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Tropical Forests: Current state, Key Pressures and Possible Measures

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State of the Tropical Forests and Its Implications

Tropical forests are distributed largely between the tropic of Cancer and tropic of Capricorn. It covers parts of Asia, Africa and Latin America. These forests shrunk significantly over the years due to a number of factors. For instance, close to 86% of the global forest cover loss between 1990 and 2010 occurred in the three main rainforest basins, which make up the largest part of the tropical forests (Table 1). However, the trends are

showing some positive signs with stringent measures being taken in the rainforest countries. For instance, the rate of deforestation has shrunk by almost 63% in the three rainforest-basins of the world in the time 2000-2010 compared to the one in 1990-2000. Thus, despite the declining rate of loss, still tropical forests are shrinking at a very significant rate.

Table 1. Changes in the areas of the three main rainforests (FAO 2011)

	Area (1000 ha)			
	1990	2000	2010	Change (Δ 1990-2010)
Amazon	874,321	835,847	799,394	-74,927
Congo	316,078	308,864	310,807	-5,271
Southeast Asia	277,817	252,324	242,048	-35,769
Aggregate of the Rainforest basins	1,468,216	1,397,035	1,352,249	-115,967
World forest area	4,168,399	4,085,063	4,032,905	-135,494
Proportion of Rain forest basins	35.22%	34.20%	33.53%	
Proportion of Rain forest loss from the world forest loss	85.59%			
Relative decline in deforestation between 2000-2010 compared to 1990-2010	62.90%			

Tropical forests are believed to have the highest biodiversity concentration both in terms of diversity and endemism. The loss of these forests therefore has a very strong implication for global biodiversity. More to the loss is also that these forests harbor the largest population of indigenous communities who depend on the forests for their subsistence and all other needs. In terms of benefits to the human population, tropical forests are also high on the scale as they are major sources of forest products such as fuelwood, construction wood, traditional medicine, water, and many other uses. This excludes timber that goes to different parts of the globe as export commodity.

Moreover, tropical forests are of critical significance in avoiding emission of greenhouse gases (GHGs) that contribute to global climate change. They sequester large amounts of carbon and other GHGs that if released could lead to significant climate change effects. Realizing the potential within the tropical forests, the initiative on Reducing Emissions from Deforestation and forest Degradation (REDD+) was formed, and the push to implement the mechanism is now gathering pace finally. Thus, conserving these forests is of crucial importance for global efforts to abate climate change.

Tropical forests play another critical role in facilitating hydrological processes. For

instance, the major river basins of the world i.e. the Amazon, the Mekong, the Nile, the Congo basin, Lake Victoria basin, etc. are all situated in the tropics surrounded by considerable areas of forests. The water quantity in the basins is often associated with the extent of forest cover that is contributing to the hydrological processes taking place in the areas.

In general, tropical forests are crucial for biodiversity conservation, indigenous communities' livelihoods, hydrological processes and climate change. Any further depletion of these forests has significant ecological, economic and social implications. Therefore, strategies to curb the forces that exert pressure on this forest should be of high priority.

The Drivers

Three broad categories of anthropogenic pressures could be of strong relevance to the shrinkage of tropical forests around the globe. They are: 1) timber extraction, 2) land use change due to export commodity production such as oil palm, rubber, cocoa, coffee, beef, soybean, etc., 3) land use changes due to crop production for subsistence needs.

Timber: Timber extraction from tropical forests has been ongoing for decades if not centuries. Though the large share of the extraction was for export purposes, recently the domestic consumption of tropical timber has been rising significantly. This is largely due to the booming population and the growing economies in the South both implying rise in domestic demands for wood especially for construction and energy.

With the rising demand for tropical timber both on international and domestic markets, the value from this practice has increased significantly. As a result, besides legally permitted extraction of timber by authorized companies or parties, illegal timber

extraction from tropical forests has increased significantly. Both exploitation approaches expose tropical forests to severe destruction in many cases. The impacts of the legal permits in themselves are sometimes refutable due to the procedures used. For instance, many of these permits to exploit the forests are issued by government entities that sometimes fail to consider the wider environmental impacts of the extraction. Formalities that address sustainability issues are often entertained superficially as the revenue earned from the timber often guides the decision process. In some instances, corruption in the timber industry is also influencing the decisions even when proper regulatory instruments that consider ecological sustainability are in place. For instance, exceeding the legally permitted volume of timber is among the examples of such cases.

The other dimension of timber extraction that is significantly affecting tropical forests is the illegal timber extraction. Recent reports from the International Timber Trade Organization (ITTO) revealed that in many tropical countries the share of illegally extracted timber is considerably high (Smith 2002). Current efforts such as certification and timber tracing are helping a lot in reducing illegal timber trade.

Land use changes for commodity crops production: Among the main factors leading to the depletion of tropical forests is the clearing of intact forests to produce commodity crops demanded highly on the global markets. These produce include palm oil, rubber, cocoa, coffee, beef, soybean, etc. Oil palm is among the fast growing commodity crops in the tropics (Koh and Wilcove 2008) with area coverage of about 3.6 million ha in 1961 and expanded to 13.2 million ha in 2006 (FAO 2007 cited in Koh and Wilcove 2008). A significant portion of this expansion is assumed to have happened on forestlands. For instance, Koh and Wilcove (2008) revealed that 55-59% of the oil palm fields in Malaysia and 56% of the

fields of the same crop in Indonesia occurred by clearing forestlands. Rubber is another key commodity crop having a significant impact on tropical forests. Li et al (2007) indicated that about 139,576 ha of tropical rainforest in South West China was lost to rubber plantations between 1976 and 2003.

Directly related to both illegal timber extraction and commodity production is the process of land expansion for speculative reasons that happened, for example, in Brazil (Margullis, 2003). After illegal logging takes place, occupation is consolidated by the establishment of precarious cattle ranching or agriculture activities, in many cases with low productivity indicators. Property rights are assured by physical occupation, which has, initially, priority over ownership documents. By subsequent legal regularization, land titles may be obtained.

Land use changes due to subsistence needs: Close to 70% of deforestation in the Amazon is largely due to cattle ranching by smallholder farmers (Nelleman 2012). The slash and burn agriculture in the Congo basin forest is also largely due to the need to produce more food and wood for the consumption of the smallholder families. In some tropical countries, the expansion of slash and burn agriculture is due to degradation of farmlands. Recently such form of deforestation is on the rise with growing demand for food due to increasing rural population. Shifting cultivation by smallholder farmers is also considered as among the main drivers of deforestation and of forest degradation (Fox 2001).

The Measures: The Need for North-South Ventures

Reducing tropical deforestation needs a concerted effort from all entities, regions, sectors and actors. This implicitly means that there is a need for action from the forest products consumers i.e. largely the global North and the local communities. With the same magnitude, there is a need for the global South to effectively implement the necessary measures to sustain this forest for future generation. In recent decades, there is a growing trade agreement and negotiations between the North and South that often included commodities that are directly produced from tropical forests e.g. timber and commodities whose production is associated with land use changes affecting tropical forests e.g. beef, oil palm, rubber, soy, etc. A North-South venture is therefore crucial for achieving the intended goal of sustaining the forest for the future.

This in a way does not mean that we reinvent the wheel but continue supporting and strengthening the implementation of

measures that showed impact in reducing the rate of forest loss in the period 2000-2010 for instance. What is paramount is for the global North to continue with support on measures that were effective in minimizing the rate of deforestation and for the South to continue with the determination and goodwill (including political) to effectively put in place the measures without misappropriation of the public and private funds allocated for the activities. Below are some measures that need to be taken into account.

Promoting the production and consumption of certified forest products

Recent statistics show that 50-90% of all the forestry products in the producer countries is illegal (Nelleman 2012). The same source indicates that the global estimate of illegally traded wood is between 15% and 30%. Hirshberger (2008) for example states that close to 56% of the wood imports from Africa

to Europe are from illegal sources. The infiltration of illegal forest products in the global market particularly in the timber trade may discourage producers that are certified as per the government requirements or other standards such as EU Forest Law Enforcement, Governance and Trade (FLEGT), Forest Stewardship Council (FSC), Rainforest Alliance certification and other mechanisms to ensure sustainable timber supply. Timber importing countries should create awareness about certified timber so that consumers are sensitized and can discriminate illegal timber. This might also require consumer country governments and entities to devise mechanisms of incentivizing/encouraging their consumers. More to the awareness creation is also that consumers have the moral obligation of saving tropical forests by consuming legally produced timber.

Governments in the South should also be engaged in strict timber regulations to save their forests by optimizing revenues generated from the forests taking into account the future of the forests. They should also be ahead of the game with the illegal loggers who change their tactics every time. For instance, Assunção et al (2015) indicated that despite the 80% decrease in annual rate of deforestation in Brazil between 2004 and 2012, the problem has now shifted to small-scale logging which gradually is increasing and is very difficult to detect. Therefore, policies should be adaptable to also address such changing styles of deforestation. Besides, to curb the illegal timber extractions, governments in the South should also strengthen the regulatory mechanisms e.g. policies regulating the extraction level of timber, devise legal options to deal with trespassers of the timber extraction regulation and eliminate unnecessary policy barriers for those engaged in sustainable and environmentally friendly timber extraction methods.

In the Brazilian case, the new forest code brought several opportunities for both the North and South to engage in additional

initiatives to the expansion of sustainable forest products (SFB 2012). According to the new code, private rural properties, not considered small¹, are supposed to maintain a fixed proportion of their area in natural vegetation. The natural vegetation area is called “legal reserve” (LR), and the proportion varies from 20% in the Atlantic Forest to 80% in the Amazon biome. The code also determines that some sensitive areas, located on river margins, river springs surroundings etc., called “permanent preservation areas” (APPs) should also be kept with native vegetation.

Landowners, who, as of 22 July 2008, did not meet the minimum area for legal reserve, would have to restore or compensate for difference between the minimum requirement and the actual existing amount of native vegetation. For compensation, the new forest code provided alternatives, such as the “environmental reserve quotas” – CRA (May et al., 2015), which allows a certain property to compensate for shortage of LR, by using excess of legal reserve in another property, within the same biome. The deficit of APPs should be restored, in small and large properties.

Soares-Filho (2013) and Soares-Filho et al (2014) present estimates for the total amount of LR to be restored or compensated around 20 million hectares, with estimates for the deficit of APPs to be around 5 to 6 million hectares. Although there is the possibility of compensating for the LR with the CRA mechanism, for example, depending on regulatory issues (CRA per biome or per states), opportunity costs in areas with LR deficit, on transaction costs, and on availability of LR surplus, it is likely that a large amount of the total amount of LR deficit will have to be restored. Passive restoration is possible in the Amazon biome, but for other biomes, a large amount of LR area will have to go through a

¹ Small properties are the ones with size less than 4 fiscal modules. The fiscal modules vary depending on the region, and they range between 5 and 110 hectares.

process of active reforestation. Considering the total area of LR not compensated and not passively restored, together with the total area of APPs, it is possible that Brazil will go through a process of restoring more than 10 to 15 million hectares of forest. In a recent visit to the USA, Brazilian President Dilma Rousseff signed a commitment to recover 12 million hectares of forest till 2030.

The new forest code allows for 50% of the deficit of LR to be restored with planted forests. Therefore, there is room for new certification policies for wood products from planted forests corresponding to LR restoration projects. On the other hand, there are several alternatives for productive active restoration projects, not based on wood production, as discussed on Caldeira and Chaves (2011), Martins and Ranieri (2014). These alternatives can be applied both to LR as well as to APPs. Certification mechanisms could be fostered to create incentives for agroforestry products, coming from LR and APPs restoration initiatives. Therefore, North-South cooperation arrangements could be created to encompass restoration products, related to planted forests and agroforestry systems.

Managing food consumption behaviors

Currently there is a major global concern about the food production and consumption behaviors in general. One among the many problems is that considerable portion of the food produced is being wasted (Bond et al 2013). Globally, estimates from 2009 show that close to 32% of whole food produced (by weight) is lost or wasted. Fifty-six per cent of this loss occurs in the developed world while the rest 44% occurs in the developing world (Lipiniski et al 2013). Analysis from FAO (2013) shows that the food waste affects biodiversity and habitats particularly in tropical and subtropical areas. The report also revealed that almost 99% of the food wastage at agricultural production stage occurs in

countries facing medium to strong land degradation problems. Thus, when more of what is produced is wasted there is often a need for additional new farms.

In tropics and subtropics, deforestation due to agricultural expansion is still prominent (FAO 2013). Gibbs et al (2010) shows that 55% of the new agricultural lands created between 1980 and 2010 were actually by clearing intact forests. If food waste is not abated, then the land required to produce food is going to increase. Especially in the tropics where land degradation is also a major challenge, this may imply that new agricultural lands need to be created to provide food for the sharply increasing population.

In general, it is necessary that both developing nations and developed countries enhance food use efficiency. This does not mean that people should consume extra but rather procuring what could be consumed alone. In many instances, the effects of food waste on forest resources may not be directly visible. However, it is crucial to recognize the system wide impacts of such drivers on forest ecosystems.

Certification mechanisms for sustainable land use and deforestation reduction

Several successful initiatives happened in Brazil, promoted by interactions between the private and the government sectors, in order to reduce deforestation by focusing on the main driving products. As discussed previously, soy and beef have been the main commodities produced in deforested areas in the Amazon biome. The beef moratorium and the soy moratorium are two important schemes to inhibit the production of these two products within deforested areas.

The soy moratorium is an environmental pact established among representative entities of Brazilian soy producers, NGO's, and later on was supported by the Brazilian government. The idea was to adopt measures

against deforestation in the Amazon area. It was initially anticipated to be valid for two years, beginning in July 2006. The participant producers (initially accounting for 94% of the total soy production in Brazil) agreed not to commercialize soy produced in areas deforested for expanding soy plantation in the Amazon biome.

Nowadays, the moratorium is monitored by satellite image analysis (Landsat/TM and Terra/Modis). INPE has been playing a major role in this process, being responsible for the satellite monitoring (see Rudorff et al, 2011). Since 2008, the moratorium has been prorogated yearly, and it is in vigor. Several analysis have shown the effectiveness of the pact, although there has been observed some small conversion from forest to soy plantation.

The beef moratorium was idealized by the NGO Greenpeace, and was signed by four major beef Brazilian exporters and by various beef retailers, compromising not to buy beef from animal production in areas illegally deforested. The idea was to guarantee an environmental complying origin for the beef exported to international markets. Rural establishments that deforested illegally after October 5, 2009, will have difficulties selling to main beef retailers and exporters.

Fostering initiatives to tackle the production of driving commodities of deforestation may constitute another important way for the North-South cooperation to work. The Brazilian cases are good example that could be replicated in other regions and for other products, with increasing participation of North countries to promote sustainable practices in South.

Investing in improving the livelihoods of forest dependent communities

The tropical region is also characterized by strong dependency on forest resources both for energy and construction purposes. The communities largely do not afford modern

efficient energy and construction technologies unlike other parts of the world due to relatively high poverty rate. Compared to other forest regions of the world, tropical forests support the largest population of indigenous and smallholder farming communities. Though in many instances timber remains the frequently cited commodity from tropical forests, non-timber forest products that are extracted from the forests also play a crucial role to sustain the livelihoods of the local forest dependent communities. Due to lack of alternative options, forests often serve as risk mitigation strategies against factors such as crops losses, drought, etc. (Pattanayak and Sills 2001). With the growing population in the tropics and strong dependency on wood for energy and construction, the pressure on the tropical forests may continue to rise. One way of tackling this is by investing in improving the livelihoods of the rural smallholder communities so that they could be empowered to access alternative energy sources (e.g. renewable energy) and non-wood construction options.

Facilitating the implementation of REDD+, EU FLEGT and other forest friendly schemes

REDD+ and EU FLEGT are increasingly being adopted as global mechanisms uniting both the South and North in various initiatives. Promoting such mechanisms and investing in their implementation could be a very progressive step towards reducing the losses of tropical forests. REDD+ as a performance based incentive scheme is becoming popular in the tropics and other forest countries due to its potential to provide economic benefits to the local communities for their efforts to conserve forests. REDD+ allows for economic incentives to be provided through market and non-market mechanisms upon verification of reported emission reduction. Such emissions can be through 'reducing emissions from deforestation', reducing emissions from

degradation', 'conservation of forest carbon stocks', 'sustainable management of forests' and enhancement of carbon stocks. Since 2005 several countries have been engaged in developing REDD+ programmes with varied results (Minang et al 2014).

Improve policy-making, policy implementation and enforcements

Evidence suggest that progressive forest policies that devolve forest management to local communities and includes all stakeholders interests especially of the private sector can significantly reduce deforestation and forest degradation in tropical forest environments (Arts et al 2002; Ribot 2013). Investments in reforms that allow better enforcement of forest policies can be important determinants of forest conservation success in many tropical countries. For example, recent successes in curbing deforestation in Brazil have been attributed in large part to improved implementation and enforcement of forest laws and regulations (Boucher 2014). Many countries are meeting their protected area targets on paper. While some are successful, considerable proportion of the protected areas remains largely encroached (Nelson and Chomitz 2011), demonstrating that policy implementation and enforcement needs to be addressed.

Towards a more integrated inter-regional policy scheme

Finally, it is important to consider the interdependence between local policies and global consequences, both South-South as well as North-South. Most of deforestation is driven by pressures for commodities production, as discussed above. Due to intense trade integration, world demand is supplied by different regions, and land dependent products are shifting to tropical forest regions, where there is still land availability and good climate conditions. One consequence of the

integrated supply and demand global network is that local policies affecting land use, and consequently, commodities supply in one country may imply in higher deforestation pressure in other areas.

To address this issue, we performed an exercise using a global land use model, named GLOBIOM², developed by IIASA. The model is based on the equilibrium between global supply and demand, and it aims to mimic the production behavior of land related products, in different world regions. The underlying hypothesis is that production will be supplied in such a way to minimize costs and maximize output. One of the implications is that commodity production will occur where land productivity is higher and production costs are lower. The model also considers both within-region transportation as well as trade costs.

To understand how local policies affect land use in other countries, we consider three policy scenarios for Brazil. The first scenario, what we call business as usual (scenario BAU), we consider historical deforestation trends, although some legal restrictions, such as the Law for Mata Atlântica, are also considered. The second scenario corresponds to the implementation of the new forest code (scenario FC). Finally, the third scenario (FC+) encompasses the forest code as well some incentives for small farmers, entitled for legal reserve amnesty, engage into LR restoration. Therefore, in the third scenario, in principle, there would be more conversion from non-forest to forest cover. For more details on model implementation and policy scenarios, the reader can refer to the documentation available at www.redd-pac.org.

² GLOBIOM stands for Global Biosphere Management Model. For more details on GLOBIOM, see www.globiom.org. For details on GLOBIOM customized for Brazilian policies, see www.redd-pac.org.

Figure 1 - Brazil's Total Soy Production

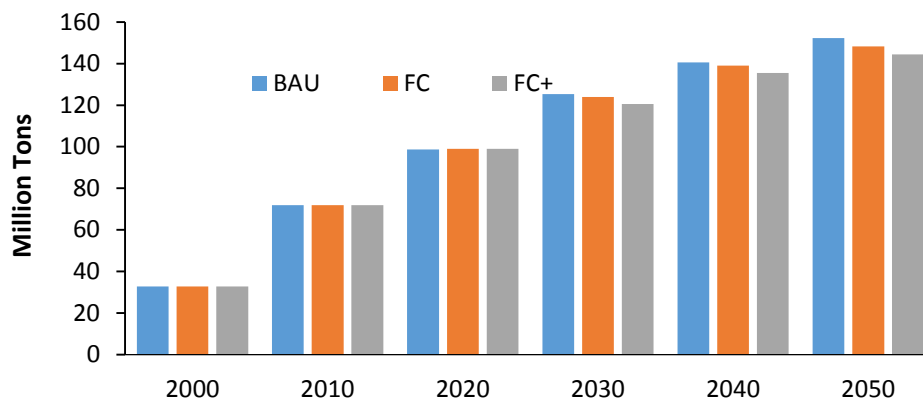
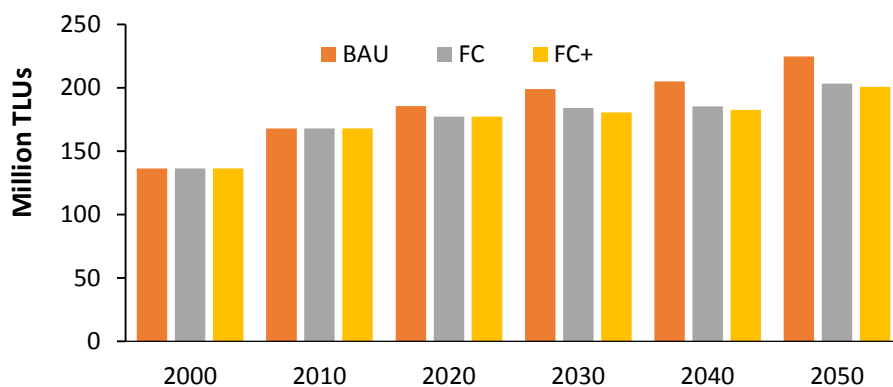


Figure 2 - Brazil's Total Livestock Production



Figures 1 and 2 present the projected trajectories for Brazil's total soy production (in million tons) and total number of animals (in million TLUs³), from 2000 to 2050, under our three different policy scenarios. For the FC and FC+ scenarios, both production and TLUs will be lower than in the BAU scenario, and it can be associated with more restrictions on land expansion or more incentives for forest restoration. On other hand, although not

shown in this paper, figures on forest cover and biodiversity protection will be higher.

Because of the decrease in total production for both meat and soy, for scenarios FC and FC+, when compared to scenario BAU, Brazil's total export trajectories will also show a decrease. Meat exports for the FC and the FC+ scenarios will be around 10% lower than the exports under the BAU scenario, after 2030. Soy exports will also drop by 4% for the FC scenario and by 7% for the FC+ scenario, after 2040. Production will then shift to other regions, to satisfy global demand. Soy exports from other countries in South America will increase by more than 5% after

³ TLU stands for tropical livestock unit. It can be used to harmonize, in the same unit, different kinds of livestock (bovines, goats, sheep, poultry etc.). One bovine in Brazil corresponds to 0.7 TLU.

2040 under the FC scenario and by more than 10% under the FC+ scenario. Soy exports from the USA will increase by 4% and by 9% under the FC and the FC+ scenarios, after 2040. Meat exports will grow in other South America countries by more than 5%, for both the FC and the FC+ scenarios. Meat exports from some African countries will also grow by more than 3%, for the FC and FC+ scenarios.

The simulations using GLOBIOM have shown the clear dependence between production in different countries, and how local policies in a specific area may affect land use in other regions. In the case of land use

restricting policies, to be able to supply the extra amount of demanded commodities, some countries will probably go through more deforestation pressure. The exercise also showed that production reduction in the South can affect countries both in the South and in the North. If land productivity in the new production areas is lower than productivity in the country implementing the policy, it may happen that total net deforestation may even be higher than the situation without the local policy. Therefore, both North and South should engage in more integrated inter-regional policy designs.

Summary

- Tropical forests are continuously shrinking despite the declining annual rates of deforestation.
- Timber extraction, land use change for commodity crops expansion and land use change due to subsistence crop production are among the major human-induced drivers leading to depletion of tropical forests.
- Measures to curb tropical deforestation require concerted effort by both the global North and South so that the consumption-related and the production-related factors are addressed properly.
- Because of the global integration of supply and demand for land related commodities, both North and South should engage in more integrated inter-regional policy schemes.

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