

Geothermal Development in Protected Areas; Case History from Costa Rica

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ABSTRACT

Costa Rica is recognized worldwide as a leader in environmental protection, 25% of its extent is under different levels of natural conservation. This characteristic constitutes an important challenge for developing geothermal energy, as a great part of the recognized geothermal resources are associated with areas of different degrees of environmental protection, including national parks. This document discusses the different environmental aspects related to the effort to develop geothermal fields in national parks in Costa Rica, the law proposed, the environmental management carried out in geothermal projects and the new conceptual management implemented so far. As a conclusion the sustainable development of geothermal projects in protected areas is feasible and necessary to ensure the population well-being without significant impacts on the natural resources.

1. INTRODUCTION

As a result of the first geothermal studies, many areas of potential geothermal resources were located, two of these areas are Borinquen and Las Pailas. Las Pailas Geothermal Field is located at the Rincon de la Vieja Volcano in Cañas Dulces Liberia between the basins of the rivers Colorado and Blanco. At the moment, the first unit Las Pailas I is producing 42 MW and Las Pailas II unit (55 MW) is under construction. Both areas are near the Rincon de la Vieja National Park but studies show that the most important geothermal resources are inside the park.

In Costa Rica the laws clearly protect the environment but also the right of the inhabitants to well-being. However the protection of the natural resources in a national park is absolute. It is not possible to develop any projects in these areas even if it is demonstrated that they are compatible with the environment.

The Costa Rica environmental Law (1995) indicates:

- The environment is a national heritage for all of its inhabitants. This implies the obligation to protect it, but also the right to use it to provide well-being.
- The government has to ensure the sustainable use of natural resources.
- Damage to the environment is a social, economic and cultural offense.

This law establishes seven categories of protected zones:

- Forest reserves.
- Protected zones.
- National parks.
- Biological reserves.
- Wildlife national refuges.
- Wetlands.
- Natural monuments.

The most important of these areas are the national parks which are also the most extensive ones. The national park law indicates that in the national parks it is forbidden to use natural resources, build roads, buildings, etc. Unfortunately most of the identified geothermal resources in Costa Rica are related to protected areas.

Conservation and environmental developments are two different but related concepts that need to be implemented together. Conservation of the environment cannot be sought by sacrificing development and the nation's well-being, since conservation alone does not contribute to poverty reduction. Poverty is an important thing to consider when we talk about conservation because people do not worry about conservation or sustainable development if they have an unacceptable well-being. For this reason, the national authority has to find a way of using natural resources to improve the quality of life of the population while also protecting those resources.

The government uses Environmental Impact Assessment as a tool to introduce the principles of conservation and protect the environment, mainly in large projects. However, the resources to ensure accomplishment of Environmental Impact Assessment recommendations are limited. Thus, creative options are needed in order to enable exploitation of geothermal natural resources associated with national parks while also ensuring the adequate management of the environment.

2. GEOTHERMAL RESOURCES AND PROTECTED AREAS

In Costa Rica, 25% of the country is environmentally protected. By law, an area of 2 kilometers radius from the crater of any volcano is declared a national park, as a result the most important and extensive national parks are related to volcanoes. Unfortunately in Costa Rica the studies have identified the most promising areas for geothermal development along the volcanic zone of the country, as shown in Figure 1. The red areas represent identified temperatures of 200°C and 3 km deep.

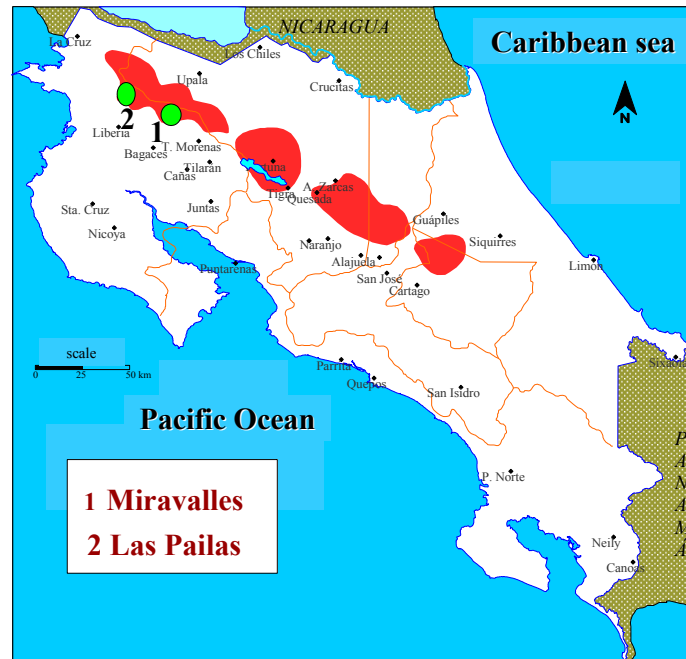


Figure 1: Geothermal zones

It is necessary to consider that not only is temperature important but permeability and fluids are also critical. When these factors are addressed, the prospective areas identified by detailed studies are reduced. Figure 2 shows clear examples of these and also shows the location of the national parks and its relationship to the zones of geothermal potential. This condition creates problems for geothermal development in Costa Rica because detailed studies undertaken indicate that the highest quality resources are located inside the national parks. As shown in Figure 2, the yellow zones are confirmed as commercial zones, but studies suggest that the main resources are inside the parks. This condition is more evident in Las Pailas and Tenorio.

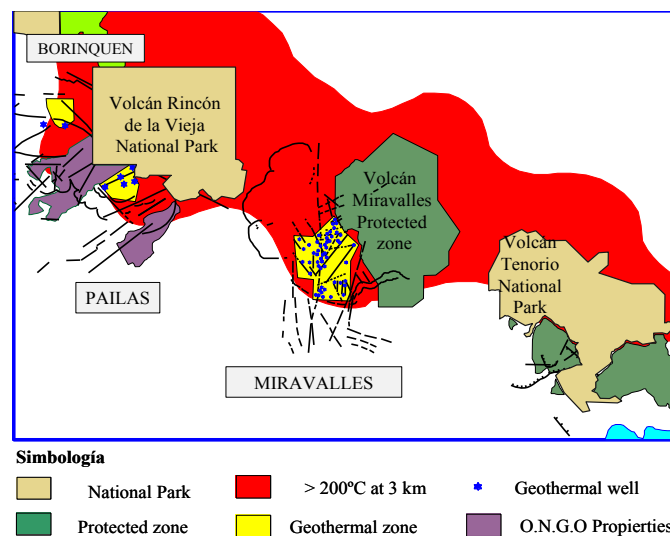


Figure 2: Geothermal zones and protected areas

There are many international examples of geothermal development within national parks; two examples discussed here are from the Philippines and Kenya. In the Philippines, there are geothermal developments in the Mt. Apo and Negros National Parks (Dolor,

2006) where three geothermal power plants, with a total of 146 MW, are installed. In Kenya, the Olkaria geothermal project was developed in the Hell's Gate National Park and 137 MWe was produced in 2006 (Mwangi, 2006). As in the Philippines, the process was complex and involved many environmental issues but at the end the results demonstrated that geothermal development can coexist with nature. These experiences show that it is not an easy process, mainly because the people are always worried about the impacts of the projects. Once they understand the importance of the energy for the country, the benefits of the projects for the communities, and the low impacts on the parks, they allow the development.

In Costa Rica, the Miravalles geothermal project also can be used as an example of the coexistence of geothermal development and natural conservation. In 1973 when the projects started, the existing basic land use was grazing and the area was completely deforested. During project development, most of the land was acquired from the owners as they desired to sell the properties. ICE started an induced and natural reforestation process and as a result all the land is now reforested and a variety of fauna has returned. The visual impacts are now very low and the positive coexistence of geothermal development and regeneration of the natural environment is evident.

Detractors of development within national parks argue that developing a project in deforested areas is not equivalent to developing projects within national parks and they are right. But the fast recovery of the flora and the amazing recovery of the fauna at Miravalles can be directly attributed to the geothermal development there. If the impact of geothermal operations was detrimental, the recovery at Miravalles would not have happened as observed. This demonstrates that geothermal activities can be environmentally benign and managed to benefit the environment, compatible with a conservation philosophy.

Figures 3 and 4 are examples of the positive effects of the geothermal developments if well managed environmentally. Figure 3 shows land administrated by private people and Figure 4 shows the same land ten years after acquisition by ICE and the grade of recovery is clear.



Figure 3: Private owner's land (2001)



Figure 4: Land acquired by ICE, after few years (2012).

Figure 5 shows ICE properties at the boundaries of Separation Unit one in 1993. The area was mainly grassland. Figure 6 shows the land condition in twenty years. It is clear that recovery of the flora has occurred since ICE took control of the land. These lands now are mainly forest. These examples show these systems do not affect the natural conditions in an adverse way.

The reduction of CO₂ emissions is another important positive effect of the geothermal projects. Figure 7 shows different emissions for different power plants. These data indicate total emissions of 122,310 kg of CO₂ per MWh from a 135MW power plant using fossil fuel and only 7,965 or 2,700 kg for the same energy production using a geothermal plant considering the non-condensable gas

(NCG) of Miravalles and Las Pailas respectively. The reduction of the CO₂ emissions will be extremely important if Costa Rica replaces thermal electricity production with geothermal production.

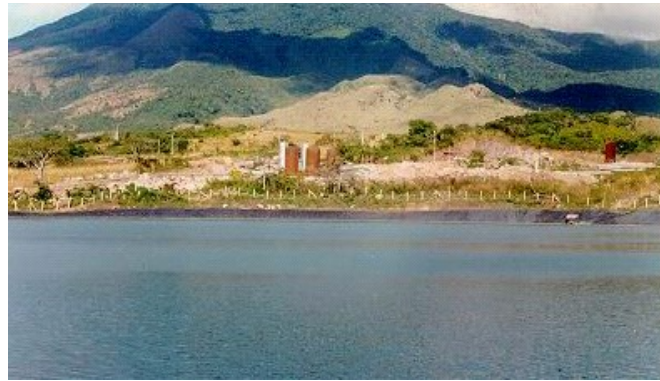


Figure 5: Forest condition at the initial stages (1993)



Figure 6: Forest condition currently (2014)

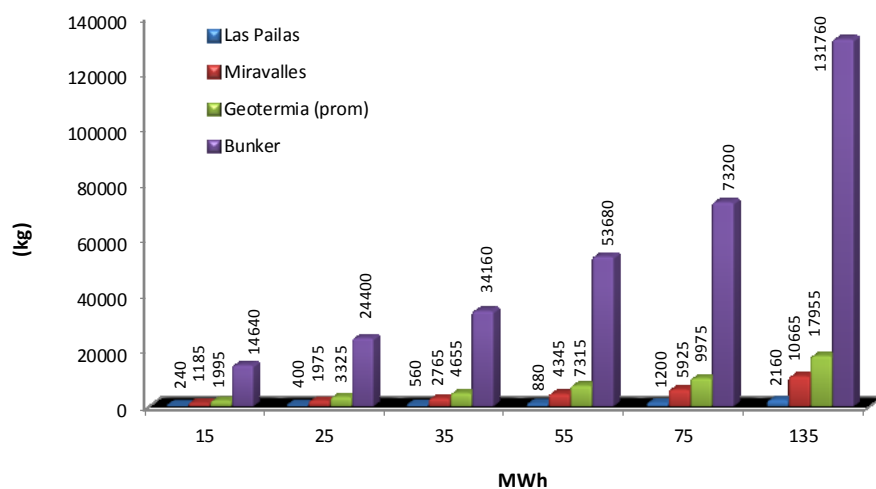


Figure 7: CO2 emissions (kg/MWh)

In order to demonstrate the successful coexistence of these activities, another approach is to develop a geothermal project within a private protected area in Costa Rica. Due to the importance of these issues, ICE and the NGO Guanacaste Dry Forest Conservation Foundation are working together to demonstrate the impacts of the geothermal process in a protected area. The idea is to share experiences and create an environmental model through the development of a geothermal project at Las Pailas II, a sensitive area. At this time the project is going well since the design of roads, well platforms and well drilling design, and other environmental impacts are clearly controlled. An environmental protocol has been designed to control all these activities, people working on site

receive environmental education, the management of residual materials and the use of dangerous materials are documented and controlled, and activities are coordinated with the personnel of the environmental group. These management strategies and processes ensure the development of an environmentally conscious project which can be used as a model for geothermal development in national parks.

Considering these examples, it is necessary to look for alternatives to modify the law to enable the exploitation of the geothermal resources in national parks. Although studies have shown that adequate temperatures occur outside of the national parks, these areas do not have sufficient permeability and fluids present for commercial success.

For this reason, Bill File Number 16,137 was presented to the Congress, but after several analyses it was shelved. Unfortunately many sectors do not agree with the Bill even when they agree on the importance of the exploitation of these environmentally friendly natural resources. After this first attempt, a new Bill was presented with the File Number 17,680, which is now under discussion in Congress. The main objective of the Bill is to authorize ICE to exploit geothermal resources in the Rincon de la Vieja National Park (RVNP), with the total amount of areas impacted by the project being substituted with other lands with ecological interest to the environmental authority in compensation. ICE will also pay rent for use of the resources. These contributions need to be used to improve the management of the national park and could be used in strategies and equipment to control forest fires. In 2013 a total of 4,010 ha in protected areas and 51,000 ha in private lands were burned. If we consider that a 55 MW geothermal development in RVNP requires only about 300 ha and at a minimum can also generate the financial resources to support the necessary logistics for fire control within protected areas, this benefit alone, independent of other foreseen positive outcomes, justifies the development.

Many of the people who raise complaints do not propose real alternative solutions to the energy problem. According to the “Plan Nacional de Energía 2012” by 2020 energy demand will increase by 29% and the price of energy will increase every year because the severe summers obligate ICE to produce energy using fossil fuels. The poorest populations are located around the national parks and poverty within these communities is also increasing. Industry, businesses and the individual consumers all demand low energy costs and the best solution appears to be geothermal energy. Even with these realities however, some of the environmental groups still oppose projects.

Some of the aspects used to shelve projects are:

- The national parks are so sensitive the government cannot allow just anyone to develop geothermal energy in national parks, only public institutions under high regulation can be allowed.
- The geothermal development needs to be done under the supervision of the administrator of the protected areas; they need to participate in the planning and environmental management.
- The areas of geothermal interest need to be clearly identified; it is not possible to open all the national parks.
- It is necessary to try to find resources in areas outside of the national parks in order to keep the commercial development out of these areas.
- It is not clear how the geothermal development can affect these areas: the impacts of such developments on the natural resources are not well known yet.

Even when all these arguments are respected it is still necessary to use the geothermal resources located in the Parks. The country cannot continue to depend on fossil fuels to generate energy because is quite expensive, and because the environment impacts are also high. Most importantly, it has been demonstrated that geothermal energy developments need not present a high impact on the environments. For these reasons, the new Bill proposed needs to be widely discussed, improved and approved. This Bill proposes to allow geothermal exploitation in National Parks under the supervision of the administrator of the protected areas and only in predetermined zones of the National Parks. Of course this is an important step toward the future use of important geothermal resources associated with National Parks.

3. CONCLUSIONS

- The coexistence of geothermal development and conservation activities is possible.
- It is necessary to allow geothermal development in national parks, once the protection of the natural resources has been ensured.
- The laws enabling geothermal resource exploitation in national parks needs to be effective and should not allow politicization of these projects.
- International experiences as well as the national one demonstrate of the feasibility of developing environmentally friendly geothermal projects in national parks.

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