

Wind Complexes Environmental Licensing in Bahia backwoods ridges, Brazilian Semiarid

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Abstract— Bahia's backwoods ridges belong to a mountain range called "Serra do Espinhaço" which historically are explored by regular or clandestine mining companies. Since the beginning of 2010's decade, the abundance of wind has attracted companies interested in the use of it for energy generation. Nevertheless, these ridges also are part of recharging zones that supplies important water reservoirs in Brazilian's semiarid and Caatinga's region. The ridges riches awoke interest in some companies who insist to explore in a predatory way, and take advantages of State's regulatory flexibility, violating stability, and compromising essential ecosystem services in Brazilian semiarid region. The use of renewable energies is not free from environmental impacts. Scientists and social organizations denounce serious problems related to the licenses and operations of the wind enterprises, who, by the way, have been investigated by Bahia's Public Prosecutor's Office. It is important to evaluate and describe the consequences of implementing these wind farms, whose defects threaten local communities. This research is based on the Environmental Information System of Bahia's State and intends to analyze qualitative and quantitatively and describe some failures identified in environmental licensing processes for wind projects. This study also aims to analyse the modus operandi of the energy sector companies related to the communities that live together with this kind of undertaking in a region known as an important center of biodiversity and endemism. The researched region contributes to the water supply of about one million people in the Brazilian semiarid region.

I. INTRODUCTION

The use of wind to produce energy is an expanding enterprise in Brazil. According to ANEEL (2021), by 2024, the wind power capacity installed in the country will be

increased from 19 to 30 GW. Nowadays, the wind energy corresponds to 10% of the energy shared with National Interconnected System (Sistema Interligado Nacional - SIN), according to Brazilian Association of Wind Energy (ABEEólica, November 2021), making the wind energy the

second source of the Brazilian electricity matrix, exceeding the amount of energy generated by thermoelectrics (ABEEólica, 2021a).

According to Camargo-Schubert EngenheirosAssociados (2013), Bahia's wind potential estimated capacity is 70 GW, which is considered a potential of great magnitude. This magnitude corresponds to 13 times its current capacity and results in an energy production estimated at 273 TWh/year.

Bahia is the second largest Brazilian state that generates wind energy (Table 1). It also is one of the states with highest potential (ABEEólica, November 2021).

Table 1. Installed capacity, number of wind farms and wind turbines by state.

State	Power (MW)	Number of wind	Wind turbines
RN	5.575	191	2.444
BA	5.267	201	2.261
CE	2.385	92	1.115
PI	2.355	81	1.007
RS	1.836	80	830
PE	798	34	417
MA	426	15	172
SC	239	14	173
PB	157	15	121
SE	35	1	23
RJ	28	1	17
PR	3	1	5
Total	19.103,4	726	8.585

Source: ABEEólica (June/2021).

Attractive to investors, the abundance of bahian winds exposes local populations to actions of energy conglomerates that act behind the scenes of global mobilization for renewable energies. These conglomerates advance devastatingly in the territories where they settle bases, bringing negative consequences in the social, economic, and environmental dimensions.

On the other hand, it is observed, both in Bahia and in other Brazilian states (Araújo et al., 2020; Brannstrom et al., 2017; Gorayeb et al., 2016, 2019; Meireles, 2011), that the environmental licensing agencies, who are responsible for protecting environmental, act permissively and flexibly, offering companies in the sector a free territory to act illegally.

The purpose of this paper is to point out some gaps found on the environmental licensing in Bahia, Brazil, based on the analysis of public documents referring to wind projects in activity in Bahia's backwoods ridges, Brazilian semiarid.

II. METHODOLOGY

This study was based on a qualitative and quantitative analysis. It also is documental research carried out by official documents available on government platforms of the state of Bahia, Brazil. The platform that was used was the Environmental Information and Water Resources System of Bahia (Sistema Estadual de Informações Ambientais e de Recursos Hídricos do estado da Bahia - SEIA). By consulting this platform, it was possible to recover files that instructs environmental licensing processes for wind enterprises. In addition, official documents made available by the Public Prosecutor's Office of the State of Bahia were also consulted.

Georeferenced data provided by the National Electric Energy Agency (ANEEL, 2021), organization that regulates the Brazilian electricity system, were also consulted.

III. RESULTS AND DISCUSSION

Wind speed is one of the determining elements to ensure the economic viability of a wind farms, and speeds from 5.5 m/s are considered viable. The Fig. 1 presents the annual potential of wind energy in Bahia. The yellow colour represents speeds of 6.5 m/s, while the red and purple colours represent even higher speeds.

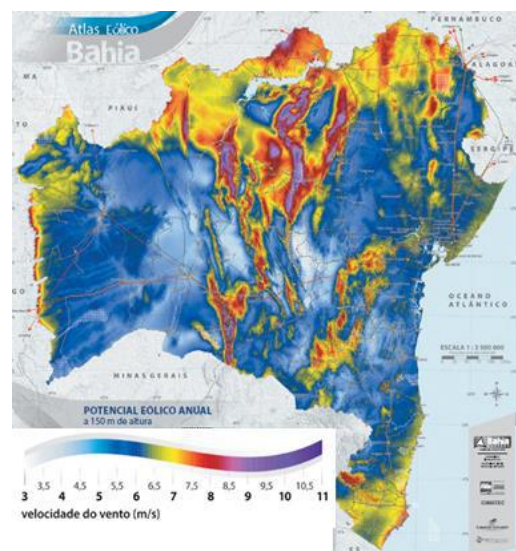


Fig. 1. Annual wind potential of the state of Bahia (at 150 meters height). Source: (Camargo-Schubert Engenheiros Associados, 2013).

The analysis of the documents available on SEIA platform and those available in the Civil Investigations initiated by

the Public Prosecutor's Office of Bahia indicated that exceptionally large wind farms (some of them with more than a thousand wind turbines) are being fragmented into smaller (micro-sized) projects.

Brazilian legislation determinates that quantitative and qualitative factors guide the type of environmental license, consequently, the depth of the studies required to instruct the licensing process.

In accordance with the Resolution of the State Council of the Environment n°. 4.180 April 29, 2011(CEPRAM, 2011), that talks about the environmental licensing process of electric power generation enterprises, by the aeolian source in Bahia and approves the technical standard that guides the implementation of this type of enterprise, the size of wind farms, defined by the number of wind turbines, is the criterion that determinates the depth to be required in the context of studies that support the environmental licensing process.

Table 2 offers the parameters of the Resolution CEPRAM 4.180/2011, as well as the correlation between the size of the wind farm and the type of environmental license required.

Table. 2: Size of wind farms and type of environmental license.

Size of wind farms	Number of wind turbines	Type of environmental license
Micro	< 15	L.S.
Small	≥15 > 30	
Medium	≥30 a 60	L.L.; L.I.; L.O.; L.A.
Large	≥ 60 a 120	
Exceptional	≥120	

Source: Resolução CEPRAM 4.180 de 29 de abril de 2011 (CEPRAM, 2011).

The consequence of the fragmentation of exceptional and large undertakings into smaller undertakings is the use of simplified procedures, such as superficial studies and small sampling effort without the participation of civil society, in situations where the current legislation determines conducting Environmental Impact Study followed by the Environmental Impact Report (EIA/RIMA) and Public Hearings.

According to the Resolution CEPRAM/2011, the enterprises with more than 30 wind turbines must pass through environmental licensing process that is carried out in three, or up to four, stages: Location License (Licença de Localização - L.L.), Implementation License (Licença de

Implantação - L.I.), Operation License (Licença de Operação - L.O.) and, when applicable, Expansion License (Licença de Ampliação - L.A.). The greater rigor attributed to wind farms of this size, implies in the obligation of EIA/RIMA. In this case, the legislation also determinates the realization of a public hearing, providing opportunities for civil society participation.

Only simplified studies that are systematised in a document called Simplified Environmental Report (Relatório Ambiental Simplificado - RAS). are required for smaller wind farms (with less than 30 wind turbines). The approval of the RAS guarantees that the enterprise obtains, in a single step, the Simplified License (Licença Simplificada - L.S.) for its implementation and operation.

An emblematic example that illustrates this type of conduct is being implemented in Tombador ridge. This ridge crosses some cities in Bahia: Miguel Calmon, Várzea Nova, Jacobina and Mirangaba. The wind farm, namesake of the ridge range, is responsibility of the company Casa dos Ventos Energias Renováveis S.A. and counts on the implementation of 1.069 wind turbines in two phases: one with 157 wind turbines and the other with 912. The Energy Project has an installed capacity of about 1.864 MW.

The Tombador Ridge Wind Complex is divided into several companies, each attributed to a single wind farm, according to Barrero et al. (2021). Smaller companies receive minor responsibilities that should be assigned to the larger enterprise. In other words, the documents analysed indicate that the company has been using strategies to force the classification of projects of exceptional size in micro enterprises, linked to smaller and unknown companies.

However, the State Decree 14.024, June 6, 2012 (Bahia, 2012) prevents the fragmentation of larger enterprises, because it is not allowed

the division of enterprises or activities for the purpose of classifying them into smaller classes, and the competent environmental agency must adopt measures to curb such initiatives. (Bahia, 2012)

There is no way for an environmental licensing agency to assume that so many wind farms deployed individually and contiguously would correspond to an individual wind farm. If the attempt to break up exceptionally large enterprises went unnoticed by the agency, there would still be another legal instrument that should be activated to prevent such deviation from being committed: The Resolution CONAMA 462 from 2014 (CONAMA, 2014). This resolution says that in case of "separate licensing of parks within the same complex" it is necessary to "assess the cumulative and synergistic impacts" even in the case of different wind farms.

The National Council for the Environment (CONAMA), in an exclusive Resolution, the Resolution CONAMA 462 from 2014, to instruct the environmental licensing of wind farms, says that:

it will be up to the licensing agency to classify the environmental impact of wind power generation projects, considering the size, location and low polluting potential of the activity (BRAZIL, 2014).

Beside the quantitative aspect, related to the size of the undertaking, it was also analysed qualitative aspects, related, for example to where the wind projects are being implemented after the environmental licensing process. It has been observed that many projects are being implemented in priority areas for Caatinga's conservation defined by the Environmental Ministry Ordinance 463 of 18 December 2018.

An example that can be mentioned is Delfina Wind Farm, owned by Enel Green Power Delfina Eólica S.A. This wind farm has 114 wind turbines in operation. It is located in Campo Formoso and it is currently operating in an area that belongs to an category of extremely high biological importance, according to the mentioned Ordinance MMA 463/2018 (Brazil, 2018).

The mentioned example is not an isolated fact, other companies have been obtaining environmental licenses from Environment and Water Resources Institute (Instituto do Meio Ambiente e dos Recursos Hídricos – INEMA) for implementations in priority areas of Caatinga's conservation, some of them already with the license and other with the license in progress.

Companies like Atlantic Energias Renováveis S.A., Campo Formoso I Energias Renováveis S.A., Ventos dos Guarás I Energias Renováveis S.A., Morrinhos Energias Renováveis S.A. and Andorinha Energias Renováveis S.A. in Campo Formoso city, are inside priority conservation areas, characterized by high biological importance in the extremely high action priority class, which destination recommendation, given by the Ministerial Ordinance, is the creation of an Integral Protection Conservation Unit (Brazil, 2018).

In accordance with Fonseca et al. (2017) a total of 282 priority areas of conservation were catalogued, corresponding to 36.7% of the Caatinga territory. The definition of these areas was defined with the occurrence of what specialists call "conservation targets", which are endangered fauna or flora species and even alternative habitats, considered essential for the survival of species.

Still in accordance with the authors mentioned before, from the 282 catalogued areas, 73 are in Bahia's territory, corresponding to 43% from the priority conservation areas.

Neri et al. (2019) verified that until 2018's beginning, 6.313 wind turbines worked in Brazil. 78% from these turbines were installed in Caatinga's area and 47%, corresponding to more than five million hectares, on areas mapped by the MMA (Brazil, 2018) for this biome conservation.

Analysing the projections for new wind turbines installation, the authors mentioned above, verified that others 14.696 new wind turbines probably would be installed, and 5.570 from these would advance on priority conservation areas of Caatinga. Most of them in areas considered as 'very high' and 'extremely high conservation priority' due to the high degree of endemism and the incidence of endangered species (Brazil, 2018).

Neri et al. (2019) estimate that an area of 11.6 million hectares of Caatinga, which corresponds to 13% of this ecosystem, characterized by the state itself as a priority for biodiversity conservation, will be occupied by wind farms. The authors do not include in these data the areas necessary for the implementation of transmission lines, which the projects are generally licensed separately.

Following the qualitative analysis about the environmental license for wind farms, it is observed the occurrence of endangered fauna species, such as bats and parrots. As stated by UICN's (União Internacional para Conservação da Natureza) standards, all seven species of bats considered endangered in Brazil, occur in Bahia backwoods ridges (CEMAVE / ICMBio, 2020).

Another example is the *Anodorhynchus leari* Bonaparte, 1856, endemic endangered specie from Caatinga (Fig. 2). According to (Lugarini et al., 2012), this specie is proven to be distributed in the cities: Canudos, Jeremoabo, Euclides da Cunha, Paulo Afonso, Sento Sé, Campo Formoso, Monte Santo e Santa Brígida, where wind farms are being licensed.



Fig.2. *Anodorhynchus leari* Bonaparte (*Psittacidae*), 1856.

Source: J.A. Siqueira.

This parrot, along with its mind food, the *Syagrus coronata* (Mart.) Becc., are protected by National Action Plan (Plano de Ação Nacional - PAN) for the conservation of *Anodorhynchus leari* (Lugarini et al., 2012).

Another species of parrots considered endemic and with proven occurrence in the region is *Cyanopsittaxixii*. One of the most endangered species of the world, (ICMbio, 2020), *Cyanopsittaxixii* is also protected by a national plan that counts on public investment for its execution, the National Action Plan for the conservation of this specie (Barros et al., 2012).

According to the Red Book of Endangered Brazilian Fauna (Livro Vermelho da Fauna Brasileira Ameaçada de Extinção)(MMA, 2008), although the species are in a terminal phase, there is still hope that it can be reestablished in the environment from which it was eradicated. Nevertheless, this return depends on efforts and political decisions that enable the complex process of release and readaptation.

It is observed, therefore, that CONAMA Resolution 462, 2014 (CONAMA, 2014) is being ignored by the licensing agency of the state of Bahia, Brazil. The aforementioned Resolution determines that:

It will not be considered of low impact, requiring the presentation of an Environmental Impact Study and Environmental Impact Report (EIA/RIMA), in addition to public hearings (...), wind farms that are located (...):

V - in regular areas of route, landing, rest, feeding and reproduction of migratory birds contained in the Annual Report of Migratory Birds Routes and Areas of Concentration of Migratory Birds in Brazil, emitted by Chico Mendes Conservation of Biodiversity Institute – ICMBio, within 90 days.

VII – in areas of endangered species and areas of restricted endemism, according to official lists (CONAMA, 2014).

In July 2021, Bahia's Public Prosecutor's Office recommended that the French company Voltalia halt the construction of the Canudos Wind Complex and that INEMA cancelled their environmental license. One of the reasons that justified this decision is that this company was located in an area of *Anodorhynchus leari*'s route (MINISTÉRIO PÚBLICO DA BAHIA, 2021). In addition, more than 70 associations and entities have prepared a Public Charter to expose the concern of civil society and charge attitude of the authorities. (Barrero, Marques, Oliveira, et al., 2021).

The threat that wind farms offer to birds in general is the risk of death by collision with the moving parts of wind turbines (Bonfim& da Silva, 2021; Erickson et al., 2014; Frenz, 2016; Manville, Albert M., 1998). According to Barrero, Marques, & Freitas (2021), each tower has a set of three blades that move circularly in a vertical area of about 2 hectares for decades, without interruption. The higher number of wind turbines, higher is the probability of death by collision.

Considering the 1.069 wind turbines in environmental license process in Tombador ridge, for example, the airspace that could offer risk corresponds to an area 21.380.000 square meters. As an aggravating factor, some species have the behaviour of flying in flocks, being able to collide with the blades of the wind turbines at once, as is the case of *Anodorhynchus leari*(Lugarini et al., 2012).

During the analysis that based this paper, it was revealed that the Executing Agency of the State Policy for the Environment and Biodiversity Protection in Bahia, which is also responsible for giving environmental licenses (INEMA) has been assuming a flexible approach in relation to wind farms. The agency's way of proceeding worries civil society organizations and the Public Prosecution of Bahia, which has been investigating and recommending corrections in the licensing process for the good of the community and the conservation of biodiversity.

The problems found in the licensing process in Bahia backwoods ridges (Barrero, Marques, & Freitas, 2021; Barrero, Marques, Oliveira, et al., 2021) reflects negatively on an important centre of biodiversity and endemism (Siqueira Filho & Lira, 2021) that, despite suffering from the effects of drought, still provides for about one million people in the Brazilian semi-arid region (Conceição, 2021; Marques et al., 2021) and directly reflects on local communities, where wind farms are installed.

The consequences of this wind projects model of implantation are also revealed in the anthropic sphere. Bahian communities, many of them recognizably traditional (Alcântara & Germani, 2009; Germani, 2021), located in areas that have wind potential, are often surprised by the visit of representatives of large wind farms. These representatives use moral harassment, creating false expectations and causing frustrations in residents of these communities. Among the false expectations reported by people of the communities, it can be mentioned substantial income from participation in the energy business, income from traditional land leases, jobs and other individual or collective promises (Ribeiro, 2021; Traldi, 2021).

Because of this exposure to which communities are subjected, it is increasingly common for conflicts to occur between local residents, historically united by ties of friendship, kinship or cronyism.

The absence of supervision by the State in relation to the actions of wind companies that happened in Bahia's backwoods ridges was also observed in Mexico by Huesca-Pérez et al. (2018). The authors detected conflicts between the populations, the state, and the companies when analysing the socio-environmental impact of wind farms on communities and indigenous peoples in the Isthmus from Tehuantepec.

To enable the implementation of wind farms, one of the conditions is the guarantee of a properly regularized physical space that accommodates the parks with wind turbines, access roads, transmission lines and other necessary improvements. For this purpose, one of the most common ways is to rent the land traditionally occupied by local residents (Ribeiro, 2021). As, normally, the local residents do not have the title deed and even enough education enough to ensure its regularization, interested companies end up making themselves available to perform this service, often assuming the condition of attorney for the farmers possessors.

Once the area is regularized, a rent contract is elaborated with clauses that favour the companies' interest more than the families' who historically owns the land. Unassisted and helpless by the State, families feel obliged to agree to abusive clauses (that they are not even aware of) of these contracts, such as the period of validity that generally is very long, and confidentiality clauses.

In addition to the contractual issues that formalise the relationship between companies and local residents, the presence of wind companies changes the environmental balance directly affecting local communities.

Among these interventions, it is highlighted the noise pollution, caused by the intense traffic of machines, small

vehicles, and the noise from wind turbine blades. Air pollution, caused by dust from soils without vegetation for the operationalisation of the enterprise besides the constant traffic of vehicles, including trucks and heavy machinery.

The gaps left by Bahia State about the environmental licensing for wind enterprises, points out to an inadequate permissiveness to wind companies advancing over vulnerable areas. It also promotes asymmetric negotiations with local communities, some of which are recognised as traditional: Fecho e fundo de Pasto Community, Quilombola Communities, and Indigenous Villages (Ribeiro, 2021).

Valença & Bernard (2015) compared the American, Canadian and Portuguese environmental licensing of the wind enterprises with Brazilians'. Their conclusion is that the environmental legislations of these countries for this type of enterprise are inadequately permissive to companies operating as renewable energy. Even so, Brazilian legislation is even more fragile and permissive than that of the countries analysed, as observed by the authors.

Furthermore, Valença & Bernard (2015) evaluate that one of the gaps in Brazilian environmental licensing is the possibility of fractionating large wind complexes into smaller wind farms, a situation that, as clarified above, allows simplified and unrigorous studies to be presented, instead of robust studies that ensure the maintenance of ecological balance and the safety and well-being of the population.

Nevertheless, it is important to consider that carrying out detailed studies is not a guarantee that this maintenance will effectively occur, as Bernard et al. (2014) state. These authors consider that the requirement and preparation of EIA/RIMA, for example, does not necessarily imply the elimination of failures in the environmental licensing process. The poor procedure of these studies, the authors emphasise, can result in the underestimation of the real impacts arising from the installation and operation of wind farms on flying wildlife, such as birds and bats, as well as on the life of society in general.

Biases arising from poor procedure or poor evaluation of these studies end up being legitimised or validated by the State itself, making it even more difficult for civil society organisations to manifest in order to discipline the irregular advance of these wind complexes.

Environmental Impact Studies (EIA) of wind projects, whether in Brazil or in countries such as the United States, Canada and Portugal, are unsatisfactory and cannot prevent significant environmental damage such as soil erosion, pollution and siltation of rivers and lakes, damage to flora, fauna and human beings. (Bernard et al., 2014; Valença&

Bernard, 2015). As rule of thumb, these authors also verify that the synergistic and cumulative effects of smaller adjacent wind enterprises are disregarded in these countries.

Valença & Bernard (2015) consider that environmental agencies cannot ignore the cumulative effects of adjacent wind farms. According to these authors, the contiguous installation of parks can cause, in practice, a greater effect than that provided individually in the reports of each park.

According to Neri et al. (2019) with regard to state and federal laws in Brazil defining criteria, commitments and compensation for maintaining balance in ecosystems, large energy conglomerates seek to reduce the costs of implementing these projects to maximise profits from their operation.

Valença & Bernard (2015) claim that wind companies define on their own the effort and investment they intend to dedicate to conservation actions according to the legal weaknesses found on each Brazilian state. This explains the slowness in creating Conservation Units in promising regions for these companies. The difficulty in creating more restrictive and therefore more effective Conservation Units for Biodiversity conservation, such as National Parks and Biological Reserves, for example, is even greater.

The Boqueirão da Onça National Park (PARNA), created by Federal Decree 9.336 of April 5, 2018, aiming the full protection of biodiversity, covers municipalities located in areas with abundant winds, such as Sento Sé, Juazeiro, Sobradinho and Campo Formoso. According to Siqueira Filho et al. (2021), originally, before the publication of the decree, it was planned the full protection of an area of about 820.000 hectares (Siqueira Filho et al., 2015). After 12 years of negotiations with the energy sector, PARNA was reduced to less than half (347.557 hectares) which polygonal is not consistent with the arrangement of the communities of the Caatinga biota to which the park should protect (Siqueira Filho et al., 2021). However, it is observed that the layout of the park reserves the most promising areas for wind exploitation, which allows us to conclude that its layout served the interests of wind enterprises instead of protecting biodiversity.

According to the analyses made so far, there is great commitment of wind companies to camouflage themselves as simple enterprises, free of significant environmental impacts, when, in fact, they are fragmented mega-enterprises. These forms of fragmentation can be understood with the following aspects:

Initially, deciding to separate the Wind Complex into two phases: generation and transmission of energy, which

already constitutes an improper simplification of a highly complex endeavour.

To divide the power generation phase into almost a hundred wind farms and sub-parks with a maximum of 15 wind turbines each.

To ignore the synergistic and cumulative effect of these wind farms and sub-parks, analysing them individually.

As if that were not enough, these wind farms are still advancing on vulnerable areas, threatening biodiversity and the communities installed there.

Interestingly, these failures went unnoticed by the licensing agency of Bahia. It is possible to reverse the situation in the ongoing environmental licensing processes, as well as in future ones. However, the doubt remains about the licenses already issued: would it only be left for present and future generations the regret of irreversible loss of biodiversity and endangered and endemic species? Or is there still a way to minimise the failures committed? It is understood that the first challenge is to recognise by the state that there were failures in the environmental licensing process.

IV. CONCLUSION

It is concluded that a state policy is underway in Bahia that relaxes the environmental licensing process of wind projects. One of the aspects of this flexibility with a broader reflection is the fractionation of large or exceptional enterprises into micro and small enterprises, contrary to the current legislation that explicitly prohibits this type of conduct. It is understood that this state policy endangers the semiarid ecosystems where watersheds of recognised relevance are located, such as the basins of the Itapicuru, Salitre, Paraguaçu and São Francisco Rivers (Marques & Wagner, 2021).

The flexibility observed during the research does not occur only in Bahia, it is also observed by other scientists, both in research developed in Brazil and abroad, indicating a global trend of replacing the usual energy sources by renewable sources.

As one of the Brazilian states with the greatest wind potential, it is up to INEMA, the executing agency of the State Policy on the Environment and Biodiversity Protection and the State Water Resources Policy (Bahia, 2006), to signal paths that serve as a reference for the other states of the federation. Considering this context, the organisation can take the lead in an energy reform in the country, requiring greater commitment from investors, charging the use of cleaner and more efficient technologies, as well as guiding so that the distribution of these enterprises does not negatively affect the ecosystem balance, nor the local populations

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