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Deforestation and Migration

ABSTRACT

This article deals with the relationship between migration and deforestation. Based on the existing literature, it outlines how these factors can interact. It then illustrates these interactions using the example of three countries in South America that have experienced a particularly high deforestation rate in recent years: Brazil, Mexico and Paraguay. The study shows that the interactions between migration and deforestation are diverse and can have many reasons. Migration can be both a consequence and a cause of deforestation. Further research is needed to further understand possible measures that mitigate the potential negative effects of migration on forests on the one hand, and to reduce migration flows caused by deforestation on the other. We recommend a more productive use of forests and mechanisms that internalize associated externalities, such as CO_2 generation or ecological values.

In recent years, the deforestation of rainforest locations all over the world has increasingly attracted public attention. Forests are public goods that create positive externalities, keep our ecosystem in balance, promote biodiversity around the world and are vital for the preservation of animal species and their habitats. They also store CO_2, mitigate climate change, protect water catchment areas and prevent soil erosion. In many parts of the world, forests still serve as habitats for ancient civilizations and indigenous tribes.

WHY AND HOW DOES DEFORESTATION AFFECT MIGRATION?

But what is the value of forests? In recent decades, forests have increasingly been perceived as an obstacle to growth in rural areas and their productive value has been questioned (Deb 2014). Even if forests can be used to produce forest products such as medicinal plants, handicrafts or honey, they are usually not as profitable as alternative production activities (te Velde et al. 2006). Although forests generate firewood and noble wood, their investment periods are long. Depending on country and conditions, productive forestry has a life cycle of five to 28 years (Frey et al. 2018). Therefore, in many places forests have had to give way to other productive activities, such as agriculture and livestock farming. Paraguay, for example, is the world's fourth-largest soybean exporter and produces 8 to 9 million tons of soybean per year (Nepon 2019). Brazil is the largest exporter of beef. One third of all beef exports worldwide come directly from the Amazon region (McAlpine et al. 2009). And Mexico is the world's largest producer of avocado. About six out of ten avocados consumed worldwide originate from the Central American country (Ayala 2020).

Figure 1 gives an initial insight into the loss of forest area in the north of Latin America in recent years.

The positive externalities generated by forests for our society are not taken into account in the process of deforestation. In the case of Paraguay, for example, Ramstein et al. (2019) estimate a CO_2 price of USD 180.5/tCO_2, while a World Bank guideline assumes a price of 40 to 80 USD in 2020 (World Bank 2017b). But forests generate even more social benefits, from disease prevention to water purification and flood mitigation. For some population groups, they provide cultural value of aesthetic or spiritual nature and offer places of refuge. According to FUNAI estimates, at least 68 unreached tribes still live in the Brazilian Amazon (van Boehout Solinge 2010). For this population group, land and resources are inextricably linked to their livelihood and worldview.

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Figure 1

Forest Area Loss from 2001–2015 in Latin America

Note: The red area indicates forest area loss.
Source: Hansen/UMD/Google/USGS/NASA; Earthstar Geographics; Esri, HERE, Garmin, FAO, NOAA, USGS Link: https://arcg.is/zraTO.

DEFORESTATION AND JOBS

If forests disappear, the values associated with them disappear too. It is therefore obvious that deforestation and the destruction of forests will lead to migration in many parts of the world. In addition, the alternative production models that are implemented instead of forests are usually introduced by large corporations and generate few jobs in rural areas since they are often highly technical (Oxfam 2020; Azevedo-Ramos 2007). Bustos et al. (2016) find that a one percent increase in the area cultivated with genetically modified soybeans reduces the share of agricultural workers in Brazil by 0.09%. Furthermore, while state investments can favor large companies in their production, they can also economically damage parts of the rural population (Garrett and Rausch 2016). The quality of life of the rural population is declining as they are exposed to harsher weather conditions, have to walk longer distances to collect firewood or to hunt animals. Other food sources become increasingly inaccessible due to the degradation of the (rain) forest, too. Hunger and emigration are the consequences, especially among the poorer population groups. According to the WWF (2013), the strong growth observed in Paraguay in recent years is based on an economic model that leads to the concentration of land, resources, wealth and power among a few, while small farmers are not prioritized or supported by national policies.

On the other hand, deforestation can also create jobs. Economic conditions for the rural population in Indonesia have improved (Afriyanti et al. 2016) due to rainforest deforestation and palm oil production. In the deforested area, agriculture is based on booming export goods. In Ghana and Burkina Faso, for example, forest-free areas are considered economically more valuable than forested areas (Pouliot et al. 2012). In Bolivia, the profits from timber and soybean production outweighed the costs of cleared forest areas in the short term, thus improving the living conditions of the population in rural areas (Kaimowitz et al. 1999). This could subsequently lead to rural-rural or even urban-rural migration of people in search of work opportunities and unused land.

However, Kaimowitz et al. (1999) stress the short-lived nature of economic progress due to rising marginal costs. Increased agricultural activity, which went hand in hand with the deforestation of the rainforest in Malaysia, reduced the poverty rate enormously. Once the rate fell below a certain point, however, the rate of deforestation was reduced. As soon as the rural population achieved a certain level of prosperity through palm oil production, they began to pursue more productive activities in urban areas (Miyamoto et al. 2014). This again may also lead to migration flows in the long term.

DEFORESTATION AND CLIMATE CHANGE

A further connection between deforestation and migration emerges via climate change. The European Parliament refers to migrants displaced by natural disasters or climate change as climate refugees or climate migrants. Migration as a consequence of climate change is well known and has been highlighted in the scientific literature for several years, especially in relation to sub-Saharan Africa, as well as countries in Latin America (Barrios et al. 2006; Gray and Bilsborrow 2013). Deforestation is no exception to this and is similar in its form as a determinant of migration. In the short term, the rainforest deforestation becomes a threat to indigenous peoples and can result in their involuntary migration. In the long term, the consequences may be more far-reaching than the direct effect on the rainforest. Areas that are cleared, for example, for pasture use for livestock breeding, cause an increase in mean surface temperature and lower precipitation (Nobre et al. 1991). Such anomalies in precipitation and temperature have an impact on the financial situation of the population in these areas, which can cause voluntary migration (Cattaneo et al. 2019).

MIGRATION AS A CAUSE OF DEFORESTATION

Juniwaty et al. (2019), in turn, explain that, conversely, migration also affects forests and their use. One reason for this is that rural populations change due to migration. If, for example, it is mainly men who migrate and women who stay behind in villages, the use of the forests changes, since women demonstrably pursue different productive activities in forests than men. On the other hand, immigration from cities or other rural areas also affects the use of forests. Juniwaty et al. (2019) also address the importance of educational migrants. When family members migrate for education, this generates costs for rural households, which can lead to an intensification of agriculture and thus to deforestation. With regard to migration to rainforest areas, Thiede and Gray (2020) show that migrant women in Latin America are increasingly moving to areas with few indigenous inhabitants. Amacher et al. (1998) find that migrants in the Philippines prefer regions where there is a lot of state-owned forest available and good transport routes. At the same time, these are characteristics that particularly encourage deforestation. Carr (2009) describes that especially forest areas with low population density are exposed to massive deforestation, since control over illegal logging is more difficult to enforce in such areas. Amacher et al. (2009) also point out that migration increases the supply of labor, thus lowering wages and making forest clearing more profitable for companies. Remittances also play a role. While some scientific analyses show that monetary remittances are invested in agriculture and livestock

Table 1

Channels of Interaction between Migration and Deforestation

Type of migration	Deforestation
Migration as a driving force for deforestation	
Urban-rural migration/ international migration	In search of better job opportunities and unused resources, migrants from urban areas settle in regions with a lot of land in order to transform it productively.
Urban-rural migration/ international migration	Migration leads to changes in the socio-economic characteristics of the remaining population, using the forest in different ways.
Educational migration: rural-urban migration	Family members who migrate from rural areas generate costs that can be covered by income from productive activities generated from deforested land.
Remittances	Remittances generate additional income, which can take away the pressure on generating profits from deforestation but can also be transformed into investments in the intensification of agriculture.
Migration as a consequence of deforestation	
Rural-urban migration/ International migration	The transformation of the forest into alternative means of production, such as agriculture or livestock farming, can lead to job losses and poverty, especially in connection with high mechanization and loss of property and land.
Disaster-induced migration	Deforestation leads to aggravation of climate change through flooding, temperature increase, and habitat destruction.
Culturally-induced migration	Especially with regard to indigenous peoples, the cultural and spiritual habitat is being destroyed, resulting in migration.

Source: Authors' compilation.

farming and accelerate the deforestation process (Angelsen et al. 2020; Bakehe 2019), others show that the additional income reduces agricultural activity in favor of forest conservation (Afawubo and Noglo 2019; Hecht 2008).

In summary, there are two overarching dynamics that influence the interaction of migration and deforestation, namely, migration both as a driver of deforestation and as a consequence of it. Table 1 provides an overview of the different interactions between migration and deforestation.

Only a few scientific papers have so far examined the impact of deforestation on migration in more detail. Migration flows that result from deforestation can be internal migration from and to rural areas and rural cities, but also generate international flight movements. Data on migration directly caused by deforestation is scarce. However, population movements caused by natural disasters can provide an indication of this. In 2019 there were 54,000 new disaster-related refugees in Paraguay, 16,000 in Mexico and 295,000 in Brazil (IDMC 2020a and 2020b). The IDMC puts the number of global refugees due to disasters in 2019 at 24.89 million.

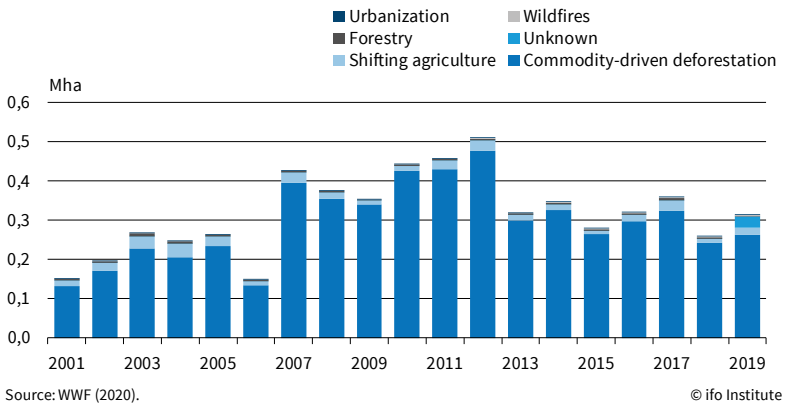
In the following, we provide insights into three countries that have experienced high rates of deforestation in recent years. How do deforestation in Mexico, Brazil and Paraguay and their migration flows interact? What are their dynamics? What do they have in common, and how can we counteract the negative effects that result from them?

DEFORESTATION IN BRAZIL, MEXICO AND PARAGUAY

Paraguay's deforestation rate was the highest in South America until 2004. An analysis by the Earth Observation Center (2018) indicates that between 1999 and 2016, 750,000 hectares of the Atlantic tree cover were deforested. Today, only 15% of it remains in the Eastern region of Paraguay (PROFOR 2019). Moreover, almost 20% of the Gran Chaco region has been converted for agricultural purposes. Data from Global Forest Watch shows that 93% of deforestation between 2001 and 2019 was due to resource-related logging. In 2019, approximately 262,000 hectares of land were deforested. In 2001, the figure was 131,000 hectares. 100% of deforestation occurred in natural forests, equivalent to 289 million tons of CO_2 (between 2013 and 2019). The rate of reforestation, on the other hand, is low in the middle range in international comparison, with a rate of 8,940 hectares in 2010. Figure 2 shows that deforestation in Paraguay is mainly due to raw materials. According to the WWF (2020), there were 900,000 hectares under soybean cultivation in Paraguay in 1990 and 3 million hectares in 2012. A similar picture emerges in the livestock sector. Be-

Figure 2

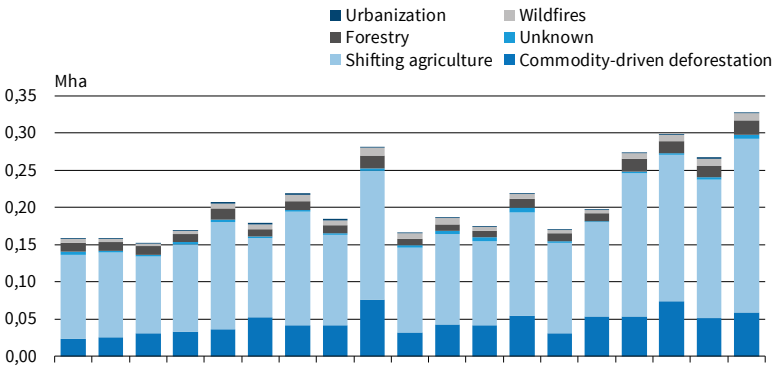
Annual Loss of Forest Cover in Paraguay



Source: WWF (2020).

Figure 3

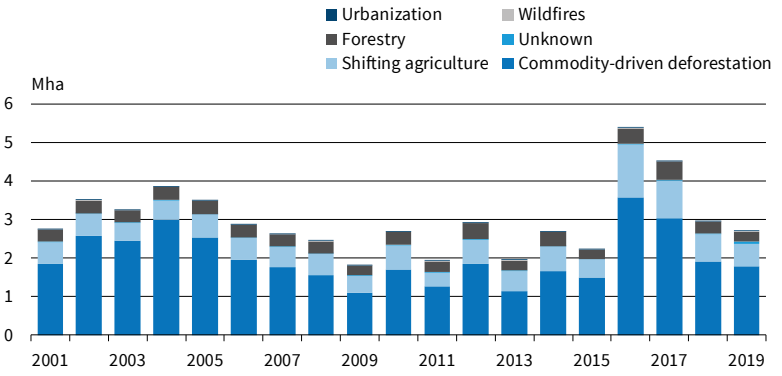
Annual Loss of Forest Cover in Mexico



Source: WWF (2020). © ifo Institute

Figure 4

Annual Loss of Forest Cover in Brazil



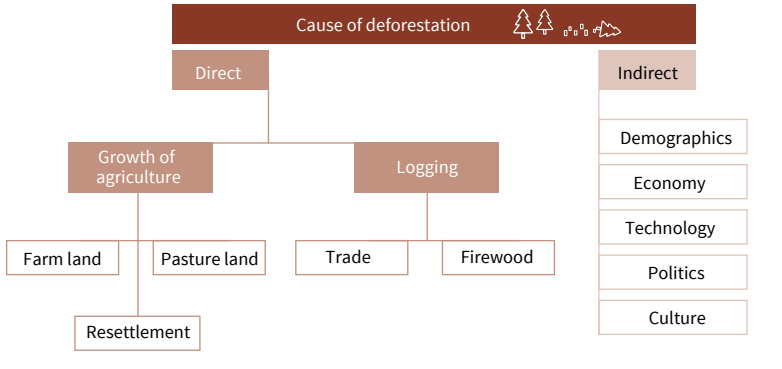
Source: WWF (2020). © ifo Institute

tween 2005 and 2017 the meat export increased from 186,000 tons to 397,000 tons (UNA 2017).

In 2010, 49.8 million hectares of Mexico's territory were covered with forest. This corresponds to a total forested area of 26% of the country. Over the following nine years, the aggregate forest declined by 321,000 hectares (Global Forest Watch 2020). A continuous increase in the decline of forested areas can be observed over the last 20 years. This corresponds to an equivalent of 83.3 million tons of CO_2. The reforestation rate is 633,000 hectares during the period 2001 to 2012, representing 0.79% of the global reforestation during this period. Most of the forest loss is attributed to the relocation of agriculture. The causes of temporary or permanent deforestation in this category are small or medium-sized farms. In the southeast of the country, which is heavily affected by deforestation, the main reason are slash-and-burn clearances to gain agriculturally usable land (Diaz-Gallegos et al. 2010).

Figure 5

Direct and Indirect Factors of Anthropogenic Deforestation



Source: Geist and Lambin (2001). © ifo Institute

Since the Brazilian National Space Research Institute INPE began measuring in 1988, annual deforestation rates in Brazil have varied between 2.91 million hectares (the peak in 1995) and 457,100 hectares (the lowest value in 2012) (Arima et al. 2014). After several years of relaxed pressure on activities associated with Brazilian rain forest deforestation, the deforestation rate has been increasing again since 2013. Between August 2018 and July 2019 alone, over 1 million hectares of the Brazilian rainforest disappeared (Barlow et al. 2020). For the period from August 2019 to July 2020, INPE's Real-Time Rainforest Monitoring System (DETER) even reports an increase in deforestation of 34.6%, compared to DETER's previous year's figures. Data from Global Forest Watch shows that resource-related deforestation contributed to about 67% of Brazil's forest loss between 2001 and 2019, while about 20% was converted to agricultural land. With 7.59 million hectares deforested between 2001-2012, Brazil records the fourth largest amount of reforested land in the world during this period.

Deforestation has various reasons, which are summarized in Figure 5. Migration plays a role primarily in the expansion of agriculture, as do other indirect factors. Migration interacts with deforestation in the areas of demography, economy, politics and culture.

DEFORESTATION AND MIGRATION: A FEW INSIGHTS

In 2015, Paraguay counted 171,000 refugees due to catastrophes, the highest number to date.[1] According to the IDMC (2020b), the number of internal refugees was at 54,000 in 2019.

Deforestation and Migration in Paraguay

Between 1997 and 2002, the IOM (2020) reported 272,000 internally displaced people in Paraguay. At the same time, the number of emigrants (10-12% of the population) significantly exceeded that of immigrants (3-5%). The former are predominantly young (20-30 years old) and female (60%).

A CDE study (2015) analyzes the dynamics of said migration movements based on both qualitative and quantitative data. It points to the unsustainable production system as a main driver of internal migration, which leads to the concentration of resources, creates few employment opportunities and contributes

[1] Strong floods in Southern Latin America caused large migration movements.

to urbanization and rural impoverishment. Census data from 1982 indicates that 57.25% of the population live in rural areas. That number had dropped to 43.28% in 2002. Comparing agricultural data from 2002 to 2008, we can observe the disappearance of 38,000 smallholders from rural areas (equivalent to 613,000 hectares of land) within a 6-year period. The qualitative interviews conducted as part of the study indicate a lack of incentives and opportunities in rural regions as one of the main causes of migration, and the inaccessibility of affordable credits, the extension of soy production through commercial firms and the disappearance of the wood industry are important factors. Consequently, small farmers frequently sell their rural property and seek their fortune in urban centers (see CDE 2015). Moreover, the increasing pressure on the indigenous population and their territorial property induces additional migration movements.

Deforestation and Migration in Mexico

Between 1940 and 1970, migration movements in Mexico are defined by a combination of push and pull factors. The rural population was economically restrained by a shortage in capital to invest in agricultural machinery. A main cause lies with policy decisions, eventually leading to the "ejido-system",[2] shifting profits from smallholders to big landowners.

Small farmers tried to compensate for the lack of capital with additional labor input—usually in the form of family growth. As a result, the cultivated land was divided among more heirs, which ultimately made the rural population even more vulnerable to economic shocks and encouraged emigration. At the same time, the industrial sector boomed in urban areas and offered employment opportunities (Janvry et al. 2015). These factors triggered rural-urban and international migration movements.

In 1950, 26% of Mexicans lived in cities that had more than 15,000 inhabitants—50 years later, the percentage had reached 61%. In their sample analysis from 2000, Villarreal and Hamilton (2012) find that women from rural areas account for a disproportionately large percentage of emigration. Moreover, younger people move at significantly higher rates. Furthermore, urban emigrants tend to be more educated than rural emigrants. Until 2015, the trend toward emigration from rural areas to metropolitan regions continued. From 1995 to 2010, most people moved to Mexico City, to border cities such as Tijuana and Ciudad Juarez, or to cities experiencing an economic upturn, like Cancún. Migration between smaller cities subsequently intensified from 2010 to 2015 (Pérez-Campuzano et al. 2018).

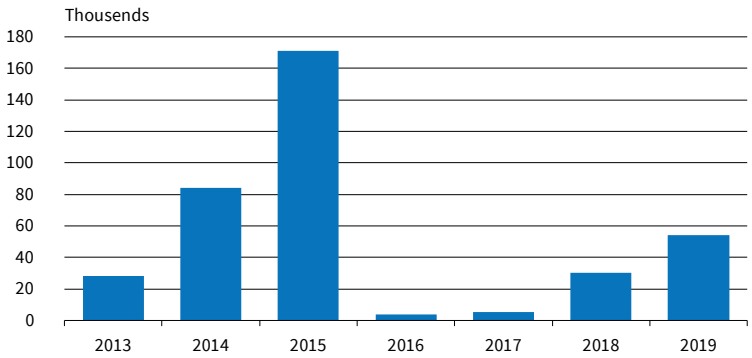
To escape poverty in rural areas, the affected population frequently seek employment as seasonal workers. In addition, some carry out illegal slash-and-burn activities as a means of improving their dire economic situation (Vidal et al. 2014). For households, migration is considered a strategy to diversify income. The need for economic security can thus be identified as one of the main drivers of migration. Otherwise, flooding in Mexico is often a cause of disaster-related flight. Still, the interaction between migration and deforestation cannot be conclusively assessed. In some areas, emigration has a positive effect on forest cover, while in other areas the effect appears to be negative (Schmook and Radel 2008).

Deforestation and Migration in Brazil

In the 1960s and 1970s, the so-called Brazilian "economic miracle" caused large migration flows from Brazil's poverty-stricken northeast to the cities in the southeast, where employment prospects were superior (Lima Amaral 2013). The percentage of the urban population, which in 1950 was only 36% of the total population, grew to 81% in 2000. In 1970, for the first time, more people lived in Brazilian cities than in the countryside (Matos and Baeninger 2001). This period marked Brazil's transformation from an agrarian to an urban society.

Figure 6

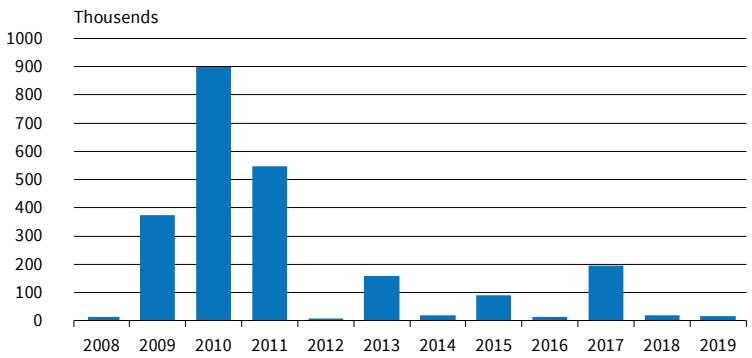
Number of Internally Displaced People (Paraguay, 2019)



Source: IDMC. © ifo Institute

Figure 7

Number of Internally Displaced People (Mexico, 2019)

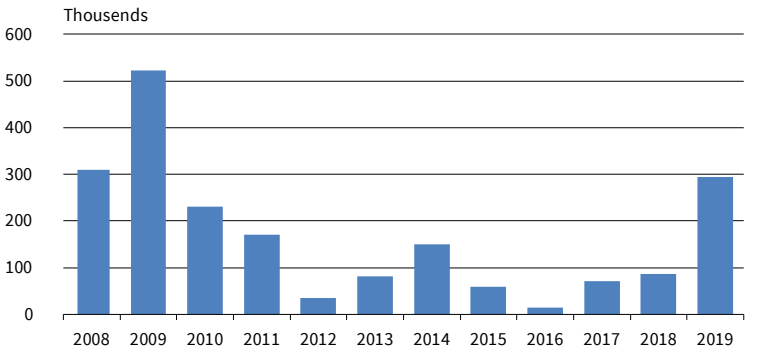


Source: IDMC. © ifo Institute

[2] During the Mexican Revolution, large areas of land were collectively held in so-called "ejidos." Only its members held rights to cultivate the land. Land areas were not tradable.

Figure 8

Number of Internally Displaced People (Brazil, 2019)



Source: IDMC. © ifo Institute

On the one hand, higher wage levels in the metropolitan areas of southeastern Brazil (Rio de Janeiro and São Paulo) are offset by higher price levels, which is why the high net migration figures in the southeast declined significantly from the 1980s onward, particularly due to the withdrawal of low-skilled workers. Instead, the migration figures in the border regions increased. From 1970 to 2004, Brazil's north, where most of the Amazon rainforest is located, has seen a consistently positive migration balance (Amaral 2013). One reason for the migration flows could be the availability of land, which has thus contributed to deforestation. In fact, as described above, Brazil's Amazon rainforest has seen a simultaneous increase in deforestation rates. Most of the internal migrants, however, do not move to rural regions, but rather to cities like Manaus or Belém (Egger 2019).

According to the population census from 2010, Brazil had 4.6 million internal refugees between 2005 and 2010 (Baptista et al. 2018). Surprisingly, only 32% of migrants moved to metropolitan areas (2009-2010). Nevertheless, wages in the South still exceed those in the rest of the country by 31% in 2015 (Firpo and Pieri 2018).

To conclude, all three countries have experienced strong migratory movements, especially from the countryside to the city, as well as international and urban-rural migration. Some explanatory factors are shown in Table 1. However, further studies are needed to establish a causal link. Still, the interaction between migration and deforestation through changes in production processes and employment opportunities, and loss of habitable space are clear, and likely inevitable.

DEFORESTATION AND MIGRATION— WHAT CAN WE DO ABOUT IT?

How should one try to counter these reciprocal effects? There are several starting points in order to prevent deforestation and migration that arises from it. One possibility would be to protect tracts of forest by nationalizing them. Another would be to assign a monetary value to the positive externalities that forests bring about or to foster productive forest-related activities, e.g., through subsidies. In the following, some examples for the latter are elucidated.

Paraguay: A Project for Sustainable Biomass Growth

In cooperation with the United Nations, the government of Paraguay launched the "Poverty, Reforestation, Energy and Climate Change" project (PROEZA) in 2018. The USD 90 million project aims to achieve climate goals and reduce poverty. In order to generate sustainable biomass growth, the government of Paraguay is relying on market mechanisms and incentivizes landowners to reforest. Approximately 14,800 households among indigenous population groups are estimated to benefit directly from the project and others from indirect impacts of the initiative (Green Climate Fund 2017). Start-ups are also discovering business opportunities in Paraguay and are taking advantage of fallow land as a sustainable investment opportunity. Rapidly growing eucalyptus is to generate long-term profit and at the same time afforestation is to be generated as a positive externality (Treecoin 2020). Culturally induced migration can thus be reduced both by the PROEZA project and by commercially successful business ideas. Assigning forests a productive value leads to the creation of jobs, which in turn could discourage people from emigrating, or even lead to people to migrate to these areas.

Mexico: Establishing a Forestry Commission and Sustainable Forest Management

On 4 April 2001, the Mexican government created the "Comision Nacional Forestal" (CONAFOR 2020) as part of the Secretariat for Environment and Natural Resources. The goal of the institution is the development, promotion, conservation and restoration of Mexican forests. Among other things, the Commission participated in the international initiative for "Reducing Emissions from Deforestation and Forest Degradation" (REDD+). During the six-year project, progress was achieved in the agricultural and forestry sectors. However, the ecological effects of the project are attributed to the long-term effects of existing achievements. Furthermore, REDD+ financing created temporary jobs (Bauche 2015). For a more effective development of the project efforts, indigenous population groups were consulted (Špirić 2018). The commercialization of forest areas as well as direct cash flows to poor population groups as part of the project can, similar to remittances, trigger negative or positive impacts on the migration dynamics in the affected areas.

To counteract recent developments in deforestation and logging, the World Bank is also involved in Mexico. It launched the "Forest and Climate Change"

project: 2 million hectares of forest area were put under sustainable management. The financing for this project amounted to USD 460 million. The project focused on capacity strengthening of institutions, creating knowledge of sustainable forest management and developing alternative sources of income. The World Bank is also involved in the "Strengthening Entrepreneurship in Productive Forest Area" initiative, which is considered an extension of the "Forest and Climate Change" project. The focus lies on the sustainable commercialization of forested areas for the forest-dependent population (World Bank 2020). This, in turn, reduces rural exodus, since it mitigates economic hardships of the rural population.

Brazil: Instruments for Afforestation

Between 1950 and 2017, 405 projects were initiated in Brazil to combat deforestation and promote the recultivation of forest areas. Half of the initiatives were launched by forestry companies. Another 48% were commenced by family-owned agricultural enterprises. Only 2% of all projects could be attributed to governmental and non-governmental organizations. However, politically imposed environmental protection permits were not always adhered to (da Cruz et al. 2020). In addition, the Amazon region in Brazil continues to be affected by illegal slash-and-burn agriculture. In 2014 each hectare of forest planted contributed USD 2,228 to Brazil's GDP. According to the World Bank (2017), an afforestation process covering an area of 12 million hectares could create up to 215,000 new jobs.

Toward the end of the twentieth century, the Brazilian government established several institutions and commissions that enabled adoption of (protective) regulations concerning the Amazon region. Political instruments were used to preserve the rainforest and to support sustainable reforestation. The most significant contribution was made with the "Action Plan for the Prevention and Control of Deforestation in the Legal Amazon" (PPCDAm). The initiative was divided into three phases: from 2004 to 2008, from 2009 to 2011 and from 2012 to 2015. Three main objectives were defined: (1) territorial and land use planning, (2) environmental protection and its oversight, and (3) promotion of sustainable productive activities. The annual deforestation area was reduced by 84% from 2.77 million hectares in 2004 to 450,000 hectares in 2012. Biodiversity and control over public land have also been improved (Pires and Majano 2015). These measures show how effectively climate change can be tackled and thus reduce the number of refugees caused by disasters. Brazil, under the government of Jair Bolsonaro, is currently undergoing a change of direction in its environmental policy for the Amazon region. It is not yet possible to assess the impact that the politically induced weakening of the Brazilian environmental agency IBAMA, the strengthening of cattle breeders and plantation owners, and the end of the expansion of protection zones for indigenous people will have on the rainforest and climate change.

CONCLUSION: MIGRATION AS A CONSEQUENCE AND CAUSE OF DEFORESTATION

Deforestation and migration are highly relevant topics in the current Covid-19 context. Not only does Covid-19 affect the quality of life and security of millions of refugees, but also the deforestation of the rainforest (López-Feldman et al. 2020). In 2020, deforestation has increased by 59% in areas with indigenous inhabitants, according to Greenpeace (2020). The WWF (2020) states that the deforestation of the rainforest under Covid-19 has doubled so far. In March alone, the rainforest shrank by 650,000 hectares. Other studies show that the development of virus variants is favored by conducting deforestation (Afelt et al. 2018).

This issue is also highly relevant in the context of climate change. The acceleration of climate change through deforestation is widely accepted and known. This, in turn, leads to climate refugees, and the destruction of the habitat of indigenous peoples. Other starting points for the interaction of deforestation and migration are the conversion of forests into alternative productive activities and the associated loss or generation of jobs. In other cases, people settle in forest-rich areas in search of unused resources. Another possible channel is through remittances leading to income that could be used for or against deforestation.

Using three examples, namely Paraguay, Mexico and Brazil, we have shown that the interactions between migration and deforestation are manifold. Migration can be seen both as a consequence and a cause of deforestation. The exact interactions and causal relationships require further research in order to mitigate the potential negative effects of migration on forests and to reduce the migratory movements generated by deforestation. It is recommended that forests be used in a more productive manner and to internalize forest externalities, such as CO_2 generation and ecological values. Forests play a crucial role in the formation of a sustainable and future-oriented production model.

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