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Impacts of the invasion of *Cryptostegia madagascariensis* according to farmers on the Bode farm in Parambu, Ceará

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ABSTRACT

Invasive alien species are threats to ecosystems and the livelihoods of rural communities. This study analyzed the perception of farmers from Fazenda Bode, Parambu, Ceará, about the impacts of the invasive Cryptostegia madagascariensis. Semi-structured interviews were conducted with 20 farmers, complemented by field observations. All the interviewees reported knowing the species, which has been present in the region for over fifteen years. The main impacts pointed out were: a reduction in agricultural and fodder production (50%), the death of animals (15%), restricted access to water resources (75%) and the death of native species (70%). Most farmers do not adopt control methods, and the few that have been applied (cutting, burning, use of oil) have proved ineffective. It is concluded that the invasion by C. madagascariensis compromises the economy, animal health and local natural resources, highlighting the need for participatory management actions and specific public policies to mitigate its effects.

Keywords: Exotic species; Environmental impacts; Viúva alegre; Socio-economic impacts.

Impactos da invasão de *Cryptostegia madagascariensis* de acordo com os agricultores da fazenda Bode em Parambu, Ceará

RESUMO

As espécies exóticas invasoras são ameaças aos ecossistemas e à subsistência de comunidades rurais. Este estudo analisou a percepção de agricultores da Fazenda Bode, Parambu, Ceará, sobre os impactos da invasora *Cryptostegia madagascariensis*. Foram realizadas entrevistas semiestruturadas com 20

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agricultores, complementadas por observações de campo. Todos os entrevistados relataram conhecer a espécie, presente na região há mais de quinze anos. Os principais impactos apontados foram: redução da produção agrícola e de forragem (50%), morte de animais (15%), restrição de acesso a recursos hídricos (75%) e morte de espécies nativas (70%). A maioria dos agricultores não adota métodos de controle, e os poucos aplicados (corte, queima, uso de óleo) mostraram-se ineficazes. Conclui-se que a invasão por *C. madagascariensis* compromete a economia, a saúde animal e os recursos naturais locais, evidenciando a necessidade de ações de manejo participativo e políticas públicas específicas para mitigar seus efeitos.
Palavras-chave: Espécies exóticas; Impactos ambientais; Viúva alegre; impactos socioeconômicos.

Impactos de la invasión de *Cryptostegia madagascariensis* según los agricultores de la hacienda Bode en Parambu, Ceará

RESUMEN

Las especies exóticas invasoras son una amenaza para los ecosistemas y los medios de vida de las comunidades rurales. Este estudio analizó la percepción de los agricultores de Fazenda Bode, Parambu, Ceará, sobre los impactos de la invasora Cryptostegia madagascariensis. Se realizaron entrevistas semi-estructuradas con 20 agricultores, complementadas con observaciones de campo. Todos los entrevistados afirmaron conocer la especie, presente en la región desde hace más de quince años. Los principales impactos señalados fueron: la reducción de la producción agrícola y forrajera (50%), la muerte de animales (15%), la restricción del acceso a los recursos hídricos (75%) y la muerte de especies autóctonas (70%). La mayoría de los agricultores no adoptan métodos de control, y los pocos que se han aplicado (tala, quema, uso de aceite) han resultado ineficaces. Se concluye que la invasión por C. madagascariensis pone en peligro la economía local, la sanidad animal y los recursos naturales, destacando la necesidad de acciones de gestión participativa y políticas públicas específicas para mitigar sus efectos.
Palabras clave: Especies exóticas; Impactos ambientales; Viúva alegre; Impactos socioeconómicos.

INTRODUCTION

Invasive alien species represent one of the greatest environmental challenges and are widely recognized as one of the main threats to biodiversity conservation and ecosystem integrity on a global scale (PADALIA et al., 2015; NAJBEREK et al., 2022). When exotic species manage to establish viable populations, they begin to compete with native species for key resources such as light, nutrients, water and space, causing negative impacts in invaded areas (SOUZA et al., 2017; NOBIS et al., 2018).

The introduction of invasive alien species promotes changes in the provision of ecosystem services, with potential negative impacts on human well-being (VAZ et al., 2017). In particular, invasive plants can modify soil properties, influence nutrient cycling and interfere with water use, compromising the productivity and sustainability of agricultural systems (VANTAROVÁ et al., 2023). Furthermore, once established, these species require high investment in management and control, further exacerbating the scale of the problem (SIMBERLOFF, 2003).

Biological invasions are closely related to human activities throughout history and today (GARCÍA-LLORENTE et al., 2008). Among the various aspects involved, the economic and social impacts on the affected communities stand out (SHRESTHA et al., 2019; PAUDEL et al., 2024). However, most studies in this area focus on an essentially biological perspective, and there is a scarcity of research that addresses the effects of invasive species on humans and society in general (SHACKLETON et al., 2019). In this scenario, the population's perception of these species is a fundamental element for the effective management of invaded areas (HEAD, 2017).

In Brazil, the semi-arid region is predominantly occupied by the Caatinga, a formation characterized by high biodiversity and endemic species (FERNANDES; QUEIROZ, 2018). The rural population of this region depends mainly on natural resources for their survival (CUCHILLO et al., 2013). The ecosystem services provided by the Caatinga are being affected by factors such as intense exploitation (MAGALHÃES et al. 2019) and the presence of invasive exotic species (FABRICANTE et al., 2015; SOUSA et al., 2016).

Several invasive exotic plants are part of the flora of the Caatinga, and damage such as the displacement of native species and soil alteration has been recorded (SOUSA et al., 2016). This shows that the ecosystem services offered by the Caatinga to its population may also be being affected by invasive exotic species. According to Shackleton et al. (2019) the invasion of exotic species is capable of affecting the growth of agricultural crops and forests, causing economic losses. In Brazil, for example, USD 104.33 billion is related to damage caused by invasive species, while USD 1.9 billion has been invested in preventive actions such as management, control or eradication of species (ADELINO et al., 2021).

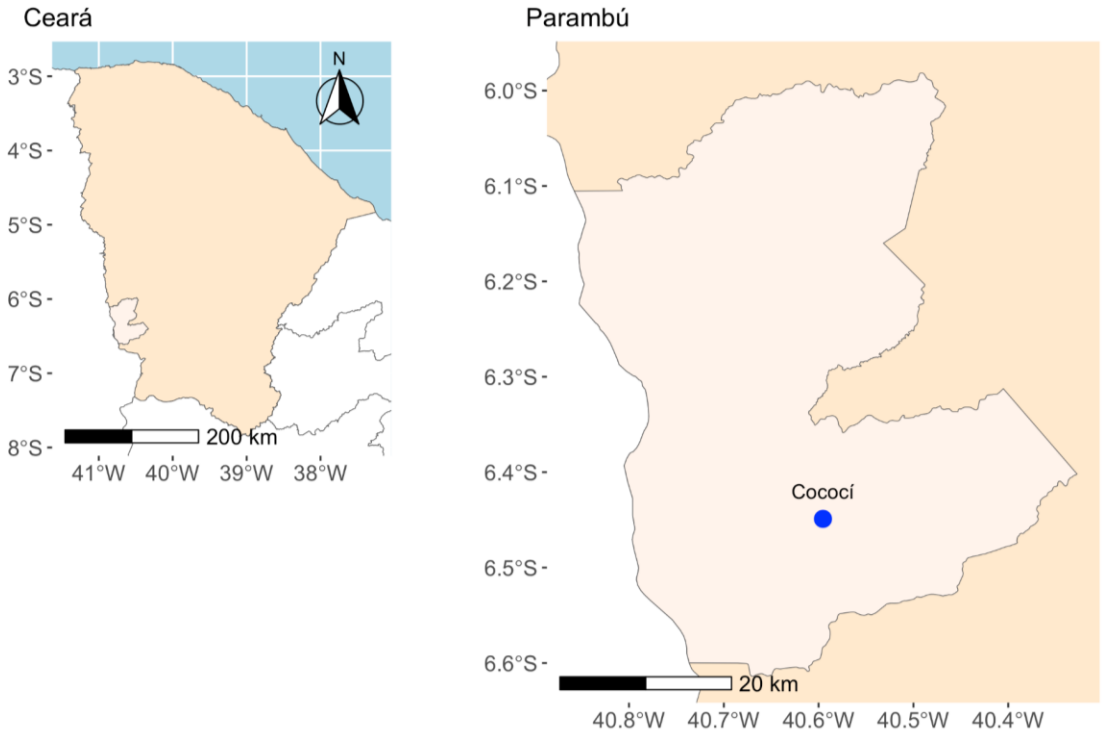
Cryptostegia madagascariensis Bojer ex Decne. (Apocynaceae) is an exotic species introduced to Brazil as an ornamental and in the Northeast it has become invasive. This species has caused serious damage to the vegetation of the riparian forests of Ceará's caatinga, competing with native species and, above all, with the carnauba tree [*Copernicia prunifera* (Mill.) H.E. Morre], killing it by shading, since it develops climbing branches, with large biomass production, which prevent light from passing through (SOUSA et al., 2016).

Studies on *C. madagascariensis* mainly focus on ecological/botanical aspects and few consider the socio-economic dimension (BARROSO et al., 2024). This research seeks to answer the following question: what are the impacts of C. madagascariensis, according to the farmers of Fazenda Bode, Cococcí, Parambu? Thus, we will analyze the social, economic and environmental impacts caused according to the farmers' perception.

MATERIAL AND METHODS

The research was carried out in an area characterized by the high presence of the species C. madagascariensis. The site is on the banks of a stream and is located on Maringá Farm, in the district of Cococí, in the municipality of Parambú (Figure 1). The region's climate is semi-arid, with the months of January to April being considered the region's rainy season. It is also a region with predominantly Caatinga vegetation. The main economic activities in the region are agriculture and livestock farming.

Figure 1 - Map of the location of Fazenda Bode in Coccocí, Parambu, Ceará.



Source: prepared by the authors (2025).

To assess the impacts caused by *C. madagascariensis* in the region, interviews were conducted with local residents. To this end, a questionnaire was drawn up for the members of the Bode Farm Association. These farmers, who have lived in the community for many years, are mainly involved in agriculture and livestock farming. The association is a space for community organization, where monthly meetings are held to discuss issues related to regional development.

The questionnaire used was semi-structured, enabling both the collection of standardized answers and the recording of additional observations about the interviewees' statements. In total, it contained 12 questions organized into five axes: (i) profile of the farmers who live with the invasive species; (ii) perceptions of the plant; (iii) possible uses or benefits attributed to it; (iv) negative impacts, including economic losses and changes to the environment; and (v) management or control practices adopted. Before the survey was carried out, during a meeting of the association, all participants were informed about the nature and objectives of the research and were given a Free and Informed Consent Form, in accordance with Resolution 466/2012 of the National Health Council.

After the interviews, as indicated by the farmers, field visits were made to areas where *C. madagascariensis* occurs for observation and photographic records. When analyzing the data, we calculated the Relative Citation Frequency (RFC) = (Number of informants who cited species X) / (Total number of informants), for the information obtained. We also calculated the

ICF (Informant Consensus Factor), which measures the degree of agreement between interviewees on the impacts of a species (HEINRICH et al, 1998). Values close to 1 - high consensus (everyone reports the same impacts); values close to 0 - low consensus (a lot of variation between reports):

$$ICF = (Nur - Nt)/ (Nur - 1)$$

Nur = total number of citations (responses) for a category (e.g. economic impacts) and Nt = number of different impacts reported within that category. The results were presented in tables and graphs. The graphs were made using SigmaPlot 12.5 software.

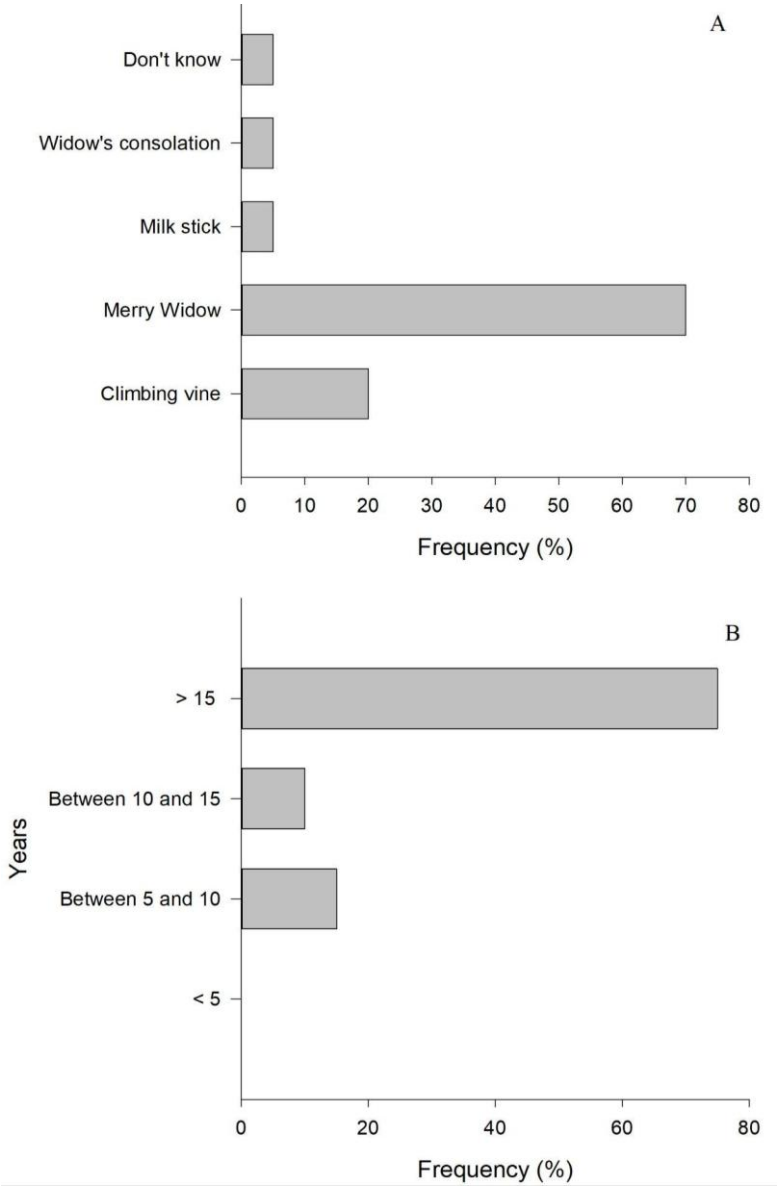
RESULTS AND DISCUSSION

Twenty farmers from the community association were interviewed, six of whom were female and 14 male, aged between 18 and 88, with the highest frequency in the 40 to 66 age group. This shows that the research covered different profiles of the community in terms of gender and age. All the participants said they knew or had heard of the invasive species *C. madagascariensis*. This result is relevant because it suggests that, in future management actions or the implementation of control measures, residents can contribute valuable information to the region.

The recognition of the species by those interviewed is a strategic starting point for planning control measures that take into account the views of the local community. Simberloff (2011) states that populations who are not involved or who oppose invasive species management often report that their perspectives have been ignored in the process. In this sense, Novoa et al. (2018) point out that the inclusion of social studies from the initial stages to the implementation of management projects increases the efficiency of actions, since it directly incorporates those who live with the invasive species.

As for the popular name of the species, four different ones were mentioned: viúva alegre (mentioned by 70% of the interviewees), vine, consolo de viúva and stick of milk. Around 10% of the participants said they didn't know any of the plant's names (Figure 2A). According to the interviewees, the most widespread name, joyful widow, is related to the fact that the plant remains evergreen and flowering even during the dry season, being one of the few species in the region that maintains this characteristic during this period.

Figure 2 - Popular name of *Cryptostegia madagascariensis* in the region (A) and length of time residents have observed the plant in the region (B).



Source: prepared by the authors (2025).

In the perception of the farmers, this invasive species has been present in the region for a long time. Around 75% of those interviewed said that this species has been present in the region for more than 15 years. Another 10% said they had known it for more than 10 years and 15% of the farmers interviewed said they had known it for between 5 and 10 years (Figure 2B). This result shows that this species has been occurring in the region for many years, implying that early measures could have been taken to contain its expansion.

It is therefore important to keep an eye on the arrival of new species, information from current databases shows that for all groups of organisms on all continents, the number of exotic species has steadily increased and more arrivals may occur if left unchecked (PYŠEK et al.,

2020). In a new habitat, some exotic species can adapt quickly. A study by Woods and Sultan (2022), with 35 populations of native and introduced *Polygonum cespitosum*, identified that in introduced areas the species produces more propagules when growing conditions are limited.

The interviewees were also asked about the occurrence of the invasive species near their homes or workplaces. Of the total, 70% stated that the plant occurs where they live, while 30% reported that it does not occur on their property, but they recognized its presence on neighboring land. According to Yletyinen et al. (2021), landowners' decisions on whether or not to control invasive alien species directly influence the extent and density of the invasion, as well as affecting the behavior of other landowners. In this study we can see that farmers are aware of the occurrence of this exotic species.

When asked about the use of the species in the region, all the farmers said that it had no use whatsoever. Because it has no utility value, the plant is often ignored, which facilitates its proliferation and occupation of new areas. It should be noted that this species has been introduced in various regions for ornamental purposes and, in general, biological invasions are closely related to human activities, both historical and current (GARCÍA-LLORENTE et al., 2008).

With regard to the damage to health attributed to the invasive species, 80% of those interviewed said they were unaware of any negative effects; 5% reported cases of itchy skin; another 5% mentioned poisoning and the death of animals; and 10% of farmers reported the loss of animals that died trapped in the dense biomass formed by the plant. We found no reports of these impacts in the literature (Table 1).

Table 1 - Health, economic and environmental damage from *Cryptostegia madagascariensis* reported by farmers.

	Type of damage	Frequency (%)	Impact reported in the literature
Health	Unknown	80	-
	Itchy skin	5	-
	Animal poisoning	5	-
	Death of trapped animals	10	-
Economic	Affects production on neighboring lands	30	Economic losses (BARROSO et al., 2024)
	Damages crop and forage production	50	Causes the death of native plants (De Sousa *et al*., 2016)
	Prevents the occurrence of important native species	15	Causes the death of native plants (De Sousa *et al*., 2016)
	Unknown	5	-
Environmental	Death of native plants, such as: *Copernicia prunifera* (Mill.) H.E.Moore; *Sarcomphalus joazeiro* (Mart.) Hauenschild; *Melanoxylon braúna*; *Xiquexique gounellei (*F.A.C.Weber ex K.Schum.) Lavor & Calvente (Figura 3); *Aspidosperma pyrifolium* Mart. & Zucc.	70	Causes the death of native plants (De Sousa *et al*., 2016)
	Unknown	30	-
Effect on essential resources	Prevents access to streams and ponds	100	Prevents people and animals from accessing rivers (Andrade, 2013)

Source: prepared by the authors (2025).

When the questionnaire was applied, it was possible to observe that due to the lack of information, farmers live with various damages on a daily basis without understanding that they are happening. According to Shackleton et al. (2019), invasive species can impact human health

directly, by increasing the prevalence of certain diseases, or indirectly, by intensifying the occurrence of natural disasters, such as fires.

Economic damage was also described, with 30% responding that the presence of the species does not cause damage to their land because they uproot it, but they know that it causes damage in neighboring areas; another 50% reported that it affects the production of fodder for animals and also harms the productivity of crops; 15% reported that where this invader occurs, other important native species do not develop or are prevented from being born; and another 5% reported that they were unaware of it, due to a lack of information about the species (Table 1). Shackleton et al. (2019) state that many invasive species cause negative impacts on the livelihoods of communities, as they generally require additional labor and financial resources to control them. In addition, according to these authors, they can reduce incomes, food security, adaptive capacity and reduce well-being.

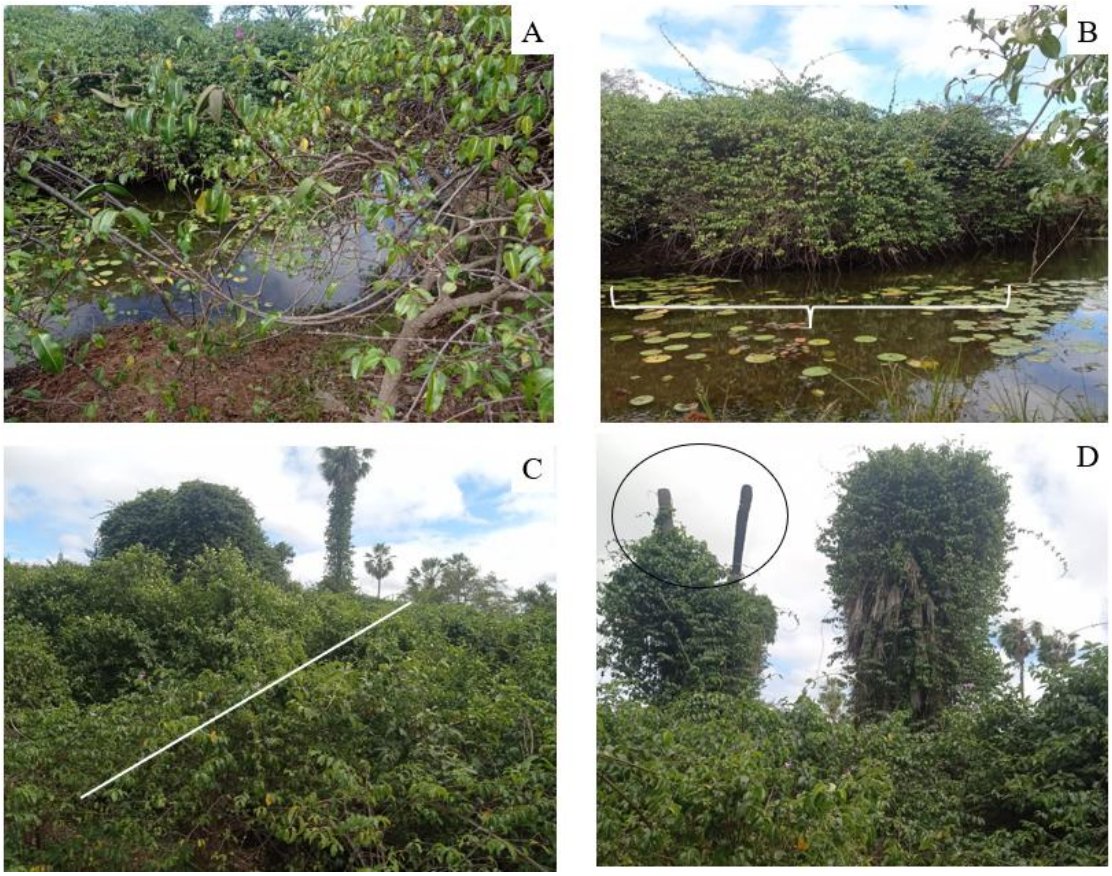
As for the environmental damage that farmers identify, 70% say that in the region this invasive alien species has already caused the death of species native to the region, such as: *Copernicia prunifera* (Mill.) H.E.Moore; *Sarcomphalus joazeiro* (Mart.) Hauenschild; *Melanoxylon brauna*; *Xiquexique gounellei* (F.A.C.Weber ex K.Schum.) Lavor & Calvente (Figure 3); and *Aspidosperma pyrifolium* Mart. & Zucc..While 30% of those interviewed said that they did not know how to report environmental impacts (Table 1). In this case, the lack of perception of environmental impacts seemed to be related to a lack of understanding of how the presence of this invasive plant was affecting the environment. The decrease in recruitment of native species is probably related to the high biomass production in invaded areas, along with their climbing habit, which causes a reduction in light intensity, limiting the natural regeneration of native species (ANDRADE, 2013).

Figure 3 - Invasion in areas of *Xiquexique gounellei* (A - C).

Source: prepared by the authors (2025).

With regard to the impacts of this invasive species on water resources, all the interviewees reported that, in the areas where it occurs, access to streams, dams and ponds becomes unfeasible (Table 1). The species forms a dense barrier that completely prevents passage, making it difficult for both humans and water-dependent animals to access (Figure 4A-D).

Figure 4 - Invasion of *Cryptostegia madagascariensis* on river banks (A and B) and in areas where *Copernicia prunifera* occurs (C and D).



Source: prepared by the authors (2025).

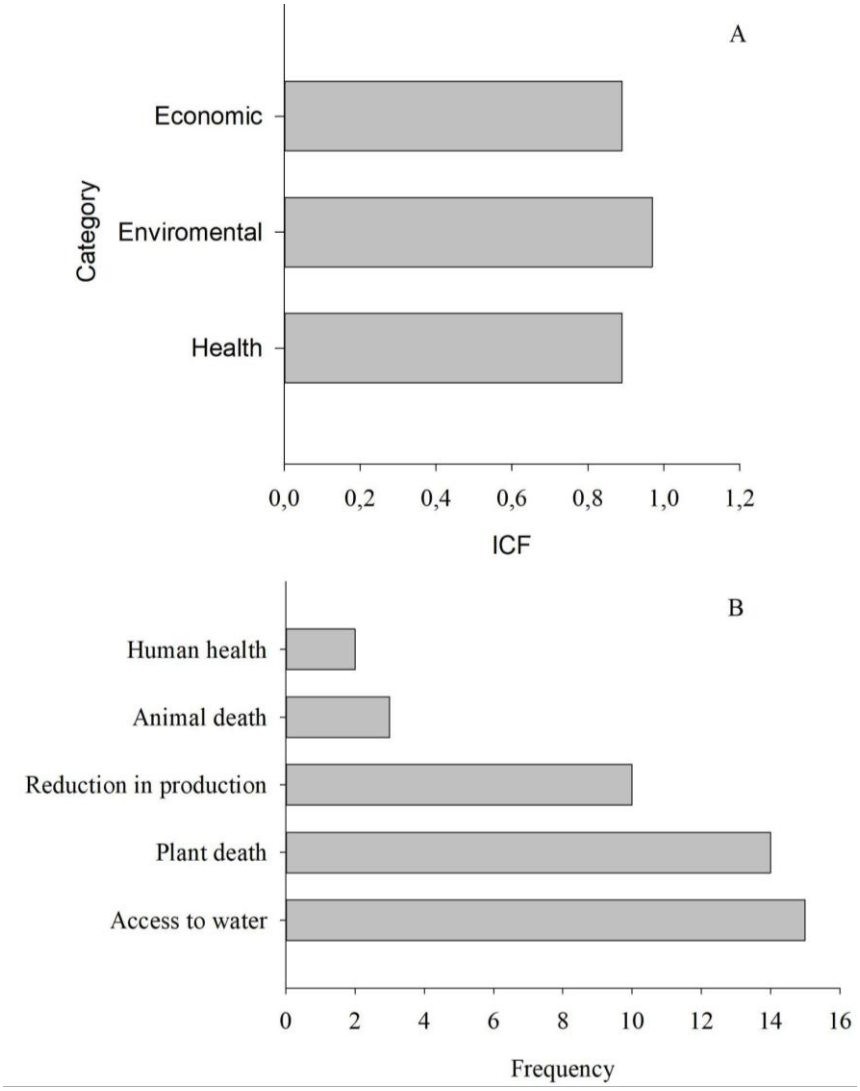
Other undesirable effects of invasive alien species reported less frequently were reduced water flow and quality, and restricted human mobility. In Kenya, the spread of *Prosopis juliflora* (Sw.) DC. restricted the local population's access to water sources and caused digestive and feeding disorders in livestock (KELSCH et al., 2020). Shackleton et al. (2017), state that the presence of the invasive *Lantana camara* has reduced the availability of natural resources, such as native medicinal plants, and has hindered the movement of people and livestock.

In a survey on the perception of invasive alien species, Shrestha et al. (2019), observed that farmers were aware of the direct and immediate negative impacts they cause on their

livelihoods, biodiversity and ecosystem services. In general, it was observed that most farmers are aware of the effects that *C. mandagascariensis* causes in the region.

Farmers report various impacts caused by *C. madagascariensis*, the main ones being the effects on access to water and the death of native species (Figure 5A). According to Araújo (2017), *C. mandagascariensis* can be an aggressive invader due to its rapid growth and the ease with which its seeds can be dispersed by wind, water, animals and humans. In the study region, it is possible to observe a large agglomeration of them in riparian forests.

Figure 5 - Main impacts caused (A) and Informant Consensus Factor (ICF) (B) by the invasive *Cryptostegia madagascariensis*.



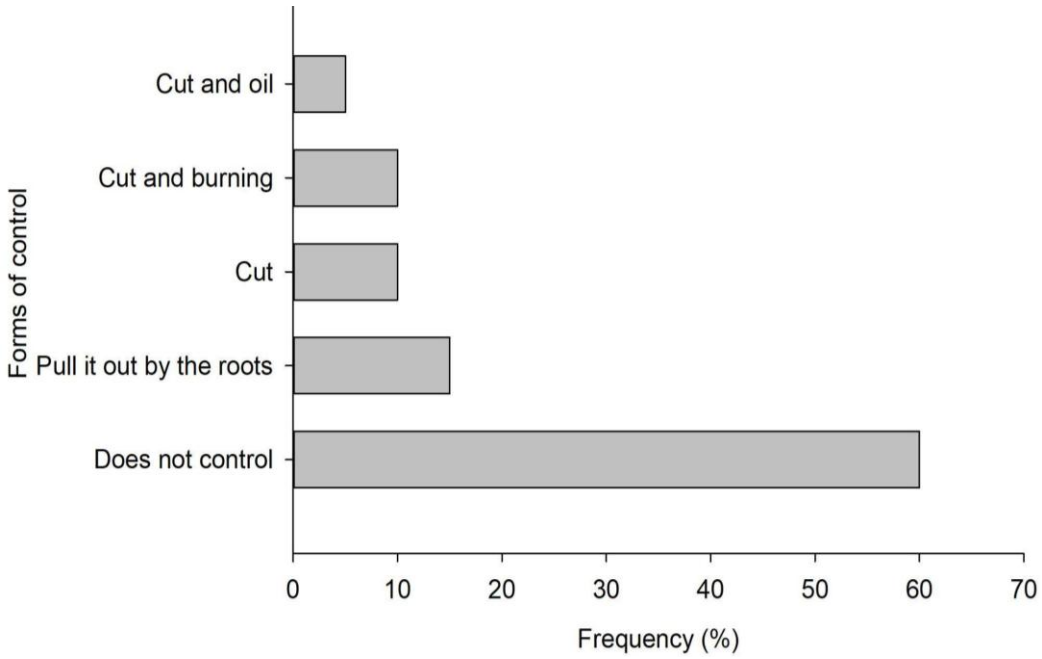
Source: prepared by the authors (2025).

The ICF values show that the farmers interviewed reported similar damage in the categories we surveyed, health, environment and economic. The highest ICF was in the environmental category, with 0.97 (Figure 5B). Negative impacts on the environment

(displacement of native plant species, among others) are one of the most common damages (POTGIETER et al., 2019).

All the farmers interviewed reported that the presence of the invasive plant has increased significantly in recent years in the region. As for the control practices adopted, 5% said they cut the plant and apply oil; 10% cut followed by burning; another 10% use cutting alone; and 15% reported that, because they recognized the ineffectiveness of cutting alone, they opted to manually uproot the young individuals in an attempt to prevent spread. A worrying fact is that 60% of farmers said they did not use any control method, despite the numerous negative impacts attributed to the species (Figure 6).

Figure 6 - Methods used by farmers to control *Cryptostegia madagascariensis***.**



Source: prepared by the authors (2025).

The methods used by farmers in Parambu are mechanical and easily available to them. In general, non-chemical methods are the most common approach worldwide for trying to control invasive plant species with a view to the restoration process (WEIDLICH et al., 2020). Although the interviewees reported that cutting alone is not enough to eliminate this invader. During the conversation, they said that even when they mow their properties, new seeds arrive through dispersal from neighboring properties.

Faced with a scenario in which there is still no efficient control method to eliminate this invader, small efforts to contain its expansion are important. In the long term, this can help maintain biological diversity (ZAVALETA et al., 2001).

CONCLUSIONS

The biological invasion of *C. madagascariesis* causes different impacts according to the farmers. Most of them know this species by the name of the happy widow and it has been occurring in the region for more than 15 years. Damage to health, the economy, the environment and services such as water supply was identified. Among the damages cited were the death of animals, a reduction in crop productivity and the death of important native plants caused by its occurrence. Farmers use control methods such as mowing, cutting and the application of oil and burning, but these methods are not effective in combating the development of this species, especially in environments close to the river.

It is understood that after its introduction into an environment it is necessary to have appropriate interventions so that the environment is not invaded. To this end, it is of great importance that farmers are aware of the impacts caused by *C. madagascariensis* and understand that preserving native vegetation is important so that ecosystem services are available.

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