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ADVENTURE IN THE TROPICS: JOINING FORCES TO HEAL THE BRAZILIAN ATLANTIC FOREST

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YOUNG REVIEWERS:


EMANUELE
AGE: 15


GIORGIA
AGE: 15


SAMUELE
AGE: 15


SANTIAGO
AGE: 8

Imagine a magical place with tall trees and amazing animals—the tropical forest. But these forests are disappearing, and we want to make the world better by bringing back their beauty. Restoring forests also helps fight climate change and keeps plants and animals safe. However, we cannot do everything at once, so we need a plan. Planting trees costs money, but some scientists have found that certain forests can grow back all on their own! This is excellent news, but we must also be careful to help other very important places that cannot regrow alone. We need a plan to bring back the forests that can regrow on their own and those that cannot. Ideally, if everyone joins, the cost will be minimal. By working together with nature, we can make the forest healthy again!

This article was written with important contributions from Emmily Gastauer from the Colégio Militar de Belém.

FOREST RESTORATION—KNOWING WHERE TO START

Tropical forests are globally disappearing due to the expansion of pastures and farmlands. To make the world a better place, we need to stop this negative trend and bring back these beautiful ecosystems. Replacing forests is called **forest restoration**, and it helps us fight climate change and protect plants and animals [1]. Large areas of tropical forests need restoration, but we cannot do everything at once. So, how do we decide which areas to restore first?

Planting trees is expensive. Some researchers are searching for smarter ways to restore forests to reduce costs. One possibility is called **natural regeneration**. This means letting the forests grow back by themselves without planting new trees. Natural regeneration works better in places with more forests, while places without forests nearby may have a more challenging time growing back on their own. A recent study found that lots of damaged land in the Brazilian Atlantic Forest can grow back naturally. This can prevent tons of carbon dioxide from getting into the atmosphere, which helps to fight climate change, and create habitats for many plant and animal species [2].

While natural regeneration seems like a beautiful solution, we must be careful. If we just let all forests grow back naturally, we might miss some important areas. Many sensitive areas have suffered illegally from **deforestation** and may not regrow on their own, so we should immediately take care of these areas. Some of these areas can contain many rare species or fragile habitats such as springs, river banks, or mountaintops—some of which are protected by a Brazilian law called the **Brazilian Forest Code**.

When we work to restore forests, it is important to make sure restoration efforts are distributed fairly to everyone who owns the land (Figure 1). We do not want all the restoration work to go to those who might not have a strong say in politics, like small farmers who just grow food for their families. Everyone should help, and we do not want more vulnerable people to have too much work while the influential owners of large farms keep doing things the easy way. Further, when we bring back forests on farmland, the farmers might lose money because they can no longer use the land for farming. These are called opportunity costs and depend on what (and how much) farmers are growing on the land. So, adding it all up, forest restoration might end up costing more than just the money spent on planting trees!

To plan restoration efforts, we analyzed the possible consequences on both the environment and people, such as farmers, so we could prioritize which areas to restore in the Brazilian Atlantic Forest. To

TROPICAL FORESTS

Forests that are found in warm regions near the equator with dense vegetation and where many different animal species live.

FOREST RESTORATION

Planting trees and taking care of them to regrow a forest in an area impacted by deforestation or other damaging factors like wildfires.

NATURAL REGENERATION

The ability of forests to regrow on their own without human help. Regeneration is greater if extensive forests exist near a deforested area.

DEFORESTATION

Removal of trees from forests to build cities, roads, or farms, which causes harm to all kinds of species living in the forest and even the climate.

BRAZILIAN FOREST CODE

Laws in Brazil that protect ecologically sensitive areas, such as riverbanks, springs, lakes, steep slopes, and mountaintops, from logging and other impacts.

Figure 1

To choose which areas of the Brazilian Atlantic Forest to restore first, we must include all the unique places where animals and plants live while ensuring that everyone plays a fair role in helping to fix things.

Figure 1

do this, we analyzed the land in terms of its potential for natural regeneration while also considering types of land ownership.

POSSIBLE FOREST RESTORATION PLANS

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It can refer to all the different species of plants, animals, fungi, and other organisms that live on Earth or in a particular area.

ECOLOGICALLY SENSITIVE AREAS

Natural areas that need extra care and protection because they are unique and home to rare species of plants and animals.

The Brazilian Atlantic Forest is a global **biodiversity** hotspot that spans 1,110 million hectares (a football pitch is roughly around 1 hectare in size) along the Brazilian coast. This forest has been highly damaged in many areas and requires ambitious restoration goals, with a target of restoring 15 million hectares of forest by 2050.

First, we wanted to know how the potential for natural regeneration is distributed among various land cover types, such as pastures, soy plantations, sugar cane crops, **ecologically sensitive areas**, and farm size. To do so, we combined a map showing the natural regeneration potential [2] with a map of land-cover types [3]. To include ecologically sensitive areas, we mapped all ecologically sensitive areas [4]. Finally, we added information about land ownership [5], which we classified into urban areas, public areas (including conserved lands and indigenous lands), private farms (separated into small, medium, and large farms), and areas without information.

We then created two plans to restore 15 million hectares of the Brazilian Atlantic Forest. Plan 1 focuses on places where trees can grow back by themselves, which is called natural regeneration. In Plan 2, we give nature a little hand by planting trees where they cannot grow back on their own. This helps bring back forests in all the ecologically sensitive areas. We also figured out which areas have the lowest overall restoration costs: the cost to plant trees plus money losses because restored areas can no longer be used for farming.

To restore an area with zero natural regeneration potential, we determined that it would cost US$ 5,482 per hectare, while an area with

100% natural regeneration potential costs nothing to regenerate. The amount of money that farmers no longer earn because their farming is interrupted was also estimated for each area based on the various types of farming, like cattle raising or soy farming [4].

WHERE FORESTS CAN REGROW—AND WHERE THEY CANNOT

We found more than 15 million hectares of ecologically sensitive areas protected by the Brazilian Forest Code in the Brazilian Atlantic Forest. The bad news is that about half of this area is seriously damaged and must be restored immediately. This is 10,000 times the area of New York City! Even worse, only 38% of this area can regrow by itself, while 62% will depend on tree planting to recover (Figure 2).

Figure 2

Comparison of two plans for forest restoration activities in the Brazilian Atlantic Forest (image designed using icons from Flaticon.com).

Figure 2

Furthermore, forests that can regrow by themselves are concentrated in a land-use category called Mosaic of Agriculture and Pastures that provide livelihoods for the most vulnerable Brazilian citizens. However, the area that can regrow by itself in huge plantations is ten times smaller! Another shocking result of our research was that small rural properties hold 2.5 times more areas that can regrow by themselves than large rural properties.

So, if we opt for Plan 1 and let nature recover 15 million hectares in the Brazilian Atlantic Forest, we would restore more places from the Mosaic of Agriculture and Pastures than places in large plantations. This would impact the farming activities of vulnerable people and small farm owners, while large farming companies would continue their business as usual.

PLAN 2 IS THE BETTER WAY

Plan 2 is a fantastic way to help nature. Plan 2 aims at planting new trees where needed to repair all the special places currently not covered by forests. This is good for nature and for people. The restored areas will be protected by the Brazilian Forest Code so that they will be safe from damage, including future deforestation. Further, Plan 2 helps to reforest regions that do not have many trees left, which brings animals and plants back to regions where they have been lost.

Plan 2 also makes sure that all landowners become involved, especially those with enormous properties. Although Plan 2 costs more to implement, it also saves money in the long term compared to just letting nature do its thing. This is so because the money spent on trees is less than when farmers stay a long time without farming. So, it is smarter to choose areas that are not so good for farming to help forests get better.

MOVING FORWARD

Saving forests is crucial for animals, plants, people, and the planet. In this article, we showed that a mix of letting nature grow back on its own and planting new trees is the best way to help the Brazilian Atlantic Forest. This helps the environment, spreads costs fairly, and does not cost too much. Now that we have a plan, it is time to put it into action! For that, we must figure out which trees to plant to help animals affected by deforestation. There are some challenges, like making sure we have enough seedlings for planting or checking how well the restoration is going. Currently, we are developing procedures to check how animals repopulate the regrowing forests. We also need to make sure everyone joins in. Teamwork is key and, by working together, we can make a big difference in saving our forests and helping all the plants and animals that call these forests home!

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CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

AI TOOL STATEMENT: The initial drafting of the article was performed by the authors using a text editor. Subsequently, the text was refined with the aid of ChatGPT, which was developed by OpenAI to enhance clarity and coherence, with a particular focus on making the language more accessible and kid-friendly. The text underwent revisions to reflect the authors' intended message accurately. While AI tools have significantly contributed to presenting complex scientific concepts in a more understandable format, the authors are responsible for the accuracy, interpretation, and conclusions drawn from the information.

YOUNG REVIEWERS

EMANUELE, AGE: 15

I am Emanuele and I am at the third year at the GB Grassi scientific high school in Latina. I found this work very interesting because the topic covered is very close to my heart. I think it is very important to involve more kids with these initiatives.

GIORGIA, AGE: 15

Hi, my name is Giorgia and I am in my third year of scientific high school. I have always had a passion for the world around us and I do not like the fact that it can be destroyed by human beings at all. I think we should all, even if in a small way, contribute to the recovery of our planet.

SAMUELE, AGE: 15

Hi, my name is Samuele. I live in Latina and I am in my 3rd year of scientific high school at the G.B. Grassi. I am very passionate about scientific subjects such as biology, math, and physics. I really liked this marine biology course and it made me discover many things that I did not know, including how to review a scientific paper.

SANTIAGO, AGE: 8

Hello, I am Santiago and I am 8 years old. I like to build 3D-puzzles, play video games, and play at the park with other kids. I love reading adventure books and drawing.

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