developing theoretical and methodological approaches that define possible solutions. It always seems to me that, from a practical point of view, these solutions should be put at the service of the neediest sectors in the territories and communities, and therefore we are very pleased that this project has the territory of Guanacaste as its area of influence. In the framework of the Sustainable Development Goals or the 2030 Agenda, communities not served by public institutions deserve to receive a high quality water resource. In this regard, I believe that the HIDROCEC, and other projects that the National University has in conjunction with public universities, fully meet this purpose, even in the face of cuts in financial resources for public education by the various governments in office. We will not give up generating knowledge in favour of seeking solutions to the different problems mentioned above.

We hope that the objective of this academic event and international seminar, which is to present examples of Nature Based Solutions and water resource management in Costa Rica and Latin America, will be fully achieved. We would like to thank the international experts who will accompany us, for their efforts to promote a substantive discussion together with the participants and national experts. Of course, to the organisers who have been able to pool and combine the necessary resources to bring this academic event to a successful conclusion, particularly the efforts of the Chorotega region.

Thank you very much and congratulations for the organisation of this international seminar.

MSc Luis Fernando Coto Picado, Director

National Service of Groundwater, Irrigation and Drainage (SENARA)

I am pleased to be here with you all this morning. My warmest greetings on behalf of the SENARA staff to Dr. Martín Parada, Dr. Andrea Suárez, Mr. Roberto Ramírez, colleague of the institution, Mr. Catalin Stefan, Master Catalina Zapata, Dr. Pavel Bautista, Master Carolina Alfaro and all those present.

For SENARA, as a pioneer institution in climate change adaptation, it is very important to actively participate in this type of seminar. Given that the planet decades ago, and now seeing here graduates, I believe that you were not born when people were already talking about the problems facing the planet and, in our case, Costa Rica, about the possibilities of continuing to maintain our water consumption scheme and all those other elements that limit development and above all our possible survival in future decades, since we are facing the great challenge of being able to coexist man-nature.

Man's impact on nature in order to improve productivity, yields and, with a view to improving profits, we have moved away from sustainable practices in all areas of human endeavor. It is important to point out and propose both public policies and allocate resources for further research, technology transfer, as well as climate change adaptation measures.

Groundwater, sometimes ignored, is a resource that is increasingly vulnerable, with present and future consequences for the sustainability of all ecosystems. If we look at the news, it is becoming more and more common to hear about contamination of wells, problems of big cities whose roads turn into rivers shortly after heavy rainfall, of urban complexes bordering the limits of protection areas, of mountains invaded by developers' desires, producing great challenges and all this at the expense of our water. It does not mean that at the expense of conservation we must paralyse development, but both activities must be in conjunction.

Let us pay attention and actively participate in the different presentations this morning. It is important to promote greater commitment from academia, government institutions and citizens. This is the only way to solve the crisis we are in. Otherwise, Mother Nature herself will take charge and is taking charge of correcting the alterations that our civilisation has caused. There are several times in which nature has acted and man has had to react or even species have disappeared due to climate change.

Finally, SENARA, an institution created by law of the Republic, has among its main functions the management and conservation of water resources, and is at the disposal of all those present to participate and support the management so that together we fulfil our mission: to safeguard for present and future enjoyment, the water resources that the country and the world require to continue with its path of sustainable development.

I don't want to miss this morning and this audience to talk for two paragraphs about something that is connected to what we are talking about today, the Paacume project, water for Guanacaste. If we are talking about a seminar where what we are going to talk about is the protection of water resources through natural practices, the Paacume project proposes a management scheme for water for multiple uses and, above all, to try to protect the aquifers in the coastal zone. At this moment we are working together with the president's office to evaluate all the studies that have been done and try to

move the project forward. And in view of this, I was just talking to one of the organisers, it is extremely important that we continue together in this connection, and if you with this project in the Chorotega area, welcome to all the effort we have to make there to be able to carry out the project in the best possible way and to achieve the objectives we are looking for: water for human consumption, water for tourism, water for irrigation and, in a residual, water for electricity generation.

Welcome, we hope that everyone will make the best use of all the spaces for discussion and that at the end of the morning, consensus can be reached in favour of this fundamental issue which is the protection of water resources, which, as I said, I have been working in the agricultural sector for many years, and sometimes those of us who work in this sector do not see the subsoil. At the moment I have made the two connections and we are about to work on a water security - food security project, they are all elements that go hand in hand and are not far from what we are talking about this morning.

Good morning and best of luck.

Keynote talks

The workshop integrated a series of keynote talks from project consortium and associated partners, such as UNA, SENARA and TUD.

SPEAKERS:

ANDREA SUÁREZ SERRANO

Water Resources Center for Central America and The Caribbean (HIDROCEC-UNA),
Costa Rica

ROBERTO RAMÍREZ CHAVARRÍA

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PÁVEL BAUTISTA SOLÍS

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Costa Rica

MODERATOR:

CAROLINA ALFARO CHINCHILLA

School of Chemistry, National University of Costa Rica (UNA)

Introduction of the GREAT project: "Facilitation of green adaptation techniques for reduction of seasonal water scarcity in Costa Rica"

ANDREA SUÁREZ SERRANO

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Dr Andrea Suárez Serrano (HIDROCEC-UNA, Costa Rica) provided an introductory talk about the role of nature-based solutions

Dr. Suárez Serrano opened the workshop by introducing the concepts of ecosystem services and Nature-based Solutions (NbS). The latter is defined as that mimic natural processes and rely on ecosystems as a whole and ecosystem services. NbS can enable the management of socio-ecological systems to achieve sustainability or the enhancement of ecosystem services. In this way, they help us to cope with challenges derived from climate change, while at the same time increasing water and food security. NbS are an umbrella concept that includes many different approaches, such as ecosystem restoration, ecosystem-based adaptation, ecosystem-based mitigation, ecosystem-based disaster reduction, infrastructure approach (natural Infrastructure, green infrastructure and blue Infrastructure), ecosystem-based management (integrated coastal management or integrated water resource management) and ecosystem protection, among others. When it comes to water security, there main aspects to be considered within the framework of integrated water management: increasing availability, improving quality and reducing risks. Finally, she presented some examples of NbS and their applications to water security issues.

Groundwater management in Costa Rica

ROBERTO RAMÍREZ CHAVARRÍA

National Service for Groundwater, Irrigation and Drainage (SENARA), Costa Rica

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Mr Roberto Ramírez Chavarría (SENARA, Costa Rica) talked about the role of SENARA in groundwater management in Costa Rica

Mr Ramírez explains the creation and beginning of the organisation, which main tasks are (1) to investigate, protect and promote the use of the country's water resources, both surface and groundwater and (2) to carry out, coordinate, promote and keep up to date hydrological, hydrogeological, agrolological and other research it deems necessary in the country's river basins, as well as socio-economic and environmental research in the areas and regions where it is feasible to establish irrigation and drainage districts. Afterwards, he presented some of the results of the research and modelling carried out on groundwater (exploitation and restriction of aquifers, land use and territorial planning). Other products are the regulatory plans and sustainable use plans developed for some municipalities in order to have a better territorial regulation and to know the water potential in the area. Later he described steps required to establish a "development plan for the management of water in the aquifer" (PAS, in Spanish), one of the most robust tools for the management of groundwater in the country. Also, SENARA conducts numerical modelling of hydrogeological processes with the creation of different consumption and climate scenarios to support the decision-making processes in communities.

Grey-blue-green infrastructure for climate change adaptation

CATALIN STEFAN

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Dr Catalin Stefan (TUD, Germany) talked about the role of grey-blue-green infrastructure

Dr. Stefan started his talk with an explanation on how natural processes such as runoff and infiltration change when a basin is urbanised. This urbanisation relies mostly on grey infrastructure but it has not been able to cope with the challenges we are facing nowadays. Then, blue-green infrastructure (BGI) emerges as a possible solution to revert said processes to a more “natural” level and to improve human well-being. Lastly, he introduces the platform ClimateScan developed Deltares (<https://www.climatescan.org>), which is an online citizen science platform for BGI with more than 8000 projects around the world. In the second part of the talk, Dr. Stefan showed some BGI examples from around the world and explained their benefits, limitations and opportunities for their implementation in Costa Rica.

Identification, analysis and promotion of best practices for sustainable groundwater management in Latin America

CATALINA ZAPATA BARRA

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Catalina Zapata (TUD, Germany)

Ms Zapata starts the presentation with an overview of the water-related issues in Latin America and how managed aquifer recharge (MAR) can contribute to tackle these problems. Later she showed MAR cases successfully implemented in the region to raise awareness about this innovative and yet underused solution. The examples showed diverse infiltrations techniques in both urban and rural settings with benefits for people as well as for ecosystems.

Characterisation of rainwater harvesting systems for water security in the Chorotega Region, Costa Rica.

PÁVEL BAUTISTA SOLÍS

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Dr Pável Bautista Solís (CEMEDE, UNA)

Dr Bautista mentions that his objective is to present some of the examples of rainwater (and other sources) harvesting systems that have been implemented for the last 12 years in the province of Guanacaste. He first explains the concept of rainwater harvesting systems, which are traditionally implemented to support the agro-livestock sector in Costa Rica, but are also applicable in urban and peri-urban systems. However, he says that this technology dates back to pre-Spanish conquest times, such as the Quochas or the sowing of water used in Peru and the Aguadas in Guatemala. In Costa Rica, these systems are known as reservoirs or water harvesting. He then presents projects built by students and the community in Chorotega, the benefits derived from them and also what aspects need to be improved.

Q&A session

The keynote presentations were followed by a session of questions and answers focusing on a wide range of water-related challenges of the Costa Rican society: from technical aspects regarding the advantages of enhancing the subsurface water storage, to capacity development and prioritization of water management solutions in the country.

QUESTION:

Manrique Esquivel (ONG Instituto Nectandra)

What would be the advantage of implementing a system of water harvesting vs. more traditional measures such as reforestation, natural regeneration, assisted ecological restoration? If I have a given area above a spring, would it be better to create an artificial pond or better to implement water harvesting or leave natural regeneration? What considerations should be taken into account for this?

ANSWER:

Andrea Suárez Serrano (HIDROCEC-UNA)

You have to define it through the objective, whether you want to protect the ecosystem or recharge groundwater, although both are strongly connected. Sometimes natural recharge will be the best, because there are natural recharge areas that can be made use of, for example the upper parts of the mountains. Basically, we need all the technical elements to ensure which is the best solution and if there are different possibilities, choose depending on the sites, the slopes, etc. In this sense, knowledge is fundamental in order to be able to define what kind of solution would be the right one. The solution is also going to depend on the environmental conditions. Urbanisation covers a huge part of the world. So, if we are talking about basins where there is already a fairly developed urbanisation process, where the natural recharge areas are being replaced by other spaces, we could talk about other alternatives, such as spatial planning. So, we need to assess the objectives and to be attentive to the opportunities. Perhaps some of you may have accompanied us in previous seminars where we had a specialist from Mexico who presented how in Mexico City, by overexploiting groundwater, they are having so many problems, including a strong land subsidence.

QUESTION:

Mario Mora (Civil society)

I disapprove of laws and regulatory plans that are not enforced, there is no urban or rural planning. Why doesn't AyA build a network that collects rainwater in a reservoir for multiple uses? Why don't the municipalities plan for houses to build rainwater reservoirs to mitigate the problems? There are also problems of solid waste clogging drains and getting into watercourses. There is no short or medium-term planning to counteract this need for water that is worse with climate change. We are destroying protected areas with the exploitation of gold, with deforestation, with the hunting of animals, with the deterioration of biological corridors with pollution... so efforts have to be made today. Water is something for everyone, for humans, for animals, for industries, for flora. How are we going to follow up on all these projects, all these decrees to see if they are really being complied with and thus conserve our biodiversity, our country.

ANSWER:

Andrea Suárez Serrano (HIDROCEC-UNA)

More people like you are needed because in the end Costa Rica is a democracy. We have a democracy that must be defended and democracy does not exist if there is no participation. So, the issue of citizen participation in these processes with the commissions that are set up in the communities or in the ASADAS assemblies is fundamental, despite the fact that many say: *people don't come to the assembly, people don't participate*. We are taking away our right to demand what is in the law. So, it is the

citizens who are the first defenders and guardians. We must also emphasise the efforts of academia, both here and in Guanacaste, where we are strengthening citizen science so that information reaches the people and communities are empowered. The spaces created by decrees are important, but the organised groups in the communities are ultimately the ones who oversee that these processes are being carried out in the best way possible. An effort has also been generated through the national alliance of rivers and watersheds in Costa Rica, and the citizen water observatories. We have to empower ourselves as a society, as citizens. Institutions are part of all this work, but sometimes they are limited in terms of personnel at the country level and at the level of the problems we have. But it is through the pressure that we exert as citizens that we can hold them accountable and keep track of whether everything is actually being implemented and improved. Pressure for improvement. We all have a part to play and we need to raise awareness in the communities and strengthen environmental education.

QUESTION:

Rodrigo Rojas (Lecturer at Liberia Campus – UNA)

What is SENARA's role in the GREAT project?

ANSWER:

Roberto Ramírez Chavarría (SENARA)

We, as SENARA, have been working with this project from the beginning and we started with topics related to hydrogeological modelling. It is an educational process, where there is an exchange of experiences and an improvement of the capacities we have. The experience that our colleagues have in aquifer management, not only in hydrogeological modelling, but also in management, we have been working on through webinars and other activities and feedback. For example, yesterday we were talking about innovation in these issues, not only doing hydrogeological modelling, but also monitoring the whole system and coupling it to the modelling in order to be introducing data and to be able to have a better idea of the aquifer. I hope that in this country it would be possible to replicate the fact that well concessions are granted based on a hydrogeological model and to be able to make scenarios on a given well. And as my colleague mentioned, despite the fact that induced recharge was carried out, it was not enough for the exploitation that was being carried out in the mentioned aquifer. So, all of this can be done through modelling systems and monitoring systems. This exchange of information within the project is improving Costa Rica's knowledge on groundwater management.

QUESTION:

Rodrigo Rojas (Lecturer at Liberia Campus – UNA)

We are very interested in the capacity building and knowledge transfer proposals of the GREAT project.

ANSWER:

Catalin Stefan (INOWAS – TUD)

The capacity development and knowledge transfer are very important in the GREAT project. The program has several components. One of them is these stakeholder meetings that we are having now in Heredia and we also had one in Nicoya, where we tried to bring together experts from different fields and discuss the potential of blue-

green infrastructure and nature-based solutions as added-value contributions to the existing water infrastructure in the country. In addition to these large meetings, we had bilateral meetings with several institutions in the country. We had meetings at different universities, such as UCR and TEC, and we had meetings with representatives of AyA, SENARA and ASADAS from Guanacaste, especially Brasilito, Potrereros, and Huacas-Tamarindo. Additionally, we assessed and mapped the needs and tried to understand what is the role of these solutions at the local scale. We had a training course on groundwater modelling in Liberia in 2019 for the students and researchers from HIDROCEC. Our free, open-source software was also introduced to SENARA. The second course was online because of the pandemic we could not travel. Further, we had a workshop and training course on managed aquifer recharge (MAR), especially focusing on MAR modelling. We ran a series of online webinars on MAR modelling, governance, nature-based solutions. Finally, we also welcomed researchers and partners from UNA to Germany. We had one visit two years ago and this year in September we will have the next visit. We plan to see MAR sites, water works, WWTPs, reservoirs and other locations, to better understand how the systems work in Europe and how they could be used in Costa Rica. We also focused on the education of students. From our Master's Program on Groundwater and Climate Change, two students were working on a groundwater model for Huacas-Tamarindo basin. The model is also going to be discussed this Friday with the representatives of the local ASADAS. And from the Costa Rican side we have one student attending the 4th International Summer School on MAR (co-organised by us), taking place from 29 August to 8 September in Dresden.

QUESTION:

Gonzalo Mora (Programa Interdisciplinario Costero, UNA)

Ecological flow was not mentioned in any of the presentations, so I would like to know if there is any successful experience in Costa Rica that collaborates in the recovery of the ecological flow or the natural or social landscape. This is particularly important in coastal areas, where vulnerable social groups are in charge of water management.

ANSWER:

Pável Bautista Solís (CEMEDE, UNA)

First of all, there is the national system of conservation areas, where 25 % of Costa Rica's territory is dedicated to this objective alone. In Guanacaste, for example, people are working with integrated watershed management. On the other hand, SENARA has been fundamental in this project in terms of research, outreach and work with local populations, without forgetting that the people who receive us in coastal areas can contribute a lot. Academia, institutions and communities must work together to try to solve these large and complex problems we face. In urban areas, there is the experience of the Natural Urban Routes for the restoration of the María Aguilar River. The people who have worked there are from diverse backgrounds and the financing has been in conjunction with private companies. So, there is a private interest of the real estate companies to have beautiful landscapes, but there are also other organisations such as Río Urbano that want to recover these areas of riverside forests for the ecosystem. This project, which is a nature-based solution, seeks to improve the quality of the river and generate safer spaces for human well-being. Reclaiming our natural spaces and providing recreational spaces helps to recover all the natural river-aquifer processes as well.

Conclusions

The workshop provided a range of solutions aiming at the conservation and protection of ecosystem services in the country. It offered a platform for discussion about the advantages and limitations of nature-based solutions in Costa Rica and fostered an exchange of ideas about the development of sustainable water resources management.



Group photo with the participants to the final project workshop "Nature-based solutions for water security in Costa Rica" held in Heredia, Costa Rica, 10 August 2022

Concluding remarks

CAROLINA ALFARO CHINCHILLA

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Carolina Alfaro Chinchilla (School of Chemistry, UNA) was in charge of introducing the speakers as well as moderating through the questions in the plenary session, after which she gave some final remarks and comments on the discussed topics and closed the event.

While it is necessary to move forward with the 2030 Agenda, the current situation in Costa Rica is more similar to the rest of Latin America in terms of water supply and sanitation. In this sense, the low cost of water in the country (1.3 USD/m³) does not facilitate the transition or adoption of innovative projects such as those mentioned in the presentations because of the false security that water is plentiful, even when there are already sectors with water stress. It is also necessary to address how groundwater contamination events can be prevented, not just acted upon once the problem is detected. In this way, nature-based solutions, alone or in conjunction with traditional infrastructure, can address situations of water scarcity or ecosystem deterioration. However, it is important to emphasise that any project must involve citizen participation from the earliest stages. Likewise, it is not enough to carry out a good modelling of hydrogeological processes, but a correct transfer of information is also needed, and in this regard, citizen science platforms and cooperation between institutions become relevant. Finally, it is recognised that it is essential to "go back" and change our approach to a more holistic vision as used in ancestral techniques.

Annexes

Annex 1 | Team of experts

Annex 2 | Workshop agenda

Annex 1 | Team of experts

(in alphabetical order)



ALFARO CHINCHILLA, Carolina, MSc

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Ms. Alfaro works at the School of Chemistry where she teaches various courses related to cleaner production and environmental chemistry. Her research work is oriented to demonstrate and improve alternative water sanitation systems, especially in the tropical conditions. She is interested in the transfer of technical and scientific knowledge that allows the appropriation of sanitation technologies by users in small communities.



BAUTISTA SOLÍS, Pável, PhD

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Pável Bautista Solís is a Mexican agronomist specializing in rural development (Universidad Veracruzana, Mexico). He holds a master's degree in ecological agriculture with emphasis on land use planning (CATIE, Costa Rica); and a doctorate in tropical agroforestry sciences with emphasis on rural development (University of Bangor, United Kingdom). He has been working on research and technical cooperation projects in Central America for 18 years. His lines of research and practice include environmental livestock, agroecology, rural development, water governance and adaptation to climate change. He currently coordinates the PRO-RBA (FUNDER-UNA) and CADICO-DTR (FUNDER-UNA) projects; and is co-principal investigator of the GREAT project (BMBF-MICITT), all implemented in communities vulnerable to the impacts of climate change in the province of Guanacaste and Puntarenas, Costa Rica.



COTO PICADO, Luis Fernando

Director, National Service of Groundwater, Irrigation and Drainage (SENARA)

For the past 28 years, he has been immersed in the area of educational administration and teaching, with a major emphasis on supporting educators, researchers and students to meet academic objectives. During his years of service, he has held positions in the Administrative and Human Resources Management at CATIE and Academic and Administrative Management at EARTH, in which he has sought to incorporate quality approaches, staff development and corporate social responsibility. Another major focus of his professional career has been supporting the administrative management of local governments, especially the municipalities of Guácimo and Turrialba.



PARADA GÓMEZ, Martín, PhD

Vice Rector, National University of Costa Rica (UNA)

Academic at the School of Economics, Faculty of Social Sciences. Bachelor in Economics, Master in Economics and Development, Central American Postgraduate Degree in Economics and Development from the National Autonomous University of Honduras and PhD in Economics from the University of Tilburg, The Netherlands. His experience in academic management was acquired as director of the School of Economics and coordinator of the research programme "Productive sectors, competitiveness and trade". He is a researcher in the analysis of productive sectors and small and medium enterprises through the method of global value chains and other methods and approaches to competitiveness analysis. He also teaches undergraduate and postgraduate courses at the School of Economics. He is a consultant for national and international organisations on issues related to economic development, productive sectors, project evaluation and development of micro, small and medium-sized enterprises.



RAMÍREZ CHAVARRÍA, Roberto, MSc

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Mr. Ramírez Chavarría is a geologist and civil engineer and has a Master in Hydrogeology and Water Resources Management from the University of Costa Rica. He worked at SENARA for 22 years, currently as Director of the Directorate of Research and Water Management. Part of the work done in SENARA are calculations of water balances, potential or calculated by fluctuations in levels, hydrogeological studies in the Central Valley and Guanacaste. He participates in Technical Commissions related to groundwater contamination by hydrocarbons and arsenic, water balances, hydrogeological studies in prioritized aquifers, and in projects with the International Atomic Energy Agency (IAEA).



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Dr. Stefan is the Head of the Research Group INOWAS at the Department of Hydrosociences of the Technische Universität Dresden, Germany. Together with his team, Catalin strives to achieve his research goals through a multicultural, international perspective. The research foundation of his work is based on two pillars: understanding the processes occurring during managed aquifer recharge and development of web-based simulation software for groundwater modeling applications. Dr. Stefan is co-chair of Commission on Managed Aquifer Recharge of the International Association of Hydrogeologists (IAH).



SUÁREZ SERRANO, Andrea, PhD

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Dr. Suárez is the General Coordinator of the Water Resources Center for Central America and The Caribbean (HIDROCEC) at the Universidad Nacional Costa Rica (UNA). Dr. Suárez has a 20-year academic career, always linked to research projects on water resources. In addition, Suárez has stood out for her gifts of leadership and management of research projects and the development of the career in Hydrological Engineering at UNA. In addition, she is responsible for managing resources necessary to establish the laboratories of HIDROCEC and leading the work of this center of research to become a regional reference on management related studies integrated water resource. Dr. Suárez was the director of CEMEDE and HIDROCEC (2016-2018), where in addition to her administrative responsibilities she developed research on integrated watershed management, drinking water quality and water treatment.



ZAPATA BARRA, Catalina, MSc

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Catalina is a Natural Resources Engineer from the University of Chile, where she participated in research related to strategic programs for sustainable river basins, hydroelectric development from a socio-environmental perspective and the links between snow cover and hydrological response. Later she obtained specialization diplomas in Project Evaluation and Management, and Hydrology and Watershed Management. Her core focus lies on IWRM, and sustainable environmental resources management and bridging the gap between science, policymakers, and civil society. Previously, she worked at the Superintendence of Environment in Chile, whose mission is to monitor and audit the environmental regulations established by the law. Then she obtained a master's degree in Groundwater and Climate Change with her thesis in Managed Aquifer Recharge at TUD.

Annex 2 | Workshop agenda

Date: 10 August 2022. **Location:** Auditorio Institucional Cora Ferro Calabrese, UNA.

Agenda International Seminar: Nature-based Solutions for Water Security		
Time	Activity	Speaker
08:30 – 09:15	<i>Participants registration</i>	-
09:15 – 09:25	Welcome address	Dr Martin Parada Gómez Vice-Rector for Extension, UNA
09:25 – 09:35	Welcome and opening of the event	MSc Luis Fernando Coto Picado Director of SENARA
09:35 – 09:55	Introduction of the GREAT project: "Facilitation of green adaptation techniques for reduction of seasonal water scarcity in Costa Rica"	Dr Andrea Suárez Serrano Coordinator HIDROCEC-UNA
09:55 – 10:15	Nature-based Solutions for water security in Costa Rica	MSc Roberto Ramírez Chavarría Director of Investigation and Water Management Unit, SENARA
10:15 – 10:30	<i>Coffee break</i>	
10:30 – 10:50	Grey-blue-green infrastructure for climate change adaptation	Dr Catalin Stefan Head of the Research Group INOWAS, TUD
10:50 – 11:10	Identification, analysis and promotion of best practices for sustainable groundwater management in Latin America	MSc Catalina Zapata Researcher INOWAS-TUD
11:10 – 11:30	Characterisation of rainwater harvesting systems for water security in the Chorotega Region, Costa Rica.	Dr Pável Bautista Solís Researcher, CEMEDE-UNA
11:30 – 11:40	Plenary session	MSc Carolina Alfaro Chinchilla Researcher LAGEDE-UNA
11:40 – 12:00	Final remarks and closure	MSc Carolina Alfaro Chinchilla Researcher LAGEDE-UNA Dr Andrea Suárez Serrano Coordinator HIDROCEC-UNA
12:00	<i>Lunch</i>	