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# IMPACT OF EU BIOENERGY POLICY ON DEVELOPING COUNTRIES

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## BRIEFING PAPER

# IMPACT OF EU BIOENERGY POLICY ON DEVELOPING COUNTRIES

**Abstract**

Against the background of the renewable energy targets of the European Union, the EUs interest in biomass has considerably increased in recent years, not only for energy crops grown on arable land but also for woody biomass. This brief analyses some of the main impact dimensions with regard to land access, energy and food security and environmental impacts in developing countries. The developing countries most likely to export woody biomass to feed Europe's demand are west and central African countries as well as Latin American countries. While clear links between the increasing EU demand for wood for energy generation and impacts in developing countries, both negative and positive, need to be drawn on a project level, the additional demand for biomass worldwide will have macro effects. The rising demand for woody biomass energy is likely to raise the global price for wood, thus adding pressure on forests and other ecosystems and driving land use conflicts. More specific risks include deforestation when natural forests are replaced by monoculture plantations and long term impacts on local food and energy security. This brief concludes with potential approaches to tackle these impacts including biomass sustainability criteria, increased efforts towards resource efficiency and support for developing countries to build up good governance mechanisms.

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# EXECUTIVE SUMMARY

In April 2009, the Council of the European Union adopted a directive setting a common EU framework for the promotion of energy from renewable sources (Directive 2009/28/EC). The overall goal of the Directive is that by 2020, 20% of the EU's final consumption of energy should come from renewable sources. The directive also sets an EU-wide goal for the transport sector. Until 2020, a 10% minimum share of the energy consumed in the transport sector has to come from renewable sources.

In this context the interest in biomass in the EU has considerably grown in recent years, not only for energy crops grown on arable land but also for woody biomass. In the EU, woody biomass for energy is predominantly used in the heating/cooling sector and for the generation of electricity. While new technologies allow for the conversion of woody biomass into liquid biofuels (so called second-generation biofuels), the current use of woody biomass for transportation fuels is still limited. The developing countries that are most likely to export woody biomass to feed Europe's demand are west and central African countries as well as Latin American countries, particularly Brazil.

This brief has put some light on some of the main impact dimensions growing wood export from developing countries can have with regard to land access, energy and food security and environmental impacts. While clear links between the increasing EU demand for wood for energy generation and impacts in developing countries, both negative and positive, need to be drawn on a project level, the additional demand for biomass worldwide also has macro effects. First and foremost, the rising demand for woody biomass energy is likely to push the global price for wood, thus adding pressure on forests and other ecosystems and increasing conflicts between different land uses. More specific risks are deforestation corresponding with the replacement of natural forests by monoculture plantations. Rural communities are potentially harmed in their access to land and water, their food and energy security for decades given the long-term nature of most investments and projects.

The briefing concludes with potential approaches to tackle these impacts, which include the extension of binding sustainability criteria from liquid biofuels towards solid and gaseous biomass used for electricity, heating and cooling. Considering the bigger picture, it also addresses the need for energy and resource efficiency to reduce the EU's ecological footprint and the need to support developing countries' efforts to build up good governance mechanisms.

# 1. INTRODUCTION

In April 2009, the Council of the European Union adopted a directive setting a common EU framework for the promotion of energy from renewable sources (Directive 2009/28/EC), also called the Renewable Energy Directive (RED). The overall goal of the Directive is that, by 2020, 20% of the EU's final consumption of energy should come from renewable sources. The directive also sets an EU-wide goal for the transport sector. Until 2020, a 10% minimum share of the energy consumed in the transport sector has to come from renewable sources. As renewable electricity in the transport sector is still a niche, the majority of this transport target is likely to be met by expanding the production of liquid biofuels.

In this context, the interest in biomass in the EU has grown considerably in recent years. Apart from energy crops grown on arable land, the demand for woody biomass, which can be used for so-called second generation biofuels (e.g. biomass to liquid and cellulosic ethanol) as well as for renewable heating and electricity, has also increased.

The aim of this briefing is to assess the impacts on developing countries of the EU's rising demand for biomass for bioenergy production with a **particular focus on woody biomass** such as wood chips, logs, firewood, wood pellets and mill residues[1]. It will particularly assess:

1. impacts on the **access of rural communities to land and water,**
2. the extent to which the interest in biomass could undermine the efforts of developing countries to meet their own food needs (**food security**),
3. impacts on the access to renewable sources for energy consumption **(local energy security)**, as well as
4. the impacts that a growing demand for woody biomass by the EU could have on rural communities in developing countries, in particular in terms of **environmental impacts and land degradation**,

In order to estimate the extent of the described impacts, this briefing will first outline the different production and use options for woody biomass for bioenergy. It will then analyse the current and anticipated trade flows of woody biomass from developing countries and draw conclusions about the impacts of the described development.

[1] Firewood and charcoal are, and wood chips, mill residues, wood pellets and logs can be, produced specifically for use as fuel. FERN (2011) refers to these six products as 'primary woody biomass'. The term 'woody biomass' comprises all these products but also includes the wooden products (including furniture but excluding pulp, paper and fuel) which are made from them. At the end of its service, this wood can be used as fuel.

# 2. PRODUCTION AND USE OF WOODY BIOMASS FOR BIOENERGY

Compared to other renewable energies like wind or solar energy, biomass has the advantage that it is equally suitable as a transport fuel, a source of renewable electricity or as a source for heating. Bioenergy can hence play a role for the achievement of both the overall RED target of 20% renewable energy and the 10% renewable target in transport.

However, the use of woody biomass for energy competes with other sectors such as paper, construction, furniture, etc. for feedstocks like sawdust, shavings, logs, and sawmill chips. While the wood bioenergy sector is still small compared to the pulp and paper industry, it is one of the fastest growing markets for wood (Global Forest Coalition 2010).

At the global level, biomass energy makes up 77 per cent of world renewable energy, and trees and woody plants account for 87 per cent of that biomass. Such woody biomass is often burnt directly for domestic heat and cooking, especially in the global South (Cotula et al 2011).

Woody biomass is used by the energy sector for heating, cooling and electricity, with heating as the core sector (AEBIOM 2011). The most important sector for wood consumption for energy generation in the EU 27 is traditional wood fuel in the form of logs, round and split, mainly for heat and hot water production in private households (Mantau et al. 2010). The demand for woody biomass in the transportation sector, while currently limited, is likely to increase once second-generation biofuels[2] become commercially available on a larger scale.

An analysis of the National Renewable Action Plans of the EU Member by Hewitt (2011), reveals that the quantity of wood required to satisfy the 2020 targets is likely to be too large to be met by increased production within the EU.[3] The quantity used in generating electricity from solid biomass within the EU is likely to double between 2010 and 2020, while the quantity used for heating and cooling is likely to increase by about 50 per cent. The increase of additional biomass that may be required within the next 10 years is most likely between 100 and 200 million cubic metres (Hewitt 2011).

A study undertaken in the "EUwood"-project (Mantau et al. 2010) comes to comparable results: "wood volumes for energy generation are expected to increase by 66% between 2010 and 2020. Wood consumption for energy generation is expected[4] to grow from 346 million $m^3$ in 2010 (3.1 EJ) to 573 million $m^3$ (5 EJ) in 2020 and might reach 752 million $m^3$ in 2030 (6.6 EJ)"[5]. However, the demand for wood energy could increase more dramatically if countries do not meet energy efficiency targets.

Woody biomass exported from developing countries to biomass power plants in the EU is to a large extent produced on biomass plantations (Cotula et al 2011). Already in 2005, planted forests supplied an estimated 15–20 percent of the world's woodfuels[6], whether in the form of residues from industrial timber and pulp plantations or as whole trees from dedicated bioenergy plantations (Mead, 2005 cited in FAO 2010a)[7]. Biomass plantations grow various plants for wood pellet and wood chip production.

[2] Second generation biofuels are made from lignocellulosic or woody crops, agricultural residues or waste.

[3] However, errors when converting statistics and inconsistencies of data make it hard to draw firm conclusions from the statistics (Hewitt 2011).

[4] These assumptions need to be seen against the methodological assumptions including e.g. energy efficiency and renewable energy targets achieved and wood losing its share of renewable energy (Mantau et al 2010).

[5] Gross energy consumption of wood and wood waste in the EU 27 has increased from 125 million tonnes in 2000 (83% of total biomass and waste consumption) to 175 million tonnes (67%) in 2009 (Eurostat, cited in Sikkema et al 2011).

[6] According to the (FAO 2010a) woodfuels are any type of biofuel derived directly or indirectly from trees and shrubs grown on forest and non-forest land.

[7] In 2005 there were an estimated 141 million hectares of plantations worldwide. Of this area, 8.6 million hectares – including 6.7 million hectares in Asia – were being grown specifically for woodfuel, mostly consisting of fast-growing trees such as Populus, Salix, Eucalyptus and Acacia species (FAO 2010a). In Brazil, for example, 25 percent of Eucalyptus

**Plantations specifically for energy wood** mostly consist of fast-growing trees such as Populus, Salix, Eucalyptus and Acacia species European power plants are also fed by biomass from bamboo in Guyana, Melia dubia trees in Ghana, eucalyptus plantations in the Republic of Congo, rubber tree plantations in Liberia, and eucalyptus and pine plantations in Brazil (Clenergen 2011, FoE Scotland 2010). In Brazil there has been a substantial expansion of plantations for pulp fibre and bioenergy, with 70% of the plantations being eucalypt and 30% pine (Couto et al 2011).

## 3. OVERVIEW OF CURRENT AND ANTICIPATED TRADEFLOWS

As shown above, the additional wood required to satisfy EU bioenergy demand cannot be met by domestic resources because the area of productive woodland is limited and can hardly be expanded due to competing land uses.[8]

Figure 1 gives an overview of raw material availability in different regions and continents. It shows that with respect to developing countries, West and Central Africa in particular, as well as South America and Southeast Asia, have an increasing harvest potential for woody biomass.

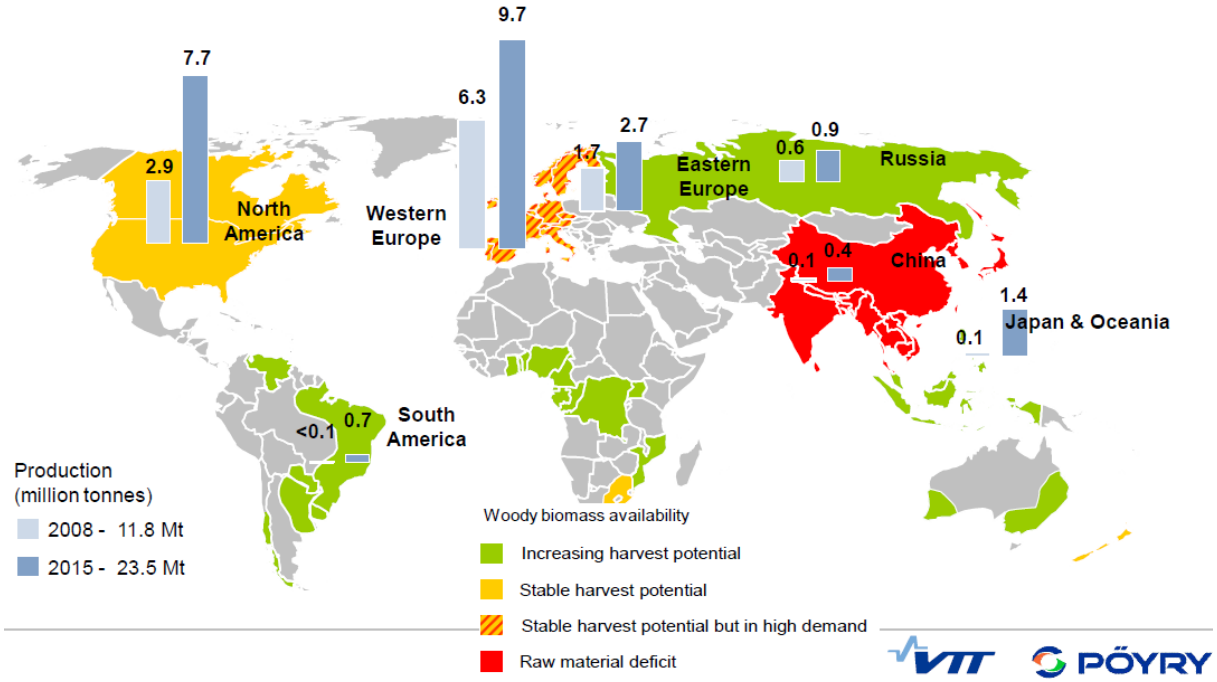


Figure 1: Global overview on raw material availability and pellets production (Source: AEBIOM 2011)

While countries such as France and Germany are pursuing a model that mainly relies on domestic supplies, many EU countries such as Italy, the Netherlands, Sweden and the UK already import increasing volumes of wood pellets.

In the United Kingdom, for example, plans to expand bioenergy will push the demand for biomass up to 60 million tonnes per year, compared with the one million tonnes burnt or co-fired in the country's

plantations are grown specifically to provide charcoal for the pig-iron, steel and cement industries (Andersson et al., 2002; Ceccon and Miramontes, 2008, cited in FAO 2010a).

[8] Even if changes in forest management practice in some Member States might result in increased supplies of woody biomass, this process will take time (given the time it takes for trees to grow) and might not be consistent with sustainable forestry practices (Hewitt 2011).

biomass power stations today (Cotula et al 2011). Hence, the projected demand for wood chips and pellets will exceed — by five or six times — the locally available supply of ten million tonnes a year (Bonsall, R. 2010 cited in Cotula et al 2011). Clegg Consulting estimate "that the rising UK demand alone could lead to almost doubling of world trade in wood chips and pellets" (cited in Cotula et al 2011).

The EU imports 80 per cent of global pellet production (10 million tonnes produced in 2009) and is by far the largest importer of wood pellets worldwide: the Netherlands consumes about 35 per cent of the wood pellets imported by the EU. Towards the end of 2010, Belgium, Denmark and Sweden each accounted for a further 10 per cent of the total. By contrast, most of the firewood, wood chips and other residues are imported by Finland, Italy and Sweden (Hewitt 2011).

Trade of biomass for energy production between countries in continental Europe consist primarily of refined products like wood pellets, wood briquettes, wood chips, and also biofuels for transport (to date, predominantly biodiesel). Trade flows in local and regional biomass markets in CE countries can hardly be detected. Concerning intra-EU trade in wood pellets, Denmark, Italy, and Sweden are the leading importers and have accounted for most of the increase since 2009. Germany, the Baltic States (primarily Latvia), Austria and Portugal are the main suppliers in the intra-EU trade in wood pellets (Hewitt 2011).

Hence, the sources for this demand are likely to be met by **imports** from

- **existing exporters** particularly of wood chips and pellets, such as Canada, Norway, Russia and the United States, where the anticipation of growing demand from western Europe is already driving major investments. However, the extent to which supplies from these sources can keep expanding is uncertain (Cotula et al 2011, Hewitt 2011), and
- **non-traditional suppliers**, including countries from the Global South.

**Africa** is likely to play a big role in feeding European demand for biomass, as it is perceived to be abundant in available land. Due to climatic conditions tree growth rates tend to be higher[9]. Some companies are already moving to service or replant existing tree plantations for this purpose e.g in Ghana, Liberia, Madagascar, Mozambique, Tanzania and Congo (see Cotula et al 2011).

**Brazil** is often considered to be the EU's most promising potential source of wood-based fuel in the southern hemisphere, due particularly to its infrastructure and proximity (Hewitt 2011), with operators in Brazil becoming increasingly interested in exporting to Europe. Brazilian exports of wood based products particularly come from plantations (Cotula et al 2011). Brazil has over 4 million hectares of eucalypt plantations, some of which are dedicated to the production of charcoal while others include forestry and agricultural production (Coutu et al 2011).

In addition to the above mentioned, Belarus, Switzerland and Ukraine also supply a substantial volume of primary woody biomass to the EU, mainly as mill residues, logs and (in rapidly increasing quantity) firewood. Croatia and, to a lesser extent, Bosnia-Herzegovina account for a smaller proportion of the total amount of wood supplied from non-EU Europe (Hewitt 2011).

Figure 2, although not exhaustive, highlights some examples of land being acquired in the Global South to establish tree plantations wholly or partly for biomass energy for export or domestic markets.

[9] In natural temperate forests, growth rates range from 1 to 4m$^3$ per hectare, each year. In temperate and sub-tropical plantations of conifers such as pines, this range rises to 10–30m$^3$ per hectare, each year. Tropical pine plantations are faster still at 15–45m$^3$ per hectare each year. Fastest of all are tropical eucalypt plantations that can reach growth rates of up to 60m$^3$ per hectare each year. (Evans 1982 cited in Cotula et al 2011)

Figure. Land areas under known tree plantations wholly or partly for biomass energy in the global South.

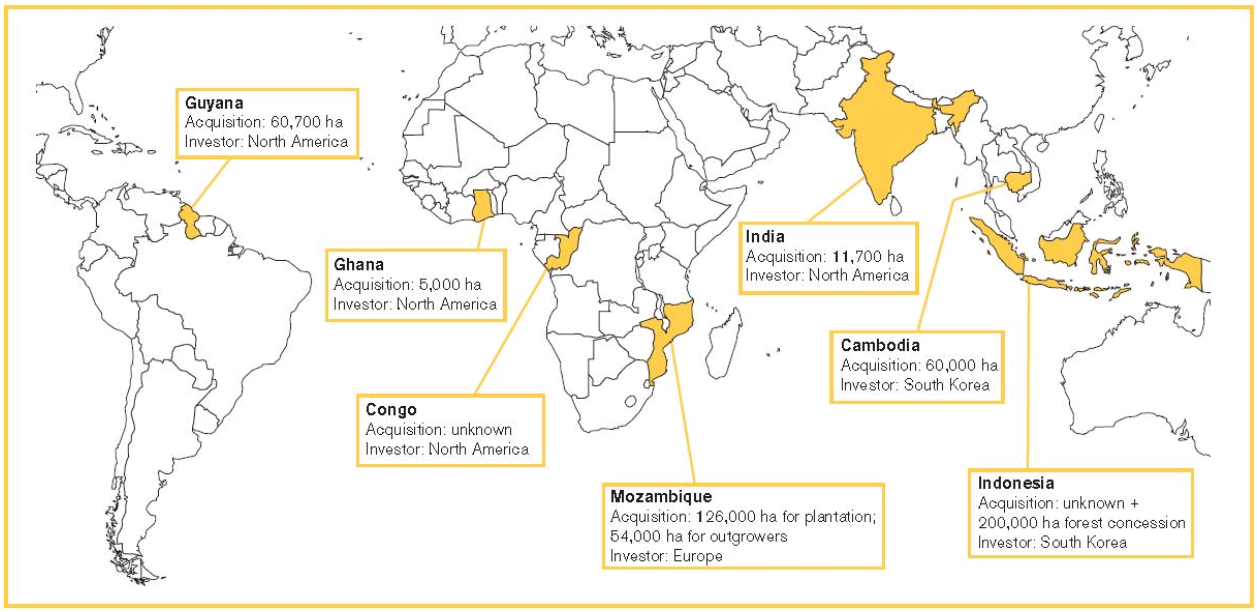


Figure 2: Land areas under known tree plantations wholly or partly for biomass energy in the global South (Source: Cotula et al. 2011)

# 4. IMPACTS

Developing countries will play a major role in supplying wood to meet the global and EU demand for bioenergy because of the perceived harvest potential and comparably low extraction costs. The question is how this rising demand for energy wood in the EU will impact developing countries and the people living there.

While there are **benefits** that can be gained, e.g. in terms of job creation and improved energy access, there are also reasons for **concern**: some of the potential exporting countries (see above) are characterized by food insecurity, vulnerable land rights and governance structures that often cannot ensure compliance to regulations, e.g. with regard to sustainability requirements.

It is also important to note that due to "**leakage effects**" in markets through a) the competition between woody bioenergy and other uses for woody biomass and b) competition between market demand for woody biomass in the EU and other regions/ countries, the range of indirect impacts due to biomass plantations is even greater than the direct impacts of woody biomass production for export to the EU's bioenergy sector.

It is therefore difficult to draw a clear link between the increased demand of woody biomass in the EU and one particular impact of the extraction of woody biomass in a specific country. Hence, the following analysis is restricted to some general insights particularly for developing countries in Sub Saharan Africa and partly Southeast Asia and potential impacts driven by the increasing demand for wood in the EU and beyond.

Impacts that will be analysed below are:

a) access of rural communities to land
b) access of rural communities to water
c) food security
d) local energy security
e) environmental impacts and land degradation

### 4.1 Access of rural communities to land

Research on the impact of bioenergy on the rural communities focuses largely on biofuel crops, but woody biomass production can have many of the same impacts. As with biofuel crop plantations, bamboo or eucalyptus plantations require large amounts land, which investors increasingly try to obtain in developing countries. The severe consequences this can have on rural populations are currently discussed under the terms **"land grabbing" and "water grabbing"**. Scientists, scholars and NGOs such as FIAN, Friends of the Earth, GRAIN and the Oakland Institute have argued that land deals have negative impacts on local communities. Adverse affects may include displacement, change of livelihoods and disempowerment for local groups.

Since 2001, 227 million hectares of land have been sold, leased, licensed or are under negotiation in **large-scale land deals** (Oxfam 2011). In general, these large-scale contracts are likely to include land that is used or claimed by local communities (Cotula 2011). These rural stakeholders have a limited say in the reallocation of their land, the terms of agreements, or the benefits they can gain.

Only 2-10% of all land in Africa is formally tenured (World Bank 2003), so most communities do not have a **formal** legal **claim** to the land they use and consider their own. The situation is especially grim in countries where these customary rights are not legally recognized, such as in Cameroon. As a result, Cameroon's government signs legal contracts over the use of land (Cotula 2011) without consulting rural communities. This lack of legal protection is relevant since the European Biomass Assocation (AEBIOM) recognized Cameroon as a country of increasing biomass harvesting potential (see Fig. 1) (AEBIOM 2011). In Ghana, where contracts to lease land for biomass feedstock cultivation are signed between chiefs and companies, it is unclear how representative the chief's views are of the interests of the rural communities (Cotula et al. 2011).

The conversion of large areas of land to biomass plantations does not only affect the people living on the particular plot of land, but also those in the **surrounding areas**. In Brazil, local populations are opposed to the development of new plantations of eucalyptus and acacia to supply the UK with wood pellets. As Raul Krauser from the Movement of Small Peasants explains, 'We already have bitterly accumulated a list of impacts on the lives of peasants from eucalyptus monoculture expansion: acquisition of big unproductive farms that should be destined to agrarian land reform; rise in land prices in the whole region; […] pressure on [peasants] to sell their lands […]' (Overbeek 2011).

Leasing contracts signed between investors and national governments often are of an **extensive duration**. MagForestry's concession for land for eucalyptus plantations in the Republic of Congo lasts until 2075 (MagForestry 2011), and Clenergen's sublease on land for biomass production in Ghana will be valid for a minimum of 49 years (Clenergen 2011). The long duration of contracts means that agricultural knowledge and livelihood strategies in communities will be lost before contracts expire (Cotula 2011). The leases may even change the landscape of the area permanently: MagForestry's contract in Congo not only permits eucalyptus farming, but also provides mining and mineral exploration permits over large swaths of the land (MagForestry 2011).

Even where protection for communities' **customary rights over land formally exists** and commitments to consult communities about changes in land ownership are foreseen in the contracts, such **provisions are often insufficient or even ignored**. A study on biofuels in Mozambique, which is also considered to be high in potential for future woody biomass supply, found that government support for large private investments and weak inter-institutional coordination exclude rural communities from the benefits from biofuel production (Nhantumbo and Salomão 2010). In Mozambique, consultations with communities were often cursory and did not provide communities with information on how the projects would impact their agriculture, charcoal production and fisheries.

Only after concerted resistance, communities were able to negotiate concrete terms on job creation and the provision of houses, schools and water installations (Nhantumbo and Salomão 2010). Unfortunately, many of such promises remain unfulfilled, as those who obtain **jobs** are not necessarily the same individuals who were displaced or who lost access to water (Cotula, 2011). The mechanized nature of biomass plantations may offer fewer benefits to affected communities, especially in the long term: in certain plantations, bamboo will be harvested by machinery rather than human labour after the fourth year (Clenergen 2011).

The production of feed stocks for EU biomass power plants may also compound **human rights concerns** in developing countries. The Swedish power company Vattenfall uses wood chips created from rubber trees in Liberia in its power plants in Europe. The rubber tree plantations from which the trees are harvested are owned by Firestone-Bridgestone, among others (Rainforest Rescue 2010), and have been the subject of human rights investigations. The UN Mission in Liberia has documented the dire state of the plantations: the plantations use child labor and have 'deplorable living conditions and poor sanitation' (2006). Thus, it may be difficult to trust rubber companies to accurately portray the significance of the rubber trees to the local populations or to vouch for the rural communities' interests.

### 4.2 Access of rural communities to water

As mentioned above, woody biomass imported from developing countries to the EU is likely to come to a large degree from biomass plantations. These plantations often have a high **demand for water,** which mostly depends on the size of the plantations and the species used. Many environmental NGOs have reported cases where eucalyptus plantations, for example, draw tremendous amounts of water from the soil leading to substantial declines in local ground-water levels. This can deprive local communities of their water resources even if the water and nutrient use efficiency for the wood-producing plantations is better than those of native species/ forests (Lima, 1993 in Cuoto et al. 2011). The **use of pesticides and herbicides** in monoculture plantations and their contamination of local water sources (Overbeek 2011) is another issue of concern. Herbicides are commonly used in plantation forestry to prepare sites for planting or to control plant competition during establishment.

As in the case of land, communities' **water rights** are customary and have limited protection. Investors, however, typically try to define and negotiate the amount of water they will be guaranteed. Under normal conditions, this can create conflicts over water use with local populations, but it is especially worrying in times of drought. In some land contracts, as it has been shown for two cases in Mali and Sudan, investors were provided with unrestricted access to water, potentially leading to water insecurity for local communities (Skinner and Cotula, 2011).

Lastly, ambiguity in land contracts for biomass production can lead to confusion over communities' future access to water. In Guyana, where Clenergen currently has a concession of 5 000 acres, the company has the right to sublease up to 145 000 acres (58 679 ha) of savannah land along a river in the future (Clenergen 2011).

### 4.3 Food security

Many developing countries that may be future energy wood exporters are dependent on food imports or even direct aid to meet the basic food demands of their populations (e.g Ethiopia, Mozambique, Sierra Leone, Cambodia, etc.). Such countries are most vulnerable to volatile food prices on the international markets (see FAO 2011) and to natural disasters such as droughts, floods, pest invasions and others. They often do not have the capacity to invest in the agricultural sector to make food production more efficient and to build up necessary capacities in rural areas. Moreover, many people lack access to land, which is, according to the UN Special Rapporteur on the Right to Food, key to

ensuring food security in developing countries (see De Shutter 2010). Non-existent or unclear land rights prevent people from legally claiming land for their livelihoods and put them at high risks of being evicted from their lands in case of commercial interest from investors, e.g. for producing biomass for export (see also the section on land access in this briefing).

Energy wood production for export to the EU, e.g. from biomass plantations, imposes risks to food security in developing countries in different ways. First, there can be **direct competition for fertile lands** between growing energy crops or woody biomass and using the land for growing food crops for local consumption. It has to be noted that even though this is seen as a potential development path for increased biomass production, degraded or marginal lands are not in the core interest of investors for the same reason that farmers prefer fertile lands to grow their crops: yields are likely to be higher (also for woody biomass) and costs can be kept low if the land is connected to existing infrastructure and transport routes. In India, jatropha trees that can be planted on marginal lands were planted on fertile lands in order to achieve higher yields (Luoma 2009) So even if there are many species such as bamboo and melia dubia trees that can be cultivated in poor soils and do not need to use arable land (Clenergen 2011), it is likely that due to better yields, plantations will not be planted in these marginal areas. Similar problems could occur in countries like Mali, where bioenergy contracts have failed to specify the exact geographic location of land concessions, and instead, investors have determined the most suitable location for their plantations based on their own feasibility studies, which can jeopardize crop land (Cotula 2011). Thus the increasing competition for land for energy wood production and food crops may increase food prices, lead to social pressures on local populations and may result in "land grabbing" (see section on land access in this briefing).

Second, if the land was previously used by local communities for pasturing, collecting firewood or for gathering and selling products, converting the land into biomass plantations could lead to a **loss of** those **income opportunities**, which are in turn needed to buy food. For example in Sub Saharan Africa, the wood-based biomass energy sector employs a significant workforce, providing regular income to tens—if not hundreds—of thousands of people who often have few alternatives to earn cash income (World Bank/AFREA 2011). Unlike in most industrialised countries, land has multiple essential functions to rural people in developing countries. Forests in particular provide a wide range of "services" by supplying wood for energy and building purposes, providing non-timber (food) products, and also by regulating water supply and stabilising micro-climatic conditions. According to the FAO (2011), forests play an important role in the food security of one billion of the poorest people on the planet by providing food or cash income through a wide range of products such as wild yams, bush meat, edible insects, fruits, leaves, mushrooms, nuts, honey and medicinal products. The replacement of these forest ecosystems by biomass plantations puts people in serious risks, and even growing biomass in neighbouring areas can harm the integrity of such ecosystems and diminish the services the people are living on (e.g. through water extraction, pesticide use or habitat fragmentation).

Third, the growing demand for biofuel crops is already a **significant factor in the increase in food prices**. As long as governments impose mandates to achieve binding bioenergy targets, this will aggravate the price inelasticity of demand that contributes to volatility in agricultural prices (FAO, IFAD, IMF et al. 2011).

Fourth, and this is a rather indirect impact, the promotion of biomass plantations in a country where the majority of people live directly or indirectly from agriculture can undermine an alternative model of future land use. Such alternative models could allow many people to feed themselves through self-sufficient farming and food production for local and regional markets. With the expansion of biomass plantations, it is often argued that such projects could enhance the economic development in these countries and could provide jobs to local people. However, the mostly industrialised and capital

intensive practices of biomass plantations often do not fit the needs of the people living in this area. The 2008 International Assessment of Agricultural Knowledge, Science and Technology for Development[10] and the International Fund for Agricultural Development (IFAD) argue that improving food security in those areas would instead be achieved through investments in capacity building and education, access to land and information as well as a diversification of income opportunities. These measures would also make rural communities less vulnerable towards the volatility of food prices. However, such integrated approaches are unlikely to be compatible with the current business model of most biomass plantations.[11]

An approach to combining energy wood plantations and food production can be agroforestry systems. An example for eucalypt-based agroforestry in Brazil is the Cia Mineira de Metais (CMM), located in Vazante, Minas Gerais State, where most of the eucalypt timber is converted to charcoal. In that region, eucalypt trees are planted at 10 x 4 m spacing (250 stems/ha) and intercropped with rice in the first year after establishment. In the second and third years, soybeans are intercropped. Finally, in years 4 to 12, pastures are established between the trees, and cattle grazing becomes the agricultural component of the agroforestry system (Couto et al. 2011).

### 4.4 Local energy security

Almost half of the world's population relies on wood-biomass energy for cooking and heating. The majority of this population lives in developing countries, where four out of five people live without electricity, mainly in rural Sub-Saharan Africa and South Asia. Household biomass use is 89% of total wood consumption in Africa, 81% in Asia and 66% in Latin America (World Bank/AFREA 2011).

According to the World Energy Outlook (2010),[12] 918 million people in Sub-Saharan Africa will rely on wood-based biomass in 2030 (compared to 575 million in 2004[13]), 1 769 million people in Developing Asia (including India and China) (compared to 1 865 in 2004[14]) and 79 million in Latin America (compared to 83 million in 2004[15]). **Sub-Saharan Africa** (SSA) and **developing Asia** are therefore the main regions with **high dependence** on wood-based energy for local energy security. Moreover, as shown above, in Asia and Latin America biomass consumption has reached a peak, in Sub-Saharan Africa it is even expected to grow.

Besides biomass energy from forests, sources from **non-forest land can also play a role**, depending on the region. According to Openshaw (2010) trees on non-forest land, particularly agricultural land, can be an important source of wood and biomass energy for rural households and may account for up to 85% of rural energy.

Biomass use in the ASEAN Member[16] countries Indonesia, Malaysia, Philippines, Thailand and Vietnam illustrates the importance of non-forest wood sources for local energy supply. In these countries forest

[10] The IAASTD brought together governments, NGOs, the private sector, producers, consumers, the scientific community, Multilateral Environment Agreements (MEAs) as well as multiple international agencies involved in the agricultural and rural development sectors.

[11] While some dependency structures remain, certain business models (e.g contract farming, management contracts, supply chain relations and joint ventures) for co-existence between large and small-scale farming have proven to be successful in some areas (Vermeulen and Cotula 2010).

[12] Cited in World Bank/ AFREA 2011

[13] World Energy Outlook 2006, cited in World Bank/ AFREA 2011(according to the same numbers only 4 million people in North Africa will relied on wood based biomass in 2004)

[14] World Energy Outlook 2006, cited in World Bank/ AFREA 2011

[15] World Energy Outlook 2006, cited in World Bank/ AFREA 2011

[16] Association of Southeast Asian Nations

contribute between 10 and 50% of total national woodfuel supplies, with the balance coming from non-forest sources (such as non-industrial plantations of coconut, rubber and oil palm, as well as fruit orchards and garden trees). The share of non-forest wood energy in total household-level consumption is reported to be as high as 93% in Indonesia and the share in total wood energy supply as 85% in the Philippines (FAO n.d.). Forest and non-forest sources produce woodfuels by the felling of trees. Alternatively, energy wood is obtained as lops and tops from forest harvesting as dead wood, fallen branches, twigs and dead stumps at site; as by-products of wood-based industries; as surplus non-commercial wood derived from land clearing; or as recovered wood e.g. constructions (FAO n.d.).

In Sub-Saharan Africa, fuelwood and charcoal are the main energy sources, with the former primarily used in rural areas, and the latter being the main energy source for cooking in urban areas (World Bank/ AFREA 2011). The collection of fuelwood from forests has led to a wide removal of forests in the 70s and 80s. Today, the sources of firewood are more diversified with wood from land clearing for agriculture, commercial and residential development, and other land-use changes playing just as important a role for local energy security as actual forests do. An African example from a 1996 production survey in Malawi showed that nearly 40% of fuelwood came from open land (such as farm land) and from roadside trees, grassland and urban trees. Only 15% of the wood came from plantations and woodlots (Openshaw, 2010).

Therefore, when assessing the potential risks of EU's woody biomass demand for local energy security in developing countries, one must differentiate between potential export countries with a high or low local energy security dependency on woody biomass.

In addition, conflicts with local energy security are likely to occur if

- designated sites for the production of woody biomass for export (e.g. energy wood plantations) displace land uses that have a significant role in feeding local energy needs (e.g. open land with trees, orchards etc.) or in ensuring local income.
- woody biomass that currently feeds local energy needs (be it from forest use or from plantations) is redirected to export and hence no longer available for the local population.

Regardless of the source of these wood exports, any significant loss in local wood availability is likely to have a negative impact on local energy security, especially in countries where the proportion of the population that depends on woody biomass for its primary energy source is high, such as in SSA and developing Asia.

An example that illustrates the manifold links between economic impacts, land access as well as food and energy security issues is the case of the Swedish power group Vattenfalls plans to invest in a **Liberian biomass project**: The project would see the production of wood chips from Liberian rubber tree waste that can be burnt to produce electricity. The wood chips would come from Buchanan Renewable Energy (BRE). BRE is buying up old rubber trees and turning them into wood chips for export. This has serious economic impacts on people in urban areas and large towns that rely on charcoal produced mostly from rubber wood. The price of charcoal has gone up about 100% as more rubber wood is now sold to BRE instead of being burnt for charcoal. The overwhelming majority of Liberian people rely on charcoal for domestic energy needs; therefore this increase in price is significant[17]. Additionally, although Vattenfall claims that they use rubber tree waste that would otherwise be burned or would rot, Friends of the Earth Scotland and Rainforest Rescue argue that the trees are used for creating charcoal for local consumption (FoE Scotland 2010).

[17] Article Financial Times, April 6, 2010 and interview Silas Kpanan Siakor, director of the Sustainable Development Institute in Liberia and winner of the 2006 Goldman Environmental Prize, cited in Global Forest Coalition 2010

### 4.5 Environmental impacts and land degradation

Energy wood production and harvesting systems can be integrated with an existing management regime (e.g. the collection of residues for energy during conventional timber harvesting) or can occur independently such as through casual collection of firewood in forests or from trees outside forests. They can also be based on a purpose-grown resource such as on fast growing energy wood plantations. The environmental impacts of these practices vary in nature and extent according to the **scale, intensity and type of production, tree species and harvesting system used** (FAO 2010a).

Generally, all forms of energy production have certain environmental impacts, but compared to other energy carriers or other biomass usages, woody biomass for energy has some particularities. Potential environmental **benefits** are as follows:

- If trees are planted on degraded agricultural land, improvements in biodiversity, soils and water (on water impacts see also separate section in this paper) are possible such as the prevention from soil erosion due to **afforestation** (FAO 2010a, Trettin et al., 2008).
- The potential **reduction of wildfire** through thinning or the removal of logging residues, which in turn can also have downsides as dead wood and residues from forestry are important for biodiversity protection and nutrients cycles,
- Dedicated energy wood plantations can reduce the exploitation of native forests (e.g. Cuoto et al 2011).
- Compared to most annual crops e.g. for biofuels, **woody biomass crop production reduces water runoff and sediment loss** and improves soil organic matter, soil structure as well as water and nutrient-holding capacity. Woody biomass plantations physically stabilize soil by their roots and leaf litter and can reduce wind erosion when planted as shelterbelts. However, harvesting of woody biomass plantations may be accompanied by increased erosion as forestry clear-cutting, especially on steep slopes, often results in a large increase in water erosion. For this reason, woody biomass plantations should be designed for rotational harvesting (Korb et al. 1998).
- If produced and harvested sustainably, they potentially provide a renewable source of energy with **low net carbon emissions compared to fossil fuels**. However, the whole life cycle for wood based energy production (e.g. wood shipping over distances) needs to be taken into account in order to assess potential carbon emission savings.

Despite these potential benefits **environmental risks** associated with energy wood production can be severe:

At a global level, deforestation and forest degradation is continuously taking place and is already responsible for 20 % of worldwide greenhouse gas emissions. While European and North American forests are growing, **deforestation and forest degradation** mainly take place in developing countries, where effective governance structures for forest conservation and sustainable management of forest resources hardly exist. While fuelwood consumption by rural households is no longer considered a principal cause of forest degradation (World Bank/AFREA 2011 and FAO 2010a), the additional demand of woody biomass for energy production in the EU and elsewhere is likely to impose additional pressure on forests in such countries mainly through increasing wood prices resulting in higher incentives for wood production and logging. As current research shows, land clearing for agriculture, commercial and residential development, and other permanent land-use changes are the main contributors to forest

removals (Dewees, 1989; ESMAP, 2001; Arnold et al., 2005 cited in World Bank/AFREA 2011). Moreover, most domestic woodfuels used in developing countries today do not come from forests but from scrub, bush fallow and the pruning of farmland or agroforestry trees. In contrast to domestic use, however, clearing associated with agriculture and the harvest of fuelwood for small-scale industries such as brick-making, tea-curing and tobacco-drying is a significant agent of deforestation in many developing regions (FAO 2010a). Charcoal, on the other hand, is mainly produced from natural forests under de facto open-access management regimes, often leading to significant forest degradation and—when coupled with other land-use changes—to permanent deforestation (World Bank/ AFRE 2011). Harvesting wood from natural forests for charcoal production occurs mainly in three ways: (a) as a by-product of some other wood extraction, (b) when forests are converted to other land-uses, including shift and burn agriculture, or (c) when wood is removed specifically for charcoal production (World Bank/ AFRE 2011).

**A direct conversion of land** that was previously natural forest to plantations is usually associated with negative environmental impacts even before the trees are grown, because ecosystems and biodiversity have been harmed by logging. **Indirect impacts and land use changes** have similar consequences and can be illustrated by the following example: Higher rubber prices can lead to increased clear cutting of secondary forests and replacement with rubber farms. In other areas, farm lands would be converted to rubber plantations and farmers would then shift to nearby forests that would otherwise remain standing (Global Forest Coalition 2010). In general, deforestation and forest degradation does not only lead to losses of carbon stocks in vegetation and soil but also severely effects biodiversity, water retention, micro-climatic regulation and soil fertility, especially in tropical and sub-tropical regions.

**Monoculture plantations** bear a low biodiversity value, higher risk of pest infestations and often high water demand when replacing natural forests. As much of the additional woody biomass demand of the EU is likely to come from such energy wood plantations, they deserve particular attention, most importantly in regard to two aspects. Firstly, energy wood production and management often **requires more input factors** (fertilisers, pesticides etc.) than conventional timber production (FAO 2010a) with subsequent impacts on soil, biodiversity and water. Secondly, the international **definition of "forests" as opposed to "plantations"** is not entirely clear, which has severe consequences for the declaration of deforestation: The FAO (2010b) defines "forest" as "land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ." Under this definition, it has been possible to replace primary forests with monoclonal plantations of genetically engineered exotic tree species, without this being considered deforestation. This definition has also made it possible to use the term "forest" to refer to the industrial monoculture tree plantations that are expanding at the expense of the destruction of other ecosystems. The term is also used by UN organizations and initiatives, such as the UN Framework Convention on Climate Change, and numerous national governments implement this definition in negotiations, programmes and policies.[18]

**Genetically modified tree species** are often grown in large-scale plantations. The current research on genetic modification of trees addresses the reduction of the lignin content, increases of growth rates and resistance to disease, insects or extreme environmental conditions. Unstable low-lignin trees are being engineered for cellulosic ethanol and/or pulp production whereas fast-growing and cold-resistant trees are attractive for wood bioenergy for heat and electricity. The impacts of growing GMOs on the environment have been controversially discussed for many years, partly due to the lack of long-

[18] In September 2011. more than five hundred scientists have therefore called on the FAO to review the definition of forest, so that a clear distinction can be made between biologically diverse forest ecosystems and monoculture tree plantations (following an initiative of the World Rainforest Movement).

term studies and the different perception of risks in growing them without a higher level of certainty. Among the major concerns are unexpected mutations of genetically engineered plants and trees that can spread across large areas and/or establish themselves in native forests and/or cross-fertilise with native trees as well as with pathogenic strains in trees that might lead to human illnesses and unknown consequences to other organisms.

Among the root causes for deforestation and forest degradation are **weak governance structures for forest conservation and sustainable management** of forest resources, in particular in developing countries.[19] A large number of countries are party to intergovernmental initiatives to put in place criteria and indicators to monitor sustainable forest management, but they are not entirely based on common principles and criteria and do not have a mechanism for verifying compliance with the agreed principles. Instead, voluntary certification schemes such as the Programme for the Endorsement of Forest Certification (PEFC) or the Forest Stewardship Council (FSC) have been set up to verify sustainable forest management. Only 8% of all forests are certified in the world today, compared to almost 45% in the EU (COWI 2009, cited in EC 2010). However, even for those certified wood production areas there are growing doubts of the sustainability of wood/plantation management.[20]

In the EU, the raised concerns about the sustainability of bioenergy also include the issue of the content and level of appropriate action to be taken. While the 2009 Renewable Energy Directive (RED) already contains sustainability standards for liquid biofuels for transport, there are currently **no binding sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling**.

The RED criteria relate to (1) greenhouse gas emissions savings, (2) protection of land with high biodiversity value, (3) protection of land with high carbon stock (wetlands, continuously forested areas, canopy) and (4) protection of peatland. However, these sustainability criteria could not completely prevent increasing greenhouse gas emissions from biofuels production, in particular because of the enduring problem of (indirect) land use change.

After a first report in February 2010 (EC 2010), the European Commission is reassessing the need for binding and specific sustainability criteria for biomass sources in electricity, heating and cooling by the end of 2011. On the basis of the conclusions of the expected report, the Commission may come forward with a legislative proposal that would extend sustainability criteria set out in the Framework Directive on Renewable Energies to solid and gaseous biomass sources in electricity, heating and cooling (EU issue tracker, December 2011).

[19] In Sub-Saharan Africa for example only a small numbers of urban-based fuelwood traders are typically able to obtain exploitation permits, often resulting in an oligopolistic fuelwood industry. Rural users often have to compete among themselves and well as with demands from urban and industrial users (Arnold et al., 2003 cited in World Bank/AFREA 2011). Also, besides creating oligopolistic market structures, current licensing systems are not related to sustainable harvests. As a remnant of colonial times, most license systems still operate merely for revenue collection, without the quantities of wood harvested linked to any measures of sustainability (World Bank/AFREA 2011).

[20] For more details see for example www.fscwatch.org and FERN 2011

# 5. CONCLUDING REMARKS

A clear link between the increasing EU demand for wood for energy generation and impacts, both negative and positive, for rural communities in developing countries can only be drawn if concrete examples for woody biomass for energy projects and investments are assessed. However, the expected impacts of a generally increasing demand for biomass worldwide are complex and need to be considered beyond case studies.

In general, additional demand for wood and other natural resources automatically leads to additional pressure on ecosystems and habitats, which increases the risk for environmental degradation, further conflicts between different land uses and respective actors who depend on the benefits from the land. Such risks and impacts driven by the progressing scarcity of land are not new and have been studied and reported in many areas in the world. What is new is the pace with which investments for large scale projects from industrialised countries are made. This race towards inexpensive but fertile land in developing countries is not only driven by ambitious renewable energy targets but also by expected food shortages in many emerging economies, which became grimly evident in the period of the global food crisis in 2008 and 2009.

This brief has shed some light on some of the main impact dimensions growing wood exports from developing countries can have. Most importantly, deforestation associated with the replacement of natural forests by monoculture plantations has environmental impacts. Rural communities are potentially harmed in their access to land and water and in their food and energy security for decades because of the long-term nature of most investments and projects. The origin of such harmful impacts is similar for all dimensions: Land, which has previously fulfilled several basic functions for the livelihoods of people, does not only change its possessor but is also used in a more profit-driven way, which usually excludes a high share of people from the benefits generated from this land. A key reason why this occurs in many illustrated cases around the world is the lack of land rights for people, unclear land titles und tenure and a perceived need from governments in developing countries to boost (foreign) investments for economic development in their countries. In the specific case of woody biomass, the people most vulnerable to such developments are those who strongly depend on wood resources for their basic needs, which is mostly the case in Sub-Saharan Africa and South-East-Asia, and to some extent also in Latin America.

Another macro-effect, which is boosted by the additional demand for biomass worldwide and severely affects the economic conditions of poor people around the world, is the increased volatility of food prices. The instability of markets for agricultural commodities mostly affects those countries which are dependent on food imports and face food shortages regularly. Some of these countries are also in the scope of further land investments for biomass plantations, which has an accelerating impact on food insecurity in those countries.

This situation imposes a high degree of responsibility on the countries that drive the increasing biomass demand, among which the EU plays a key role. REDD+ (Reducing emissions from deforestation and degradation) and FLEGT (Forest law enforcement, governance and trade) are current policy processes where the EU is actively involved and which address the issue of deforestation in developing countries. The European Commission financially supports REDD+ through the World Bank and different UN climate funds as well as by a "REDD facility", which offers expertise to poor countries to improve forest governance and to increase capacity building. FLEGT consists of voluntary partnership agreements between the EU and wood exporting countries, which aim for ensuring the legality of wood sources under environmental, social and economic perspective. To date, agreements were concluded with Cameroon, Central African Republic, Ghana, Indonesia, Liberia and the Republic of Congo. Such

processes can be used to address environmental and social impacts caused by the increasing EU demand for woody biomass, mainly by seeking solutions on a bilateral level with partnering countries.

Furthermore, the current consideration of the European Commission to extend the binding sustainability criteria from liquid biofuels towards solid and gaseous biomass used for electricity, heating and cooling can be helpful in the reduction of negative impacts. However, it has to be noted, that these criteria only address the major negative environmental impacts and still face some fundamental weaknesses. For example, indirect land use changes are not yet included in biofuels sustainability requirements. Other macro-effects such as higher prices for wood driving plantation expansion and increased logging elsewhere in the world principally cannot be covered by sustainability criteria and respective certification schemes as envisaged in the RED.

To address these impacts in developing countries a meaningful reduction of the EUs ecological footprint[21] - which is still more than double in size, compared to the productive area available in Europe - needs to be achieved. This deficit is created by importing goods (including but not only energy wood) and services from beyond its borders. In order to alleviate it, substantial efforts towards greater energy and resource efficiency[22] and savings are needed in order to alleviate the pressure on natural resources and ecosystems outside Europe.

It is also important to broaden the debate about environmental sustainability standards to include additional crucial issues such as food security, local energy security and land access. Finding integrated answers to the wider implications of increased EU wood demand in developing countries seems inevitable to address the complexity of impacts it will have. It will also be crucial to support developing countries to build up good governance mechanisms that alleviate the vulnerability of local communities to external factors.

In addition, approaches (e.g. outlined by the World Bank/ AFREA 2011) to enhance sustainable woody biomass development in developing countries include implementing and sustaining community-based forest management (including agroforestry systems), decentralized management which transfers rights and responsibilities of wood-based biomass production to local communities and the avoidance of top down command and control systems and instead the involvement of local stakeholders throughout the process.

[21] The Ecological Footprint is an indicator that measures the amount of biologically productive land and sea that is needed to provide all resources humanity uses for final consumption. In 2003 the EU Ecological Footprint was 2.26 billion global hectares (gha), 4.7 gha per person. In contrast, Europe's total supply of productive area in the same year was 1.06 billion gha, or 2.2 gha per person. According to the 2010 Living Planet Report in 2007 at a global scale the available biocapacity was 1.8 gha per person (EDCNRP 2011).

[22] Including e.g. cascade utilization of biomass, i.e. reuse and recycling of biogenic wastes, by-flows and residues.

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