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Henrique de Amorim Almeida · Joel Oliveira Correia Vasco ·
Ricardo de Jesus Gomes · Sandra de Jesus Martins Mourato ·
Vânia Sofia Santos Ribeiro *Editors*

Proceedings of the 2nd International Conference on Water Energy Food and Sustainability (ICoWEFS 2022)

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Preface

The second **International Conference on Water, Energy, Food and Sustainability (ICoWEFS 2022)**, taking place in Portalegre (May 10–12, 2022), Portugal, aims to be a major forum to foster innovation and exchange knowledge in the water-energy-food nexus, embracing the Sustainable Development Goals (SDGs) of the United Nations, bringing together leading academics, researchers and industrial experts. The conference expects to foster networking and collaboration among participants to advance the knowledge and identify major trends in the abovementioned fields.

The world is facing unprecedented challenges to mitigate climate change and adapt to its negative impacts, affecting the global economy and society. Europe intends to take the lead on the transition to sustainability, as a chief priority of Horizon Europe is a European Green Deal to transform Europe in a climate-neutral continent, fostering disruptive innovation and the deployment of new technologies and innovative solutions, helping to create a sustainable future.

Innovation regarding water, energy, agri-food, bio-economy, natural resources and environment will speed up the transition toward sustainability, promoting water and food security in the world.

A climate-neutral continent by 2050 will drive technological, economic and societal transformations toward circular economies and green and clean technologies and the decarbonization of energy-intensive industries.

The conference will be a networking and collaboration among participants to advance the knowledge and identify major trends in the fields mentioned above, even in an online format according to the health rules.

We are grateful to the authors from 16 countries with their contribution of 55 papers accepted to be presented at ICoWEFS 2022 and published by Springer Nature, to the directors and staff of the Polytechnic of Portalegre and the Polytechnic of Leiria for their support, to the research centers and sponsoring companies, to the members of the scientific committee and external reviewers, keynote speakers and, finally, to the members of the organization, who with redoubled efforts during a pandemic time managed to carry out this conference.

We hope that we can meet again at the next ICoWEFS Conference.



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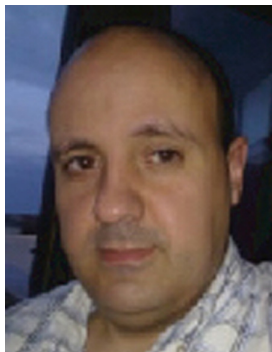
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Keynote Speakers

Combating Climate Change with Phytoremediation. Is It Possible?

Ana Luisa Fernando

NOVA School of Science and Technology, Lisbon University, Portugal



Ana Luisa Fernando is Associate Professor at Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Portugal. She is Researcher at MEtRiCS, Mechanical Engineering and Resource Sustainability Center, hosted by Universidade do Minho and Universidade NOVA de Lisboa. She was graduated in Applied Chemistry (UNL), in 1990, with an MSc in Food Technology/Quality (1996, UNL) and a PhD in Environmental Sciences (2005, UNL). She has been working in the field of Food Technology and Safety, by testing natural compounds extracted from plants into biopolymers for food packaging or as additives for food preservation. Parallel to those activities, she has been working with industrial crops for 30 years, with special interest on studies related with the sustainability of industrial crops production and its exploitation as a source of biomass, ecocompounds and ecomaterials for the bio-economy. She has supervised: 7 PhD thesis (concluded), 12 PhD underway, 111 MSc thesis (concluded) and 74 graduation thesis (concluded). She is currently coordinating the ERANETMED project MediOpuntia, and she is also coordinating nationally the H2020 projects GOLD and MAGIC and is Author and Co-author of several publications.

Some Applications in Hydrogen, Renewable Energy and Bioenergy

José Luz Silveira

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José Luz Silveira is graduated in Mechanical Engineering from the Federal University of Itajubá (1986), Mathematics from the Education and Research Foundation of Itajubá Faculty of Philosophy, Sciences and Letters (1985), master's in Mechanical Engineering from the Federal University of Itajubá (1990) and Ph.D. Mechanical Engineering from the Faculty of Mechanical Engineering – UNICAMP (1994). He is Visitante Senior at Federal University of ABC – UFABC, Full Professor at São Paulo University – UNESP, Coordinator of Institute of Bioenergy Research and Head of Laboratory of Optimization of Energy Systems. He has experience in mechanical engineering, focusing on energy, thermodynamics and heat transfer, acting on the following subjects: renewable energy, bioenergy, cogeneration, thermoeconomic analysis, fuel cell, technical, economic and environmental analysis of power systems.

Management of Biomass Parks in Power Generation Plants

Julio Terrados-Cepeda

University of Jaén, Spain



Dr. Julio Terrados-Cepeda holds a Ph.D. in Engineering from the University of Jaén (Spain) since 2005 and master's degrees both in Aeronautical Engineering (Madrid Polytechnics University, 1989) and in Business Administration MBA (IDEOR, 1994). He teaches and researches at University of Jaén since 1994 and serves currently as Tenured Senior Lecturer at Projects Department. He is also External Professor at Universidad Internacional de Andalucía (UNIA), Universidad Internacional de La Rioja (UNIR), and Visiting Professor at Universidad de Cartagena (Colombia).

Dr. Terrados main research interests are focused on strategic planning, sustainable energy planning and renewable resources assessment. He has co-authored thirty-nine peer-reviewed papers and twenty-four books and chapters. He has been also main Researcher or Participant in about twenty research projects funded by public institutions or private companies. He currently leads the research group GIDIES (R&D in Engineering, Energy and Sustainability) at the University of Jaén, which focuses its research on the evaluation of renewable energy resources, the management of smart grids and smart cities, the thermal and electrical use of biomass and energy planning and foresight.

In the academic field, Dr. Terrados has been Vice President for Strategic Planning, Quality and Social Responsibility at University of Jaén, Rector's Delegate for Strategic Planning and Quality at University of Jaén, Vice President for Strategic Planning, Assessment and Social Responsibility at International University of Andalucía (UNIA) and Director of the Engineering Graphics, Design and Projects Department, among other positions.

In the professional area, Dr. Terrados has been Managing Director of the Energy Management Agency of Jaén region, International Programmes Manager at Canava Electronica S.A. and Eurofighter Control Manager at Construcciones Aeronauticas S.A. (Airbus Industries).

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From Extraction to Reparation: American National Security and Territorial Adaptation in the Climate Crisis

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Abstract. We are now witnessing the results of our collective destruction around the world. From centuries of colonialism and industrialization where forests were leveled, marshlands drained, rivers tamed, and oil burned, this global alteration is no longer hidden. Many of the lands bearing the brunt of the effects were the ones leveraged as key extraction zones which accelerated the crisis we face today. This paper argues that USVI (United States Virgin Island) mangrove ecosystems can be a case study for fundamental analysis for restoration and conservation ecology issues for sustainable boosting of local communities. It is argued that under the concept of a “reparation zone” a bridge can be achieved in the gap between environment, human community, and disciplinary separation to work towards a pluralistic approach through a new cultural reparation ecology to better represent, operate, and solve the myriad issues of climate change in the Greater United States. By focusing on American territorial possessions, this paper examines lingering plantation histories and argues for how nature-based solutions can generate a new methodology towards addressing climate threats and socio-cultural injustices.

Keywords: Climate change · Nature based solutions · National security · American studies

1 Natural Security at Risk

Over the course of its 245 years, the United States has built itself into a major global superpower (Fig. 1). At the foundation of this superpower lies one critical tool: land. What was once a series of 13 colonies grew and expanded through purposeful means to create a country and empire that now spans over 15,000 km from east to west. For a country that wasn't a major territorial superpower in the 18th century or major military power of the 19th century, the United States relied on a form of nation-building that centered itself on the land. Forests for wood, plains for farming and ranching, mountains to mine, and coasts to fish all converged to form a spirit of potential and opportunity. But this opportunity for endless extraction and cultivation has now been met with a serious cost.



Fig. 1. The growth of the United States from 1803 to 1947.

One key driver of American production and growth was the plantation system. Utilized by European colonial powers through the Americas, Southeast Asia, and Africa, plantations used enslaved labor systems to extract various crops or raw materials to then ship to be processed or sold in the global economy. Today, scholars are reflecting on the plantations system itself and framing it as a critical moment in the Anthropocene’s development. Donna Haraway argues that, “scholars have long understood that the slave plantation system was the model and motor for the carbon-greedy machine-based factory system that is often cited as an inflection point for the Anthropocene” [1]. While central to carbon accumulation we are facing today, the plantations were not the sole responsible operation for the climate crisis but present a concise framework towards understanding the nuances between economic growth, cultural violence, ecological exploitation, and political stability. Michael Murphy and Caitlin Schroering posit that, “the plantation directs out attention to global socioecological inequality, or ‘the ways in which humans, nonhumans, and ecosystems intersect to produce hierarchies – privileges and disadvantages – within and across species and space that ultimately place each at great risk.” [2].

As a result of the plantation mechanic, what the United States once built itself on as a source of nation-building, these lands and its people are now facing the collective results of centuries-long consequences. Moving forward, how the United States re-adapts former plantation landscapes will be a critical test of maintaining a natural security; one that is fair and just (Fig. 2).

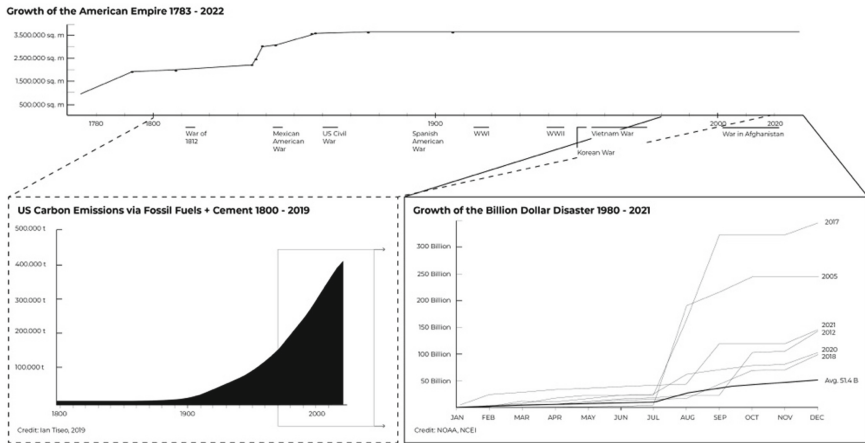


Fig. 2. As the United States grew in geographic size and industrialized, the country began witnessing a substantial increase in billion-dollar disasters starting in the 1980s.

2 Addressing Periphery: The Reparation Zone

Typically framed in the American South, plantations were also utilized in areas outside of the contiguous 48 states. Today, these lands are maintained as territories (Puerto Rico, US Virgin Islands, American Samoa, Guam, Marianna Islands) with the exception of Hawai‘i, which was elevated to statehood in 1959. Within the American conscience, these peripheral lands are often outside daily thought and politically remain outside of policy. Today, the territories lack full congressional representation and only have non-voting representatives in Congress. However, these islands are facing increased rates of hurricanes and typhoons, drought, temperature rise, ocean acidification, and more. As the United States works towards climate adaptation through funding and policies like the Bipartisan Infrastructure Bill (2021) and potentially Build Back Better, there is a unique opportunity for the US to address its territories - its peripheries - and works towards including them in a climate-secure and adaptive future.

Historically, these lands were sites of extraction and experimentation. For outside Colonial and Imperial powers, these were physical spaces to conduct massive experimentation to cultivate and extract the most amount of cash crops as possible. But even more so, these were also spaces to test the limits of enslaved human labor. In the years after the slave plantation system, many of these lands are still dealing with the effects of major land alteration and human exploitation. Stemming from the work of Michael Williams where he offers the concept of the “extraction zone” [3], it is now important to reconfigure this notion.

In a new opportunity to address these chronic issues of climate risk and cultural injustice, the US can tackle territorial and peripheral issues through the concept of a “reparation zone”. The reparation zone would stand as a policy identifier which frames critical spaces to focus re-investment opportunities centered around climate adaptation measures along with funds and programming to address the cultural and social issues that stem from exploitative historical practices. By utilizing this framework, the identified

spaces, lands, communities, or territories become centered and fast-tracked to quickly realize what may normally be trapped in bureaucratic red tape or political stand still. These reparation zones can then primarily focus on implementing nature-based solutions to help tackle the physical threats of climate change, but also how their benefits can help provide jobs, protect cultural heritage, and maintain the human communities that live in the spaces.

As post-plantation American landscapes are found in tropical climates and oceanic geographies, there is a paramount imperative to quickly work towards their adaptation and resilience in the wake of climate change. The US must no longer see these places as extraction zones, but instead catalyze the opportunity to address chronic injustices through climate adaptation and resilience.

3 Mangroves: Socioecological Infrastructure

We all rely on trees, yet for many different reasons. For some, trees provide critically needed shade to cool their sidewalks, others may see trees as a food source. Some see trees as spiritual connectors to the divine realm. Looking to the writing of Rosetta Elkin, she argues that, “as a plant-dependent species, our livelihoods and health are determined by the achievement of plants” [4]. To focus this concept of the reparation zone on one strategy and in one post-plantation landscape, I aim to explore the potential for mangrove restoration in the US Virgin Islands as a form of disaster management and habitat creation.

Mangroves were once a major buffer around the edges of many Caribbean islands. The mangrove forests were the interstitial space between land and water where aquatic fish species used their roots for food and spawning and where birds nested. Culturally, mangrove wood was used for shelters, crafts, and more (Fig. 3) [5]. Today, very few mangroves remain in the Virgin Islands, exposing the shores of the islands and its communities to the threats of sea level rise and storm surge.

The 2017 hurricane season produced two category 5 storms: Hurricanes Irma and Maria. In the two-week period that these storms hit the islands, over 70% of structures of St. Croix were damaged or destroyed. NOAA’s National Center of Environmental Information estimated Hurricanes Irma and Maria produced 167 billion USD in damage across Puerto Rico and the US Virgin Islands [6]. However, by reintroducing mangrove stands and forests into these islands, they can begin to mitigate this damage through storm surge and flooding reduction, helping to protect onshore assets both human and nonhuman.

While ambitious, the abilities of mangroves in climate adaptation are well studied. Zhang et al. found that creating a mangrove stand at 2.5 km in width can reduce storm surge by 50% and an 8 km stand increases the reduction to almost 100% [7] (Fig. 3). By identifying the needed shallow-water habitats for red mangroves to thrive, tactical mass tree planting strategies can be deployed to create a new blue-green infrastructural asset that helps to mitigate increased rates and volatility of hurricanes (Fig. 4). Michael Getzner and Muhammad Shariful Islam found that the average ecosystem value of a hectare of mangrove forest registered at 21,100 USD in 2018 prices [8]. Just one 8 km × 100 m tract with a projection of 100% wave reduction would hold a value of 1.680.000

USD. While the value of these services is complex in nature, the value of mangroves should also aim to include other latent values like cultural value and greater asset and infrastructure protections. As mangrove establishment gets implemented, these latent values must also find ways to transfer back into community development and security

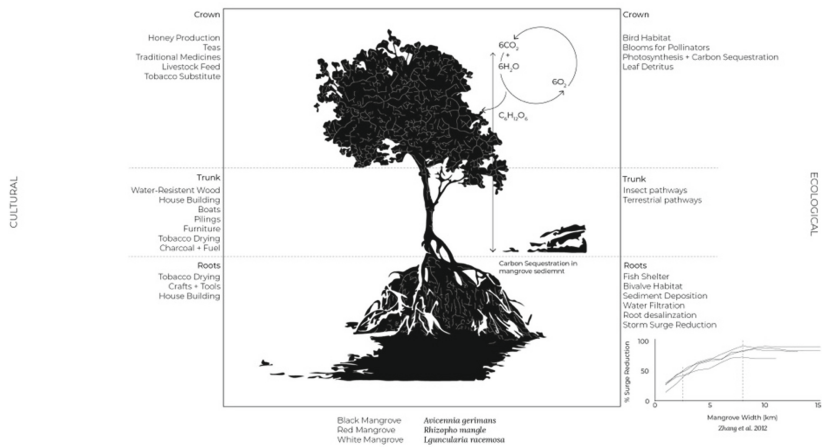


Fig. 3. The mangroves of the Virgin Island and Caribbean at large provide critical ecological services and cultural value.

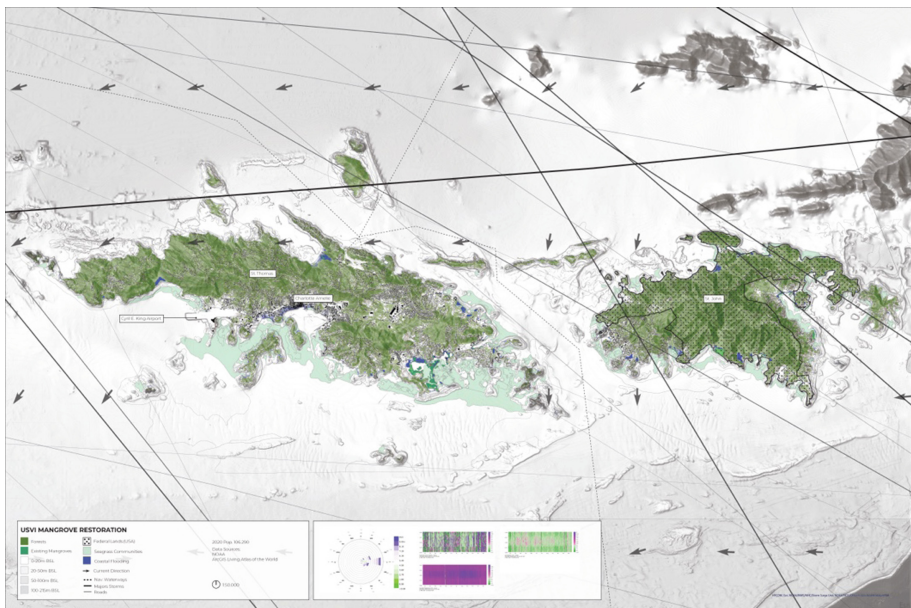


Fig. 4. The Islands of St. Thomas and St. John highlighting seagrass beds as potential new sites for mangrove reforestation.

as well, helping to benefits the residents and communities themselves. In short, the creation of a living land trust through climate adaptation can help additionally provide funds back into local communities to further address needed reparations. Not only will the re-established mangroves act as an almost blue-green wall against the wave power of hurricanes, it will also generate additional habitats for terrestrial and aquatic species that can be leveraged as a green tourist amenity, helping local communities capitalize on this investment even further.

By deeming the USVI as a potential “reparation zone” the US can channel funding and resources into these islands to fast-track climate adaptation and risk aversion. As former plantation landscapes whose land was heavily altered to facilitate crop cultivation and whose labor greatly suffered, re-establishing the lost mangrove buffers can be a potential beginning to a new relationship with the mainland and the federal government. This opportunity is just one measure in a menu of many other options and strategies that can work to engage disparate power structures and disenfranchised peoples and create a new dialogue of co-creation and adaptation for a climate-prepared future (Fig. 5).

4 Periphery Prepared



Fig. 5. Mapping social vulnerability from the Centers for Disease Control and Prevention and the Agency for Toxic Substances and Disease Registry with billion-dollar disasters from 2016–2021.

As the United States works towards a national *natural* security, its territories and peripheral lands must be included in funding opportunities, policymaking, and into implementation. While the climate crisis presents a litany of risks that are perpetually evolving, the US has the opportunity to reconfigure its relationships with its peripheral lands and their peoples to work towards a climate-inclusive and climate-adaptive future (Fig. 5).