IMPACTS OF INCREASED FOREST BIOMASS DEMAND IN THE EUROPEAN BIOECONOMY

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Abstract

We provide a sensitivity analysis of a 1% increase of intermediate input use of forestry biomass in all sectors of the EU28 in a global Computable General Equilibrium framework depicting land use by Agro-Ecological Zone combined with a rather high resolution with regard to sectors and regions. We find considerable indirect land use effects outside the EU28 despite the rather small shock which reflects the existing integration of global biomass markets. We conclude that policies promoting EU biomass use need to consider these indirect effects which offset, for instance, first order GHG savings from a substitution of fossil inputs by biomass.

Keywords

Bioeconomy, Indirect Land Use, Computable General Equilibrium.

1 Introduction

Responding to global concerns about climate change and natural resource depletion driven by population and economic growth, many countries are designing policy strategies to shift from a fossil-based to a more bio-based economy (GBC, 2015). Expected benefits from such bioeconomic transformations include not only cleaner energy, but also more environmentally friendly food, feed, and material value chains (McCormick et Kautto, 2013). Bio-based growth in these sectors could create new job opportunities in rural areas and foster high value-added economic sectors, such as the pharmaceutical industry (Wield, 2013; Philippidis et al., 2015). In the EU, the development of a more bio-based economy is part of the so-called green economic growth strategy fostered since the early 1990s in the context of different policy frameworks (agriculture, environment, climate change, energy and R&D) (Scarlat et al., 2015). In 2012, under the framework of the EU 2020 strategy for smart and green growth, the European commission launched the “EU bioeconomy strategy” which aims to reduce the dependency on oil imports, to improve food security, to promote rural development and to increase energy security. Furthermore, in order to support global climate change mitigation, the EU launched the Renewable Energy Directive (EC, 2009) which sets a minimum 20% target of the EU’s final energy consumption stemming from renewable resources by 2020. In 2014, under the 2030 climate and energy framework, the EU aims at reducing its GHG emissions by at least 40 % in 2040 compared to the year 1990.

Already today, the bioeconomy plays a major role in the EU with a turnover of around €2 trillion and around 22 million jobs across different traditional and emerging bioeconomic sectors (SAT-BBE,2015). A substantial share of the bio-based industries in the EU relies on biomass resources. In fact, in 2012, around 2 billion tons of biomass were used, 65% for food and feed, 19% for processing and 12% for energy production (Scarlat et al., 2015). With 62%, the largest share of renewable energy (biomass, solar energy, wind energy, hydro and others) produced in the EU stems from biomass, of which 80% is woody biomass from forestry (Proskurina et al., 2016). Covering around 42% of the total EU area, forests play a significant role in the EU bioeconomy with a production value of €456 billion and 3.5 million jobs (Scarlat et al., 2015). Elbersen et al., (2012) estimate that forest biomass represents around 50 % of total EU biomass potential. Proskurina et al., (2016) add that, in order to achieve their national renewable energy and GHG emissions targets, EU countries with large forestry sectors such as Finland, France and Germany will need to better mobilize their forest resources while others such as the UK are expected to increase woody biomass imports, for instance of wood pellets.

The economic, social and environmental sustainability of larger increases in biomass demand is uncertain and debated amongst the EU member states in the ongoing post 2020 EU policy debate. Firstly, increased biomass production will require more land, triggering land use and cover changes potentially not only in the EU, but also in the rest of the world (Banse et al., (2011); Britz et Delzeit, (2013)). O'Brien et al., (2015) conducted a study to measure the EU's land footprint in the context of the growing bioeconomy. They found that the EU27 is a net importer of agricultural land (45Mha of imported agricultural land in 2011) with a quite high cropland footprint exceeding the global per capita average by around 33%. (Indirect) land use change and related effects thus are one key challenge for expanding the EU bioeconomy. In that context, a comprehensive study conducted by Cuypers et al., (2013) analysed the impacts of the EU biomass consumption on deforestation. It found that over the period from 1990 to 2008, the EU27 imported around 9 Mha of deforestation embodied in crops and livestock products. Further studies found that increased EU biofuel demand has driven deforestation and biodiversity losses in tropical forests, for instance by expanding palm oil plantations in Indonesia and Malaysia (Fitzherbert et al., 2008; Mukherjee et Sovacool, (2014)). Other studies focused on socio-economic implications of the bioeconomy, i.e. its contribution to food security, employment, and rural poverty. Special focus was on biofuels as perhaps the most visible newly emerging commercially produced bio-based product (Ewing et Msangi, (2009); Johnson et Altman, (2014); Suttles et al., (2014)), even if some biofuel programs, for instance in Brazil are longstanding. Authors claimed that large-scale production of biofuels, especially if based on traditional field crops, will increase international food prices and thus decrease the purchasing power especially of poor households in developing countries with large budget shares for food where poverty, inequity, and food insecurity are still major concerns.

However, bioenergy is just one potential dimension of the bioeconomy. Technological innovation opens new opportunities to use biomass in industrial sectors which diversifies the bioeconomy (Boehljeai et Bröring, 2011). Given the high biomass potential of the European forestry sector and the many sectors which could potentially use or increase its use of woody biomass, this paper aims to quantify the global economic and environmental effects of increased forest biomass demand in the EU28.

To explore economic and environmental implications of a growing bioeconomy and to quantify impacts at regional and global scales, various modelling approaches have been used. Wicke et al., (2015) classified these into: (1) Computable General Equilibrium (CGE), and (2) Partial Equilibrium (PE) models, (3) bottom-up approaches, and (4) Integrated Assessment Models (IAM). Reflecting the role of global trade in biomass, PE and CGE models depicting the global supply chain of traded commodities global are increasingly used to assess worldwide effects of the bioeconomy (SAT-BBE, 2015). In this paper, we focus on Global Computable General Equilibrium (CGE) trade models, because we are interested in (1) economy wide effects and (2) the role of economic mechanisms, such as price changes, in reallocating global demand for forest and cropland in response to our scenario assumptions.

Computable General Equilibrium (CGE) models designed for economic and trade policy assessment are increasingly improved and extended to address bioeconomy-relevant sustainability dimensions such as land use change and related GHG emissions, climate change and biodiversity loss (Wicke et al., 2015). For example, Banse et al., (2011) studied the global impacts of the EU biofuel production on land use and GHG emissions and found that in the absence of the adequate sustainability regulations, large expansion of biofuels made from agricultural biomass may result in an increase of the EU GHG emissions due to cropland expansion. In addition to first generation biofuels, several studies employed CGE modelling frameworks in order to investigate opportunities and challenges of biomass use in more advanced bioeconomic applications such as second generation biofuels (Banse et al.,2008), biochemicals and bioplastic (Smeets et al., 2014).

Mobilization of forest biomass in large-scale energy production is analysed in several CGE based studies. For example, Suttles et al.,(2014) used the FARM model (Darwin et al., 1995) in order to quantify economic and land use effects of EU and US forest-based bioenergy production and to assess the role of renewable energy policies in ensuring a sustainable use of forest resources. FARM is one of the pioneer CGE models extended to cover land use and climate change impacts. Results show that higher woody biomass use in energy production in both EU and US will lower CO2 emissions compared to fossil resources. Moreover, Philippidis et al., (2016) used the Modular Applied GeNeral Equilibrium Tool (MAGNET) in an attempt to examine the sustainability of the EU biomass consumption. They claimed that a reduction of GHG emissions resulting from an over-consumption of biomass and its related indirect effects could be achieved through a coherent public interventions and higher coordination between EU regions at the aim to secure an optimal use of biomass. In recent years, reflecting increased awareness of global environmental issues, the widely used standard Global Trade Analysis Project (GTAP) CGE model has been extended and modified to capture linkages between the environment and the entire economy. Specifically, the GTAP-AEZ model (Lee et al., 2005) was developed to quantify land use changes and related GHG emissions, drawing the FAO's Agro-ecological zoning. It has been mostly employed in assessing the direct and indirect land use change effects of first generation biofuels. In the broader field of energy and land use related analysis, further GTAP extensions are relevant: GTAP-E depicting in detail energy-capital substitution and quantifying CO2 emissions from fossil energy use (Burniaux et Truong, 2002), GTAP-AGR adding some detail in agricultural production (Keeney et Hertel, 2005) and, GTAP-Bio that captures substitution between fossil-based products and biofuels (Birur et al., 2008).

Based on the lessons learned about indirect land use changes from first generation biofuel programs, our study pays special attention to land use implications of increased EU28 forest biomass consumption as part of a green-growth strategy. Accordingly, we use GTAP as a global trade model to consider that EU biomass production is well integrated in global markets. At the same time, GTAP as a CGE depicts the national and global value chains of biomass production and use and considers relevant economic mechanism such as substitution between domestic and import demand or intensification of land use. As land use issues at the forefront of fostering the bioeconomy, we add the GTAP-AEZ land use extension. In order to assess the importance of the considering detail in energy and land use sectors in the analysis, we conduct a structural sensitivity analysis by running the model in different configuration where we also add the GTAP-E and GTAP-AGR extensions. Based on the broad definition of the bioeconomy[1] provided by the German Bioeconomy Council (GBC, 2015), we consider not some selected bioeconomic sectors,

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[1] The bioeconomy refers to: "The knowledge-based production and utilization of biological resources to provide products, processes, and services in all sectors of trade and industry within the framework of a sustainable economic system". (GBC,2015)

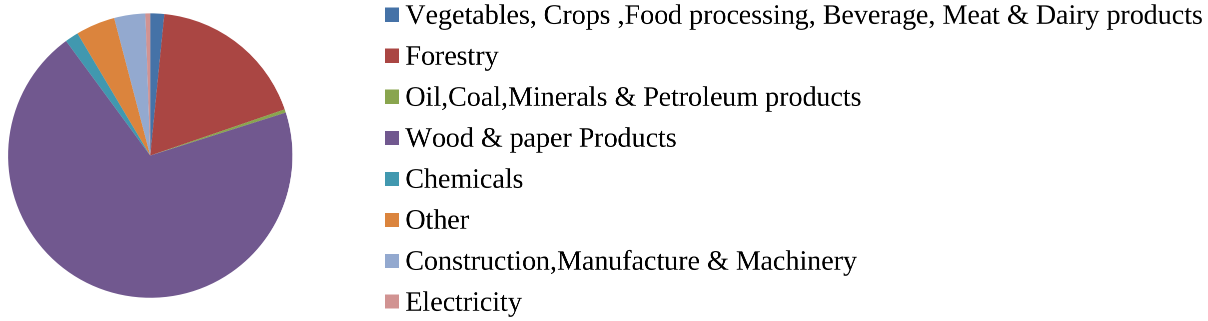
such as biofuels, but a more holistic view where all (traditional and emerging) sectors increase their forest biomass use.

2 Method and data

2.1 Scenario design

A transformation from the fossil-based to a more bio-based economy may involve innovation induced gains in resource use efficiency, but will, at least in the short-term, require a considerably larger biomass input than a fossil-based economy. Moreover, a broader green growth strategy will require biomass use beyond traditional processing sectors of primary biomass such as the food, feed, textiles and wood industry. Accordingly, our scenario explores an increase of intermediate input use of forestry inputs also in industries where forest biomass use is traditionally rather low. Specifically, we assume a 1% increase in intermediate demand for forest products in all sectors. Figure 1 describes the initial sectoral distribution of forest biomass use in the EU28 before simulating the scenario.

Figure 1: Sectoral distribution [%] of forest biomass use in the EU28



Source: Own calculation based on GTAP8 data, 2016

As intermediate demand is an endogenous result in a CGE analysis and cannot be shocked directly, our scenario changes rather the parameterization of the production function. Specifically, we increase the intermediate input coefficients for forestry output in all sectors by 1%. That would however imply overall higher intermediate demand. Accordingly, we decrease all other intermediate input use such that a given prices, production costs would not change. However, price changes are unavoidable in the closed accounting framework of a CGE once a simulation with the updated production function is conducted, as a higher overall demand for forestry products and lower one for other intermediate will provoke structural adjustments in the economy that will be discussed in the result sections.

2.2 Data

This paper uses the GTAP8 database (2007 reference year), the latest version where matching Agro-ecological zone (AEZ) data were available. As usual in global CGE analysis, we aggregate that data base, however only with regard to regions while maintaining the full resolution of 57 production sectors. We consider two different regional aggregations with 35 and 68 regions (see appendix 1) to check to what extent results depend on regional aggregation. We always add the GTAP-AEZ land use data base on global land cover by AEZ and, for structural sensitivity analysis, in some experiments the GTAP-Energy data based providing CO_2 emissions distinguished by fuel and by sectoral use in each region.

2.3 Modelling approach

The base for our analysis is the GTAP Standard model (Hertel, 1997). Technically, we use a flexible and modular implementation in GAMS provided by Britz et Van der Mensbrugghe, 2016 which allows us to perform structural sensitivity analysis.

In our analysis, land heterogeneity as a key factor for land use modelling is captured by adding always the GTAP-AEZ extensions to the GTAP Standard model. Following Darwin et al., (1995), the GTAP-AEZ database distinguishes land use by 18 AEZs (Lee et al, .2005) by two main criteria. The first one is the length of growing period in 6 categories of 60 days which depends on temperature, precipitation, soil characteristics, and topography. The second reflects climatic characteristics by three main zones (tropical, temperate and boreal). Moreover, GTAP-AEZ reduces aggregation bias as land use changes between sectors only take place within the same AEZ (Lee et al., 2005). Within each AEZ, land supply is constrained by a nested constant elasticity of transformation (CET) structure depicting land rent maximization. The upper nest allocates land among cropland, pasture, and forest based on relative returns to land while the second nest depicts allocation between different crops.

In addition to GTAP-AEZ, we add for structural sensitivity analysis the GTAP-E and GTAP-AGR extensions. GTAP-E contributes CO_2 GHG emissions from the combustion of fossil fuels and depicts at the same time detail in capital-energy and fuel substitution based on a nested CES-presentation in the production function (Burniaux et Truong, 2002). The GTAP-AGR extension provides an improved representation of agro-food sectors: feed substitution in the livestock sector, substitution for agricultural inputs in food processing sectors and a differentiation between farm and non-farm households along with CET transformation of primary factors between agricultural and non-agricultural sectors (Keeney et Hertel, 2005). A comparison between results obtained by different model configuration is carried out where these two extensions are used or not with a focus on global production and land use impacts.

3 Results

We first present in sections 3.1-3.4 results based on the GTAP-Standard model plus the GTAP-AEZ extension, before section 3.5 discusses selected changes when sectoral production functions and primary factor use are depicted in more detail based on the GTAP-E and GTAP-AGR extensions.

3.1 Effects on sectoral output

When using GTAP-Standard plus GTAP-AEZ, we find that a shift in the production technology increasing the intermediate input coefficient for forestry in all sectors of the EU 28 by 1% slightly increases global forestry production by 0.17%. At the regional level, Europe shows higher increases by around 0.43% in the EU and by around 0.28% in the rest of Europe. That increase in forestry production comes at the price of a slightly reduced output of other land use sectors such as wheat, paddy rice and oil seeds by -0.02%, -0.04% and -0.03% respectively(see table 1 below). These results reflect the reallocation of production factors and intermediate inputs from other economic sector to forestry. For example, in the EU, demand for labour of the forestry sector rises by 0.69%. Demand for other inputs also raises e.g. chemicals that increase by 0.27% in the rest of Europe. Production in other regions outside the EU like in Brazil is less affected.

Table 1: Sectoral output changes [%]

	EU28	Rest of Europe	USA	Former Russia	Brazil	Indonesia
Forestry	0.43	0.28	0.08	0.19	0.04	0.06
Paddy rice	-0.04	-	-		-	
Wheat	-0.02	0.01	0.01	-0.01	-	
Cereal grains	-0.01	-	-		0.01	
Vegetables	-0.02	-	-		0.01	
Oil seeds	-0.03	-	-	-0.01	0.01	
Plant-based fibers	-0.03	0.01	-	-0.01	-	0.01
Vegetable oils and fats	-0.01	0.01	-	-	0.01	

Source: Own calculation, 2016

3.2 Effects on final demand

As increased intermediate demand for forestry output provokes price increases, government and household demand for forestry products decrease by -0.19% and -0.15% respectively at a global level. Household demand deceases by -0.62% in the EU28. Still, export demand of forest products increases by around 0.4% globally and 0.6% in EU28 (see table 2). That reflects the heterogeneity of domestic forest potential among EU member states and globally; some countries with abundant forests are expected to increase their exports to the EU.

Table 2: Effects on final demand [%] for forestry sector

	World	EU28
Household demand	-0.15	-0.62
Government demand	-0.19	-
Export demand	0.40	0.60

Source: Own calculation, 2016

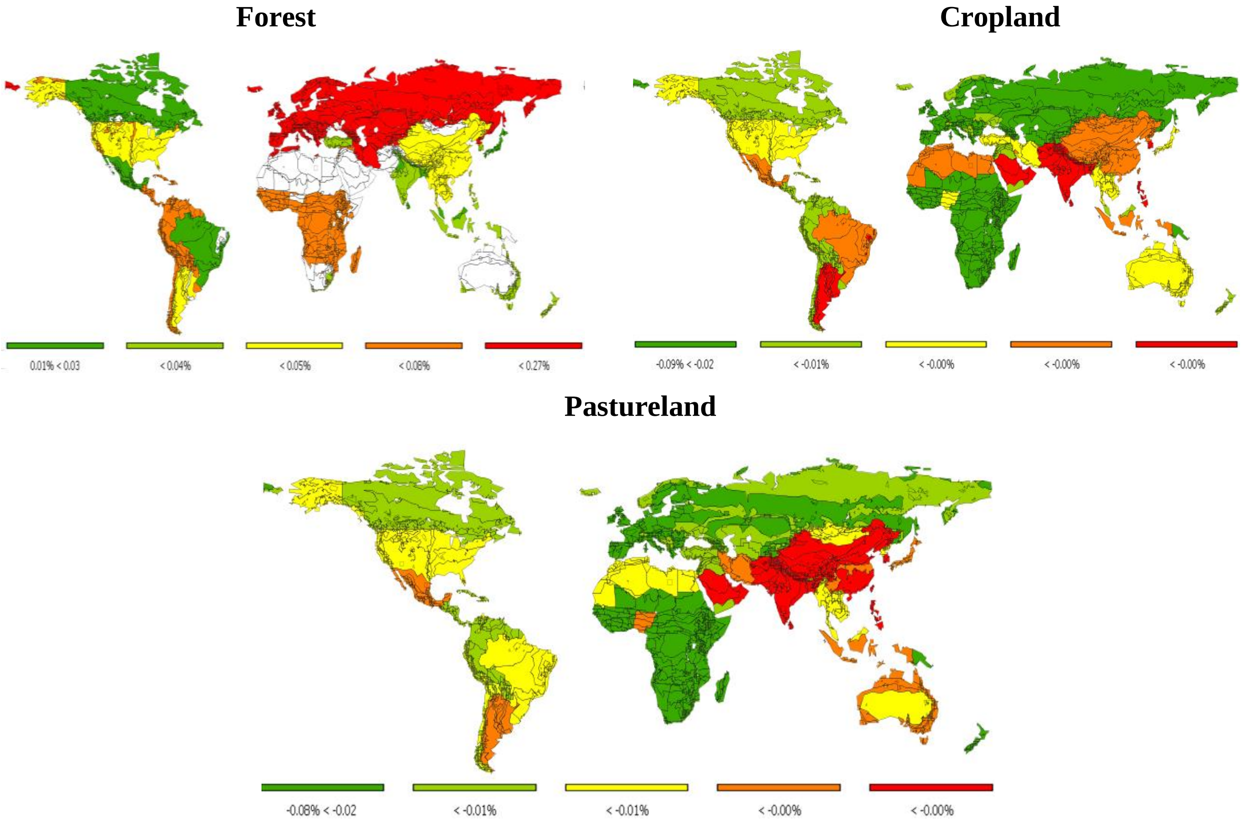
3.3 Effects on land use and land cover changes

Global effects

Increased use of forest biomass both in traditional and new applications such as chemicals and materials will create pressure on land resources. Based on our simulation results, we find that the EU 28's forestry sector would use 0.27% more land, simulated to shift from other agricultural sectors, mainly from cereals, vegetables, oil seeds and milk to the forestry sector. That mechanism is also seen globally: forest areas are expected to increase at the expense of cropland and pastureland which show a global decrease by -0.02% for each land cover, even if we only shock the EU28 demand for woody biomass at the margin.

The maps in figure 2 indicate that EU countries are expected to show the highest expansion of forests in all AEZs while outside-EU effects are mostly observed in Former Russia where forest areas are expected to rise. Land conversion to forests reflects its increased profitability as the price for woody biomass goes up. Pastureland in the EU is also expected to be converted to forests while outside-EU effects are negligible. The rise of forests over cropland might increase the dependency of the EU on agricultural and food imports from the rest of the world.

Figure 2: Effects on Land cover



Source: Own calculation, 2016

Effects on land use and land cover changes at country level

A rather aggregation is often seen as a major limitation of CGE models. Therefore, this sub-section conducts a sensitivity analysis by increasing the regional disaggregation from 35 to 68 regions. Specifically, the EU28 is disaggregated into 13 regions and countries[2] instead of solely 1 region (EU28) in the first experiment. While overall results for the EU are rather similar to what was discussed above, we find some heterogeneity inside the EU. Forest lands would expand mainly in Poland, Spain, Germany and France by 0.35%, 0.29%, 0.26% and 0.20%, respectively (see table 3 below).

Table 3: Land factor demand in forestry sector [%] for selected EU and non-EU countries

	EU		Non-EU
Spain	0.29	Former Russia	0.10
Portugal	0.09	Brazil	0.02
Poland	0.35	Malaysia	0.02
Belgium	0.18	Indonesia	0.03
France	0.20	USA	0.04
Germany	0.26	Kenia	0.07

Source: Own calculation, 2016

[2] Germany,France,Belgium,Greece,Italy,Netherlands,Poland,Portugal,Spain,UK,Romania,Rest of EU13 and rest of EU15

A comparison between simulation results of the two different databases shows similar global land use changes. Total cropland and pastureland are expected to decrease globally in all AEZs by -0.02% for both. That seems to underline that the model is overall rather robust with regard to regional aggregation once a certain level of detail such as the 35 regions in the original analysis is reached. However, detail might be necessary to, for instance, properly quantify CO_2 emission effects from land use change.

3.4 Effects on trade patterns of forest biomass

The increased demand for forest inputs also impacts biomass trade flows. Total EU imports of forest products rise by around 1.5%. As it can be seen from table 4, these imports are mainly coming from Europe. In spite of the increased imports of forest biomass from other regions, such as the USA, Indonesia and Brazil, we notice that the intra-regional trade of forest products in the European countries is still dominant.

Table 4: Effects on EU 28 imports of forest products by origin

	Baseline (1000 tons)	Scenario [%]
Indonesia	0.02	3.78
Brazil	0.02	3.95
EU28	4.17	0.02
Rest of Europe	0.27	1.95
USA	0.36	3.78
Former Russia	0.94	3.97
Ukraine	0.13	1.97

Source: Own calculations, 2016

A comparison between simulated impacts shows an overall good agreement when using higher regional detail under our second experiment. In fact, we find, as in the first one, that the EU28 is expected to raise its forest biomass imports from the rest of the world. A big share of these imports is coming from the European countries (74%). The highly disaggregated database allows us to explicitly define the origins of these imports. We find that Germany, Belgium and France show higher increases in their forest product exports. The main reasons behind the increasing imports of forest products from EU countries rather than from other outside forest biomass exporters can mainly be explained by the low transaction costs and strong trade integration among the EU countries. However, model parameters may also affect simulation results, e.g. elasticity of substitution between domestic and imported goods, and between imports from different regions.

3.5 Structural sensitivity analysis

GTAP-AEZ-E-AGR

In that section, we check to what extent a more detailed representation of the agricultural sector (GTAP-AGR) and adding detail in depicting substitution between different types of energy, capital and intermediates (GTAP-E) changes key results presented above when the GTAP Standard model plus GTAP-AEZ only is applied.

Similar to previous simulation results from GTAP- Standard plus GTAP-AEZ model, we find that a 1% increase in intermediate input coefficients for forest inputs let forest lands expand in all regions, but especially inside Europe. However, forestry production in the EU rises somewhat stronger by 0.46% once GTAP-E and GTAP-AGR are added. That can be explained by considering substitution in intermediate demand in energy use and inside the agricultural food and sectors.

That more realistic depiction of production dampens somewhat price effects (more generally, the less flexible production and demand are depicted, the higher are price changes and vice versa). At the same time, GTAP-AGR considers that factors are not fully mobile between agricultural and non-agricultural sectors. Compared to the simpler model configuration, that especially dampens increases in forestry production in developing countries with larger primary factor use shares in the agricultural sector. As a consequence of more flexible forest expansion in Europe and less flexible expansion in developing countries, impacts on global trade are dampened (see table 5 below).

Table 5: Effects on EU28 imports of forestry products by country of origin in two model configurations

	Baseline (1000 tons)	Scenario [%] GTAP-AEZ	Scenario [%] GTAP-AEZ-E- AGR
Canada	0.02	3.89	3.75
Brazil	0.02	3.95	3.80
USA	1.20	3.78	3.63
Rest of Europe	0.25	1.95	1.90
Former Russia	0.77	3.20	3.10
Ukraine	0.02	1.97	1.94

Source: Own calculation, 2016

The GTAP-E extension allows additionally quantifying changes in the CO_2 emissions. Results indicate that the increased demand for forest biomass by the EU28 would essentially trigger a slight increase in CO_2 emissions in the forestry sector in Europe (see table 6 below).

Table 6: Effects on CO_2 emissions [%] by country for selected agricultural and forest sectors

	Forestry	Wheat	Cereal grains	Vegetables, fruit, nuts	Paddy rice
World	0.16	0.00	0.00	0.00	0.00
Canada	0.06	0.01	0.00	0.02	-
USA	0.11	0.00	0.00	0.00	0.00
Brazil	0.06	0.00	0.00	0.01	0.00
EU28	0.29	-0.02	-0.02	-0.01	-0.03
Rest of Europe	0.38	0.01	0.00	0.01	-
Former Russia	0.25	0.00	0.00	0.00	0.00
Ukraine	0.50	0.00	0.00	0.00	0.00

Source: Own calculation, 2016

In fact, the increased forestry production will be accompanied by using more energy inputs resulting in higher CO_2 emissions. For example, in the EU 28, the demand for coal and gas in the forestry sector will rise by around 0.30% for each input. However, total CO_2 emissions from all sectors would remain constant in some regions e.g. Former Russia and decline slightly in others e.g. -0.003% in the EU28.

4 Summary and conclusion

The paper explores global impacts of increased forest biomass use in traditional and emerging applications in global CGE modelling framework. We shift production technology in the EU28 such that intermediate input coefficients in all sectors for woody biomass increase by 1% and displace in a cost-neutral way at benchmark pries other intermediates. We add the GTAP-AEZ land use model to the Standard GTAP model, employing a GTAP8 database with full sectoral detail (57 production branches), aggregated to 35 regions. Our scenario shows increased forestry production predominantly in Europe, but to some extend in many regions such as Brazil. Increased demand for forest biomass increases forest lands, expanding at the expense of cropland and pasture, again mostly in Europe. Still, land use changes occur globally to satisfy higher demand for forest biomass in Europe.

In order to assess the sensitivity of our results to the level of the database aggregation, we conducted a second experiment in which we used a highly disaggregated database (57 sectors and 68 regions). Results are consistent with the findings of the first experiment (57 sectors and 35 regions), but allow to explore regional impacts in more detail, for instance results for individual European countries. Furthermore, we conduct structural sensitivity analysis by depicting key sectors (energy, agriculture) and their outputs in more detail by added the GTAP-E and GTAP-AGR extensions. GTAP-E indicates that the transition to a bio-based economy in the EU28 could be accompanied by a slight increase in CO_2 emissions from the forestry sector due to increasing use of energy inputs. Overall, simulation results from different model configuration (GTAP-AEZ, GTAP-AEZ-E, and GTAP-AEZ-E-AGR) do not differ much. However, a more detailed description of substitution of different energy sources in production and demand, in feed use and in the food processing industry as well as considering that factor mobility between agricultural and non-agricultural sectors is limited overall dampens the global footprint of increased EU woody biomass use.

This paper provides first insights how a European green growth strategy fostering forest biomass use could play out in terms of global land use change and related environmental indicators. Some caveats of our approach deserve future research efforts. For example, scenario assumptions could be refined based on current innovation trends leading to differentiated changes in intermediate input demand across economic sectors. AEZs are still relatively large spatial aggregation units and, thus, land use changes can have very different environmental impacts depending on where within AEZ they occur. Hence, approaches to spatially disaggregate CGE-based scenario outcomes should be explored along with techniques to integrate global trade models with life cycle analyses for selected global value chains.

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Appendix 1: Regional aggregation

35 regions

EU28- Ukraine - Former Russia - Israel- USA- Canada - Argentina - Mexico - Brazil - Australia - New Zealand -Turkey - Bahrain - Islamic Republic of Iran - Malaysia - Indonesia - Japan- Philippines - Korea- China - India -Belarus - Mediterranean Africa- Nigeria - South Africa - Rest of North Africa - Rest of Europe - Rest of Oceania- Rest of south Asia- Rest of East Asia - Rest of south East Asia- Rest of Africa- Rest of Western Asia- Rest of Latin America- Rest of the world.

68 regions

Israel - Australia - New Zealand - Rest of Oceania - China - Japan - Korea - Indonesia - Malaysia - Philippines - India - Rest of South East Asia - Rest of South Asia - Rest of East Asia- Canada - United States of America (USA) - Mexico - Brazil - Argentina - Chile - Peru - Colombia - Venezuela - Rest of Latin America - Rest of North America - Belgium - France - Germany - Greece - Italy - Netherlands - Poland - Romania - Portugal - Spain - UK- Rest of EU15 - Rest of EU 13 - Switzerland - Belarus - Former Russia - Ukraine - Gulf - Islamic Republic of Iran- Turkey - Taiwan - Thailand - Rest of Western Asia - Viet Nam - Bangladesh - Pakistan - Burkina Faso - Cote d'Ivoire - Madagascar - Ghana - Kenia - Benin - Ethiopia - Uganda -Tanzania - Nigeria - South Africa - Rest of Africa - Egypt - Morocco - Other Mediterranean Africa - Saudi Arabia - Rest of the World.