FINAL REPORT

RESEARCH PROJECT "Renaissance" Renewable Energy Acting in Sustainable And Novel Community Enterprises

Survey About Social and Economic Impacts Of Energy Use of Biomasses in the Area of Lombardy Region: Energy Crops and Compensation Measures

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1. Abstract

Large-scale energy crop production requires large land areas, which could lead to changes in agricultural land use patterns. Land use for energy crop production competes with land use for food production, forestry or environmental protection and nature conservation. This requires better insight in the possibilities and consequences of using agricultural land in a country or region for biomass production.

European countries have huge land resources and their agricultural production is characterized by comparatively low labour and agricultural production costs and relatively low productivity. Their accession means being part of the Common Agricultural Policy (CAP) and other European policies and legislation. It is expected that this change will stimulate a further rationalisation of agriculture. It has to be avoided that large areas of farmland are abandoned and unemployment is created as a consequence of policy reforms and competition with agriculture in Western Europe.

Therefore, biomass production in EU could serve as alternative for the agricultural sector.

When it turns out that the bio-energy potential in EU member states is large enough and could be realize that competitive cost levels, EU's could contribute significantly in meeting the EU's Kyoto commitments of reducing CO2 emissions by supplying bio-fuels to the European market. To answer these questions, a regional biomass potential assessment is implemented for the EU states.

In this paper we will discuss the results and consequences of the insights gained for Lombardy Region. This paper is backed up by a separate evaluation carried out in the Lombardy Region including site-visits, interviews with key parties and collection of specific data about specific compensation actions in order to create low impacts of new infrastructures on th environment.

Methodological approach for bottom-up analysis of biomass potentials and cost supply curves

The regional biomass potential assessment is implemented for a set of scenarios. The methodology is based on land use changes over time. A certain amount of land is needed to meet the required production for food (derived from agricultural crops and livestock) and wood products. The surplus available land can possibly be used for biomass production.

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As this concept is only feasible when biomass production is profitable for the stakeholders involved, price and cost relations are included in the assessment. Final deliverable are cost-supply curves from different sources (energy crops, residues) and production systems for the EU.

The scenarios used for the regional biomass potential assessment characterize the main current and future drivers in Europe related to agriculture and land use. They are placed in the context of the SRES scenarios from the IPCC. Relevant drivers in Europe are for example the debate about ecological agriculture, GMO or the WTO negotiations. These drivers are translated to quantitative parameters (for example level of trade, self-sufficiency, yield levels) and subsequently used in the analysis of the regional biomass potential assessment.

Regional biomass potential assessment

The total available biomass potential in a Nuts- level2 region is the sum of biomass from energy crops and agricultural and forest residues.

The regional biomass potential assessment is based on land use changes over time for a set of scenarios. A scenario, with a defined set of parameters, requires a certain demand for food and forest products. A certain area of agricultural land and forestland will be needed to meet this demand. The size of this area will depend on 1) demand and 2) the defined production system (productivity).

The current land minus the required future land for crop, livestock and wood production gives the surplus available land for biomass production. Surplus available land can be used for energy crop cultivation. The biomass from energy crops is calculated by multiplying the available surplus agricultural land with the productivity data for energy crops.

The main parameters, defined in the scenario's, that influence the required land for food and thus the land available for biomass production are demand of forest and food products and (agricultural) productivity.

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2. Bioenergy and short rotation crops in EU policies and in Region Lombardy

The agriculture sector for food provisioning in Lombardy is one of the most important in Italy and in Europe. In 2009 the regional agriculture production item was something like 12 milions of euros. It represents almost the 15% of the correspondent Italian level. Furthermore it is 3,7% of regional GDP, and this amount arises at 10,6% if we include transports and trade sectors.

The productive units are almost 70.000, and in this figure we consider both production as transformation activities. The workers employed are 226.000, of which 150.000 people are firmly employed (it is equal to 4,2% of the total amount of the labour force at regional level)[1].

It is no possible to obtain a complete definition of lombard agricultural system because of the no clear boundaries of this economic branch at regional level and no enough information about import/exports and intersectorial flows.

We present a brief synthesis about the agriculture structure in Lombardy and the land use in order to present the possible links between traditional use of agriculture for food products and the use of these kind of territories for bio-energy productions.

The idea is to investigate about the possible exploitation of marginal, residual lands staying along infrastructures like airports and highways, which border on rural areas. In this way, the part of agricultural activities for food production has not been damaged, but farms incomes could be integrated by these kind of energy crops exploitation.

So, we present now the structure of agriculture in Lombardy, the land use, the main existing infrastructures in the region and possible areas for pilot projects.

[1] INEA, 2009 Il sistema agro-alimentare lombardo, p.19

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Eurostat (2007) presents in the Regional Yearbook the situation of NUTS-2 level regions in Europe. Lombardy has a high level intensity production crops, with a general supply level equal to the 1,24% of the EU total amount. In detail we can recognize that the level of maize production (4,7%) and of rise (22,4%) are really high in comparison with EU average productions of similar products.

The average features of the Lombard farm structures and the profitability in productions are clearly higher than EU-27 average level. The average areas is twice the corresponding Italian mean and it is over the 38% compared to EU level; the dimension of cow livestocks is four time the EU average, and the labour indicators are almost equal to European indices.

The GDP per hectare is superior of 3,5 times of EU average and also GDP per working unit is 3,1 times higher than EU average.

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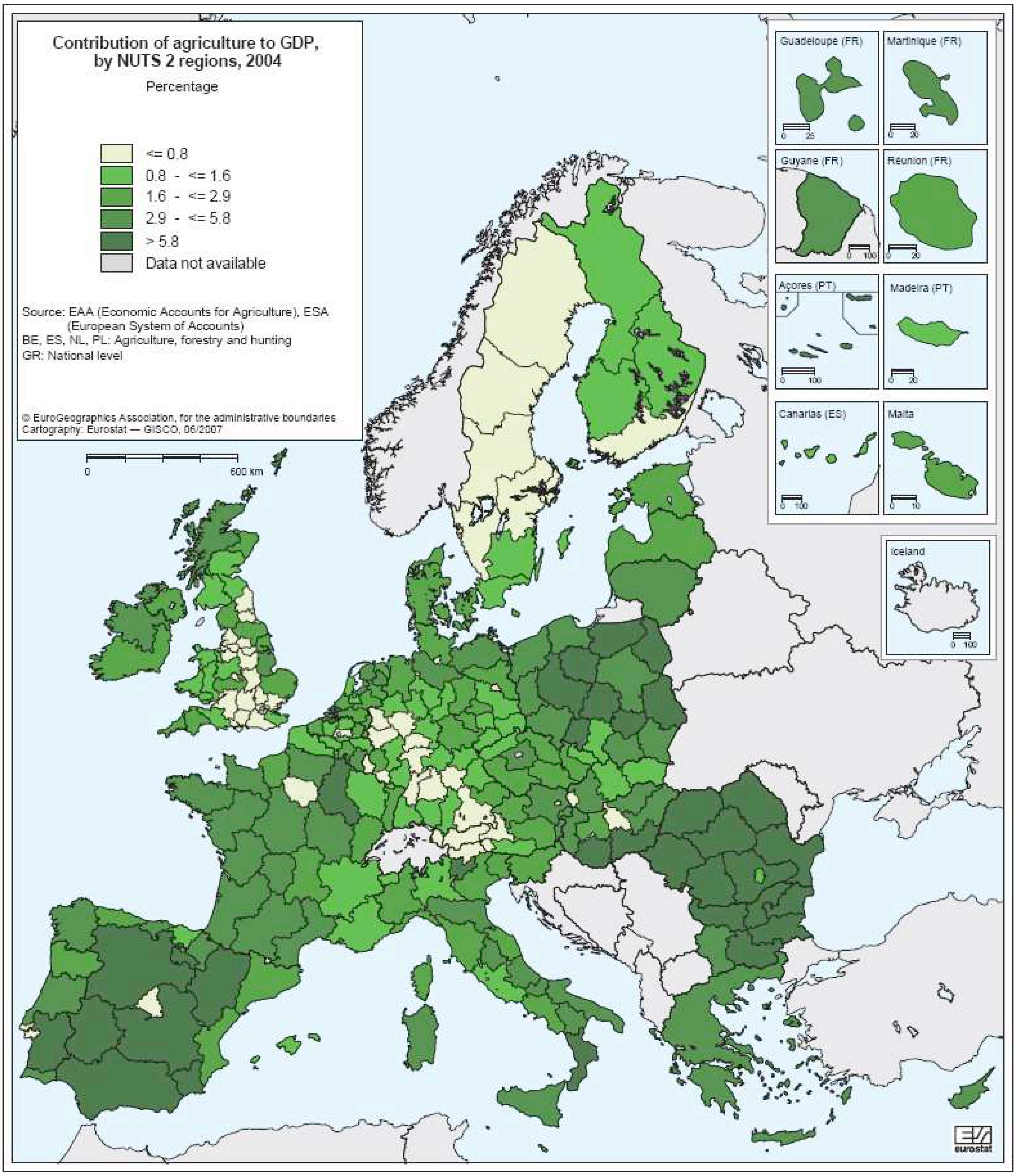
Figure 2.1. Contribution of Agriculture to GDP by NUTS Regions, 2004



Source: Eurostat, Regional Yearbook, 2007

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Furthermore, these information are confirmed by ISTAT (2007), which publishes these figures about the agriculture structure in Lombardy:

Table2.1: Agriculture Structure – Italy, Lombardy and EU-27

	Lombardy	Italy	EU-27	Lombardy/Italy (%)	Lombardy/EU-27 (%)
Farms (n.)	57.490	1.679.440	13.700.400	3,42	0,42
Stock-farms (n.)	22.370	30.9170	8.570.670	7,24	0,26
Cows breedings (n.)	15.560	146.990	334.210	10,59	0,47
Tot area for agriculture (he)	1.258.470	17.481.540	215.396.450	7,05	0,58
Tot area used (he)	995.320	12.744.200	172.485.050	7,81	0,58
Livestock (n)	2.772.270	9.900.670	135.282.290	28,00	2,05
Workers (n.)	118.870	3.174.150	26.669.390	3,74	0,45
Work units (tot)	75.860	1.302.180	11.693.120	5,83	0,65
Area per farm (he)	17,31	7,59	12,59	228,15	137,52
Livestock/area	2,79	0,78	0,78	358,53	355,13
Workers/farm	2,07	1,89	1,95	109,40	106,22
Livestock/farm	1,32	0,78	0,85	170,18	154,60
Area/Unit	13,12	9,79	14,75	134,06	88,95
Family farms (%)	82,5	83,8	80,1	98,48	103,05

Source: ISTAT Survey 2007 in INEA (2010)

The typical structures of the farms are based on family work, but they present average areas that are bigger dimension than the EU average areas.

Furthermore there is an interesting difference between areas which are used as crops and the total available amount: almost 263.250 he are not directly used for agricultural production.

The Bioenergy situation in Lombardy is the following one, as we can read in the latest survey of INEA and Region Lombardy-Agriculture (2010).

During these last two year Region Lombardy has been analysing the potential of bioenergy crops with accurated surveys and cofinancing research projects. The goal is to have a detailed map of different biofuel and build up scenarios and models based on

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real existing data. The first results of these research projects will be available in the first part of 2011[2].

Regarding plants situation, in 2009 biogas plants are 58, and they are located for the 70% in the provinces of Brescia, Cremona, and Mantova, because of the large livestocks farms in these areas.

The total power is equal to 100 Mwe, something as 10% of Italian biogas plants potential. In October 2010 the number of total biogas plants increases at 86 units, of which only 31 are located in Cremona.

11 biomass plants are active. They produce heating energy and they use forest scraps and local materials.

Table 2.2 Biogas Plants in Lombardy (2009)

	Operative Plants		Planned Plants		Total	
Province	Units	Mwe	Units	Mwe	Units	Mwe
Bergamo	2	0,4	8	3,5	10	3,9
Brescia	13	8,0	29	12,8	42	20,7
Cremona	16	10,1	24	13,7	40	23,7
Lodi	8	6,7	14	8,9	22	15,6
Mantova	13	5,8	25	19,1	38	24,9
Milano	1	0,6	2	---	3	0,6
Pavia	4	4,9	6	3,3	10	8,2
Sondrio	1	0,7	0	---	1	0,7
Lombardy	**58**	**37,1**	**108**	**61,2**	**166**	**98,3**

Source: INEA (2010) on elaboration by DEPAAA on data furnished by Lombardy Region Agriculture Sector

[2] For further information see www.bioenergy.eu

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Table2.3 Biomass Plants in Lombardy (2009)

	Plants	Mwt	Mwe
Varese	1	1,0	
Sondrio	3	42,0	1,1
Bergamo	1	2,0	2,0
Brescia	4	24,3	6,1
Pavia	1	-	0,3
Mantova	1	0,5	-
Lombardy	**11**	**69,8**	**9,5**

Source: INEA (2010) on elaboration by DEPAAA on data furnished by Lombardy Region Agriculture Sector, Fiper

The actual demand of biomasses at a local level indicates a possible evolution, uses marginal abandoned areas between infrastructures and agricultural areas.

We should consider that the future world potential for biomass could reach 150-400 EJ/yr (up to 25% of world primary energy) by 2050 using available farm, forest and urban residues and by growing perennial energy crops.

Some of the 1 bn ha of marginal and degraded lands unsuitable for food production could be reclaimed for productive use by growing selected energy crops.

There are competing uses for non-food biomass resources (including for heat, co-firing and biofuels, as well as for bio-materials and bio-chemicals). Global trade in biofuels could help compensate for regional differences in the availability and accessibility of biomass resources.

For example, if we analyse the grid of principal roads system in Lombardy together with the agricultural areas, we can create a link in the use of areas between existing and future infrastructures and agricultural areas. It's a similar evaluation about airports infrastructures, which are located closed to agricultural areas.

That "buffer-land" is traditionally maintained, but without a concrete evaluation of their potentials for bioenergy productions and exploitations.

Figure 2.2 Principal roads system in Lombardy Region

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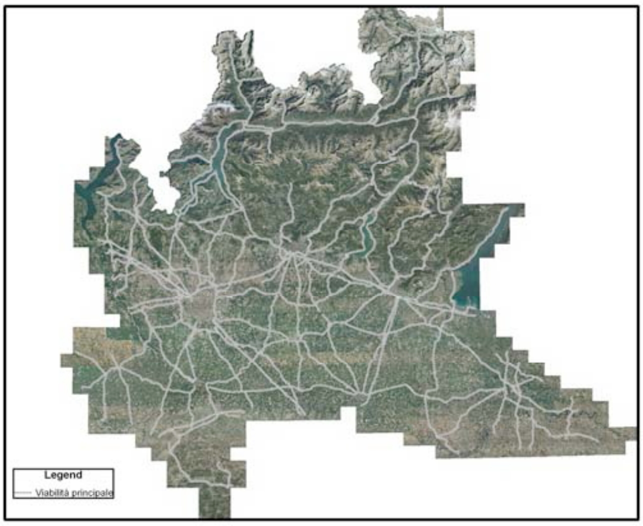
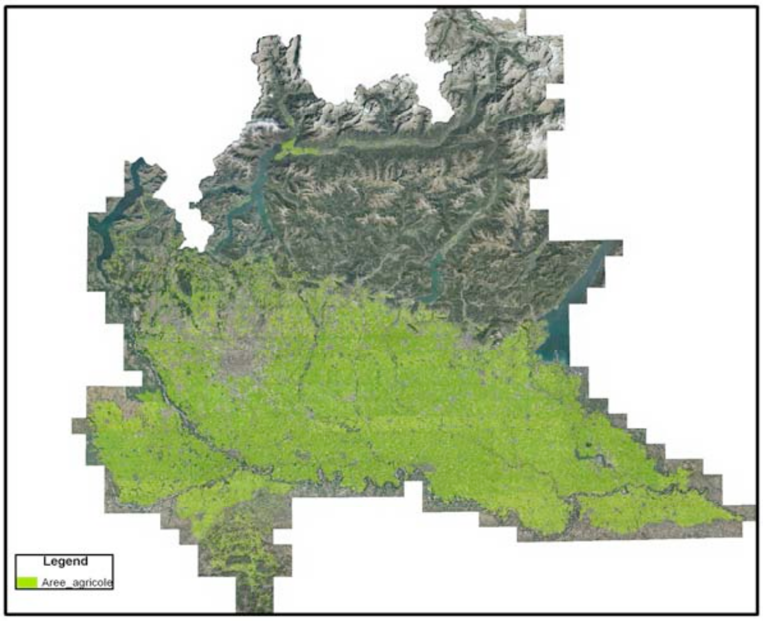


Source: personal elaboration on data from Region Lombardy

The regional road system is almost 31.600 km long and it represents the 8% of the entire Italian road infrastructures.

Figure 2.3 Agricultural areas in Lombardy Region



Source: personal elaboration on data from Region Lombardy

If we lay the figure 2.2 on the figure 2.3, we could easily verify that half of the main roads pass through half of the existing agricultural areas at least.

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In this way, almost 15/18000 kilometers of streets could be the boundaries of marginal areas, which can be used for bioenergy productions, without any food production shifting, but creating mitigation interventions with short rotation crops.

Not only the streets could be evaluated for this purpose. We also could think to other infrastructures as Malpensa Airport, which is located in an area characterized by large surfaces of green crops, forestries

We purpose for example the possible use of the areas along airports infrastructures as Malpensa or new road infrastructures as Pedemontana or the BreBeMi.

If at Malpensa Airport we analyse the areas around the two strips that are 3920 metres long, with the DUSAF Map support(Figure5) we can suppose that in the area considered the biomass by the marginal and abandoned parts ought to be collected and it could be used as fuel for closed small biomass/biogas plants.

This hypothesis could be applied also at new planned regional road infrastructures. In particular, in order to test this idea, if we analyse the route of Pedemontana (Figure4) we could think to create a short supply chain for biomass plant, using short rotation crops in order to mitigate the environmental and acoustic impact of this new street.

These two hypothesis are only examples, but they could be used as pilot project if there would be a social acceptance of the mitigation actions-bioenergy productions.

From an economic point of view the costs of mitigation could be partially covered by the results of short rotation crops.

This approach requires different analysis tools in order to investigate if the project is coherent with sustainability criteria and if the local communities could consent this kind of intervention. In particular we think that these tools should be used in the first phases of the planning, in order to orientate the following steps.

The tools are:

- LCA (Life Cycle Analysis) and LCCA (Life Cycle Cost Analysis) of the project, in order to quantify the environmental impacts in the use of the resources, the effects on air, soil and water and the economic costs of the entire project.

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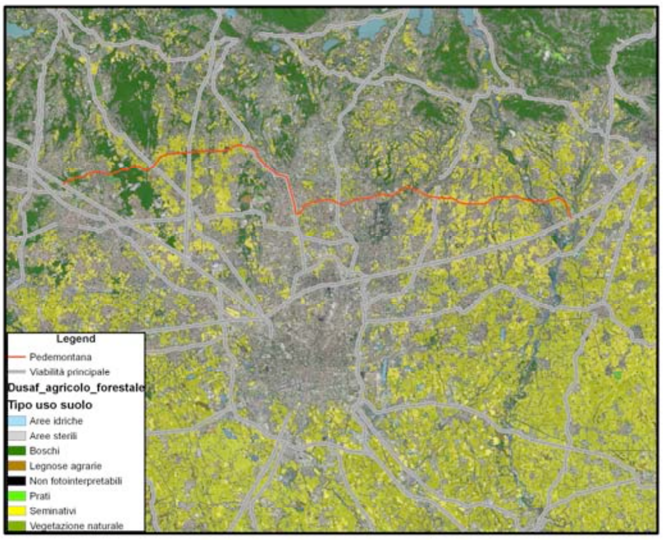
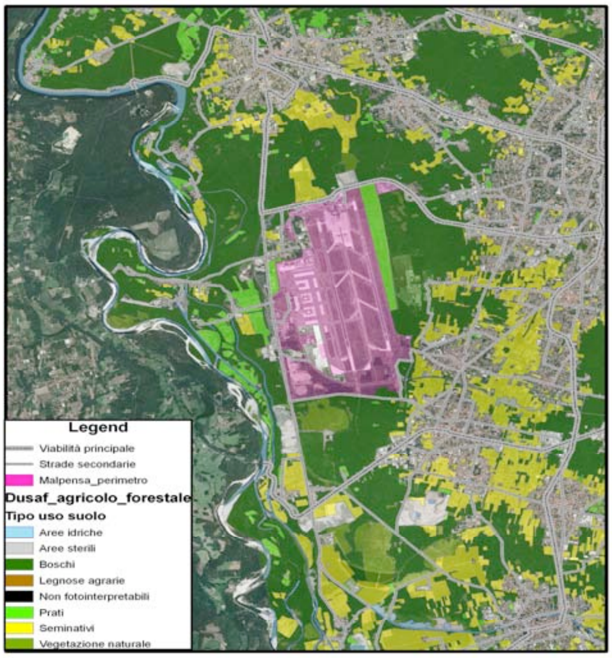
- Procedure of EDD (Environmental Due Diligence) with a particular attention about financial and social aspects, in order to analyse the risks connected with the project, and involve stakeholders and local communities around the planning of the project.

Figure 2.4: Pedemontana Road System



Source: DUSAF

Figure 2.5 Malpensa Airport Infrastructure



Source: DUSAF

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3. Impacts of bioenergies on the regional sustainable development in agriculture

The agriculture sector is passing through a deep transition period. The European financing programs are strongly reduced and the final market is divided between food supply and bioenergy production.

A big constrain is the protection of the environment following sustainability rules. This is the central priority in order to permit that land use for satisfying nowadays needs not create permanent losses in organic soil inheritage for the next future.

In this perspective is important non only understanding the dynamics of human-environment systems, but also the evaluation of practical interventions that promote sustainability in particular places and contexts; and to improve linkages between relevant research and innovation communities on the one hand, and relevant policy and management communities on the other.

Liquid biofuels can provide a much needed substitute for fossil fuels used in the transport sector.

They can contribute to climate and other environmental goals, energy security, economic development, and offer opportunities for private companies to profit. If not implemented with care, however, biofuel production can put upward pressure on food prices, increase greenhouse gas (GHG) emissions, exacerbate degradation of land, forests, water sources, and ecosystems, and jeopardize the livelihood security of individuals immediately dependent on the natural resource base. Guiding biofuel development to realize its multiple potential benefits while guarding against its multiple risks requires the application of a similarly diverse set of tailored policy interventions. Most session participants agreed that any single rule – such as production subsidies, a simple ban on biofuel production, or the immediate revocation of existing mandates for biofuel use – is too blunt an instrument, and will almost certainly do more harm than good.

Biofuels and Sustainable Development

Biofuels have emerged as a centerpiece of the international public policy debate. All of the G8+5 countries, with the exception of Russia, have created transport biofuel targets. Some

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countries have mandated the use of these fuels. For example, in January of 2008 the European Union reaffirmed a goal that 10% of vehicle fuel be derived from renewable sources by 2020. And the U.S. Energy Security and Independence Act requires that 36 billion gallons of renewable fuels be blended into gasoline by 2022. Recently, however, increased food prices triggered in part by converting food crops such as maize to fuel have raised public concerns about such goals. These concerns have been reinforced by several studies which indicate that biofuels may aggravate the net emissions of greenhouse gases rather than reduce them. While the potential benefits of biofuels have induced some governments to embrace their potential, many leaders are now concerned about the costs – particularly those that impact food prices and the environment.

Biomass can be used to provide energy in many forms including electricity, heat, solid, gaseous, and liquid fuels. These bioenergy options have been actively pursued in both the developed and developing world. Further, approximately two billion of the world's poorest people use biomass directly for cooking and heating, often seriously endangering their health and their environment.

Policymakers, business representatives, academics, and members of civil society believe in the development of biofuels. Someone thinks that biofuel is a substitute for high priced petroleum, either to ease the burden on consumers, to diversify the sources of energy supplies, or to reduce escalating trade deficits. Some others have focused on biofuels as a way to extend available energy in the context of increasing world demand for transportation fuels. Others target biofuel as a substitute for more carbon intensive energy. Still others see biofuel as an economic opportunity. This latter group can be divided into two sectors: those who see biofuel as an economic development opportunity, and companies who see biofuels as a potential market in which to invest.

The world currently uses 86 million barrels of oil per day, with forecasts that demand for liquid fuels will increase to 118 million barrels by 2030.

Most of the incremental fuel will come from OPEC and specifically from the Middle East. Between 2006 and 2008 the world's supply of oil has had difficulty keeping up with demand, and prices have skyrocketed to $140 per barrel and more. As more and more funds are required to pay for oil products, importing countries find their current account

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balances eroding and the costs of producing and transporting goods and services increasing. Today, many forecasters predict that while prices will fluctuate, the era of low-cost oil is over and countries must adjust by seeking alternative energy options and strategies.

More than 60% of the oil consumed in the OECD countries is used for transportation.

While there are many substitutes for oil in the heating and power sectors, this is not the case in the transportation sector. Fossil fuel based alternatives, such as oil shale and coal liquefaction, could potentially provide additional transportation fuels, but their production will have large impacts on greenhouse gas emissions and water resources.

In the short term, producing liquid fuels from biomass is one of the only alternatives to petroleum-based transportation fuels. As a result, countries are looking at a menu of biofuel options to reduce their future reliance on petroleum. Since biofuels are likely to be produced in countries outside of OPEC, they may also allow oil-consuming nations to diversify the sources of their transport fuels, and hence provide energy security benefits. While some debate the significance of the energy security advantages, until alternative transportation fuels (such as hydrogen and electricity) can be produced and consumed at a competitive price, biofuels are one of the few short-term options available to national governments worried about dependence on imported oil.

Growing concern over global climate change has motivated growing interest in all manner of renewable energy sources, biofuels among them. With transport contributing around 25% of global carbon dioxide (C02) emissions and with very few viable alternative fuels available, biofuels have been presented as a potentially significant contributor to strategies for reducing net greenhouse gas emissions from the transportation sector. There is little question that when produced and used appropriately, biofuels can deliver substantially lower net greenhouse gas emissions than fuels derived from fossil sources. This is particularly true when considering the greenhouse gas intensive synthetic fuels produced from coal or oil shale that are one of Biofuels and Sustainable Development the principal alternatives for liquid transport fuels. But the net greenhouse gas emissions of biofuels vary significantly depending on the feedstocks and technologies used in their production and consumption. And the overall impact of biofuel development on climate is more complex still, tied up with differences in carbon stocks and solar reflectance between the

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biomass crops and the vegetation they replace. It seems virtually certain that biofuels will (and should) have a role in national and global strategies to address the dangers of climate change. What is the most appropriate nature, scale, and location of that role remains an open question.

Biofuels and their feedstocks could be an important source of export income for developing nations or for regions which pass through short-term economic crisis. History has shown that participating in the global economy through export activity is a crucial part of the economic development process. In some tropical countries, biofuel production can bring with it "stepping stone" effects such as the extension of transportation networks, as well as job creation.

In addition to growing biofuels for export, countries can substitute domestically-produced biofuels for imported oil products, reducing the micro and macro impacts of the sharp escalation in oil prices. In addition, biofuels present an opportunity for new entrepreneurial companies and small holders to emerge while simultaneously increasing economic activity in both developed and developing countries.

Just as there are multiple goals that many seek to achieve through appropriate biofuel production and use, there are also multiple concerns. Many have blamed biofuels for higher food prices.

Critics have also questioned the carbon mitigation claims surrounding biofuels. Others have pointed out that some kinds of increased biofuel production may dramatically increase nitrogen flows into lakes, streams, and coastal waters. Intensive use of land to produce biofuels – just like intensive use of land to produce food and fiber – can have serious impacts on conservation and ecosystem services, and on the livelihood security of poor land users. There are economic challenges as well. Many of the poorer tropical countries identified as potential targets for future investments currently lack the transportation and agricultural infrastructure to fully realize the potential of biofuels. Furthermore, trade barriers continue to block the development of a global biofuels market. More generally, critics argue that without appropriate public policy, the potential benefits of increased biofuel production may be outweighed by the costs.

It is important to carefully characterize the concerns raised about biofuels in order to tailor

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effective policy. Any single policy that attempts to address every challenge simultaneously is almost certain to be ineffective and would likely foreclose the opportunity to realize the potential Biofuels and Sustainable Development benefits outlined above The broader point remains, however, that by being specific and clear about goals and constraints on the one hand, and specific interventions to address each of them on the other, an analytical rather than ideological approach to biofuels can become possible. In this way, policymaking can isolate problems about biofuels and start down the path toward mitigating those problems so as to secure in a responsible manner the potential benefits
that biofuels can almost certainly offer to society.

According to the Food and Agriculture Organization of the United Nations (FAO), global food prices have increased dramatically, rising by nearly 40% in 2007 and continuing to increase at the time of this session. Nearly all agricultural commodities have been affected, including major grains such as maize, wheat and rice.

The causes of the price hikes include adverse weather in key production areas, higher agricultural input prices (especially oil and oil-derived products such as fertilizers), and limited elasticity in agricultural production capability. Demand for food has also grown, especially in Asia and sub-Saharan Africa. While experts differ as to the extent of its role, increased biofuel production has also clearly played a part in higher food prices, shifting land away from food production and triggering increased competition for land use.

Another major underlying factor in the increase in food prices is that agricultural practices have not kept up with changing challenges and demands. Agricultural research and development has been underfunded for several decades, as have investments in rural infrastructure such as modern irrigation technologies and roads. In addition, energy and environmental policies that have pushed biofuel development have had little interaction or coordination with agricultural policies. Thus, biofuels production has not been fully integrated or embedded in strategic agriculture policy.

When measured over the entire production chain, the production of some biofuels, such as sugarcane-based ethanol, results in significant reductions in carbon dioxide emissions compared to conventional gasoline. The production of some biofuels can lead to smaller reductions, or even increases, in net carbon emissions.

Biofuel development that results in an increase in greenhouse gas emissions, rather than

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a reduction, erodes climate goals. Polices are needed to ensure forest protection and to encourage changes in agricultural practices to reduce net greenhouse gas. There is presently a lack of consistent methodologies for carbon emissions accounting that would allow society to precisely assess the impact of different agricultural and forestry practices. The absence of an agreed methodology is a major barrier to the development and implementation of a sustainable biofuels industry and associated policies.

Air pollution, water pollution (especially nitrogen run-off), deforestation, loss of biodiversity, and overuse of water for irrigation in countries that are likely to face increased water shortages over the next several decades are all issues that require close attention in the development of agriculture for both increased food and biofuel production. The extent to which mixed-model development, including production from small holders, might balance ecosystem protection with economic development should be examined more closely.

A free and open market for biofuels in which products, technologies, and producers can freely compete on relevant terms will encourage product improvement, capacity growth, and cost reductions. But clearly the environmental land use and economic costs will require regulatory intervention to set minimum standards and create a level playing field. Concerns about the market can be grouped into three areas: trade, incentives, and infrastructure.

Trade: Currently, a world market for biofuels does not exist. Import tariffs and non-tariff trade barriers erected by potential biofuel-consuming nations constrain the emergence of a functioning global market and eliminate economic opportunities for a number of developing countries. Such policies also reduce access to lower-priced biofuels in consuming countries. However, direct competition should be avoided where possible between western farmers intent on protecting their domestic markets and food and fuel suppliers from developing regions intent on identifying and accessing new markets.

Incentives: Session participants raised concerns about the inadequate design of existing incentives and mandates for biofuel production. Many were uncomfortable with mandates, arguing that they often target the wrong goals, and therefore serve as an ineffective instrument for achieving the full potential benefit from biofuels. However, as a recent UNCTAD study pointed out, no country has ever established a biofuels market without the use of mandates and subsidies. Prematurely removing existing mandates would have a chilling effect on the nascent biofuel industry, as investors who have committed funds in response to these mandates might walk away, stranding established production capacity. Uncertainty about policy and programmatic consistency was identified as a major constraint on future investment.

Infrastructure: An additional market challenge is that many of the poorer potential biofuel-producing nations lack the transportation, institutional, regulatory, and service infrastructures to support a biofuel industry.

It is unlikely that investments in this infrastructure will precede investments in biofuel production since development banks will not provide financing unless the demand for the product is clearly identifiable.

Many poorer developing countries lack the regulatory, institutional, and legal systems necessary to induce investors to take the financial risks inherent in building a nascent industry. Their governments are struggling to develop and implement such systems and need technical, and in some instances financial, assistance to design appropriate governance frameworks.

The biofuel debate is about how countries use their land. As food and fuel prices increase, competition for the world's land, especially for forests – will become more fierce. Many countries, including those in the developed world, lack the institutional capacity to tailor policies and programs that integrate agriculture, energy and environmental policies into a coherent land use policy. Governments will be under increased pressures to play the role of facilitator between local communities, businesses, and interest groups.

They presently lack a coherent menu of institutions and policies to fill this new responsibility. For many governments, this would be a particularly challenging and unfamiliar task for which technical assistance and external policy advice may be required.

What's be done? The production of biofuels in locations where they can be grown most efficiently and where undesirable impacts are the smallest, and the consumption of biofuels in locations where the need for them is greatest. There was a strong feeling among the participants that the potential benefits of an international market in biofuels could be outweighed by risks of damage to food and environment systems unless adequate protective measures were simultaneously introduced.

These protective measures will likely include the explicit recognition that sustainable production of biofuels cannot be expanded indefinitely. There are intrinsic limits on the productive capacity of ecosystems, constraining yields per unit of available area, and the amount of area that can be dedicated to sustainable biofuels production.

Biofuel production is infrastructure intensive. At the national level, many poorer countries will find it difficult, especially in the early years, to develop the physical and institutional infrastructure needed to exploit their potential for sustainable production of biofuels unless provided with substantial outside support.

Without the means to transport and store both the feedstock and the final product, biofuel companies in poorer developing countries will not be able to attract significant investment. Much of the needed support is of a public good variety that can generally be provided only by international, bilateral, and private aid programs. Such assistance should be directed to traditional development infrastructure projects such as roads to connect production areas with refining facilities and markets. (Such projects, wherever possible, should be "dual use," providing infrastructure needed for biofuel development that can also support agricultural and other development.)

Additional assistance for public good infrastructure is also needed to support the development of biofuel-related public goods such as research and production processes that help to reduce environmental impacts that would otherwise be externalized (e.g., highly efficient irrigation and fertilization; low-impact harvest). Some of the infrastructure support needed for biofuel development can generate returns to investors and is thus a potential opportunity for loans or direct foreign investment. Examples include investments in production, refinery/processing, and product distribution facilities.

Certification or standards protocols for the sustainable development of biofuels should be treated as means to advancing sustainable development of biofuels, not as an end in themselves. They need to balance the complexity desired to cover all concerns with the simplicity needed to promote practical and timely development and implementation. Actions are Biofuels and Sustainable Development needed to stimulate the development of an efficient market for biofuels while simultaneously guiding that development in sustainable directions. There was support at the Session for the idea that while standards or certification protocols may be needed to realize many of the major goals for the sustainable development of biofuels, efforts to control or regulate biofuels through any

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single global certification process or standard are likely to fail. Instead certification processes should be targeted towards specific, clearly defined problems that are not, or cannot be, addressed by other regulatory or policy mechanism. A "one measure for all problems" approach relies on an overly blunt instrument and is not likely to succeed.

To encourage competition and improvements, biofuel product standards should be developed for categories of fuels (such as fuel for spark-ignition engines) rather than particular products (such as ethanol). Such product standards are generally most useful if developed and promulgated under international auspices with engagement of both producers and consumers in their design.

Depending upon the methods used to produce them, biofuels may have net impacts on the global carbon cycle and on emissions of other critical greenhouse gases that are either positive (releasing less carbon dioxide and other greenhouse gases than fossil fuel alternatives), or negative (releasing more carbon dioxide and other greenhouse gases than fossil fuel alternatives). The direct and indirect impacts on land resources from increased demand for biofuels are intrinsically no different than the impacts from increased demand for food.

If, however, biofuel development projects claim that they should receive special treatment or financing because of their supposed contribution to solving the climate problem, then they need to be able to document that contribution for buyers, investors, and regulators. Similar needs exist if land- use interventions generally (e.g. forestry, food, and fiber production) are called upon under future climate agreements to account for their net contribution to greenhouse gas emissions. To provide such documentation, reliable and standardized life-cycle- accounting (LCA) methods be developed to assess the net carbon budgets associated with particular biofuel and other land use projects, is essential. More generally, assessment frameworks need to be developed and applied that will allow us to address the impacts of alternative biofuel strategies not only on greenhouse gas emissions, but also on other determinants of climate change (e.g. surface reflectivity).

Furthermore, it is relevant to trace the impact of biofuel development on food production or other ecosystem services. In this perspective biofuels should be grown only on soils that do not support forests, are degraded, or are otherwise unable to support food crops. We note also concerns that any substantial additions of fertilizer use due to biofuel

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development could further exacerbate existing problems of eutrophication in rivers, lakes and in hydro grid.

Biofuel development requires comprehensive plans for assuring food security and the conservation of ecosystem services, imposed on other proposals for land use change.

Targets for biofuel use and incentives for biofuel production have had a major impact on the rate and pattern of biofuel development.

Few would argue that these impacts have been optimal. Unintended consequences have emerged because mandates and incentives have often targeted the means (i.e. specific technologies or volumes of use) rather than the ultimate goals of biofuel development. For example, volume mandates have almost certainly pushed producers to use crop feedstocks, since crops tend to have the best developed production technologies and are therefore usually the cheapest way to produce volume. The resulting competition between fuel and food has been a major source of tension. Better incentives should target goals, such as focusing biofuel development on non-food biomass, low net carbon life cycles, or approaches that protect ecosystem services. At the enterprise level, second generation biofuel production is often more expensive than fossil fuel production. Hence companies will seek greater financial rewards and subsidies for developing these fuels. Any such rewards or subsidies should be clearly linked to greenhouse gas reductions and the attainment of sustainability goals.

The shortcomings of many existing mandates and incentives notwithstanding, there was a belief among many Session participants that precipitous roll-backs or moratoria on existing mandates or incentives should be avoided. As mentioned in section 2.4, such actions may have serious impacts on biofuel investment, undermining confidence, stranding assets, and generally setting back the development of sustainable biofuels.

Needed instead is careful analysis of the mandates, with targeted adjustments only where necessary for sustainability. In addition, governments should begin an orderly, innovation-sustaining transition toward incentives that are targeted on such multi- dimensional goals such as reduction of net GHG emissions, increasing utilization of non-food feedstocks, the attainment of sustainability targets, the conservation of biodiversity, etc

Very little is going into research on the agricultural and natural resource systems needed to sustainably “scale up” a significant biofuel production system, into the limits of

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sustainable expansion, or into the ways that biofuel production interacts with the environment at global, regional, and local scales.6 Indeed, for years, the international system has neglected research and development in the agriculture and natural resource sectors. Even the most basic food and fiber crops have suffered from underinvestment.

For the complex, multi-use landscapes that will almost certainly be an essential component of a strategy for sustainable development of biofuels, only the very beginnings of the necessary knowledge base exist. Along with a lack of investment in biotechnology, irrigation, and roads, this underinvestment in knowledge has resulted in a long-term decline in land productivity. Food, fiber, and fuel production could be stimulated by increasing investment in research and supporting reforms targeted at increased production of multiple crops to serve multiple uses. The interactions among agriculture, energy, and the environment require that more of the research should be interdisciplinary in nature and should focus on the boundaries between these three fields. The increased demand for food and the emerging interest in biofuels has created a new challenge for governments at all levels. Biofuels are not only an energy issue, but also have major land use implications and thus must be approached from energy, agriculture, and conservation perspectives; all of which come together in land use. Most national governments separate agricultural, energy and environmental policy and natural resources planning into separate agencies.

It is important that biofuels not be the primary driver of land use policy. Regional governments should embrace the principles of integrated planning, but to do this they must be able to tap into and coordinate the interests of the many diverse stakeholders. This coordination can best be achieved at the local or regional level, which means that the role of the national governments becomes more that of a facilitator, providing guidance, financial assistance, and technical support to local and regional institutions. Local governments will often not have the technical capacity to design and develop the matrices to measure the impacts of land use changes. Thus national governments should provide technical guidelines and implementation training to sub-national governments. It also means that the relevant national agencies must develop coordinating mechanism, both among each other and with local entities.

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Context

Biofuels are emerging in a world increasingly concerned by the converging global problems of rising energy demands, accelerating climate change, high priced fossil fuels, soil degradation, water scarcity, and loss of biodiversity.

Since most current modern biofuels are made from food crops, concerns about arable land use competition, risks to food security, vulnerable communities, water resource constraints, and deforestation arise. Meanwhile new crop feed stocks are being developed and advanced biofuel production methods using forest, crop, and urban residues, as well as from non-food crops, are also progressing, but have yet to be commercialized and deployed in the marketplace on a large scale comparable with the size of the energy market.

Many countries have a competitive advantage in producing biofuels. Meanwhile, many other countries are unable to meet their biofuel needs from domestic sources.Therefore, increased biofuel trade holds promise. Also, when bioenergy displaces fossil fuels, in transport and power generation, or is produced in conjunction with soil carbon storage in the form of bio-char for example, opportunities arise for trade in carbon emission reduction units.

Future biofuel markets could be characterized by a diverse set of supplying and consuming regions. From the current fairly concentrated supply (and demand) of biofuels, a future international market could evolve into a truly global market, supplied by many producers, resulting in stable and reliable biofuel sources. This balancing role of an open market and trade is a crucial precondition for developing biofuel production capacities worldwide.

While domestic mandates ensure the existence of markets, they can also further distort markets for energy and agricultural products. The co-existence of mandates with other policy instruments such as subsidies, tariffs, import quotas, export taxes and non-tariff

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barriers have not always resulted in effective deployment and efficient production and can restrict the opportunities that biofuels present.

The current negative image of biofuels in some quarters, provoked in part by a rather complex set of national public support schemes, is threatening the fulfillment of their promise and must be addressed.

Paramount to a solution is an orderly and defined schedule for elimination of subsidies, tariffs, import quotas, export taxes and non-tariff barriers in parallel with the gradual implementation of sustainable biofuels mandates. These measures will provide the necessary conditions to reduce risks and to attract investment to develop and expand sustainable production. Several different efforts to reach these goals are ongoing including multilateral, regional, and bilateral negotiations, as well as unilateral actions. Ad hoc public and private instruments such as standards and product specifications and certification may also prove useful for addressing technical and sustainability issues. In addition, the development of a global scheme for sustainable production combined with technical and financial support to facilitate compliance, will ensure that sustainability and trade agendas are complementary.

Actions and Stakeholders

In this perspective LCA assessment and involvement of stakeholders are necessary steps. This last process is characterized by the following phases:

Integrate and better coordinate policy frameworks

This requires: coordinating national and international action among key sectors involved in biofuel development and use, including agriculture, energy, environment, and transport;

negotiating a schedule to gradually eliminate the tariff and non-tariff barriers to biofuels trade;

1. agreeing on internationally compatible fuel quality technical standards whilst recognizing that several countries are already engaged in efforts to harmonize these standards; transparency in blending and other regulatory requirements at national and sub-national levels;
2. reviewing policies in agriculture, energy and other sectors that contribute to

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inefficient production and market distortions in biofuels and their feed stocks;

3. and adopting local, bilateral, regional and/or other frameworks for biofuels trade agreements with the objective of collaborating with existing frameworks (for example the UN Framework

Convention on Climate Change; and the G8 established Global BioEnergy Partnership - GBEP) to achieve convergence towards a comprehensive international land use improvement agreement.

Assess benefits and impacts of biofuels trade, use and production, and monitor them

This requires:

- agreeing on sustainability principles and criteria that include effective, mutually agreed and attainable systems, via means such as certification, consistent with World Trade Organization (WTO) rules;
- recognizing that several key international efforts are already underway both in governmental and non-governmental contexts and that an iterative review of such criteria should be undertaken in order to continually raise the standards through advances in knowledge from research and through experience gained in the field;
- harmonizing life-cycle analysis - LCA - methodologies for biofuels, including GHG life-cycle accounting methodologies, recognizing that efforts both at the international and national levels are already under way;
- continued mapping of degraded and marginal land; and
- continued mapping of carbon stocks, areas rich in biodiversity, and other high conservation value areas. Transparency, accessibility and application of these maps need international agreement and must have sufficient resolution such that small scale farmers are not excluded. It is recognized that efforts to map carbon stocks are being stimulated by the IPCC and undertaken by several other global land use mapping organizations but they must be better coordinated.

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Address negative indirect effects of biofuels trade, use and production

As with other sources of energy, agricultural and forest products, and urban wastes, biofuels have positive and negative impacts. In an ideal world, sustainability criteria would be applied to all food, fodder, fiber and all energy production and thus put biofuels on a level playing field with fossil fuels. Until such a system exists, there will be an excess of indirect positive and negative impacts on conservation areas, GHG balances, and food security from land use change, as well as price variations specifically associated with biofuels.

Addressing indirect impacts explicitly requires:

continued global research to identify and quantify links between biofuels and land use change;

mechanisms to promote biofuels that do not have negative land use change impacts;

mechanisms that mitigate these negative impacts but do not unduly increase transaction costs for producers; and social safeguards at the national level, that ensure that vulnerable people are not further disadvantaged through food and energy price increases and other potential negative economic side effects.

Reward positive impacts and investments, including through carbon management

Enhanced market opportunities will open up capital in order to follow the most profitable business models. Some benefits from biofuels use do not have an associated income stream. Therefore even sustainable trade as outlined in this document will not necessarily flow to the best performers. Under- funded benefits fall into the categories of:

rural and social development;

ecosystem services, including biological carbon fixation and water resource management; and better practices that might reduce crop yields but restore ecosystem health, such as conservation agriculture.

Rewarding better practice will require:

- using existing and innovative tools to ensure that markets reward environmental and social performance, including carbon sequestration, without additionality

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requirements;

- recognizing that the post-Kyoto regime will possibly reward biological carbon fixation, and this should be encouraged;
- ensuring that biofuels development is accomplished by shared benefits, rights and rules of law;
- recognizing that biofuel projects that create significant rural and social development benefits will likely be under-invested in due to difficulties in integrating smallholders into markets, tendencies to concentrate buying power within supply chains, and a lack of financial markets for small producers;
- understanding that many business models exist that equitably share benefits throughout the supply chain, especially at the farmer level. National policies, bilateral agreements, foreign assistance, and international financial institutions should give preferential treatment to these types of production systems to the extent feasible and to projects that encourage development of small scale production and regional biofuels markets; and acknowledging the link between bioenergy and rural development for improving rural incomes and abating poverty and thus providing a basis for increased investment and more efficient and sustainable agriculture.

Use informed dialogues to build consensus for new projects

Promoting an informed and continuous dialogue engaging all relevant stakeholders is key to ensuring equitable distribution of benefits of biofuel projects, and to addressing other elements of sustainability. It is particularly important to encourage biomass producers, both farmers and foresters, into the dialogue. To be effective, these dialogues must be translated into the allocation of public and private budgets to meet the consensus achieved on priorities for specific projects and Research and Development and Demostrations portfolios.

Build capacity to enable producers to manage carbon and water

Capacity building programs are needed for farmers, foresters and small and medium-sized enterprises active in bioenergy and biosphere carbon management systems, such as biochar soil improvement techniques and water management technologies. Capacity

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building is also needed for the development of effective technology innovation systems involving research and education, extension, industrial capacity to participate in joint ventures with supportive government agencies and an engaged civil society.

We should put attention about possibile scissors effect between food and biofuel productions. Recent agricultural commodity price increases for the most part can be attributed to factors unrelated to biofuel production. These are increasing food and fodder demand as such, speculation on international food markets and incidental poor harvests due to extreme weather events. Also, high oil prices and related high costs of fertilizers have an impact on the price of agricultural commodities.

- Low productivity in agriculture in many regions has resulted in unsustainable land-use, erosion and loss of soils, deforestation and poverty. Increased productivity over time as a result of better farm management, new technologies, improved varieties, energy related capital investment and capacity building would gradually increase the intensity of land use so that sufficient land becomes available the meet the growing demand for food, fodder, fiber and biofuel production.

Over time, first generation biofuels are likely to become more GHG efficient and co-exist with second generation biofuels as they are further developed. Tropical and sub-tropical regions will continue to enjoy comparative advantages in producing cost effective feed stocks for both of the possibilities.

Furthermore in the planned renewable technologies implementations we should analyse the costs of intervention with the support of the tool of Life Cycle Cost Analysis (LCCA) that is an economic evaluation technique that determines the total cost of owning and operating a facility over period of time.

Life Cycle Cost Analysis can be performed on large and small buildings/plants or on any other asset. Many plants planners apply the principles of life cycle cost analysis in decisions they make regarding construction or improvements to a facility.

Keeping this definition in mind, one can breakdown the LCC equation into the following three variables: the pertinent **costs** of ownership, the period of **time** over which these

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costs are incurred, and the **discount rate** that is applied to future costs to equate them with present day costs.

In this way, LCCA permits to extend the analysis of the project to all the life long period, evaluating the real economic impacts of the investment.

Moreover the LCC could evaluate environmental and social aspects that are necessary components in a renewable energy technologies implementations, even if their numerical values are difficult to quantify.

The items which are included are planning, design, construction or acquisition, operations, maintenance, renewal and rehabilitation, depreciation and cost of finance and replacement or disposal.

Furthermore in LCCA we consider benefits and indirect or intangible costs as well as direct costs.

In this way, the whole-life costs and benefits of each option are considered and usually converted using discount rate into present value costs and benefits. This results in a benefit cost ratio for each option, usually compared to the "do-nothing" counterfactual. Typically the highest benefit-cost ratio option is chosen as the preferred option.

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4. Social and economic analysis of bio energy crops as compensative measure of new infrastructures

New infrastructures can be a source of possibilities and opportunities for the development of a region, but they change deeply landscapes and the land use of a territory.

Compensations and mitigation actions are necessary for environment goals and also in order to reduce the impact of the infrastructures on life of the local communities, as an integrant part of the local sustainable development policies and not a danger for the economies or for the environment.

Following this approach, environmental impacts of new extension of highways or airports, or tunnels could be reduced by projects of maintenance or creation of green lands directly connected with the same infrastructures.

Furthermore if the green lands could be used for bio energy crops, we can reach two great results with a unique action: compensation action for environment and possibility of economic profit for local communities.

In this case we should use a method which safeguardes social and economic/financial stakeholder and lenders, investors and farmers interests.

The introduction and support of an Environmental Due Diligence (EDD) review is the right answer to this requirements.

For Environmental Due Diligence we consider the collection and assessment of data referred to environmental status or impacts prior to an infrastructure project in order to identify and quantify environment related financial, legal, and reputational risks.

The purpose of a due diligence review is to ensure that a projected investment does not carry financial, legal, or environmental liabilities beyond those that are clearly defined in an investment proposal. It has become a way for financial institutions to incorporate environmental and social considerations in their investment review process. UNEP-SEPI suggests this kind of process in order to support also RET (Renewable Energy Technologies) projects

So we can consider the EDD Process divided in three parts:

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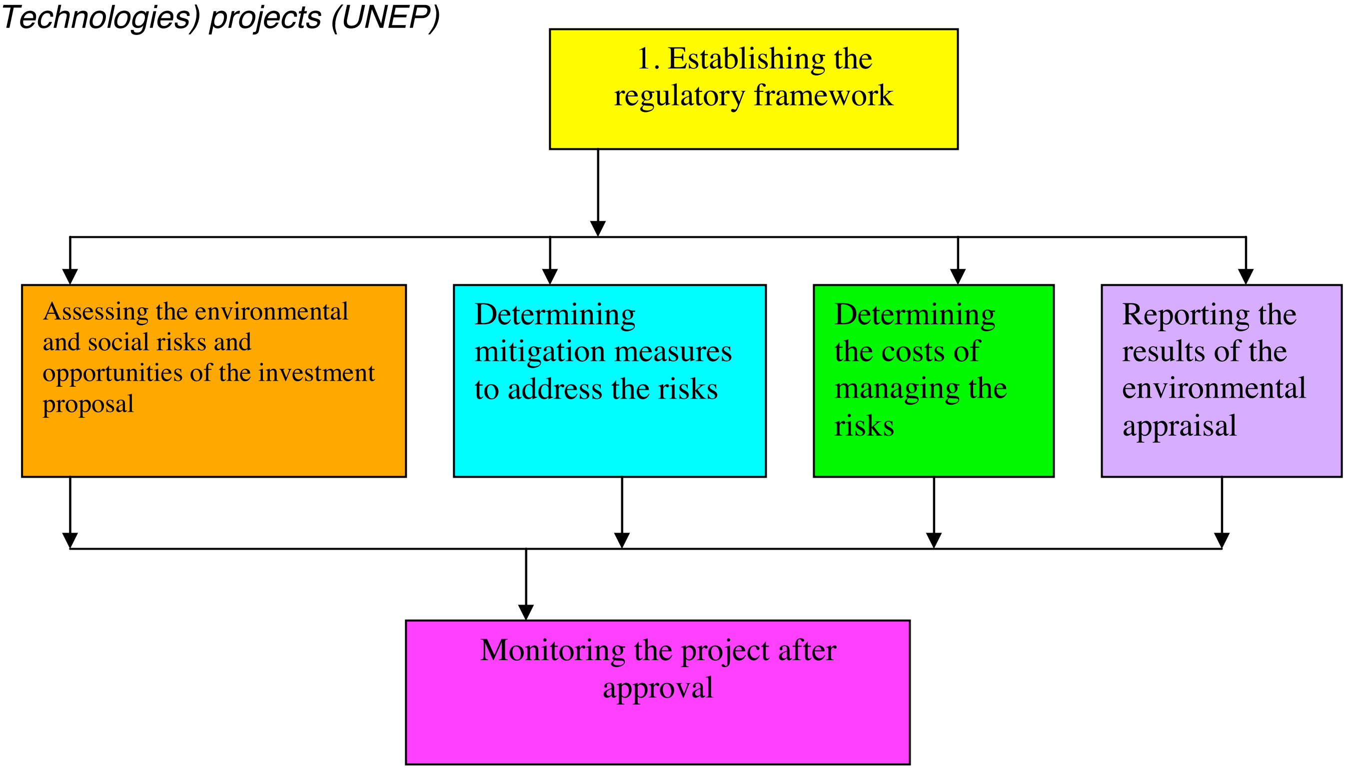
- The regulatory framework
- Environmental Appraisal
- Monitoring the evolutions of the project after its approval

Figure 4.1: Procedure for environmental due diligence of RET (Renewable Energy Technologies) projects (UNEP)



1. The first stage of the procedure is establishing the relevant regulatory framework for the project, including national regulations, international standards, and good practice guidelines.

The environmental laws provide the background for determining the main issues that should be considered during the environmental appraisal process. Environmental regulations, standards and guidelines provide practical information concerning emission limits, permitting requirements, pollution abatement and control techniques and equipment, best management and operational practices, etc., against which the investment proposal should be benchmarked.

Two timeframes must be considered for this process: first, that of existing laws and regulations that currently affect the project, and second, that of anticipated laws and

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regulations (e.g. in process of development, discussion, or approval) that may change the conditions under which the project must operate.

2. The second stage is the core of the entire process. It comprises four main steps: a) assessing the environmental risk; b) determining mitigation measures; c) estimating the cost of risk management; and d) reporting the results.
To facilitate the first two steps of this stage a number of new EDD tools are proposed. These tools are intended to complement, not replace, any EDD tools currently used for environmental review procedures. In addition, it is important to note that since these tools are intended for general use, they may not reflect all the possible environmental and/or social issues related to a particular investment. The analyst should incorporate additional issues as needed.

3. The third stage is the environmental monitoring of the project. This part has two objectives:
a) to ensure that the project sponsor complies with the applicable environmental standards and various environmental components of operations included in legal agreements;
b) to keep track of ongoing environmental impacts associated with project operations and of the effectiveness of any mitigation measures.

a) Assessing the environmental and social risks and opportunities of the project
The objective of this task is to provide an initial evaluation of the environmental risks and opportunities presented by a particular energy crop project. The expected outcome of this step is a matrix that provides the final decision makers with an estimate of the risk potential of a project with respect to a number of potential environmental issues.

Two tools have been developed to aid the investment analyst in this task.
Table 4.1 provides a list of potential environmental issues that may be associated with a biomass project based on energy crop. The issues have been divided into four categories: effluent emissions, on-site contamination and hazardous materials issues; biodiversity protection issues; worker health and safety issues; and environmental issues sensitive to

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public perception. The table provides a checklist of information that an analyst may use to determine the risk potential of each issue for the project in review. This information may be contained in the documentation provided by the project developer, for example in an EIA or other type of environmental assessment report that may accompany the proposal; or it may be ascertained during on-site field visits, stakeholder meetings, etc. Other possible sources of information include media reports, telephone conversations, electronic or post mail, etc. In any case, the responsibility for providing relevant information to the satisfaction of the analyst rests ultimately with the project developer/sponsor.

In some cases, the table also provides best practices and/or mitigation measures that could be planned, proposed or carried out on-site to manage a particular issue. It is important to note, however, that these best practices/measures are generic and therefore only meant for illustrative purposes.

Other important information to be used to assess the risk potential of an energy crop system include:

- impending environmental legislation that may affect the project;
- the environmental liability regime of the host country;
- project sponsor characteristics including previous compliance problems and history of accidents.

Table 4.1 Checklist for environmental and social risk assessment of an energy crop system

Risks	Information to look for
Effluent emissions, on-site contamination, hazardous material issues	
1. use of pesticides	Volume and choice of pesticides used Integrated pest management scheme in place Pesticides storage and disposal Method of application employed Studies on waste water releases, and runoff or leaching potential, into local water ways
2. use of chemical	Rate timing and methods of application Studies on watse water releases, and runoff or leaching potential, into

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fertilizers	local water ways
3. Brownfield location	Previous land use: if land was used for intensive arable cultivation, or other potentially contaminating activity, look for soil and groundwater studies to check for potential on-site contamination
4. Emissions of NOx, SO2, Co, particulates, VOC	Conversion technology used, with higher to lower emission potential arising from the following schemes in this order: -co-firing schemes; -direct combustion systems - gasification systems Scale of generation plant Maturity of the technology Combustion methods, fuels, conditions and modes of operation Compliance with local, national and/or international air quality standards limits
5. emissions of CO2 and other greenhouses gases	Conversion technology used: if the energy crop is sustainably produced, this point is only applicable to co-firing schemes Scale of generation plant
6. Solid waste	Volume and chemical composition Disposal method
Biodiversity Protection Issues	
7. Introduction of non-native species	Studies about suitability of chosen crop to site soil and water conditions, sensitivity of local ecosystems to introduced species, etc Farming and containment practices to control spread of introduced species in neighbouring fields
8. Use of GMO's	Farming and containment practices to control speread of GMO species in neighbouring fields
Worker health and safety issues	
9. Pesticide application	Compliance with local health and safety regulations Compliance with international health and safety guidelines, such as

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	IFC's Plantation Guidelines, which cover issues such as training, supervision, proctective clothing etc Outstanding worker compensation claims
10. Accidents from crop cultivation and harvesting (poisoning, fires, etc.)	Compliance with international, local, and national health and safety regulations Operations and maintenance routines in place Training of personnel Emergency plans in place Outstanding worker compensation claims
Environmental issues sensitive to public opinion	
12 Signinificant land use	Site location (e.g. proximity to highly populated areas, ecologically important areas, areas with high recreational value, Greenfield locations, etc.) Scale of the project (the higher the scale, the more land is necessary for crop plantations) Land use being replaced by the plantation (e.g. agricultural, recreational)
13. Soil erosion or compaction	
14. Contamination of soil/ground water/surface water	Studies on wastewater releases, and runoff or leaching potential of agrochemicals (pesticides, fertilisers, herbicides, etc.) Compliance with regulated pollutant emission levels of liquid effluents (e.g. local, national or international liquid effluent standards)
15. Water depletion	Crop suitability to available water sources for irrigation Irrigation management plans in place
16 Loss of biodiversity	Prior land use replaced by plantation: on degraded lands or excess agricultural lands, biodiversity is likely to improve. Plantations should never replace natural forests, such as tropical rainforests Farming practices concerning use of pesticides, herbicides, or insecticides for crop cultivation activities.

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17 Visual impact	Site location (e.g. proximity to highly populated areas, areas with high recreational value, etc) Use of the best practice plantation establishment guidelines
18 Noise from generation activities	Compliance with noise emission levels Complaints from neighbours

Source: UNEP, SEFI, *EDD Guidelines release 1.1*

The second table, **Table 4.2**, is a matrix in which the user can enter the appropriate letter (i.e. L, L-M, M, M-H, H) according to his/her estimation of the risk each issue presents for the project in review. The purpose of the table is simply to provide a snapshot of the environmental and social risks of a particular project and their corresponding risk rating at aparticular point in time. This risk rating can help the investment analyst decide further actions in the EDD process.

Table 2 also presents a column of potential environmental opportunities of a project to present a more balanced view of the environmental impact (both positive and negative) that may be attributed to a particular project.

The assessment of a certain risk potential will depend on the results of the review of relevant information, as well as on the analyst's experience and common sense.

b. Identifying risk management measures

Once the environmental and social risks of the project have been assessed, the next step is to identify what measures would be needed to eliminate, reduce, or manage those risks. In the case that the project sponsor has recommended measures for managing potential risks, the analyst must decide whether the measures are acceptable. If no or only inadequate risk- mitigation measures have been recommended, the project developer must modify the project to ensure satisfactory risk management.

Risk management measures may be identified through industrial or sectoral best practices, international or other widely used/accepted standards, etc.

The following question list may provide some assistance determining the extent of compliance of the project with regulations, standards, and best-practice guidelines and protocols for risk management. The question list has been constructed in a modular form, with the first module containing general questions that should be answered for all projects, while subsequent modules should be applied only if considered necessary or relevant.

Table 4.2 Question lists for an energy crop system

Level	*Questions*
Level I: all the project	1. Has the project complied with all legislated requirements for operation, receiving all necessary licences and permits? (Land use for crop plantation, plant operational permits, requirements from local and national governmental authorities, etc.)
	2. Has the plantation been established according to best practice guidelines to mitigate visual impact? (E.g. Avoid straight edges, follow natural topography, promote species diversity in plantation)
	3. Are good farming practices used for the plantation of the crops? (Including agrochemical use and application, soil protection measures such as no tillage, winter covers, etc., sustainable management of water used for irrigation, etc.)
	4. Are best practices followed for pesticide storage and disposal? (Labelling of containers containing pesticides, fire prevention systems, secondary containment to prevent leakages, locked and posted area for pesticide storage, etc.)
	5. Are prevention and mitigation measures for worker health and safety considered at the plantation? At the generation plant? (Emergency plans, basic medical facilities on site, sanitary facilities, etc.)
	6. Are workers properly trained and equipped for carrying out their activities at the plantation? At the generation plant?
	7. Are air emissions from the generation plant regulated and are these regulations complied with?
	8. Are liquid effluents from the farming activities and from the generation plant regulated and are these regulations complied with?
	9. Is the composition and quantity of solid waste from the generation plant (ash) known, and is it disposed of in an environmentally acceptable way?

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	10. Are there proper operation and maintenance routines at the generation plant?
	11. Have all moderate and high risk issues identified in the previous stage, other than those that may have been covered in questions 1-10, been appraised and have mitigation measures been proposed?
Level 2: Optional questions	12. Has an environmental impact assessment report, an environmental audit, or any similar environmental assessment been prepared with respect to the project? Is one required?
	13. Has a site visit been planned? Is one required?
	14. How can the environmental liability regime of the host country affect the financial institution?
	15. Have there been any protests or complaints about the project? If so, what have they focused on?
	16. What are the potential environmental benefits of the project? Is the general public aware of these environmental benefits?

c. Determining the costs of managing the risks

When the mitigation measures have been determined, the next step is to estimate the cost of the risks and their management. This includes both the real cost of the mitigation measure itself, as well as the potential costs associated with non-compliance (e.g. increased charges, fines and other penalties, the closure of an operation by environmental authorities, project delays due to permitting requirements, etc). Estimating such costs is important even if the financial institution or investor may not be directly responsible for them: first, any unforeseen costs can compromise the financial viability of the proposal; and secondly, the financial institution could be held liable under certain liability regimes. How exact the cost calculation should be and the level of detail is up to the analyst.

The analyst must also take into consideration any future liabilities that could occur as a result of changed environmental legislation, regulations, and standards.

Costs should be determined on a case-by-case basis, depending on the results of the

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previous step.

d. Reporting the results

The third step of the environmental appraisal stage is to present the key findings of the EDD review in a report that can be used during the investment decision process. The final report should include at a minimum the following information:

1- Brief description of the project

2- General information about the project sponsor

3- Status of compliance with host-country regulations, international standards, best-practice guidelines

4- Main environmental impacts and proposed mitigation measures (including an assessment of the adequacy of these mitigation measures if necessary or appropriate)

5- An analysis of how the costs of the necessary mitigation measure affects the project's financial viability

6- Environmental opportunities (potential benefits of the project)

7- Any missing information that may be significant for the assessment of the environmental risks and opportunities of the project

8- In the case of moderate and high-risk projects, the key findings should highlight high-risk potential issues and their mitigation measures, as well as the results of environmental assessment reports and site visits that may have been carried out during the review process.

9- Further actions required by the financial institution or the project sponsor with respect to environmental issues

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3. Monitoring the project

If the project has been approved, the final stage of EDD is the monitoring stage. For this purpose, specific provisions should be included in the legal documentation, for example, the requirement of annual environmental reports, independent environmental audits at specific intervals, site visits, etc. This is especially important for high-risk projects, for which the agreements between project sponsor and financial institution or investor should always include an environmental reporting and evaluation clause. In this case the monitoring should be carried out at regular intervals (e.g. annually or semi-annually), preferably including independent site visits or audits in addition to the project sponsor's environmental evaluation reports.

For low and moderate risk projects, environmental reports from the project sponsor on an annual or semi-annual basis should be sufficient.

Significant changes in the project (e.g. projected expansions, changes in technology), changes in the type of finance (e.g. from loan to equity), and/or foreclosures should **always** be preceded by a re-assessment of environmental risk. This is in order to determine whether the

changed project carries environmental and social risks and opportunities that were not considered in the initial review. The environmental monitoring of the project should continue until the loan has been repaid, the financial institution or investor has divested its equity share in a company, or the operation has been cancelled.

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5. State and Performance Indicators

There are different definitions of the term indicator. We define indicators as 'measurable parameters, which characterize a system by reduction of complexity and integration of information'. They shall give quantitative and qualitative information about the condition or the development of systems and should serve as decision aid. give a more specific indicator definition for the forestry sector. They define an indicator as 'any variable or component of the forest or the relevant management systems used to infer attributes of the sustainability of the resource and its utilization'.

A verifier is defined as data or information that enhances the specificity or the ease of assessment of an indicator Verifiers are needed for indicator assessment and the control of the fulfillment of sustainability criteria. Different systems that can provide criteria and indicators with relevance for one or several areas of biomass trade were analyzed. These systems were categorized into such that contain sustainability criteria; indicators for sustainable development and indicators to assess the sustainability of projects

State indicators describe the state of the protected good, the desired state of the situation for the stakeholders or the envisioned effect of the actions to be taken within the system

Table 5.1. Examples of state indicators and the criteria they describe

Criteria described	**Example state indicators**
Compliance with laws and international agreements	The licensee can demonstrate compliance with the national and local regulations and discharge any (administrative) obligations arising there from
A safe and healthy work environment	First aid boxes must be present at all permanent sites and in the vicinity of fieldwork
No illegal overtime	A working hours and overtime regulation is put in place
Market access for small farmers and producers	The majority of the members of the organization are small producers providing more than 50% of the total production of the fairtrade products

Source: Lewandoswski, Faaij (2006)

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The second step of the development of sustainability standards is the formulation of sustainability criteria and indicators to measure the performance of these criteria. The development of sustainability criteria requires the analysis of local conditions and, for the formulation of what is to be considered sustainable, the involvement of local stakeholders. Therefore, the relevant stakeholders have to be identified in the very beginning. The analysis of the local conditions the inquiries of the local people give insight into the aspects for which criteria are needed. For example criteria that address the prevention of erosion will most probably be selected in slope areas with erosion susceptibility, but can be meaningless in flat areas with no or low danger of erosion.

Most sustainability standards were developed by stakeholder involvement using different approaches like performing interviews and workshops.

Table 5.2. Examples of Indicators for the avoidance of soil erosion, according to different systems of certification of the process (ISO 14001 or similar protocols)

Indicator
The management plan has to include information on measures taken to prevent erosion, improve soil conditions, etc.
Avoid practices that aggravate erosion and favor practices that conserve soil
Field cultivation techniques that minimize soil erosion must be adapted
Clear-cuts in areas susceptible to erosion (e.g. directly next to rivers or steep slopes) are prohibited
A soil conservation plan to minimize erosion must be implemented. The plan must consider the topography, type of soil, climatic conditions and agricultural practices of the area. Windbreaks, vegetative barriers, cover crops and contour planting must be employed where conditions warrant
There is visual or documented evidence of crossline techniques on slopes, drains, sowing grass or green fertilizers, trees and bushes on borders of sites, etc.

Source: Lewandoswki, Faaij (2006)

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