ANNEX J: CASE STUDY 10: CLIMATE CHANGE – IMPACTS OF THE AGREEMENT ON LULUCF EMISSIONS IN THE ANDEAN PARTNER COUNTRIES

1 INTRODUCTION

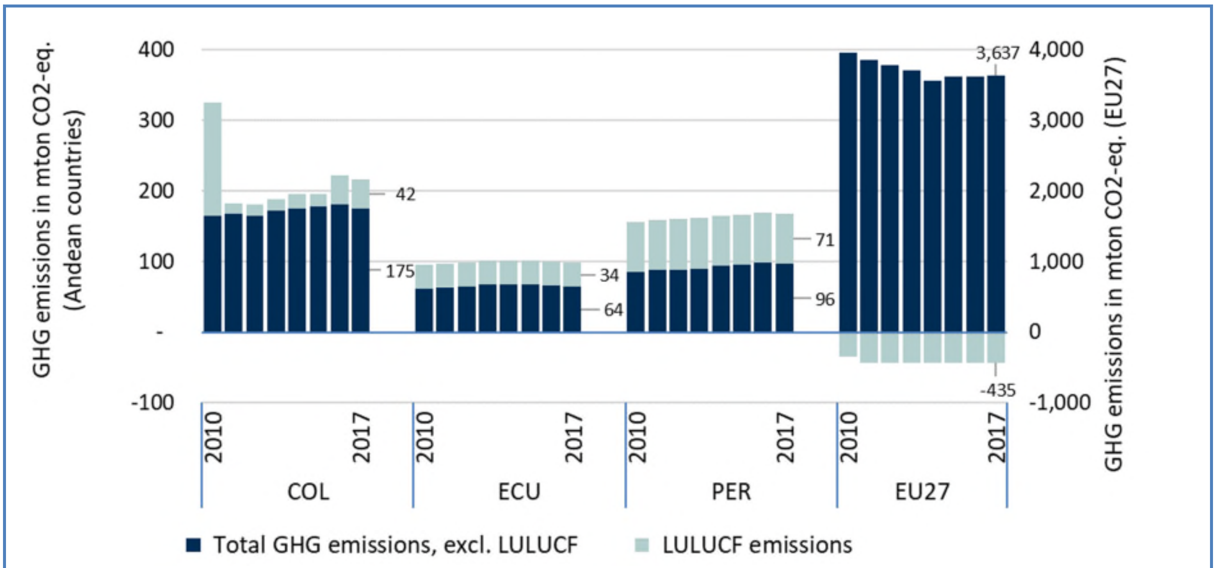
Whereas in many countries gross greenhouse gas (GHG) emissions account for the lion's share of a country's impact on global warming, the LULUCF (land use, land use change and forestry) sector is a key determinant in the Andean partner countries' impact on global warming, given the role of the Amazon as a carbon sink. For that reason, this case study complements the climate change analysis in the general environmental analysis (on gross GHG emissions) in the main report by assessing the Agreement's impact on the LULUCF sector in all partner countries.

We first establish the current situation and recent trends/baseline related to LULUCF in the Andean partner countries (section 2). Section 3 provides the methodological model for the analysis, followed by the impact analysis itself, which consists of a quantitative part (Section 4) and a qualitative one (section 5). Section 6 concludes.

2 BASELINE

Performance - LULUCF activities can result in large amounts of additional GHG emissions, which has been the case in the Andean countries between 2012 and 2020. However, LULUCF activities could also mitigate climate change by the removal of GHGs from the atmosphere and halting the loss of carbon stocks (UNFCCC, n.d.a). Both phenomena are observed in the LULUCF emissions for the signees of the Agreement, as shown in Figure 2: The LULUCF sector of the Andean countries *emitted* GHG emissions to the atmosphere every year. In contrast, the LULUCF sector in the EU *removed* 435 Mt of CO_2eq in 2017. In the Andean countries, Colombia, Ecuador, and Peru, LULUCF emissions account for a very significant share of the total GHG emissions. In 2017, these shares equalled 19%, 35% and 43%.

Figure 2: Gross GHG emissions (excl. LULUCF) and LULUCF emissions in Mt CO2 eq. (EU27 on secondary axis).



Source: Trinomics, based on CAIT and World Bank

In **Colombia**, an abrupt change is observed in LULUCF emissions in 2011. However, this is driven by a change in methodology rather than an actual decrease in emissions, as reported by the country.[1] Although in 2017 the share of LULUCF emissions in the total GHG emissions was relatively low in Colombia (19%) compared to Ecuador (35%) and Peru (43%), it is noted that LULUCF emissions have risen over the past years (2011-2017) in Colombia. The deforestation and forest degradation in the Amazon has been a major pressure on the local CO_2 sinks. Agriculture (incl. change of land to pastures, illicit crops, livestock), and illegal mining are some of the key drivers of the deforestation and associated LULUCF emissions (IDEAM, 2018). In **Peru**, agriculture including extensive cattle ranching, gold mining, hydroelectric generation, and the exploitation of hydrocarbons (e.g. oil), among others, are the main drivers of a high deforestation rate and thus of the significant GHG emissions (CDP, 2019). In **Ecuador**, changes in agricultural land are the main pressure contributing to LULUCF emissions (MAE, 2017b).

Governance - The Andean countries included emission reductions in the LULUCF sector in their Nationally Determined Contributions (NDCs) commitments to the Paris Agreement. **Colombia**'s NDCs reaffirm its pledge to reduce deforestation in the Amazon region as a key strategy to reduce emissions. **Peru** presented eight measures specifically targeting emissions of the LULUCF sector including, for instance, promoting conservation, sustainable forest management, and assignment of emission rights in its NDC. **Ecuador**'s NDC contained eight lines of actions such as expanding protected areas and strengthening forest monitoring that jointly have the potential to result in sectorial GHG reductions of 4% (16% under the condition of sufficient international support). While these commitments are positive, what will be more important is that each country puts in place the measures needed to meet its target, reports on its progress in a transparent manner consistent with the Paris Rulebook, and sets successive NDCs that constitute the country's highest possible ambition.

In this regard, besides the commitments set in the Paris Agreement, the Andean countries joined the Reducing Emissions from Deforestation and Forest Degradation (**REDD+**) **Programme** aiming to reduce the LULUCF-related emissions. REDD+ is a framework negotiated under the UNFCCC to guide activities in the forest sector to reduce emissions from deforestation and forest degradation, as well as the sustainable management of forests and the conservation and enhancement of forest carbon stocks (UNFCCC, n.d.b). In **Colombia**, in the context of REDD+, the Amazon Vision (PVA) and REDD Early Movers (RED) Programmes constitute the basis of payment-for-performance to avoid deforestation in the Colombian Amazon (GGGI, 2018). The Programme rewards emission reductions because of reduced gross deforestation by targeting the beef, dairy, cocoa, rubber, and non-timber sectors and investing the collected funds to further contribute to the efforts to stop deforestation (KfW and GIZ, 2015). In **Peru,** the REDD+ strategy is still under development, led by MINAM and financed by international organizations such as the Moore Foundation and the German bank KfW (MINAM and CIFOR, 2012). In **Ecuador**, the REDD+ Action Plan is framed on the National Climate Change Strategy and guides LULUCF emissions mitigation actions that include sustainable forest management, and transition to sustainable production systems, among others (MAE, 2017a).

---

[1] While both inventories are based on IPCC guidelines from 2006, the BUR used tier 1 and 2 guidelines while the Third National Communication is based on tier 2 and 3 guidelines, which include also local emission factors. As a result, emissions in 2010, which is used as base year in Colombia's INDC, are much higher in the Third National Communication when compared to the BUR. See: https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2018-11-01_climate-change_25-2018_country-report-colombia.pdf.

3 THE IMPACT OF THE AGREEMENT ON LULUCF EMISSIONS – THE CAUSAL CHAIN

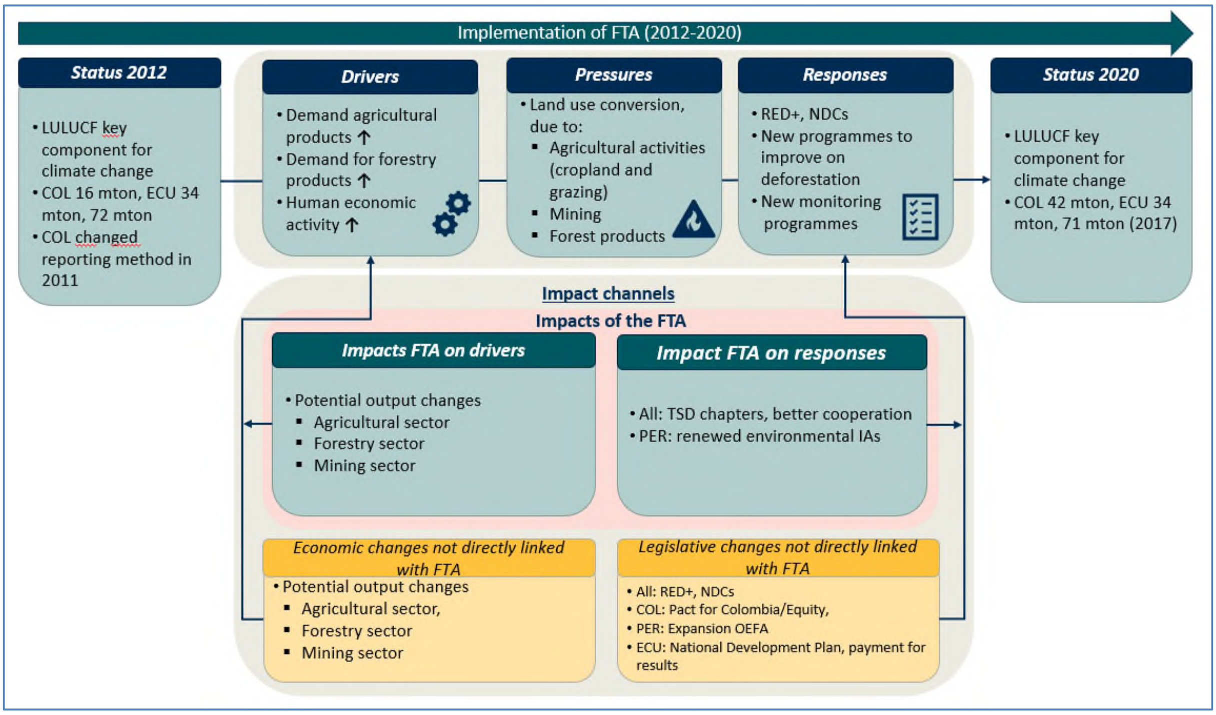
Figure 3 shows the causal chain that has been developed to transparently analyse the potential impacts of the Andean Agreement on LULUCF emissions in the Andean countries. Three elements are integrated into one figure:

1. **DPSIR framework** - The DPSIR (Driver, Pressure, Status, Impact, Response) framework allows to interpret certain environmental impacts by establishing a causal relation between indicators and their analysed effects. The framework is often used in biodiversity analyses. The causal chain developed for this case study applies the logic of the DPSIR framework, though small deviations were made to make it more targeted. The chain shows the status *before* the implementation of the Agreement and in 2020. In between the two status boxes, drivers, pressures, and responses that are relevant for LULUCF emissions are shown. Drivers – societal developments affecting pressures – include increased demand for agricultural/mining/forestry products and increased human economic activity. Pressures – human activities exerting strain on the environment - include land use conversion and deforestation (mostly driven by agriculture, forestry, and mining). Responses – (policy) actions to address pressure - include the REDD+ programme, the inclusion of LULUCF emissions within the NDCs, and several national policies.

2. **Impact channels** – The middle part of Figure 3 shows the pathways through which the Agreement can affect the environmental status. It can do so by affecting the drivers (mainly through the economic effects on the Agreement) and/or the responses (e.g., by changes in the implementation of environmental legislation, or by lowering environmental footprints of products with more strict standards). In the context of the impact of the Andean Agreement on LULUCF emissions in the Andean countries, potential output changes in the agricultural, forestry and mining sectors are identified as the key channels through which the Agreement may affect the drivers of LULUCF emissions. The provisions of the Trade and Sustainable Development (TSD) Title are identified as the key channel through which the Agreement may have affected the Responses.

3. **Agreement induced effects and external effects** – The lower part of the figure emphasises the role of external developments, unrelated to the Agreement. It shows that developments unrelated to the Agreement can also affect both drivers and responses. It also shows the key challenge in assessing the impacts of the Agreement – isolating the Agreement-induced impacts from external developments.

Figure 3: Causal chain and DPSIR for Agreement's impact on LULUCF emissions



4 QUANTITATIVE ANALYSIS – BUILDING ON LAND USE CHANGE ANALYSIS

Based on the causal chain developed for this case study (Figure 3), it is concluded that the potential impacts of the Agreement are to be found through the tariff reduction-induced economic changes or through potential Agreement-induced responses. The impact through Agreement-induced economic changes can be estimated quantitively, building on the economic modelling results (providing tariff reduction-induced output changes) and the quantitative land use change analysis (hereafter: the land use change analysis), which is performed in the overall environmental analysis.

The approach to estimate the impact on LULUCF emissions resulting from tariff reduction-induced economic changes, combines the insights of the land use change analysis and the methodology in Banerjee et al. (2020). The estimated tariff reduction-induced changes in cropland and grazing land are based on the land use change analysis. LULUCF emission intensity data from IPCC is used (like in Banerjee et al.), which includes biophysical data on carbon pools, per type of land use, as shown in Table 1.

Table 1: Carbon density of different types of land use in CO_2/ha

Description	Aboveground biomass	Belowground biomass	Soils	Dead matter	Total
Cropland	50.0	0.0	13.9	0.0	63.9
Grasslands	2.9	4.7	12.0	0.0	19.5
Forest	141.0	52.2	47.1	17.5	257.7
Herbaceous and shrubby vegetation	37.6	15.0	16.0	0.0	68.6

Source: IPCC (2006)

To estimate the LULUCF emissions corresponding to the tariff reduction-induced land use change, assumptions have been made based on the CGE results and observed trends in land use change over the relevant period. Firstly, if the tariff reduction-induced land use change with respect to grazing land was negative, and if the tariff reduction-induced impact on cropland was positive, grazing land was assumed to have been converted into cropland.

Secondly, if the tariff reduction-induced increase in cropland area was larger than the decrease in grazing land, it is assumed that the remaining part of cropland was converted from herbaceous and shrubby vegetation into cropland. Thirdly, if the tariff reduction-induced change in both grazing land and cropland was negative, it is assumed that grazing land and cropland were converted into herbaceous and shrubby vegetation.

Based on these assumptions, the LULUCF emission factors (resulting from the net change in LULUCF emissions between different types of land uses) were calculated. Lastly, the estimated tariff reduction-induced changes in cropland and grazing land were then multiplied with the corresponding emission factors to estimate the tariff reduction-induced LULUCF emissions. The results of this analysis are shown in Table 2. It is estimated that LULUCF emissions and removals from the agricultural sector (cropland and grazing land) resulting from tariff reduction-induced economic changes in Colombia, Peru, and Ecuador equal 0.41, -0.05 and -0.04 Mton CO_2 per year respectively in 2020. In Colombia, this corresponds to roughly 0.2% of total GHG emissions. For Peru and Ecuador, it suggests that the tariff reduction-induced output changes in the agricultural sector did not lead to additional LULUCF emissions.

Table 2: Estimated tariff reduction-induced LULUCF emissions based on land use change analysis and Banerjee et al.

	Conversion	Tariff reduction-induced land use change	LULUCF emissions	Tariff reduction-induced LULUCF emissions
		Hectares (ha)	*Ton CO_2/ ha*	*Mton CO_2*
COL	Forest - cropland	3,714	193.8	0.72
	Grazing land - cropland	7,052	-44.4	-0.31
	Total			**0.41**
PER	Cropland - herbaceous/shrubby vegetation	-4,336	4.7	-0.02
	Grazing land - herbaceous/shrubby vegetation	-554	49.1	-0.03
	Total			**-0.05**
ECU	Cropland - herbaceous/shrubby vegetation	-2,007	4.7	-0.01
	Grazing land - herbaceous/shrubby vegetation	-633	49.1	-0.03
	Total			**-0.04**

Source: Quantitative land use analysis (Trinomics and IVM), Banerjee et al. (2020) and IPCC (2006).

5 QUALITATIVE ANALYSIS

5.1 Impact on agricultural LULUCF emissions

As explained in the land use change analysis, it is unlikely that the Agreement resulted in increased grazing activities in any of Andean countries. Therefore, it is expected that the potential tariff reduction-induced impacts related to LULUCF emissions are related to the transformation of forest land to cropland, and it is thus the focus of the analysis presented in this section.

In **Colombia**, the agricultural sector is the largest driver of LULUCF emissions. As shown in the economic analysis, bananas and plantains and coffee, remain today at the top of the EU agricultural imports from Colombia; while palm oil and avocados are the agricultural products that showed the largest increases in production between 2012 and 2020 (the production of avocados showed a 1,323% average annual growth over the period 2012 to 2019, see economic analysis in the main report).

Even though the agricultural sector is the largest driver of LULUCF emissions in Colombia, other phenomena, such as poverty, social inequality, the lack of opportunities and armed conflict in the region also contribute to LULUCF emissions (FAO, 2020). Murad and Pearse (2018) provided insights on land use change (between 2000 and 2016) in the Amazon rainforest and the biophysical and socioeconomic factors driving these changes, and concluded that the differences in deforestation rates observed in neighbouring countries within the same region suggest that the causes are complex and related not only to the suitability of the climate and soil for activities such as agriculture and livestock farming, but also to the specific social, economic and political conditions of the region (e.g., internal armed conflicts, violence and insecurity). No single factor driving deforestation and forest degradation was found; rather, different regions within the study area displayed different rates and causes (the main being livestock production and commercial agriculture) (Murad and Pearse, 2018). This variety of factors influencing land use change in Colombia should be kept in mind when assessing the Agreement potential impact on LULUCF emissions.

In line with the economic analysis, the CGE results show a positive impact on output in the horticulture sector, especially for the products in the model sectors *vegetables, fruits and nuts (VFN)* and *other crops*. Although it is difficult to single out individual crops responsible for land-use change and corresponding LULUCF emissions in Colombia, some trends can be identified for specific crops. First, in the case of bananas and plantains, the increase in cultivated areas for bananas and plantain production was confirmed by previous research. Quintero-Gallego (2019) described that after a slight decrease in 2012, plantain cultivated areas in the Quimbaya area increased from 2,178 ha to 4,824 ha in 2016. In total, 7,324 ha were cultivated with plantain in the Quindío region in 2016 (Quintero-Gallego et al., 2018). According to the study, it is highly probable that plantain (along with other products) continued pressuring land covers in the area after 2009 and driving the transformation and degradation of forests -and especially pasturelands- for growing crops as plantain (Ibid.). Secondly, regarding avocados, the area planted with avocados in Colombia increased by 127% between 2012 and 2016 (IDEAM, 2019). In the Quindio region, the cultivated area with avocado plants had tripled between 2007 and 2016, suggesting a probable change in land covers in that region (Quintero-Gallego et al., 2018). As discussed above, these developments are also reflected in the growth rates analysed in the economic analysis. Though it is unclear to what extent the increase of cropland for plantain and bananas and avocados -and associated LULUCF emissions- is directly driven by the Agreement, it is plausible that the Agreement may have influenced the reported crops expansion and thus contributed to an increase of LULUCF emissions.

The CGE results show a slight increase in *crops nec* (that includes, among others, coffee and cocoa beans) from Colombia which may as well have affected LULUCF emissions. Thought this CGE estimated increase in *crops nec* cannot be directly inked to the trade of coffee or cocoa beans (as these are both products for which the Agreement does not establish tariff preferences because they have a zero MFN tariff), there is evidence of an increase in the area planted with cocoa and coffee beans in Colombia since the start of application of the Agreement. In fact, the area planted with cocoa is reported to have increased by 89% between 2012 and 2016 (IDEAM, 2019). Yet, the impact of cocoa on land use change and thus LULUCF emissions in Colombia continues to be debated. On the one hand, some authors have shown the potential impact of land use change of cocoa production (Castro-Nunez et al., 2020). On the other, results from correlations and spatially explicit analyses have demonstrated that regardless of its widespread production across Colombia, cocoa has not been an important driver of deforestation between 2005 and 2020 (Ibid.). As such, there is no evident link between the FTA and land use change in Colombia driven by cocoa beans production. Similarly, in the case of coffee, there is no evidence that the FTA has impacted LULUCF emissions of the sector: the Colombian National Centre for Cleaner Production reports that the age of the coffee farms in Colombia permit to conclude that land use change happened more than 20 years ago, and therefore, it is no considered as a current source of LULUCF emissions (CNPML, 2020). In the coming years, however, a combination of factors, particularly climate change, could trigger a new wave of forest clearance, as farmers are forced to shift production to higher altitudes, sometimes encroaching on sensitive montane ecosystems (SEI, 2020). The potential positive impact on the production of and trade in sustainable and organic products (including cocoa and coffee beans) was also raised by stakeholders (see impact-screening Colombia). For instance, the government and its development partners are identifying market opportunities to produce cocoa with zero deforestation in areas prioritized for the peace process. In fact, in 2019 Minambiente ratified its commitment to the global initiative 'Cocoa, Forests and Peace' and endorsed a 10-year action plan to promote Zero Deforestation cocoa production models (Minambiente, 2019a), which has received support from the private sector (Luker Chocolate, n.d.), but also critics due to the lack of a clear roadmap to implement those commitments (Agro Empresario, n.d.).

Besides the products included under the categories *VFN* and *other crops*, the ex-ante Sustainability Impact Assessment (SIA) and other stakeholders previously raised concerns about the increase of palm oil production in Colombia because of the Agreement (TSIA, 2009) (TNI, 2016). During interviews, an international environmental organisation also raised concerns about the potential negative effects on forest degradation due to the lack of incentives for palm oil producers. Yet, according to the CGE results, the tariff reduction-induced output changes of *oil seeds* and *vegetable oils* is negative, which suggests[2] that the Agreement led to a decrease in palm oil production in Colombia thus far (or rather a slower growth than would have occurred in the absence of the Agreement) and therefore no additional LULUCF emissions. However, oil palm cultivation in Colombia has expanded 166% in the last 15 years (IDEAM, 2019), which may have resulted in structural changes within the sector and an increase in LULUCF emissions. The flows analysis by the Trase database[3] (a supply chain transparency initiative focused on traded agricultural commodities) shows that the EU has been the main importer of palm oil from Colombia between 2013 and 2018. In addition, according to Fedepalma, during the first quarter of 2019, the main export destination of palm oil was the EU (69%), and most of Colombian exports of oil palm products (91%) "benefit from preferential conditions of the different free trade agreements in force" (Fedepalma, 2019), which suggests a causal link between increased palm oil exports (and corresponding impacts, including LULUCF emissions) and trade agreements. The CGE model results confirm this, as total vegetable oil exports are estimated to have increased by 9.8%; but in line with the model simulations this export increase does not come from increased production but a shift from domestic use to exports. Palm oil production is expected to increase by more than 177,000 ha in the 2016-2030 period (IDEAM, 2019). An increasing trend towards good practices and sustainable production of palm oil in Colombia has also be highlighted during the interviews conducted for this study. For example, Solidaridad (2019) showed that the import of sustainable palm oil from Colombia to the EU increased from 23% to 31% between 2014- 2018, and that a growing trend of (ISCC) certified biofuels has been observed (from 7% in 2017 to 26% in 2018).

In **Peru**, the three main LULUCF emission sources are: change in land use from forest lands to agricultural lands, forest management in forest lands remaining forest land (wood/firewood production, and forest fires) and change of forest lands to grasslands (following Peru's NDC). According to the CGE results, the Agreement triggered output reduction in the meat and dairy, and wood and paper sectors. Taking this into account, the main impact pathway through which the Agreement may have changed LULUCF emissions in Peru is the change in land use from forest lands to agricultural lands.

As shown in the economic analysis, since 2013, EU imports of fruits from Peru have grown fast and fruits became the largest import commodity in 2019 (see main report). This growth included various products (e.g., avocados, berries, grapes, and miscellaneous tropical fruits). The estimated tariff reduction-induced output change in Peru in the *VFN* sector corresponds to roughly 14,000 ha (though the *net* impact on cropland area is negative as production decreases in other sectors outweighed this increase). Some of the crops within the *VFN* sector are historically associated with deforestation, such as banana (e.g., Horgan, 2005; Zambrano et al., 2021). However, the *VFN* sector also includes crops unrelated to deforestation and forest degradation (e.g., potatoes, which account for 25%

[2] The oil seeds sector is dominated by palm oil, representing 84% of the value of production. As such, a decrease in output in the oil seeds sector provides a strong indication of a decrease in palm oil production.

[3] See Trase- Transparency for Sustainable Economies https://trase.earth/

of total value of production in the sector). Concerns have been expressed regarding asparagus and avocado production in the Ica and Villacurí valley in Peru (see Impact screening- Peru). Based on data limitations, it cannot be concluded if and to what extent asparagus output changes have been caused by the Agreement's tariff preferences.[4] Furthermore, Vázquez-Rowe et al. (2016) reported that additional cropland in Peru for green asparagus did not lead to land use change, which suggests a limited impact on LULUCF emissions. Since asparagus is one common air-freighted good (Ritchie et. al, 2020), a higher impact on GHG emissions of asparagus is expected to come from transport than from land use change.

In addition, the economic modelling results show a slight increase in the output of *cereal grains* other than wheat from Peru, which may as well have contributed to land use change. Prior research suggests that the boom of quinoa has led to the emergence of a 'new geography of quinoa' production in Peru. This has been accompanied by the transformation of farming practices and a trend towards increasing competition for land use (an increase of 264% in the area under quinoa cultivation in Peru has been reported between 1995-2014). This, at the same time, may have led to decreased agrobiodiversity due to land use competition, which is seen in the reduction in crop diversity (Bedoya-Perales et. al, 2018). According to SUNAT, in 2019 25% of the Peruvian quinoa was exported to France, Netherlands, Italy UK and Belgium.

A slight increase in the output of *oil seeds* and *vegetable oils* in Peru was observed from the economic modelling. According to our results, the production of palm oil may have led to a slight increase of deforestation in Peru (around 600 ha). This amount is considered too low to attribute to deforestation within reasonable boundaries of uncertainty; as it could have also been produced in existing oil-palm areas, or on former deforested areas. For the pre-Agreement period, some authors have reported that 72% of new palm oil plantations in the Amazon region had expanded into forested areas, representing 1.3% of the total deforestation for Peru for the years 2000–2010 (Gutiérrez-Vélez et al., 2011). Further, it is important to note that the main destination of the Peruvian palm oil has historically been the domestic market, and this is expected to remain the same (90% of total national production by 2025). However, unlike 2015, when a very low share of exports (<1%) were attributed to small and medium-sized producers, annual exports from this producer's segment are projected to jump from 82 tonnes to 20 000 tonnes by 2025 (Minagri, 2016). As corporate plantations have been linked to higher deforestation and forest degradation rates than plantations from small producers (who have traditionally expanded to (previously) degraded or deforested lands (DAR 2015), it is not unlikely that ahead of the expected expansion of smaller producers (after 2015), the export of palm oil was not linked to deforestation and forest degradation in Peru, and thus to the associated LULUCF emissions.

The main way by which the Agreement may be impacting the LULUCF emissions in **Ecuador** is the change of forest land to agricultural land, considering the CGE modelling results that showed an output increase for *cereal grains* and *VFN.* According to the economic analysis, particularly two sectors improved performance since the start of the Agreement: fish preparations and fruits. With regards to fish, in some regions (e.g. Chone) grazing land has been converted into pools to cultivate crustaceans (e.g. shrimps) over the past years (Acción Ecológica, 2020). With regards to fruits, it is estimated that the Agreement resulted in a *net* decrease in cropland areas (considering *all* crops produced).

Stakeholders have raised concerns about the impact of banana production in Ecuador. In a manifesto published in 2020, a group of banana producers in Ecuador denounces the

[4] The share of asparagus in the value of production of the VFN sector is only 3%, which suggests that the role of asparagus may be limited.

illegal increase of area for banana production in 30,000 hectares between 2018 and 2020 closely driven by Agreement (APROBANEC and others, 2020).

5.2 Impact on LULUCF emissions in the mining sector

As shown in the economic analysis, one of the fastest growing sectors in **Colombia** between 2012 and 2020 were precious minerals (35.2% increase on average per year), in particular gold (see the economic analysis in the main report). The CGE results do not show any tariff reduction-induced impact in the economic output of *minerals*, as these are not affected by the tariff preferences (as imports of minerals are generally duty-free in the EU). Although no conclusion about the causal relation between the Agreement and the mining sector can be drawn from these CGE results, it should be noted that new research has suggested effects on the LULUCF emissions driven by this sector in Colombia. For instance, a remote-sensing analysis showed that alluvial mining (especially gold mining) has severely affected the Pacifico Region in Colombia, causing deforestation and forest degradation (mainly shrubland, followed by wetlands and grasslands) between (60% of forest loss was associated to alluvial mining and illicit crops) (Anaya J. et al., 2020). The study notes that the deforestation connected to barren land from 2014 to 2017 is likely associated with alluvial gold mining (Ibid). In addition, a recent study showed that LULUCF emissions in the Amazon may be affected by impacts on carbon sink lost because of gold mining activities, as these significantly limit the regrowth of forests, and reduce their ability to accumulate carbon (Kalamandeen, M. et al., 2020). Although there is no evidence to prove the impact of the Agreement on LULUCF emissions caused by the mining sector in Colombia, the Agreement may be related to LULUCF emissions in the mining sector.

In **Peru**, mining belongs to the main drivers of high deforestation rates and thus of the significant LULUCF GHG emissions (CDP, 2019). Even though copper is the most exported product from Peru to the EU, there is no clear evidence that the Agreement caused additional pressures on LULUCF emissions by the mining sector in Peru. However, an accelerated land use change between 2000 and 2017 leading to forest degradation has been driven by the mining sector in areas such as Madre de Dios (one of the regions with highest levels of deforestation in Peru) (Tarazona et al., 2020). Trends like the one observed in Madre de Dios and the favourable environment for private investment created by the Government (only in 2014, 50,000 *legal* mining concessions were granted) (Cáceres, 2020) may suggest a potential increase of LULUCF emissions by the sector driven by the Agreement.

In **Ecuador**, mining is not reported as a contributor of LULUCF GHG emissions (MAE,2017b). Therefore, it is likely that the Agreement did not have any impact in the LULUCF emissions of mining.

5.3 Responses - mitigating measures and the role of the Agreement

Since the implementation of the Agreement, the Andean countries have worked on some concrete regulatory measures that may have generated (in)direct positive impacts on the reduction of LULUCF emissions. In relation to the Paris Agreement, both Peru and Colombia submitted their revised NDC commitments in 2020.

In **Colombia**, the National Plan for Development, *Pact for Colombia, Pact for Equity* creates the National Council for the Fight Against Deforestation was created, which seeks to combat illegality. This is complemented by the *Artemisa campaign*, which is a permanent strategy that seeks to confront the crime of deforestation that has been affecting the country.

In addition, *Pacto de Leticia por la Amazonia* was signed in 2019, by which Colombia aims to receive financial support of the governments of Norway, Germany, and the United Kingdom to promote low-carbon development for the Amazon region through the better use of land and other natural resources. One of the LULUCF related measures aims to implement a program to strengthen technical capacities for monitoring forest surface and deforestation and forest and soil degradation, including the generation and analysis of satellite images for monitoring the Amazon region (Minambiente, 2019b).

During the stakeholder consultations conducted for this study, the role of the *Guide to export and import timber and non-timber products* in sustainable forest management was highlighted by the Ministry of Environment of Colombia. Though it does not focus on a specific market (i.e., the EU), it helps to trace products while meeting international market standards. On this issue, according to Minambiente, the EU through partnerships such as Budgetary Support or the FLEGT (Forest Environment Governance and Trade initiative) have contributed to the forest governance process and the strengthening of traceability processes.

Peru expanded the number of sectors (including agriculture) that fall under the Environmental Assessment and Enforcement Agency (OEFA) (TSD Sub-committee, 2018, 2019). Besides, according to the MINAM, Peru strengthened its environmental impact assessment system as a reaction to civil society organisations' complaints.[5] As a result, the National Service of Environmental Certification (SENACE)[6] allows civil society to have access to the environmental impact assessments of public and privates' projects. As of March 2021, 257 entries were registered in the agricultural sector (including e.g., environmental plans, impact assessments, etc). In the palm oil sector, for instance, four projects were published in 2013. However, during the interviews conducted for this study, environmental NGOs expressed their concerns on a trend towards more flexible environmental standards and rules that have undermined the environmental regulatory controls in Peru. One example is the Sustaining Technical Reports (ITS) that modify the established procedure of Environmental Impact Studies (EIAs).

Ecuador implemented several policies to combat deforestation and forest degradation, such as the National Development Plan 2017-2022 and the Action Plan National REDD+ that was issued in 2016. These responses have resulted in a reduction of the deforestation rate in Ecuador. Ecuador has been a beneficiary of "payment for results" by the governments of Norway and Germany, within the framework of the program REM (REDD+ for Early Movers), for an approximate amount of 52 million dollars. Likewise, the Green Climate Fund also granted an incentive within the framework of "payment for results" for 18 million dollars for the forest conservation. National Forest Monitoring System is a system that provides the necessary data to strengthen and measure actions in terms of reducing deforestation.

In addition, Ecuador reported that it is making progress on the implementation of the REDD+ Action Plan, a national policy that will contribute to the goal of zero net deforestation by 2030 (TSD Sub-Committee, 2019). The pact for forests (social pact for the production and consumption of legal and sustainable managed forest) includes the objectives strengthening forest certification. The fact that the progress on achieving the zero-deforestation goal has been a persistent subject of discussion in previous TSD Subcommittee meetings shows the interest of the EU in helping Ecuador to accomplish the goals set. During the interviews, the Ministry of Ecuador highlighted the importance that the cooperation with the EU had for enhancing the national commitments.

Based on literature review and stakeholder interaction, it is found that the role of the Agreement, or more specifically the TSD chapter, with regards to these developments seems to be very limited. Though the TSD chapter created a new platform for dialogue and cooperation, only one of the above-mentioned initiatives seems to be pushed by TSD related programmes or dialogues: the improved Peruvian environmental impact

[5] In 2017, civil society organisations issued a complaint to the EU, expressing their concerns about Peru's lack of compliance with its trade and sustainable development commitments.

[6] https://www.senace.gob.pe/nosotros/sobre-senace/

assessment framework. Notwithstanding the significance of environmental impact assessments on the long term, it seems unlikely that the Agreement has contributed to positive LULUCF related impacts through this measure so far.

6 CONCLUSION

Over the period of the Agreement, LULUCF emissions accounted for a considerable share of the total GHG emissions in the Andean countries. In this case study, complemented by inputs from other sections of this study, the causal link between developments in LULUCF emissions and the Agreement is explored, focussing on impacts related to tariff reduction-induced economic changes (building on the CGE results) and tariff reduction-induced regulatory changes. It is concluded that:

- For **Colombia**, it is estimated that the tariff reduction-induced economic changes in the agricultural sector contributed to an *increase* in LULUCF emissions in Colombia of about 0.4 Mton CO_2 in 2020, which corresponds to about 0.2% of total GHG emissions in Colombia. In particular, the palm oil industry may have influenced this result. The CGE modelling results show an increase in exports to the EU of palm oil due to shift from domestic use to exports. Furthermore, Fedepalma (2019) concludes that 91% of palm oil benefitted from preferential conditions of *different* trade agreements. Future analysis on the impact of the projected expansion of palm oil cultivation in Colombia will be required to establish a clear link between LULUCF emissions related to palm oil and the Agreement. Given the tariff reduction-induced increase in the *vegetables, fruits and nuts* sector, as well as the sharp increase in avocado exports to the EU, it may be the case that avocado cultivation has contributed to the increased LULUCF emissions, though causality cannot be proven given data limitations. Given the relatively low share of avocados in the total value of production of the *vegetables, fruits and nuts sector*, it is likely that most of the increase the LULUCF emissions is driven by other crops.

- In **Peru**, it is estimated that the tariff reduction-induced economic changes contributed to a net *decrease* in LULUCF emissions in Colombia of about 0.05 Mton CO_2 in 2020 (which corresponds to less than 0.1% of annual LULUCF emissions). This can be explained by the estimated net decrease in cropland and grazing land. Given the estimated tariff reduction-induced increases in cropland for *vegetables, fruits and nuts* and *oil seeds*, production growth of crops within this sector (such as bananas, avocados, and asparagus) may have resulted in gross additional LULUCF emissions. Yet, Vázquez-Rowe et al. (2016) reported that additional cropland in Peru for green asparagus did not lead to land use change, which suggests a limited impact on LULUCF emissions.

- In **Ecuador**, it is estimated that the tariff reduction-induced economic changes contributed to a *decrease* in LULUCF emissions in Colombia of about 0.04 Mton CO_2 in 2020 (which corresponds to less than 0.2% of annual LULUCF emissions). This can be explained by the net decrease in cropland and grazing land.

With respect to LULUCF emissions related to mining activities, the results suggest that there may be an increase of the LULUCF emissions of the mining sector driven by the Agreement in Colombia and Peru; however, the CGE modelling results do not allow to establish a casual link for this sector.

With respect to the Agreement's impact on LULUCF emissions through provisions of the TSD chapter, it is concluded that all Andean countries have started to implement measures to address the negative impacts on climate change caused by LULUCF emissions. Even though the Agreement is likely to open doors for improved cooperation between the EU and the Andean countries, the Agreement does not seem to have resulted in direct positive impacts in the LULUCF sector so far.

SOURCES

Acción Ecológica (2020) Cuando el mar entra a la tierra - Shrimp Production In Highlands Its expansion in the lower basin of the Guayas River, peasant lands and ancestral communes.

Agro Empresario (n.d.) La creciente demanda de sin deforestación podría no ayudar a los bosques colombianos. Retrieved from: https://mundoagropecuario.com/la-creciente-demanda-de-cacao-sin-deforestacion-podria-no-ayudar-a-los-bosques-colombianos/

Anaya, J. A., Gutiérrez-Vélez, V. H., Pacheco-Pascagaza, A. M., Palomino-Ángel, S., Han, N., & Balzter, H. (2020). Drivers of forest loss in a megadiverse hotspot on the Pacific Coast of Colombia. Remote Sensing, 12(8), 1235.

Banerjee, Cicowiez, Malek,Verburg, Vargas, and Goodwin (2020). The Value of Biodiversity in Economic Decision Making: Applying the IEEM+ ESM Approach to Conservation Strategies in Colombia. http://dx.doi.org/10.18235/0002945

Bedoya-Perales, N. S., Pumi, G., Talamini, E., & Padula, A. D. (2018). The quinoa boom in Peru: Will land competition threaten sustainability in one of the cradles of agriculture?. Land Use Policy, 79, 475-480.

Centro Nacional para la Producción Más Limpia CNPML, Quantis International, Colombia National Coffee Federation, Cenicafe (2020). Environmental Footprint Of Coffee In Colombia. Retrieved from: https://www.shareweb.ch/site/ElAguaNosUne/Documents/ENVIRONMENTAL%20COFFEE%20IN%20COLOMBIA.pdf

DAR (2015). La transformación del bosque. Titulación de predios y cambio de uso de suelos en la Amazonía peruana. Lima: DAR, 2015. 180pp

Fedepalma (2019) Balance económico del sector palmero colombiano en el primer trimestre de 2019. Retrieved from: https://publicaciones.fedepalma.org/index.php/bole12oletíntin/issue/archive

Hannah Ritchie and Max Roser (2020–) "- "Environmental impacts of food producti"on". Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/environmental-impacts-of-fo'od' [Online Resource]

IDEAM (2019) Estudio Nacional del Agua. Bogotá. 452pp. Available at: http://documentacion.ideam.gov.co/openbiblio/bvirtual/023858/023858.html

Kalamandeen, M., Gloor, E., Johnson, I., Agard, S., Katow, M., Vanbrooke, A., & Galbraith, D. (2020). Limited biomass recovery from gold mining in Amazonian forests. Journal of Applied Ecology, 57(9), 1730-1740.

Lukor Chocolate (n.d.). Los cultivos de cacao, una alternativa a la deforestacíon en Colombia. Retrieved from: https://lukerchocolate.com/blog/creando-valor-compartido/cacao-una-altarnativa-a-la-deforestacion-en-colombia

MINAGRI (2016) Plan Nacional de Desarrollo Sostenible de la Palma Aceitera. https://repositorio.minagri.gob.pe/jspui/handle/MINAGRI/187

Minambiente (2019a) Colombia, primer país en Latinoamérica en reafirmar su compromiso con el cacao Cero Deforestación. Retrieved from: https://www.minambiente.gov.co/index.php/noticias/4457-colombia-primer-pais-en-latinoamerica-en-reafirmar-su-compromiso-con-el-cacao-cero-deforestacion

Minambiente (2019b) Plan de Acción – Pacto de Leticia por la Amazonía. Retrieved from: https://www.minambiente.gov.co/images/2019/PLAN_DE_ACCION_PACTO_DE_LETICIA_POR_LA_AMAZONIA.pdf

Murad, C. A., & Pearse, J. (2018). Landsat study of deforestation in the Amazon region of Colombia: Departments of Caquetá and Putumayo. Remote Sensing Applications: Society and Environment, 11, 161-171.

SEI (2020) Colombian Coffee Futures. Retrieved from: https://www.sei.org/featured/colombian-coffee-futures/

Tarazona, Y., & Miyasiro-López, M. (2020). Monitoring tropical forest degradation using remote sensing. Challenges and opportunities in the Madre de Dios region, Peru. Remote Sensing Applications: Society and Environment, 19, 100337.

Vázquez-Rowe, I., Kahhat, R., Quispe, I., & Bentín, M. (2016). Environmental profile of green asparagus production in a hyper-arid zone in coastal Peru. Journal of Cleaner Production, 112, 2505-2517.