Working with nature for sustainable wellbeing in Costa Rica

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1. Introduction

The prevailing theory of the origin of the name of Costa Rica argues that when Christopher Columbus arrived at the coastal province of Limón in 1502, he was impressed by the jewellery made out of gold that the indigenous people were wearing. He therefore thought that this country was a "rich coast". Today we know that the country's "gold" is green and blue - that the treasure it holds is its terrestrial and marine biodiversity. This is different, and ultimately much more valuable, kind of rich coast than the one the first explorers imagined.

Costa Rica has a small terrestrial area of 51,100 km^2. Half of this is covered by forests of different kinds (MINAE et al. 2018b), from dry forests in the north of the country to tropical rain forests in the mountains and mangroves along the Pacific coast. Through these forests large rivers run, connecting the country with a complex highway of water, finally reaching the ocean. As our planet, Costa Rica more than a green country is a blue one, with a marine area ten times larger (589,683 km^2) than its terrestrial area, with a Pacific coast 1,254 km long and a Caribbean one of 212 km. Along these shores, there's a wide arrange of ecosystems, including coral reefs, sandy and rocky beaches, seagrass meadows, a tropical fjord in the Golfo Dulce, upwelling areas such as the Gulf of Papagayo, estuaries, an oceanic island (Isla del Coco), coastal islands, an oceanic trench more than 4,000 m deep, hydrothermal vents and a thermal dome (MINAE et al. 2018b).

This ecosystem richness is due to Costa Rica's lucky location at the center of America, uniting two of the great biogeographic fields, the Nearctic and the Neotropic. It also has a very diverse topography. Both these conditions created habitats approximately for 122,000 species, a staggering 6% of the world's biodiversity, putting Costa Rica among the 20 most biodiverse countries on Planet Earth (MINAE et al. 2018a).

From an early stage as an independent nation, Costa Rica recognized both the intrinsic and economic value of its unique natural resources. It therefore put nature conservation as one of the pillars of its development. This development strategy would later be called "green economy". The United Nations Environment Program (UNEP) defined a green economy as "one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities". This means a socially inclusive economy with low carbon emissions, and efficient resource use. It also means maintaining, enhancing and restoring nature as a critical economic asset and as a source of public benefits, especially for poor people that depend on it in a more direct way for their livelihoods and security (UNEP 2011).

Green economy is mostly associated with terrestrial socio-ecological systems. From the coastal-marine perspective, a sister concept has also emerged, the blue economy, defined as "an economy that is in balance with the long-term capacity of ocean ecosystems to support this activity and remain resilient and healthy" (Economist Intelligence Unit 2015). Both green and blue economies aim to provide an alternative framework to our current "brown economy", which disregards the limits of the Earth System to provide the resources on which development is based, as well as ignoring social imperatives under the assumption that economic growth will fix them.

The green and blue economy strategy of Costa Rica has yielded positive results not only for the environment, but also for society as a whole. In 2016, Costa Rica ranked number one in the Happy

Planet Index, an index that combines four elements: well-being, life expectancy, inequality of outcomes and ecological footprint. The idea is to show how residents of a country use environmental resources to lead long and happy lives (HPI 2020).

This high ranking of this small Central American country is rooted in bold decisions from the government in the past to improve the wellbeing of its citizens. These include the creation of a universal access health system, free access to education for all Costa Ricans, the abolishment of the army and the protection of nature for the benefit of the country and the rest of the world.

In many ways, these development decisions, and many others that have put the country on a sustainable development path, are interrelated and interdependent. For example, abolishing the army put peace at the heart of the country and freed important economic resources that are now dedicated to education and nature conservation. A higher education rate has also permitted reduced poverty, which has given people other sources of income rather than exploiting the environment.

In this chapter, we highlight three of the main sustainability measures and policies the country has adopted to work with nature instead of against it: 1) Protecting more than 25% of its territory, 2) paying farmers to protect and restore the forest and 3) producing electricity almost entirely with renewable energy. Working with nature means acknowledging the multiple benefits that ecosystems provide to society, known in the scientific literature as ecosystem services (Costanza et al. 1997; Millennium Ecosystem Assessment 2005) and protecting and restoring the natural capital (i.e. the ecosystems) that provide these services. For example, the economic value of ecosystem services from seven Ramsar Wetlands in Costa Rica have been estimated in $3.2 billion/year, a value higher than some sectors of the GDP of Costa Rica, such as agriculture,

forestry and fisheries ($2.71 billion/year) and construction ($2.69 billion/year) (Hernández-Blanco et al. 2017). Another study estimated the value of the benefits provided by the mangroves of the Gulf of Nicoya, such as the provision of food (i.e. fisheries), coastal protection and climate regulation, at $86 million/year - a value that represents 0.16% of the GDP in Costa Rica in 2015 (Hernández-Blanco, Costanza, and Cifuentes-Jara 2018).

2. Protecting biodiversity for economic development

Despite providing essential services to human well-being, nature at a global level suffers from anthropogenic threats that degrade its health and therefore its ability to provide these benefits. Land use change is one of the main drivers of environmental degradation (IPBES 2019). Currently, agriculture accounts for half of the habitable land on Earth[1], and 77% of agricultural land is dedicated to livestock (including grazing land for animals and arable land used for animal feed production) (Ritchie 2019).

In the case of Costa Rica, from 1950 to 1987 the country had one of the highest deforestation rates in the world, going from 72% to just 21% forest cover (Rodríguez Zúñiga et al., 2012; Sader and Joyce, 1988). This decrease in forest cover was mainly due to the growth in cattle ranching and general agriculture (Rodríguez Zúñiga et al., 2012), an activity focused only on the provision of one benefit (i.e. food) at the expense of the wide variety of ecosystem services that the forest provides. To address its high deforestation rate, Costa Rica started taking important steps for nature conservation in the second half of the 20th century, such as establishing in 1963 the first protected area in the country (Cabo Blanco Absolute Natural Reserve), and creating in the late 70's the National Park Service. One of the most important millstones in the environmental history

[1] Habitable land covers 71% of the planet, the rest is glaciers (10%) and barren land (19%)

of Costa Rica was the creation of a Forest Law in 1996 that established two keystone measures: 1) banning land use change (i.e. deforestation) and 2) creating a nation-wide Payment for Ecosystem Services program (the next section describes this program in detail). Together, these efforts have stopped deforestation and increased forest cover annually, reaching 52% cover by 2018 (Corrales-Chaves 2019).

In 1998, two years after the landmark Forest Law, the Biodiversity Law was established, which created the National System of Conservation Areas (SINAC by its acronym in Spanish), allowing Costa Rica to consolidate its conservation strategy aimed at halting deforestation. Today, SINAC has 145 Protected Areas (PAs), where the management categories with the most PAs are protective zones (21%), national parks (19%) and mixed national wildlife refuges (19%). The area of these PAs cover 25% of the continental territory of Costa Rica, and 2.6% of the marine Exclusive Economic Zone (Corrales-Chaves 2019)(Table 1 and Figure 1).

Table 1. Number and extent) of management categories of SINAC's Protected Areas. Corrales-Chaves, 2019

Management category	Number of PA	Percentage of the total PA	Continental protected area (km^2)	Continental percentage	Marine protected area (km^2)	Exclusive Economic Zone percentage	Total
Marine management area	2	1.38	0	0	10443.31	1.85	10443.3
Absolute nature reserve	2	1.38	14.28	0.03	16.88	0	31.16
Biological reserve	8	5.52	216.4	0.42	52.01	0.01	268.41
National park	28	19.31	6325.63	12.36	3763.72	0.67	10089.4
Wetland	11	7.59	363.35	0.71	0.07	0	363.42
Natural monument	1	0.69	2.3	0	0	0	2.3
Forest reserve	9	6.21	2159.6	4.22	0	0	2159.6
Protective zone	31	21.38	1557.25	3.04	0	0	1557.25
National wildlife refuge							
State	12	8.28	667.01	1.3	195.47	0.03	862.48
Mixed	27	18.62	1628.78	3.18	358.95	0.06	1987.73
Private	14	9.66	82.64	0.16	0	0	82.64

Management category	Number of PA	Percentage of the total PA	Continental protected area (km^2)	Continental percentage	Marine protected area (km^2)	Exclusive Economic Zone percentage	Total
TOTAL	**145**	**100.00**	**13017.24**	**25.42**	**14830.41**	**2.62**	**27847.7**

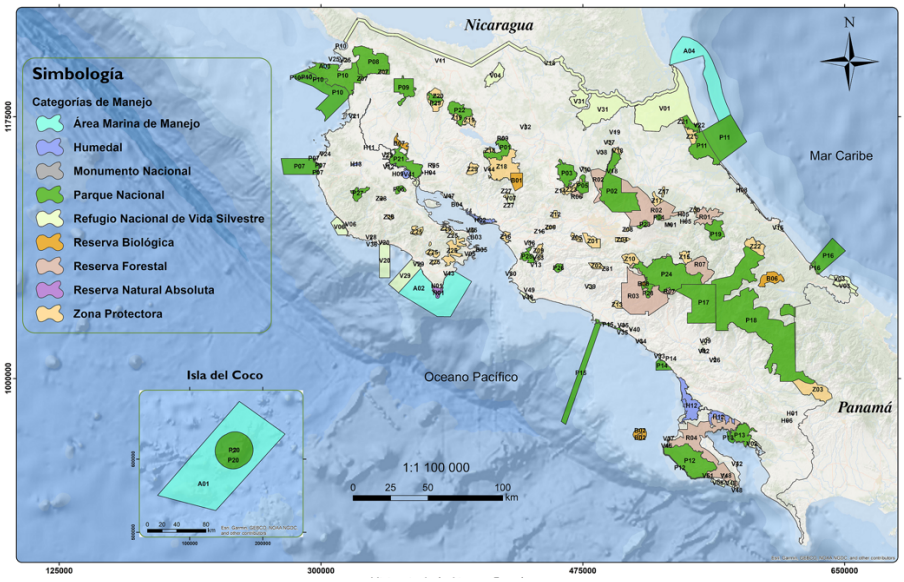

Figure 1. Protected Areas of Costa Rica

Source: SINAC 2021

Dedicating a quarter of the national territory to conservation could raise some concerns to some people that perceive environmental protection as a threat to the economy. Because Costa Rican law mandates that the only activities that are allowed in PAs such as national parks are education, research and ecotourism, some of these lands can have a significant opportunity cost since they could be used for farming, real estate projects and energy production (e.g. hydro power, geothermal), among others. Nevertheless, the vision of the government of Costa Rica to invest in nature conservation has proven to be beneficial not only for biodiversity but for people. Costa Rica has been able to steadily increase its GDP per capita (Figure 2) at the same time it has increased

its forest cover, currently having one of the highest GDP per capita in Latin America (The World Bank 2020).

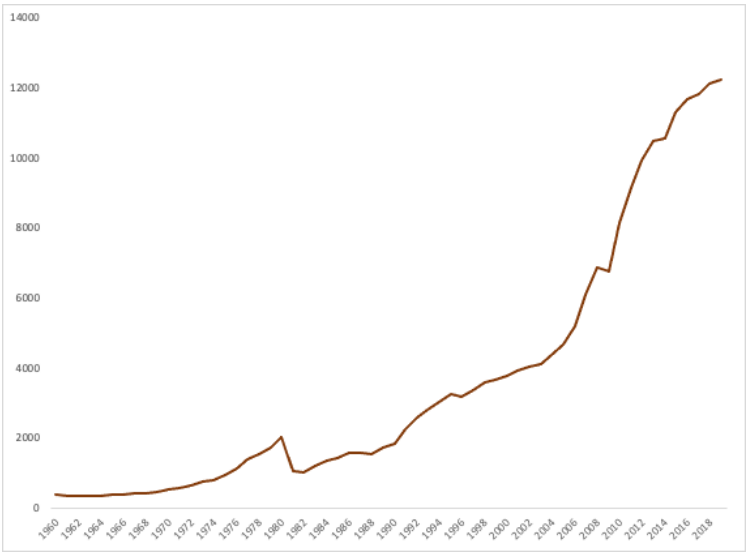

Figure 2. GDP per capita (current US$) of Costa Rica from 1960 to 2020.

Source: The World Bank 2020

The sustained increase over the years in the extent of the PAs has been a major reason that Costa Rica has become a world-class tourist destination. Tourist visitation increased sixfold in the last 30 years, with a visitation in 2018 of just over 3 million tourists (Programa Estado de la Nación 2019), which generated $3,824 million for the country for the same year (Banco Central de CR 2019) and employed 469,576 people directly and indirectly (INEC 2019). According to the Costa Rican Tourism Institute, between 2016 and 2018, approximately 64% of all tourists who visited Costa Rica did so to carry out activities related to ecotourism (Instituto Costarricense de Turismo 2019).

The United Nations World Tourism Organization refers to ecotourism as forms of tourism that have the following characteristics: 1) All nature-based forms of tourism in which the main motivation of the tourists is the observation and appreciation of nature as well as the traditional

cultures prevailing in natural areas, 2) it contains educational and interpretation features, 3) it is generally, but not exclusively organised by specialised tour operators for small groups, 4) it minimises negative impacts upon the natural and socio-cultural environment, and 5) it supports the maintenance of natural areas which are used as ecotourism attractions by generating economic benefits for host communities, organisations and authorities managing natural areas with conservation purposes; providing alternative employment and income opportunities for local communities; and increasing awareness towards the conservation of natural and cultural assets, both among locals and tourists (UNWTO 2020). The International Ecotourism Society generally defines ecotourism as responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education (The International Ecotourism Society 2020).

From an ecological economics perspective, ecotourism can be analyzed through the identification of the capital that this sector depends on and its contribution to human well-being. Generally speaking, there are four major types of capital: (1) human capital (i.e. human beings and their attributes, including physical and mental health, knowledge and other characteristics that make people productive members of society); (2) social capital (i.e. the network of personal interconnections, social networks, cultural heritage, institutional arrangements, among others); (3) built capital (i.e. buildings, machinery, transport infrastructure, and all human artifacts and services); and (4) natural capital (i.e. ecosystems, nature) (Costanza 2012; Hernández-Blanco and Costanza 2019).

In this way, PAs represent the natural capital that provides ecosystem services (i.e. the benefits that society receives from ecosystems) that thousands of people benefit from, such as climate and water regulation, pollination, habitat for biodiversity, food, and recreational opportunities such as

ecotourism. However, the benefits that tourists receive do not flow directly or solely from natural capital, it instead interacts with the other capitals in order to create human well-being. For example, in addition to having a natural area such as a national park with a high level of biodiversity (natural capital), tourists must have knowledge that the park exists, the willingness to visit it, and in most cases the basic knowledge about biodiversity they can expect to find in the area (human capital). Additionally, for tourists to enjoy the national park, they require roads and all the necessary infrastructure to reach the national park and move around within it, along with other amenities such as restrooms, information stations, etc. (built capital). Finally, there must be the institutions that manage the national park (SINAC in the case of Costa Rica), the social networks that allow the PA to be known, and in many cases the family and friendship ties that allow the enjoyment of natural capital in group (social capital).

Natural capital and its ecosystem services can be economically valued taking into account their non-use values (i.e. existence and legacy values), and their use values (i.e. direct, indirect, and option values). In this sense, PAs can also be analyzed from that perspective, with existence values expressed by society's desire to conserve them, indirect use values for ecosystem services such as water and climate regulation, and direct use values mainly related to the ecosystem services of recreation or ecotourism.

In order to value the desire of experiencing a PA or the willingness to pay to protect it, economists often use a method called contingent valuation (Spenceley, Rylance, and Laiser 2017). This valuation method poses hypothetical questions to know how individuals (in this case tourists to PAs) would respond to specific types or amounts of entrance fees (Laarman and Gregersen 1996). The simplest and most commonly used format to do this is a survey in which the PA visitor is offered a binary choice between alternatives, one is the current situation and the other is an

improved situation that has a higher cost than the current situation (e.g. improved services and infrastructure, increased conservation efforts) (Carson 2000).

An important finding that has resulted from the application of contingent valuation in a large number of cases around the world is that tourists are not only willing to pay to visit PAs, but are also willing to pay more than the fee established (Spenceley, Rylance, and Laiser 2017), especially tourists from developed countries visiting PAs in developing countries (Lindberg and Halpenny 2001). In Costa Rica, the contingent valuation method has been applied to know the willingness to pay entrance fees for non-resident and resident visitors, some considering scenarios in which infrastructure and other services are improved (Table 2). For example, Shultz et al. (1998) found that the fees that non-resident tourists were willing to pay in the Manuel Antonio and Poás National Parks were 900% higher than the entrance fees in those parks at that time.

Table 2. Willingness to pay from ecotourist to enter a national park in Costa Rica

Study	Type of tourist	Manuel Antonio	Av	Braulio Carrillo	Av	Chirripó	Av	Irazú Volcano	Av	Poás Volcano	Av
Chase et al. (1997)	NR	24.9	36.7	---	---	---	---	21.75	32.1	21.6	31.9
Shulz et al., 1998	NR	14	20.3	---	---	---	---	---	---	11	16
	R	13	18.9	---	---	---	---	---	---	23	33.4
Adamson-Badilla and Castillo (1998)	NR	12	17.4	---	---	---	---	---	---	---	---
	R	5	7.26	---	---	---	---	---	---	---	---
Alpizar and Madrigal (2004)	NR	8.33-10.83	10.41-13.54	5.65-8.15	7.06-10.19	---	---	---	---	---	---
Alpizar et al. (2009)	NR	---	---	11.1	12.2	24.5	27	---	---	---	---
	R	---	---	1982.5	2504	7069	8928	---	---	---	---

Av = Adjusted value with Consumer Price Index to show all values in 2020 dollars

The economic benefits of PAs go beyond those obtained directly from entrance fees. A recent study estimated that in 2016 all PAs in Costa Rica contributed $1.8 billion to the national economy

(Moreno-Díaz 2019), where 54% of that amount is provided by hotels and restaurants that attract ecotourism. Furthermore, 14% of this contribution comes from the provision of water for the production of electricity through hydroelectrical plants (more on renewable energy in section 4), proving that nature conservation is not only a moral imperative but a great financial investment.

3. Paying farmers to protect and restore the forest

Global degradation of ecosystems is due in part to the fact that markets fail to fully incorporate the economic value of the benefits they provide, and the institutions that *can* internalize this value do not exist in most parts of the world. Therefore, a direct solution to this problem may be the creation of economic incentives capable of incorporating environmental externalities (positive externalities in the case of services provided by ecosystems), in which the beneficiaries of these services pay ecosystem managers to conserve, improve or restore ecosystems in order to maintain the flow of services (Schomers and Matzdorf 2013), a financial mechanism known as Payment for Ecosystem Services (PES).

PES are defined as "a transfer of resources between social actors, which aims to create incentives to align individual and/or collective decisions on land use with the social interest in the management of natural resources" (Muradian et al. 2010), which means that transfers can occur under a market or something similar, or through other financial mechanisms such as incentives (not restricted to economic ones) or public subsidies. Another appropriate definition of PES is “a transparent system for the additional provision of ecosystem services through conditional payments to voluntary providers” (Tacconi 2012).

As mentioned in the previous section, Costa Rica established a national PSE scheme under the Forest Law in 1996. This law identified four ecosystem services generated by forests and forest

plantations: 1) greenhouse gases mitigation (carbon fixation, reduction, sequestration, storage and absorption), 2) water provision for urban, rural or hydroelectrical use, 3) biodiversity protection for its conservation and sustainable use, scientific and pharmaceutical use, research and genetic improvement, ecosystem protection and life forms; and 4) natural scenic beauty for tourist and scientific purposes (article 3 of the Forest Law). Although only these four ecosystem services are mentioned in the law, forests provide other important services, such as raw materials (i.e. wood), air regulation, erosion prevention, pollination, and extreme events regulation, among others.

The Forest Law also created the Nation Fund for Forest Finance (FONAFIFO by its acronym in Spanish) to manage the PES program. The program receives its funding mainly from a fossil fuel tax (3.5% of revenues from the tax) and a water tax (25% of the revenues from a tax on water use). In 2018, the fossil fuel tax represented 89% of FONAFIFO's total funding and the water tax 7.5%. The remainder came from other sources (e.g. a tax on wood). FONAFIFO also offers other services related to ecosystem services that generate some funding for the scheme, such as the sale of carbon credits that are produced through forest plantations under the PES program to people and organizations that seek to offset their carbon footprint, but currently these credits only provide around 1% of the total funding.

The funds collected through these sources are used to fund two general activities on privately owned farms broadly described in terms of maintenance and recovery of forest cover. A third category are mixed systems, for small farms with an area of 10 ha or less, in which a maximum of three activities of PES can be considered (Table 3).

Table 3. Activities that are funded under the current PES program

Forest cover maintenance	Recovery of forest cover
Forest protection	Reforestation
Water resources	Reforestation with endangered species

Forest cover maintenance	Recovery of forest cover
Post Harvest Protection	Natural regeneration
	Agroforestry systems
	Agroforestry systems in coffee farms
	Agroforestry systems with endangered species
Mixed systems	

Currently, the activities strictly dedicated to forest protection receive an average of 83% of all financing from FONAFIFO. On the other hand, 10% of the funds from FONAFIFO are invested in reforestation activities, especially those under the category of "reforestation with medium-growth species" (5%) and the general category of "reforestation" (4%). Finally, other activities that receive significant funding, but at a much lower percentage than those mentioned above, are the regeneration of pastures (2%) and agroforestry systems (2%). The remaining 4% of the funds for the PES program are distributed in various sub-activities of reforestation, regeneration and agroforestry systems.

The current program functions in a *Pigouvian* way, where the government serves as intermediary between the sellers (i.e. property owners who implement the activities mentioned before) and the beneficiaries, which can vary significantly, from local to global scales. As the only intermediary, the government is therefore the only buyer of ecosystem services, and therefore their rights, creating a monopsony. This scheme is contrary to a *Coasean* one, in which there is a direct relation between producers of services and buyers, for example in the case where a company that bottles water pays farmers upstream to implement good agricultural practices to secure the quantity and quality of the water on which the companies depend.

Another key aspect of the Costa Rican PES scheme is that it's an input-based program, in which payments are made based on the implementation of a particular land use. It is not output-based, in which buyers pay for the provisioning of a specific service (e.g. payments for tons of carbon sequestered, or cubic meters of water produced or enhanced) (Engel, Pagiola, and Wunder 2008).

This allows for enhanced planning across multiple land-uses. This also allows for payments to be made in a bundled approach, where activities are funded to protect, enhance, or restore the forest ecosystems as a whole and the four ecosystem services in the process, with the understanding that other services may also be provided as co-benefits. This is more effective than a stacking or layering approach, where payments are made for separate ecosystem services (Lau 2013).

On average, FONAFIFO funds 57,400 ha annually through an average of 808 contracts. It is important to note that approximately 90% of the area in the program is for forest conservation (Corrales Chaves, 2019).

In 2021, Costa Rica's PES program will be 25 years old, demonstrating its success in allocating a constant flow of funds at all times, as well as in investing those funds throughout the country for the protection and restoration of forests. The program has become Costa Rica's flagship conservation program and has inspired the creation of similar schemes in many parts of the world. Considering the experience and success of this program, we believe that it is time for Costa Rica to regain world leadership in proposing innovative ideas for the management of natural capital, redesigning this program to reflect the new national and international context, as well as increasing its level of ambition. Generally speaking, we recommend the evolution of the program in three ways: 1) expanding the scheme to other ecosystems, including the coastal and marine ones, 2) increasing the variety of funding sources to make the programme more resilient to unexpected situations where funding can be compromised (e.g. impact from the global emergency for COVID-19), and 3) managing the scheme following an institutional framework similar to a Common Asset Trust (CAT), in which people who damage the trust (i.e. nature) are charged a fee, and those who improve it get paid (Costanza et al. 2021). CAT use more nuanced private and community property rights with legal precedent in the Public Trust Doctrine. Effective CATs embody a generalized

version of Elinore Ostrom's eight core design principles for sustainable commons management: (1) shared identity and purpose; (2) equitable distribution of contributions and benefits; (3) fair and inclusive decision-making; (4) monitoring agreed behaviours; (5) graduated responses; (6) fast and fair conflict resolution; (7) authority to self-govern; and (8) collaborative relations with other groups and spatial scales. CATs can facilitate more fair and effective public/private partnerships (PPPs) to invest in natural capital and ecosystem services. Costa Rica may again lead the way by implementing a national CAT to manage all of its terrestrial and marine natural capital assets.

Powering the nation with nature's energy

Another example of how Costa Rica has followed a sustainable development path is the way the country provides electricity for its five million citizens. In 2019, in Costa Rica access to electricity was 99.4% (ICE 2019b), meaning that practically every citizen in the country receives electricity. But more impressive is the way the country has been working with nature to do so. Since the late 70's, Costa Rica has put into action a vision of generating electrical energy using mainly renewable resources such as water, wind and the sun, with the dual goal of providing a constant flow of energy to the population as well as taking advantage of the natural resources of the country to produce clean electricity[2].

The Costa Rican Electricity Institute (ICE by its acronym in Spanish) is the biggest electricity producer of the country. It owns and manages most of the transmission system and is in charge of distributing energy to end customers in a large part of the country. By constitutive law, this institution is responsible for ensuring the supply of electricity to comply with the energy demands of the country's development. There are six other public energy companies that generate

[2] Unless otherwise said, all data from this section comes from ICE 2019c

electricity, as well as 37 private generators. In 2017, the installed capacity of the national electric system was of 3,530 MW, made up of 66% hydroelectric plants, 16% thermal plants, 6% geothermal plants, 11% wind plants, 1% biomass and 0.2% solar. Of this installed capacity, ICE operates 70% with its own plants and 20% with plants contracted to independent private generators.

The national electricity mix has varied during the last four decades. In the early 80's, after the completion of the Arenal hydropower plant (the first large plant in the country), Costa Rica produced almost all of its electricity using renewable energy. Later, mainly due to some dry years in which hydropower couldn't supply the electricity demand, the country increased the use of fossil fuels. In 1994 they represented 17% of all electricity produced. From 1996 to 2006, thanks to the contribution of new geothermal plants, such as Miravalles that started in 1994, and wind farms such as Tejona that started in 2002, as well as good hydrological conditions, the use of fossil fuels was minimal. Since 2015 the country has been able to produce almost 100% of electricity using renewable energy. In 2019, 69% of the electricity was produced with hydropower, 13% from geothermal energy, 16% from wind power, and 1% from solar energy (ICE 2019a).

Maintaining in the future the current clean electric matrix will be a challenge. On one hand, electricity demand is rising as in the majority of the world. On the other hand the main sources of renewable power have already been exploited. For example, approximately 35% of the remaining hydroelectrical potential is inside indigenous zones, and another 20% in national parks and forests reserves. Furthermore, an important part of the potential geothermal generation is also in national parks, and current environmental legislation prohibits any activity in these protected areas other than research, education and ecotourism.

To face this challenge, Costa Rica is investing more in technologies that until now played a small role in electricity production, such as wind and solar power. For example, wind power is a good complement to hydroelectric energy throughout the year and especially in the dry season. In general terms, the cycles of the El Niño phenomenon (dry years) have windier conditions, thus favoring greater generation with wind energy. In La Niña cycles (very rainy years) there is less wind, but there is more hydroelectric generation. This complementarity also occurs on the annual horizon because the wind pattern in Costa Rica is stronger during the summer months than in the winter. In the case of solar power, electricity generation is more difficult in a country that has high cloudiness, and therefore it will be limited for now to more individual projects that can complement electricity consumptions in houses and buildings.

Another source of electricity generation that Costa Rica is starting to use more is biomass energy (i.e. renewable energy derived from living or recently living organisms, mostly plants). Currently, the country has an installed capacity of 47 MW using organic agricultural waste. The great majority of this capacity comes from dry biomass, mainly bagasse[3] from sugar cane mills. Although energy production from bagasse represented 0.6% of the electricity produced in 2019 (ICE 2019a), it is a clear example of the potential that public-private partnerships have to solve sustainability issues such as climate change mitigation and integral waste management.

Energy production from biomass also represents a strategy of circular economy. This type of economic model is defined as an industrial system that is restorative or regenerative by intention and design, replacing the predominant linear pattern of production and consumption, and therefore aims towards the elimination of waste from the life cycle of the product or service (The Ellen MacArthur Foundation 2012). We believe Costa Rica has a great potential to integrate circular

[3] The dry pulpy fibrous material that remains after crushing sugarcane stalks to extract their juice

economy at the core of its development strategy, mimicking the rich ecosystems the country has, where energy is fully produced in a renewable way and there is no waste, everything biodegrades or becomes a resource for other species.

A final note on electricity production in Costa Rica has to do with innovation and investment in non-conventional renewable energy projects. Having 10 times more marine area than terrestrial, the country is exploring the possibility of moving from a terrestrial-focused energy production towards a generation model where oceans can play an important role. The Costa Rican Electricity Institute is planning to start generating wave power by 2030 (Garza 2020), which is a fairly constant source of energy production through the year, unlike solar, wind or hydroelectric, which depend on weather conditions. It has been estimated that the technical potential for annual electricity production is 3.8 TWh in the Exclusive Economic Zone (EEZ) from the Caribbean Sea, and 15 TWh in the EEZ from the Pacific Ocean (Brito e Melo 2013).

Conclusions

Costa Rica has been a world leader in areas that are becoming increasingly important – peace, sustainable management of natural capital, and the shift to 100% renewable energy sources. Most importantly, Costa Rica has demonstrated the successful implementation of governance based on the goal of maximizing the wellbeing of humans and the rest of nature as an integrated and interdependent system.

There is a saying among "Ticos" that is also an example that can lead the world. "Pura vida" means literally "pure life", but the deeper meaning is for a life that is focused on wellbeing in all its aspects. It is one of the reasons that Costa Rica ranks so high on international comparisons of happiness and wellbeing.

A successful and sustainable future for humanity will require a move away from our current addiction to GDP growth at all costs toward a world based on sustainable wellbeing. Already a few countries (Scotland, New Zealand, Iceland, Finland, Wales) have established the Wellbeing Economy Governments (WEGo - https://wellbeingeconomy.org/wego) as part of the broader Wellbeing Economy Alliance (www.wellbeingeconomy.org). Costa Rica is considering joining this group. Together such an alliance can produce a world where we can all say *pura vida* and mean it.

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