



As ethanol production becomes increasingly lucrative, how can nations ensure that expansion is environmentally sustainable? Brazil's experiment with sugarcane agro-ecological zoning may provide some answers.

## SUGARCANE AGRO- ECOLOGICAL ZONING: GREENING THE EXPANSION OF ETHANOL

### SUMMARY

Brazil's huge expansion in sugarcane production has led to questions being raised about environmental impacts and sustainability. In response to the ethanol industry's growth, in particular since the introduction of flexible fuel technology in 2003, the Federal Government moved to provide technical support for formulating public policies aimed at encouraging the sustainable expansion of sugarcane. One key strategy the government decided to adopt was providing guidelines for land allocation and rural development policies. To do so, the Government created the National Agro-Ecological Zoning of Sugarcane (*Zoneamento Agroecológico da Cana de Açúcar*), commonly known as ZAE Cana. This policy instrument is the first of its kind to adapt principles of zoning to the production of a biofuel in Brazil. Through ZAE Cana, the government is able to drive expansion in the areas most favourable for cultivation in terms of potential output and least irrigation needed. At the same time, to reduce environmental harm, certain areas that are environmentally fragile or possess high biodiversity are designated as off-limits for ethanol crops. Importantly, ZAE Cana includes incentives and clear mechanisms for monitoring, such as requirements for compliance before financial institutions will issue loans. Brazil's experience shows that competition between food and fuel production and the loss of fragile native biomes can be avoided through effective implementation and enforcement of zoning, especially when coupled with incentives for compliance. Evidence suggests that if implemented from the onset of ethanol expansion, ZAE Cana could have preserved native forests and increased sugarcane production by incentivising cultivation on more productive lands. The Brazilian experience may be relevant for decision makers from other regions considering the sustainability of fuel crop expansion in their own countries.





## THE CHALLENGE OF SUSTAINABLY EXPANDING ETHANOL PRODUCTION AREAS

As the demand for producing ethanol and other renewable biofuels increases, pressure also rises to expand production areas into sensitive ecosystems. Biofuel production can bring economic, energy and environmental gains in terms of increased GDP and energy security, and decreased greenhouse gas (GHG) emissions as a result of fossil fuel substitution. All of these are considerable incentives for embarking upon ambitious biofuels programmes. Despite these benefits, though, the environmental costs of unchecked land expansion can potentially make increasing ethanol production unsustainable.

The motives for unsustainable expansion are common across developing nations. Actors that enter the biofuel crops market tend to focus on profits, potentially switching from previous land use, or replacing other less profitable crops in order to make more money, without taking into consideration the impact on land, food competition or biodiversity.

The expansion of sugarcane in Brazil has proven to be unsustainable due to a lack of knowledge about biodiversity and stringent laws to protect it. Researchers like Martinelli,<sup>1</sup> Smeets,<sup>2</sup> Bernard<sup>3</sup> and Almeida<sup>4</sup>, among others, especially in Brazil, demonstrate that environmental impacts associated with ethanol production in Brazil have been important obstacles to sustainable biofuel production. Through their articles, they present the most significant impacts from sugarcane ethanol's life cycle and the consequences on people and ecosystems.

Like Brazil, many countries in Africa and Asia have huge forests and environmentally fragile territories, but with limited or weak property rights. These sorts of countries are also still dependent on their natural resources, with the exportation of primary goods and derivatives playing a significant role in the economy. Furthermore, these countries often have a weak or incipient environmental framework, in part because the institutional level of development is low, so environmental laws and institutions are not strong enough to control the exploitation of natural resources sustainably.

ZAE Cana was not developed until almost 40 years after the introduction of *Proálcool*, the government programme that launched Brazil's ethanol industry. Other developing countries could gain advantage by implementing agro-ecological zoning from the outset of biofuel production or expansion, thus avoiding the problems that Brazil is only confronting now.<sup>5</sup>

## RECENT SUGARCANE EXPANSION: THE NEED TO USE ZONING AS A PLANNING TOOL

The expansion of sugarcane production in recent years has been significant, especially after 2005, when sales of the flex fuel fleet began growing even faster, thereby boosting demand for ethanol. Production of sugarcane grew at high rates, reaching 627 million tonnes in 2010, with a maximum value in 2009.<sup>6</sup> In this period, the harvest area grew from 5.6 to almost 10 million hectares of land, representing a 72% increase in four years. Figure 1 below depicts the growth of both land area used and sugarcane yield.

The land expansion needed to support such an increase in

<sup>1</sup> Martinelli, L., Filoso, S. 2008. [Expansion of Sugarcane Ethanol Production in Brazil: Environmental and Social Challenges](#). *Ecological Applications* 18 (4) 885 - 898.

<sup>2</sup> Smeets, E. et al. 2008. [The Sustainability of Brazilian Ethanol - An Assessment of the Possibilities of Certified Production](#). *Biomass and Bioenergy* 32(8) 781-813.

<sup>3</sup> Bernard, E., Melo, F. P. L., Pinto, S. R. R. 2011. [Challenges and Opportunities for Biodiversity Conservation in the Atlantic Forest in Face of Bioethanol Expansion](#). *Tropical Conservation Science* 4 (3) 267-275.

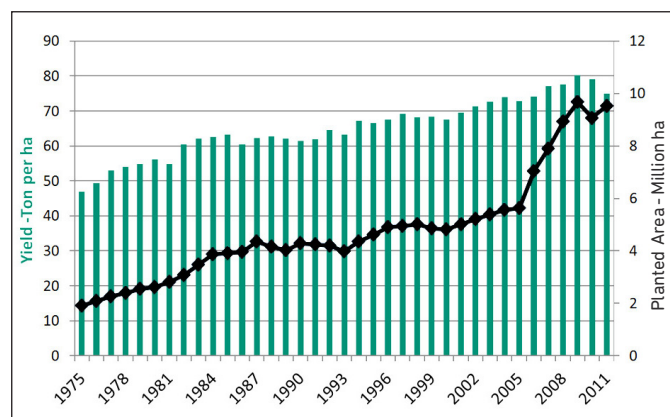
<sup>4</sup> Almeida, M. 2012. [Analysing the Brazilian Sugarcane Agroecological Zoning: Is this Government Policy Capable of Avoiding Adverse Effects from Land-use Change?](#) MSc dissertation. Victoria University of Wellington.

<sup>5</sup> There are some particularly good recent references available about ZAE Cana that provide updated information about the policy's progress and challenges, and offer an assessment of the historical development of the initiatives, as well as the possibilities for replicating ZAE Cana in other countries. These recommended readings include: Giulio, V. 2010. [Biofuels in Brazil and Land Use Change](#). *Journal of Biobased Materials and Bioenergy* 4 (3) 211-220.; Strapasson, A. 2012. [Agro-ecological Zoning and Biofuels: the Brazilian Experience and the Potential Application in Africa](#). Routledge, Oxon; Almeida, M. 2012. [Analysing the Brazilian Sugarcane Agroecological Zoning: Is this Government Policy Capable of Avoiding Adverse Effects from Land-use Change?](#) MSc dissertation. Victoria University of Wellington.

<sup>6</sup> Ministry of Agriculture, Livestock and Food Supply (*Ministério da Agricultura, Pecuária e Abastecimento* - MAPA). 2010. [Balanco Nacional da Cana de Açúcar e Agroenergia \(National Sugarcane and Agroenergy Assessment\)](#). MAPA, Brasília.



Figure 1: Evolution of Planted Area (blue line) and Sugarcane Crop Yield (red bars), 1975 - 2011



Own elaboration.

Sources: Ministry of Agriculture, Livestock and Food Supply (*Ministério da Agricultura, Pecuária e Abastecimento* – MAPA). 2010. [Balanco Nacional da Cana de Açúcar e Agroenergia \(National Sugarcane and Agroenergy Balance\)](#). MAPA, Brasília.; [Raw data from the Brazilian Institute of Geography and Statistics \(Instituto Brasileiro de Geografia e Estatística – IBGE\)](#).

production was indeed considerable, but would have been substantially higher were it not for productivity gains. On the other hand, had the investments in land productivity been higher, production would have had the potential to grow without so much land expansion, since production would require less land for the same amount of output. That being said, the government still needed to find measures to control and plan the expansion that is taking place.

According to the Brazilian Ten Year Energy Plan - 2015, generated by the [Brazilian Energy Research Company \(Empresa de Pesquisa Energética – EPE\)](#) in 2006, from 2006 to 2015 sugarcane production was forecasted to reach 0.7 billion tonnes. The most recent forecast, Energy Plan - 2021, continues to show production increasing over the next ten years, where sugarcane production and productivity will reach respectively 1.2 billion tonnes and 88.5 tonne/hectare using a total of 13 million hectares of land.<sup>7</sup>

### International and Domestic Pressure

Since 2005, expansion forecasts have been significant, so concerns about direct impacts have led the government to adopt policies to better plan the expansion of this crop. These direct impacts include replacing food

crops and native forest, sugarcane burning, disposal of vinasse, and water use, among others,<sup>8</sup> which span social, economic and environmental contexts.

The idea for ZAE Cana therefore arose from the need to evaluate the potential for the expansion of sugarcane production on dry land (without full irrigation) as a basis for planning the sustainable use of land in harmony with biodiversity. It represents a commitment to less environmentally harmful production.

International demand for ethanol increased due to a desire to increase consumption of renewable energy, reduce GHG emissions and diversify the energy matrix. Brazilian ethanol producers became interested in the foreign export market, but importers were dubious about Brazilian ethanol and its potential link to deforestation, especially in the Amazon Region. If sugarcane crops replaced native forest, the reduction of GHG emissions would be offset by the impacts from land use change. In other words, to significantly reduce emissions, sugarcane crops must replace degraded areas.

In 2009, during the run-up to the 15<sup>th</sup> United Nations Climate Change Conference ([Conference of the Parties – COP15](#)), commonly known as the Copenhagen Summit, in response to increasing pressure about deforestation and rising GHGs, the Brazilian government decided to take firm action. Targets were set to reduce deforestation in the Amazon by 80% by 2020 and a Presidential Decree launched ZAE Cana – based on a technical study, made by the Brazilian Government – to improve the sustainability of ethanol's expansion.

## INTRODUCTION TO ZAE CANA

ZAE Cana is a national environmental policy instrument through which the government intervenes in the economic domain to organise the relationship between space and production: imposing conditions on the conduct of stakeholders and guiding their activities according to the limits of nature. It is a political project of sustainable development, defining areas of the territory in which certain types of land use are permitted and certain economically productive activities are absolutely or partially prohibited.

<sup>7</sup> [Brazilian Energy Research Company – EPE](#). 2010. [Brazilian Ten Year Energy Plan](#). Brazilian Energy Research Company - EPE, Rio de Janeiro.

<sup>8</sup> For more information about environmental impacts from ethanol production and mitigation policies, see the [ELLA Brief: Brazil's Efforts to Mitigate the Environmental Impacts of Ethanol Production](#).



Established by Decree No. 6.961/2009 and sent to Congress in the form of bill (draft Law - PL in 6.077/2009), ZAE Cana vetoes expansion of sugar cane plantations and the installation of new sugar and ethanol plants in the Amazon, the Pantanal and Upper Paraguay River Basin, three of the key fragile and high biodiversity areas of Brazil.

### ZAE Cana Key Goals

ZAE Cana aims to map, evaluate and designate potential land for expanding sugarcane into areas that do not require full irrigation, excluding land with slopes greater than 12% and areas with high biodiversity. The overall goal of ZAE Cana is to provide technical support for the formulation of public policies aimed at sustainable expansion of sugarcane production in Brazil, and the specific goals of the policy include the following:<sup>9</sup>

- Provide sustainable economic alternatives to farmers
- Provide a spatial database for planning the sustainable cultivation of land with sugarcane in harmony with biodiversity and legislation
- Provide information for future planning of development centres in rural areas
- Align the ZAE technical study with government policies on energy
- Map and indicate areas suitable for the expansion of the cultivation of sugarcane in areas that do not require full irrigation
- Provide the technical basis for the implementation and control of the associated public policies

ZAE Cana mapped, either fully or partially, the territory of 21 of Brazil's 26 states, with the remaining five being excluded on account of being in the Amazon. Its provisions, however, are not yet in force, since the government opted to send a bill to Congress instead of a provisional measure.<sup>11</sup> Since the bill has not been voted on or formally passed, the rules of ZAE Cana serve only as a guideline, though interesting compliance measures have been put in place in the interim, as discussed below.

### MAIN ZAE CANA GUIDELINES

- Indicate the potential areas for sugarcane expansion that are not already in use, degraded, or subject to environmental restrictions as is the case of protected land
- Exclude the production of sugarcane in the Amazon, Pantanal and Upper Paraguay River Basin biomes
- Indicate preferred areas for expansion that minimise competition with food production
- Identify areas with agricultural potential without full irrigation, detailing climate and soil conditions so that sugarcane producers use less water
- Delineate areas with a slope of up to 12° in order to allow the use of mechanised harvesters, since current technology does not yet enable use on more inclined slopes. The purpose of this is to decrease pre-harvest burning, a practice used in manual sugarcane harvesting that generates a wealth of negative environmental impacts<sup>10</sup>

Source: Ministry of Agriculture, Livestock and Supply (*Ministério da Agricultura, Pecuária e Abastecimento* – MAPA). 2009. [Sugarcane Agro-Ecological Zoning, Zoning - To Expand Production, Preserve Life, and Ensure a Future](#). MAPA, Brasília.

### TECHNICAL DEVELOPMENT OF ZAE CANA GUIDELINES

ZAE Cana was developed by an inter-ministerial group made up of the [Ministry of Agriculture and Food Supplies \(MAPA\)](#), the [Ministry of Environment \(MMA\)](#), the [Ministry of Mines and Energy \(MME\)](#) and the Ministry of Finance, with technical support from the [Brazilian Agricultural Research Corporation \(EMBRAPA\)](#). This government group was charged with assessing the areas considered potentially suitable for sugarcane expansion and developing other ZAE Cana requirements for sugarcane producers.

<sup>9</sup> Ministry of Agriculture, Livestock and Supply. 2009 (*Ministério da Agricultura, Pecuária e Abastecimento* – MAPA). [Sugarcane Agro-Ecological Zoning, Zoning - To Expand Production, Preserve Life, and Ensure a Future](#). MAPA, Brasília.

<sup>10</sup> For more information about other Brazilian efforts to reduce pre-harvest burning, see the [ELLA Brief: From Manual to Mechanical Harvesting: Reducing Environmental Impacts and Increasing Cogeneration Potential](#).

<sup>11</sup> In Brazil, a bill refers to a set of standards that must be submitted to vote in the legislative body in order to enact a law. A provisional measure is an act coming from the president, with the force of law, but without the participation of the Legislative Power, which will only be called to discuss it and approve it at a later date.





Through digital processing techniques, the land potential for crop production of sugarcane in areas that do not require full irrigation was assessed. It was based on the physical, chemical and mineralogical features of soil expressed spatially in soil surveys and studies on climate risk. Such studies took into account the requirements of the sugarcane crop, such as precipitation, temperature, frosts and dry spells.

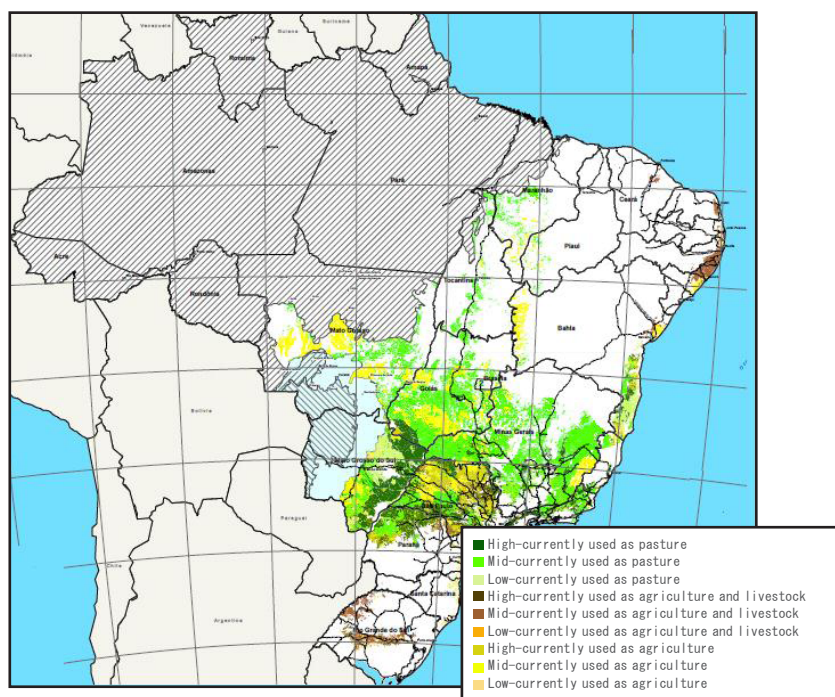
The main indices considered in the development of ZAE Cana were: land vulnerability; climate risk; potential for sustainable agricultural production; and environmental regulations. These indices were developed through assessments of climate suitability and probabilistic studies based on historical data series about climate risks in Brazilian municipalities. These municipalities were chosen based on the crop cycle and water demand, occurrence of frosts and dry spells, and the best areas and times for cultivation.<sup>12</sup>

Satellite images and a sophisticated spatial planning database were employed to identify and map out the different types of land covered by ZAE Cana, such as:

- environmental protection areas like the Amazon and Pantanal
- areas covered with native vegetation
- lands with poor soil and climate conditions and that require full irrigation
- areas with slopes greater than 12%, making them unsuitable for mechanical harvesting
- indigenous lands
- areas with high conservation value for biodiversity
- forest remnants, dunes, mangroves, cliffs and rock outcrops
- reforestation areas
- urban areas
- mining areas
- areas considered strategic for food security

ZAE Cana mapping was based on a previous mapping exercise of what remained of the country's national forests in 2002, conducted by [PROBIO](#) (*Projeto Nacional de Ações Integradas*

Map 1: ZAE Cana Map of Areas According to Use and Suitability



Note: 'High', 'mid' and 'low' refer to agricultural productivity.

Source: Ministry of Agriculture, Livestock and Supply (*Ministério da Agricultura, Pecuária e Abastecimento* – MAPA). 2009. [Sugarcane Agro-Ecological Zoning, Zoning - To Expand Production, Preserve Life, and Ensure a Future](#). MAPA, Brasília.

<sup>12</sup> Ministry of Agriculture, Livestock and Supply (*Ministério da Agricultura, Pecuária e Abastecimento* – MAPA). 2009. [Sugarcane Agro-Ecological Zoning, Zoning - To Expand Production, Preserve Life, and Ensure a Future](#). MAPA, Brasília.



*Público-Privadas para Biodiversidade* - National Project of Integrated Public-Private Actions for Biodiversity) under the Ministry of Environment. The best cartographic and thematic information available was used, with an abstraction scale of 1:250:000, where possible. The following map shows the result for Brazil.

ZAE Cana estimates that Brazil has 64.7 million hectares of total land available for the expansion of sugarcane. Of these 64.7 million hectares, 19.3 million were classified as having high productive potential, 41.2 million with medium potential and 4.3 with low potential. The area of land that was used for pasture in 2002 that is now suitable for sugarcane expansion represents 37.2 million hectares. These numbers show that the country does not need to expand sugarcane into native forest and that expansion is possible without directly affecting land already used for food production. Map 1 also shows ZAE Cana's additional ecological criteria: the Amazon, Pantanal and Upper Paraguay River Basin biomes are shown with stripes on the map, since these regions are excluded from ethanol expansion.

The southeast region of Brazil, which was once covered by Atlantic forest, is where most sugarcane plantations and mills are currently concentrated. Today, according to SOS Atlantic Forest (*SOS Mata Atlântica*), only 7% of the original Atlantic forest in Brazil is now protected. The original process to begin cultivating in this forest biome occurred before conservation concerns emerged.<sup>13</sup> Had ZAE Cana been implemented before the *Proálcool* programme, as a measure to control and delineate sugarcane expansion, the Atlantic forest may actually have been preserved.

## ENFORCING ZAE CANA BEFORE IT BECOMES LAW

As ZAE Cana is only a Presidential Decree, and not yet a full law, it can only operate as a voluntary guideline for stakeholders who want to expand sugarcane production. However, the Brazilian government has succeeded in putting in place some interesting complementary regulations that act as an alternative in the sense of requiring compliance with

### ZAE CANA LEGISLATION

[ZAE Cana Decree No. 6.961/2009](#) – Passed by former President Lula da Silva, this Decree established the ZAE Cana Technical Study and required that the National Monetary Council establish standards for funding activities in the sugar and ethanol sector according to the zoning guidelines.

[ZAE Cana Technical Study](#) – Provided technical guidance for sugarcane expansion according to soil, climate and need for water use. It outlines the technical guidelines for boosting sugarcane expansion sustainably, but has no normative power.

[ZAE Cana BILL \(PL in 6.077/2009\)](#) – Is a draft national-level law waiting to be voted on in congress. If passed with no changes, it will allow the expansion of sugarcane only under the approved zoning areas, and expansion outside of delineated areas will be strictly forbidden.

ZAE Cana guidelines, despite them not being signed into law.

The first is the National Monetary Council's passing of Rule 3.814 in November 2009 which prohibits public and private financing to sugarcane companies that produce sugar or ethanol and plan to expand outside areas delineated by ZAE Cana. It draws on previous legislation, Article 44 of Law 4.595 passed in 1964, that mandates that both public and private financial institutions be subject to penalties such as fines and imprisonment in case of infringement of policies established by the National Monetary Council.<sup>14</sup>

To further incentivise compliance with the new ZAE Cana guidelines, specific government credit and subsidised loans have been made available from the Brazilian Development Bank (*Banco Nacional do Desenvolvimento* - [BNDES](#)) for entities wishing to expand sugarcane production, on the condition that they follow the ZAE Cana guidelines. In addition, private bank loans cannot be granted to farmers without ensuring that their intended use of funds is in line

<sup>13</sup> For more information, see: Bernard, E., Melo, F. P. L., Pinto, S. R. R. 2011. [Challenges and Opportunities for Biodiversity Conservation in the Atlantic Forest in Face of Bioethanol Expansion](#). *Tropical Conservation Science* 4 (3) 267-275.

<sup>14</sup> Almeida, M. 2012. [Analysing the Brazilian Sugarcane Agroecological Zoning: Is This Government Policy Capable of Avoiding Adverse Effects from Land-use Change?](#) MSc dissertation. Victoria University of Wellington.



with ZAE Cana requirements. This effectively decentralises monitoring, passing some responsibility over to the private sector. Additionally, where illegal activities are discovered, the government has the right to withhold permits to send sugarcane to local processing facilities.

Finally, in order to increase production without putting pressure on land expansion, BNDES created a new programme to encourage sugarcane production by financing the renovation of old sugarcane farms and the expansion of the cultivated area. The funding, called [BNDES Prorenova](#), has a budget of R\$ 4 billion (US\$2 billion). It follows the ZAE Cana guidelines, meaning that only applicants that meet the zoning specifications are eligible to receive the funding.

## SHORTFALLS OF ZAE CANA

Although ZAE Cana has had important successes, some criticisms, shortfalls and political constraints warrant being mentioned here.

The most obvious is the fact that ZAE Cana has not been signed into law. Based on the results of the Technical Study, ZAE Cana was made official through the publication of Presidential Decree 6.961/2009, and was sent to Congress in the form of Bill PL 6.077/2009, where it remains. Its legal launch has been expected since the technical study was completed, however Congress has not yet voted on the bill. The reasons for this are multiple, starting with the time consuming bureaucratic process that bills go through in the Brazilian Congress. As this bill is currently not considered an urgent matter by federal deputies, it takes a long time to be discussed, reviewed, corrected, voted upon and approved.

Apart from these bureaucratic issues, there is an internal

dispute inside the government between environmentalists and the agribusiness sector. The environmentalists won the first round: the federal proposal prohibits the expansion of sugarcane plantations and the establishment of new sugar and ethanol plants in the Amazon, Pantanal and Alto Paraguay Basin, along with the other environmental measures described above. However, agribusiness has warned that they seek to impose a series of changes to the text before ZAE Cana is passed into law.

Apart from the political problems, the indirect effects of the expansion of sugarcane plantations are not covered by ZAE Cana. For example, ZAE Cana does not allow deforestation to clear land for planting sugarcane. However, ZAE Cana is not an integrated agricultural policy. Thus, it deals with sugarcane in isolation, without taking into account the reciprocal influence of pastures and other crops. Subsequently, these other crops might be replaced by sugarcane cultivation if less profitable than ethanol or sugar. This means that the expansion of sugarcane plantations, even in demarcated areas, displaces other agricultural activities and livestock in areas excluded by ZAE Cana. Furthermore, the bill does not establish restrictions for existing plants or for new projects that have already obtained an environmental licence in the excluded areas.

From an environmental standpoint, ZAE Cana did not consider the Ministry of Environment's [Map of Priority Areas for Biodiversity Conservation](#), meaning some strategic areas for biodiversity conservation were not excluded. Furthermore, the expansion areas are relatively close to the ecosystems of the Amazon rainforest, Pantanal wetlands and Upper Paraguay River Basin. This proximity could cause direct environmental pressure due to sugarcane burning and use of agrochemicals, which would have spillover effects on the nearby fragile ecosystems.

# CONTEXTUAL FACTORS

## ENABLING SUCCESSFUL AGRO-ECOLOGICAL ZONING REFORM



The recent growth and projections for further increases in ethanol production after the introduction of flexible fuel technology raised concerns amongst both the government and civil society about the environmental impacts of sugarcane expansion. Fearing the invasion of sugarcane crops into fragile biomes like the Amazon and Pantanal, and the direct and indirect environmental impacts of ethanol production, the government created a multidisciplinary group in charge of developing ZAE Cana to delineate the areas for sugarcane expansion. ZAE Cana emerged as a tool to assess, but especially, to plan the expansion of sugarcane production, avoiding and reducing as many environmental impacts as possible.

International pressure to reduce deforestation, and increasing trade restrictions, also gave the Brazilian government an incentive to introduce ZAE Cana. This came at a time when the national government was designing a series of measures to reduce GHGs in order to stand out in the international climate negotiations. Thus, ZAE Cana was born thanks to an inter-ministerial group created by presidential decision. This government group was charged with assessing the areas considered possibly suitable for sugarcane expansion and developing other ZAE Cana requirements for sugarcane producers.

Indeed, Brazil was able to draw on its strong human capital, with ZAE Cana completely developed by engineers,

meteorologists, biologists, physicians and mathematicians from the Brazilian Agricultural Research Corporation ([Embrapa Solos](#)) with the political support of the Ministry of Agriculture, Livestock and Food Supply (*Ministério da Agricultura, Pecuária e Abastecimento* – MAPA). These institutions were directly connected to the expansion of sugarcane production since the beginning of the *Proálcool* programme.

The coming together of various ministries to develop the zoning tool positively affected its success. The cooperation and interaction of the various ministries pulled together the best strengths in terms of satellite imaging, land surveys, and agricultural and environmental standards, along with financial mechanisms. With the various ministries working together on the tool, consensus was achieved relatively quickly.

Finally, financial institutions played a vital role in enabling ZAE Cana to achieve its ends. On the one hand, government-subsidised loans incentivise sugarcane expansion in suitable areas, while on the other, financial institutions nationwide are obliged to ensure that loans for farmers will not be used for unsustainable expansion. This public-private duty of care helps to make ZAE Cana effective in terms of ensuring compliance, an especially remarkable achievement given that the law mandating ZAE Cana has not even been passed.

### LESSONS LEARNED

**1** Sugarcane agro-ecological zoning is an important planning tool to enhance sustainability of sugarcane expansion by identifying suitable areas and restricting areas of environmental relevance. The guidelines set out in ZAE Cana promote efficient use of space by enhancing expansion into degraded areas, and discouraging unsustainable practices, like pre-harvest burning when expanding operations.

**2** That being said, Brazil implemented the first agro-ecological zoning for sugarcane 35 years after the development of the

Proálcool Programme. If established from the outset, sugarcane production and productivity could have been higher, with significantly diminished environmental impacts.

**3** Since ZAE Cana is a tool that may be employed to make fuel crop expansion sustainable without affecting food production or threatening the natural environment, demonstrating this to potential international customers helps to improve the image of biofuels and thus increase potential sales volumes.

**4** Given that ZAE Cana is not a federal law, it does not have regulatory power, so its provisions are merely guidelines. However, establishing funding restrictions on sugarcane stakeholders through the National Monetary Council requires them to follow the zoning guidance. Involving public and private financial institutions in the policing of sugarcane expansion reduces the need for a costly monitoring and fining system, and acts as an alternative in the meantime while the policy has not been signed into law.

### CONTACT [SSN](#)

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