The Relationship between Amazon Rainforest Deforestation and Economic Development

Jiaqi Xu [1,*,†], Qinglin Zeng [2,†], Ziheng Zhang [3,†]

[1] Department of Social Science, University of California, Irvine, U.S

[2] High School Affiliated to Nanjing Normal University

[3] Diablo Valley College, Pleasant Hill, U.S

* Corresponding Author Email: xuj11@uci.edu

† These authors contributed equally.

Abstract. The Amazon rainforest is the largest and most species-rich tropical rainforest on Earth. It not only absorbs carbon dioxide, but also produces oxygen. It produces 10% of the oxygen supply every year. When people destroy rainforest, it not only affects the economy, but also the species. For example, some animals used to live on the edge of the forest, but now the trees on the edge have been cut down and can only live deeper, but there are many ferocious animals living in it, which may kill them or even cause species extinction, so the biological system is affected by Seriously disrupted, the cycle of the animal food chain could become disjointed. Therefore, how to protect the economy from damage while protecting the rainforest has become a hot topic. Since the damage from the destruction of the rainforest is most evident in Brazil, it deserves more attention. This article will provide an in-depth understanding of the relationship between rainforest and the economy from a number of different perspectives, as well as social, personal and governmental recommendations for improved rainforest maintenance.

Keywords: Amazon Rainforest, Economic, Environment, Cost and Benefit Analysis, Policy.

1. Introduction

The topic of this paper is to study the economic impact of Amazon rainforest deforestation, and it illustrates this topic in three ways. First, the Amazon rainforest used to cover 7 million square kilometers. But now, due to the excessive deforestation by people. The area has shrunk by 3,988 square kilometers. In this case, it has turned from the "lungs of the earth" to a source of carbon emissions. It has seriously affected the climate and the environment. With the disappearance of trees, local communities have turned to less profitable cattle grazing and farming, and land fertility has rapidly declined. The quality of life has relatively declined and the land is often abandoned. This also has a negative impact on the economy. Our group mainly uses cost-and-benefit analysis to weigh the relationship between economic development and environmental protection. In addition, deforestation has destroyed local biological systems and even led to the extinction of some species, which has become a factor for our group to consider whether to enhance environmental protection.

2. The relationship between Amazon deforestation and Brazil's economic

2.1. The impact of ranching and agriculture

From figure 1 below, we can clearly see that there are many factors that can be the drivers of deforestation in the Amazon rainforest, and the most serious one is ranching (raising livestock), which accounts for 63 percent. Matt Finer, Amazon Conservation Association's director and senior research expert, also supposes that livestock can be the dominant factor of deforestation. In the late 20th century, pasture activity and large-scale subsistence agriculture led to an increasing deforestation region. Until 2000s, more than three-quarters Amazon rainforest's deforestation was used for raising cattle (Butler) [1]. 3,980 square kilometers or more of the Amazon rainforest were destroyed, according to data from Brazil's National Institute for Space Research (INPE), approximately 5 times

New York City (Roy) [2]. Besides, from the scatter plot shown above (Fig.2), we can also find that there is a positive relationship between the change in crop and pasture area and the change in the deforested area, which means that the higher the pasture and crop area is, the higher the deforested level is. Though it is not a strong correlation, it gives us a hint that these two things have a positive relationship, so the pasture might be one of the factors or drivers of deforestation.

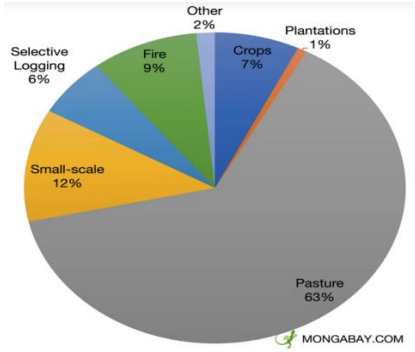

Figure 1. Deforestation factors in Amazon rainforest (Data source: World Resources Institute)

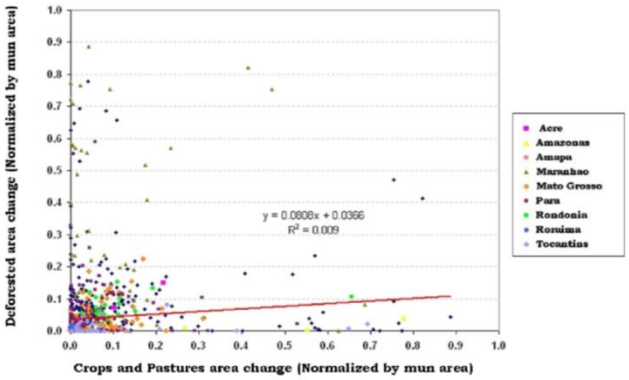

Figure 2. Scatter plot of the relationship between the change in crop and pasture area and the change in a deforested area (Data source: Barona)

This satellite map from the University of Maryland (Fig. 3) shows that a majority of Brazil's deforestation occurs on major roads, shown on the map as highways 163, 230, 319, and 364 [3]. These roads are majorly located in the southeastern and east parts of Amazonas, Rondônia, Pará, and Acre, which are the main hotspots for both cattle grazing activities and other agricultural production that depends on these roads to transport goods in and out of the rainforest.

Figure 3. Hotspots result of University of Maryland satellite result (Data source: Image Courtesy of MAAP)

What this paper have to admit is that cutting for pasture indeed brings many economic benefits, such as new business opportunities, new investment, etc. From the plot (Fig. 4.), the relationship

between income and deforestation suggests that deforestation is positively associated with higher income levels (GDP per capital shown on the graph), meaning that deforestation might somewhat lead to higher GDP and economic development. But the problem is, based on research in Journal Science, even though deforestation for ranching in Brazil's Amazon rainforest may bring quick returns to local villagers, it usually ends up leaving the area as poor as previous one. The study shows deforestation to clear land for ranching or agriculture usually has a short-term impact on the local economy due to the fact that the new resources deforestation brings always attract investment and development, including new roads [4-5]. But, after analyzing the education and income level and life expectancy in 286 Brazilian communities, the researchers concluded that once resources are depleted, the level of development in an area that has undergone deforestation is no different from that area before deforestation, and the land used for ranching before will be finally abandoned (Ewers) [5]. In all, these are all short-term development at the expense of long-term destruction. But, for the promising development of the Amazon rainforest, what people should focus on is its long-term effect, instead of the short-term profit spur. So, here comes the question, how can environmental protection balance with economic growth?

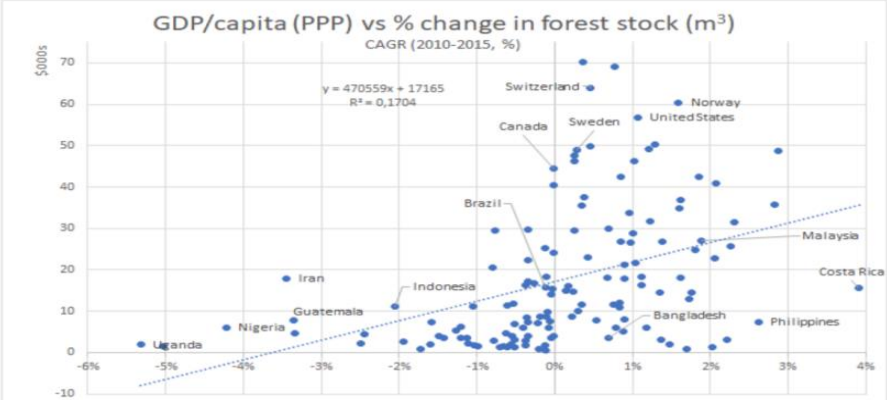

Figure 4. The relationship between GDP/capita and recent change in forest stock (Data source: World Bank and UN Global Forest Resource)

Under this circumstance, the cost-and-benefit analysis can be used to make decisions. The paper written by Andersen compared the total economic value of the Amazon rainforest with the net present value of other ranching lands. At today's deforestation levels, the result shows that the possible benefits of deforestation outweigh the expected costs (Andersen) [6]. However, such costs will rise when the size of deforestation increases, and it will eventually exceed the value of ranching land. In the long run, deforestation of tropical rainforest will have a significant economic impact, costing pasture and agriculture a striking $422 million per year. Therefore, the benefit of rainforest conservation seems to outweigh the cost it brings based on a cost and benefit analysis, which means that protecting the Amazon rainforest might be the most appropriate method at the moment. Or, a more brilliant suggestion is that the government should produce some environmentally friendly products or investments to simultaneously protect the rainforest while developing their economy.

Take the International demand for beef and soybeans for instance, it drives ranchers to clear land for these products. As the world's largest exporter of beef and soybeans, Brazil exports about 1.64 million tons of beef to its major markets, and data shows that exports of these products exceeded $35 billion by 2020. Such a high demand leads to higher supply and thus severe cutting, making the deforestation level in the Amazon rainforest become even worse. In 2006, a moratorium on buying soybeans from newly deforested areas took effect. The agreement is called the Soy Moratorium, and its central idea is that the company will not buy soybeans from soybean traders whose supply comes from clearing the rainforest (Greenpeace) [7]. Due to this moratorium, since 2008, less than 2 percent of the soybeans grown in the Amazon came from deforested areas, and meanwhile, the total deforestation declined by 84% and remained on a downward trend since 2012 [8]. More surprisingly, due to the fact that this Soy Moratorium innovates the existing farmland to make sure that soybean

production in the Amazon occurs only on this land, despite the reduction in soy-related deforestation, soy production in the Amazon increased by 400% compared to 2006, demonstrating that agriculture production can be increased when protecting rainforest (FAIRR Initiative) [9]. With such an innovative shift from a single-cropping system to a double-cropping system - a system in which farmers grow and harvest two crops continually on the same plot of land within the same year - farmers can take full advantage of the limited growing season and increase their net benefits to a large extent (Chakravorty) [10]. This is the so-called green innovation that protects the rainforest and increases economic profit at the same time.

2.2. The impact of ecosystem

The cost-benefit analysis above has illustrated how deforestation will have a significant impact on Brazil's economy in the long run. The benefits of protecting the rainforest seem to outweigh the costs. In addition to using cost-benefit analysis to determine whether decisions need to be taken to protect the rainforest. The government should also consider the impact of Amazon deforestation on Brazil's economy.

The World Economic Forum claims that ecosystems make a contribution to more than fifty percent of the world's GDP (even up to $44 trillion). And according to Chris Arsenault, the Brazilian part of the Amazon rainforest emitted a net of 3.6 billion tons during this period [11-13]. Over time, the Amazon rainforest has gone from being the "lungs of the earth" to being a source of carbon emissions that pollute the environment. The destruction of the Amazon forest ecosystem and its high carbon emissions due to environmental degradation and increased deforestation will have a serious impact on the Brazilian economy.

In an article written by Carrero and some other researchers, they are appalled by the accelerating deforestation in the Amazon. In the article, researchers expressed concern about the “tipping point”. This leads to a collapse in the rainfall cycle that keeps the conditions of moisture, including North America, South America, and some other regions of Europe [14]. Of course, the Amazon rainforest ecosystem is also involved. Researchers also note that such reduced rainfall will do harm to agricultural production and continental food security.

At the same time, people are likely to face more frequent and intense droughts because of climate events, reduced moisture, and increased forest fragmentation. Besides, the droughts also make fires more intense, leading to a more destructive fire season. Fires reduce the size of forests and increase the rate at which rainforest disappear.

As mentioned in a journal posted on PLOS ONE by Daniel and some other fellow authors, a majority of the world's forests play a part in protecting soil carbon storage and maintaining watershed functions. The abundance of forests is also related to the biodiversity of the forests. At the present time, the frequent fires caused by the massive felling of trees in the tropical rainforest will lead to a massive reduction of forests. The regeneration of tropical rainforest is particularly important in the wake of forest decline. The regeneration of tropical rainforest requires seed dispersal. In the tropics, the main vectors of seed dispersal in open areas (i.e., the darkened land created after a fire) are birds and bats. Although it is generally accepted that seeds can be dispersed by rain, wind, and gravity, the seeds that can be dispersed by rain, wind, and gravity are mostly small and light. The effect of wind and gravity is also small. Animal dispersal has been shown in many studies to be overwhelmingly dominant. For example, it was reported that in the early forests of the Venezuelan Amazon, seeds spread by bats and birds had greater input than those dispersed by wind [15]. However, large seeds (seeds dispersed by animals) did not disappear as quickly as small bugs but were passed on. From the above arguments, it can be inferred that if heavy deforestation and frequent fires reduce biodiversity, then it may affect the recovery time and the extent of forest recovery after fires and deforestation. If this situation continues, a vicious cycle may be formed. Eventually, most of the Amazon rainforest will not be able to reach its original level of prosperity and may even disappear. The loss of the Amazon forest would affect precipitation worldwide and reduce agricultural production beyond the

region's borders. If agriculture in nearby countries suffers, the economy of that country may also be influenced.

When deforestation in the Amazon increases carbon dioxide emissions. This will damage the environment and reduce the air quality around the Amazon forest and may cause air pollution in the long term. When nearby residents live in an environment with air pollution for a long time, it may increase their incidence of lung disease. It is possible that the government needs to spend more on health care. But higher health care costs than before are likely to be borne by local residents. Local residents may have to pay higher taxes than before to fill the fiscal gap caused by higher government payments for health insurance. This could increase income inequality and widen the gap between the rich and the poor.

As the impact mention before, the Brazilian government needs to stop the deforestation of the Brazilian rainforest if it wants to stop the economy from being affected by the destruction of the ecosystem. This is not an impossible task, as Brazil has come close to success before. Between 2004 and 2012, damage to the Amazon rainforest fell sharply as Brazilian authorities tightened environmental regulations while rewarding communities in the Amazon basin for finding alternative ways to generate income without reclaiming the rainforest. In less than a decade, 80% of rainforest deforestation was reduced.

Similarly, in this article mentioned above, the authors note that every year's deforestation rate in the Brazil's Amazon declined by 80% between 2005 and 2012 and speculate that this decline is related to the reduced participation of medium and large landowners. The decrease in participation of medium and large landowners may be due to dysfunctional agreements, government's policy interventions, and unfavorable currency exchange rates. However, until 2018, the annual deforestation rate in the Amazon rainforest had skyrocketed to 122%. According to these data, it is clear that the policies implemented by the Brazilian government between 2005 and 2012 were effective in reducing the deforestation rate in the Amazon region. However, the government has not consistently implemented policies to keep the rate at a relatively low level.

3. Results

Over ranching and agriculture both do harm to the environment of Amazon rainforest. These damages will threaten the ecological balance, but more importantly, will adversely affect the economic development, not only the local economic expansion, but also the global economic integration development. Our planet is a whole, and the global economic situation is inextricably linked. Therefore, in order to maintain the economic balance of the world, every country have to make contribution to protect the environment, weigh the relationship between the economy and the environment, and think about better solution towards various similar problems like deforestation of Amazon rainforest.

4. Conclusion

In conclusion, it is very important to protect the rainforest from being over-cut. The Amazon rainforest has countless meanings to human beings. Protecting it is to prolong the survival time of human beings. Once it is destroyed, the extinction of human beings will enter the countdown. The government must examine the interests of all parties, pay attention to their comments, manage the pace of development, and set priorities. Create national parks or nature preserves, forbid the logging of forests, and safeguard people, animals, and other living things. Improve and clarify the laws that control deforestation. These include mandating that logging businesses register and get licenses, limiting the quantity of exports and the rate of replanting saplings. enormous reforestation Create environmentally responsible tourism that protects forests while also offering amenities for employment and sightseeing. Educate the public, increase ecological awareness, and make everyone aware of the importance of tropical rainforests. Create a plan for sustainable growth and make policy

improvements. manage. distribution of resources and land usage. The objective is to preserve the ecological environment while allowing humans to use the forest so that our children and grandchildren will have adequate resources to survive on. As for individuals, they should not wantonly destroy forests for their own personal gain. Only in this way, our living environment, economy, and the species of the earth will not be too negatively affected. Our children and grandchildren have room to live.

References

[1] Butler Rhett A. (2021). Amazon Destruction. https://rainforests.mongabay.com/amazon/amazon_destruction.html.

[2] Roy Diana. (2022). Deforestation of Brazil's Amazon Has Reached a Record High. What's Being Done? https://www.cfr.org/in-brief/deforestation-brazils-amazon-has-reached-record-high-whats-being-done.

[3] Radwin Maxwell. (2021). Amazon Deforestation Map Shows Devastating Impact of Ranching, Agriculture. https://news.mongabay.com/2022/03/2021-amazon-deforestation-map-shows-devastating-impact-of-ranching-agriculture/.

[4] XPRIZE. (2020). Economic Benefit of Saving the Amazon rainforest. https://www.xprize.org/prizes/rainforest/articles/economic-benefits-of-saving-the-rainforests.

[5] Yale E360. (2009). Benefits of Deforestation in Brazilian Amazon are Temporary. https://e360.yale.edu/digest/benefits-of-deforestation-in-brazilian-amazon-are-temporary.

[6] Andersen Lykke E. A cost-benefit analysis of deforestation in the Brazilian Amazon [D]. Institute of Applied Economic Research, ECONSTRO, 2015.

[7] Greenpeace USA. (2016). 10 Years Ago the Amazon Was Being Bulldozed for Soy — Then Everything Changed. https://www.greenpeace.org/usa/victories/amazon-rainforest-deforestation-soy-moratorium-success/.

[8] Kastens Jude. Soy Moratorium Impacts on Soybean and Deforestation Dynamics in Mato Grosso, Brazil [J]. PLOS ONE, 2017.

[9] FAIRR Initiative. (2020). Amazon Soy Moratorium. https://www.fairr.org/engagements/amazon-soy moratorium.

[10] Chakravorty, Adityarup. Maximizing Returns from double-crop soybean [J]. Crop Science Society of America, 2021.

[11] Arsenault Chris. (2021). New Study Offers Latest Proof That Brazilian Amazon Is Now a Net CO2 Source. https://news.mongabay.com/2021/09/new-study-offers-latest-proof-that-brazilian-amazon-is-now-a-net-co2-source/.

[12] Ionova Ana. (2022). Will Brazil Really Save the Amazon? https://www.bbc.com/future/article/20211028-how-much-action-is-brazil-taking-on-climate-change.

[13] Action Aid Recycling. (2021). The Economic Effect of Deforestation. https://actionaidrecycling.org.uk/economic-effect-of-deforestation/.

[14] Carrero G C, Fearnside P M, do Valle D R, de Souza Alves C. Deforestation trajectories on a development frontier in the Brazilian Amazon: 35 years of settlement colonization, policy and economic shifts, and land accumulation. Environmental management [D]. Environmental Management, 2020.

[15] Daniel P, Dylan C, Florencia M, Mark A, Chadwick O, William Wayt T. Successional, spatial, and seasonal changes in seed rain in the Atlantic forest of southern Bahia, Brazil [J]. PLOS ONE, 2022.