BioTrade2020plus

Supporting a Sustainable European Bioenergy Trade Strategy

Intelligent Energy Europe
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Deliverable 2.1

Availability and Sustainable potentials

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The BioTrade2020plus Project

Objectives

The main aim of BioTrade2020plus is to provide guidelines for the development of a **European Bioenergy Trade Strategy for 2020 and beyond** ensuring that imported biomass feedstock is sustainably sourced and used in an efficient way, while avoiding distortion of other (non-energy) markets. This will be accomplished by analyzing the potentials (technical, economical and sustainable) and assessing key sustainability risks of current and future lignocellulosic biomass and bioenergy carriers. Focus will be placed on wood chips, pellets, torrefied biomass and pyrolysis oil from current and potential future major sourcing regions of the world (Canada, US, Russia, Ukraine, Latin America, Asia and Sub-Saharan Africa).

BioTrade2020plus will thus provide support to the use of stable, sustainable, competitively priced and resource-efficient flows of imported biomass feedstock to the EU – a necessary pre-requisite for the development of the bio-based economy in Europe.

In order to achieve this objective close cooperation will be ensured with current international initiatives such as IEA Bioenergy Task 40 on "Sustainable International Bioenergy Trade - Securing Supply and Demand" and European projects such as Biomass Policies, S2BIOM, Biomass Trade Centers, DIA-CORE, and PELLCERT.

Activities

The following main activities are implemented in the framework of the BioTrade2020plus project:

- Assessment of **sustainable potentials of lignocellulosic biomass** in the main sourcing regions outside the EU
- Definition and application of sustainability criteria and indicators
- Analysis of the **main economic and market issues of biomass/bioenergy imports** to the EU from the target regions
- Development of a dedicated and **user friendly web-based GIS-tool** on lignocellulosic biomass resources from target regions
- **Information to European industries** to identify, quantify and mobilize sustainable lignocellulosic biomass resources from export regions
- **Policy advice on long-term strategies** to include sustainable biomass imports in European bioenergy markets
- **Involvement of stakeholders** through consultations and dedicated workshops

More information is available at the BioTrade2020plus website: **www.biotrade2020plus.eu**

About this document

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SUMMARY

This report presents an overview of the selected countries for the Biotrade2020+ project. Six countries were selected initially to analyse in a general form the technical potential for production of biomass and possibilities to export it in different carriers to the EU. The countries selected are: Brazil, Colombia, Indonesia, Kenya, the United States and Ukraine.

This is the first step of a methodology developed between the partners of the project to assess in further steps the sustainable potential linked to the market and transport logistics.

The background information for the assessment is important to consider in the future specific case studies any initial hotspot or area of concern. This report presented an overview of each one of the selected countries with general data of population and GDP as well as some general information on the main economic activities and the current land use.

As a second step the report presents the current availability of biomass at national level. This biomass refers to agricultural residues, forestry residues, dedicated plantations and dedicated crops. A review of some sustainability issues including land tenure, social and working conditions and in some cases the current certification schemes used. This last case was more evident for those countries which are already exporting biomass in form of pellets to the EU.

Most of the countries present a high theoretical potential which was assessed either directly by calculation of the current production or through literature review. This potential will change and will be more realistic once the full methodology is applied to the specific case studies.

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ACRONYMS AND ABBREVIATIONS

EC	European Commission
EU	European Union
FAO	Food and Agriculture Organization
FFB	Fresh fruit bunches
FSC	Forest Stewardship Council
GDP	Gross Domestic Product
IEA	International Energy Agency
ILO	International Labour Organization
LHV	Lower Hating Value
OECD	Organization for Economic Cooperation and Development
RSPO	Roundtable on Sustainable Palm Oil
RPR	Residue Production Ratio
TPO	Timber Product output
UN	United Nations

1. Introduction

The trading of biomass has increased significantly in the last years. The International Energy Agency (IEA) forecasted an increased import of wood pellets to Europe from 2.3 million tons in 2010 to over 16 million tons in 2020 under a business as usual scenario, while a „high“ import scenario forecasted a total of 33 million tons by 2020 (IEA, 2011).

The areas considered to be main exporters to the EU included Russia, North America, Central and South America, West Africa and Mozambique (Birdlife, 2012).
Although the regions are considered in most studies (see IEA, 2011; Birdlife 2012; Cocchi et al 2011; Lamers et al, 2012) and different supply chains have been studied (Bradley et al, 2014) a general overview of the technical potential is still required in order to assess the sustainability potential and projections under different scenarios of these and added regions.

This report presents the general methodology followed to select the regions, the technical potential of current and future lignocellulosic biomass (agricultural residues, forestry residues and dedicated and biomass crops) as well as selected bioenergy carriers.

2. Methodology

The methodology chosen for the selection of the regions followed the overall general methodology (See report on methodology). The methodology is divided in three main areas: the selection of the regions, the considerations for the theoretical potential in each region according to selected feedstock and the overall background information of the regions.

The focus regions include the US, Ukraine, Brazil, Colombia, Indonesia, Kenya and Mozambique. The feedstock that will be considered are those which can produce different carriers such as wood chips, pellets, torrefied biomass and pyrolysis oil

The theoretical potential was calculated according to the availability of the selected feedstock and the residue production ratio identified in the literature as well as already calculated ratios and residues available.

The overall methodology is illustrated in Figure 1 an according to the general methodology the selection of case studies and their assessment include the technological, and market potential. sustainable potential (see report on methodology).

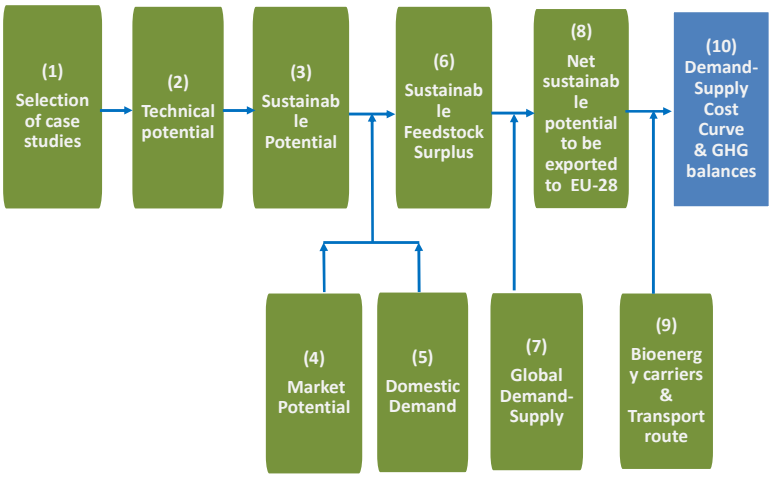


Figure 1. Overall methodology of the Biotrade2020+ project.

The background information for the selected countries helped to identify the regions in each country that were more promising for the availability of the feedstock but also that included some of the technological facilities (including transportation and other logistics). The information provided from the Advisory Board (AB) also contributed to better select the particular regions. Figure 2 shows the methodology and information followed in this report.

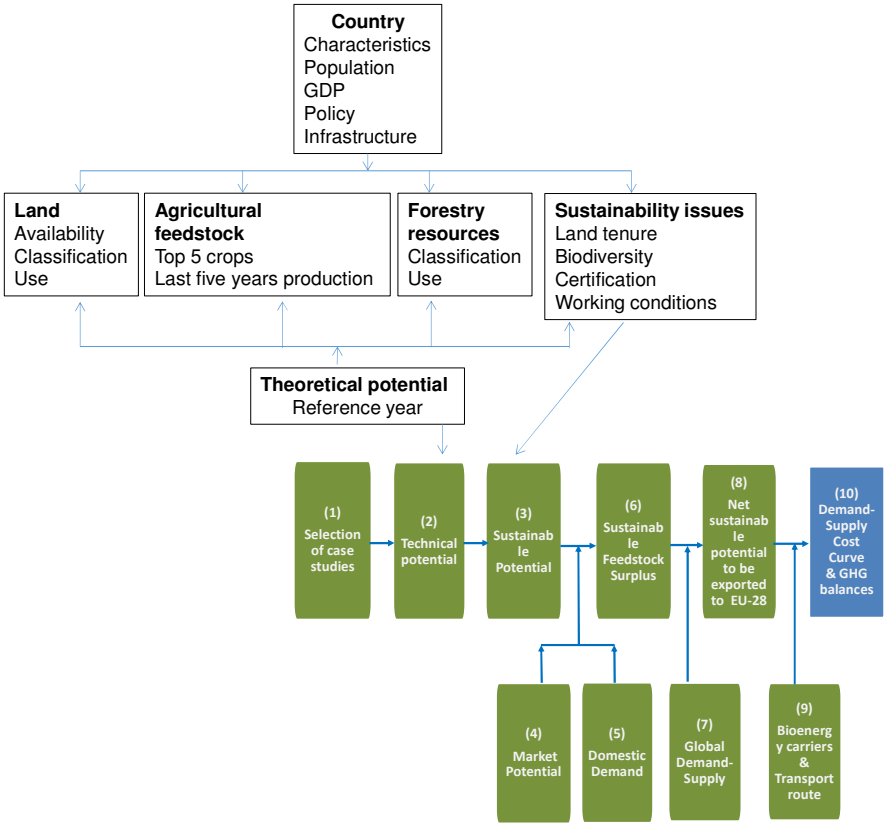


Figure 2. Methodology for selected countries and regions.

The following section presents the information collected for the selected countries and regions. This was based in literature review, partners' previous work in the selected countries and information provided by the Advisory board members.
The detailed information and technical, sustainability and market potentials along with scenarios, is included in the specific case studies as the information needed requires more detail and in some cases field work provided mainly by students working in the regions.
Additional socio-economic issues such as the willingness to harvest and the management of the forests, in terms of the use of the resources (e.g. recreational, conservation, market) are not discussed in this report but considered in the specific case studies.

The summary of the countries and feedstock potential presented in this report is shown in Table 1.

Table 1. Summary of countries and feedstock potential.

Country	**Feedstock**				
	Forest residues	**Agricultural residues**	**Forest plantations**	**Biomass crops**	**New forest plantations**
Brazil		√		√	√
Colombia		√		√	
Kenya		√	√	√	
Indonesia		√			
United States	√		√		√
Ukraine	√	√		√	

3. Selected supplying countries and regions

This section presents information about the selected countries and the theoretical assessment.

1. Overview of the country
    Land cover/land use and Land availability
2. Energy Mix
3. Main energy crops or residues
4. Sustainability issues
5. Policies
5. Technical potential for the reference year

The theoretical potential assessments vary from one country to another depending on the crops or selected residues (see Table 1). The assessment also varies and some have been taken from the literature including previous reports conducted in the region or country. A detailed assessment is presented in the Case Studies reports as explained in the methodology.

The baseline for the theoretical potential is considered 2012. For other data (e.g. crop production) the last 5 years were considered in order to assess the differences of crop production, either increasing or reducing. The residues are considered as primary residues (crops and forestry).
Countries are not presented in an specific order.

3.1 BRAZIL

3.1.1 Overview of the country

Population & Economy

Brazil is situated in South America (Figure 3). It is currently ranked the 7th strongest (or largest) economy in the world. It has a total population of 202,65 million of which 85% is urban and the rest rural population and an annual population growth rate of 1.02%.
The Gross Domestic Product (nominal exchange rate) in 2014 was $3.073 trillion with a $15,200 USD GDP per capita.The country has a large and well-developed agricultural, mining, manufacturing, and service sectors. Agriculture is a major sector of the Brazilian economy, and is key for economic growth and foreign exchange. Agriculture accounts for about 6% of GDP (25% when including agribusiness) and 36% of Brazilian exports. Brazil has one of the most advanced industrial sectors in Latin America (CIA, 2015).

Figure 3. Map of Brazil (US State Department, 2015)

The total area of the country is 8,511,965 sq. km. Figure 4 shows the area of each type of land use. The main environmental problems reported for Brazil include the deforestation in Amazon Basin as well as degradation and water pollution caused by improper mining activities; wetland degradation and severe oil spills (CIA, 2015).

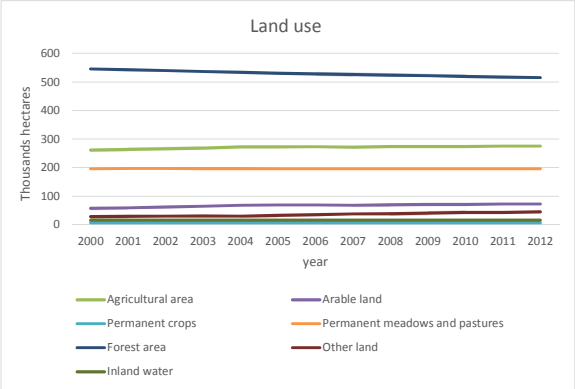


Figure 4. Classification of land use (FAOstats, 2015).

Energy sector

Nearly half of Brazil's energy comes from renewable sources compared to an average of less than 20 percent for the rest of the world. Sugarcane ethanol and bioelectricity produced from leftover fibers, stalks and leaves make sugarcane the largest source of renewable energy in Brazil (Sugarcane org, 2015). Sugarcane provides more than 15 percent of the country's total energy needs, second only to oil and ahead of hydroelectricity. Almost 40 percent of the country's gasoline needs have been replaced by sugarcane ethanol - making gasoline the alternative fuel in Brazil (Sugarcane org, 2015) (Figure 5).

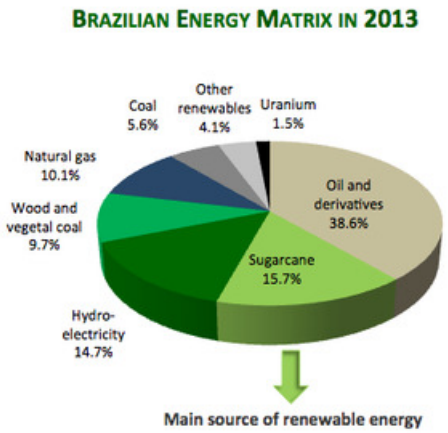


Figure 5. Energy Balance (UNICA, 2014).

From the total use of energy in Brazil in 2012 (253.4 Mtep), the main user was the industrial sector (35.1%), followed by the transport sector (31.3%), residential (9.4%), energy sector (9.0%), agriculture (4.1%), services (4.5%) and no-energetic (6.6%) (MME, 2013). The industry uses a total of 57% of renewables and from this, sugar cane bagasse provides 21.1%, charcoal 4.6%, vegetable oil 3.0% and woody biomass 8.4% (Figure 6).

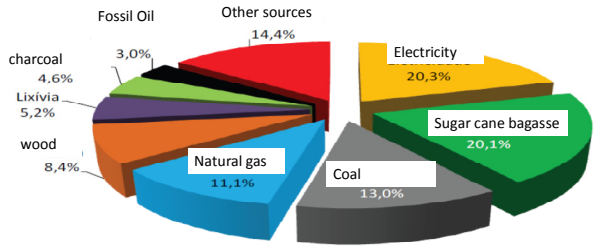


Figure 6. Industry use of energy (MME, 2013).

3.1.2 Bioenergy and Biomass

The biomass use for ethanol production and energy generation in Brazil is one of the most researched in the wold. Currently Brazil. The Ministry of Mines and Energy (2012) reported an increment of 1.7% in biodiesel production, mainly from soybean oil (70%). The sugar cane production was of 593.6 million tons, 4.9% higher than in the previous calendar year.

The energy production from biomass sources was of 43.6 Mtep from sugar cane biomass and 25.7 Mtep from woody charcoal.

The main agricultural crops with possibilities for using as biomass residues include those in Table 2.

Table 2. Main agricultural commodities in Brazil (FAOstats, 2015).

Agricultural commodity	Quantity (t)
Sugar cane	721077287
Maize	71072810
Soybeans	65848857
Cassava	23044557
Oranges	18012560
Rice, paddy	11549881

Figure 7 shows the national main crops' (including cocoa beans) production in has and tons in a time series years showing sugar cane as the man growth in tones while soybean is the main crop with an increment in hectares.

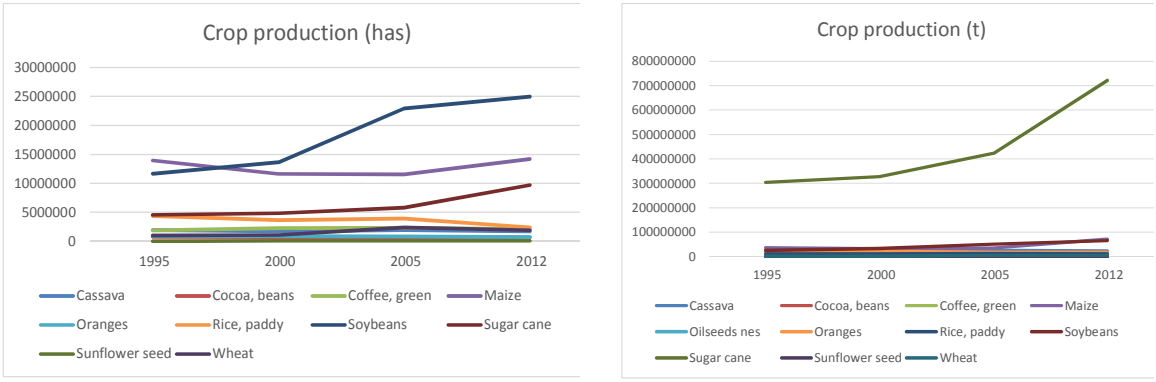


Figure 7. Main crops production in has and tones in Brazil in time series (Source: Faostats, 2015).

Considering the Residue-to-Product-**Ratios** (**RPR**) indicated by the FAO (1998) the estimated residues for selected crops is presented in Table 3.The selection of these crops considers the assessment of the biomass atlas for Brail, the consisten growth or increment shown in the last 10 years (as per Figure 7) and the possibility of producing carriers for these residues (e.g. pellets).

Table 3. Residue-to-product ratio (minimum and maximum) of selected crops at national level in Brazil (Data source: Faostat, 2015)

Feedstock	Type of residue	RPR (FAO) minimum	Tons	RPR (FAO) maximum	Tons
Sugarcane	Bagasse	0.1	72.11	0.33	237.96
Sugar cane	Tops	0.1	72.11	0.3	237.96
Soybeans	Straw	1	65.85	3.94	259.44
Maize	Stalk	1	71.07	4.33	307.75
Maize	Cob	0.2	14.21	1.8	127.93
Maize	Husk	0.2	14.21	1	71.07
Cassava	Straw	0.16	3.69	1	23.04
Rice	Straw	0.42	4.85	3.96	45.74
Rice	Husk	0.2	2.31	0.35	4.04

Nevertheless, the production at national level produces raw figures that still need to consider other issues from the methodology (Figure 1). For instance, soy residues (straw) need to be left on the soil[1] and rice residues are already under use for electricity generation[2]. Additionally, the assessment needs to focus on the regions where the feedstock is available and other logistics are considered (e.g. closeness to ports, industrial facilities.
For these reasons, the following regions are considered for the specific case study in Brazil: São Paulo, Minais Gerais, Paraná, Bahia, Espirito Santo, Rio Grande do Sul and Santa Catarina.

Forestry
The forestry resources in Brazil are considerable. It has approximately 463.2 milion hectares (54.4% of the country) of natural and planted forests, just second in the world after Russia. Of these 463.2 million hectares, 456.1 million hectares are native forests and 7.1 M hectares were plantations in 2012 (SNIF,2015).

Table 4. Composition of species in plantations in Brazil (SFB, 2013).

Species	**Scientific name**	**Area (ha)**	%
Eucalípto	*Eucalyptus* spp	5.102.030	71,00
Pinus	*Pinus* spp	1.562.782	21,75
Acácia	*Acacia mearnsii / Acacia mangium*	148.311	2,12
Seringueira	*Hevea brasiliensis*	168.848	2,36
Paricá	*Schizolobium amazonicum*	87.901	1,22
Teca	*Tectona grandis*	67.329	0,97
Araucária	*Araucaria angustifolia*	11.343	0,16
Populus	*Populus* spp	4.216	0,06
Others		33.183	0,12
Total		**7.185.943**	**100**

The two main species used are pine and eucalyptus. Figure 8 shows the distribution of these in the country.

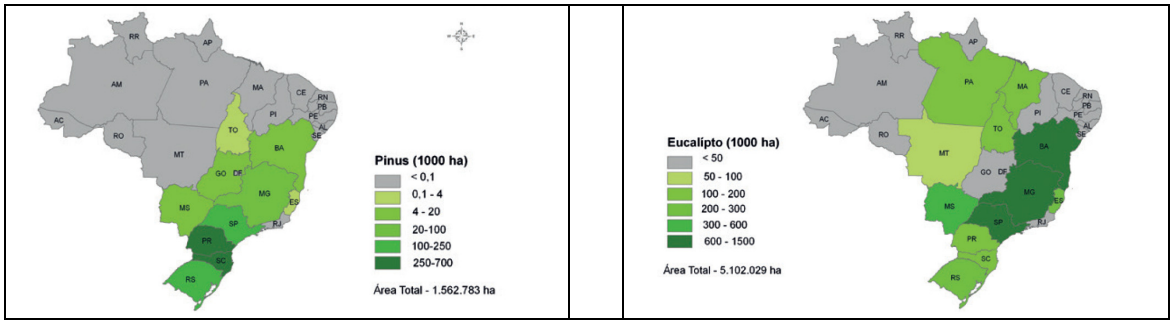


Figure 8. Distribution of pine and eucalyptus plantations in Brazil (SFB, 2013).

Furthermore, plantations have increased in Brazil in the last years. This has been due to environmental favourable conditions but also to better techniques for management, improved

[1] http://www.cnpso.embrapa.br/producaosoja/retencao.htm
[2] www.anee.gov.br

genetic seeds and cloning techniques. Figure 8 shows the growth in plantations from 2005-2012 and it is expected to continue growing.

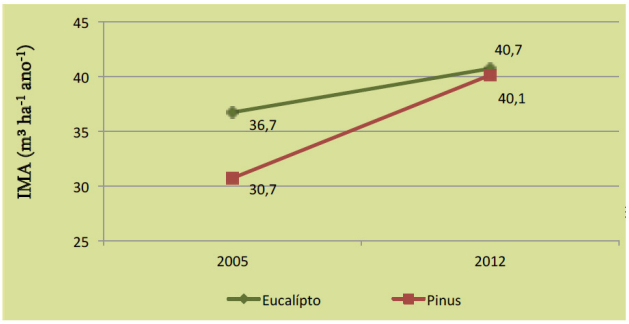
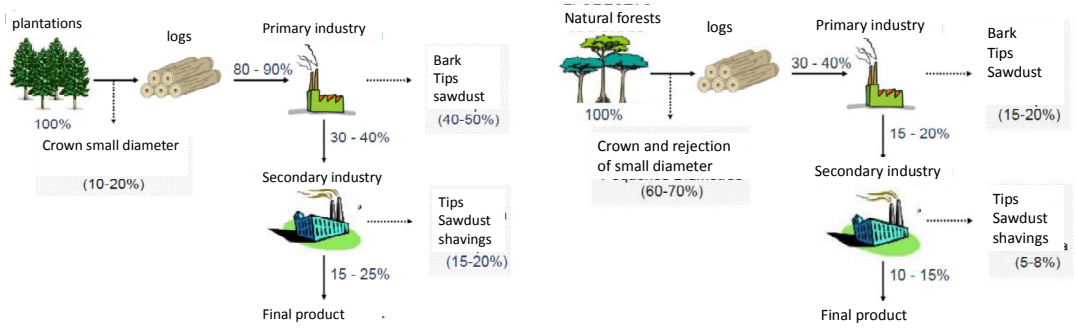


Figure 9. Growth in forest plantations in Brazil (SFB, 2013).

The forest sector produces 3.5% of the GDP in the country, equivalent to $37.3billion USD and 7.3% of the export products ($ 10.3 billion USD). From this figure cellulose is responsible for $4 billion USD, $4 billion for timber, other products $2.9 billion, furniture $1.05 billion USD and US$ $1.65 billion USD for charcoal used in the steel industry. It also generates 7 million jobs in the country (SNIF, 2015).

Residues production is considered to be 7% of the bark, 10% of sawdust and 28% of the cuts. The residues produced vary along the supply chain of the wood industry depending is they are from native forest or plantations. Figure 10 presents these differences in residues. It can be observed that in natural plantations the production in the field is higher than in plantations. Nevertheless, in the supply chain from plantations the total of residues is about 70-90%. From natural forests the generation of residues in the supply chain is about 60% and this is considered for the lack of proper management and irregularities of the plants (Bortolin et al, 2012).



a. Plantations b. Natural forest

Figure 10. Production of forestry residues in plantations (a) and natural forests (b) (Bortolin et al, 2012).

The residues of the forestry industry have different uses that include the production of small furniture, uses in farms (fences), boxes for fruit transport, energy and compost. Cerqueira et al (2012) cautioned that the amount produced could have negative environmental impacts and suggested the sector will benefit from better management.

Table 5 shows the production of residues and pellets in Brazil in 2014 while Figure 11 shows the production per month, region of origin in Brazil and main areas of export in Europe and the World (SNIF, 2015).

Table 5. Production of residues and pellets in Brazil in 2014 (SNIF, 2015).

Product	unit	Amount	Value in $USD
Wood pellets and other	T	6,993	3,459,840
Wood residues	m3	654	108,258
Total		7647	3,568,098

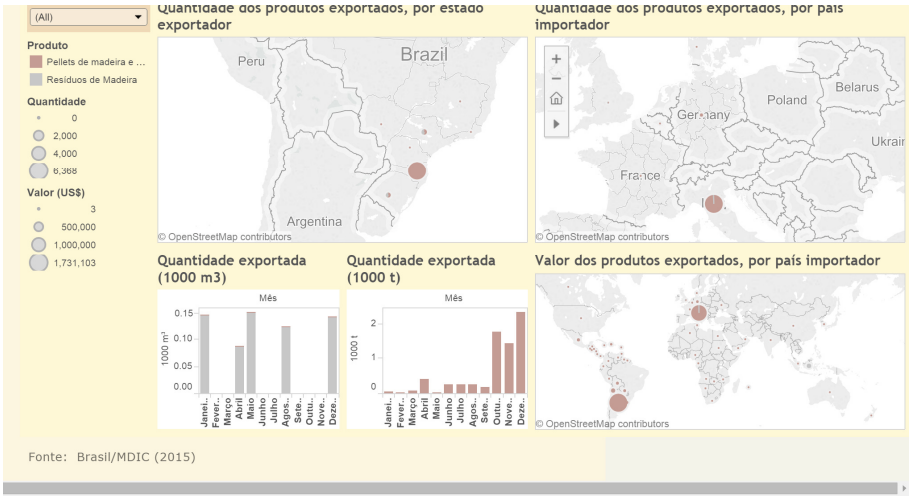
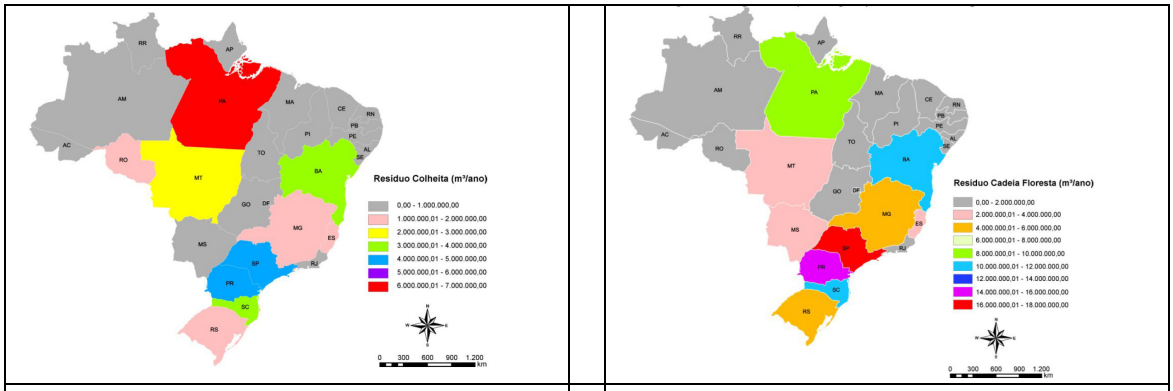


Figure 11. Production of pellets and residues in 2014 by month, origin and destination (SNIF, 2015)[3].

Finally, the production of residues is different per region. This depends on the type of species, the type of industrial sector, the type of machinery used among other issues (Bortolin et al, 2012). Figure 12 figure presents the differences in production of residues in the supply chain, mainly in the collection of the wood (logging) and secondly in the process (timber and other activities).



A B

Figure 12. Residues production in Brazil showed by region. A. at the field and B. during the process (Bortolin et al, 2012).

According to Bortolin et al (2012), residues production in Brazil in 2012 were of 87,840,218.78 m³. The region with more production was the South with a value of 31,609,453.07 m³ (35.99%), followed by the Southeast (25,811,178.43 m³ - 26.33%) and the North (11,341,445.23 m³ - 15.48%). Regarding

[3] http://www.florestal.gov.br/snif/producao-florestal/index.php?option=com_k2&view=item&layout=item&catid=14&id=246

the states, São Paulo is the one with the largest production 16,290,298.85 m³, followed by Paraná, Santa Catarina, Bahia, Pará and Minas Gerais. Although some residues cannot be used as it is referenced by CENBIO[4].

This classification has been used to select the states mentioned above that have possibilities for exporting material. As it can be observed from figures 11 and 12, Sao Paulo, Rio de Janeiro, Santa Catarina and Rio Grande Sul are not just producers of residues but also exporters to other countries.
The possibilities of this are due to their proximity to the Atlantic coast which also host harbors explained in the following section.

3.1.3 Sustainability Issues

Land Security

According to Bolanos (2014[5]), although Indigenous Peoples and local communities in Latin America legally own or control almost 40 percent of the region's forest, the lack of political will to clarify and safeguard these rights has created a tenure system with several conflicts mainly contesting land. Insecurity in local forest tenure not only endangers the welfare of the communities living in the forests but reduces their effectivity to safeguard these ecosystems.
Brazil hosts extensive forests, grasslands, and wetland ecosystems. Despite legal provisions to provide protection to an estimated 3.7 million square kilometers of public and private lands, there are significant human and development pressures on all of these areas. An estimated 1% of the population owns 45% of all land in Brazil. Nearly five million families are landless (USAID, 2012). A classification of different types properties

Biodiversity
Brazil is party to all the major international environmental treaties/conventions/protocols, a significant indicator of the country's sensitivity to biodiversity and conservation issues. The last report to the Convention on Biological Diversity (CBD) was in 2005.
More than 20 percent of Brazil is under protected area status (ten percent is a general internationally recognized standard), although it is unclear how much of these areas have formal and workable management plans. Ecofys (2010) noted that High Conservation Value areas (HCV) were known in the country and that steps were being undertaken to include them under Brazil's protected area system.

Food security

Brazil has improved the per capita food intake as well as reduced undernutrition in the last 10 years (see Table 6). Food production is growing as well. Brazil has made great strides in food security and nutrition governance over the last ten years, with laws and institutions that are the legacy of the Zero Hunger programme. Significant advances in poverty and hunger alleviation demonstrate the success of this intersectoral, participatory and well-coordinated approach (FAO, 2014).

[4] www.iee.usp.br/gbio
[5] http://www.landesa.org/commentary-series-part-ix-forest-tenure-security-for-long-term-security-against-deforestation/

Table 6. Food supply per capita (A) and prevalence of undernutrition (B) in Brazil (FAO, 2015).

A

Per capita food supply				
	Quantity [kcal/capita/day]			
	1996	2001	2006	2011
Food Supply	2840	2892	3096	3287

B

Prevalence of undernutrition				
	Prevalence [%]			
	1999-01	2004-06	2007-09	2010-12
Undernutrition	12	9	8	7

Social issues

The current state of the ILO conventions in Brazil is shown in Table 7. The ratification of conventions needs to be translated into the legal system of the country. Therefore a link to the enforcement of legislation is also in place and can be seen in Table 9 below.

Table 7. ILO Conventions and state in Brazil (ILO)

ILO Number	Name of Convention	Ratified
29	Forced or Compulsory Labour	√
87	Freedom of Association and Protection of the Right to Organise	N
98	Right to Organise and to Bargain Collectively	√
100	Equal Remuneration of Men and Women Workers for Work of Equal Value	√
105	Abolition of Forced Labour	√
111	Discrimination in Respect of Employment and Occupation	√
129	Inspection of Agriculture	√
138	Minimum Age for Admission to Employment	√
182	Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labour	√

Although progress has been made, the incidence of child labour in Brazil is still significant. Currently, child labour tends to occur mostly in the form of domestic service, family agriculture, commerce, and services in the urban informal sector (Chianca et al, 2011). According to USAID (2012), forced labor is a serious concern, exacerbated by the high concentration of land ownership. Forced labor is used in logging operations, alcohol and sugar refineries, and on large coffee estates (*fazendas*). Chianca et al (2011) reported a committee set up in Bahia considered that forced labour will continue to exist as long as it remains profitable.

In June 2009 the National Commitment for the Improvement of Labor Conditions in Sugarcane Production was launched by the Brazilian federal government, UNICA, the Federation of Rural Workers in the State of São Paulo (FERAESP), the National Confederation of Workers in Agriculture (CONTAG) and the National Sugar-Energy Forum to encourage and recognize best labor practices in the sugarcane industry (Ribas Chadad, 2010). Today 98% of all workers are fully documented and we estimate that forced labor may occur in 1% of the industry (personal communication UNICA).
An additiona l programme called RenovAction created by UNICA in partnership with the Federation of Rural Workers of the State of São Paulo (FERAESP) in 2009 aimed to train every year 7,000 workers from local communities in six sugarcane production areas in the state of São Paulo as a preparation for mechanisation in the sector.

Logistics

Roads for transport in Brazil are in general of good quality and connect the country across. The infrastructure for transport by sea is also of high importance having differences in sizes in different regions of the Atlantic coast.

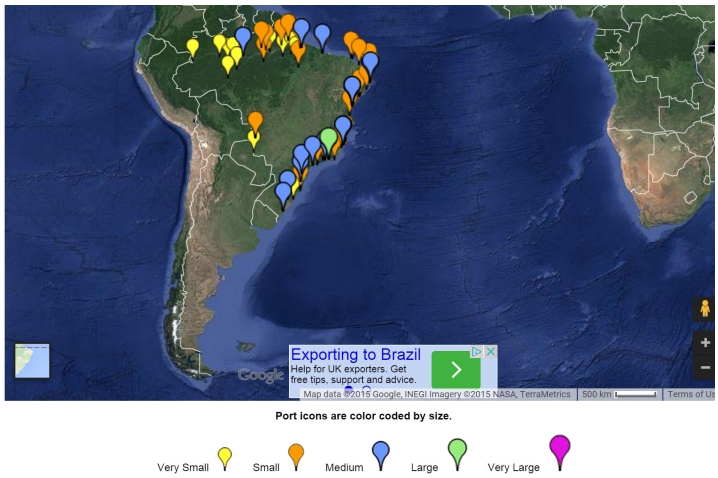


Figure 13. Main ports in Brazil (worldportsource, 2015)[6]

The Brazilian port system is administrated by the Secretariat of Ports of the Presidency (SEP-PR) of the Ministry of Transport. The SEP-PR is in charge of policies, programmes and support to the development of seaports. Out of the 34 public maritime ports under the management of SEP, 16 are administrated by state or municipal governments. The other 18 are controlled directly by the Dock Companies, which are joint stock companies, whose major shareholder is the Federal Government (Mello, 2012).
The main ports in Brazil for export are described in Table 88.

Table 8. Main ports in Brazil (Mello, 2012).

Port	State	Main export products
Porto de Santos (largets port)	Sao Paulo	sugar, soy, containerized cargo, coffee, corn, wheat, salt, citrus pulp, orange juice, paper, automobiles and alcoho
Porto Victoria	Espiritu Santo	steel products, soluble coffee beans, cocoa, cereals, marble and granite, iron, pig iron and bulk
Porto de Paranaguá (second largest)	PR	agricultural products, with emphasis on soybeans and soybean meal
Porto de Rio Grande	Rio Grande do Sul	are soybeans, soybean meal, wheat and rice
Porto de Rio de Janeiro	Rio de Janeiro	Iron ore, manganese, coal, wheat, oil and gas are the main products disposed.
Porto de Itajaí	Santa Catarina	wood, ceramic floors, machinery, sugar, paper and tobacco
Porto de São Sebastião	Sao Paulo	vehicles, parts, machinery and equipment, steel products and general cargo.
Porto de Itaqui	Maranhão	aluminum, copper, ethanol, pig

[6] http://www.worldportsource.com/ports/BRA.php

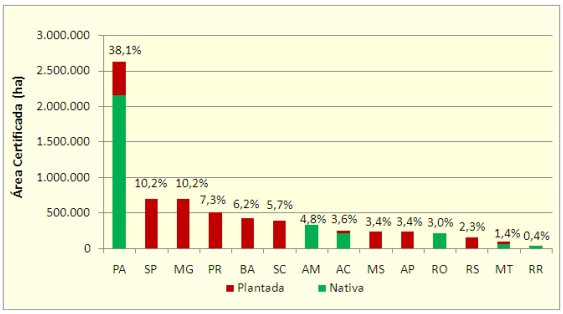
		iron, soybean meal, manganese ore and soybeans.
Porto de Aratu	Baía	transport gasoline, sulfur, ammonia, naphtha, fertilizer, copper concentrate and coal.

The state of the ports is variable but Mello (2012) referred to the state of rail system and other infrastructure surrounding the ports as some of the main problems regarding the exports infrastructure.

Certification

The Green Protocol: in June 2007 the São Paulo Governor and Secretaries of Agriculture and the Environment signed with UNICA the Agro-Environmental Protocol to promote sustainable environmental practices in sugarcane production and processing in the state.
Bonsucro and the Roundtable for sustainable biomaterial are other leading certification schemes used in Brazil.

Certification is used in Brazil with the FSC (Forest Stewardship Council Internacional/Brasil) and PEFC (Program for the Endorsement of Forest Certification Schemes) used more commonly.
Certification started in Brazil in 1994 with FSC first area certified in 1995. The other used certification system is CERFLOR since 2002 (Programa Brasileiro de Certificação Florestal) recognised and approved by PEFC (SNIF, 205). There are around 15 main certifiers in Brazil.



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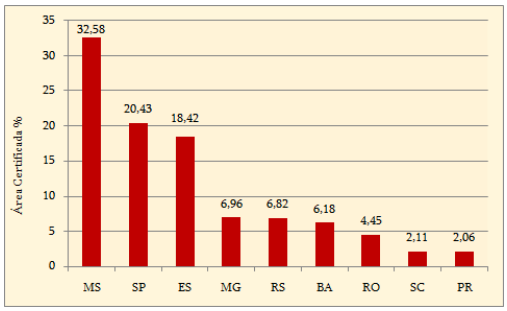

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Figure 14. Area certified under FSC (A) by type of forest and state and by CERFLOR (B) total certified area by state.

Until the end of 2012 there were 919 chain of custody certifications by FSC of wood products and 93 combined certifications of forest management and chain of custody by FSC which made an average of 7.2 million hectares of forest (3.9 M hectares of plantations, 3 M hectares of native forests and 300 thousand hectares of mixed forest management (SNIF, 2015). Until 2012, CERFLOR certified a total 1,463,308.35 hectares of forests, from which 65,078.37 ha de were native and 1,398,229.98 ha were plantations (SNIF, 2015) (see Figure 14). Other certification systems for other commodities exist such as BONSUCRO (sugar cane), ICCT, RTRS (soy), among others.

3.1.4 Policy

A report produced for the European Commission reviewing the baseline in 2008 for biofuels production reviewed the policy and regulations in Brazil. There were available environmental legislation in Brazil includes 257 laws, written in Portuguese and around 150 laws were relevant for

biofuels and about 54% of the relevant laws have a national coverage. Most of these laws are also relevant for solid biomass particularly in the feedstock production as can be seen in Figure 15.

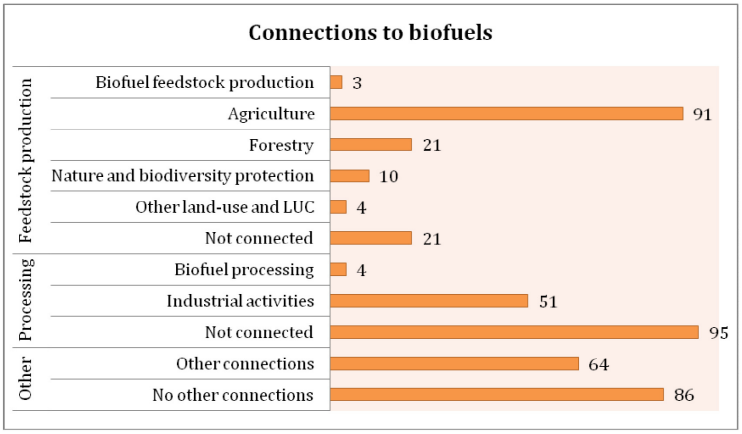

Figure 15. Connections between environmental legislation and biofuels in Brazil (Ecofys, 2010).

In regards to the share of sustainability issues related to the RED (as a reference), several Laws in Brazil also include some of these aspects as can be seen in Figure 16.

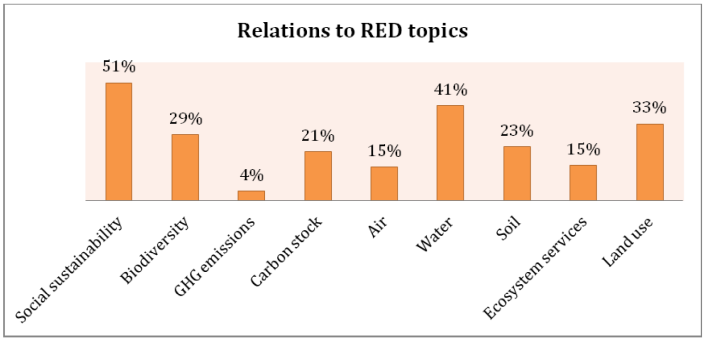

Figure 16. Share of Brazil's biofuel related legislation that consider each RED topic (Ecofys, 2010).

In 2008, the Sao Paulo State set up the Agroenvironmental Planning Map in a partnership between the Environmental and the Agricultural Secretariats of São Paulo State (ZAA) . The objective of the Plan is to organise the expansion of the sugar cane and energy sector as well as subsidie public policies related to this sector (SMA, 2015).

For the Biotrade2020 project, forestry regulation is of high relevance. This is where most of the changes in policy have occurred in Brazil. Particularly the forestry legislation which was updated in 2012 and is known as the New Forestry Code. It has new reforms mainly in environmental issues regarding the zoning and activities permitted but also some social issues regarding the benefits of managing and using forests (

The report of Ecofys showed the main indices used to demonstrate how compliance with legislation in Brazil is managed in the practical sense. The results are from 2010 and they will need to be reviewed in the case study report for Brazil.[7]

[7] http://www.brasil.gov.br/meio-ambiente/2015/05/novo-codigo-florestal-completa-tres-anos; http://pt.wikipedia.org/wiki/Novo_C%C3%B3digo_Florestal_Brasileiro

Table 9. Compliance with legislation indices for Brazil (Ecofys, 2010).

Indicator	Score	Description
CPI - Corruption Perception Index	3.7 / 10	Corruption is perceived medium
GII – Global Integrity Index	76 / 100	Anti corruption framework is moderate
ID – Index of Democracy	7.1 / 10	Classified as "flawed democracy".
EI - Enforcement Index	6.1 / 10	Potential to enforce legislation is intermediate
RLI – Rule of Law Index		Not reported

3.2 COLOMBIA

3.2.1 Overview of the country

Population & Economy

Colombia had a population at 48.32 million in 2013 with a 1.3% annual growth (World Bank, 2013). Its GDP in 2013 was USD$378.1 billion with a 4.1% 5-year average growth. The country is heavily dependent on its rich natural resources such as petroleum, coal, natural gas and a variety of precious metal such as gold and platinum (Paiyi, 2009). The country is divided in 32 departments (Figure 17) and one capital district, Bogotá. Bogotá is also the capital of the department of Cundinamarca (Fields, 1980).

Figure 17. Map of the 32 departments in Colombia. (Source: Wikipedia)

Land Use

Colombia is a large country with diversified characteristics in terms of climate, soil, geology, topography, vegetation cover and current land use which forms the basis for six regions. It has a total area of 114 million ha, of which approximately 50% is covered with forest (Castiblanco et al, 2013), as shown in Figure 18. Colombia is one of the most mega-diverse countries worldwide (Dias, 2003). With only 0.77% of the world's land area it contains 10% of its known species (IDEAM, 2004). About 90% of its non-agricultural land is protected area. The main agricultural activities of Colombia are coffee, dairy, sugar, bananas, flowers, cotton and cattle (NL Agency, 2013). However, Only 9.6% or 4.1 million ha of agricultural land is used for crops. Annual crops represented 33% of the cultivated area, whereas permanent crops and plantations accounts for 59%, the rest 8% was fallow land (Figure 19). The most extensive land use is cattle grazing which accounts for over 70% of the agricultural land, usually exhibiting low productivity levels (McAlpine et al., 2009).

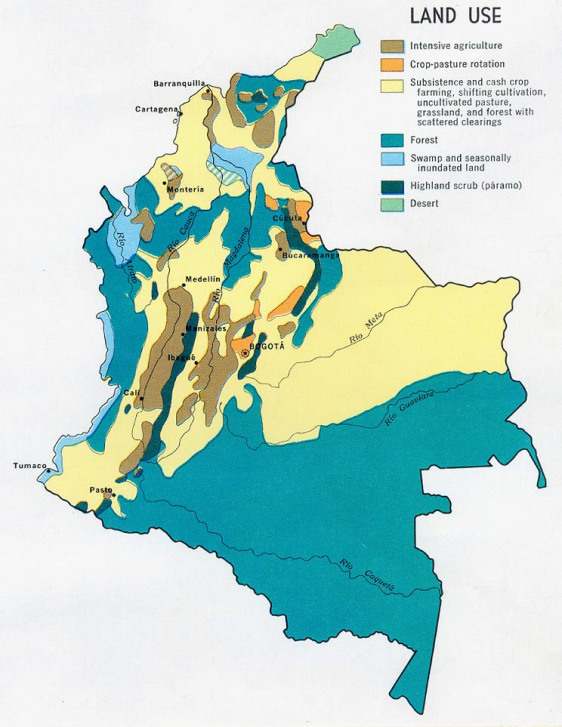

Figure 18. Land use in Colombia (Source: Colombia Environmental Minister, 2014)

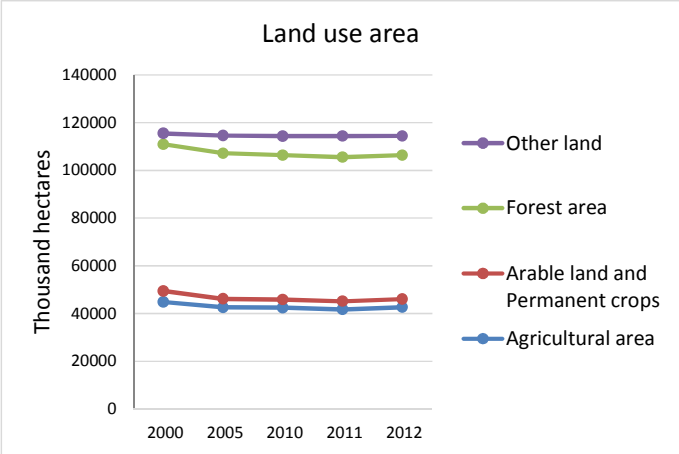

Figure 19. Land use area of Colombia. Source: FAOstat, 2015.

Energy Sector

The power market is liberalized in Colombia. In 2012, Colombia's energy capacities installed, which is shown in Figure 20 consists of 64% large hydroelectricity, 17% natural gas, 7% Oil, 7% Coal and 5% renewables. In the remote areas, where conventional power generation is more expensive, many diesel 'mini-grids' are under operation, which aims at an increase in renewable energy usage to 20% by 2015, and 30% by 2020 locally. On the other hand, as a country rich in fossil fuel resources, Colombia also exports large amount of net power, including coal, oil and natural gas to countries worldwide .

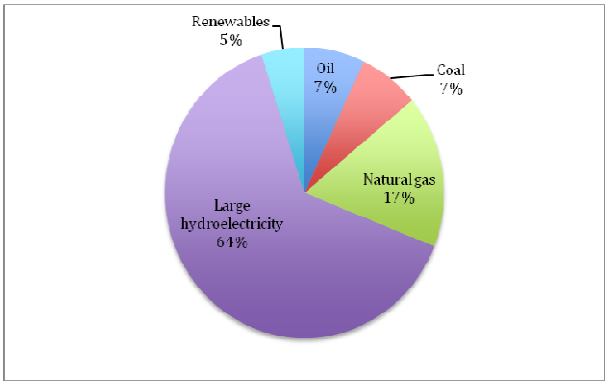

Figure 20. Energy sources in Colombia, 2012 (Source: BNEF)

3.2.2 Bioenergy and Biomass

Colombia is among the region's leading biofuels producers, it produced 324.7 million litres of ethanol and 173,043 tonnes of biodiesel in 2009 using sugar cane and palm oil as their main feedstock (NL Agency, 2013). The biofuel industry generates an estimated 24,000 direct and 48,000 indirect jobs (NL Agency, 2013). Sugarcane and palm oil were commercially introduced to Colombia since the early 1900s. As one of the highest yield countries in the world, each of the crops contributes to approximately 4% of the GDP in the agricultural sector. Furthermore, current land use for bio-ethanol production only accounts of 405,737 ha (FOA stats, 2014) whereas the Ministry of Agriculture and Rural Development (MARD) estimates the area with potential for sugarcane production at 3.9 million ha. Hence, solid biomass residues produced from the sugarcane and palm oil processing industry, along with other agricultural and forestry residues present a great potential for domestic energy generation and export. Table 10 shows the main agricultural and forestry residues produced in Colombia and their feedstock will be assessed further.

Table 10. Main biomass feedstock available in Colombia (MARD, 2014)

Type of feedstock	residues
Oil Palm	EFB, fibres, shells
Sugarcane	Bagasse, leaves
Rice	Husk, straws
Coffee	Husk
Livestock	Manure
Forestry	Residues, fuel wood, pellets

Oil Palm

The milling process of the oil palm fruit in Colombia is one of the most important generators of biomass per cultivated hectare comparing to other oil or bioenergy type crops. In 2013, with its 51 palm oil mills and a productive area of 250000 ha around the country, Colombia produced about 5 Million tonnes of fresh fruit bunches (FFB) at a yield of 19.965 tonnes per ha. It generates 945.064 kilotonnes of raw palm oil and 224.427 kilotonnes of kernel (Table 2) (FAOstat, 2014). In addition, it is estimated that about 100,000 ha of additional land are cultivated for palm oil between 2008 and 2013 (Table 10). Details of this land transition are not known. However, pastures, croplands and lands for natural vegetation can be replaced from previous years experiences (McAlpine et al., 2009). Despite this land change, in 2010 oil palm sector generated 2.6% of the agricultural GDP with its plantation area only occupied less than 1% of the total agricultural lands (FEDEPALMA, 2011).

Oil palm plantations are located in four zones in 2008, north, central, eastern and the western zones, shown in Figure 21. The eastern zone has the most plantations, which contributes to 39.1% of total plantation area, followed by 28.5% in north, 28% central and 4.5% in west zones (FEDEPALMA, 2011). However, the plantation area in western zone mainly occurred in areas that were previously forested (Seeboldt and Salinas, 2010). Furthermore, poor infrastructure, armed conflicts, and the existence of collective territories of Afro- Colombian communities have limited the development of the oil palm industry in this region (Seeboldt and Salinas, 2010; BID-MME, 2012).

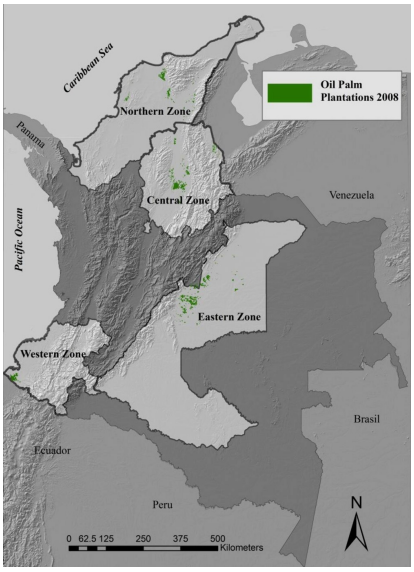

Figure 21. Location of oil palm plantation areas in 2008, and plantation zones in Colombia as defined by FEDEPALMA.

Given the increase in palm oil plantation and production, availability of considerable amounts of by-products of high energy value such as EFB, fibres, shells and POME means that the oil palm industries has a possibility of generating electricity in isolated regions and exporting its biomass as energy sources (Table 11)(Garcia et al, 2010). The percentage availability of palm oil residues per tonne of FFB in Colombia, provided by interviewee from Cenipalma is listed in Table 12. It is shown that 20-23% EFB, 11- 14%fibre, 5-7% shell and 65-85% POME can be produced in each tonne of FFB. Hence, the potential available palm oil residues in 2013 is between 7.19- 5.04 million tonnes, or 2.20- 1.80 million tonnes of solid biomass (excluding POME), shown in Table 13, these results are proportionally in line with literature value from 2010 (Garcia et al, 2010).

Table 11. Palm oil cultivated area and production data from 2008 to 2013 (Source: Garcia et al, 2010).

Catalogue	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Cultivated area of palm oil (ha)	165000	165000	165000	230000	230000	250000
FFB yields (hg/ha)	193939	193939	187879	200600	203081	199650
FFB production (tonnes)	3200000	3200000	3100000	4613805	4670860	4991241
Oil, palm (tonnes)	777800	804838	753039	804838	753039	945064
Palm kernels (tonnes)	179000	179341	174327	212244	215504	224427

Table 12. Percentage Availability of biomass residues and effluents from palm oil mills in each tonne of FFB in Colombia (Cenipalma personal communication, 2014).

Country	FFB %	EFB (% in FFB)	Fibre (% in FFB)	Shell (% in FFB)	POME (% in FFB)
Colombia	100	20-23	11-14	5.0-7.0	65-85

Table 13. Maximum and minimum amount of palm oil residues estimated for 2013 (Cenipalma personal communication, 2014).

	FFB	**EFB**	**Fibre**	**Shell**	**POME**	**Total**
Max (tonnes)	4991241	1,147,985	698,774	349,387	4,991,242	7,187,388
Min (tonnes)	4991241	998,248	549,037	249,562	3,244,307	5,041,153

Sugarcane

The Cauca River valley in Southwest Colombia is the major sugarcane production region (about 200,000 ha in 2006). This region concentrates the best cultivable lands for sugarcane cropping with its soil richness and sufficient water availability. Five ethanol production plants in large sugar mills are currently operating (Quintero et al, 2008). As shown in Table 14, the cultivation area of sugarcane increased from 383388 ha in 2008 to 405737 ha in 2013, as yields vary each year, the production of sugarcane varies from 36.7 million tonnes to 32.3 million tonnes.

Generally, 1 tonnes of sugarcane generates about 308.6 kg of bagasse (Cardona et al, 2010) and similar amount of leaves (NL Agency, 2013). As shown in Table 15, the amount of bagasse produced in 2010 is 8,478 kilotonnes. Hence, total sugarcane residues including bagasse and leaves can be estimated at about 16 million tonnes, which is in line with the value from literature (NLAgency, 2013).

Table 14. The cultivated area, yields and sugarcane production from 2008 to 2013. Source: FAOstats, 2014.

Year	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Cultivated area (ha)	383388	379505	348531	381961	408816	405737
Yields (hg/ha)	842489	967049	955439	913435	816102	859580
Sugarcane production (tonnes)	32300000	36700000	33300000	34889673	33363560	34876332

Table 15. Bagasse produced from sugarcane between 2005 and 2010. (UN, 2014)

Year	**Bagasse (1000 tonnes)**
2010	8,478
2009	9,712
2008	6,638
2007	10,570
2006	10,566
2005	9,599

Apart from its palm oil and sugarcane production, Colombia also has large plantation areas for rice and coffee, of which their residues can be used as biomass for energy generation. Both rice and coffee residues consist high cellulose and hemicellulose content and low moisture content. For every ton of coffee beans produced, approximately 1 ton of husks are generated during dry processing, whereas for wet and semi-wet processing this residue amounts to more than 2 ton (Saenger et. al., 2001). For rice husk, every ton of paddy produced, generates about 750 kg of rice straw and 250kg husk (Gadde et al, 2009). Hence, in 2013, 2,434,853 tonnes of rice were produced with 1.217426 million tonnes of rice residues, whereas 464,640 tonnes of coffee beans were produced with an estimation of same amount of husk (Table 16).

Table 16. Total production of rice, rice residues, coffee and coffee residues in 2013. *total straw available excluding the 2⁄3 left on land as soil fertilizer (European standard). (Gadde et al, 2009).

Rice paddy (tonnes)	Rice straw (tonnes)	Rice husk (tonnes)	Coffee beans (tonnes)	Coffee husk (dry tonnes)
2,434,853	1,826,139.75	608,713.25	464,640	464,640
Total residue	1,217,426 tonnes*		464,640 tonnes	

A summary of the residues from feedstocks with possibilities to be used for carriers to export to Europe is presented in Table 17. The Atlas produced in Colombia focuses in three different types of residues: agriculture, livestock and urban waste. Figure 22 shows the yearly production of agricultural residues by municipality.

Table 17. Summary of the agricultural residues produced in Colombia (Escalante et al, ny).

Cultivo	Producción [1] [t/año]	Tipo de residuo	Origen del residuo	Factor de residuo [2] [$t_{residuo}/t_{producto\ principal}$]	Masa de residuo [t / año]	Potencial energético [TJ / año]
Palma de Aceite	872.117	Cuesco	RAI	0,22	189.074	2.627,44
		Fibra		0,63	546.381	6.778,89
		Raquis de Palma		1,06	924.618	6.607,31
Caña de Azúcar	2.615.251	Hojas - Cogollo	RAC	3,26	8.525.718	41.707,22
		Bagazo	RAI	2,68	7.008.873	76.871,65
Caña Panelera	1.514.878	Bagazo	RAC	2,53	5.680.790	62.305,56
		Hojas - Cogollo	RAI	3,75	3.832.640	18.749,01
Café	942.327	Pulpa	RAI	2,13	2.008.192	7.206,79
		Cisco		0,21	193.460	3.338,57
		Tallos	RAC	3,02	2.849.596	38.561,52
Maíz	1.368.996	Rastrojo	RAC	0,93	1.278.642	12.573,18
		Tusa		0,27	369.629	3.845,88
		Capacho		0,21	288.858	4.383,73
Arroz	2.463.689	Tamo	RAC	2,35	5.789.669	20.699,41
		Cascarilla	RAI	0,2	492.738	7.136,53
Banano	1.878.194	Raquis de banano	RAC	1	1.878.194	806,31
		Vástago de banano		5	9.390.968	5.294,27
		Banano de rechazo	RAI	0,15	281.729	495,34
Plátano	3.319.357	Raquis de plátano	RAC	1	3.319.357	1.425,00
		Vástago de plátano		5	16.596.783	9.356,64
		Plátano de rechazo	RAI	0,15	497.903	875,43
TOTAL	14.974.807				71.943.813	331.645,71

RAC: Residuo Agrícola de Cosecha RAI: Residuo Agrícola Industrial

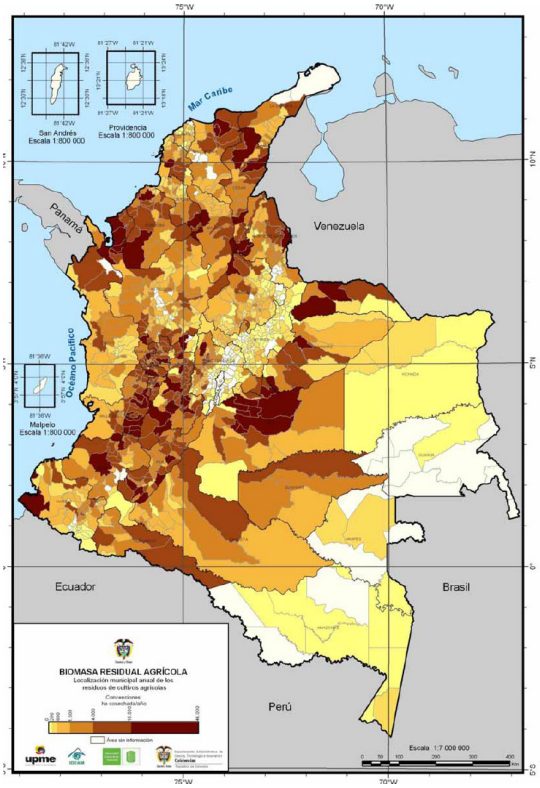

Figure 22. Municipalities with agricultural residues production per year

From Table 17, it is possible to see that sugar cane and palm oil have the best possibilities for using residues. The following figures show the results of the Atlas Analysis regarding the location of these residues. Figure 23 shows the municipalities producing residues of sugar cane.

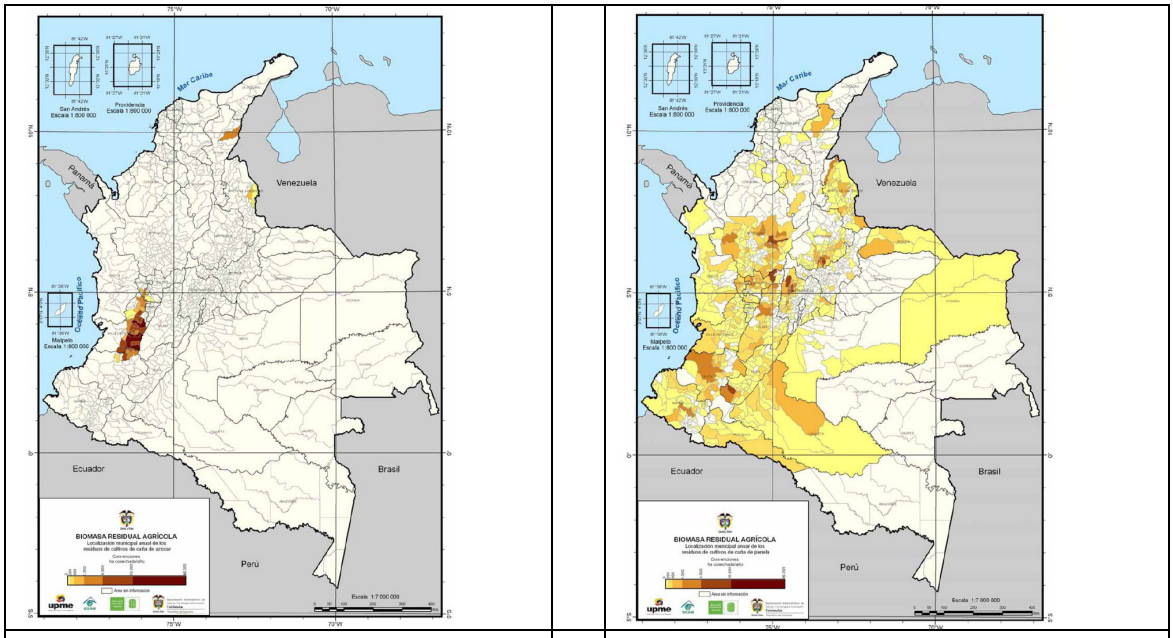

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Figure 23. Municipalities' annual production of residues of sugar cane.

Forestry

Although more than half of the country's land is covered by forests, most of them are protected areas with diversity of animal and plant species. Hence, Colombia presents limited potential for forestry biomass compared to other types of biomass. The amount of forest residues and products produced in 2013 is presented in table 18. It shows that chips and particles and charcoal are the main products in the country.

Table 18. The amount of different type of forestry products produced in Colombia, 2013.

Type of forestry products	Amount
Chips and particles (m3)	227,000
Wood Fuel(C)(m3)	2,236,000
Wood Fuel (NC)(m3)	6,068,000
Wood Residues (m3)	61,000
Wood Charcoal (m3)	315,805

Another alternative in Colombia is the residues of bamboo. Bamboo although it forms forests, in Colombia is included in the Environmental Ministry rather than in Agriculture and Forestry. A report by ECN (Daza et al, 2013) estimated the residual guadua-biomass potential in Colombia (Table 19). Although the potential is considerable, torrefaction would need to be implemented to produce pellets as carriers rather than chips. This could be a possibility after 2020.

Table 19. Residual guadua-biomass potential

Natural stands	Hectares	kton/year	MWth
National	51,000	765	480
Coffee axis	28,000	420	260

Apart from the exploitation of *G. angustifolia* stands, an alternative scenario is the establishment of bamboo plantations as dedicated bioenergy crops. As for the coffee axis, when the total area with potential for high productivity is considered (125,000 ha)

3.2.3 Sustainability Issues

Land rights

Land in Colombia is classified as state property owned by the nation; private property owned by individuals; and communal land, which is possessed by indigenous groups, Afro-Colombian communities, and cooperatives or groups of urban dwellers (UN-Habitat 2005)

In general, land security in Colombia is facing some problems:

- Inequitable land distribution in Colombia

More than 68% of the rural population lives below the poverty level, whereas 0.4% of the population owns 62% of the country's best land. In order to solve this inequity and protect the rights of tenant farmers, the Government of Colombia (GOC) has attempted land reform programs throughout the time, from 1936, when the first reform law, law 200 was passed (Grusczynski and Jaramillo 2002). However, internal corruption and the lack of capacity to implement changes have resulted in little success (Elhawary 2007). Land rights have been one of the main concerns regarding social sustainability in the production of bioenergy crops, particularly in developing countries where

communal land is available. For the case of Colombia there have been reports on the problem of forced displacement of rural communities especially for the cases of palm oil[8], [9]. The new Law for Victims of Displacement seeks the restitution of land to those displaced by conflict and support the legal use and tenure of land. Some of this areas require the implementation of agricultural projects where small holders can participate. (Daza et al, 2013).

Colombia has one of the highest rates of internal displacement in the world. There are over 3 million officially registered Internally Displaced Persons (IDPs), 5 million estimated by NGOs. In some cases, combatants have displaced communities in order to utilize the land for commercial agriculture. Overall, approximately 4 million hectares of land have been abandoned and rural population is as small as 26% (UN-Habitat 2005). Although the number of newly-displaced IDPs has decreased significantly in recent years, the continued displacement of people indicates the persistence of rural violence. At the same time, people who are displaced from rural areas fled to urban areas where as residents of informal settlements, they largely lack formal tenure as well as access to basic services (USAID, ny).

Within the biomass sector, land rights issues occurs in the oil palm sector when oil palm plantations have been located in regions with persistent intensification of the armed conflict and with problems of illegal redefinition of rights of land ownership (Seeboldt and Salinas, 2010). In addition, in the major sugarcane plantation region of Cauca River valley, it is said that industrial sugar cane cultivation and transnational mining activities are causing social and environmental conflicts related to water and access to land, where air contamination from burning, water pollution caused by chemicals, water and soil depletion and forced displacement take place (LAR, 2014).

Biodiversity

Colombia is listed as one of the world's "megadiverse" countries, hosting close to 14% of the planet's biodiversity (CBD, 2013). According to WWF (2013), the main pressures affecting land biodiversity in Colombia include growing population, infrastructure development, inadequate use of resources, over-harvesting, illegal logging in coastal tropical rainforest, erosion and social and cultural conflicts (Daza et al, 2013; Diaz-Chavez et al, 2013). Other activities such as the projected expansion of industrial-scale agriculture (e.g. oil palm and rice cultivation) and extensive cattle ranching pose a threat to the Orinoco Basin. Colombia has a National Nature Parks System that has consolidated the conservation of more than 10 million acres, corresponding to 10% of the national territory. All ecosystems are represented within this protected area network, where dry forests and savannahs are the least abundant (CBD, 2013).

Food Security

As one of the most important indicators, food security issues has been widely discussed in the biomass sector. For instance, Castiblanco et al (2013) stated that 20% of new oil palm plantations in Colombia has replaced agricultural lands, particularly areas that were previously used for the production of rice, banana and mixed agriculture. Perez (2011) and Infante and Tobó (2010) point to the likely increases in land, labour wages and agricultural input prices, which displace subsistence crops to more marginal lands and impact on local food prices and food security.

Staple food in Colombia consists of maize, potatoes, plantain and beans. The variation of their cultivation area, production and imported amounts between 2008 and 2013 are shown in Figures 24-26. Although production of maize fluctuates with its cultivation area extremely every year, its

[8] http://www.javeriana.edu.co/Facultades/C_Juridicas/pub_rev/documents/03-LAPROTECCIONDELAPROPIEDAD_000.pdf
[9] ww2.**unhabitat**.org/programmes/**landtenure**/documents/ColumbiaFinal.doc · DOC file

imported amount dropped dramatically from 2008. Production of other crops all presented a decline with slight decline in cultivated area. Wheat production and cultivated area declined the most, at about 80% reduction. The reasons are varied including floods, land displacement and a policy focusing more in maize production (IFPRI, 2015). However, imported amounts of all staple food show stability with slight increase, excluding maize.

To conclude, since Colombia is still relying on importation for its domestic staple food supply, cultivation area of these crops should be kept or even increased, as increasing population could boost demand. In addition, as importation can result in price violation and increased market vulnerability, increasing import is not the best solution for resolving food security issues. Alternatively, yields can be increase as technology evolves and marginal lands or degraded lands can be used for non-food plantation.

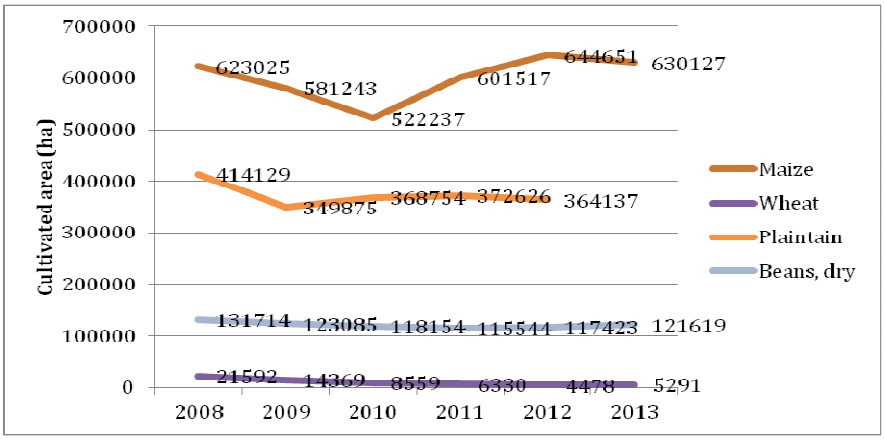


Figure 24. Area cultivated for staple food crops in ha from 2008 to 2013. Source: FAO

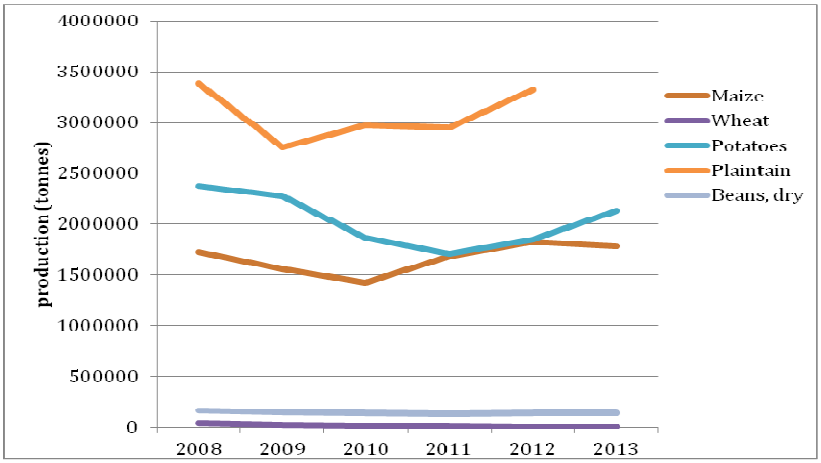


Figure 25. Production of staple food crops in tonnes, from 2008 to 2013. Source: FAOstat, 2014

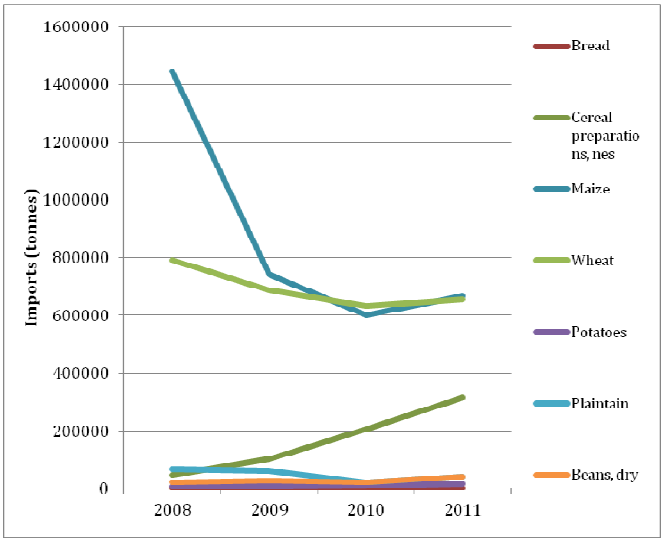


Figure 26. Imports of staple foods and bread from 2008 to 2011. Source: FAOstat, 2014.

Social issues

Labor Conditions

Labor rights in Colombia are set forth in its Constitution, the Substantive Labor Code, the Procedural Code of Labor and Social Security, sector-specific legislation, and ratified international conventions, which are incorporated into national legislation. All labor laws apply to the country's 15 export processing zones with no additional laws or exemptions (US 2005)

Child labour

Colombia has ratified both convention 138 and 182 regarding the abolition of child labour.

The current minimum employment age in Colombia is 15 years, based on the Code of Childhood and Adolescence (DNP, 2006). Children under age 15 may receive permission from the Labor Inspectorate to work for pay in artistic, cultural, recreational or sports-related jobs, up to 14 hours per week. Approximately 10.4 % of children ages 5 to 14 were estimated to be working in 2001 in Colombia (reference). The majority of working children were found in the services sector (49.9 %), followed by agriculture (35.6 %) and manufacturing (12.6 %). The ICBF estimates that about 80 percent of working children work in the informal economy.

Discrimination & Gender Equity

Colombia has ratified convention 100 on Equal remuneration and convention 111 on Discrimination. Despite reasonable legal provisions, in practice, women have less access to quality employment such as managerial positions, receive lower wages especially in rural areas, and are less protected at the workplace (DNP, 2006; Viafara, 2007; ILO, 2007).

Indigenous persons are also subject to discrimination in Colombia (reference). Ethnic minority Afro-Colombian, palenquera, and raizal populations experience greater levels of poverty, marginalization, and social vulnerability due to their limited access to the labor market (Grueso, et al, 2007) this is largely owing to the fact that ethnic minorities such as the Afro-Colombians may be discouraged from higher educational achievement because they experience greater disadvantages than do non-minorities in accessing technology, developing specialized labor skills, and fully integrating into the labor market (Grueso et al, 2007).. To resolve this issue, the Office of the UNHCHR has engaged in

advisory, support and exchange activities with representatives of civil society and NGOs in the area are making huge effort in improving the situation (UNHCHR, 2007). However, in rural areas, the unemployment of Afro-Colombians (17.6%) is lower than non-Afro-Colombians (15.2%), whereas in urban area the opposite situation takes place.

Right to Organize and Collective Bargaining

Colombia has ratified the ILO core Conventions on the Right to Organize and Collective Bargaining and on Freedom of Association and Protection of the Right to Organize. However, the right to strike and the right to collective bargaining are restricted in particular for public sector workers and there are also limitations in the private sector (ILO, 2007).

Forced Labour

Colombia has ratified both ILO core Conventions on forced labor. However, its current system of legal treatment of trafficking cases is inadequate and the prosecution of such cases is difficult (IOM, 2006; US Embassy 2007; US, 2007).

Within the biomass sector, the synergies of the sugar sector, controlled by a few economic groups, have not allowed achieving a great impact upon the creation of new rural jobs.

3.2.4 Policy

Colombia has implemented three policies regarding renewable energy by 2012 (BNEF, 2014), these are:

- A biofuel mandate, which targeted at 10% biodiesel blend with conventional diesel and 10% ethanol blend with conventional gasoline.
- A clean energy target, which aims at a 3.5% on-grid and 20% off-grid generation from renewable sources by 2015. This is already fulfilled.
- Tax breaks for sales from alternative energies (wind and biomass resources) for 15 years. For this exemption, generators are required to hold carbon emissions certificates and to invest fifty percent of the certificates in social infrastructure projects (Law 788 of 2002) (GTZ, 2002).

However, Colombia's level of clean energy investment is relatively week among all Latin American countries. It attracted $1.2 billion in renewable capital from 2006 to 2012, but little of that came in the last few years. Most of them went in to small hydro and biomass projects. Despite that, Colombia is ranked highly in metrics related corporate awareness of greenhouse gas management by BNEF

Other policies regarding air, water, soil, conservation areas and forestry are in place in Colombia. Colombia is also a signatory of different international conventions (Table 20).

Table 20. International Conventions signed by Colombia.

Acronym	Convention	Date of signature	Date of ratification
CBD	Convention on Biological Diversity	1992	1994
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna	1973	1981
ITTO	Convention of the International Tropical Timber Organisation	2006	2011

OTCA	Amazon Cooperation Treaty	1978	1979
CMS	Convention on Migratory Species	Not signed but memory of understanding	
RAMSAR	Convention on wetlands	1981	1997
UNFCC	United Nations Framework on Climate Change		2001
UNCDD	United Nations Convention to Combat Desertification		1999

Policies on social issues related to the feedstocks produced in Colombia include:

- Law 70 of 1993 or Law of Black communities
- Law 21 of 1991, for the ratification of the Convention 169 of the International Labour Organisation on Indigenous and Tribal communities
- Law 141 of 1961 (and modifications in Law 50 of 1990 and Law 584 of 2000) – on the Labour Code
- Law 80 of 1993 – General Regulation on Contracts in Public Administration
- Law 100 of 1993 – Integral Social Security System
- Resolution 02400 of 1979 – Industrial Security Regulation
- Law 1448 de 2011- Law of victims-Land/ Policy of land restitution.

And the conventions signed from Colombia on ILO are presented on table

Table 21. ILO conventions signed by Colombia.

ILO Convention	Ratified	In force
Convention concerning Forced or Compulsory Labour (No 29)	1969	√
Convention concerning Freedom of Association and Protection of the Right to Organise (No 87)	1976	√
Convention concerning the Application of the Principles of the Right to Organise and to Bargain Collectively (No 98)	1976	√
Convention concerning Equal Remuneration of Men and Women Workers for Work of Equal Value (No 100)	1963	√
Convention concerning the Abolition of Forced Labour (No 105)	1963	√
Convention concerning Discrimination in Respect of Employment and Occupation (No 111)	1969	√
Convention concerning Minimum Age for Admission to Employment (No 138)	2001	√
Convention concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labour (No 182).	2005	√

3.3 INDONESIA

3.3.1 Country Overview

Population and economy

Indonesia has a total population of 253,609,643 (July 2014 est.) made of different ethnic groups including: Javanese 40.1%, Sundanese 15.5%, Malay 3.7%, Batak 3.6%, Madurese 3%, Betawi 2.9%, Minangkabau 2.7%, Buginese 2.7%, Bantenese 2%, Banjarese 1.7%, Balinese 1.7%, Acehnese 1.4%, Dayak 1.4%, Sasak 1.3%, Chinese 1.2%, other 15% (2010 est.) (CIA, 2015).
It has a GDP of $856.1 billion (2014 est.) with a GDP pp of estimated in $10,200 USD. Main proportion of GDP per sectors is divided in the following form:
agriculture: 14.2%
industry**:**45.5%
services**:** 40.3% (2014 est.)

The main agricultural products are: rubber and similar products, palm oil, poultry, beef, forest products, shrimp, cocoa, coffee, medicinal herbs, essential oil, fish and its similar products, and spices. The industrial sector is dominated by: petroleum and natural gas, textiles, automotive, electrical appliances, apparel, footwear, mining, cement, medical instruments and appliances, handicrafts, chemical fertilizers, plywood, rubber, processed food, jewellery, and tourism.

Land use
Indonesia is a 189 million ha land area extended over an archipelago of over 17,000 islands, of which around 6,000 are inhabited (Figure 27). Two thirds of Indonesia's land area (127 million ha) is designated as "forest zone", although it is estimated that up to 30% of this land has no forest cover. Most land in this zone lies on Indonesia's outer islands. The government categorises forest zone land, allocating various functions to different areas. From these, 55 million ha is designated as protection and conservation forest, which is afforded varying degrees of protection, while production and conversion forest, allocated to economic activity, account for 70 million ha (Ministry of Forestry 2006).

Figure 27. Indonesia's archipelago (nations online)

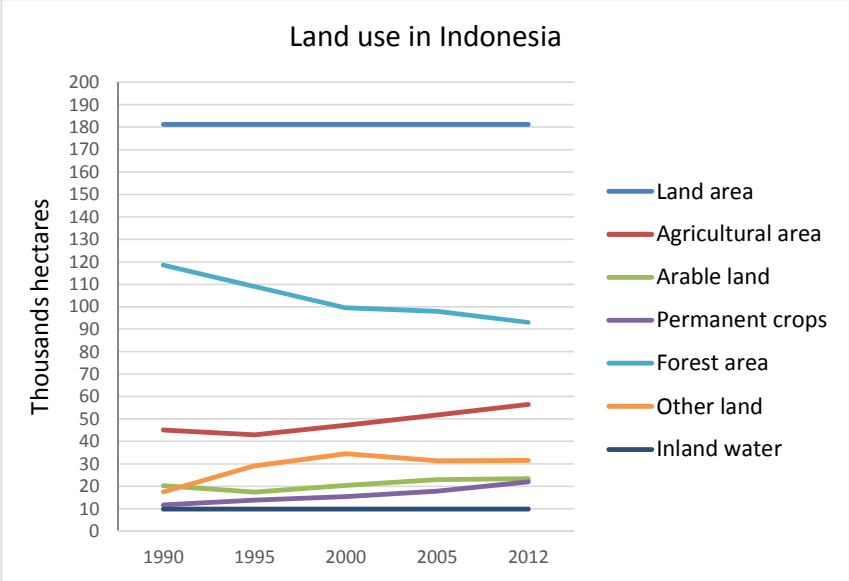


Figure 28. Land use in Indonesia (FAOstat, 2015).

Deforestation is one of the major environmental problems in Indonesia. Agricultural area has increased while forest area has decreased in the last 20 years. Most of it is attributed to the cultivation of oil palm (see Figure 28).

The main commodities of Indonesia reported by FAO in 2012 are presented in Table 22.

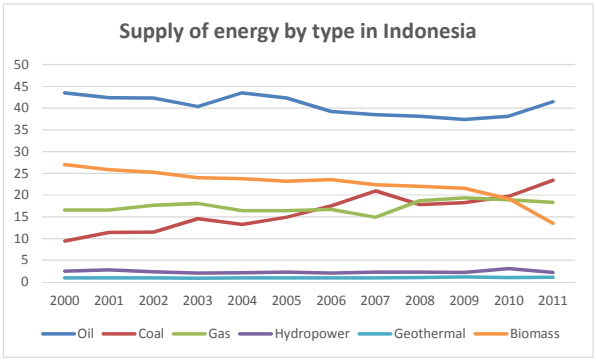
Table 22 Main commodities produced in Indonesia (FAOstat, 2015).

Top Ten commoditiesProduction quantity 2012		
	Commodity	**Quantity [t]**
1	Rice, paddy	69056126
2	Sugar cane	28700000
3	Oil, palm	26900000
4	Cassava	24177372
5	Coconuts	19400000
6	Maize	19387022
7	Palm kernels	6560000
8	Bananas	6189052
9	Fruit, tropical fresh nes	3147488
10	Rubber, natural	3040400

Energy Sector

The Government elected in 2014 has emphasized domestic economic growth in his first few months in office and in November 2014 reduced fuel subsidies, a move which could help the government increase spending on its development priorities. This will have an impact in renewables although it is not yet clear.

Oil, coal and gas are the main sources of energy in Indonesia and although biomass figures in the energy statistics, it is mainly due to the traditional use of biomass (EDSM, 2012) (Figure 29).



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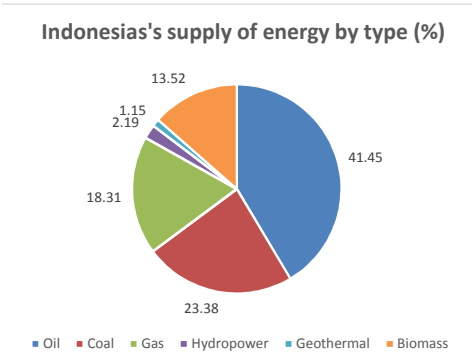


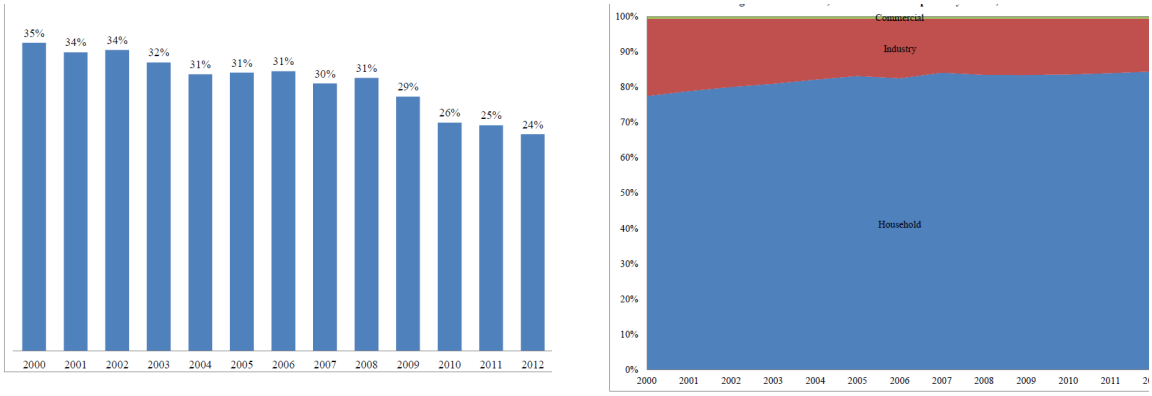
B

Figure 29. Supply of Energy in Indonesia by type , historic (A) and in 2012 (B). EDSM, 2012.

Indonesia has implemented important changes since the IEA published its first review of the country's energy policies in 2008. Key milestones include the 2007 Law on Energy, the 2009 Law on Electricity, the 2009 Law on Mineral and Coal Mining, and the 2014 National Energy Policy (IEA, 2015)

Indonesia has a 5 percent biodiesel mandate which has been in place and removed and it is now heading for B10 — and an E3 ethanol mandate. Nevertheless, due to the situation with oil prices,

Indonesian biomass consumption grew .33 percent from 2000 until 2012 but its contribution to the Indonesian energy mix has declined during the same time period (Figure 30 A). Indonesia's largest biomass user for energy is households (Figure 30 B), with approximately 84 percent of total biomass consumption. Firewood, forest and agricultural waste are the most common type of biomass used by Indonesian households.



A B

Figure 30. Biomass use in Indonesia by year (A) and by user (B)

3.3.2 Bioenergy and biomass

Feedstocks

The main biofuel crops/products identified for the case of Indonesia were palm oil and molasses. The production of palm oil has been growing in the last years as shown in the figure below.

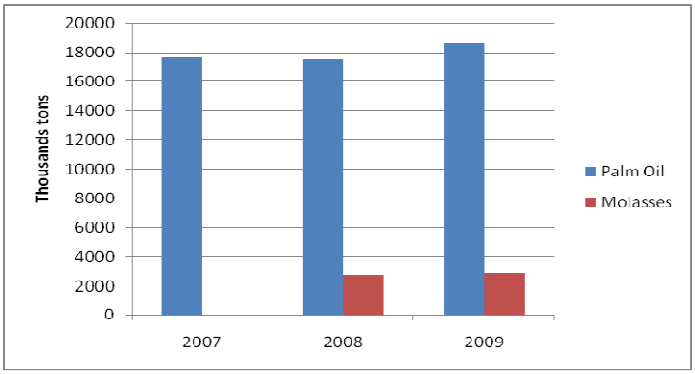


Figure 31. Production of palm oil and molasses in Malaysia.

The major crop residues considered for power generation in Indonesia are palm oil, sugar processing and rice processing residues. According to Bioenergy Consutl (2014)[10] there are 67 sugar mills in operation in Indonesia and eight more are under construction or planned. The mills range in size of milling capacity from less than 1,000 tons of cane per day to 12,000 tons of cane per day. Current

[10] http://www.bioenergyconsult.com/biomass-energy-resources-in-indonesia/

sugar processing in Indonesia produces 8 millions MT bagasse and 11.5 millions MT canes top and leaves.
Additionally, there are 39 palm oil plantations and mills currently operating in Indonesia, and at least eight new plantations are under construction. Most palm oil mills generate combined heat and power from fibres and shells, making the operations energy self –efficient. However, the use of palm oil residues can still be optimized in more energy efficient systems.

The types of residue generated by the palm oil industry include Empty FruitBunches (EFB), Palm Mesocarp Fiber (PMF) and Palm Kernel Shell (PKS) as a potentialsource of solid fuel. EFB, mesocarp fiber and kernel shell are generated at palm oil mills.EFB is the residue generated at the thresher, where fruits are removed from fresh fruitbunches. Mesocarp fiber is generated at the nut/fiber separator while kernel shell is generated from the shell/kernel separator (Fauzianto, 2015)

Table 23. Estimated residues for main crops in Indonesia

Feedstock	Type of residue	RPR min	tons	RPR max	tons
Sugarcane	Bagasse	0.1	0.05	0.33	0.1485
	Tops	0.1	0.045	0.3	0.1485
Rice	Straw	0.42	5.81080584	3.96	54.787598
	Husk	0.2	2.7670504	0.35	4.8423382
Oil palm*	fibres	0.14	0.9912	0.15	0.9912
	kernel shells	0.06	0.4248	0.07	0.4248
	empty bunches	0.23	1.6284		

RPR FAO and Ma et al 1986
* Koopmans and Jaap Koppejan (1997)

There are other residues estimates found in the literature. For instance for South Sumatra, Bustan et al (2011) estimated the following amount of residues from palm oil (Table 25) and the following characteristics of the residues (Table 24).

Table 24. Characteristics of solid residues of oil palm (Bustan et al, 2011)

Parameter	Fiber	Shell	EFB
RPR	0.119	0.069	0.244
Moisture content	23	20	60
Energy use factor	0.85	0.65	0.03
Oil content %	7		1.2
LHV (MJ/kg)	10.11	15.23	3

Table 25. Palm oil Residue potential (Bustan et al, 2011)

Regency	Production (Ton/year)	Energy potential (GJ Thermal /yr)	Technical Potential (MWh/yr)
Lahat	151,708	330,708	22,965.8
Pagaralam	10.1	22	1.5
Empat Lawang	0	0	0
Musi Banyuasin	486,846	1,061,274	74,699.6
Banyuasin	253,449	552,493	38,367.6
Musi Rawas	332,548	724,921	50,341.7
Lubuk Linggau	63	137	9.5
OKU	111,783	243,675	16,921.9
OKU Timur	80,843	176,229	12,238.2
OKU Selatan	36	79	5.5
OKI	376,081	819,818	56,931.8
Ogan Ilir	22,935	49,996	3,471.9
Muara Enim	216,992	473,020	32,848.6
Prabumulih	3,258	7,102	493.2
Total	2,036,553	4,439,476	308,297

The production in Indonesia may vary from one island to another but major production is in Sumatra (Figure 32).

Figure 32. Regional distribution of palm oil in Indonesia

3.3.3 Sustainability issues

Land rights

Indonesia faces a number of issues related to land ownership mainly because of the large number of people in rural areas of Indonesia who have little or no land (an average of 0.5 ha of land); also because of the high levels of inequality in the distribution of agricultural land ownership, and the large number of land disputes and conflicts recorded, covering almost 608,000 ha of land (Wright, 2011). Many such conflicts have resulted from the allocation of land for plantation estate development (Wakker, 2005 in Wright, 2011).

These issues are attributed to a number of problems and weaknesses in Indonesia's system of land governance such as the inherited system from colonial times, the lack of transparency, complexity and confusion surrounding the legal framework governing land rights and more recently the palm oil concessions, there is a lack of adequate legal recognition of customary rights to land (Wright, 2010).
Land rights are partially recognised by the Indonesian constitution, but are legally subordinated to the needs of national development and government agencies have discretionary power in deciding whether to respect them (Colchester et al, 2006).

Food security

A long term trend since the 1970s has been a decline in food insecurity in Indonesia.
Indonesia produces potentially high-value crops such as cocoa and spices but according to IFPRI (2015) further investment is needed to improve the systems needed to take full advantage of such high-value products. Food insecurity and under-nutrition are persistent challenges, and the country's

stunting levels are alarmingly high. In 2007, an estimated 7.7 million children under 5 (36.8%) were stunted (2007). The stunting rate is higher than 30% in most districts (ranging from 23-58%) (WFP 2012).

For the above reasons, the government of Indonesia has formulated a development plan spanning 2005-2025. The overall plan includes 5-year medium-term plans, each with different development priorities. The current medium-term development plan covering 2009-2014 is the second phase and focuses on:

- promoting quality of human resources
- development of science and technology
- strengthening economic competitiveness (IFPRI, 2015)

FAO's country data also shows an improvement in food security reducing the undernutrition value and improved per capita food supply (Figure 33).

Indonesia: Per capita food supply

	Quantity [kcal/capita/day]			
	1996	2001	2006	2011
Food Supply	2548	2424	2484	2713

Source: FAOSTAT, FAO of the UN, Accessed on May 26, 2014.
http://faostat.fao.org/site/368/default.aspx#ancor

A

Indonesia: Prevalence of undernutrition

	Prevalence [%]			
	1999-01	2004-06	2007-09	2010-12
Undernutrition	18	15	12	9

Source: ESS, FAO of the UN, Accessed on October 9, 2012.
http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/

B

Figure 33. Indonesia's food security indicators (FAO, 2015).

Socio-economic

Despite Indonesia having committed to the main ILO standards (Table 26), there are some that still need to be enforced specially those related to child labor.
Companies need to comply with workers right and the payment of minimum wage.

Table 26. ILO conventions signed in Indonesia

ILO Convention	Ratified	In force
Convention concerning Forced or Compulsory Labour (No 29)	1969	√
Convention concerning Freedom of Association and Protection of the Right to Organise (No 87)	1976	√
Convention concerning the Application of the Principles of the Right to Organise and to Bargain Collectively (No 98)	1976	√
Convention concerning Equal Remuneration of Men and Women Workers for Work of Equal Value (No 100)	1963	√
Convention concerning the Abolition of Forced Labour (No 105)	1963	√
Convention concerning Discrimination in Respect of Employment and Occupation (No 111)	1969	√
Convention concerning Minimum Age for Admission to Employment (No 138)	2001	√
Convention concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labour (No 182).	2005	√

Certification

The standards used in Indonesia for palm oil are the Round Table for Sustainable Palm Oil (RSPO) and there is one set up by the Government the Indonesian Sustainable Palm Oil (ISPO). There is no report on the use of other standards such as ICCT or Bonsucro for the molasses.
For forestry FSC, PEFC are used.

Biodiversity
There is a wealth of information related to biodiversity and natural resources conservation in Indonesia. The geographic breadth of the country and complex habitats and the richness of its biological resources also make it difficult to monitor in general terms. Policy and scientific/technical jurisdiction is spread across several line ministries; this makes data collection and monitoring a gargantuan (and often politically charged) task. Terrestrial, fresh water aquatic, marine/coastal and atmospheric environment issues are governed by no less than seven ministries, plus an additional ministry for planning. The basic law(s) governing land use and land use changes that require EIAs have been recently re-established in Environmental management law No. 32 of 2009. This is overseen by the Ministry of the Environment and provincial environmental assessment agencies (BPLHD).

Indonesia is party to all of the major international environment treaties/conventions/protocols – generally seen as a good indicator of environmental awareness and activity. The Fourth Report to the Convention on Biological Diversity was prepared by the Ministry of the Environment in 2009. In addition the country has a National Environmental Action Plan, the Agenda 21, developed in 1997/98. This plan, although by now becoming out of date, helped to shape thinking and national and regional priorities important to current activities and plans.

3.3.4 Policy

The Government of Indonesias enacted Indonesia's National Energy Policy (Presidential Regulation No. 5/2006 (regulation 5) in early 2006. Regulation 5 formalized the development of biofuels in Indonesia, (ethanol and biodiesel), and established a five percent biofuel mandate by 2025. According to regulation 5, biofuel development, will help diversify and secure energy supplies and support sustainable economic development. MEMR also issued Regulation No. 32/2008 in conjunction with regulation 5. Regulation 32 establishes a progressive set of targeted biofuel mandates during the 2008-2025 timeframe (USDA, 2014).

Other policies by topic (NCIV, 2013) relevant are:

- The 1999 Forestry Law (FL) no 41/1999 which states that the management of state forest located within the jurisdiction of customary law communities (*Masyarakat Hukum Adat*) may be classified as *Adat* Forest.
- The Plantation Estate Law 18/2004 (PEL) which is the main regulation that encourages the expansion of the palm oil estates .
- The Basic Agrarian Law (BAL, 1960) determines that *ulayat* rights and other similar rights of customary law community (M*asyarakat Hukum Adat*) applies to the earth, water and air and should be recognized, as long as these communities really exist, and as long as it does not contradict national and State interests.
- National Land Bureau issued Regulation no 5/1999 on Registration of *Adat* Land which regulates *Adat* Land as Non State Domain.
- The Regulation of the Minister of Agriculture No. 26/2007 (Spatial Planning Law) provides Guidance of Estate Business Permits and determines that the individual ownership of land for palm oil is at least 20% of the total area of the community which is developed for palm oil

3.4 KENYA

3.4.1 Overview of the country

Kenya is located on the eastern part of the African continent. It lies across the equator at latitude of 4° North to 4° South and Longitude 34° East to 41° East. It contains a total area of 582,650sq km including 13,400 sq. km of inland water and a 536km coastline.
Kenya is divided into seven agro-ecological zones ranging from humid to very arid. Less than 20% of the land is suitable for cultivation, of which only 12% is classified as high potential (adequate rainfall) agricultural land and about 8% is medium potential land. The rest of the land is arid or semi-arid. Furthermore, only 60% of the high potential land is devoted for crop farming and intensive livestock production while the rest is used for food and cash crop production, leaving the rest for grazing and as protected. The most important current environmental issues include water pollution from urban and industrial wastes; degradation of water quality from increased use of pesticides and fertilizers; water hyacinth infestation in Lake Victoria; deforestation; soil erosion; desertification; and wildlife poaching for game meat and animal trophies (Diaz-Chavez et al, 2012).

Figure 34. Kenya (Oneworldnations[11])

The population Size is of 39, 423, 264 and the country has a GDP of 61.83 billion US Dollars, GDP per capita is 1, 600 US dollars and it is divided in:

- Agriculture 24%
- Industry 17%
- Services 59%

[11] http://www.nationsonline.org/oneworld/map/kenya_map.htm

Land use

Figure 35 shows the classification of land area in Kenya. Forestry are has been reduced in the last 10 years and arable land has increased. Only 8% of arable land and 75 percent of Kenya's workforce engaged in agriculture, Kenyan farmers face growing problems of soil erosion, deforestation, water pollution, and desertification (FSD, 2015). The drought of 2006 caused left 3.5 million people with barely enough food to survive while in the north of the country affected pastoralism and created wider conflicts over water (FSD, 2015).

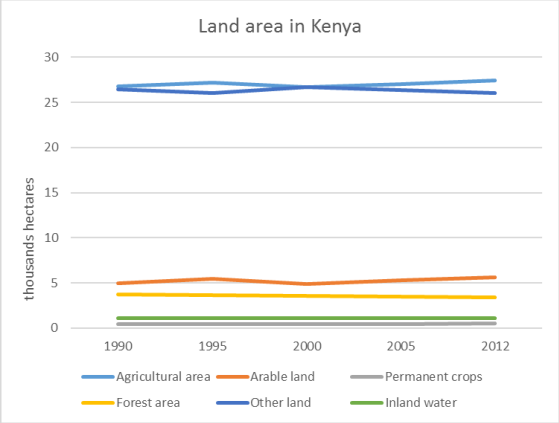


Figure 35. Land use area in Kenya (FAOstat, 2015)

The main products produced and exported include Tea, coffee, sugarcane, horticultural products. The industrial sector includes production of small-scale consumer goods (plastic, furniture, batteries, textiles, soap, cigarettes, flour), agricultural products processing; oil refining, cement; tourism.

Energy Sector

The main source of primary energy in Kenya is biomass (wood fuel), which accounts for about 70% of all energy consumed, 90% of rural household energy needs. The main sources of biomass for Kenya include charcoal, wood-fuel and agricultural waste The balance is supplied by petroleum (21%) and electricity (9%). A significant share of the electricity (over 60%) is produced from hydro power (EEAP, 2015) and recently Kenya has been ranked eigth largest geothermal producer in the world.

3.4.2 Bioenergy and biomass

Biomass is faced with the challenge of competing with other areas of interest such as land use, forestry and agriculture. The GoK is currently looking for ways of discouraging deforestation which has resulted from the increasing demand of fuel wood because of the fast growing population. The government through The Ministry of Energy is working on a framework that aims at shifting from traditional to modern biomass technologies. the extraction rate of biomass is higher than the natural growth of forests making biomass a non renewable energy sources (EEP, 2015).

According to the FAO (2015), the main commodities in Kenya (per production) are shown in Table 27.

Table 27. Top ten commodities in Kenya (FAOstat, 2015).

	Commodity	Quantity [t]
1	Sugar cane	5822633
2	Milk, whole fresh cow	3732960
3	Maize	3600000
4	Potatoes	2915067
5	Mangoes, mangosteens, guavas	2781706
6	Bananas	1394412
7	Milk, whole fresh camel	933616
8	Cassava	893122
9	Sweet potatoes	859549
10	Cabbages and other brassicas	684000

Nevertheless, other crops were identified with potential to produce enough residues to be used as potential resources for different carriers to be exported to the EU. These crops were identified as follows: maize, mangoes, bananas, sugarcane, potatoes, beans, coffee, sisal, wheat, cassava, sorghum, pigeon & cow peas (considered as one product), sweet potatoes, rice and coconuts were selected (Table 28) (Dardamanis et al, 2015).

Table 28. Technical potential of selected crops in Kenya (Dardamanis et al, 2015).

Agricultural products	**Technical potential of residues in mass and energy**					
	Field thousand t	Process thousand t	Total thousand t	Field PJ	Process PJ	Total PJ
Maize	10,037	6,026	16,063	125	93	218
Mangoes	5,562	0	5,564	89	0	89
Bananas	2,649	0	2,649	42	0	42
Sugarcane	1,165	1,252	2,416	19	16	35
potatoes	1,050	0	1,050	18	0	18
Beans	1,123	0	1,122	18	0	18
Coffee	0	1,029	1,029	0	13	13
Sisal	131	669	800	2	10	12
Wheat	654	0	654	11	0	11
Cassava	518	0	518	9	0	9

As the above potentials are considered at national level, the potential of the selected crops by region in Kenya is analysed in the specific case studies report. The case study report shows also the competition with other uses as in the case of sugar cane bagasse used in Kenya for other uses[12].

Forestry

Kenya has 56.9 million hectares of land of which 3.47 million hectares are covered with forests, equivalent to 5.6% of the country (FAO, 2010). The country has a low deforestation rate and since reduced from 0.35% in 1990 to 0.31% for the period 2005-2010 (FAO, 2010). The most immediate threats to Kenya's forests are linked to the rapidly increasing population numbers, agricultural expansion, unsustainable wood utilization levels, high energy demand, and over-grazing (REDDdesk, 2015.)

[12] http://cogen.unep.org/

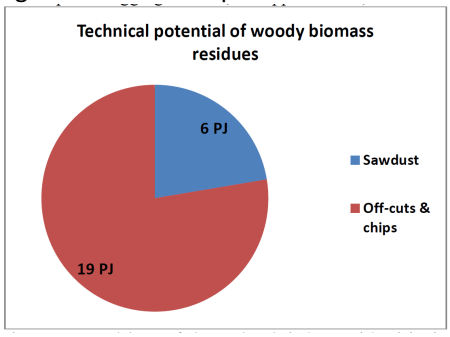
The case study of Kenya (Dardamanis et al, 2015) identified four woody biomass products that dominate the Kenyan market: timber, poles, firewood and charcoal.

Table 29. Woody biomass products in Kenya (Dardamanis et al, 2015).

Year 2013	Timber in million m3	Poles in million m3	Firewood in million m3	Charcoal in million m3	Total in million m3
Supply Potential	7.36	3.03	13.65	7.36	31.40
Available Supply	2.40	2.88	12.97	1.18	19.43
Lost Volumes	4.96	0.15	0.68	6.18	11.97
Percentage loss	0.676	0.05	0.05	0.84	N/A

These products were evaluated to assess the technical potential (in PJ) considering sawdust and off-cuts and chips presented in Figure 36. The case study of Kenya presented the calculations by regions.

Figure 36. Technical potential of residues of woody biomass for Kenya.



The Kenyan Forest Service recently reported an increasing importation of timber from the Democratic Republic of Congo and Angola's Cabinda area due to the construction boom in Nairobi (UNEP, 2012). There is also increasing demand for firewood from tea factories and for electricity transmission poles. Regarding this timber shortage, the business of growing Eucalyptus in Kenya has been proposed as the best option for enhancing domestic supply, since investment costs are low compared to other cash crops. Growing Eucalyptus has been reported to be a profitable business in Kenya and that farmers would be willing to plant trees on their fallow land (UNEP, 2012).

3.4.3 Sustainability issues

Land tenure

Land tenure in Kenya falls into four different entities namely government (public), County councils (local authorities), Individuals (private) and groups (communal). Different legal instruments govern different categories of land and owners thereof. To date, land ownership in over 40% of Kenya still remains informal. Land Policy (2009) designates all land in Kenya as either Public, private or Communal land (Diaz-Chavez et al, 2011).

Biodiversity

Some of the environmental and biodiversity issues in Kenya are related to deforestation for many reasons. The project “Protect the Kakamega forest” aims at Kenya's only mid-altitude rainforest and home to rare species of birds, reptiles, insects, and monkeys. Several initiatives involve educating farmers to co-exist with the forest and offering lessons to local schools on ecology, agroforestry, beekeeping, and/or horticulture. (FSD, 2015).

Food security

The number of acutely food insecure people is stable at about 1.6 million, mainly concentrated in pastoral and marginal agricultural areas. In particular, food security of poor households is a concern in southeastern and coastal areas that harvested a well below average “short-rains” season crop production at the beginning of the year (FAOstat, 2015b). The FAO (2015a) data on food security shows that the per capita food supply has increased in the last 20 years and the undernutrition status has reduced (Figure 37). Nevertheless, imports of maize from neighbouring countries are still constant and food security is associated with weather conditions (rainfall) for the internal production (FAOstat, 2015b).

Kenya: Per capita food supply				
	Quantity [kcal/capita/day]			
	1996	2001	2006	2011
Food Supply	2060	2068	2163	2189
Source: FAOSTAT, FAO of the UN, Accessed on May 26, 2014. http://faostat.fao.org/site/368/default.aspx#ancor				

A

Kenya: Prevalence of undernutrition				
	Prevalence [%]			
	1999-01	2004-06	2007-09	2010-12
Undernutrition	33	33	32	30
Source: ESS, FAO of the UN, Accessed on October 9, 2012. http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/				

Figure 37. Food security data for Kenya A. Per capita food supply; B undernutrition state (FAOstat, 2015).

Socio-economic and labour conditions

Kenya has so far ratified 49 ILO Conventions, 6 of which have been denounced. Section 2(5) of the Constitution of Kenya provides that the general rules of international law shall form part of the law of Kenya, while Section 2(6) states that any treaty or convention ratified by Kenya shall form part of the law of Kenya under the Constitution (ILO, 2010). Child labour is still one of the main social labour prolems in Kenya. Table shows the ratified IL conventions related to working conditions with links to the activities related to biomass production (Table 30).

Table 30. ILO conventions ratified by Kenya.

No.	ILO Convention	Ratified	In force
29	Convention concerning Forced or Compulsory Labour	1969	√
87	Convention concerning Freedom of Association and Protection of the Right to Organise	1976	No
98	Convention concerning the Application of the Principles of the Right to Organise and to Bargain Collectively	1976	√
100	Convention concerning Equal Remuneration of Men and Women Workers for Work of Equal Value	1963	√
105	Convention concerning the Abolition of Forced Labour	1963	√

111	Convention concerning Discrimination in Respect of Employment and Occupation	1969	√
138	Convention concerning Minimum Age for Admission to Employment)	2001	√
182	Convention concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labour	2005	√

A report from UNEP (2012) indicated that fostering sustainable biomass production in Kenya will have a positive impact on local employment and income generation. The forest industry is still based on traditional, labour-intensive production techniques, particularly in the firewood and charcoal production and therefore will benefit of technological improvement. The charcoal industry employed nearly 700,000 people in 2010 supporting about 2.5 million family members. This industry provides high labour stimulus in rural and poorer areas, and expanding the number of wood fuel plantations would provide even more local employment (UNEP, 2012). The eucalyptus plantations are expected to grow in the future.

3.4.4 Policy

Kenya has different policies regarding the energy sector, agriculture and forestry.

- The Energy Policy is contained in Sessional Paper no. 4 of 2004 and focuses on all forms of energy including bioenergy.
- The Energy Act 2006
- Agricultural policy
- Kenya Forest Policy of 2005
- Land Policy 2009
- Draft National Environmental Policy (NEP), 2008
- Environmental Management and Coordination Act No. 8 (EMCA) of 1999.

3.5 UNITED STATES

3.5.1 Overview of the country

Population and economy

The United States covers an area of 9 826 million square kilometres, with a population of 318.9 million (estimated) in 2014 (IEA, 2014). It remains the largest economy in the world, with a gross domestic product (GDP) in current prices (2013) of USD 16 800 trillion or USD 51.7 thousand per capita. The GDP composition is:
agriculture: 1.6%
industry: 20.7%
services: 77.7% (CIA, 2015)

Figure 38. Map of United States (CIA, 2015).

The main agricultural products include: wheat, corn, other grains, fruits, vegetables, cotton; beef, pork, poultry, dairy products; fish; forest products while the industry is highly diversified inhigh-technology innovator, petroleum, steel, motor vehicles, aerospace, telecommunications, chemicals, electronics, food processing, consumer goods, lumber, mining (CIA, 2015).

Land area

Forestry area in the USA is about 33.3 of the total area of the country. Forests face impacts from land development, suppression of natural periodic forest fires, and air pollution. The area of forests has been reduced in the last 20 years and it is expected to continue experimenting reduction (Figure 39).

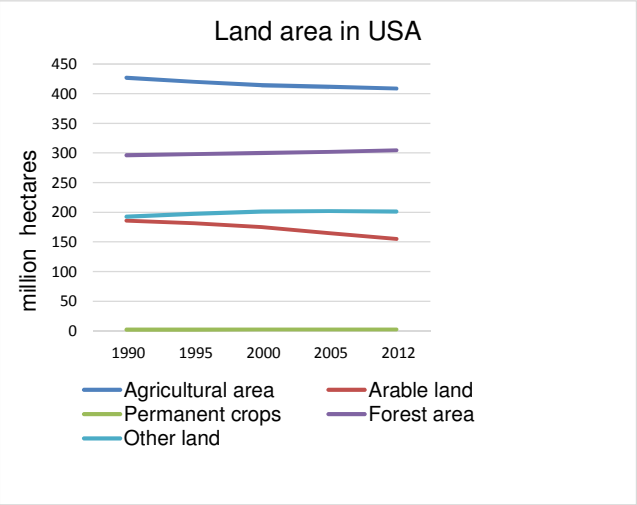


Figure 39. Land use area in the USA (FAOstat, 2015a).

Energy sector

Around 30% of energy production was from natural gas in 2013, followed by coal (25.8%) and oil (24.8%). The total share of fossil fuels has remained relatively constant over the past decade, shifting away from coal towards more oil and gas (Figure 40). Solar, Geothermal and Wind were insignificant (IEA, 2014).

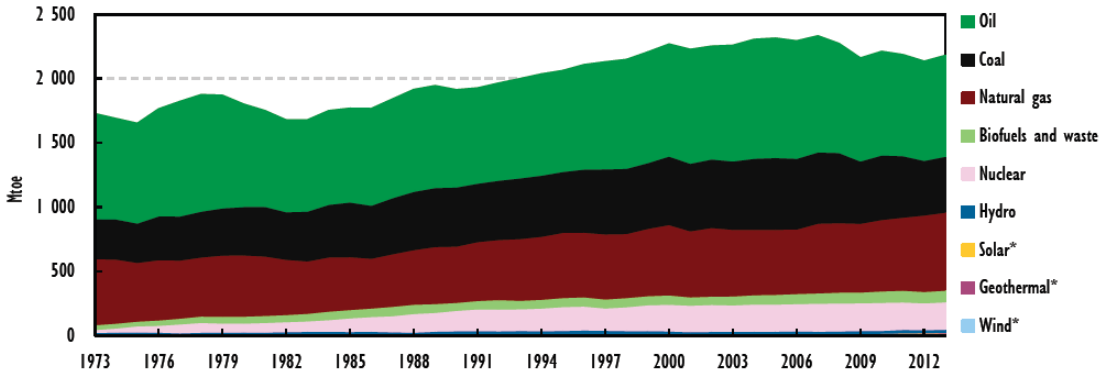


Figure 40. Electricity generation by source in USA (IEA, 2014).

3.5.2 Bioenergy and biomass

Forestry

Forestry residues include logging residues, excess small pole trees, and rough or rotten dead wood. These residues could be collected after a timber harvest and used for energy purposes. Typically, forest residues are either left in the forest or disposed of via open burning through forest management programs (USEPA, 2007).

Historical levels of timber removals from the U.S. South (1995-2011) (Figure 41) include removals for softwood and hardwood pulpwood and sawtimber, and for industrial wood products and composites (Abt et al, 2014).

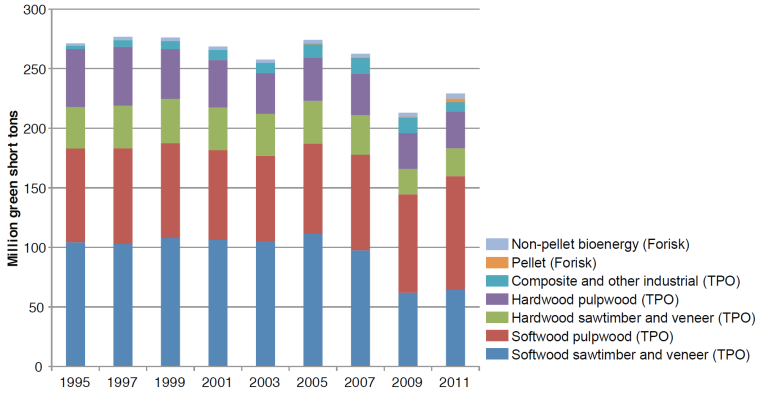
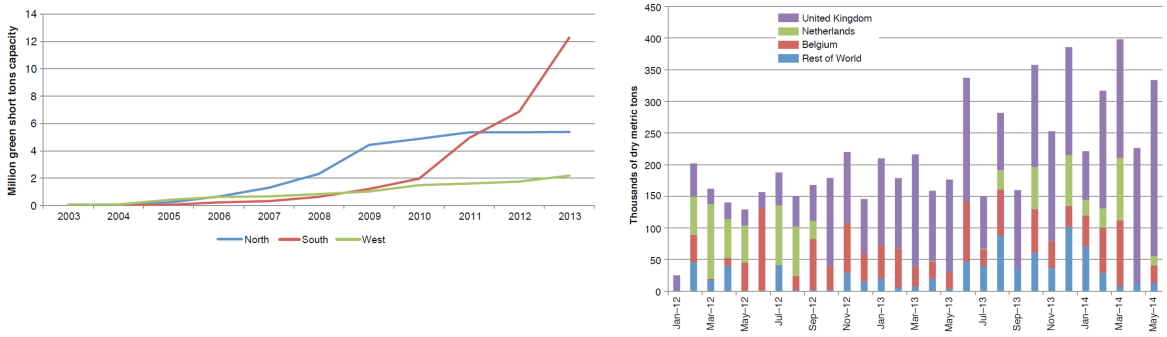


Figure 41. Timber product output (TPO) removals for U.S. South (excluding Texas) for 1995–2011 (Abt et al, 2014).

Pellet production has increased in the USA responding to the EU market demand. Figure 42 shows the origin of the pellets in the USA while figure shows the destination of the pellets and the main destinations of the pellets.



A B

Figure 42. Growth in pellet production capacity by U.S. region from 2003 through 2013. (Forisk Consulting, 2014, in Abt et al, 2014). B Destination of pellet exports from the United States for January 2012 to May 2014. (U.S. Department of Commerce, 2014 in Abt, 2014).

As the Southeast of USA is the area where pellets production has increased and from where pellets are being export to the USA, the analysis for BIOTRADE2020+ is focused on it. The case study of the USA (IINAS, 2014; Iriarte et al, 2014) produced an assessment of the roundwood removal in this region

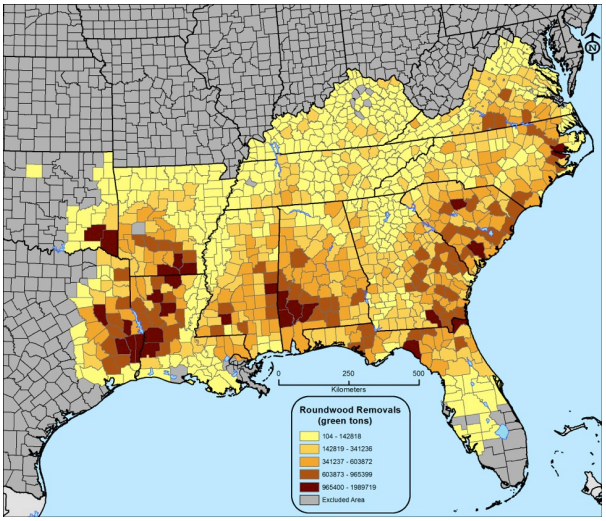


Figure 43. Roundwood removals in the USA (Perlack, 2011 in IINAS, 2014).

A report produced for DECC in the UK estimated that by 2020, there could be approximately 23.8 - 51.5 Modt/year of North American forest residues available, that would otherwise be burned on the roadside, and between 1.7 and 12 Modt/year of unused saw-mill residues, depending on the recovery of the lumber market (Stephenson and MacKay 2014). The report also estimated the potential use dead trees that have been killed by natural disturbances and would otherwise be burned as a waste at the roadside although a significant issue associated with this feedstock is the inconsistency of the annualised volumes within a designated landscape, and the high costs associated with its recovery and utilisation.

The USA and Canada also plan to use forest residues for electricity generation in the future that may limit the availability of residues for export to Europe. According to Stephenson and MacKay (2014) forest residues often have high contents of bark and non-combustible elements, such as alkali metals, which can cause problems of slagging, fouling and corrosion in boilers, therefore some electricity stations require pellets produced from biomass with low bark contents, such as roundwood. It is therefore conceivable that a significant proportion of the feedstock used for the production of biomass pellets in the future might be roundwood (pulpwood in the USA). This roundwood is harvested from North American forests at a rate of ~ 210 Modt/year, and is generally classified as saw logs and pulpwood, with saw logs used for construction, and pulpwood and residues from saw log processing used for the production of particleboard, fibreboard, paper products and wood pellets.

The global market of pellets has changed the market and production of pellets in the South of the USA and although it is “new” forest product markets have long influenced the use and condition of southern forests as it produces about 60 percent of all wood products in the United States (Wear et al, 2013). The available feedstock for production of pellets until 2016 is presented below.

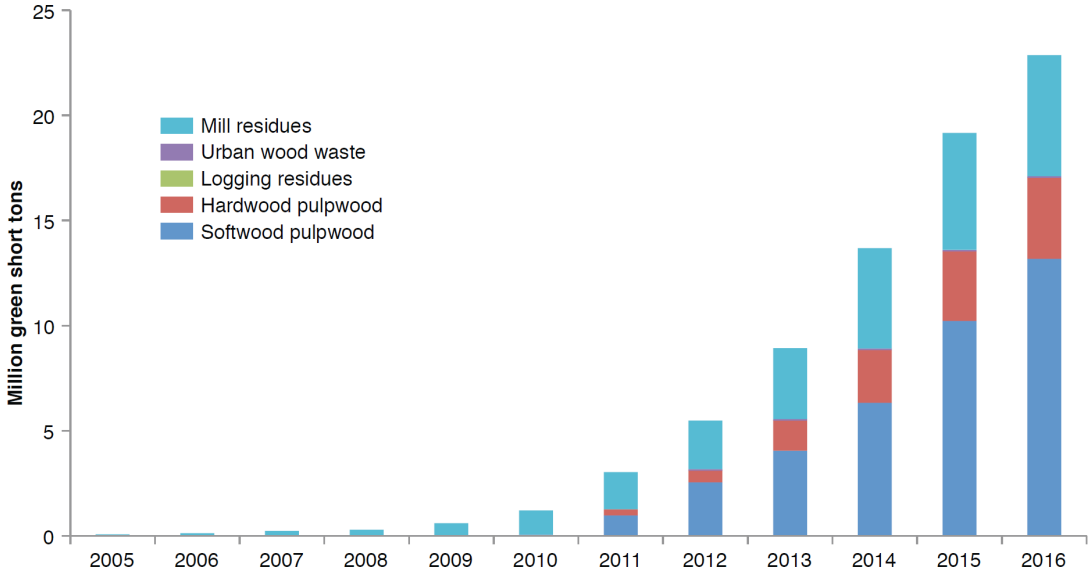


Figure 44. Feedstock source for use in pellet production in the U.S. South for 2005–2016 (Forisk Consulting, 2014, In: Abt et al, 2014).

Stephenson and MacKay (2014) reviewed different publications to estimate the resource availability from two sources: residues from forest logging in the USA and those from forest residues that otherwise would be burnt on the roadside, both presented in the table below.

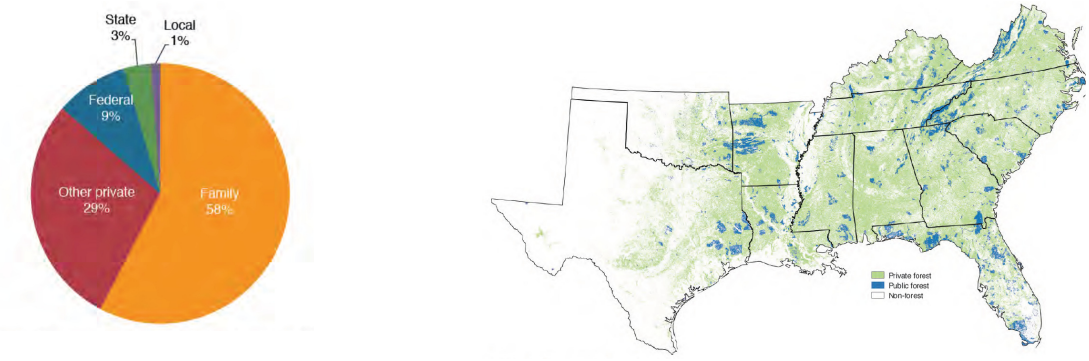
Table 31. Resource availability of forest logging residues and residues that would otherwise be burnt on the roadside (Stephenson and MacKay, 2014)

Resource availability of forest logging residues		
Resource description	**Resource availability**	**Reference**
Forest residues collected after conventional harvesting techniques. Assuming that a minimum of 30 wt% should be left in the forest to prevent soil degradation and loss of habitats. Includes pre-commercial thinnings.	13.0 to 47.0 Modt/y, depending on the biomass economic value.	US DOE, 2011
Forest residues, potentially available from fire-treatment processes.	14.0 to 35.0 Modt/y, depending on the biomass economic value.	US DOE, 2011
Forest residues from the conversion of forest to other uses.	4.4 to 12.0 Modt/y	US DOE, 2011
Forest residues currently left in the forest, assuming 35% should remain in the forest.	28.0 Modt/y	Forisk, 2011
Resource availability in 2020 of forest residues that would otherwise be burned as a waste		
Residues description	**Resource Availability (Modt/y)**	**Reference**
Residues from fire-treatment of US forests	0.0 to 17.5	Lower: Forisk, 2011 Upper: US DOE, 201153
Residues from clearing of US forests	4.4 to 12.0	Lower: US DOE, 2011 Upper: US DOE, 2011

3.5.3 Sustainability issues

Land security

In the South east of the United States Buttler and Wear (2013) found out that ownership has changed in the last 10 years. The public ownership grew but private ownership still dominates the region. Private landowners hold 86 percent of the forest area in the South; two-thirds of this area is owned by families or individuals (Figure 45) (Butler and Wear, 2013).



A B

Figure 45. Distribution of land ownership in the Southeast of USA (A) in percentage; (B), geographically (Butler and Wear, 2013)

Butler and Wear (2013) also found out that fifty-nine percent of family forest owners own between 1 and 9 acres of forest land, but 60 percent of family-owned forests are in holdings of 100 acres or more, although the average size of family forest holdings is 29 acres. It is expected that forest area will decrease and this will affect mainly privately owned land.

Food security

An estimated 14.3 percent of American households were food insecure at least some time during the year in 2013. The change from 14.5 percent in 2012 was not statistically significant.The prevalence of very low food security was essentially unchanged at 5.6 percent (Coleman-Jensen at al, 2013).
The food supply in the USA varied in the last 20 years but still as a whole country, it is not considered to be food insecure (Figure 46).

United States of America: Per capita food supply

	Quantity [kcal/capita/day]			
	1996	2001	2006	2011
Food Supply	3587	3709	3787	3639

Source: FAOSTAT, FAO of the UN, Accessed on May 26, 2014.
http://faostat.fao.org/site/368/default.aspx#ancor

Figure 46. Food supply per capita in the USA. (FAOstat, 2015b)

Labor conditions

According to Abt (2013) the logging sector in the South of the USA has been experiencing small increases in both industry output (3 percent) and jobs (2 percent) since 2008 and expected to carry on to 2018. Nevertheless, the increased demand from bioenergy is expected to increase mechanization and reduce demand from some traditional wood-using industries. On the other hand, wood products manufacturing is expected to increase in industry output (2.2 percent). Technical change is expected to continue (with capital substituting for labour) leading to continued declines in jobs through 2018 (8 percent) (Abt, 2013). The same will happen with the paper industry which will continue reducing in labour. Abt (2013) indicated that bioenergy demands resulting from State and Federal policies are expected to lead to increases in logging sector jobs and output but competition with the sector mentioned above may have an impact in the region although it is not expected to be great.

The USA is not signatory of all the ILO conventions related to the bioenergy sector (see table below)

Table 32. ILO conventions ratified by the USA (ILO, 2015)

No.	ILO Convention	Ratified	In force
29	Convention concerning Forced or Compulsory Labour	1969	No
87	Convention concerning Freedom of Association and Protection of the Right to Organise	1976	No
98	Convention concerning the Application of the Principles of the Right to Organise and to Bargain Collectively	1976	√
100	Convention concerning Equal Remuneration of Men and Women Workers for Work of Equal Value	1963	No
105	Convention concerning the Abolition of Forced Labour	1963	√
111	Convention concerning Discrimination in Respect of Employment and Occupation	1969	√

138	Convention concerning Minimum Age for Admission to Employment)	2001	√
182	Convention concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labour	2005	√

Biodiversity

The South has 1,076 native terrestrial vertebrates: 179 amphibians, 525 birds, 176 mammals, and 196 reptiles. Species richness is highest in the Mid-South (856) and Coastal Plain (733). Land use changes have occurred for several centuries now in the region and the impacts of the fractioning of forest land and climate change are the most important ones. Hotspots for plants and vertebrates were identified by Griep and Collins (2013). The authors indicated that new tools and approaches to managing uncertainty (e.g., scenario planning, sensitivity analysis, or ecological risk analysis will be necessary for conservation strategies. Land use changes from natural forest to managed plantations might adversely affect endangered species in certain locations but changes from agricultural systems to forests might improve habitat conditions (Alavalapati et al, 2013).

3.5.4 Policies

Current relevant policies with an impact on U.S. forests production and biomass include:

- The Renewable Fuel Standard for transportation fuel production (RFS, enacted with the Energy Independence and Security Act of 20073)
- Biomass Crop Assistance Program (BCAP) through which woody biomass from non-industrial private forestlands can be funded.
- The Energy Independence and Security Act of 2007 (EISA)
- Agriculture Act of 2014.9 EISA
- The Forest Land Enhancement Program

3.6 UKRAINE

3.6.1 Overview of the country

Population and economy

Th total population of Ukraine in 2014 was of 44,291,413. It has a GDP of $337.4 billion it is $7,400 GDP per capita distributed as follows (CIA, 2015).:
agriculture: 9.9%
industry: 29.6%
services: 60.5%

The main agricultural products of Ukraine are grain, sugar beets, sunflower seeds, vegetables; beef, milk, while the industry sector focus is on coal, electric power, ferrous and nonferrous metals, machinery and transport equipment, chemicals, food processing (CIA, 2015).

Figure 47. Map of Ukraine (worldatlas[13])

Land use

According to FAOstat (2015), the land use of Ukraine is mostly arable land (53.85%), permanent crops (1.48%) and other (44.67%). The temporary crops land has increased in recent years due to the growth of cereals (Figure 48).

[13] http://www.worldatlas.com/webimage/countrys/europe/ua.htm

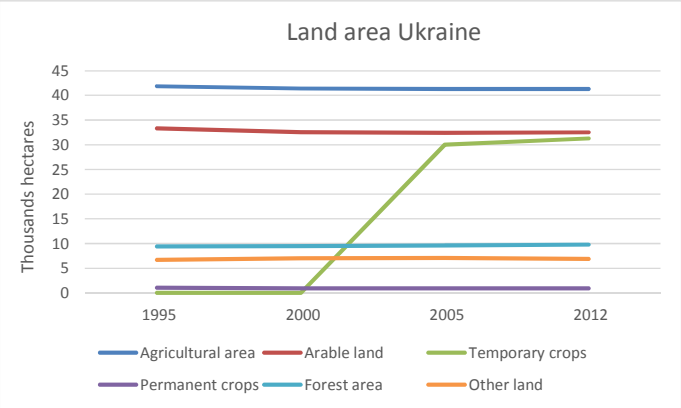
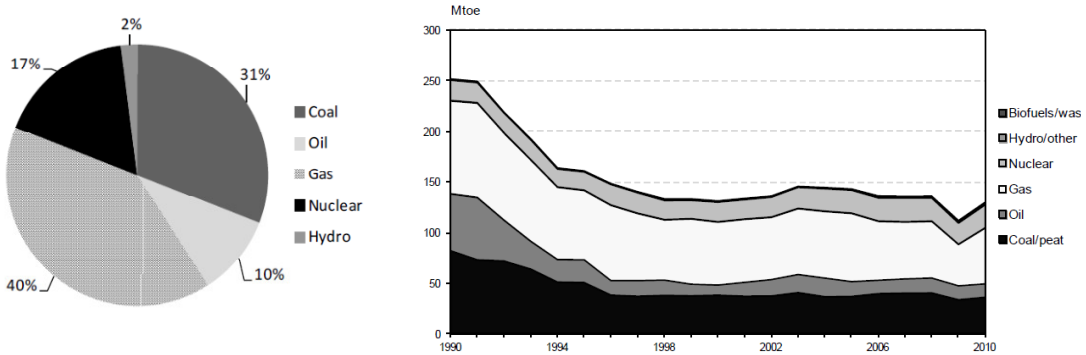


Figure 48. Land use in Ukraine (FAOstat, 2015).

Energy sector

The energy mix in Ukraine is dominated by natural gas (40%) and biomass and other renewables may have a larger proportion but there is not enough data (Figure 49).



A **B**

Figure 49. Primary Energy mix (A) (legend reads from coal 31% clockwise) and (B) Total primary energy supply in Ukraine in 2010 (IEA, 2012)

Renewable energy, primarily biomass and waste, is used for heat production in private households and public buildings in rural areas, as well as for heating and processes in the wood products industry. There is no reliable data on heat production from but seems to be higher estimates of biomass consumption. Estimates are that the total heat production from renewable energy sources does not exceed 1 million gigacalories (Gcal) (IEA, 2012).

3.6.2 Bioenergy and biomass

The main ten commodities in Ukraine are

Ukraine — Top Ten commodities, Production quantity, 2012

	Commodity	Quantity [t]
1	Potatoes	23250200
2	Maize	20961300
3	Sugar beet	18438900
4	Wheat	15762600
5	Milk, whole fresh cow	11260102
6	Sunflower seed	8387100
7	Barley	6936400
8	Soybeans	2410200
9	Tomatoes	2274100
10	Cabbages and other brassicas	1922400

Source: FAOSTAT, FAO of the UN, Accessed on February 4, 2015.
http://faostat.fao.org/site/567/default.aspx#ancor

Lakyda et al (2011) found that the technical potential of forest biomass was 89.08 petajoules (PJ) (2.1 million tonnes of oil equivalent [Mtoe]) and that of agricultural waste was 501.43 PJ (12 Mtoe) based on 2008 data. The agriculture sector of the country generates significant agricultural waste. It was estimated that it could be used to produce enough biogas to replace 2.6 billion cubic metres (bcm) of natural gas per year. With agricultural expansion, biogas potential could grow to the equivalent of 7.7 bcm of natural gas (Biomass, 2015).

The potential of biomass was calculated in 2011 (SEC, 2011) as per the table below.

Table 33. Biomass potential in Ukraine (SEC, 2011).

Type of biomass	Potential, kt/yr	Utilization, kt/yr		Share of the potential	
		energy production	production of pellets/briquettes	energy production	production of pellets/briquettes
Firewood	4219 th.m^3*	2657 th.m^3		63%	
Wood residues and waste	1348	435	74	32%	5,5%
Straw of cereals	4750	29.5	2	0,6%	0,04%
Sunflower husks	842	500	214	59%	25%

Agricultural biomass is concentrated in the central, south eastern and southern regions, while the potential for forest biomass is in the northern and western parts of the country. The potential of agricultural residues is also large due to the favourable climatic and soil conditions in Ukraine to grow cereals.

Table 34. Agricultural residues potential in Ukraine (SEC, 2011).

Potential of agricultural residues in Ukraine (2008) Type of agricultural residues	Theoretical potential, PJ	Technical potential, PJ
Primary agricultural residues	1135.52	415.05
Secondary agricultural residues	32.9	18.29
Total	**1259.29**	**501.43**

Although the share seems to be large the competition with other uses such as animal husbandry and the impacts on soil and water for increasing the production, therefore sustainability issues need to be considered as well.

Forest residues have potential considering the large cover forest in Ukraine which is concentrated in the north and the west parts of country (Geletukha et al, 2010). Although in the last 50 years forested area in Ukraine increased at about 1.5 fold (basically due to extensive reforestation and afforestation programs) these areas do not represent a biomass potential (mainly in the Steppe zone) because they need to be in line with sustainability criteria from the reforestation and afforestation programmes.

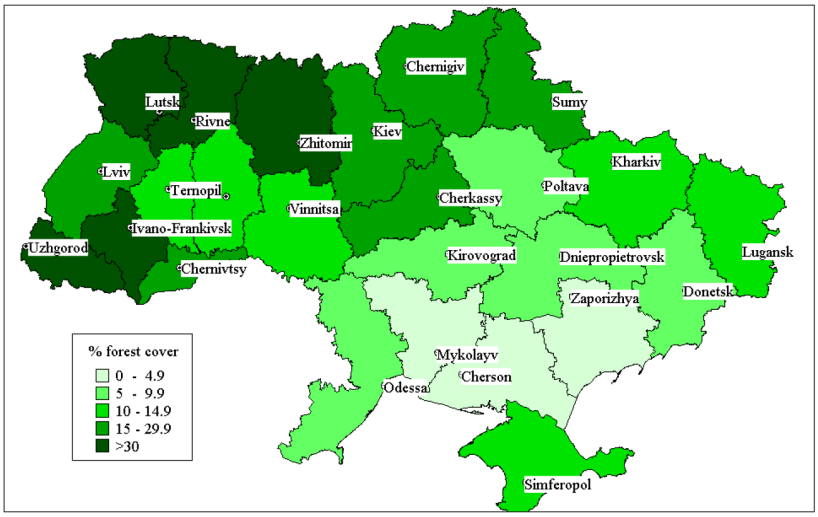


Figure 50. Forest cover in Ukraine (Geletukha et al, 2010).

The forest biomass potentials were assessed by Geletukha et al (2010) for a total area of forested lands in Ukraine (closed canopy forests) that consist 9.4 million ha or 15.6 per cent of the Ukraine's territory (Table 35).

Table 35. Potential of forest biomass in Ukraine (Geletukha, 2010).

Type of forest biomass	Theoretical potential		Technical potential	
	PJ	Mt	PJ	Mt
Stemwood	263,72	14,7	49,95	2,79
Primary forest residues	28,70	1,79	22,63	1,41
Secondary forest residues	19,82	1,11	16,50	0,92
Total	**312,24**	**17,6**	**89,08**	**5,12**

Ukraine produces wood products such as sawdust briquettes, pellets, fuel wood chips, charcoal and firewood. An estimated 60% of these products are exported (IEA, 2012).

3.6.3 Sustainability issues

Land tenure

The Oakland Institue in 2014 reported that over 1.6 million hectares (ha) of land in Ukraine are now under the control of foreign-based corporations. Further research has allowed for the identification of additional foreign investments. Some estimates now bring the total of Ukrainian farmland controlled by foreign companies to over 2.2 million ha (Oakland Institue, 2015).

In general, Ukraine's land reform has been a lengthy process and has posed major obstacles for the rural population. To date, agricultural policies have provided hardly any state support for small and medium farmers in Ukraine, and the government seems to lack much of an understanding of how to foster rural development. In both cases, policies might exist on paper but are not implemented (Demyanenko, 2008: 8-9)

To date, agricultural policies have provided hardly any state support for small and medium farmers in Ukraine, and the government seems to lack much of an understanding of how to foster rural development, therefore policies exist in paper but are not implemented. Currently, although private smallholders stilll dominate many foreign companies are taking over the land the same as oligarchs (Plank, 2013).

Biodiversity

Ukraine occupies only 6% of the region in Europe but possesses 35% of its biodiversity. This is due to its favorable location, with a lot of migration routes and natural zones occurring in the country. Biota comprise over 70 thousand species, including many rare, relict and endemic species. According to the Convention on Biological Diversity (2015), the main pressures on biodiversity are due to fragmentation of landscapes, the development of infrastructure and urbanization, pollution, over-exploitation of bioresources, destruction of certain types of landscapes as a result of agricultural activities and the introduction of alien biological species (CBD, 2015).

Food security

In 2008 Ukraine was declared by the UN as the solution for world food production due to the large production of cereals. FAO statistics (2015) shows a relative stable food supply per capita until 2011 (Table 36)

Table 36. Food supply per capote in Ukraine (FAOstat, 2015).

Ukraine: Per capita food supply				
	Quantity [kcal/capita/day]			
	1996	2001	2006	2011
Food Supply	2799	3013	3244	3142
Source: FAOSTAT, FAO of the UN, Accessed on May 26, 2014. http://faostat.fao.org/site/368/default.aspx#ancor				

Nevertheless, the conflict in Eastern Ukraine following the annexation of Crimea changes the situtation. Although there have been casualties, the main problem is the a massive displacement of the population, currently estimated at around 1 million people. This has also contributed a decline in the economic with rising inflation, currently at 25%, and with significant difficulties in resupply of markets. This has led to food shortages particularly in easter Ukraine

Working conditions

According to a report by Lopatin et al (2011), 350,000 people were employed by the forest sector and 260,000 of them work in the private sector in 2006 (no recent figures were found). The estimated total employment contribution, which also includes indirect positions, was about 500,000. The State Committee of Forestry owns forests and they conduct 80% of the harvesting with their employees. The rest (0-10%) is done by contractors which are hired by the Committee (Lapetin et al, 2011).

The table below shows the ILO conventions that Ukraine has signed, related to the bioenergy/biomass sector.

Table 37. ILO conventions ratified by the USA.

No.	ILO Convention	Ratified	In force
29	Convention concerning Forced or Compulsory Labour	1969	√
87	Convention concerning Freedom of Association and Protection of the Right to Organise	1976	√
98	Convention concerning the Application of the Principles of the Right to Organise and to Bargain Collectively	1976	√
100	Convention concerning Equal Remuneration of Men and Women Workers for Work of Equal Value	1963	√
105	Convention concerning the Abolition of Forced Labour	1963	√
111	Convention concerning Discrimination in Respect of Employment and Occupation	1969	√
138	Convention concerning Minimum Age for Admission to Employment)	2001	√
182	Convention concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labour	2005	√

3.6.4 Policy

Ukraine's energy legislative framework relative to renewable energy with influence on biomass includes:

- Energy Savings (No. 74/94-BP) 1994
- Alternative Fuels No.1391-XIV) 2000, amended (No.1391-VI) 2009
- Alternative Energy Sources (No. 555-IV) 2003;
- Combined Heat and Power Production and Use of Waste Energy Potential (No.2509-IV) 2005;
- Heat Supply (No.2633-IV) 2005;
- Energy Saving Promotion (No.760-V) 2007;
- Green Tariff (No. 601-VI) 2009;
- Power Industry Promotion of Alternative Energy Use (No.1220-VI) 2009
- Promotion of Biological Fuels Production and Use (No.1391-VI) 2009.

According to FAO (nd), the Land Code adopted in 2001 shows three types of property in Ukraine: state, communal and private. Land plots up to 5 ha from the agricultural and farming lands may be transferred to the private property. On forestry other Laws apply:

- Land Code of Ukraine (adopted by the Parliament, 2001)
- State Programme "Forests of Ukraine 2002-2015" (Government resolution №581 on 29.04.2002).
- President's Decree aimed to reform forestry of Ukraine (2004)

Certification

Several ecolabels are implemented in Ukraine. Among those related to forestry are:

- Forest Stewardship Certification (FSC) for both chain of custody and forest management
- Programme for the Endorsement of Forest Certification (PEFC) schemes

There is a national certification system as well.

4. Summary of countries

This report presented an overview of six countries where potential for biomass use to be exported to the EU may exist. The theoretical potential has been assessed directly considering the production or area of crops and/or forest residues.
The land use future programmes have not been included here as this is an overview is at national level and the specific cases will be looking into detail the sustainability potential as explained in the methodology.

A summary of the overview of the countries is presented in Table 38. Some residues were not fully reviewed in this overview but will be assessed in the specific case study (e.g. agricultural residues in the USA).

Table 38. Summary of all countries' general characteristics

Country	Population million	GDP USD	Agricultural land (1000 has)	Forest land	Feedstock	Specific crops' residues	Potential	Sustainability issues	Policies
Brazil	202.65	$3.073 trillion	275605	515133.2	FR; AR; FP, NFP	Sugar cane bagasse, rice, maize, cassava. Forestry residues (eucalyptus and pine)	H	Considerations on forest management and some social issues	In place but enforcement needed
Colombia	48.32	$378.1 billion	42617.6	60297	AR, FR	Palm oil residues, sugar cane bagasse and residues, coffee residues	H	Considerations on logistics, transport and some social issues	In place but enforcement needed
Kenya	39.42	$61.83 billion	27430	3445	AR, FR, FP	Maize, coffee, sisal, rice, others. Forestry residues	L	Considerations on logistics	In place but enforcement needed
Indonesia	25.36	$856.1 billion	56500	93062	FP	Palm oil residues	M/H	Deforestation	In place but enforcement needed
United States	318.9	$16 800 trillion	408706.5	304787.6	FR, FP, FP	Timber from FP, forestry products, and mill residues	H	Considerations on local uses in the future	In place
Ukraine	44.29	$337.4 billion	41297	9757	FR, PR, AR	Cereals crops residues, forestry residues and forest products	M/H	Considerations on the current situation in the East	In place but policy needs to be implemented

FR Forestry residues
AR Agricultural residues
FP Forest plantations
C Dedicated biomass crops
NFP New forest plantations
Potential: H (high); M (medium), L (Low)

The summary above shows a preliminary qualitative assessment at national level of the selected countries. Except the United States where the SouthEast was considered since the start of the project. The potential is also general, based on the background information and the theoretical assessment. Some highlights are as follows:

- The cases of Brazil and the USA are presented as High regarding the potential of forestry plantations and residues, specially from the sawmills. For the case of Brazil, the possibilities of other agricultural residues were also considered.
- Colombia has a high tehreticla potential but one of the main impediments si related to the logistics for transport.
- In the case of Indonesia most of the potential lays on the residues of the palm oil sector.
- Kenya presents the lowest potential from the selected feedstocks and this is due to feedstock availability (theoretical potential) itself but also to the limitations in logistics.
- Finally, Ukraine has a high theoretical potential but this is mainly for forestry products, although agricultural residues can also be considered.

Future work

This report presented an overview of the countries in the following areas:
General characteristics of the country including land use
Main feedstocks and theoretical potential
Sustainability issues:, land rights, biodiversity, social issus
Policy

The individual case studies in future work within the Project Biotrade2020plus will allow to present a more detailed assessment according to the methodology presented in section 2. It will not only entail further assessment per scenarios but will also locate the regions in the countries rather than focusing on the national scale as done within this report.

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