

**FACULTAD DE INGENIERÍA**

Escuela Académico Profesional de Ingeniería Ambiental

Tesis

**Analysis of the Deforestation Process of Amazon  
from During 2001 to 2020 in Peru**

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Para optar el Título Profesional de  
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Tesis



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# Analysis Of the Deforestation Process of Amazon from During 2001 To 2020 In Peru

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# Analysis Of the Deforestation Process of Amazon from During 2001 To 2020 In Peru

Anali Chulluncuy Samaniego<sup>1</sup>, Magaly Godys Avellaneda Ponce<sup>1</sup> and Steve Dann Camargo Hinostroza<sup>1</sup>

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**Abstract.** Latin America suffers from a major problem of loss of Amazonian Forest cover, thus making Peru one of the ten most diverse countries on the planet where most of our biological diversity is found in forests and these provide us with various ecosystem services and play a very important in nature.

To calculate forest loss, the database of the "Geoforests" platform of the PNCBMCC (National Forest Conservation Program for Climate Change Mitigation) of the Ministry of the Environment was obtained, where Landsat-TM, Landsat- ETM+ and Landsat-OLI during the periods 2001-2020.

Based on the evidence, it is concluded that the Peruvian Amazon Forest, over the years, has increased hectares of loss and fragmentation of dangerous forests, predicting that by 2030 there will be almost 4 million hectares lost according to the average of annual growth, being the main causes of agriculture, illegal mining and opening of roads, prevailing the negative aspects such as the loss of biodiversity contributing to climate change.

**Keywords:** Forest loss, climate change, biological diversity.

## 1 Introduction

31% of the planet's surface is forested, which is equivalent to more than 4 billion hectares, during the years 1990 and 2020 there were 420 million hectares lost due to deforestation. Forests bring us many benefits, among them carbon reserves, reduce temperature and help us fight against environmental problems, in addition, the population benefits from forests and we depend on the ecosystem services they provide us [1].

According to SERFOR, worldwide the country with the highest forested area is Peru, occupying the tenth position, in Latin America occupies the second position with the highest forest cover. At the national level, Peru has more than 57% of the area of the humid forest [2].

In 2015, the World Wildlife Fund published "Deforestation in Peru", where they mention that the main origins of deforestation are the construction of lives, changes range in land use such as agriculture, mining commercial, and illegal logging, these problems not only afflict the flora and fauna but also generate greenhouse gases [3].

The illegal acquisition of land by miners, loggers, and farmers, the migration of indigenous populations, the increase in illegal activities, and, above all, the lack of



knowledge and cultural values, are some of the main impacts that occur indirectly on the deforestation in humid the forest [4].

In recent years the acceleration of forest loss is very worrying, and the nation's resources are affected, since a great diversity of species of flora and fauna are found in the forests, in addition to offering us goods and services for better quality. of life [5]. As the forests disappear, the ability to have breathable air is lost, as analyzed, the forests are an invaluable source, self-reflection is called for such conservation [6].

MINAM, through the virtual platform GEOBOSQUES, will generate and share monitoring information on changes in the coverage of Peru's forests, this has the purpose of supporting the conservation, prevention, and minimization of deforestation and degradation assigned to the National Program of Forest Conservation for Climate Change Mitigation (PNCBMCC)[7].

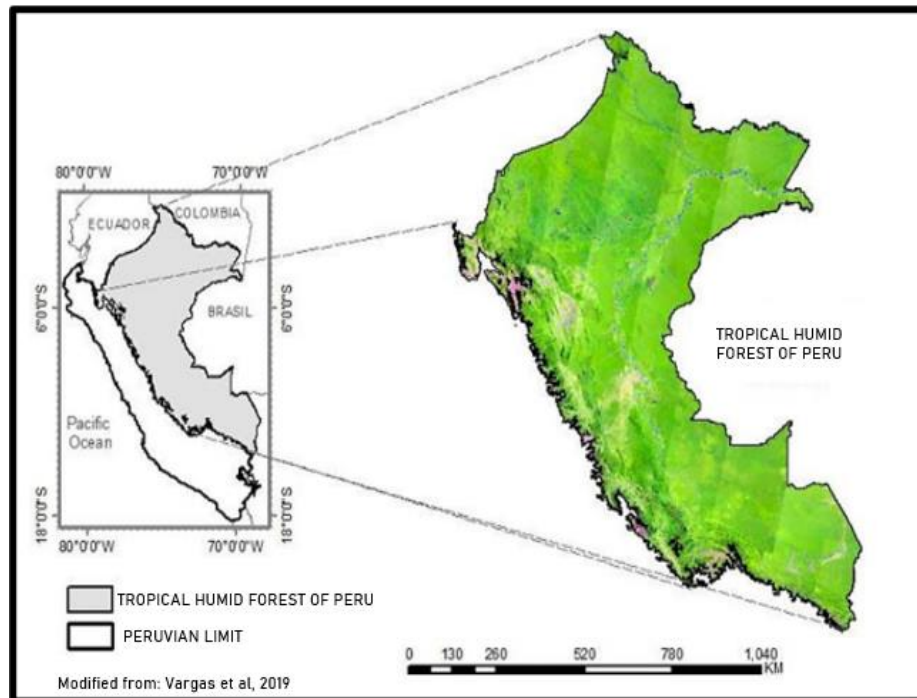
## **2 Methodology**

### **2.1 Place of study**

Peru is located in South America, to the east, it borders Brazil, to the west is the Pacific Ocean, to the north, it borders Ecuador and Colombia, to the southeast, it borders Bolivia.

The study area is limited to the Peruvian tropical humid forests, including the departments of Loreto, Ucayali and Madre de Dios, Amazonas, Cajamarca, Huancavelica, La Libertad, Cusco, San Martín, Huánuco, Pasco, Piura, Puno, Ayacucho and Junín. , whose total area reached 68,070,889 ha, with a representation of 64.3% of the country's area as of 2020, the Peruvian territory has a large area of forests, medium annual deforestation, with an inclination that is growing towards rates Increasingly high rates of forest transformation by industrial and small-scale agriculture and artisanal mining [8].

In the Peruvian tropical humid forests, the wet season is between November to May, the dry season is from June to October. During the dry season, the methods for tracking early warnings that use Landsat data show a greater event of forest loss, due to the fact because the presence of clouds and this makes the images more visible [9][10].



**Fig. 1.** Study site location (2020) **Source:**[9]

## 2.2 Sampling method

The loss of forest cover was acquired with quantitative and qualitative data that were acquired from the "Geoforests" platform of the PNCBMCC (National Forest Conservation Program for Climate Change Mitigation) of the Ministry of the Environment, this platform provides information to other different users, through a spatial and temporal analysis[11].

The PNCBMCC provides the reference for annual forest loss between the years 2001-2020 within the framework of the MNCB (Forest Cover Monitoring Module), using Landsat data. Between the period 2001 – 2011, data from the Landsat-ETM+ (Enhanced Thematic Mapper) sensor were used [12], For the 2012-2013 period, Landsat-TM (Thematic Mapper), Landsat-ETM+ and Landsat-OLI (Operational Land Imager) data were used [13][14]. Finally, for the 2014-2020 period, data from Landsat-ETM+ and Landsat-OLI were used [15][16].

In the period 2001-2016, the methodology suggested by the University of Maryland (UMD) is used [8][12][13]. This uses a supervised classification algorithm, which means that the user must create training samples manually and based on visual interpretation, this depends on the level of experience of the expert in charge of creating

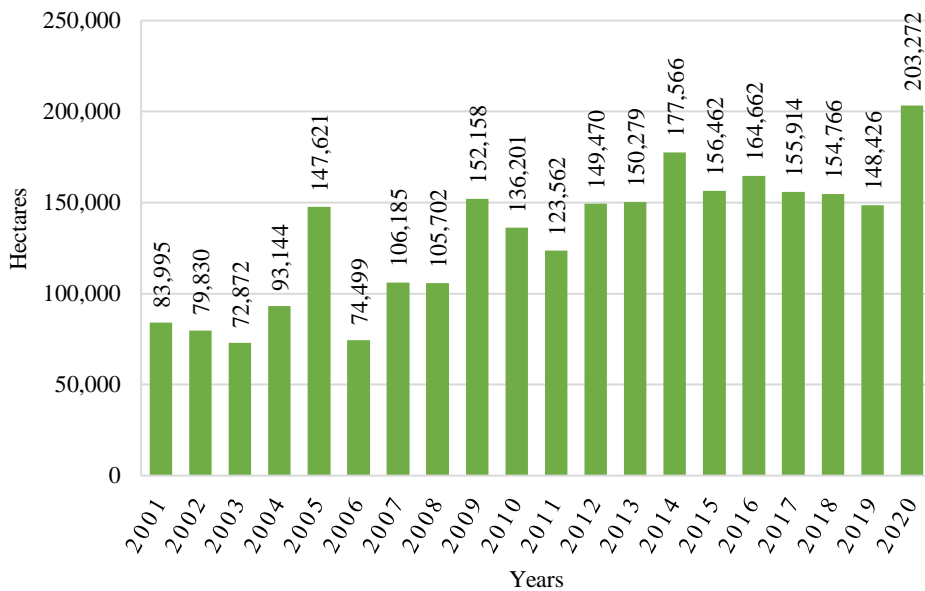
the samples, the experience of each expert cannot be measured and interpretation can be subjective.

In the 2017-2020 period, the Direct Spectral Unmixing (DSU) methodology is used, which is also used in the generation of early warnings of PNCBMCC deforestation. It is an algorithm based on MLME, it assumes that when forest cover is lost the result is a pixel of bare soil, the mixture of soil with dry vegetation or deforestation residues such as logs, which can also be mixed with standing forest, the detection is directly on the image, the expert only decides to detect up to how much percentage of forest cover loss in the pixel. Regarding the annual monitoring process, it is based on a methodological process of decision trees and the results of the loss of forest territory are finally verified and provided feedback by the National Forest and Wildlife Service (SERFOR) [17].

### 3 Results

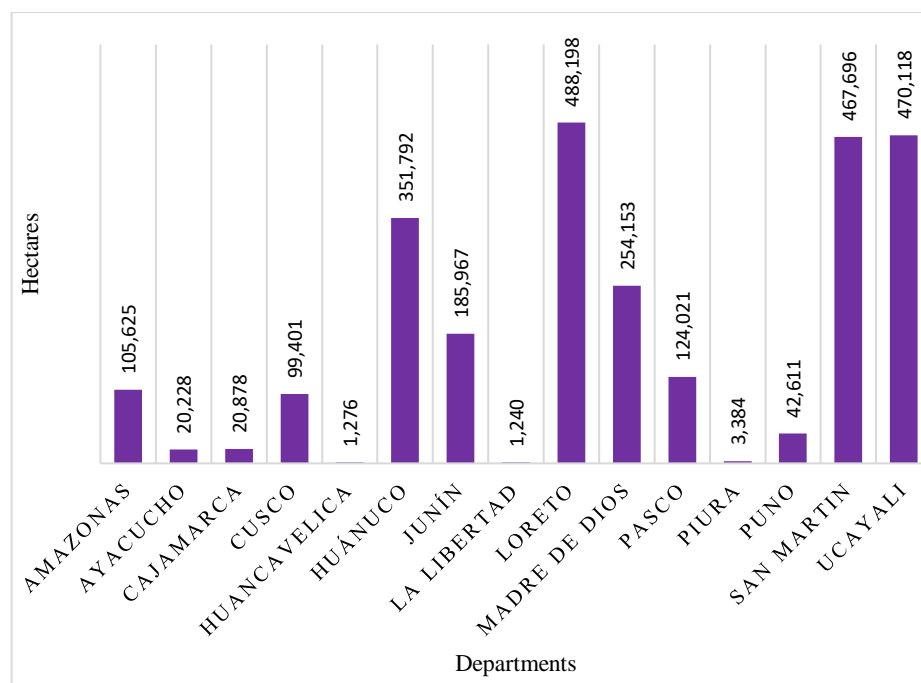
Deforestation from the period 2001 to 2020 was 2,636,586.54 ha, with an average annual forest loss of 134,346.94 ha.

According to figure 2 shown, the year 2003 was of less forest loss with 72,872 ha, and the year 2020 with 203,272 ha occurred with the greatest loss of very considerable forest concerning the other years.



**Fig. 2.:** Annual forest loss 2001-2020

During these 20 years recorded (Figure 3), the 3 departments with the most forest loss were Loreto (488,198), followed by Ucayali (470,118), and San Martín (467,696), these values being the most representative, unlike the other departments of Peru. covering the humid forest. The departments with the least loss of humid forest were La Libertad (1,240), Huancavelica (1,276), and Piura (3,384), because these departments cover less territory of Peruvian Amazonian humid forest, unlike the other departments.



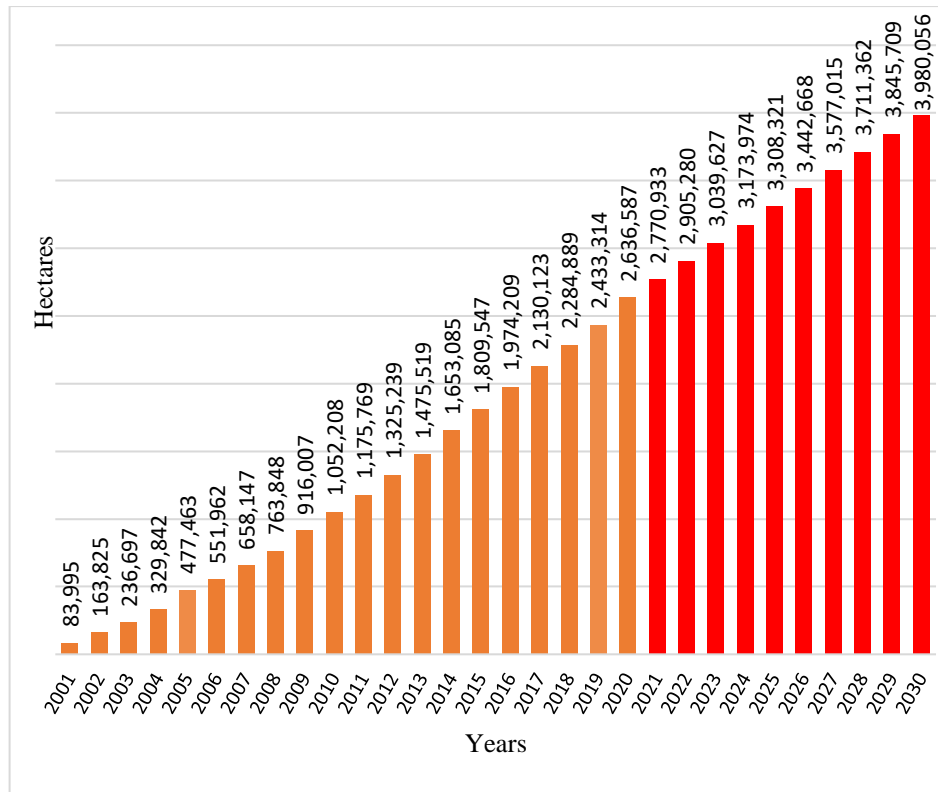
**Fig. 3.** Forest loss by departments

Table 1 shows the existing forest area as of 2020 by departments in hectares and percentages, according to the data obtained from the "Geoforests" platform of the PNCBMCC (National Forest Conservation Program for Climate Change Mitigation) of the Ministry of the Environment. It is observed that by the year 2020 the area of the existing Peruvian Amazonian humid forest is 68,070,889 ha, which represents 100% of the Amazonian humid forest of Peru until the year 2020. The departments with the largest area of forest in the year 2020 are Loreto (51.40%), Ucayali (13.59%) followed by Madre de Dios (11.55%). The departments with the smallest area as of 2020 are Huancavelica (0.03%), Piura (0.06%), and La Libertad (0.10%).

**Table 1.** Remaining forest area table as of 2020.

Forest By 2020		
Department	Ha	%
Amazonas	2,814,386	4.13
Ayacucho	205,045	0.30
Cajamarca	344,559	0.51
Cusco	3,047,979	4.48
Huancavelica	17,036	0.03
Huánuco	1,513,104	2.22
Junín	1,816,163	2.67
La Libertad	68,063	0.10
Loreto	34,990,024	51.40
Madre De Dios	7,861,327	11.55
Pasco	1,373,565	2.02
Piura	41,398	0.06
Puno	1,413,756	2.08
San Martin	3,313,357	4.87
Ucayali	9,251,130	13.59
Total	68,070,889	100.00

Figure 4 shows the dynamics of forest loss growth by 2020, the orange bars are data obtained from the MINAM platform and the red bars show the growth dynamics with an average growth of forest loss of 134,346.94 ha per year. According to the growth rate, the loss of forest by the year 2030 is predicted, estimating that by the year 2030 Peru would have 3,980,055.95 ha of Amazon rainforest lost in Peruvian territory, this being an alarming figure. These data confirm that the growth of forest loss has advanced and will continue to advance if it continues to advance at this rate.



**Fig. 4.** Increasing forest loss by 2030

## 4 Discussion

This work demonstrates the main problem in Peru, which is the loss of forest in our territory, also called deforestation, with the departments with the highest loss of the main forest being the departments of Loreto, Ucayali, and San Martín, with alarming figures during these last 20 years and the which if it continues like this will continue to affect the fragmentation of the forest much more as time goes by. The important factors that help the growth of forest loss are due to anthropic causes such as agriculture, agricultural expansion, agricultural migration carried out in an improvised and irrational way by the nearby population, livestock, as well as the openings and construction of access roads and roads [18], These, in turn, disturb the existing flora and fauna in the area, there is also illegal logging for economic purposes provided by forest species and with an end to illegal mining, this being one of the main problems in Madre de Dios [5][19][20], It is also caused by forest fires, burning of forests [21][22].

There is a great discussion of who those who represent and cause deforestation, many reports mention that they are the wood industry, such as chainsaw operators, oil workers, and miners, as well as farmers and ranchers as well as agribusiness, some

development projects, central and sectional governments, and road opening, etc [23][24].

Faced with the problem of the growth of forest loss, degradation, and/or fragmentation, it is necessary to implement, have environmental commitments, and manage projects for the restoration, management, and conservation of forests and landscapes to avoid negative impacts and factors that limit or hinder the sustainability of this problem, which due to its characteristics hurts the economy and ecology of our country.

## 5 Conclusions

The analysis shows us that our Peruvian forest is facing severe loss and fragmentation of forests.

According to the data, during these 20 years, Peru suffers from the accelerated growth of loss of hectares of forest. Of the 15 departments where the Peruvian humid forest covers, the main departments where the greatest loss of forest is generated are Loreto with 488,198 ha followed by Ucayali with 470,118 ha, and San Martín with 467,696 ha, these three departments with the highest loss figures during the years 2001-2020.

The year with a high extent of forest loss during the years 2001-2020 was the year 2020 with 203,272 ha, with an average annual forest loss of 134,346.94 ha, representing a 21.35% annual loss growth. Taking into account the average annual loss, the extensive hectares that would be deforested will be inevitable since by the year 2030 there would already be 3,980,056 ha of lost forests, this is an alarming situation, which brings and would bring consequences such as what is being experienced now the climate change.

Although we know that forests provide us with diverse and important ecosystem services and a large part of these territories that provide the highest benefits to our country are being deforested for various reasons. The main causes of forest loss in Peru are caused by anthropic activities, that is, caused by men, such as agricultural expansion and migration, construction and opening of roads, and illegal logging according to previous investigations in deforestation zones.

Due to these problems, it is necessary to promote research and technological improvement in the forestry sector. Even though our country has various normative and regulatory stocks to restore forests, some factors hinder or limit its objective of it. The issue of restoration or mitigation of forest loss should be strengthened by promoting the development of restoration programs and plans at the public or private level.

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