

EUCALYPTUS PLANTED FORESTS IN BRAZIL: A CULTIVATION HARMFUL TO WATER RESOURCES?

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ABSTRACT

The object of this study is related to the investigation of eucalyptus plantations and their possible harmful effects on water resources, in compliance with the principles of precaution and prevention. Thus, as hypotheses, the article proposes to assess whether eucalyptus are harmful to water resources, in order to recommend the replacement or continuity of the economic activity of eucalyptus planting by the adoption of specific public policies for the sector. The methodology used in the research was deductive, together with qualitative, descriptive, comparative and analytical methods. As primary sources, the research was guided by the bibliographic consultation of books and articles available in scientific journals.

Keywords: eucalyptus cultivation; planted forests; principles of precaution and prevention in Environmental Law; water resources.

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FLORESTAS PLANTADAS DE EUCALIPTO NO BRASIL: UMA CULTURA NOCIVA AOS RECURSOS HÍDRICOS?

RESUMO

O objeto deste trabalho relaciona-se à investigação do plantio de eucalipto e seus eventuais efeitos nocivos aos recursos hídricos, em observância aos princípios da precaução e da prevenção. Assim, como hipóteses, o artigo propõe-se a aferir a veracidade ou não da nocividade do eucalipto para os recursos hídricos, de modo que seja recomendada a substituição ou a continuidade da atividade econômica de plantio do eucalipto por meio da adoção de políticas públicas específicas para o setor. A metodologia utilizada na pesquisa foi dedutiva, tendo sido utilizados os métodos qualitativo de dados, descritivo, comparativo e analítico. Como fontes primárias, a pesquisa pautou-se pela consulta bibliográfica a livros e artigos disponibilizados em revistas científicas.

Palavras-chave: cultivo do eucalipto; florestas plantadas; princípios da precaução e da prevenção no Direito Ambiental; recursos hídricos.

FOREWORD

Eucalyptus plantations were introduced in Brazil in the 19th century; eucalyptus is native to Oceania, mainly from Australia. From the 1960s onwards, there was an expansion of eucalyptus and pine cultivation for various commercial and industrial purposes – including as an energy source, especially for the steel industry – whose demand has been growing in the domestic and international markets ever since. Because they are planted forests, the purpose of the trees is to be cut down or harvested, and business people in the industry reject the reforestation task they are commonly assigned with.

Eucalyptus planted forests have several uses, standing out as a source of energy for forging pig iron and ferroalloy, and for the production of furniture, wood panels, processed wood, pulp and paper.

However, the industry is commonly considered harmful to water resources and biodiversity. In general, there is a belief that, besides being a forest that yields no fruits, eucalyptus plantations, in their development, dry up springs and impairs the flow of nearby rivers. Therefore, the problem raised in this article is as follows: is eucalyptus planting harmful to the availability and use of water resources, so that the State and the producing sector are required to comply with the precautionary principle?

Therefore, the theoretical framework of the article is the precautionary principle in Environmental Law and its applicability to eucalyptus monoculture in Brazil. Thus, as hypotheses, this article proposes to assess whether eucalyptus is harmful to water resources, so that we can recommend the replacement or continuation of the economic activity of eucalyptus planting by adopting specific public policies for the industry.

In this sense, this article aims to analyze eucalyptus planting as a sustainable economic activity in the planted forest modality in Brazil. As a specific object, the article seeks to investigate the possible impacts of this cultivation on water resources, in compliance with the precautionary principle and, in second place, the prevention principle.

The methodology used in the research was the deductive one, and the methods employed were data qualitative, descriptive, comparative and analytical ones. As primary sources, the research was based on bibliographic consultation of books and articles available in scientific journals, including via the Internet.

In summary, besides its introduction, final conclusions and bibliographic references, this article was organized into three topics. In the first, we reported on the origins, cycles and expansion of eucalyptus planting in Brazilian territory. In the second item, the article addressed the theme of planted forests in Brazil and, as an example, addressed this type of cultivation in other countries with the purpose of placing Brazil in the global market for wood demand, in addition to the use of this planting as a medium for preserving native forests. The third point was devoted to the central object of the article, the impacts of eucalyptus cultivation on the availability and use of water resources and the other environmental and socioeconomic repercussions of the activity.

1 EUCALYPTUS DEVELOPMENT CYCLES IN BRAZIL

The United Nations Food and Agriculture Organization defines forest as “*Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use*” (FAO, 2015a). Considering this definition, Brazil has about 59% of its territory covered by natural and planted forests, which amounts to the second largest forest area in the world, preceded only by Russia; of this percentage, about 500 million hectares are native forests and 10 million hectares are planted forests (SNIF, 2018).

Among planted forests, and for the purposes of this article, we highlight eucalyptus, which is scattered throughout Brazilian territory. However, eucalyptus is not part of the primitive Brazilian flora, being an exotic plant from Australia, Tasmania and other islands of Oceania, having more than 730 species recognized by Botany (EMBRAPA, 2019). However, only 20 of the eucalyptus species are currently used for commercial purposes worldwide (SANTAROSA; PENTEADO JÚNIOR; GOULART, 2014).

We know about the first eucalyptus plantation in Brazil, in the city of Rio de Janeiro, in 1825 (CARVALHO; SILVA, 1992, p. 42). Thus, the cycles of forest planted with *eucalyptus grandis* and *eucalyptus tereticornis* began. The second cycle of planted forests took place in the 1970s, and the third, in its turn, in the 1980s, when genetic improvements with the development of biotechnology began. The fourth cycle of that forest followed further genetic advances and the creation of new species for use in the furniture industry. Other cycles followed, with genetic changes, including focusing on the environmental agenda and under new frameworks of legislation

(CARVALHO; SILVA, 1992, p. 42-43).

Commercially, the planted forest industry leaped forward in the 2000s and beyond. Brazilian Tree Industry (IBÁ) prepared a statistical summary showing that in 2017, investments in the area reached R\$ 6.7 billion, with R\$ 3.2 billion going for forests and R\$ 3.5 billion for the industry (IBÁ, 2017). However, Brazil reached 7.84 million hectares in 2017 (IBÁ, 2017) in the total area of planted trees alone. As a result, the participation of the eucalyptus sector totaled R\$ 73.8 billion that year, amounting to about 1.1% of the national gross domestic product (GDP) and 6.1% of the industrial yield (IBÁ, 2017). In the same period, Brazil broke a record in pulp production, reaching 19.5 million tons of the product, and moving to second place in the world, having surpassed Canada and China (IBÁ, 2017). In addition, Brazil is among the 10 countries that produce paper (10.5 million tons), wood panels (7.9 million m³), flooring (11.9 million m³) and charcoal (4.5 million tons) (IBÁ, 2017).

Brazil currently has advanced technology for eucalyptus breeding. Even Australia looks to Brazil for improved species for its planting (IBÁ, 2017). We found that the forest-based sector is widespread, so there are several activities that depend on it to survive. This is an important input whose demand has been growing worldwide due to its socioeconomic relevance. Therefore, the expansion of eucalyptus cultivation must be sustainable, since commercial timber production must come from planted forests to keep natural forests from suffering from consumption pressure.

2 THE PLANTED FOREST INDUSTRY IN BRAZIL

Forests planted for economic purposes have grown in Brazil, thus deserving attention from the environmental protection sectors. In the planted forest industry, eucalyptus and pine clearly stand out. According to the National Forestry Information System (SNIF), planted forests amount to millions of hectares, namely:

Table 1 Forests planted in Brazilian territory in hectares by species between 2014 and 2017.

Forest species	2014	2015	2016	2017
Eucalyptus	6,952,509	7,444,625	7,543,707	7,411,276
Pine	2,049,234	2,065,560	2,079,162	2,030,419
Others	364,998	427,762	400,207	410,025
Total	9,368,755	9,939,962	10,025,092	9,853,737

Source: SNIF (2018).

Table 1 shows the exponential growth of eucalyptus forests in 2014, 2015 and 2016, with a slight decrease in 2017. The data used by SNIF comes from the Brazilian Institute of Geography and Statistics (IBGE). There is a big difference between eucalyptus and pine crops, when compared to other forest species planted in Brazil. Eucalyptus, even more than pine, is more widely used in industry.

As an example, in Minas Gerais, Brazil's largest eucalyptus producer, planting occurs most frequently in the regions of Rio Doce, Midwest, Northwest, Central North, Jequitinhonha and Mucuri (BORGES; LEITE; LEITE, 2018). In 2016, Minas Gerais reached 1,955,578 million hectares of planted areas (SNIF, 2018).

Despite the expansion of planted forests in Brazil, with the predominance of eucalyptus, and the country having a favorable climate for the production of commercial timber, Brazil is still shyly positioned in the international market, as can be seen from the world ranking in million hectares planted provided by the Global Forest Resources Assessment:

Table 2 Distribution of planted forests in millions of hectares per country.

Country	Millions per ha
China	78,982,000
Russia	19,841,000
Canada	15,784,000
Sweden	13,737,000
India	12,031,000
Japan	10,270,000
Poland	8,957,000
Brazil	7,736,000
Finland	6,775,000

Source: FAO (2015b).

As can be seen, Brazil has a low participation in the growing international market, and must face several challenges to increase its production, including removing myths that still remain in this type of enterprise.

With stimuli for production, Brazil would surpass countries such as China, Russia and Canada, since in Brazil the harvesting time of the major planted species is 5 to 7 years, while in those other countries that time is longer because of the low temperatures. Thus, Brazilian growers have been missing opportunities in the face of a highly promising market, with Brazil having basic conditions to increase its participation in international trade.

As we saw, Brazil holds the eighth position in the world ranking of planted forest production and is the largest producer of pulp, according to the National Forestry Information System (SNIF, 2018). SNIF expects that, by 2050, the planet's population will reach 9.1 billion people, and demand for bioenergy will increase, so there will be a need to plant more than 250 million hectares of forests to meet demand for this commodity.

Although economic discussion is important, considering the promotion of socioeconomic inclusion, as well as the generation of wealth, this paper focuses on verifying the negative impacts of eucalyptus planting on water resources.

Thus, in the next topic, the correlation between the expansion of eucalyptus planting and the possible environmental impacts of this production will be verified, especially regarding the availability and use of water resources.

3 THE IMPACTS CAUSED BY EUCALYPTUS PLANTING IN THE ENVIRONMENT, PARTICULARLY ON WATER RESOURCES

It is difficult to say that an exotic plant such as eucalyptus does not adversely affect the environment, especially when Brazil has about 10 million hectares of planted forests (SNIF, 2018). However, there are no conclusive studies on the negative impacts of eucalyptus cultivation on water resources. Although scientific and technical studies on the negative externalities of eucalyptus cultivation have not been completed, principle 15 of Eco-92 requires that:

In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation (CARVALHO, 2002, p. 139).

The precautionary principle acts in such a way as to require the prudence of the State, civil society and private initiative in relation to any human activity, which, in the face of scientific or technical uncertainties, may cast doubt on its potential to pose a risk to the environment. Therefore, there is no need to be mistaken in identifying the precautionary principle with that of prevention, since it is intended to prevent known impacts, while the former acts as a warning against the ignored danger (COSTA, 2005, p. 214).

Considering eucalyptus cultivation as a type of planted forest around which there is a growing demand for the multiplicity of commercial, industrial and energy use of this plant species, it is necessary to clarify the myths regarding the planting of eucalyptus forests. The first of these is in the mistaken sense that eucalyptus consumes more water for its development than other plants, to the point of drying up springs. However, Thelma Shirlen Soares says that eucalyptus monoculture suffers from a certain “prejudice due to errors made at the beginning of its planting, when the legislation itself allowed the replacement of native forests” (SOARES *apud* QUEIROZ, 2004, p. 39).

Regarding water resources, studies developed by Mora and Garcia (2000) show that the total water consumed by eucalyptus plantations is equivalent to that of native trees, being even lower than that of major agricultural crops. For example, with one liter of water, *eucalyptus grandis* can produce 2.9 grams of wood, whereas a native species of Cerrado (Brazilian mainland vegetation) produces only 0.4 grams with the same amount of water.

Regarding, comparatively, the rate of nutrient removal from the soil due to the planted species, measured in kg/hectare per year, see Table 3:

Table 3 Annual nutrient consumption in hectares for each species.

Cultivation	Nitrogen	Phosphorus	Potassium
Eucalyptus	13	4	44
Coffee	93	4	127
Corn	127	26	37
Sugar cane	208	22	200

Source: Mora e Garcia (2000, p. 79).

Scientific research helps dispel myths about the harmful effects of planted forests on springs and rivers. Therefore, synergy between public agencies and economic sectors around the subject is required, in partnership with research institutes.

From this perspective, biologists Claudia Santana dos Santos and Jose Luis Caetano da Silva developed a research on the environmental and social impact of eucalyptus plantation in the far south of the state of Bahia. The result was not favorable to the cultivation of this species, as it demonstrates several harmful aspects (SANTOS; SILVA, 2004). Some of them will be pointed out here.

As for the soil of the Northeast Region area, more specifically, the far

south of Bahia, the researchers state that the area has a flat and undulating relief, with hot and humid climate, temperatures ranging between 22°C and 24°C, and rainfall around 1,500 to 1,750 mm. It is, therefore, a microregion with little probability of desertification, but which has presented serious anthropic modifications as a result of the actions of loggers and charcoal producers on the vegetation cover, aggravated by extensive cattle raising and monocultures (SANTOS; SILVA, 2004).

Another harmful impact on Bahia soil, specifically regarding in eucalyptus cultivation, derives from the intensive use of pesticides. This fact is more worrying due to the proximity of these planted forests to surrounding protected areas (SANTOS; SILVA, 2004).

Regarding the availability and use of water resources, the specific aspects of the region deserves attention, since its watershed is composed of several perennial rivers, such as Jequinhonha, Caraíva, Cahy, Jurucucu and Santo Antônio (SANTOS; SILVA, 2004). These rivers – and, as a consequence, streams and creeks – are at serious risk of contamination, because eucalyptus planting includes the use of water resources for irrigation and washing of the planting and harvesting machinery from the beginning (SANTOS; SILVA, 2004).

The researchers describe the impacts that eucalyptus farms have on the surrounding Atlantic Forest, considering that these trees have accelerated growth, that is, they compete with the natural vegetation cover of the far south of Bahia. They also highlight the proliferation of typical eucalyptus pests, such as dinosaur ants, which after harvest migrate to the remaining native forests (SANTOS; SILVA, 2004).

At the same time, eucalyptus cultivation has social repercussions, as it affects the traditional communities of the region, as warned by Gomes and Samapaio (2019, p. 96): “It must be kept in mind that traditional knowledge is a constitutive and inseparable element of the culture of each traditional community”. This way, communities living off subsistence family farming are compromised because arable land, water resources, fauna and flora suffer from interference from eucalyptus plantation. In addition, some 30,000 hectares of land claimed by these communities are currently covered by eucalyptus (SANTOS; SILVA, 2004). Planting mechanization is another relevant socioeconomic problem. As eucalyptus harvesting requires the use of local labor, the employability of the activity announced by the forestry sector developers is not realistic (SANTOS; SILVA, 2004).

With an outlook more focused on water resources, Clarisse Barreto researched eucalyptus planting in some rural São Paulo municipalities, including Caçapava, Santa Branca and Cunha, in the Paraíba River Valley. That author explains that “Among several interpretations attributed to eucalyptus culture, the one that concerns its effect on reducing watercourse flows is a recurring criticism” (BARRETO, 2019, p. 10). To verify its object of study, the author investigated the correlation between the rainfall level in the regions and the amount of eucalyptus cultivation per hectare.

Barreto (2019) says that, in 2014, the municipalities of Caçapava, Santa Branca and Cunha had, respectively, 2,515 ha, 4,000 ha and 1,245 ha of eucalyptus plantations. The researcher collected data on the annual average rainfall of each region and its average evapotranspiration potential. The author used the qualitative research method through semi-structured interviews with questions regarding general changes in land use and the reduction of river flows relative to eucalyptus planting (BARRETO, 2019).

The author concludes in her work that

The location of the properties in relation to the plantations was a factor that may influence the perception of these plantations as a land use that reduces the watercourse flow rates, but that was not a driving factor.

[...]

In this research, the representations of eucalyptus plantations as a land use that impairs water availability were constructed based on arguments such as the observation of the reduction of watercourse flows from the moment this land use was established in certain places, the area occupied by the plantations, their establishment near watercourses, their high demand for water, the rapid growth of the trees, and their deep roots. The experience and identity of former plantation workers emerged as legitimizing elements of these arguments (BARRETO, 2019, p. 119).

Reading of Barreto’s work critically, we noted that research on the impact of eucalyptus cultivation on river flows has been linked to socioeconomic aspects. In the three municipalities studied, data collection through semi-structured interviews detected a problem regarding the employability of the activity, namely: “The lack of job creation by the company was a strong criticism, especially in Santa Branca and the rural neighborhood of Cunha” (BARRETO, 2019, p. 116). Thus, in apparent terms, decreasing river flows would not be considered harmful by the population if there were sufficient jobs in these cities. The author summarizes her observations by arguing that:

Negative impressions often point to environmental degradation and low job offerings. We also noted that, in Santa Branca, the municipality with the largest presence of industrial plantations established by the company, the interviewees' speeches are more complex, considering and pondering on the advantages and losses present in the activity. Thus, we understand that the relationships established between the activity and the societies involved were represented in various ways, revealing the enormous human complexity of the matter. The Paraíba Paulista Valley, a region of ancient occupation and a long history of capitalist exploitation of natural resources, poses challenges to the observer. When reflecting on water availability and the development of industrial eucalyptus cultivation, one cannot highlight associal and economic data as a key to understanding the activity. The multiple realities revealed by the interviews show that this measurement takes into account individual and shared memories, present interpretations and future expectations that are also linked in cultural, affective and social structures established with the territory (BARRETO, 2019, p. 117).

Barreto concludes that even though it is clear that planting eucalyptus forests decreases river flows, this was not the major concern of people living in those municipalities. However, they know that activity has negative impacts on water resources.

Although relevant to Barreto's research (2019), there are partially conflicting positions, such as Mora and Garcia (2000), who claim that eucalyptus cultivation should be technically understood from the agricultural-environmental aspect, apart from any analyses related to employability of economic activities. In this sense, when making a correlation between eucalyptus planting and the availability and use of water resources, Mora and Garcia (2000, p. 69) agree that:

Culturally, one has the misconception that "eucalyptus dries the soil up". Numerous studies have already shown that, with regard to water consumption and tolerance to drought or water deficit conditions, there are different responses according to each crop or species planted. In the case of eucalyptus, some species from Australia (*E. regnans*, *E. marginata* and *E. obliqua*, for example) actually have high water consumption because the stomata remain open and consequently have a high rate of perspiration [...] Other species, on the other hand, are more water efficient than many crops.

Therefore, we must be careful about the technical aspects of the production of eucalyptus planted forests and their potential for reducing river flow or drying up water resources. In this scenario, Mora and Garcia report that "The great majority of eucalyptus species have developed physiological mechanisms to adapt to water deficit conditions (lack of water in the soil), that is, water consumption restriction mechanisms"

(MORA; GARCIA, 2000, p. 71). And the authors further ensure through research that “During the most intensive growth phase, both eucalyptus and any other fast-growing plants can have a negative balance between infiltrated water (rain and irrigation) and water absorbed by the roots” (p. 71).

In addressing monoculture activity, Ching Liu, Kuchama, and Krutovsky (2018, p. 5) warn more forcefully that:

Regarding the social impacts, the introduction of large-scale plantations often leads to the change in the ownership from local communities to large private companies, hence, resulting into a loss of traditional goods and cultures, customary rights, and livelihoods associated with forced resettlement and unequal distribution of resources [...]. Moreover, effects on the environment include the loss of soil productivity and fertility, disruption of hydrological cycles, risks associated with plantation forestry practices (e.g., introduction of exotic species), risks of promoting pests and diseases, [...] (BALDODANO, 2000; COLCHESTER, 2006).

However, Moledo *et al.* (2016) believe that eucalyptus cultivation is a relevant economic activity for Brazil, and disagree with the idea of attributing excessively harmful effects to the environment to eucalyptus. The authors understand that “As for water balance in microbasins near planted forests, eucalyptus has always been considered a great villain. However, this statement is valid for the summer season, where the average consumption is 15 l/day, while in winter this figure drops to 4 l/day.

Those authors carry out technical work on the impacts of eucalyptus crop planting and present a well-structured management plan to mitigate all its negative aspects. The consequences, as already identified in other works, generally have repercussions on water resources, fauna, flora and socio-economic aspects. However, the authors attest that, by employing complex studies and proper management, all listed problems can be solved or mitigated, because “forest management or self-sustained management is the application of business methods and best practices supported by technical knowledge. The principles include forestry, which is a vital part of management plans” (MOLEDO *et al.*, 2016, p. 514).

Moledo *et al.* (2016) prove in their work that the forest management plan has a primary function in the operation and management of forestry areas. They believe that “management plans, especially at the operational level, should be specifically developed based on the geoenvironmental characteristics of the areas to be explored, thus enabling the establishment of adequate operational practices for the deployment of sustainable actions” (p. 529).

As can be seen, almost all authors agree eucalyptus planting has several impacts on the environment, and particularly on water resources. However, the position of Mora and Garcia, even though theirs is an older work from the year 2000, shows a balanced view, especially when they state that:

From the physical point of view, several plantations occupied land in areas not recommended for them, such as areas considered suitable for agricultural crops, steep slopes, riverbanks and others. There have also been changes in the landscape of certain regions, including areas already degraded by extractive activities. Due to the operational planning systems adopted, the planting interfered with soil conservation (erosion) and water quality processes. Considering the biological aspects, the first projects did not include management plans to guarantee the biodiversity of the water and land systems, with consequences down to the present day. Pesticides and fertilizers were used with limited knowledge about their interference with humans and the environment. Also, the use of controlled fire as a pre-planting area cleaning method and forest fire prevention and control systems was intensely questioned. Deforestation and vegetation cleaning fires have raised questions about the “Greenhouse Effect” (MORA; GARCIA, 2000, p. 78).

It can be seen that eucalyptus planting practices, in the above-mentioned cycles, were performed without adequate studies and without taking into account the complexities of eucalyptus being a plant belonging to another biome. Therefore, planting without proper care caused environmental and socioeconomic impacts with consequences still to this day. Reading of several domestic and foreign articles shows that in, other countries, there are also some myths about eucalyptus monoculture.

However, the texts used in this paper give strong indications about the benefits of planted forests, the major one being the possibility of reversing deforestation of native forests, when properly cultivated. In addition, planted forests assist in erosion control, provided that appropriate soil management measures are taken; that is, they act in soil fixation and rain runoff, regulating the water cycle in the microbasins where the forests are inserted (MORA, GARCIA, 2000). At the same time, the commercial and industrial value of eucalyptus culture is open to several socioeconomic segments relevant to Brazilian sustainable development.

According to information gathered in the preparation of this paper, and due to its length and depth, we could not reach a favorable or contrary standing to the production of planted eucalyptus forests in Brazil. However, the issue is more related to the elaboration, implementation, monitoring, evaluation and updating of public policies (CUSTÓDIO; OLIVEIRA,

2015) to manage the problems that arise with the growing eucalyptus culture.

On the other hand, it became evident that planted forests have a relevant function as an alternative for sustainable socioeconomic development, by moving away from natural forests the growing demand for wood in the most diverse industrial and commercial segments. This scenario requires a proper legal framework and the deployment of appropriate administrative measures to promote the sector, in partnership with civil society and private initiative, in order to make it compatible with the necessary environmental protection, specifically with conservation, the availability, and use of water resources.

FINAL CONSIDERATIONS

Starting from the proposed problem-theme, which was analyzed in the context of the theoretical framework, and in order to answer the hypotheses presented, it can be concluded that there is a vigorous scientific discussion regarding the degree of harmfulness of eucalyptus planting or lack thereof. As mentioned in the text, there are some species that can cause great impact and others that, due to specific care, like the choice of region, make it possible for the planting to be beneficial. Thus, at first, we would recommend complying with the precautionary principle in eucalyptus planting activities, so that species with the lowest impact are selected for planting.

The long experience of eucalyptus plantation in Brazilian territory and the knowledge that can come from it allows us to consider some positive aspects of this cultivation. The first of these concerns the genetic advances that the improvement of the species has been going through, so as to cause less environmental impact and yield greater economic profit for the purposes for which production is intended. The second factor is the multiplicity of its commercial, industrial and energy use, and its potential to meet the growing worldwide demand for wood. A third very important aspect is the preservation of native forests, which are now the object of lower demand and speculation, as a consequence of replacing the supply of this demand with planted forests, which results in the legality and control of logging in that segment. A fourth feature is that studies show that adequate eucalyptus planting public policies can substantially reduce the harmful effects of eucalyptus cultivation. Therefore, the planted forest

sector, if well organized and monitored, can become an important means of sustainable development, while meeting the legitimate demands for land and energy sources, especially biomass.

In conclusion, this article proposes that, with regard to eucalyptus cultivation as a modality of planted forests for commercial, industrial and energy purposes, the environmental principle of most appropriate application is the prevention, rather than the precautionary principle. This paper recommends observance of the principle of prevention due to the good experience and knowledge already gained from the long history of eucalyptus cultivation in Brazil. In addition, the precautionary principle cannot be inflexibly applied, as it would impede the development of the planted forest sector, which fulfills relevant socioeconomic and even environmental functions, as detailed in the above paragraph.

Research in this segment should continue, so that eucalyptus can be planted with the necessary reserve for environmental protection. The hypothesis presented in the introduction was partially confirmed, namely, that eucalyptus cultivation should not be replaced by another, but subject to the elaboration, implementation, monitoring, evaluation and updating of specific and appropriate public policies to manage the environmental problems that arise from it, in compliance with the principle of prevention.

Therefore, although not totally conclusive, the technical and scientific studies of the environmental impacts of eucalyptus planting, the knowledge already acquired by the long tradition and experimentation of this culture in Brazilian territory, added to the good prospects of well-structured management already applied in this segment, recommend the continuity of that economic activity according to the principle of prevention.

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Article received on: 2-Oct-2019.

Article accepted on: 19-Nov-2019.

How to quote this article (ABNT):

COSTA, B. S.; OLIVEIRA, M. L. Eucalyptus planted forests in Brazil: a cultivation harmful to water resources? *Veredas do Direito*, Belo Horizonte, v. 16, n. 36, p. 115-132, sep./dec. 2019. Available at: <http://www.domhelder.edu.br/revista/index.php/veredas/article/view/1671>. Access on: day month. year.