Graduate School of Development Studies

Impacts of Deforestation on Poverty:
Case Study of the Region San Martin in Peru

A Research Paper presented by:

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in partial fulfillment of the requirements for obtaining the degree of
MASTERS OF ARTS IN DEVELOPMENT STUDIES

Specialization:
Environment and Sustainable Development
ESD

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The Hague, The Netherlands
November, 2010

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Chapter 1
Introduction

1.1 Background

One of the most relevant environmental degradation issues reported at the international and regional spheres is deforestation. From the 1980s, the relevant literature is focused on understanding what the drivers of deforestation are because its economic, social, and environmental effects may put at risk human well-being and biodiversity for current and future generations. Even though its definition and quantification is in constant flux and evolution there is a consensus that deforestation has to be controlled and globally its expansion reduced.

In fact, the definition of deforestation was established globally by the FAO as ´depletion of tree crown cover to less than 10%´(Wunder 2000 quoting FAO 1993:10). Even so, countries created their own definition according to their particular perspectives. For instance, Peru defines it as ´the process of disappearance of forest cover, fundamentally caused by human intervention' (translation from Ministerio del Ambiente 2009:61) and 'the process of destruction of forest' (translation from Ministerio Agricultura 2005:51).

So far, the last evaluation of FAO (2010) reports reduction in deforestation among some countries yet others still maintain high deforestation rates. Indeed, it is calculated that almost 13 million hectares were converted into non-forest use land or were lost by natural causes, compared to the 16 million hectares of deforestation registered annually in the 1990s.

Along with the discussion about how we should accurately estimate forest destruction (Wunder 2000) and its role as driver of many socioeconomic and environmental problems such as climate change, sustainable development, biodiversity, and environmental services, in development studies there have been many efforts to link deforestation with poverty and poverty alleviation/mitigation.

In fact, it has been claimed that this nexus between environmental degradation and poverty could have more than one connection. Specifically, related literature has positioned poverty as driver, result, or co-factor ('downward spiral- perspective'). This relationship also becomes more complex when the poverty concept incorporates non-monetary aspects such as life expectancy as indicator of health, literacy and school enrollment as indicators of education, powerlessness, governance, capabilities, and others.

Of course these environmental problems are no strangers to Peru where the forest area is 68 million hectares, equivalent to 53% of its total national territory, and deforestation effects on average 10% of the forest areas. Policies to tackle deforestation and poverty have been built mostly in an isolated way even though connections have been suggested in the literature. Some studies (Barrantes and Trivelli 1996, Perz et al. 2005, Ministerio del Ambiente 2009, Armas et al. 2009, Zwane 2007) suggested that among the direct causes of deforestation in the Amazon rainforest are poverty and policies that promotes migration, road infrastructure, growth population, cropland extension and cattle ranching, logging extraction and forest concessions, as well as cultivation of coca for illegal purposes.

Furthermore, connections in the reverse way have been suggested. In other words, deforestation may be producing negative social and environmental impacts which diminish quantity and quality of assets, entitlements, and capabilities of the poor. So far the World Bank (2007) has estimated that the cost of deforestation is approximately 0.2 percent of country's GDP in 2003 taking into account only direct and indirect use forest values lost. However, neither official publications such as The National Reforestation Plan nor other studies (Ministerio del Ambiente 2009, Armas et al. 2009) have defined the magnitude of such impacts specifically on poverty. Consequently, this research is looking to fill this information gap in order to help improve future interventions and enhance environmental insights.

This paper is divided in five parts. First, the specific research questions and sub-questions that this research paper will respond to are presented. Second, an overview of current deforestation and poverty in Peru and in the study area is developed. Third, the theoretical framework, including the conceptual background is discussed. This part comprises a review of environmental degradation and poverty theory and the benefits of forest for poverty alleviation approach. Four, the data analysis and results will be shown where we will detail data collection methodology used to support our conclusion in the last chapter.

1.2 Objectives of the Study

This research aims at evaluating and explaining effects of deforestation on poverty taking as case study the region of San Martin in Peru. In this process, the study intents to respond the following main research question: Can an increase/reduce in poverty level be attributed to deforestion?. Complementary, the sub-questions addressed in this study are:

i. What is the magnitude of the impact of deforestation on poverty?
ii. How can the relationship between deforestation and poverty be explained?

Chapter 2
Deforestation in Peru: Case of Region San Martin

Overview of deforestation in Peru

Peru holds a forest area of 68 million hectares covered by natural forest which is equivalent to 53% of its total national territory and almost all this forest is located in Peruvian Amazon rainforest (Barrantes and Trivelli 1996, Ministerio del Ambiente 2009). According to Ministerio de Agricultura (2005), the total Peruvian deforested area in 2004 was 7.3 million hectares. The Peruvian regions with higher deforestation rates were San Martin (1.62 million hectares), Loreto (1.1 million), and Ucayalí (964 thousand hectares). This regional information reveals an increase in deforestation in the country taking into account that Ministerio de Agricultura (2010) estimated 7.1 millions of deforested hectares in 2000. In this later context, the most deforested regions still were San Martin with 1.3 million, Amazonas with 1 million, and Loreto with 945 thousand hectares. Table 2.1 summarises the situation of deforestation in 2004 and 2000.

Table 2.1
Deforestation by Region

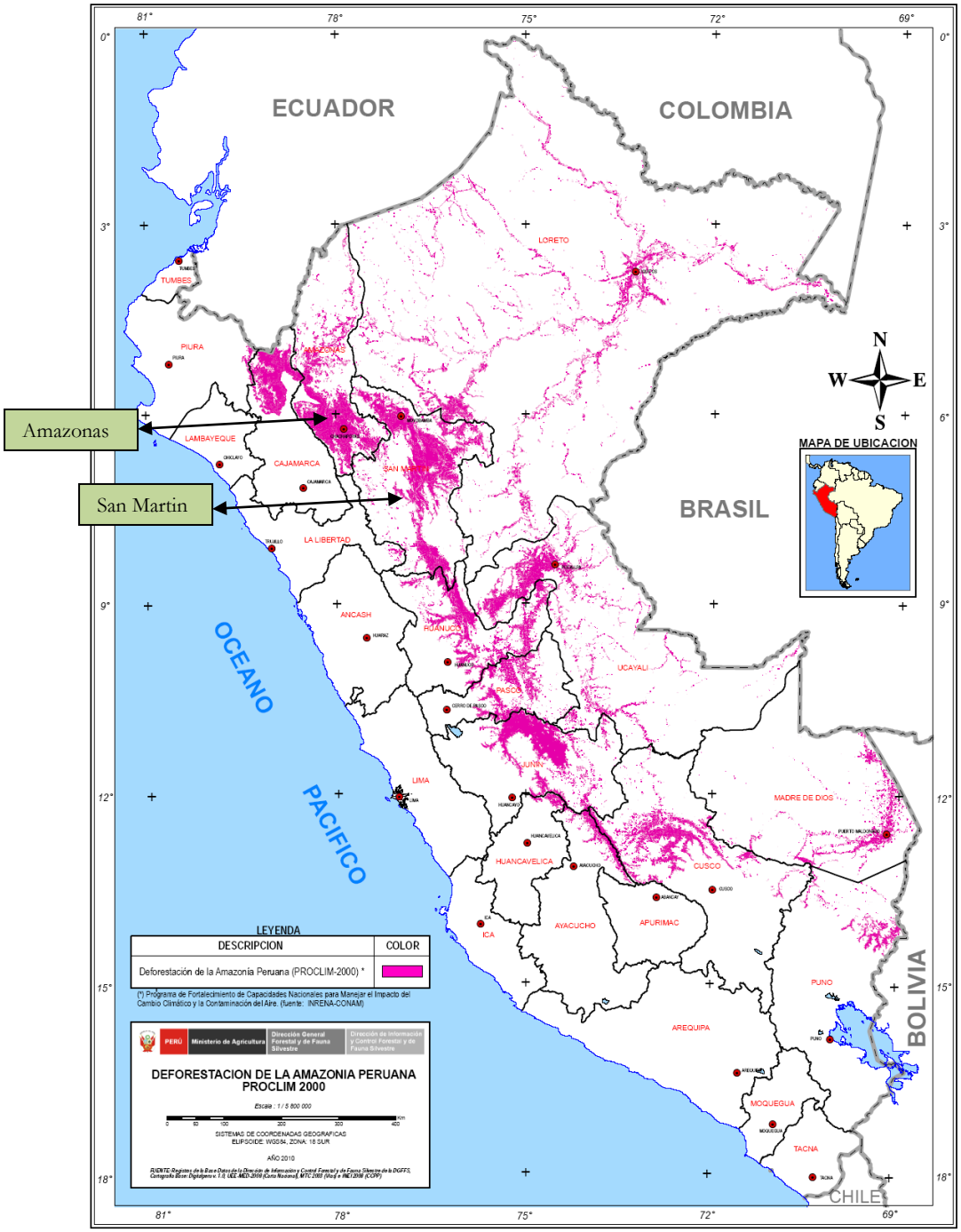
Regions	Deforestation (has)	
	2004 (1)	2000 (2)
SAN MARTIN	1,627,788	1,327,668
LORETO	1,137,961	945,590
UCAYALI	964,387	627,064
HUANUCO	739,520	600,620
JUNIN	627,386	734,272
CUSCO	550,818	537,601
PASCO	388,277	302,007
CAJAMARCA	381,660	520,030
AMAZONAS	349,455	1,001,467
MADRE DE DIOS	287,648	203,878
PUNO	203,119	146,033
AYACUCHO	98,078	135,366
HUANCAVELICA	11,100	51,986
LA LIBERTAD	10,755	7,231
PIURA	9,885	31,734
Total of deforested area	7,387,838	7,172,547

(1) Information presented by National Plan of Reforestation

(2) Information estimated by PROCLIM / INRENA

Source: Ministerio de Agricultura 2005, 2010

Map 2.1
Deforestation in Peru 2000



Source: Ministerio de Agricultura 2010

The Table 2.1 and Map 2.1 above show that San Martin is the most deforested region in Peru for both years 2000 and 2004 and its deforested territory represented between 18 and 22 percent of the total national forest loss. We may observe there is a large difference between 2000 and 2004 in the region of Amazonas. Additionally, previous studies have laid out deforestation rates in the country for earlier time periods.

The deforestation rate increased from 3.6 million hectares or 5.5 percent in 1985 to 4.5 million hectares or 7 percent in 1990; in other words, the annual average rate increased nearly 200,000 hectares or 0.29 per year (Perz et al. 2005). Similarly, large disparities among regions were evident. For instance, Amazonas and San Martin accumulated 2.5 percent of deforestation or more by 1990, but the average annual rates were just around 1 percent (ibid).

In contrast, Roxana and Trivelli (1996) found an annual deforestation between 261,158 and 300,000 hectares between 1993 and 1995, respectively. From 1990 to 2000, it is calculated that 149,631 hectares were lost annually while among 2004 to 2008 this loss was on average 128,100 hectares (Armas et al. 2009). For the next years, using two possible scenarios one called "business as usual" and the other "governance", it was estimated annual deforestation rates of 177,078 hectares and 129,985 hectares between 2009 and 2050, respectively (ibid).

Some studies (Barrantes and Trivelli 1996, Perz et al. 2005, Ministerio del Ambiente 2009, Armas et al. 2009) determined that among factors related directly to deforestation in the rainforest region of Peru are public policies for promoting migration, cropland extension and cattle, logging extraction and forest concessions, cultivation of coca illegally as well as population growth. However, the magnitude of these factors over the whole of deforestation is not known due to the lack of quantification studies (DEVIDA 2001).

Indeed, public policies during the years 1940 and 1970 boosted migration towards the Amazon rainforest where people could expand their crops to improve well-being (Ministerio del Ambiente 2009). Next to these public policies, road and highway constructions in the Amazon rainforest that gave people the opportunity to access forest areas increasing migratory agriculture as well. This last point is crucial in the Peruvian Amazon due to the fact that 89.35 percent of its land has been classified unique to forest production or protection but not available for agriculture or cattle ranching (ibid).

In fact, shifting agriculture is practiced by those farmers who do not have land tenure recognizing by law and which are located in marginal lands or on the edge of highways or rivers. Hence, this agriculture is considered to be the main cause of deforestation in the Peruvian Amazon (Barrantes and Trivelli 1996, Ministerio de Ambiente 2009). The process is explained in Barrantes and Trivelli (1996) who indicate that migrant farmers open land by burning forest, but after two or three harvests when land has already lost its agrarian value they move to new areas and repeat this process once again. It is also highlighted that this process is dangerous given that the cleared land may not recover its capacity of natural reforestation.

Logging extraction and forest concessions are other factors that could explain deforestation in Peru because loggers practice clear-cutting or remove

wood illegally. Clear-cutting means that they basically cut all forest area but only sell those trees with high commercial wood value without any reforestation action (Barrantes and Trivelli 1996, Ministerio de Ambiente 2009). The illegal extraction takes place in zones both not authorized and authorized (Armas et al. 2009, JICA 2010) and the latter can include exceeding the permit quantity or the diameters granted. These illegal practices are observed more in remotes zones as the valley of the Apurimac and Ene. The estimations indicate that more than 221,000 m3 which is approximately 15 percent of nation timber production is illegally harvested. Meanwhile the national authority confiscated at least 42,222 m3 in lumber between 2003 and 2004, which could have a value in the market of US$ 9.2 million dollars (Ministerio de Ambiente 2009).

Cultivation of coca is related to Peruvian Amazon deforestation in the high forest (selva alta) because its weather and soil properties increases production of alkaloids in coca plants in comparison with other Amazon rainforest soils The recent estimate of deforestation caused by illegal coca cultivation suggests that approximately 24% of total forest loss in 2000 could be attributed to coca (DEVIDA 2001). Additionally, this study highlights the differences between coca and other crops such as coffee, cacao, etc. in its potential for quick expansion and resultant environmental destruction.

The coca's potential for environmental destruction is related to the rapid loss of enriched soil once coca is harvested. Later, producers have to migrate to new forest land and this movement expands coca faster than other crops. Reinforcing this migration process, the current interdiction and eradication national policies against illegal coca keep producers looking for far away places where they would have less risk of being caught and punished by authorities (ibid). Of course, the high coca market price became a key incentive for producers when they have to select between coca and other alternatives crops; for instance, on average farm price of coca is 3 dollars per kilo while other crops are below 1 dollar per kilo in San Martin (Norvak et al. nd).

The population growth was discussed by Perz et al. (2005) who find that the relationship between population and deforestation is 'largely but not entirely affirmative' (2005:31). For Peru, they suggested that deforestation could be a response to population changes; particularly, it is mentioned that the two most deforested regions Amazonas and San Martin presented high level of population densities. Nevertheless, the link between net migration and deforestation inside Peruvian Amazon rainforest is ambiguous. Different regional studies showed diverse outcomes; specifically, the regions of Amazonas and Madre de Dios had the lowest deforestation during 1985-1990 but highest positive net migration in the period 1981 and 1993. Of course, the channels through which population growth or migration could impact deforestation may be because new people look for expanding agriculture and cattle and use wood unsustainable. To illustrate last point, it has been claimed that firewood has also caused deforestation.

In fact, firewood use would be the "second cause" of deforestation in Peru being it requires specially for fuel in rural areas (Barrantes and Trivelli 1996). Therefore, the more rural people living in Amazon rainforest, the more pressure on forest resources is observed. Assuming intensive firewood extraction, Barrantes and Trivelli (1996) calculated around 50 thousand hectares would supply such necessity.

Taking into account the last statement, firewood might put together poverty and deforestation if most of poor people use it in their daily life. At the national level, recent national statistics show that poor people and extremely poor people rely more on firewood than non-poor people for cooking (see Table 2.2.1). However, this situation becomes unclear if we concentrated in Amazon rainforest where even non-poor people largely use firewood to prepare meals (58 per cent). This later point is presented in Table 2.2.2.

Table 2.2.1
Type of fuel use to cook in households at national level (%)

Year	Non poor		Poor		Extreme poor	
	Firewood	Other	Firewood	Other	Firewood	Other
2005	25.6	74.4	60.5	39.5	72.5	27.5
2006	25.6	74.4	61	39	70.4	29.6
2007	26.2	73.8	63.5	36.5	75.6	24.4
2008	27.5	72.5	64.5	35.5	75.2	24.8
2009	26.5	73.5	67.3	32.7	76.7	23.3
Average	**26.28**	**73.72**	**63.36**	**36.64**	**74.08**	**25.92**

Source: INEI- Encuesta Nacional de Hogares (2005-2009)

Table 2.2.2
Type of fuel use to cook in households in the Peruvian Amazon rainforest (%)

Year	Non poor		Poor		Extreme poor	
	Firewood	Other	Firewood	Other	Firewood	Other
2005	56.6	43.4	84.7	15.3	89.8	10.2
2006	57.3	42.7	86.4	13.6	90.3	9.7
2007	59.3	40.7	87.3	12.7	91.8	8.2
2008	63.1	36.9	93.3	6.7	96.6	3.4
2009	58.3	41.7	93.6	6.4	97.8	2.2
Average	**58.92**	**41.08**	**89.06**	**10.94**	**93.26**	**6.74**

Source: INEI- Encuesta Nacional de Hogares (2005-2009)

Given the results in Table 2.2.1 and 2.2.2, it is not possible to affirm that firewood is a mechanism through which poverty and deforestation are connected. In fact, in Amazon rainforest both groups (poor and non-poor) rely on firewood to prepare meals. Even though not much research has been done in this issue, next paragraph will shortly present one study that tested Peruvian poverty and deforestation.

The role of poverty as driver of deforestation in the rainforest region including households with poor conditions located in the high forest, high-altitude sub-tropical forest, the low forest (selva baja), and humid tropical forest in the Amazon basin could have a minor importance among the drivers ac-

cording to Zwane (2007). This conclusion is supported by an empirical estimation of income-elasticity of land clearing for which results were positive and significant statistically but with a very small magnitude. Indeed, using household surveys in three specific years the study tested if changes in land clearing could be explained by household features. Basically, what was found is that because the poor face imperfect labour markets, those households with more members will have less non-farm wage opportunities pushing them to practice deforestation activities. As the outcome of this paper affirms, 'small increases in income for the poorest smallholders in the Peruvian Selva will not reduce the rates at which these households clear land' (Zwane 2007: 346). The theoretical framework embedded in this study will be discussed later in Chapter 3.

Regarding impacts of deforestation, in the national environmental analysis for Peru (World Bank 2007) it is calculated that annually the cost of deforestation is between 0.3 and 0.6 billion soles (Peruvian currency) which is equivalent to 0.2 percent of GDP in the year 2003. Such numbers corresponds to the present value of direct and indirect-use forest values lost. This estimation excluded those costs related to natural disasters, soil or water quality degradation caused by deforestation because to it would be complex to separate deforestation phenomenon than other environmental issues.

To figure the total annual cost of deforestation, the national environmental analysis for Peru (ibid) first presents a summary of diverse studies that had calculated direct and indirect use values of rainforest per hectare as well as non-use forest value (see Table 2.3). Secondly, it takes the mean from the lowest and highest value per hectare, but this exercise excludes non-use forest value because they have a large variation depending upon the methodology used. Thirdly, it applies this mean value to the annual deforestation and calculates its present value. Thereby it estimates an annual cost of deforestation between US$28 to US$86 per hectare.

Table 2.3
Annual Values of Rainforest Benefits (US$ per hectare)

Forest Services	Annual Value		
	Low	High	Mean
Direct use values	24	56	40
Sustainable forest management	10	29	19
Non-timber products	9	17	13
Tourism and Recreation	5	10	8
Indirect use values	4	30	17
Total Direct and Indirect value	28	86	57
Non-uses values	13	52	33
Option value (Bioprospecting)	0	21	11
Existence value	13	31	22
Total value	41	138	90

Source: World Bank 2007

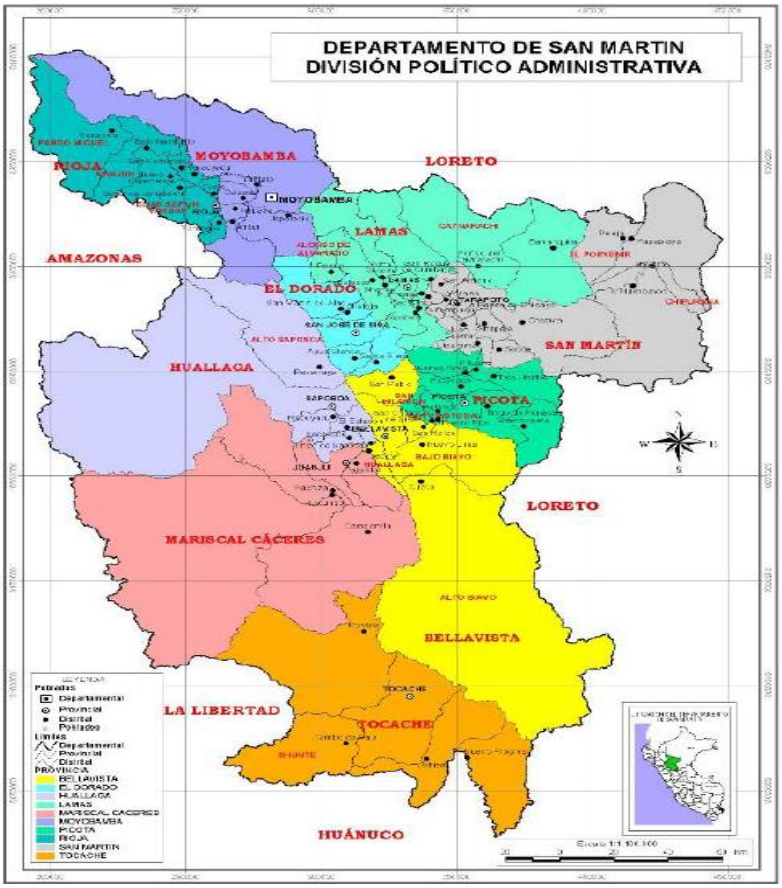
The next part will be focus on describing the situation of forest and deforestation in the Region of San Martin including a review of its socio- economic

context in order to understand the social impacts of deforestation. We chose this zone because in the studies mentioned above it has been noted that San Martin is one of the most affected parts of Peru by deforestation.

Overview of the Region of San Martin

The region of San Martin is in the north part of Peru and has approximately 51,645 km2. Created 6th September, 1906 it is composed of a political administration of 10 provinces and 77 districts (see Map 2.2). This region is located in a part of the watershed of Huallaga river and has two relief shapes: i) one explained by the Andes (92 percent of the land) and ii) another explained by Amazon plain (8 percent of the land). It has diverse climate that goes from humid and extreme cool in the Puna to warm and humid in the downstream zone of Huallaga river. This includes a hot, dry zone in the Huallaga central region due to its altitude climbing from 200 to 4,500 metres above sea level (Gobierno Regional de San Martín 2008b).

Map 2.2
Map of the Region of San Martin



Source: Gobierno Regional de San Martín 2007

The studies of Ecological-Economic Zoning (EEZ) identified that the potential productive land in San Martin is only 14.8 percent of the whole terri-

tory and the zones of protection cover 64.6 percent in which it was determined that 13.1 percent is recovery zones (ibid).

Beyond the geographic description, socio-economic aspects in San Martin will be described in the next section; especially, those features that may be related to the current forest context such as population growth, migration, agriculture, and poverty level.

Socio-economic aspects in San Martin

The population comprised 753,339 inhabitants according to the 2007, Population and Housing Census. It represents 2.6 percent of total population of Peru. From this number, the indigenous population is estimated at 1,500 which are distributed in three towns: Awajun, Chayawita and Quechua-Lamista . The population rose on average, in the period 1993-2000, at rate of 2 percent annually. This growth rate is the lowest since 1940 as it is observed in Table 2.4.

Table 2.4
Population Growth rate in Region of San Martin

Period	Population Growth rate
1940 - 1961	2.6
1961 - 1972	3.0
1972 - 1981	4.0
1981 - 1993	4.7
1993 - 2007	2.0

Source: INEI – Indicadores para San Martin

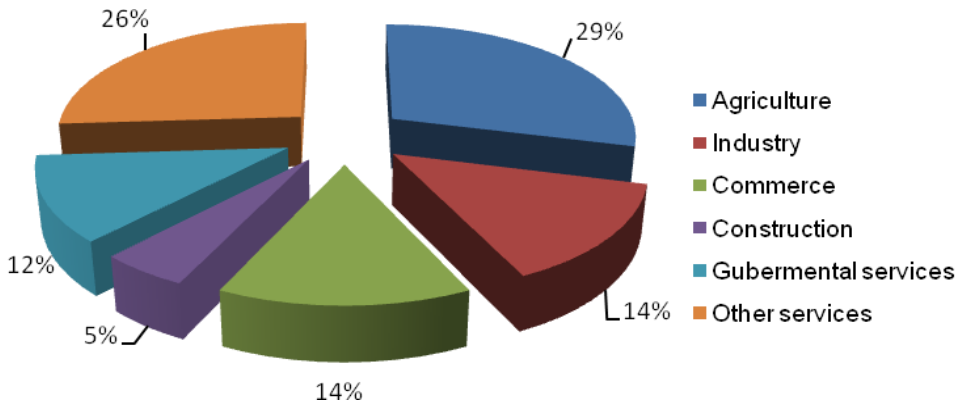
Two other demographic aspects are the fact that people live mostly in urban areas (64.9 percent) and there is high rate of migration. Immigration has risen in San Martin since 1940 when migrants represented 7.7 percent of the population. But in 1961, it had increased to 13.2 percent, moving from 94 thousand to 161 thousand inhabitants. Later between 1961 and 1972, commercial agriculture based on coffee and cotton entered a crisis due to crop disease in coffee and the fall of international trade prices. This caused emigration to other regions. Thus the migrant population decreased from 13.2% to 5.1% (ibid). Afterwards, the construction of the Rainforest Marginal Highway joined the coast and central highland in the 1970s which increased migration. According to the Census in 1981, 1993, and 2007 migration changes from 75 thousand, 175 thousand and 208 thousand people, respectively.

All these population changes have modified the population density, San Martin reached 13.6/km2 (Ministerio de Ambiente 2009). At the province level, Rioja is the most dense with 38.9/km2 whereas Moyobamba has 28.7/km2, San Martin has 27.2/km2, and Lamas 15.4 with 15.4/km2. Finally, at the district level, Tarapoto is the most populated place with 1,018/km2 following by Morales with 610/km2.

Regarding economic activities, agriculture constituted the principle activity employing 51.8% of the economically active population according to the Cen-

sus 2007 and represented 30% of the regional GDP. Next to agriculture, economically active population works in commercial sector (10%). The total distribution of GDP in San Martin by economic activity is shown in Graph 2.1.

Graph 2.1
Distribution of Gross added Value in San Martin by sector in 2006
(%)



Source: INEI- Compendio Estadístico 2005 San Martin

The agricultural sector produces mainly rice, maize, cocoa, and coffee; see Table 2.5. The rice crop is harvested in the provinces of Rioja, Picota and Bellavista where more irrigation infrastructure is available. Maize is grown in the province of Picota and coffee is grown in places above 700 meters of altitude in Alto Mayo, Lamas and Tocache (ibid). Another crop well represented in San Martin due to international demand is Sacha Inchi. Those crops for subsistence or local markets are cassava, banana, pineapple, cotton, and fruits. Livestock is the focus in the province of Moyobamba as well as the districts of Caynarachi and Barranquita in the province of Lamas. As a whole, the agriculture sector in San Martin comprises a cultivated area of 250,906 and 274,484 in 2000 and 2006 respectively, a change of 9.4% (ibid).

Table 2.5
Agricultural Production in San Martin, 2009

Crop	Production (Tons)	Position in National Production
Oil Palm	205,575	First
Coconut	8,033	First
Cocoa	11,783	First
Rice	562,213	First
Banana	311,176	Second
Papaya	23,266	Second
Coffee	48,558	Third

Source: INEI-San Martin: Producción de los principales productos, 2009

Finally, the information on poverty in San Martin gathered in the Census of 2007 indicates that the region has a higher than average poverty for Peru in both monetary and non-monetary measures. In fact, 44 percent of people in

San Martin are poor and 17 percent live in extreme poverty conditions. The gap of poverty and the severity are also above the national indicators in 14.5 and 6.3, respectively. The gap of poverty indicates the average difference between consumption of the poor and the poverty line, while the severity measure provides information about the relative position of the poor in comparison with the least poor. In other words, severity means inequality of consumption between the poor (INEI 2000). In terms of non-monetary poverty the picture remains the same.

Non-monetary poverty in San Martin remains higher than the national average. For instance, 59.1 percent of people live with at least one unmet basic need (NBI acronym in Spanish) in San Martin, but this percentage is only 40 percent in Peru as a whole. The case of two or more NBIs the region of San Martin is still higher than the national average. Next Table 2.4 compares the level of poverty in San Martin and Peru in 2007.

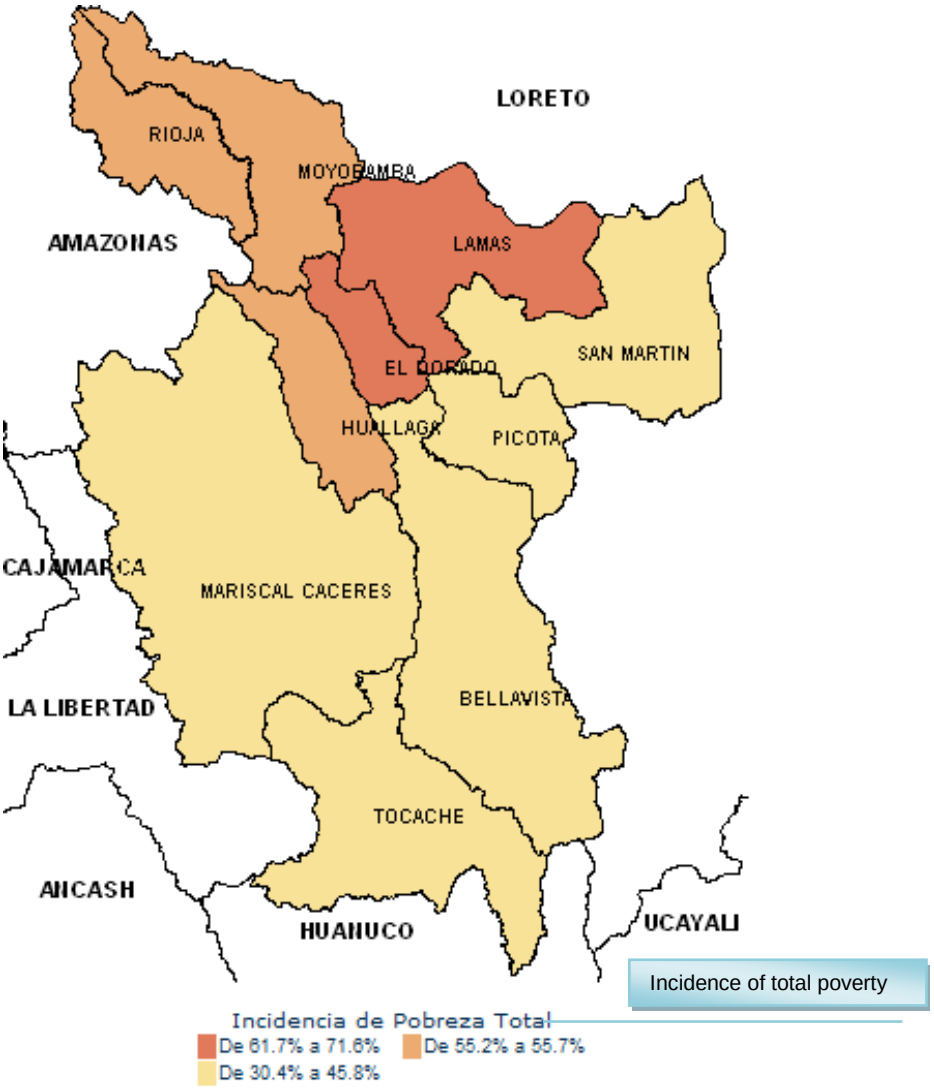
Table 2.4
Poverty in San Martin, 2007

	Peru		San Martin	
Indicator	**Number**	**%**	**Number**	**%**
Monetary poverty				
Incidence of total poverty	10,770,967	39	332,138	45
Incidence of extreme poverty	3,764,688	14	128,401	17
Intensity indicators of poverty				
Gap of total poverty		13		15
Severity of total poverty		6		6
Non-monetary poverty				
Number of unsatisfied basic needs (IBN)				
With at least one NBI	11,014,827	41	424,723	59
With 2 and more NBI	3,866,975	14	196,332	27
With one NBI	7,147,852	26	228,391	32
With two NBI	2,837,722	11	136,164	19
With three NBI	849,708	3	48,635	7
With four NBI	163,009	1	10,596	2
With five NBI	16,536	0	937	0

Source: INEI- XI Censo de Población y VI de Vivienda 2007

The distributions of poverty level in San Martin amongst provinces and districts have a large variation. Map 2.3 draws shows the distribution by provinces while the Appendix shows it by districts. As we may observe, at provincial level monetary poverty (as incidence of poverty) varies from 30% to 71% with the poorest mostly locate in the north part of the region. In the case of districts, however, there is a wider variation from 16% to 85%.

Map 2.3
Map of provinces in San Martin and the Incidence of Poverty (%)



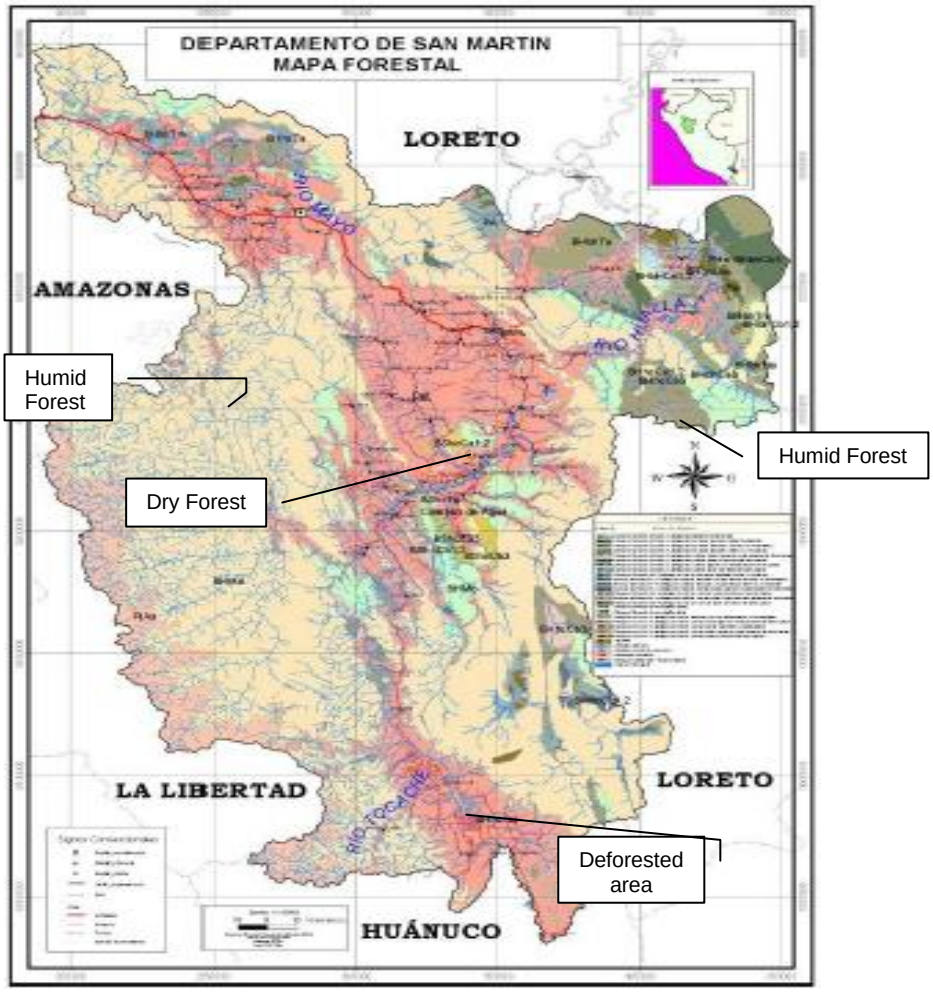
Source: INEI- XI Censo de Población y VI de Vivienda 2007

In addition to the maps showing distribution of poverty by districts, the statistics figures are calculated in Chapter 4 along with poverty situation by districts in 1993.

Overview of forest sector and deforestation in San Martin

The total forest land in San Martin is approximately 4.7 million hectares including humid forest, dry forest, and deforested areas (Gobierno Regional de San Martin 2007). In fact, the Geographic Directory in San Martin determined 22 varieties of tree coverage and created the forestry map showed in Map 2.4.

Map 2.4
Forestry Map of the Region of San Martin



Source: Gobierno Regional de San Martin 2007

The forest land includes three zones with permanent production forest (PPF), forest in native communities and protected areas. The PPF covers around 1.1 million hectares determined by Law N^{0} 27308- Forestry Law and its related regulation (JICA 2010). According to the Law, PPF comprises forest areas that can be exploited in a sustainable way by the private sector with access to such areas by auction or tender process.

The main concern in PPFs is that its territory is overlapping with protection zones. For instance, 38.4 percent of PPF is in protection zones (Gobierno Regional de San Martin 2008b) divide on 7 districts in San Martin as we may observe in Table 2.5.

Table 2.5
Permanent Production Forest in San Martin, 2010

Region	Province	District
San Martín	Huallaga	Alto Saposoa
	Mariscal Cáceres	Campanilla, Pachiza
	Tocache	Tocahe, La Pólvora
	Bellavista	Alto Biabo, Bajo Biabo

Source: JICA 2010

By the tender process between 2002 and 2004, there were 32 concession agreements given for timber exploitation in PPF. The total delivered forest covers approximately 478,404 hectares, but on average 57% have a size between 5,000 and 10,000 hectares whereas only 10% is more than 30,000 hectares. These small concession sizes could be not sustainable economically (JICA 2010) because profits limited by high production costs may limit future investments. Other problems observed in these concessions were a lack of commitment to elaborate and execute required forest plans; consequently, at least 3 concessions lost their exploitation permits equivalent to 34,518 hectares (ibid).

In 2007, recurrent problems in 39 concession agreements were still linked with financial issues, overlapping territories, and increasing migration (Ministerio del Ambiente 2009). The financial limitations came up because those who were granted a concession were loggers without management knowledge or economic resources for future investments. The overlapping problems come out in some concessions inside which were found farmers, legal settlements, schools, medical posts, and others. The increasing migration is driven by workers in the same concession who brought relatives and acquaintances.

One serious consequence of the inadequate management in concessions is deforestation. In fact, concessions in San Martin had a total forest loss of 400,330 hectares between 2000 and 2009 which is equivalent to 71 percent of the total area given through concession agreements (JICA 2010). So far, these hectares have been replaced by annual and biannual agricultural crops, yet deeper studies are absent in this matter (ibid) Of course, this situation brings about enquires over how appropriate concessions are in terms of sustainable forest management[1] and forestry production.

San Martin has a low level of production of wood outputs in comparison with the national average. For instance, lumber represented around 8% of national production between 1997 and 2005 yet from 2003 the proportion for San Martin is on average 5% (ibid). Furthermore, in 2008 this decreased to 2.2% (see Table 2.6)

Table 2.6
Forest Production in San Martin and Peru in 2008

Description	Units	San Martin	Peru	%
Wood products				
Lumber & roundwood	M^3	72,033	3'278,005	2.2%
Parquet	M^3	4,296	21,688	19.8%
Plywood	M^3	745	2,126	35.0%
Coal	Kg	-	51'418,669	0.0%
Firewood *	M^3	332,868	7'028,267	4.7%
Non-wood products				
Bambú	Units	66,650	362,207	18.4%
Pijuayo	Kg	19,000	21,025	90.4%

*Estimated according to rural population number

Source: Ministerio de Agricultura 2009

Table 2.6 shows forest production in the industry of San Martin for 2008 in comparison with the national production. As we may observe, San Martin has little production of lumber, round wood, parquet, charcoal, and firewood. In the case of non-wood products, San Martin had contributed almost all the Pijuayo, but there is no contribution in other 85 non-woods products listed by the Ministry of Agriculture in 2008.

Additionally, San Martin counts 216 medium/ small-scale enterprises in wood transformation and another 350 informal business (Gobierno Regional de San Martin 2008b). Furthermore, the National Forestry Plan in the region proposed that 1.03 million hectares should be reforested or enhanced in secondary forest management. It is believed that those hectares could meet foreign demand for forestry products because they are near to road infrastructure and towns (ibid).

On the other hand, native communities in San Martin also hold forest areas in their territories to the extent of 247,294 hectares for a population of 2,125 people. According to the Law N^0 27308- Forestry Law, Article 11, native communities are allowed to exploit forest after the forest authority has approved appropriate permits for commercial or industrial uses. So far, however, the number of forest permits remains small in San Martin where only 3 permits has been granted up to 2008 for a total of 571 hectares and a timber volume of 6,947m3. This low figure of permits is attributed to failures in legislation through which few security rights have been given to native communities (JICA 2010). Others reasons suggested by indigenous people are the lack of expertise in business and the extreme bureaucracy to resolve permit requests in a short or medium time (ibid).

Forest in native communities is also affected by deforestation. For instance, between the years 2000 and 2009 a total of 50,942 hectares were lost in San Martin which represents 20.5 percent of native communities' territory

(ibid). This situation is connected to illegal extraction from outsiders, expansion of coca crops and population growth. Indeed, among the conflicts which occurred in native communities, there are at least 31 related to illegal extraction in 2007 (see Table 2.7). Additionally, those communities that are not close to open areas or urban sectors have decided to grow coca which is then sold to drug trafficking organizations. In some cases, their members are working during refining processes to create cocaine (Norvak et. al nd). However, we do not know enough relevant details to determine how much deforestation in native communities can be attributed to drug trafficking as this information is available only the whole region of San Martin and will be presented later. The demographic factor as driver of deforestation in native communities might play crucial role according to JICA (2010) but major studies are needed for further insight into this issue.

Table 2.7
Sources of conflicts in Native Communities

Description	Peru	San Martin
Total number of native communities	1,786	90
Number of native communities facing conflicts	584	26
Ilegal extraction	553	31
Hydrocarburos explotation	162	3
Others	147	15

Source: JICA 2010

Comparing PPF and native communities, forest areas inside protected areas in San Martin represent a larger total land area. To illustrate, 1.9 million hectares are distributed between national parks, protected forest and regional conservation areas (see Table 2.8). These areas are part of the National System of Natural Protected Areas; then are under the Law N^{0} 26834-Law of Natural Protected Areas and related legislation. Beyond the fact that many protected areas in San Martin as well as the other Peruvians regions are affected by overlapping land with native communities causing land use conflicts, these areas represent a crucial problem of deforestation which in theory should not happen because they are under the umbrella of special legislation. Specifically, between 2000 and 2009 it has been found that 10 percent of forest in protected areas was deforested which is shown in Table 2.8 as well.

Table 2.8
Protected Areas in San Martin and deforestation (2000-2009)

Name	Area *	Deforested Area*
National Park Rio Abiseo	274,520	63,827
National Park Cordillera Azul	1,353,190	94,834
Protected Forest Alto Mayo**	182,000	12,304
Regional Conservation Area of Cordillera Escalera	149,870	12,404
Regional Conservation Area of Aguajal- Renacal**	5,015	605
Total	1,959,580	183,974

*Hectares **Deforestation data corresponds to 2000-2004
Source: JICA 2010, Ministerio del Ambiente 2009

The distribution of deforestation shown in Table 2.8 is related to shifting agriculture, the cultivation of coca in and surrounding protected areas, and illegal activities prompted by road access built up in forest concessions zones

(ibid). The latter is clearly illustrated in the case of National Park Rio Abiseo where apparently 6 forest concessions would push forest degradation because of a path being opened near to the Park. Unfortunately, there are not reliable data that lets us identify the actual impact of each factor on protected areas. So far, it has been stressed that San Martin is the region which sees the highest deforestation inside protected areas (ibid). In the next part, we are going to synthesise the current problem of deforestation in San Martin as well as its drivers and impacts.

Deforestation in San Martin

It is claimed that deforestation in San Martin is a result of human settlement which increased shifting agriculture and cattle, as well as coca cultivation (DEVIDA 2001, Gobierno Regional de San Martin 2008b, JICA 2010, Ministerio del Ambiente 2009). Specifically, after the construction of the Marginal Highway - called Fernando Belaunde Terry Highway, in 1970, the annual deforestation increased to high levels as shown in Table 2.9. The aggregate amount of deforestation rose from 318,151 hectares to 1.2 million hectares in the period 1963-1987 (Santisteban 2002). .

Table 2.9
Rate of deforestation (hectares/year) in San Martin

Period	Rate of deforestation
1940-1960	8,000
1960-1975	50,057
1975-1979	171,000
1995	50,000

Source: Gobierno Regional de San Martin 2008b

Tocache in San Martin was the province with the greatest deforestation in the region and in the country, rising from 15,910 to 211,023 hectares from 1963 to 1987. It remains highest for deforestation in San Martin in 2004 (see Table 2.10). This phenomenon is related to increasing illegal coca production (ibid). In general, forest loss in the 1980s was unlikely driven by agricultural production concentrated on rice and maize crops as consequence of increased public irrigation infrastructure. Drug trafficking activities cultivated in marginal zones with non-accessibility at the south part of the region is stated as main driver of deforestation (Gobierno Regional de San Martin 2008b, Santisteban 2002).

Finally, recently information reveals that San Martin lost 1,627,788 hectares in 2004 (Ministerio de Agricultura 2005) the distribution of which by province is detailed in Table 2.10.

Table 2.10
Distribution of deforestation in 2004

Province	Deforestation*	Rate of deforestation
Tocache	257,024	55%
Lamas	228,938	45%
Moyobamba	199,587	54%
San Martin	180,381	38%
Picota	159,160	85%
Mariscal Cáceres	150,741	11%
Rioja	139,797	46%
Bellavista	128,453	16%
El Dorado	93,421	29%
Huallaga	90,287	35%
Total	1,627,788	32%

*Hectares

Source: Ministerio de Agricultura 2005

Together with public investments in vital infrastructure, it has been claimed that public policies promoting land property title since 1990s reduced deforestation. In particular, the Law No 667- Law of Registration of Rural Land outlines that in order to request a land property title the beneficiary should demonstrate land possession by one year and such land must be cultivated. This may be a key incentive for shifting agriculture in the Peruvian Amazon. (Ministerio del Ambiente 2009)

Another method suggested by DEVIDA (2001) in order to clearly understand deforestation drivers in San Martin is a geographical analysis. In this analysis, the area was differentiated into two zones: i) Central Huallaga basin and Bajo and Alto Mayo; and ii) High Huallaga basin. The first zone, Central Huallaga basin and Bajo and Alto Mayo, is characterized by high quality of fertilized soil and tropical climate with precipitation over 1,000 mm. From the 1980s, public policies prompted maize and rice crop production, as a consequence of which the region was the second producer of maize and rice in Peru. This production is related to deforestation since that time.

The second zone, high Huallaga basin, is differentiated with the latter due to precipitation which on average is above 3000 mm and which has low fertility in its acid soils. Towns such as Sión, Tocache, and Uchiza in Tocache province are located in this zone where coca monoculture predominated since 1990. This monoculture has produced soil erosion in hillsides after deforestation occurred. In fact, DEVIDA (2001) attributed 41% of deforested land in San Martin is related to coca cultivation.

The reduction of coca crops went down from 20,000 hectares between 1993 and 1995 to 1,387 hectares in 2004 when productivity reached 2.13 TM/has. Although this reduction is significant, the total production would still be used for cocaine in the hands of drug trafficking groups. For instance, from the annual production of 2,952 tonnes in 2004, only 6 tonnes were sold to the nationally authorized company (ENACO, acronym in Spanish) and the rest is likely going to the drug traffic. The legal production of these 6 tons was con-

ducted by 6 farmers in this area among the total 1,206 farmers registered officially by ENACO. Because the estimation of coca producers in 2004 is 1,597 (registered/non-registered farmers) it is assumed that most of producers have been selling coca to drug trafficking groups (ibid).

Finally, this deforestation has been related to negative impacts on supply and quality of drinking water in San Martin as well as increased number of natural disasters such as floods and droughts (Gobierno Regional de San Martin 2008b). Additionally, deforestation caused by swidden agriculture has potential problems related to soil degradation due to the fact that soil loses its capacity to feed itself and warms, which kills micro fauna that helps some natural decompositions processes. In short, soil becomes more solid and unproductive (Ministerio del Ambiente 2009).

Similarly, deforestation in the Amazon Region after road constructions did have environmental and social impacts (Ministerio del Ambiente 2009). As far as environmental issues, it underlined forest degradation, increasing risks of forest fire, soil erosion, soil and water pollution, diminished environmental services from the forest, loss of tourist value, and loss of biodiversity. Regarding social impacts, it suggests invasion of indigenous land, conflicts between tribes, illicit appropriation of land, expansion of illegal crops such as coca, degradation of social services due to migrants, increase in prostitution, and others.

Chapter 3
Theoretical Background

Since the 1980s academic research and public policies have been tackling the issue of deforestation in order to eliminate or reduce its rate. Indeed, scholars have investigated the origins of deforestation and the various consequences observed in those deforested areas. So far, the relations between this phenomenon and development have been explored (Andersen et al. 2002) along with wealth theories (Wunder 2000) and land tenure (Barrantes and Trivelli 1996) among others. In the public policy field, the international community is asking for enhanced measures to reverse future impacts of deforestation claiming that sustainable forest management produces valuable ecosystem services and contributes to sustainable development (World Resources Institute 2000, FAO 2006, and IPCC 2007).

In this chapter, the focus will be the theoretical link between deforestation and poverty. In this process, we present a theory of environmental degradation and poverty. After this, we discuss the current literature on forest resources' beneficial impacts on poverty alleviation.

3.1 Analytical Framework

Environmental degradation and poverty

Poverty has been blamed for causing environmental degradation in many natural resources such as forest, land, water, and air according to the orthodox school of thought (Duraiappah 1998). This was clearly presented in the international arena by the well known Bruntland Commission Report where explicitly stated that poverty is a major factor of environmental issues, thus to tackle poverty it would be an important and necessary condition to address environmental problems.

The literature related to this nexus between poverty and degradation of natural resources comprises Malthus and neo-Malthusian theories (Swinton et al. 2003). First, T. Malthus's view put together natural resource sustainably with human management concluding that a situation with static production technology, fixed land resources, and increasing population will provoke a disastrous ending. Second, post-Malthusians developed the hypothesis described by 'too poor to invest' meaning that population growth along with economic deprivation make impossible more investment to increase productivity; consequently less productivity in the future and a downward spiral of poverty.

This last point in terms of natural resource management (NRM) is evidence that 'the capacity of rural households to invest in more sustainable natural resource management depend on both (a) having adequate aggregate assets for investment in NRM and (b) having a distribution of assets that permits capital-led intensification' (Swinton et al. 2003:1866). In fact, a set of studies in Latin American countries did indicate that rural population growth put at risk the sustainability of natural resources, but rather than just poverty what it is happening is a lack of appropriate incentives to change behaviors associated with environmental problems for both rural poor and non-poor (Swinton et al. 2003).

Similarly, testing the poverty-deforestation hypothesis for tbe Amazon region in Peru, Zwane (2007) found this hypothesis is inadequate to explain the drivers of deforestation. In this sense, the initial prediction, that there is a negative relationship between cleared lands and incomes, was shown not to be valid in Peruvian Amazon rainforest for poor rural people. This conclusion comes from a simple model of land clearing from which results were a positive but non-monotonic correlation between low-income and land clearing and a small income-land clearing's elasticity. Thus the study argued that poverty is unlikely to be a driver of deforestation. On the contrary, others factors such as size of households (members per unit of cleared land) would have more chance to enlarge deforestation due to constraints that they face in labor market for non-farm wages. The reverse relationship deforestation and poverty is also explored briefly in this study.

The statement that poverty produced environmental degradation in developing countries may be, however, more complex due to the multiple dimensions behind poverty. In fact, Duraiappah (1998) puts forward that the empirical literature has suggests that factors such as power, wealth and greed, institutional and market failures are the major contributing factors that push marginal groups to adopt unsustainable resources management. In fact, it is stressed that a direct link between power, high incomes or wealth, and environmental degradation exists as well as an indirect link with power and wealth via market and institutional failures. In this sense, it is asserted that poverty cannot be the major factor that caused environmental problems either directly or indirectly. Therefore 'It would be wrong to blame poverty generally for deforestation' (Wunder 2000: 157).

Other arguments supporting the non-role of poverty on environmental degradation state that the poor have scarce ability to disrupt natural resources over the long term, and have a preference to avoid degradation over the long term as these resources are an important economic safety buffer (Asadi et al. 20008 quoting Jaganathan 1989 and Jodha 1998). In the same way, the limitation on access to productive assets such as land, agrochemicals, forest, or irrigation by poor farmers reduces their negative environmental impacts related to those non-poor. Finally, social and political elements will define who has access to natural capital and the way in which they are managed (ibid quoting Ravnborg 2003).

On the other hand, the related literature has outlined the potential link between environmental degradation and poverty. In this relationship, the former affects negatively the latter (ibid). Specifically the case of deforestation stresses that varies impact analysis demonstrates how low-income/marginal groups suffer the consequences of unsustainable forest use (Duraiappah 1998). A summary of these connections is displayed in Table 3.1.

Table 3.1
Impact-relationship links for forest use

Impacts	Consequences	Groups
Watershed protection	Rainfall disruptions	All but low-income group hardest hit
	Increased flooding potential	All but low-income group hardest hit
Soil erosion	Productivity drop	All but low-income group hardest hit
	Water shortage	All but low-income group hardest hit
Loss of safety buffer	Loss of NTFP	Low-income
	Increased household exp.	Low-income
Productivity drop	Income drop	Low-income
Fuel wood shortage	Labor productivity	Low-income
	Increased household exp.	Low-income

Source: Duraiappah 1998 page 2,173

The Table presented above divided effected groups into two sets, the all group and the low-income group. Linkages from deforestation to poverty come from environmental impacts (watershed protection, soil degradation, and loss of safety buffer) and economic impacts (productivity drop and fuelwood scarcity) which in one another way reduce income opportunities in low-income households. However, these outcomes are imprecise as far as the magnitude of the impacts and to what extend it is likely to isolate them from the reverse relationship, poverty-environmental degradation (Duraiappah 1998, Opschoor 2007).

This hypothesis that environmental degradation increases poverty is referred to as the 'victims-view' by Opschoor (2007), who also finds this approach more 'politically correct'. At the same time, he does recognize that empirical evidence has shown that this nexus may be true in the sense that deterioration of the environment damages the poor more than the rich. Some additional points underlined were that extreme environmental conditions might push migration of poor to inadequate places, loss of soil increase vulnerability of the poor, and ending natural resources degradation is not a necessary condition for poverty reduction due to the fact that rich can consume more than the poor.

A third view in the literature is a sort of mixture between both relations mentioned above. Here, it is stated that there is a dynamic relationship between environmental degradation and poverty in which the impact of poverty causes more degradation which brings about a 'downward spiral- perspective' or a modern version of Malthus' theory of population (ibid). This vicious circle of poverty has been applied in deforestation and fuelwood consumption. A fuel-

wood trap takes place when exogenous factors cause deforestation which is followed by loss of other forest uses (food, medicine, and construction), reduced firewood consumption and decline in nutrition, as well as longer firewood collection time increasing labour opportunity costs; all these elements decrease well-being (Wunder 2000).

Taking into account that this nexus between environmental degradation and poverty is complex as was claimed above, enlarging the poverty conceptualization and understanding of environmental good and services better, recent studies have elaborated new relationships about such a nexus. Consequently, there is more knowledge about how to deal with this problem. For instance, within the poverty definition the human development approach has been added.

Andersen and Wunder (2006) called this changing 'human development extension' of the poverty definition due to health, education and nutrition entering into the poverty conceptualization. The result is poverty conceived in a broad sense beyond income/consumption gaps. Other researches develop aspects such as capabilities, entitlements, empowerment, institutions, and sustainable livelihoods.

The sustainable livelihood framework, specifically, incorporates 'all factors that matter for poor people in their daily lives' (Andersen and Wunder 2006:5), and is based on the presence of assets that poor use in their coping strategies. Part of these assets is social and environmental capital like forest. Then, 'depending on their assets, and the vulnerability context in which they [poor] operate, people choose livelihood strategies that will provide them with preferred livelihood outcomes' (Opschoor 2007:21). The set of livelihood outcomes are in this framework: incomes, well-being, health and security.

In addition, the flow of environmental services and goods takes new connotations giving rise to, for instance, studies investigating environmental poverty, ecological functioning, environmental entitlements and environmental incomes (ibid). Environmental poverty refers to situations where the environment does not provide a livelihood and security or such supply is threatened, in which case people are not able to reach their target mode of living. Whereas, ecological functioning is part of a set of functioning or capabilities essential for human life in which the circumstance of poverty is defined as a lack of capabilities. Close to this last point is environmental entitlement that refers to rights for accessing and controlling resources like tenure, property, etc. Poverty in this case being the poor exclude totally or partially from such rights. Finally, environmental incomes are those that come from natural resources use in the market by getting a payment for environmental services.

From the review done around the theories of environmental degradation and poverty it was shown that forest degradation may damage daily living of poor people more than high income people. The next part will develop this

point in order to understand under which circumstances this damage could happen and its limitation found so far by scholars.

Deforestation, forest and poverty alleviation

Table 3.1 summarized impact-relationship links for forest use. There, it is shown the mechanisms by which agents are affected by deforestation, but they can also be analysed in more depth with the literature that claims that forests may provide a flow of benefits to alleviate poverty.

This impact-relationship link became common in the literature and policies because many poor people are located in or around forest areas. It has been estimated that approximately one billion poor worldwide rely on forest resources to obtain their livelihoods (Yemiru et al. 2010). Plus, in developing countries, two thirds of rural population occupy 'marginal agricultural lands' such as highland watersheds where, rather than monocrops, farmers employ forestry, tree crops and agroforestry techniques on their land (Scherr et al. 2003). For these reasons, the poor would be likely seeing their situation worsened by deforestation.

Scherr et al. (2003) identified, at least, four groups of forest resource-dependency poor that would roughly comprise between 955 million and 1.4 billion individuals. According to this classification system, one group is the indigenous, who are around 60 million and live in natural forests and practice hunting, gathering, and shifting cultivation. The second group is comprised of those 350 million rural people who settle in or around marginal natural forests or timberlands and for which forest outputs can be a supplemental income or safety net. A third group is formed by smallholder farmers who work with remnant forest or agro forestry in order to subsist or raise income. The final group is composed by artisans and workers involving in forest-based enterprises in both the formal and informal sector. Additionally, it is pointed out that among the very poor group there are indigenous tribes, landless people located in the border of forests, as well as landless forests employees.

Similarly, Andersen and Wunder (2006) divided forest use beneficiaries into four groups according to their relation with the varying types of economic benefits (see Table 3.2). This analysis seeks to understand the categories behind the forest actors and hence to identify the different impacts when discussing forest dependence and poverty alleviation.

Table 3.2
Importance of different forest benefits to different groups

Users groups	Types of economic benefits			
	Agricultural land &nutrients	NTFPs	Timber	Ecological services
Forest dwellers				
Hunters and gatherers	Minor benefit	Main benefit	Supplement*	Variable
Shifting cultivators	Main benefit	Important suppl.	As above	Variable
Farmers adjacent to forests				
Smallholders	'Land reserve'	Supplement	Supplement*	Variable
Landless	Not important	Important suppl.	As above	Variable
Commercial users				
Artisans & traders	None	Important	Important	None
Small entrepreneurs	None	Important	Important	None
Employees in forest ind.	None	Supplement	Main benefit	None
Consumers of forest prod.				
Urban poor	None	Some products	Variable	None

*If transport access exists

Source: Andersen and Wunder 2006

Given the high correlation found between natural forest resources and poverty, it has been suggested that forest should be integrated in Poverty Reduction Strategy Papers (PRSPs) and, specifically, forest management in order to improve people's livelihoods in forest areas (Sunderlin et al. 2005). This is due to the ability of forest resources to generate either monetary and non-monetary incomes; for instance, selling timber, charcoal and resins or getting production inputs as slash-and–burn from fallow techniques along with food, medicinal plants and firewood (Byron and Arnold 1997, Wunder 2001, Fisher and Shively 2003, Scherr et al. 2003, Sunderlin et al. 2005, Belcher 2005, Yemiru et al. 2010).

Although it is recognized that data on rural or poverty incomes is not accurate at the aggregate level since some values are not considering in national statistics (Scherr et al. 2003), the monetary benefits of forests come up in the studies in many ways. To illustrate, the positive contribution of forest products on poverty in rural areas is showed by Yemiru et al. (2010) who, using a sustainable livelihood perspective, found that in Southern Ethiopia forest provides 24% of household incomes in high income groups and 52% in low income groups. In both groups, forest products generate both subsistence and cash incomes which let rural people tackle poverty or have income in crisis times. Rural households (poor and non poor) commonly seek forest resources for support when they have to face emergency situation such as crop failures, shortfalls and others incomes shocks (Byron and Arnold 1997, Fisher and Shively 2003, Belcher 2005).

In addition, one of the most common ways of earning cash incomes from forest in the rural sector is selling non-timber forest products (NTFPs). In fact,

it was estimated that households in forest margins derive between 10 and 25 percent of their incomes from NTFPs (Scherr et al. 2003). Besides that, the sale of wood products with small diameter occupies an important role for rural people because this type of wood, as well as other NTFPs activities, demands less skill and capital access.

It has been claimed that where forests have unlimited access, activities with requirements of low capital and technical skill are chosen by rural people living close to towns or rural zones with high population density. There, they sell small-diameter wood products such as mats, baskets or wood fuel. This contrasts with non-poor households who usually draw on forest resources seasonally or year-round to complement their normal incomes (Byron and Arnold 1997, Belcher 2005, Scherr et al. 2003).

One factor of local importance of non-monetary benefits from tropical forests would be food supply. Once again, forest food is usually highly connected to emergencies instead of being part of rural people's staple food. Rural people incorporate this forest food more as complement to their daily food rather than substitution to replace their staple food. However, this behaviour changes sharply in times of difficulties. In particular, forest commonly becomes a source of food when floods, famines, droughts and wars affected local people (Byron and Arnold 1997). Of course, this food consumption and safety net function can be uptake for consumption itself or for sale to have cash. The latter occurs even in distant places where people have dependency on cash activities (Belcher 2005).

Furthermore, non- pecuniary forest uses for fuel and medicines are considered as essential in term of health, nutrition, and culture. For instance, wood fuel has an important function for cooking food which is important for children' health. Similarly, plants are used as part of health treatments in those occasions where people think illness has spiritual origins (Byron and Arnold 1997).

On the other hand, the ability of the forestry sector itself to provide a flow of benefits to alleviate poverty faces many challenges. To what extent forest can effectively alleviate poverty is controversial itself (Yemiru et al. 2010). For instance, it has been suggested that for the poor with high forest-dependence, the best solution is to migrate away from the forest; thus, pro-poor programs should not insist on forest uses to put people out of poverty.

According to Levang et al. (2005), forest people need forest for their livelihoods; but, to exit poverty people should be more integrated to cities rather than being settled in remote forest areas where they do not access to better education, health services, and market opportunities. To illustrate, 'For the Puman [hunter-gatherer groups of Borneo located in the Indonesian province of East-Kalimantan] dependences on the forest is greatest in the remotest areas where other options are fewer. Forest dependency is not considered as an at-

tractive, viable option, but rather a last resort-a symptom of their limited options-that they will abandon as soon as any better option emerges'(Levang et al. 2005:229).

Similarly, Sunderlin et al. (2005) emphasises that we have to make a distinction between the opportunity of the forest to prevent rural people from increased poverty level and the possibility of pulling people out of poverty. The latter point could imply migration from forest areas to non-forest places. For that matter, forest products may play a central role in helping poor people to survive but not to escape from poverty (Byron and Arnold 1997).

These two distinctive roles of forest on poverty is also analyzed by Belcher (2005) who claims that poverty alleviation in forest terms should be split in two sides. First, poverty mitigation and second, poverty reduction. Poverty mitigation refers the potentiality of forest to diminish the severity of poverty and protect people from being worse off, and poverty reduction is the opportunity of move people above the poverty line.

Forest resources may mitigate poverty once those resources are used to meet consumption needs through products like food, fibre, medicines among others. Yet they serve to reduce poverty when the poor are able to obtain incomes from selling forestry production or getting a salary from the forestry sector. This poverty reduction could be reached for both NTFPs and timber forest products. However, some studies conclude that the NTFPs have some disadvantages as pro-poor instruments because they are inferior goods (Belcher 2005). In the economic terminology, an inferior good can be replaced by consumers once their incomes have risen due preference. Despite the fact that these products are made by applying local technology of low cost, the market prices fluctuate around zero in some markets. Thus, timber products, which are likely to attain higher market value, have higher potential for poverty reduction aims.

Timber goods would have better potentiality in poverty alleviation issues due to their higher market prices and broad demand. Even though scholars acknowledge that this assertion faces a couple of limitations to become realized, they recommend the promotion of small-scale timber enterprises in forest areas (Scherr et al. 2003, Belcher 2005, Yemiru et al. 2010). The main limitations are related to high economic requirements present in timber business that poor people could not afford easily. In particular the elevated entry costs include large investment capital required for harvesting, transportation, and operation besides the legal aspects of exploitation rights assigning by the state to large-scale enterprises. Other limitations include too high taxation costs, payments for concession areas and other state revenues policies that entrepreneurs have to bear in the forestry sector, without mentioning corruption acts which are pretty common in those arenas.

Beyond these constraints associated with large-scale logging operations, a set of competitive advantages held by low-income producers in specific forest markets are detailed in the research of Scherr et al. (2003). Based on that it is claimed the promotion of small-scale entrepreneurs is an effect poverty alleviation method. For instance, by increasing local communities' and smallholders' control over natural forests, better prices could be negotiated with potential buyers. Also local producers, getting low opportunity costs for land and labor may be able to offer some lower costs in comparison to large corporations and lower per unit costs while they produce together with crops and livestock. Besides that, it is claimed that local communities are naturally encouraged to put in practice sustainable forest management due to greater attachment to land and localities and they could have more interests in preserving their land in good conditions for their children and future local generations. Plus, local people may be able to monitor and protect forest from adversities such as encroachment, illegal harvest, fire and social unrest due to having more knowledge of their surroundings. Finally, it is supposed that low-income local producers have better reputation in social and environmental issues; thus, they could fill market niches where social responsibilities brand are premium.

At the macro level, it is claimed that community-based forest processing business might generate more local employment than highly capital-intensive operators since the latter often hire people from other regions who would fill the high technical skills requirements (Scherr et al. 2003). As a consequence, small-scale entrepreneurs would help to reach sustainable resources management in a way in which poverty can be reduced. But to achieve all these objectives, some conditions must be fulfilled and supported by good governance and regulatory frameworks.

Within the set of conditions studied are access to markets, deregulation and liberalization, campaigns for reducing corruption in the forestry sector, and others without which the aim of poverty reduction is unlikely to be achieved success. To open up access to markets where forest products compete against synthetic ones it is necessary to improve the transportation infrastructure, facilitation of credit, and enhancement of technical and management skills (Byron and Arnold 1997). Scherr et al. (2003) point out that management systems in local organizations should be strengthen using cooperation as a strategic tool, and then some value chain gaps could be filled. These cooperative actions could include, for instance, sharing transport services, having the same timber quality standards, supporting local-business policy changes, or marketing schemes.

Given that local communities face more constrains for commercialize timber and non-timber products in comparison with large-scales log industries, the participation and support of the public sector, donors, NGOs, and the private sector is seen as essential to facility financial opportunities, push first stages of commercial services, set up joint management, protect communal land use rights, and other fundamental aspects (Scherr et al. 2003). Neverthe-

less, there is not a consensus about the final results or impacts of this promotion for small-scale timber enterprises in forest areas.

The discussion developed above about the monetary and non-monetary benefits of forest for poverty alleviation goals will now be complemented with the empirical literature around effects of deforestation on low-income groups.

In some areas in Thailand, Indonesia, Papua New Guinea, Cote d'lvoire, and the Philippines has been reported that soil erosion originated by deforestation diminished crop yield (Hurst 1990, Ehui and Hertel 1992). For instance, only in Thailand between 1960 and 1982 when erosion increased, average crop yield suffered a reduction upon 15% although increased expenditures in fertilizers and pesticides.

Using data from Cote d'lvoire (ibid) it was found that initially deforestation contributes positively to yields, but the increase in deforested lands cause yields to fall at the end. The crop yields increased after slash and burn deforestation because of the nutrient content of the ash, hence yields declined over time because of the removal of organic matter, erosion, and movement of cropping activity onto marginal lands. In terms of elasticity, yield was quite elastic to cumulative deforested land; specifically, a 10% increase in cumulative deforested land results in a 26.9% decline in aggregate yields ceteris paribus.

3.2 Conceptual Framework

Deforestation

Deforestation is defined and used by scholars and government planners in a way which could, in the extreme, involve a totally opposite view from one another. For instance Wunder (2000:9) points out that 'substitution of natural forests by plantations may be regarded as reforestation by government planners, but as deforestation by conservationists'. Because of these differences, the concept of deforestation is divided into two groups: a broad and a narrow definition.

A broad definition of deforestation includes both forest conversion by eradication of trees along with changes in land uses, and all different types of degradation of forest such as density and structure, ecosystem services, biodiversity, and gene pools (ibid). By contrast, the narrow definition is limited to the changes of forest land uses for other economic activities (farming, livestock, industry, etc.) or for a total disappearance of forest cover (ibid).

A traditional example of narrow definition of Amazon deforestation is 'the complete and permanent destruction of forest for the purpose of allowing for alternative land uses (agriculture, pasture, infrastructure, etc.)' (Anderson and others 2002:5). Of course in this definition, the form of natural vegetation patterns, types and densities mixing savannah, lakes, rivers, and natural clearings, forming a variation of vegetation covers are not taken into account. Another case of narrow concept is exposed by the FAO which concept of tropical deforestation is "depletion of tree crown cover to less than 10%" (Wunder 2000 quoting FAO 1993:10).

In this research paper, the concept of deforestation is 'deforestation is the process of disappearance of forest cover, fundamentally cause by human intervention' (translation from Ministerio del Ambiente 2009:61) and 'the process of destruction of forest' (translation from Ministerio Agricultura 2005:51). This definition may be considered a narrow alternative but it is practical because it comes from the Peruvian official forestry documents.

Poverty

Poverty has been defined 'as a social condition of chronic insecurity resulting from a malfunctioning of economic, ecological, cultural and social systems, causing groups of people to lose the capacity to adapt and survive and to live beyond minimal level of satisfaction of their needs and aspiration' by Opschoor (2007:6). This definition puts together a set of approaches about poverty analysed in development studies which includes welfare factors and not only insufficient food or incomes.

During the 1980s the measure of poverty was related to the Human Development Index (HDI) that incorporates income levels plus the life expectancy as indicator of health, as well as literacy and school enrollment as indicators of education. The HDI adds new dimensions to the relations between forest and the poor; hence people in remote areas where forest is abundant could have opportunities for gaining some cash incomes or food, but they could remains poor because public basic services such as education or health security is scarce in such places (Andersen and Wunder 2006).

Later, assets and livelihoods come up in the poverty literature. Asset poverty refers to the situation where people possess insufficient assets (natural, physical, financial, human, social assets), or a mix of them. As a consequence, they are not able to afford or maintain an adequate and sustainable level of livelihood (Arnold 2001). For example, ecological poverty is defined as 'lack of ecologically healthy natural resources needed for human survival and development' (Opschoor 2007:6).

Similarly, livelihood is identified as a connection with certain capabilities, assets and activities required for a means of living, and is sustainable when it can cope with and recover from stresses and external shocks, and maintain or enhance its capabilities both now and in the future (Arnold 2001). The sustainable livelihood approach or the assets approaches are useful to get better insights of the causes of poverty related to processes focused on the individual (Andersen and Wunder 2006).

In a similar vein, we have the definition in the 2001 Wold Development Report from World Bank where poverty refers to a pronounced deprivation of well-being as a result of the lack of factors such as incomes, education and health increasing vulnerability and risk along with a lack of opportunity of being heard and powerlessness.

Of course, changing this situation of deprivation is called poverty alleviation; however, in forest-based poverty alleviation arenas it could be relevant to differentiate between poverty mitigation or avoidance and poverty elimination. Summarizing both types of poverty alleviation, Sunderlin et al. (2005:1386):

> -Poverty mitigation or avoidance, that is, the use of forest resources to meet household subsistence needs, to fulfill a safety net function in times of emergency, or to serve as a "gap filler" in seasonal periods of low income…and
>
> -Poverty elimination, that is, the use of forest resources to help lift the household out of poverty by functioning as a source of savings, investment, accumulation, asset building, and lasting increases in income and well-being

For the purposes of this research, the concept of poverty that we are going to use is based on monetary and non-monetary indicators. Although livelihood approaches, assets poverty, security and powerlessness may be more

convenient because they contain valuable information about the holistic features of rural poor people near or in the forest; the national statistics in Peru at the district level estimated so far comprised only monetary and non-monetary indicators. Meanwhile monetary indicators are based on the method of poverty line (PL) and non-monetary indicators based on the method of NBI.

The method of poverty line is related to income-consumption concept of poverty as measure of well-being. Then, to determine poverty level, the per capita household value of income or consumption is compared to the minimum basket called poverty line. Yet, if incomes are compared with consumption, the minimum basket will include all goods and services spent by each household. This latter method is applied by the National Institution of Statistic in Peru (INEI, acronym in Spanish) because it has the advantages of being a better indicator for estimating well-being as it measures the real amount of consumption rather than a potential consumption which is obtained when income is used. Another advantage is to present more less variability over time than incomes.

To determine the poverty line the INEI (2000) used as an instrument the national household survey (ENAHO, acronym in Spanish) which is calculated each year. Since the ENAHO allows inferences at regional and national levels, total consumption basket and minimum food basket are calculated. Each basket is equivalent to 2,318 kcal per capita and they are valued at real price per residence place.

Having poverty line values, the poverty incidence, gap and severity are calculated. Poverty incidence corresponds to households which have incomes or consumption below the total basket of minimum living costs. The poverty gap refers to average difference between the poor household incomes and the value of the poverty line. Finally, poverty severity indicates inequality between poor.

The method of NBIs through which is measured non-monetary poverty is based on a set of indicators of structural basic needs such as housing conditions, education, health, or public infrastructure that are required to reach an individual welfare quota (INEI 2000). In Peru, those indicators are overcrowded household, house without toilet service, house with at least one child who is not enrolled in school, and houses in which the head of house has only a primary education (INEI 2000). Using the methods of NBI's, poverty is the proportion of people who have at least one NBI.

Chapter 4
Data Analysis and Results

This chapter presents the methodology, data collection, data analysis and results for answering the main research question posed in the Chapter 1. But also this part intends to respond our sub research questions that are:

i. What is the magnitude of the impact of deforestation on poverty?
ii. How can the relationship between deforestation and poverty be explained?

4. 1 Data Collection

To respond to our research question and sub-questions this study has collected data from secondary sources available in official documents in Peru. Such information comes from the INEI, Ministry of Agriculture, Ministry of Environment, Ministry of Economy and Finance, and the regional government of San Martin.

The data consists of poverty, deforestation, and household's features variables and it covers 77 districts and 10 provinces in the region of San Martin. For the poverty variables at district level we have data from the 1993 and 2007 Population and Housing Census along with the map of poverty in 2007. The map of poverty in 2007shows information about monetary poverty (incidence, gap, severity) and non-monetary poverty. From the 1993 Census, we collected only non-monetary poverty data.

The deforestation data comes from the digital 2004 map of deforestation in the region San Martin. Moreover, we gathered information about forest land from a 2006 map of forest of the Geographic Directory (Gobierno Regional de San Martin 2007). All these maps were overlapped with the map of district limits of San Martin using ArcView 9.3 software in order to obtain the number of hectares forested and deforested by district. After this process, deforestation rates were measured and expressed as a percentage of forest area – all units of forest types- in each district. The statistics description of each variable of poverty, deforestation, and households' features are detailed in the Tables 4.1 and 4.2.

Table 4.1
Statistics description of poverty and deforestation in San Martin by districts

Indicator	Mean			Std. Dev.		
	1993	2004	2007	1993	2004	2007
Monetary poverty						
Incidence of total poverty						
Number	-	-	4,313	-	-	5,001
%	-	-	50	-	-	16
Incidence of extreme poverty						
Number	-	-	1,668	-	-	2,045
%	-	-	19	-	-	12
Intensity indicators of poverty						
Gap of total poverty	-	-	17	-	-	8
Severity of total poverty	-	-	8	-	-	5
Inequality						
Gini coefficient	-	-	0	-	-	0
Non-monetary poverty						
At least one NBI (%)	80	-	68	14	-	17
One NBI (%)	26	-	36	8	-	10
Two NBI (%)	28	-	22	8	-	8
Three NBI (%)	18	-	8	8	-	5
More than 4 NBI (%)	8	-	2	5	-	2
Deforested areas						
Hectares	-	21,140	18,441*		17,368	16,080
Deforestation rate	-	61	55*		28	28

*The information taken for 2006
Source: INEI, Ministerio de Agricultura, Gobierno Regional de San Martin

In general, what we may observe in Table 4.1 is the fact that non-monetary poverty between 1993 and 2007 has decreased for all the NBI's measures less those households with one NBI. Of course, there is limited information for describing the average tendency between 1993 and 2007 or any additional inference concerning monetary poverty incidence. Both average deforested hectares and deforestation rate decreased between 2004 and 2006.

Table 4.2
Statistics description of social variables in 1993 and 2007 (%)

Indicators	Mean		Std. Dev.	
	1993	2007	1993	2007
House				
Overcrowded houses	-	28	-	11
Without toilet by red	93	89	13	17
With children not enrolled	11	12	5	5
With high dependency	-	7	-	3
Without water by red	87	57	21	31
Without lighting	70	48	23	24
With land floor	74	69	17	18
Without appliances	-	20	-	7
Cooking with keros., firewood, coat & Oth.	-	79	-	17
Without electricity, water & drainage (serv)	-	12	-	12
Without communication	-	79	-	18
Education				
Total illiteracy	18	9	6	4
Female illiteracy	23	14	8	6
Educational level				
No education	2	12	1	4
Primary	73	56	10	8
Secondary	21	26	7	6
Post-secondary	4	6	3	5
Health				
Population without health insurance	-	55	-	13
Employers without health insurance	-	71	-	17

Source: INEI: XI Censo de Población y VI de Vivienda 2007
INEI: IX Censo de Población y IV de Vivienda 1993

From Table 4.2 presented above, it is possible to get a picture of the main social variables of the district of the region San Martin. Looking at the results shown in Table 4.1, it is observed that the population have improved their social profile for those conditions relating to housing and education. Unfortunately, there was no health information available by district as well as certain housing variables for the year 1993.

4.2 Methodology

The tools selected to analyse and evaluate the potential impacts of deforestation on poverty levels in San Martin consists of the estimation of correlation between deforestation and poverty both numerically and graphically. Both exercises will be done using the econometric program STATA 10.0 and Excel Microsoft Office 2007, respectively. For the data analysis, we calculate the deforestation rate as the area that was deforested in the years 2004 related to the total forest area in San Martin. We assume that deforestation rate in 2004 could impact on poverty change in the 2007 according to the channels laid out in the theoretical framework. Hence, our analysis will be concentrated in the nexus of deforestation rate in 2004 and poverty change or poverty level.

In fact, we expect to find positive correlation between deforestation as a type of environmental degradation and poverty. Such positive nexus could be in response to the list of possible situations that were details in Table 3.1 such as productivity decline due to soil erosion or increased household expenditures due to fuel wood shortage, and others. We are assuming that a direct line of causality from poverty to deforestation is not immediately obvious, in other words, we are taking that findings presented by Zwane (2007) and developed in Chapter 2 and 3 are facts for San Martin as region located in Peruvian Amazon rainforest.

To calculate the correlation, we define poverty change as the change in non-monetary poverty rate between 1993 and 2007. Here non-monetary poverty is defined as those which have at least one NBI for the 77 districts in San Martin. Given that there is only reliable information about monetary poverty indicators in 2007 our analysis cannot be done for changes in incidence of poverty but we will do it for the level of incidence.

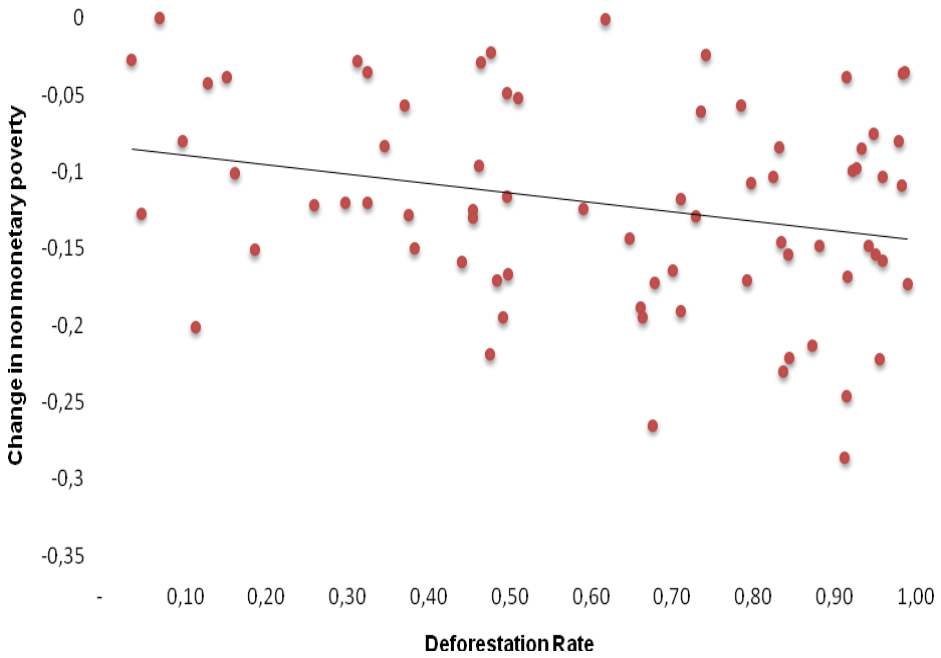
Along with the value of correlation, we will draw the graphs of deforestation rate and change of poverty for every district in San Martin. Through these graphs we have the objective of inference whether there are or not positive, negative or zero relationships between both variables. Of course, these inferences will be verified by the coefficient of correlation.

This statistical information has direct connections with most of the research questions in this study. Hence, to respond the first sub-question which is about the magnitude of the impact we are going to evaluate the value of correlation coefficient and its significant level. Finally, to answer the third sub-question the statistical results, the deforestation's background in districts of San Martin and the theoretical framework will be synthesized.

4.3 Results and analysis

Following the methodology above, scatter graphs between poverty and deforestation are drawn. First, the changes in poverty according to NBI index have been plotted with deforestation rates in 2004 (see Graph 4.1).The tendency in this case is marked with a grey line through which a negative relationship between poverty and deforestation may be inferred; however, this should be confirmed by the correlation's coefficient.

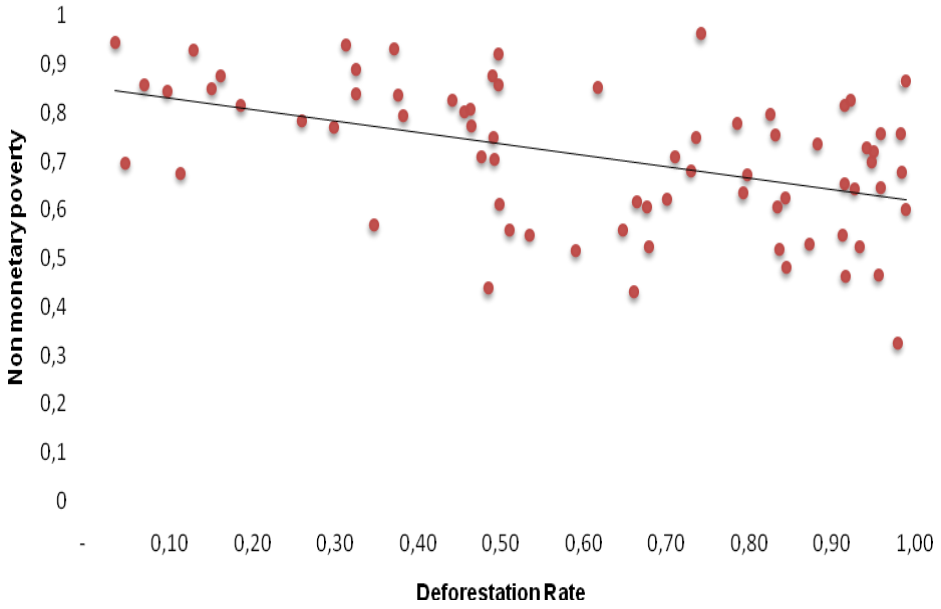
Graph 4.1
Changes in non-monetary poverty (2007-1993) & deforestation rate in 2004



Regarding the number of observations in the Graph 4.1, four districts were eliminated of the sample because their values were unusual or untypical in comparison to the rest of districts. Two districts belong to the same province, San Martin, and they are Alberto Leveau and Cacatachi. The rest of the districts were San Hilarion and Shanao in the provinces of Picota and Lamas, respectively.

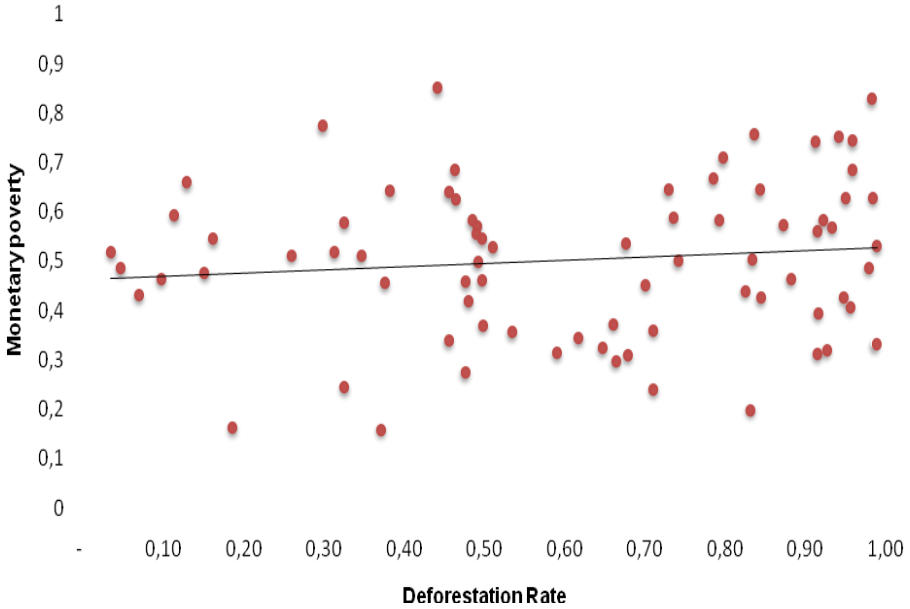
The second graph is a plot between the level of non-monetary poverty in 2007 and the deforestation rate in 2004 (see Graph 4.2). Similarly, this graph shows a negative trend line between poverty and deforestation after the elimination of outliers. In this case, the outlier districts were Cacatachi in the province of Lamas, and La Banda del Shilcayo and Morales located in province of San Martin.

Graph 4.2
Non monetary poverty in 2007 & deforestation rate in 2004



A third graph analysed is Graph 4.3 where the variables are monetary poverty in 2007 and deforestation rate in 2004. Unlike the last two graphs, here we may have a positive association between poverty and deforestation even though it could be arguable a possible null relationship due to the tendency line being almost horizontal. The number of outliers was zero in this case.

Graph 4.3
Monetary poverty in 2007 & deforestation rate in 2004



Beyond these graphs, the correlation coefficients for poverty and deforestation rate in 2004 have been calculated. This correlation analysis intends "to measure the strength or degree of linear association between two variables' (Gujarati 2004: 23). First, Table 4.3 summarizes the value of correlation coefficients for the different poverty variables and deforestation in 2004. As can be observed the absolute numbers are far from 1 which means that there would be a very weak association between poverty and forest loss. However, the correlation coefficients for non-monetary poverty have a significant level of 10% and 1% for the years 2007-1993 and 2007, respectively.

Additionally, the correlations coefficients confirm what type of relationships link our study variables. In fact, the linear association between deforestation and poverty in non-monetary terms is negative for both changes in 1993-2007 and the level in 2007. In other words, increasing deforested areas may be related to less poverty. In the case of deforestation and incidence of poverty, it would be a positive association which means that high deforestation is related to more poor people.

Table 4.3
Correlations: poverty variables and deforestation rate in 2004

Description	Years	Correlation	Significant level
Change in non- monetary poverty	2007-1993	-0.1954	0.0907
Non-monetary poverty	2007	-0.3444	0.0022
Monetary poverty	2007	0.1144	0.3217

As noted earlier, the expected outcomes were positive relationships between deforestation and poverty meaning that the former would increase the latter. Following Zwane (2007) we assumed that poverty will not be the main driver of deforestation, thus it is likely that correlation coefficients would indicate primarily impacts of forest degradation on poverty. Nevertheless, the results on Table 4.3 for non-monetary poverty are opposite to our initial expectations given the negative sign and the low correlation values which are significant at 10 and 1 percent level. By contrast, monetary poverty seems to match in the sign with the expected theoretical frame. However, we could not consider such positive sign as a definitive outcome because the correlation coefficient is not significant even at the 10 percent level.

Certainly, the level of significance would indicate to us that no relationship may exist between the degradation of forest land and poor-household's incomes that is behind the measurement of monetary poverty. Here, time could play a relevant role. Indeed, the data about deforestation rates come from the year 2004 and the impacts such as watershed protection, soil erosion, loss of safety buffer, and fuel wood shortage to affect people's incomes may take more than 3 years due to the natural process embedded in such effects. Moreover, incomes from coca or agricultural crops could have pushed down this negative relationship.

Compared to the significance of monetary poverty, non-monetary poverty seems to have a stronger connection with deforestation. But, in this case, our results are non-expected. Here, a revision of the conceptualization of non-monetary poverty as well as a review of drivers of deforestation could help to understand this unusual outcome.

What is behind the concept of non-monetary poverty is the idea of certain unmet structural basic needs by poor. In particular, this indicator counts housing conditions, education, health, public infrastructure that are required to reach an individual welfare quota (INEI 2000). It is related to social aspects of poverty instead incomes or expenditure conditions. As we mentioned above, in Peru, it specifically includes an overcrowded household, house without toilet service, house with at least one child who is not enrolled in school, and houses in which the head of house has only a primary education.

In this non-monetary poverty's concept, those households that have improved their access to education through the construction of more schools, or have been benefited by public, private projects that gave them facilities to enhance sanitary, lightening services or settlement would show a reduction in their non-monetary poverty independently of a change in income.

Taking into account that the drivers of deforestation in the region of San Martin are mainly road infrastructure, by which agriculture and cattle were expanded, as well as overlapping issues in protected areas, concessions, and native communities, it is highly likely to find public infrastructure in favour of poverty reduction surrounding and in deforested areas. For instance, inside wood concessions are locations such as schools, medical posts, road paths, and others. Similar pictures have been observed in protected areas including regional conservations areas. We cannot state categorically that this infrastructure has been directly built to reduce poverty because, in some cases, they are just part of private, public investments for promote medium/large enterprises' growth in oil, lumber, agro industrial sector. It may be true, however, that this investment has helped the poor to reach some basic needs.

As a consequence, it seems that our expectations based on the assumption of negative impacts of deforestation reducing incomes or supporting means to poor were not right. We are dealing with two issues, first the short time between our year of study (2004) and the impacted year (2007) that could too small to reveal any relevant environmental changes and the hidden impact of incomes obtained by coca crop agriculture. Second, non-monetary poverty is not increased by deforestation, but on the contrary been decreased.

Chapter 5
Conclusions

This research had as principal aim the study of the impacts of deforestation on poverty in the Peruvian region of San Martin. In doing so, two questions were presented through which the main objective was reached. These were:

i) What is the magnitude of the impact of deforestation on poverty? ;

ii) How can the relationship between deforestation and poverty be explained?

To respond to our research question this research was divided into three chapters. First, we came up with the past and current context of deforestation in Peru briefly and in the region of San Martin widely. Thereby, we showed the importance of the problem of deforestation at the national level and the common factors or drivers of deforestation. It was highlighted that the annual cost of deforestation is around 0.2 percent of GDP in 2003 and this cost excludes non-use values (option, existence value) as well as those costs related to natural disasters, soil degradation or water quality.

The review of deforestation in San Martin stated that this region is the most deforested region in the country that reached 1.6 million hectares in 2004 with a deforestation rate of 32%. And as main drivers in San Martin we mentioned road infrastructure, shifting agriculture, cattle, illegal coca cultivation and illegal extraction. In addition, we analyzed the forest loss by type of land property; for instance, how extensive is the problem in national protected areas, concessions, and native communities. A common problem in the three places was overlapping between them or other economic agents producing conflicts and uncontrolled deforestation. On the other hand, we presented data about social and economic situation in San Martin including poverty levels in the whole region but also by districts. It was underlined that among districts this is a large difference in poverty. Specifically, we did find the total monetary poverty flows between 85% and 16%.

Regarding impacts of deforestation in San Martin, some studies (Gobierno Regional de San Martin 2008b, Ministerio del Ambiente 2009) state potential or current problems such as supply and quality of drinking water, increased number of natural disasters (floods and droughts), soil erosion, soil and water pollution, diminished environmental services from the forest, loss of tourist value, and loss of biodiversity. However, none of them emphasizes the effects on the poor. To fill this gap, our research put forward a theoretical framework about environmental degradation and poverty stressing the particular relationship between deforestation in San Martin and poverty.

The theoretical framework about environmental degradation and poverty develops three perspectives through which the poor are incorporated in the dynamic process of environmental degradation. A first position stressed the role of poverty as driver of environmental degradation. For example, the post-Malthusians' hypothesis of 'too poor to invest' means that population growth along with economic deprivation make impossible more investment to increase productivity; consequently, there will be less productivity in the future and a downward spiral of poverty.

A second perspective argues that poor are mainly victims of the consequences of environmental problems in comparison with the rich who hold more assets to mitigate or reduce potential problems. In this sense, even though both groups with low and high incomes could be affected by issues such as deforestation, the poor will be always in a worse situation. For instance, Table 3.1 summarized the different connections through which deforestation hits the poor, via environmental impacts such as watershed protection, soil degradation, and loss of safety buffer which would reduce income opportunities in low-income households. A third perspective put together the previous perspectives indicating that there is a dynamic relationship between environmental degradation and poverty that creates a vicious circle of poverty.

Finally, the theoretical frameworks Chapter included a discussion about the different means by which natural forest resources and poverty are correlated. This is that forest resources are able to generate either monetary or non-monetary incomes directly from selling timber, charcoal and resins or indirectly having access to food, medicinal plants and firewood.

Given the previous background, the paper applied the theory findings and the regional context to the data about poverty and deforestation in San Martin at district level. Thus, formulating the answer to the proposed research question this analysis was done using the rate of deforestation in 2004 and the estimation of both monetary and non-monetary poverty in the 77 districts. Our findings in relation to the main research question and sub-research questions are, in that order, as follows:

- A reduction in poverty level can be attributed to deforestation in 2004 in the region of San Martin since the change on non-monetary poverty in the period 1993-2007 and the level of non-poverty in 2007 showed a significant, negative correlation coefficient with deforestation. However, it is worth mentioning that even thought the values are negative, the magnitude itself is fairly small.
- In fact, the magnitude is considered small because the values of the correlation coefficient are only 20 and 35 percent which may indicate a weak relationship.
- In the response to our last sub-research question, it must be stressed that our findings are basically referring to poverty in social terms but not in monetary terms. And our findings could be connected with the

presence of certain drivers of deforestation such as public infrastructure (roads, schools, irrigation, etc.) in the sense that the poor would have had more access to basic services during the evaluated period of time. Nevertheless, our findings might not provide accurate conclusion about what is going on in term of monetary poverty. Beyond that we stressed that the time could play a crucial role. Perhaps income impacts affected by watershed protection, soil erosion, loss of safety buffer, and fuel wood shortage might take more than 3 years responding to the long natural process. Moreover, incomes from coca or agricultural crops could also play a neutral role in this relationship.

Notes

[1] Sustainable forest management (SFM) approach is proposed by the FAO 'to enhance human well-being through support to member countries in the sustainable management of the world's trees and forests' (FAO 2006 quoting FAO 1999a). This approach distinguishes three dimensions of development: welfare-economic, social, and environmental. Originally, SFM as a forest policy response appears in global conventions in 1990s after the articulation of sustainable development in the Brundtland Report. Amongst the most influential conventions, we have the 1992 United Nations Conference on Environment and Development settled in Rio de Janeiro, Brazil, the Intergovernmental Panel on Forests held in the years 1995 and 1997, the Intergovernmental Forum on Forests 1997–2000, and the United Nations Forum on Forests in 2001. Other conferences sought to establish those criteria and indicators in order to standardize SFM as concept; for instance, the Pan-European Forest Process (before called Helsinki Process) and the Montréal Process on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests

Appendix

Map of Incidence of poverty in the Province Rioja (2007)

Source: INEI- XI Censo de Población y VI de Vivienda 2007

Map of Incidence of poverty in the Province Moyobamba (2007)

Source: INEI- XI Censo de Población y VI de Vivienda 2007

Map of Incidence of poverty in the Province Lamas (2007)

Source: INEI- XI Censo de Población y VI de Vivienda 2007

Map of Incidence of poverty in the Province San Martin (2007)

Source: INEI- XI Censo de Población y VI de Vivienda 2007

Map of Incidence of poverty in the Province El Dorado (2007)

Source: INEI- XI Censo de Población y VI de Vivienda 2007

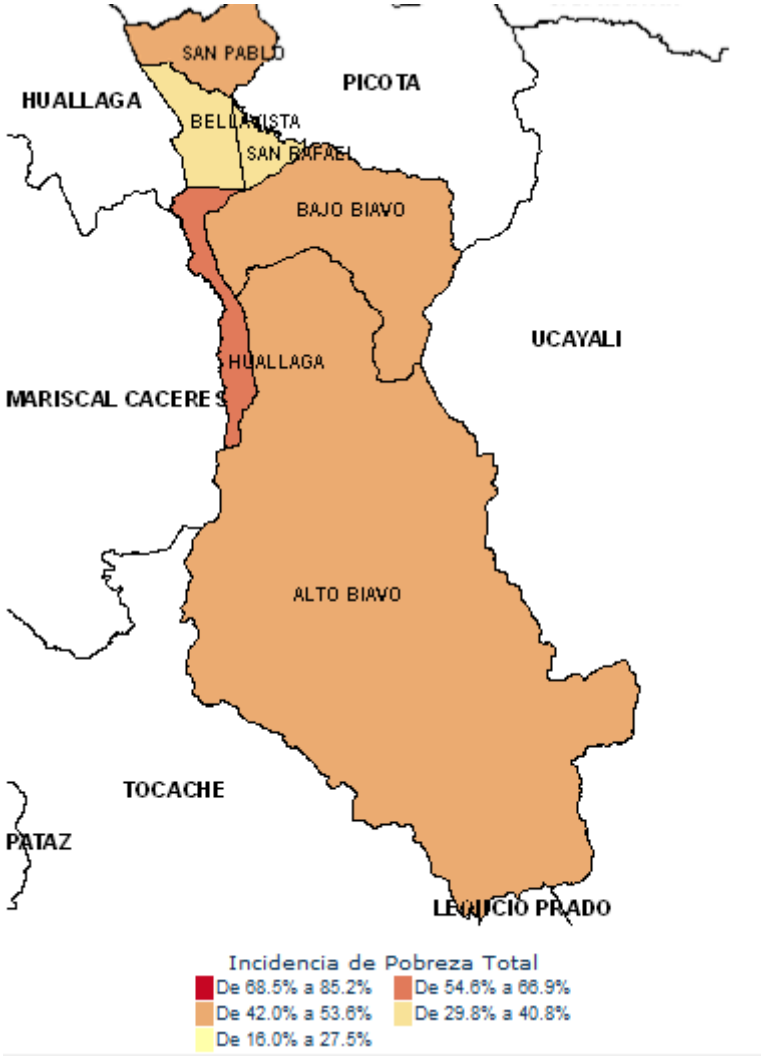
Map of Incidence of poverty in the Province Picota (2007)

Source: INEI- XI Censo de Población y VI de Vivienda 2007

Map of Incidence of poverty in the Province Huallaga (2007)

Source: INEI- XI Censo de Población y VI de Vivienda 2007

Map of Incidence of poverty in the Province Bellavista (2007)



Source: INEI- XI Censo de Población y VI de Vivienda 2007

Map of Incidence of poverty in the Province Mariscal Caceres (2007)

Source: INEI- XI Censo de Población y VI de Vivienda 2007

Map of Incidence of poverty in the Province Tocache (2007)

Source: INEI- XI Censo de Población y VI de Vivienda 2007

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