Global Assessment of Biomass and Bioproduct Impacts on Socio-economics and Sustainability

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Socio-Economic Impacts of Biomass Feedstock Production

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1 Introduction

A strong public debate on sustainability aspects for biofuels emerged in the last few years. This debate focused on negative social and environmental impacts. In consequence, several initiatives were set-up, which are engaged in developing tools to ensure sustainability of biofuels. One option to ensure the sustainability of biofuels is the application of certification systems.

The main aim of the Global-Bio-Pact project is the improvement of global sustainability certification systems for biomass production, conversion systems and trade in order to prevent negative socio-economic impacts. Thereby, emphasis is placed on a detailed assessment of the socio-economic impacts of feedstock production and a variety of biomass conversion chains. The Global-Bio-Pact project "Global Assessment of Biomass and Bioproduct Impacts on Socio-economics and Sustainability" (Contract No. FP7- 245085) is supported by the European Commission in the Seventh Framework Programme for Research and Technological Development (FP7). Global-Bio-Pact runs from February 2010 to January 2013.

In order to generate data on the ground, five in-depth case studies for socio-economic impacts are to be investigated in the framework of Global-Bio-Pact:

- Biodiesel from soy in Argentina
- Palm oil and biodiesel in Indonesia
- Bioethanol from sugarcane in Brazil and Costa Rica
- Jatropha oil and biodiesel in Tanzania and Mali
- 2nd generation biofuels and products from lignocellulosic material in Europe and North- America

In order to work towards sustainable biomass production, concrete on-site examples showing main areas of concern are good measures to practically analyze relevant socio-economic issues of biomass production. Positive and negative socio-economic impacts on micro- and macro-level will be assessed for all Global-Bio-Pact Case Studies.

The aim of this report is to provide a first overview of the most relevant socio-economic impacts of feedstock production, based on available literature. The review focuses on the biomass resources that were selected for the five different case studies.

This information is combined with a screening of the socio-economic criteria and indicators which are principally used in existing and developing certification systems and legislation to safeguard the sustainability of bioenergy.

The information from both reviews will provide a sound basis to select a set of relevant impacts that can be used to analyze the socio-economic issues of biomass production on a local, regional and national level.

2 International declarations and standards

2.1 International Labour Organization (ILO)

International labour standards respond to a growing number of needs and challenges faced by workers and employers in the economy. This section presents the subjects covered by the international labour standards of the International Labour Organization (ILO).

The ILO is an international organization responsible for drawing up and overseeing international labour standards. It is the only 'tripartite' United Nations agency that brings together representatives of governments, employers and workers to jointly shape policies and programmes. This unique arrangement gives the ILO an edge in incorporating 'real world' knowledge about employment and work. This tripartite structure makes the ILO a unique forum in which the governments and the social partners of the economy of its 183 Member States can freely and openly debate and elaborate labour standards and policies.

International labour standards are backed by a supervisory system that is unique at the international level and that helps to ensure that countries implement the conventions they ratify. The ILO regularly examines the application of standards in member states and points out areas where they could be better applied. If there are any problems in the application of standards, the ILO seeks to assist countries through social dialogue and technical assistance. The ILO has developed various means of supervising the application of Conventions and Recommendations in law and practice following their adoption by the International Labour Conference and their ratification by States.

The most relevant social and labour topics and related ILO standards for the production of biomass are shown in table 1 below [1].

Table 1: ILO standards relevant for biomass production

Freedom of Association and Collective Bargaining	
87	Freedom of Association and Protection of the Right to Organize Convention (1948)
98	Right to organize and collective bargaining convention (1949)
11	Freedom of association (agriculture): Rural workers' organizations convention (1975)
135	Workers' Representatives Convention (1971)
154	Collective Bargaining Convention (1981)
Forced Labour	
29	Forced Labour Convention (1930)
105	Abolition of Forced Labour Convention (1957)
Elimination of child labour and protection of children and young persons	
138	Minimum Age Convention (1973)
182	Worst forms of Child Labour Convention (1999)
Tripartite Consultation	
144	Tripartite Consultation (International Labour Standards) Convention (1976)
Equality of opportunity and treatment	
100	Equal remuneration Convention (1951)

111	Discrimination (Employment and Occupation) Convention (1958)
Employment policy and promotion	
122	Employment Policy Convention (1964)
Vocational training and guiding	
144	Paid Educational Leave Convention (1974)
142	Human Resources Development Convention (1975)
Wages	
131	Minimum Wage Fixing Convention (1970)
Working time	
14	Weekly Rest (Industry) Convention (1921)
175	Part-Time Work Convention (1994)
Occupational safety and health	
155	Occupational Safety and Health Convention (1981)
184	Safety and Health in Agriculture Convention (2001)
Social Security	
102	Social Security (Minimum Standards) Convention (1952)
17	Social Insurance (Agriculture) Recommendation (1921)
Unemployment benefit	
168	Employment promotion and protection against unemployment Convention (1988)
Social Security for Migrant Workers	
118	Equality of treatment (Social Security) Convention (1962)
157	Maintenance of Social Security Rights Convention (1982)
Maternity Protection	
183	Maternity Protection Convention (2000)
Social Policy	
115	Workers' housing recommendation
117	Social Policy (Basic Aims and Standards) Convention (1962)
Migrant Workers	
97	Migration for Employment Convention (Revised) (1949)
Indigenous and Tribal Peoples	
169	Indigenous and Tribal Peoples Convention (1989)

2.2 Relevant UN Declarations and objectives

In 1948 the General Assembly of the United Nations adopted and proclaimed the **Universal Declaration of Human Rights**. The following reproduces a short-listed version of the most relevant articles (for this study!) of the Declaration [2]:

- All human beings are born free and equal (Article 1);
- No discrimination (Article 2)
- Everyone has the right to life, liberty and security of person (Article 3)
- No slavery (Article 5);
- Recognition before the law and equal protection of the law (Article 6, 7)
- Freedom of movement and residence within the borders of each state (Article 13);
- Everyone has the right to own property alone as well as in association with others. No one shall be arbitrarily deprived of his property (Article 17);
- The right to freedom of thought, conscience and religion (Article 18);
- The right to freedom of opinion and expression (Article 19);
- The right to freedom of peaceful assembly and association (Article 20);
- The right to social security (Article 22);
- The right to work, to free choice of employment, to just and favourable conditions of work and to protection against unemployment. Everyone, without any discrimination, has the right to equal pay for equal work and to just and favourable remuneration ensuring for himself and his family an existence worthy of human dignity (Article 23);
- The right to rest and leisure, including reasonable limitation of working hours and periodic holidays with pay (Article 24);
- The right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, and housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness… (Article 25);
- Everyone has the right to education (Article 26);

In 1959 the UN Commission on Human Rights and adopted by the General Assembly of the United Nations wrote the Declaration of the Rights of the Child:

- The child shall be protected against all forms of neglect, cruelty and exploitation. He shall not be the subject of traffic, in any form. The child shall not be admitted to employment before an appropriate minimum age; he shall in no case because or permitted to engage in any occupation or employment which would prejudice his health or education, or interfere with his physical, mental or moral development. [principle 9]

In 1992, the United Nations Conference on Environment and Development adopted the **Rio Declaration on Environment and Development:**

- All States and all people shall cooperate in the essential task of eradicating poverty as an indispensable requirement for sustainable development, in order to decrease the disparities in standards of living and better meet the needs of the majority of the people of the world. [Principle 5];
- Environmental issues are best handled with participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access

to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided. [Principle 10]

In 2000, building upon a decade of major United Nations conferences and summits, world leaders came together to adopt the United Nations Millennium Declaration and setting out a series of time-bound targets - with a deadline of 2015 - that have become known as the **Millennium Development Goals** (MGD) [3]:

- Eradicate extreme poverty and hunger;
- Achieve universal primary education;
- Promote gender equality and empower women;
- Reduce child mortality;
- Improve maternal health;
- Combat HIV/Aids, malaria and other diseases;
- Ensure environmental sustainability;
- Develop a global partnership for development

In 2007, **the General Assembly** adopted a resolution on **Declaration** on the Rights of Indigenous People:

- Indigenous peoples have the right to the full enjoyment, as a collective or as individuals, of all human rights and fundamental freedoms as recognized in the Charter of the United Nations, the Universal Declaration of Human Rights (4) and international human rights law. [Article 1]
- Indigenous peoples and individuals are free and equal to all other peoples and individuals and have the right to be free from any kind of discrimination, in the exercise of their rights, in particular that based on their indigenous origin or identity. [Article 2]

3 Assessment of socio-economic impacts of biomass production

3.1 General studies on socio-economic impacts of biomass production

A consideration of the social impacts of biofuel production requires the recognition that effects operate through social, economic and political systems. Note that these systems are intimately interconnected – particularly in the developing world [4].

The COMPETE project[1] (Bioenergy Competence Platform for Africa) analyzed the environmental and social aspects of bioenergy for sustainable development in Africa. Based on a debate on biofuels sustainability schemes, organized in 2008, the following social, economic and policy related sustainability guidelines had been elaborated [5]:

Table 2: Sustainability guidelines for bioenergy production in Africa, as developed by the COMPETE project

Social:	• Community participation in planning; • Women's participation in planning; • Skills transfer
Economical:	• Community inclusion in business models; • Added value in the community ensured through e.g. employment and revenue creation; • Improvement in services and infrastructure
Policy:	• Compliance with national polices; • Compliance with national programs or plans; • Respect land rights and avoid displacement

A study from Kessler et al. [6] developed a list of most relevant impacts and indicators for a set of selected agro-commodity production chains. For most of the selected indicators, quantitative values are available from UNDP Human Development Reports, ILO reports and national statistics.

Table 3: Indicators used to assess socio-economic impacts for agro-commodity production chains [6]

Indicator	Relevance and description
Per capita GDP (national and administrative units)	An increase of GDP per capita is expected in production areas. GDP per capita is corrected for inflation.
Employment rate	An improved employment rate is expected in production areas. Where possible a distinction is made between rural and urban employment.
Food security, child mortality	Food security may be negatively affected due to the replacement of food crops by commodity export crops. Child mortality[2] can be used as a prox for food security.
Poverty (index)	Reduced poverty rate is expected in the production areas, as associated with improved incomes. The Human Poverty Index is an index measuring shortages in life expectancy, education, and standard of living.
Conflicts	There accounts of conflicts due to land grabbing, illegal practices as a response of rapid expansion of production volumes. Other indications for conflicts are local corruption and, cases of slavery or child labour.
Inequality	Equality in income and distribution may decline if few benefit from the production process, but trickle down and increased employment may improve inequality. A measure for inequality

[1] www.compete-bioafrica.net

[2] Comment from author: Child mortality is of course also influenced by other issues. It can therefore be questions if this is the most appropriate indicator.

	is the GINI index.

Smeets et al. [7] included various socio-economic areas of concern to analyze the impacts of sustainability criteria on the costs and potentials of bioenergy production. Specific case studies included sugarcane production in Brazil and SRC production in the Ukraine. The areas of concern were translated to a set of loose (i.e. limited set of requirements, see table 4 below) and strict criteria.

Table 4: Areas of concern and socio-economic criteria to analyze the impacts of sustainability criteria on the costs and potentials of bioenergy production [7]

Area of concern	Loose criterion	Strict criterion
Food supply	Energy crop production is not allowed to endanger the supply of food	-
Child labour	Child labour is not allowed	Similar
Wages	Fair wages must be paid so that poverty as defined by (inter-) national standards is avoided	Fair wages must be paid so that poverty as defined in (inter-) national standards is avoided and also so that wages are fair compared to national wages
Employment	Energy crop production must contribute to the direct employment	Energy crop production must contribute to employment, including all direct and indirect and induced effects
Education	(Education must be provided for the workers' children)	Education must be provided for the workers' children by the energy producer
Health care	(Health care services must be provided for all workers' family members)	Health care services must be provided for all workers' family members by the energy crop producer

The Roundtable of Sustainable Biofuels (RSB) has investigated a large number of potential socio-economic impacts associated with biofuel developments, which have been incorporated into the RSB principles. A list of key socio-economic issues and impacts, identified by RSB, which should be investigated and assessed, is provided in Table 5. RSB mentions that the investigation of impacts should however not be limited to this prescribed list, and should depend rather on the local context and the nature of the proposed development. It should also be noted that it is necessary to consider both the direct impacts associated with the proposed development as well as potential secondary and cumulative impacts. While the direct impacts may be of low significance, their significance might be elevated when considered in the broader context (for example, loss of access to land and natural resources due directly to the project development and indirectly due to densification, in-migration and resettlement) [8].

Table 5: Potential socio-economic impacts, as identified by RSB, associated with biofuel developments requiring a full ESIA [8]

Issue	Impact
Economic Benefits	• Increased employment • Increased income earning opportunities (i.e sale of goods and services) • Increased cash for consumption and savings/investment (i.e. in livestock, education, dwellings etc)
Economic losses	• Loss of labour for other existing livelihood activities • Loss of land and natural resources • Less access to land (reduced availability) • Tenure security/insecurity
Resettlement	• Loss of land, dwellings and other physical resources • Loss of crops and cleared arable land • Loss of natural resources and grazing land

(either physical or economic)	• Loss of land rights and entitlements • Compensation • Disruption of social networks and relationships • Disruption of relationship with the land and natural resources
Food Insecurity	• Ability to maintain household food production (depends on labour, productivity and cash) • Ability to purchase food (depends on availability of food, prices and income)
In-migration and Population growth and concentration	• Densification and concentration of settlement • Social tensions related to competition and differences between locals and in-migrants • Less compliance with local norms and regulations
Social conflicts	• Due to competition between groups for employment and other economic benefits • Due to competition and differences between locals and in-migrants • Due to tensions between resettled households and residents in host areas and neighbouring areas. • Due to increased pressure on land and natural resources and tensions around land administration and land use management • Due to increased crime
Disturbance and / or loss of cultural heritage sites and resources	• Impacts on graves, sacred sites and important cultural heritage sites and resources • Movement of graves
Health and welfare	• Access to sufficient potable water • Increased risk of HIV/AIDs and other diseases • Increased crime • Access to natural resources for traditional medicines • Education • Increased traffic safety risks • Health risks from employment, pollution and sanitation problems • Health risks associated with introduction of vectors, especially water borne vectors due to irrigation • Increasing need for basic infrastructure and services
Governance impacts	• Management of resettlement • Changes in administration of land rights and use • Increased pressure on land and natural resources and tensions around land administration and land use management • Development of concentrated villages and urban centers • Increased demand for basic infrastructure and services • Need to maintain roads and other basic infrastructure and services • Management of increased social tensions

The RSB, the COMPETE project and the studies from Smeets et al. and Kessler et al. provide a general overview of key socio-economic issues to take into consideration for biomass production. Apart from that, there are several studies that provide background information on one or more specific socio-economic impacts for biomass production. These are discussed in the following sections.

3.2 Impact on gender

Potential effects of bioenergy production on women will depend upon the social status and the rights of women in a specific country and in the agricultural context. As the situation of women and general health conditions in rural areas of developing and emerging countries are often weak, these aspects should be considered within a greater agricultural and societal context [9].

Traditional use of biomass and the absence of energy supply in developing countries have gender differentiating impacts, since women are primarily responsible for activities such as gathering firewood, fetching water, growing crops, etc. Since women are more vulnerable as a result of systematic discrimination, gender-specific impacts can also be observed in the bioenergy industry. Parameters that characterize the status of women in developing countries include [9]:

- Limited access to land (only 5% of female farmers in developing countries own land);
- Marginalization in downstream socio-economic activities (e.g. trade);
- Limited access to knowledge and discriminatory employment conditions.

3.2.1 Impact on Employment opportunities and risks

The growing global demand for liquid biofuels has been seen as a way to create new employment opportunities in rural areas, thus leading to increases in income generation and rural development. In China, the liquid biofuel program is expected to create more than nine million jobs in the next few years [10].

With the increasing mechanization of agricultural production that is occurring in most developing countries (mainly on large-scale plantations), the number of agricultural jobs associated with the production of liquid biofuels is likely to decrease over time [10].

Gender-specific impacts: The economic development and income generating activities might in the beginning benefit men more than women, due to underlying differential access to resources [10]. Therefore it is likely women that would profit less from the potential benefits of the bioenergy industry and suffer more from unsustainable development. The potential advantages of bioenergy concerning land displacement and food competition may improve the situation for women, commensurate to the rest of the population, but the benefits will not be entirely grasped if their role is not upgraded and their needs are not separately defined [9].

3.2.2 Working conditions

It has been argued that a large share of the agricultural jobs in the biofuel industry would be of poor quality and conditions and targeted mainly to low-skilled seasonal agricultural workers (often migrants), who tend to be particularly vulnerable. Specific studies and data on the working conditions on dedicated energy crop plantations are still scarce. There is evidence that, in some cases, working conditions on plantations (including those of biofuel feedstock) tend to have a differentiated gender impact [10].

The effect of large-scale feedstock plantations could be that workers have to work under worse conditions than on farms due to unsecured labour rights and the need to produce low-cost feedstock [9].

Gender-specific impacts: Women working on plantations generally tend to be disadvantaged, compared to men, also in terms of employment benefits and exposure to occupational safety and health risks. A significant (and growing) number of agricultural workers in developing countries are employed on a seasonal and often a casual or temporary basis (with limited, if any, social security, including medical assistance); an increasing share of these workers is women [10]. Reliable data on the share of women waged agricultural workers are difficult to obtain, given the prevalence of informal labour arrangements. There is evidence, however, that this share has been rising worldwide and women now account for 20-30 percent of total waged agricultural workers [10].

3.2.3 Health

Gender-specific impacts: There is evidence that women tend to receive on average less training and instruction than men, they often do repetitive work that can result in health problems, and face reproductive hazards as a result of exposure to agrochemicals. In Malaysia, for instance, women, who represent about half the workforce on plantations, are often recruited as sprayers of chemical pesticides and herbicides, without proper training and safety equipment. This may have serious implications for the long-term health of these women workers [10].

3.2.4 Food (in-) security

Given the differences concerning economic growth, poverty and agricultural status, the issue of food security should be examined for each country individually. In some countries, food security is not related to the production of crops, but to distribution within the country. In Tanzania for instance, crop production in good years is sufficient to meet domestic demand,

but the inefficient distribution network does not allow transporting food in undernourished regions [9].

It should be considered that the improvement of food security in developing countries is a very complex challenge that depends on several factors like market prices of agricultural products, food consumption patterns, climatic conditions, and income distribution. A stronger promotion of the agricultural sector is required with a priority to food production; simply not producing bioenergy may not solve any problem or even exclude possible solutions since biofuel production may also imply some benefits (e.g. diversification of local markets, income creation, and rural development) [9].

A number of developing countries that produce, or have the potential to produce, biofuels (or simply biofuel feedstock) are also food insecure. For this reason, it is important to assess the potential impacts of biofuels production on the food security of men and women living in these countries. The establishment of energy crop plantations and the impacts of the increasing demand for liquid biofuels on food prices might affect at least two key dimensions of food security – availability and access [10].

Gender-specific impacts: The establishment of energy crop plantations on "marginal" lands might negatively affect women's ability to meet household obligations, including traditional food provision and food security. The establishment of such plantations might also lead to a loss of wild edible plant species, which women are usually responsible for collecting and preparing and which play a key role in the food security of rural households. At the same time, biofuels production might also affect men's contribution to household food security, due to its potential negative impact on ruminant production (cattle, sheep and goats), which men are often responsible for. The combination of these processes would have a negative impact on the food security of rural households [10].

3.2.5 Effects on food and feed prices

The paper from [11] has identified several potential negative social impacts from biofuel production in Latin America including food security: Increasing food prices may have large impacts on poor people in developing countries who spend a high portion of their income on food. On the other hand, increased commodity prices could contribute to rural development and poverty reduction since small-scale farmers gain more money from their products.

The interrelations and impact of biofuel production on food and feed prices are currently still poorly understood [12]. Increased biofuels production can have impacts on food prices as long as the fuels are made from food crops or the biofuels feedstock are being grown on agriculturally productive land. The effects of biofuel production on food prices is expected to be less when i) a transition to cellulosic biofuels happens and ii) if producers are able to grow feedstock primarily on land that is marginal for agriculture [4].

A price increase on a basic food commodity will have most impacts on the most vulnerable segments of the population because these groups spend relatively a higher percentage of their income on food [4]. Impacts of biofuel production on local food security needs further investigation with special attention to impacts to the low income population. Thereby, different land uses need to be considered as land use for food, feed, fuel, products chemicals, etc [12].

Gender-specific impacts: Sudden increases in food prices would have negative repercussions in particular for poor households and vulnerable groups, particularly women and female-headed households, which tend to be particularly exposed to chronic and transitory food insecurity, due also to their limited access to income generating activities [10].

3.2.6 Land issues: conflicts

One of the most controversial subjects in developing countries is the issue of land occupation.

Especially in Africa, land ownership systems are surrounded with uncertainty, since land property is often not officially secured and cadastral registries are often non-existent. Land is often leased from the state or held communally and is not based on private property;

therefore, land rights are often in dispute. This uncertainty is crucial, since it does not allow for a calculation of how much land is actually available, how it is distributed across the country and how it is prevalently used. Against this background, potential development of the bioenergy sector could lead to increased demand for land and competition among actors, thus possibly exacerbating the aforementioned problems. This applies to both first- and second-generation bioenergy that are based on crop feedstock that requires land for cultivation.

Gender-specific impacts: In most developing countries, there are significant gender gaps particularly in land ownership. For instance, in Cameroon, while women undertake more than 75 percent of agricultural work they own less than 10 percent of the land. In addition, women, due also to the impossibility (in most cases) of using land as a collateral, generally lack access to formal credit schemes, thus being limited in their ability to acquire productive inputs [10].

3.2.7 Land issues: competition

It is important to investigate whether there is enough arable land available for food and feedstock production, and whether that land could be used sustainably in terms of soil conservation and efficient water use. Expansion of current bioenergy production is criticized especially in countries where food security is precarious since it is believed that bioenergy production aggravates competition about limited land resources [9].

The livestock sector may be particularly affected by the production of liquid biofuels. This is due to the potential conversion of part of the grazing lands to energy crop plantations, and to the increase in the price of livestock feed caused by the growing demand for agricultural commodities for the production of biofuels. This rising demand might also give rise to a potential competition for land between food and feedstock production. The land-use changes associated with the establishment of large-scale energy crop plantations might affect, in particular, ruminant production (cattle, sheep and goats), which depends critically on availability of grazing lands [10].

Gender-specific impacts: If biofuels production competes, either directly or indirectly, for water and firewood supplies, it could make such resources less readily available for household use. This would force women, who are traditionally responsible, in most developing countries, for collecting water and firewood, to travel longer distances, reducing the time available to them to participate in decision-making processes and income generating activities [10].

3.2.8 Transitions in agricultural land: from small to large scale production

Due to economies of scale, generally the production of energy crops is more cost efficient on large scale. This may lead to an agricultural transition from small to large-scale agriculture with extensive monocultures. Insight is needed on the effects of this transition, especially on social impacts [12].

Large-scale production of current generation feedstock is often criticized for depriving small farmers of their properties. Unclear land rights and poorly regulated land acquisition - conditions which often prevail in developing countries – lead to displacement of local farmers to non-arable regions or urban centres. These concerns are basically the same if dedicated energy crops are grown for second-generation bioenergy production [9].

According to [4], the early adapters in the biofuel market will be the larger farmers in areas with well-functioning markets. These farmers can afford the start-up costs of converting land to another crop, expanding land under production, or changing the technological or labor inputs.

Large-scale plantations for the production of liquid biofuels require an intensive use of resources and inputs to which smallholder farmers (particularly female farmers) traditionally have limited access. These resources include land, water and agrochemical inputs [10]. This would further increase farmers' reliance on external inputs , exposing such farmers to potential market shocks such as rapid increases in the prices of these inputs [10].

The early adapters are likely to do very well in the market. Later adapters, most likely the small farmers who take a longer period to e.g. accumulate start up costs, will enter a more crowded field of producers, leading to lower profits (or even losses). The expansion of production of biofuel feedstock will accelerate the transformation of the rural economic landscape through favoring large scale producers. With careful planning, this displacement of small producers might be avoided through mandates or encouragement of arrangements that integrate small farmers with processing plants [4].

Gender-specific impacts: Female-headed households, in relation to male-headed households, might face more barriers to accessing the market for external inputs and thus participating in biofuels production.

3.2.9 Change in traditional use and knowledge

The resilience of rural livelihoods might be reduced by the decline of traditional local knowledge linked to the loss of agro-biodiversity. The replacement of local crops with energy crop plantations would threaten especially the extensive knowledge and the traditional set of skills of smallholder farmers in the management of local crops. It would also threaten the knowledge related to the selection and storage of seeds and crops, all activities traditionally performed mainly by women [10].

The potential reduction in the number and the variety of animals (particularly ruminants) raised by smallholder farmers, due to biofuels production, would contribute to the decline of traditional local knowledge. This process would threaten, in particular, the knowledge related to the use of different animals and animal-derived products [10].

Gender-specific impacts: Women, in particular, tend to have specialized knowledge about the patterns and uses of local agro-biodiversity [10]. The potential depletion (or degradation) of natural resources and traditional uses production may place an additional burden on rural farmers' work and health, in particular on female farmers.

3.2.10 Local energy provision

The link between poverty alleviation and energy provision makes it critical to consider both when looking towards sustainable rural development. Availability of local energy and farm power is fundamental to intensifying agriculture, and agricultural development is essential to poverty alleviation. There is a growing consensus among policy-makers that energy is central to reducing poverty and hunger, improving health, increasing literacy and education, and improving the lives of women and children [13].

3.3 Impacts of soy production

3.3.1 Employment creation and losses

Literature indications mentioned in [14] estimate that the chain 'vegetable oil and sub-products' in Argentina generated around 288.000 jobs in 2004, compared to 230.000 for the milk chain and $543*10^3$ jobs for the meat chain. The Ministry of Economy has estimated that every direct job generated in soybean value chain multiplies to 17.7 indirect jobs. In comparison: one direct job in the petroleum, meat or milk sector multiplies to 10.6, 5.5 and 6.1 indirect jobs, respectively [14].

The required labour input for soybean production is also discussed by Berkum et al. [15], mentioning that large agricultural farms in Argentina with highly mechanized soybean production combined with direct seeding, generate around one labour place for every 200 hectares. In comparison, small traditional farms practicing rotation with two crops generate around one labour place for every eight hectares. The low labour input for intensive soybean production generates a process of rural out-migration compared to more traditional production systems, destabilization of livelihoods and scarcity of jobs in the agricultural sector.

Tomei et al. (2009) also mentions that the intensification of agriculture has led to a reduction in the rural labour force in Argentina. While this may free up human capital for work in other

economic sectors, in Argentina many small and medium farmers have not been successful in finding new areas of work. For many, livelihoods have been restricted to living off the rent from their lands, or to working for others. Furthermore, changes in land management have led to a rural exodus from the countryside and small rural towns to the cities in search of better economic opportunities. These changes in ownership and production are leading to the erosion of rural cultures and the loss of traditional knowledge and livelihoods [16].

The survey under *Campesinos* in Paraguay also mentions that the implementation of the technical packages of transgenic soy and the mechanization of monocultures implies a drastic reduction of employment offered in the dominant soy areas [17]. The Bolivian soy boom has made Santa Cruz the economic capital of Bolivia, but so far the development of mechanized commercial export agriculture, dominated by soy, has not brought structural improvements to the poor. In 2000, one third of Bolivian soy output was produced on large plantations by Brazilian immigrants. It has aggravated unequal income distribution [18].

3.3.2 Transitions in agricultural land: from small-scale to large-scale

The main agricultural crops in Argentina are soybeans, maize, wheat and sunflower. The traditional soybean production areas are located in Las Pampas containing parts of Buenos Aires, Cordoba, Santa Fe and Entre Ríos. In recent years, however, agriculture (primarily soybean production) has extended to less fertile and more remote areas in the northeast and west of Argentina [19]. The recent land use changes in La Pampa province (Argentina) are mainly caused by economic incentives for the farmer, receiving high prices for annual crops, and the possibility to extend the production of profitable crops to other areas within the region. Livestock production is traditionally characterized by low productivity, income and profit. The need for large areas and the low profit per area makes livestock production only viable in areas where land prices are low. Thus, when infrastructure improves and more intensive land uses such as soybean production start to predominate, cattle production will be displaced, intensified or decreased [15].

A study from [17] mentions that soy crops expanded an average of 125.000 hectares a year in Paraguay over the period 1995-2006. It is estimated that approximately half of this area consists of family farms that converted to oilseed production; the rest once belonged to *Campesino* families and was appropriated through sale, rent or eviction. Small land owners are mainly letting the land to soy producers because of the need to increase income on the short term. The sale of land leads in the longer term to a disruption of community dynamics. In general, all communities have experienced an important landscape change with the soy expansion including destruction of the ecosystem (e.g. lack of wood, limited water resources).

Tomei et al. (2009) mention that the economies of scale, inherent to the agricultural production system for soy production, as well as the many economic crises that have plagued Argentina have led to the concentration of land ownership. In addition, the high international price and profitability of soy has led to a rise in tenant farming and absentee landlords. Farmers who are unwilling or no longer able to take the production risk rent out their land to other neighbours, contractors or investment trusts, who manage production from year to year. In 2007 some 60% of farms were managed by tenants. The rise in tenancy farming has inevitably led to a loss of traditional and cultural knowledge which will be irreversible [16].

A specific case study on soy production [20] close to the Amazon soy frontier indicated the movement of *Colonos* (smallholders) to new primary forest regions or urban areas as a result of soy expansion in the area. Other socio-economic impacts included:

- The loss of community infrastructure when a few farmers bought a whole community;
- Colonos returning to their previous communities after finding no job in the urban or rural areas only to find out there is no more land to farm;
- Increasing pressure to sell their land;
- Agricultural product loss and children sick from spraying;

- Diminished or completely destroyed water sources as a result of erosion and sedimentation because of the use of agricultural machinery.

3.3.3 Food (in-) security

Soy is not only being cultivated in new areas but also in places where food for the domestic market used to be grown. More and more families are renting or selling their land to soy producers. This endangers the local food supply [21].

Tomei et al. (2009) mentions that the spread of soy farming in Argentina will also have impacts on food sovereignty, as soybeans are cultivated at the expense of traditional livestock and crop production [16].

3.3.4 Impact on food and feed prices

The study from Dam et al. [22] looked, amongst others, at impacts on food and feed prices to assess the sustainability performance from biomass production (soy and switchgrass) in La Pampa province in Argentina. Due to high inflation rates, food prices in Argentina have increased in the last few years although the government announces yearly a maximum price to avoid strong increases for the principal food products. The price of products falling in the category ‘‘oils and fats’’ increased strongly between 2002 and 2007 due to a strong international demand and insufficient production. As the price increased 218% in the period 2002–2006, the government agreed to provide a subsidy to keep local price increases within a bandwidth. This agreement was ratified in June 2007. Related to this development, there was a shortage of vegetable oils (especially sunflower oil followed by other oil types), caused by limited production capacity and increasing (international) demand. This example shows that the dynamics of food and feed prices over time is influenced by a wide range of factors (demand for land, development of international markets, growth of economies, labour costs, etc.).

3.3.5 Impact on land prices

The study from Dam et al. [22] looked, amongst others, at impacts on land prices to assess the sustainability performance from biomass production (soy and switchgrass) in La Pampa province in Argentina. Land prices increased strongly in the last few years in Argentina. Average increases of 10% in agricultural land rents in 2006/2007 compared to the previous year are mentioned and similar increases (10–15%) are mentioned for 2007/2008. This is caused by various factors.

Land rents are pushed by high outputs and price levels for annual crops as soybean or maize. This creates good income perspectives for farmers, especially with the expectation of further increasing yields. Consequently, there is a high demand for renting suitable land for annual crop production and a supply that does not catch up. Also, the agricultural sector is seen as a secure financial investment. The increase in land rents as well as other costs and investment costs forces producers to select a crop with sufficient income [22].

Also Tomei et al. (2009) mentions that the value of land has increased five times in the past decade in Argentina [16].

3.3.6 Land use rights and conflicts

The study from Dam et al. [22] looked, amongst others, at land use rights to assess the sustainability performance from biomass production (soy and switchgrass) in La Pampa province in Argentina. Land use rights are officially laid down and described in Argentina. Land property in La Pampa province is largely regulated through private ownership or tenure of land. In case the land is rented there are basically two forms of contracts. The first form is a contract in which the owner charges a fixed amount per year or per harvest. The second form is that the owner receives a certain percentage of the production obtained by the tenant.

A study from [21] mentions that the search for new agricultural land for soy cultivation has often led to conflicts with local people or indigenous communities. Tenants and communities

often find it hard to stand up for their rights when big land owners or speculators claim land for soy cultivation.

3.3.7 Smallholders: limited access for inputs

Campesinos (Paraguay) interviewed in a study from [17] indicates that soy cultivation requires a lot of capital having negative impacts for small producer in the long term. The costs of implementing mechanized soy monoculture together with the inputs required are too high for family agriculture. This weakens the cohesive family patterns because the subsistence farming is discontinued in the long term and there is a trend to look for outside farm work or to migrate temporarily. The displacement of subsistence farming also makes family farmers more dependent on market factors outside of their control.

The survey in Paraguay under *Campesinos* reveals that there is easy access to finance soy cultivation (seeds and pesticides) on the short term. This creates a ***dependency*** on these products. Later, the credit has to be repaid in cash [17].

3.3.8 Working conditions of employees

The study from Dam et al. [22] looked, amongst others, at working conditions from employees to assess the sustainability performance from biomass production (soy and switchgrass) in La Pampa province in Argentina. The recognition of the Tripartite Declaration of Principles by companies is stimulated by the Argentinean government. The Argentinean government itself has subscribed the OECD guidelines for multinational enterprises. The Ministry of Labour has established the ‘‘Network for Corporate Social Responsibility and Decent Work’’ to promote Corporate Social Responsibility. This network of companies signed a Commitment to Corporate Social Responsibility and Decent Work in 2007.

Rural work conditions in Argentina are regulated by specific resolutions. The ‘Rural Worker License law’ aims at regulating different aspects of the hiring process of permanent, temporary and harvest workers in the agricultural sector. The National Record Office of Rural Employers and Workers is established in 2001 to combat informal employment and to increase protection of workers. Literature sources show variable estimations about the amount of informal workers (with no to limited access to insurance) and formal workers in agriculture in Argentina. Accurate statistical data are difficult to obtain. Unofficial estimations range from 17.5% to 50% of the workers in the agricultural sector engaged in formal employment [22].

The survey under *Campesinos* in Paraguay [17] mentions hard working conditions for temporal workers in the soy production areas. The work in the silos is for example exhausting: the workload includes unloading around 1000 tons a day with a day shift of 10 hours. A study from [21] mentions that labour conditions for workers who clear land for soy are often very hard. Workers are paid low wages, their lodgings are bad and they receive no medical care. Based on cases from Brazil, workers are forced to work for free to pay back ‘advances’ in the form of transport, food or clothing.

3.3.9 Violence

Violations against human rights related to the working conditions of employees and child labour are not mentioned as an issue in Argentina [22]. *Campesinos* (Paraguay) interviewed in a study from [17] mentions an increase in violence towards the communities since the introduction of large-scale soy production in the area.

3.3.10 Health

Campesinos (Paraguay) interviewed in a study from [17] mentions that the sharp increase in agrochemicals had lead to contamination of waterways and disappearance of water streams. The study also reveals an absence of infrastructure and health services to confront the situation of constant pesticide exposure. In the eight communities studied, 78% of the families interviewed said that they suffered from health problems. Also affected are other (subsistence) crops and animals for husbandry.

In Argentina, there is increasing concern about impacts of the widespread use of agrochemicals, particularly pesticides, on the health of rural communities and ecosystems. In agricultural production areas, crops are routinely sprayed with pesticides, from both the ground and the air, within a short distance of local communities. People living in rural communities are therefore subject to regular, unintentional exposure to pesticides through their food, air and water supplies. Some individuals may also be directly exposed to agrochemicals due to employment in agriculture or the presence of chemical stores in their communities [16].

The health impacts of long or constant exposure to low quantities of agrochemicals are chronic and, as a result, it can be very difficult to diagnose the causes. There is a lack of official and empirical data on the impacts of pesticides on human health and the Argentinean health system records only acute poisoning. Therefore, most of the documentation regarding the long term impacts of exposure to agrochemicals comes from health practitioners, the media, and affected communities and is largely anecdotal.

In January 2009 a precedent was set when the Madres de Ituzaingó (Mothers of Ituzaingó) succeeded in winning an injunction that prevents farmers from using agrochemicals within 500 meters of their community. Ituzaingó is a suburb on the peripheries of Córdoba which is surrounded to the north, south and east by soy fields; of the 5,000 inhabitants, some 200 people have cancer, and incidences of allergies, skin irritation, foetal malformations, and neurological illnesses are also high. As a result of the ruling, the minimum distance for aerial spraying of agrochemicals will increase to 1,500 meters. The ruling applies to two agrochemicals, glyphosate and endosulphan, and may provide a precedent for hundreds of communities in similar situations (Página 12, 2009a). As a result of the ruling, and in response to increasing concern about the impacts of agrochemicals on rural communities, the Ministry of Health has established a committee to investigate the impacts of agrochemicals on local communities [16].

3.3.11 Use of GMO technology

GMO crops account for 99% of the total soy production in Argentina, being also used for biofuel production. The social, economic and environmental impacts of GMO crops still need further analysis [12]. When genetically modified herbicide-tolerant (GMO) soy was introduced in Argentina in 1998, it was rapidly adopted by Argentine farmers. The resistance of GMO soy to glyphosate facilitated weed control and by 2002, the adoption of GMO soy neared 100%. Between 1994 and 2003 the use of glyphosate rose from 1 to 150 million litres [18].

The widespread and often indiscriminate use of glyphosate has caused dozens of cases of intoxication. Weeds that have developed glyphosate resistance require cocktails of highly toxic herbicides such as atrazine to control. Intoxication of rural workers and neighbouring communities has been reported throughout the soy producing provinces [18]. The study from [17] mentions that the intensification of soy monoculture at a large scale, along with transgenic technology and the lack of rotation cycles generates an ecosystem that does not permit co-existence with other crops and farmers. It also results to indiscriminate crop spraying and dependency on input products [17].

Generally, the impact of the direct or indirect use of GMO soy in food and feed on human health is still not fully understood. Since soy production for biofuels is usually also interlinked with food production (press cake as fodder, proteins), it may also have an impact on health [16].

3.4 Impacts of sugar cane production

3.4.1 Contributions to local economy

For conditions observed in the Brazilian Center-South, it was estimated that the processing of a million ton of sugar cane for the production of bioethanol corresponds to an increase of R$ 171 million in economic production, considering the direct, indirect and induced effects [23].

According to an I/O matrix study (1997), there are 1.43 indirect jobs and 2.75 induced jobs for each direct employee in the bioethanol agroindustry sector in Brazil, resulting to an estimate of 4.1 million people dependent on the industry in 2005. The jobs created in the sector are widely distributed throughout the country. Most of them are low qualification jobs [23].

3.4.2 Employment creation and losses

In Brazil, around one million workers (of which only 14% were female in 1995) are employed in sugarcane production (which is directly related to bioethanol production [10]. Sugar cane planting, pest control and harvesting represent the greatest demand for temporary personnel. This corresponds to approximately 70% of hired labour, with different levels of employment for harvesting and non-harvesting periods. The seasonality of jobs in the sector has been decreasing as a consequence of extending harvests and higher levels of mechanization [23].

With the evolution of the technologies employed, less growth can be observed in labour demand, along with higher required qualifications and an increase in quality of the work performed [23]. Current trends towards increased efficiency and the replacement of laborers suggest that the employment benefits of sugarcane production for landless rural workers will disappear [4]. A sugar cane harvester (a machine), for instance, can replace up to eighty cutters (people). In some southern African countries, however, there are also mixed systems in place, in which a machine cuts the cane that is then collected and gathered manually. This mixed system may be particularly suitable for biofuels production, since the gathering of residues can be done at the same time that cane is gathered. As the cutting of the cane is the hardest part of human physical work. A mixed system would also contribute to opening up the labour force for women [10].

It is estimated that by 2020 the manual cutting of sugar cane in Sao Paulo will be practically non-existent. It is also anticipated that between 2006 and 2020, the number of employees in the sugar cane industry in that state will be reduced from 260 thousand to 146 thousand workers, even with an increase of 20 thousand employees in manufacturing [23]. Options for action mentioned by [23] to mitigate these effects are:

- Offering and supporting alternative economic activities for potentially unemployed workers;
- Strengthening the preparation of human workers for the agroindustry (training requirements for specialized labour)

3.4.3 Economies of scale: from small scale to large scale

Bioethanol production –and consequently the required input production - may, however, show significant economies of scale, which increase with the introduction of new technologies and higher productivity levels. Under these conditions, there is a gradual transition towards larger capacity units. This trend is aggravated because of the low attractiveness of a large number of farming activities and the economic deprivations of some regions where sugar cane production becomes one of the more viable alternatives, compared with traditional crops. Note that in some cases (due to restrictions in relief, land use capacity) the change to economies of scale is not possible or promoted [24].

There are various examples where the small scale agriculture and its production model is preserved or promoted. This is the case when [24]:

- When agricultural practices are improving from an environmental point of view (biodiversity parches, permanent preserved areas around watershed, reforestation of a percentage of the land considered for energy plantation etc)
- When agricultural policy promote land reform and settlements of small producers
- When land use changes towards higher value crops with higher level of investment.

- Also, in order to preserve small scale agriculture and its agricultural production model, it has been suggested that biofuel production be stimulated in a decentralized manner with scales that allow for the entry of the small-scale farmer as biofuel producer [23].

3.4.4 Food (in-) security

An International Energy Agency study cited in Goldemberg [25] shows that sugarcane growth does not seem to have an impact on the food production area, since the area used for food crops has not decreased. For Brazilian agriculture food availability is closely linked to the level of poverty [26].

3.4.5 Impacts on land prices

The sugarcane harvest area in Brazil is around 5.2 million hectares. The increasing demand for ethanol production is encouraging the sugar/alcohol industry to expand to other regions, including the Centre-West, the main food and feedstuff production region. An immediate effect has been the increase on competition for land uses resulting in price increases. [26]

3.4.6 Wages

Balsadi evaluated the evolution of job quality in Brazilian agriculture and provided the following conclusion for sugar cane farming workers in recent years [27]:

- An increase in job formality with a high percentage of workers with labour ID cards;
- Real gains in salary between 1992 and 2005: 34.5% for permanent employees with permanent residence, 17.6% for permanent rural employees and 47.6% for temporary rural employees;
- Increase and diversification of benefits received by workers, such as transportation and meal vouchers and housing benefits.

Other positive facts pointed out in the study [27] are the significant reduction in child labour and the increase in employee's schooling.

There is a shortage of semi-skilled workers in the sugarcane industry. Their wages have risen in recent years where they are earning wages substantially higher than those undertaking similar jobs in many cities. On average seasonal agricultural workers have earned slightly above the minimum wage levels, however there are yearly variations and it is unclear whether this rate is sufficiently high enough to avoid poverty. In the review from Smeets et al. [7], they highlighted that wages were generally above average. The main problems are related to cane cutters, which do most of the low-paid work related to ethanol production.

There are still adverse situations, especially for temporary employees hired for manual harvesting, where working conditions are much more arduous than in industry and payment is based on the amount of sugarcane cut [23]. According to a report by Oxfam [28], in Brazil sugarcane plantation workers are prevalently employed on piece-rate arrangements. This means that they are paid according to how much sugarcane they manually cut. It is well known that piece rate work can contribute to child labour and also discriminate against women, especially when they are drawn into unpaid work in order to help their husbands meet production targets.

3.4.7 Education and health services

In contrast to Mendonça [29], Smeets et al. [7] review found that sugar mills keep more than 600 schools, 200 daycares units and 300 ambulatory care units. In a sample of 47 São Paulo based units showed that ‘‘more than 90% provide health and dental care, transportation and

collective life insurance, and over 80% provide meals and pharmaceutical care. More than 84% have profit from sharing programs, accommodations and day care units''.

3.4.8 Working conditions and rights

Some sugar mills in Brazil are accused of exploitation of workers, using child labour and repressing rural workers. The producers wield substantial political power and are able to obtain resources through programs, incentives and opportunities offered by the government.

The majority of São Paulo sugarcane harvesting is undertaken by migrant workers. There are at least 40,000 migrant workers in the industry. Often they live far from their homes and support networks [29]. In the case of Costa Rica, migrant workers come from abroad (Nicaragua), leading to issues of implementation of rights and illegality [24].

Mendonça is a journalist and director of Social Justice and Human Rights Network [29]. She has documented many poor working conditions in the sugarcane industry, particularly for the cane cutters. Many migrant workers are transported from the North-East to São Paulo for a fee they can not afford, so they start working in debt. Accommodation and food costs of R$400 per month leaves very little for savings. Often food and accommodation rates are higher for the sugarcane workers than the local population, giving them little chance to get out of this vicious cycle. Harvesting sugarcane is the toughest work available, and unfortunately for many the only employment they are able to secure despite its temporary nature [29]. Note that these issues are not related to bioethanol only, but also to sugar/beverage (Cachaca) production.

Mechanization is expected to improve working conditions, although at the cost of jobs. However mechanization harvesters can only work on flat terrain, forcing the manual cutters to harvest the more difficult crops where terrain is not flat; crop quality is poor or planted irregularly. These factors will make achieving daily cut rates much more difficult [25].

Strengthened government regulations have resulted in considerable improvements in working conditions in the last decade in Brazil. Goldemberg et al. [25] points to the Brazilian Government outlawing child labour, defining the minimum age of 18 years for hard jobs and intensifying inspections on working conditions in the sugarcane sector.

3.4.9 Health

In countries as e.g. Brazil, India and Thailand (but also in other countries) the burning of sugar cane tops and leaves prior to manual harvesting is a further concern since it causes health problems and environmental pollution [9]. In Brazil, there are a number of indirect deaths from illnesses e.g. cancer provoked by the use of poisons and respiratory illnesses and allergies from sugarcane soot [29]. Goldemberg et al. [25] also found 19 worker deaths between 2004 and 2007, but noted that conditions were improving and that they were better than in other rural sectors.

Research from [30] highlights the exposure of sugar cane workers in Costa Rica (and Nicaragua) to heat. There are anecdotal reports of heat stroke victims resulting in hospitalization. It is speculated that chronic dehydration, exacerbated by exposure to extreme heat, may be linked to the high prevalence of Chronic Kidney Disease among sugar cane workers. In many cases, sugarcane field workers are required to carry their own water and often have no access to shade during their working day [30].

Another concern, as mentioned by [24], is the increase of rats and snake populations in the neighbourhood of sugar cane fields.

3.4.10 Local resources and services

Fallot [24] mentions that sugar cane production can have various impacts (positive and negative) on the services and resources in the area. Examples given are impacts on local infrastructure (roads, energy, water distribution, others). For instance:

- Trucks transporting biomass might be saturating the road system or damaging the existing roads, resulting in negative impacts on local activity and living conditions;

- If the road system is developing thanks to new biomass production, this might positively impact local economy, or negatively.

The same argumentation is true for water and energy networks

3.5 Impacts of palm oil production

Malaysia and Indonesia are the world's largest producers of palm oil, producing 86% of total global palm oil output in 2006. Other producing countries are Thailand, Nigeria, Colombia, Ecuador, Papua New Guinea, Ivory Coast, Costa Rica and Honduras. The primary mode of production is the large-scale monoculture production system. A large scale plantation estate is meaning an average economic size of with associated CPO mills of around 15,000 hectares. The sector counts as well more than a million of small scale producers with plots ranging from 1 to 50 hectares [31].

Generally, most of the palm oil is used in the food and chemical (e.g. pharmaceuticals, cosmetics) industry. A small proportion of the total CPO in Indonesia is currently used for biodiesel. It is estimated that less than 500k mt will be used for biodiesel in 2010 from the total production of 20 m tons of CPO [32].

3.5.1 Contributions to local economy

Despite various critics, Rist et al. (2010) mentions that oil palm appear to be an attractive new income opportunity to Indonesian farmers, as attested by the widespread uptake by many smallholder communities. The Indonesian government has used oil palm as a major vehicle for rural socio-economic improvement. This has been done largely through Nucleus Estate and Smallholder schemes (NES) [33]. Zakaria et al. (2009) also mention that oil palm expansion brings companies, the Indonesian government and Indonesian districts substantial income [34].

Rist et al. (2010) mentions, however, that the livelihood outcomes and benefits (based on a study among four communities) were often very different [33] due to several reasons. The outcomes of his study suggest that oil palm has in fact been a source of significant livelihood improvement for many rural communities in Indonesia. Rist et al. (201) mentions that oil palm offers greater returns to labour than other agricultural land use options as well as additional benefits including a shorter fallow period and significantly reduced labour requirements [33].

Susila [35] found that oil palm activities contribute 5–11 million Rp ($500–1000) or over 63% of smallholder household incomes in two locations in Sumatra, and considered the small proportion of poor people (\10%) in oil palm communities at these sites indicative of the commodities' contribution to poverty alleviation. Simulations of alternative future land use options in the district of Malinau in Kalimantan have also indicated potential improvements in household incomes of between 60 and 150% as a result of oil palm development.

The study from Rist et al. (2010) concludes that rural smallholders are not impoverished by oil palm development but can be by the sale of their land in its development. The cultivation of oil palm may afford new income opportunities to many Indonesian farmers but while economically advantageous in the short term, the longer term economic implications remain uncertain. Concerns have been raised that the adoption of oil palm by smallholders at the expense of, for example, diverse agroforestry and swidden systems may expose them to future economic risk from price fluctuations [33].

3.5.2 Wages

A report on palm oil plantation expansion in West Kalimantan, Indonesia, [34] mentions that plantation workers earn low wages and are typically employed on a daily basis. According to [31], many laborers are paid according to their production targets. To reach these targets, they sometimes need structural – unpaid – help from their wives and children. Plantation wages are at a subsistence level, barely covering the costs of sending children to school. Minimum wage legislation is not consequently applied and working tools and safety equipment are not always provided.

3.5.3 Land use rights

The Indonesian government has established the Nucleus Estate and Smallholder schemes (NES) to involve smallholders in oil palm production. In these schemes farmers transfer a proportion of their land to an oil palm company for establishment of an estate plantation (referred to as 'inti'); the remaining land is also planted by the company but retained as individual smallholdings by the farmers (referred to as 'plasma') [33].

Typically households are asked to give up 10 ha of land to the company, and in compensation are allocated 2 ha of oil palm plantation. Once the smallholder receives his plot, he can either manage it by himself or entrust it to the company. Where smallholders cannot allocate a sufficient portion of land they must repay smallholding establishment costs to the company. In some cases smallholders sell their land directly to the company and are paid compensation for loss of land use opportunities [33].

One third of the current area under oil palm in Indonesia is cultivated by smallholders, approximately 2.4 million ha, and much of the expected future expansion will occur as a consequence of smallholder uptake. Assessment of empirical data on reported, and indeed other potential livelihood impacts, is required to shed light on the apparent contradiction between NGO claims of negative livelihood impacts and the evident enthusiasm of farmers for oil palm [33].

The study from Rist et al. (2010) indicates that, while detailed legislative processes govern the location of oil palm development in Indonesia, the means by which this occurs vary significantly. Variation in the amount of land given up to the company in relation to that received back as an oil palm smallholding, the amount of debt that the farmer must pay back for the planting of oil palm on the area of land retained, as well as the time period over which this must be done were the main factors characterizing variation in deals within and across our study sites and their associated financial outcomes.

According to [31], land right conflicts are persistent in the oil palm plantation sector. Indonesia's forestlands provide livelihoods to some 100 million people, of which 40 million are indigenous people. Because these communities rarely have formal rights, licensed palm oil companies have taken over large tracts, which communities perceive as theirs by customary law.

Sawit Watch, a NGO monitoring land-use conflicts in Indonesia, mentioned in 2006 that 13% of the land occupied by palm oil plantations has been (or still was) involved in land conflicts [36]. A study on palm oil plantation expansion in Ketapang in West Kalimantan [34] stipulates the following land conflicts that took place in 2008:

- Land development by companies without communities' consent;
- Double issuance of oil palm concessions over the same area;
- The re-sale of smallholder plots that are still subject to credit schemes;
- Failure of plantation companies to develop legally required local development projects;
- Failure of plantation companies to hand over smallholder estates to the actual smallholders in a timely fashion.

3.5.4 Land use change and re-allocation of lands

Rist et al. (2010) mention that farmers in Indonesia (based on selected communities) generally gave up their fallow or less productive land to oil palm, in most cases old rubber agroforests that are no longer considered profitable. Consequently former sources of income are rarely displaced and the income from oil palm may be considered as complementary to these, although the development of these fallows likely results in loss of environmental goods and services [33].

Rist et al. (2010) found that farmers frequently sold their land to companies rather than developing a smallholding leaving them without a source of agricultural income, or with such income significantly reduced. Alternatively the short term horizon of some farmers meant that while they developed an oil palm smallholding they gave up in the first years following planting, selling off the land and the oil palm before it reached production. The cost of fertilizer was frequently cited as a reason for this along with a dislike of living in a new plantation village far from relatives [33].

3.5.5 Risk for impact on environmental and cultural services

Although less productive land is often used for development these fallows provide many environmental goods and services. In more remote areas where livelihoods are largely subsistence-based the consequences may be more significant than in the sites with which we have most experience. Negative implications for cultures and ways of life in moving from autonomous farming to a market dependant livelihood, or in some cases to wage labour, are also likely [33].

3.5.6 Conflicts and illegal land tenure

In Colombia, the biofuel sector has been blamed for the unjust re-allocation of new land for palm oil cultivation which was formerly owned by Afro-Colombians. This illegal land tenure is accompanied by a high level of corruption [11]. Land right conflicts are also mentioned in Papua New Guinea: Here, land is commonly owned by communities with customary decision making processes. The introduction of palm oil puts these processes under a lot of pressure, resulting in conflicts with and between communities [31].

Rist et al. (2010) observed several conflicts relating to land tenure across the study locations in Indonesia including the handing over by local government of traditional common land to oil palm companies or to trans-migrants. Cases of land owners accusing companies of stealing their land are not uncommon; however some are not adequately justified [33].

3.5.7 Conflicts: Clarity of development contracts

Rist et al. (2010) mentions that lack of clarity of development contracts emerged repeatedly across the study locations in Indonesia as source of conflict. The study rarely encountered a farmer who had actually read the contract that he had signed. Those that had were seldom able to understand the wording used and relied instead on verbal agreements with local officials. When contractual terms were later under question the main points of uncertainty related to who retained ownership of the land and the terms of debt repayment. Typically the company ‘takes’ the land for an oil palm cycle but what happens after this period is unclear and rarely specified in the terms of the contract. In relation to the debt incurred for planting of the smallholding, many farmers do not know how much they owe the company or how this payment is calculated [33].

3.5.8 Lack of local governance and unfulfilled promises

Rist et al. (2010) mentions that lack weak local governance emerged repeatedly across the study locations in Indonesia as source of conflict. Both companies and local government officials made promises to smallholder communities that were not fulfilled and hence became a source of conflict. Commonly companies failed to meet the terms of community agreements, particularly in the development of schools and clinics or the provision of technical assistance in plantation management [33].

3.5.9 Smallholders: limited access to inputs

According to [31], oil palm smallholders in Indonesia and Malaysia are fully dependent on neighbouring plantation companies for inputs (e.g. seeds, fertilizer) and marketing.

3.5.10 Smallholders: risk for exploitation

As oil palm fruits have to be processed within 24 hours, smallholders have no choice but to supply their fruits to the CPO mill of the plantation company. This may lead to exploiting their

bargaining power and offering very low prices to smallholders, especially when there are no strong collective bodies defending their interests.

A report on palm oil plantation expansion in West Kalimantan [34] also mentions that oil palm smallholders are subject to unfavourable terms in attaining a fair share of the value chain. Also, they are more vulnerable to changing market conditions. Having lost all of parts of their land for agriculture, smallholders are forced to buy their food for cash. This can lead to dire situations when a company is not functioning or refuses to follow up on obligations. In the case of the *Benuah Indah Group* in Ketapang, smallholders demonstrated in March 2009 as they had not been paid by the company for their palm oil fruit since October / November 2008 [34].

3.5.11 Health

The report from [31] refers to a study in 2002 amongst palm oil plantation workers in Malaysia where widespread pesticide poisonings were reported and problems associated with the pesticide *paraquat*. Around 30,000 women work daily as pesticide sprayers.

A report on palm oil plantation expansion in West Kalimantan [34] also mentions that female workers are typically at risk because they are usually employed as sprayers of herbicides and pesticides. In February 2008, local media reported that 37 plantation workers had been poisoned by chemicals in a plantation. The chemicals were applied in the nursery, apparently without proper protective measures.

McCarthy and Zen [37] mention the possible risk of pollution from air and water courses on communities not directly involved but living adjacent to areas of oil palm development.

Increasing rat populations associated with plantations have decimated adjacent rice farms in some areas of West Kalimantan [33]

3.6 Impacts of Jatropha production

Jatropha is a wild plant which has not yet undergone selective breeding, leading to considerable variation between plants, and fruits which do not ripen all at the same time. Currently, Jatropha production occurs in both centralized and decentralized models [38]:

- The centralized model involves either plantations owned by fuel companies directly, or farmers contracted by the fuel company for the production of seeds. Pressing and transesterification facilities are centralized.
- A decentralized model involves smaller scale production by farmers, with local seed collection points, oil pressing centres and potentially local transesterification facilities.

3.6.1 Contribution to local economy

Jatropha production has been seen as a tool for local empowerment and poverty alleviation, especially in countries in Africa and India. The benefits of a centralized model for communities are guaranteed market for seeds and crop management support, which is expected to enhance rural development through job creation, income generation and capability support. However, in comparison a decentralized model is expected to increase the local availability of biodiesel and by-products [38].

The cultivation of jatropha may expand livelihood options with the opportunity to earn income for smallholder growers, oil mill out-growers and members of community plantation schemes or through employment on private-enterprise jatropha plantations [13].

3.6.2 Economic risk

Feedstock production, particularly the harvesting costs of jatropha, may prove excessive. Jatropha growing could prove uneconomical if higher oil-yielding and non-toxic varieties are not forthcoming. The level of economic returns that would attract and retain investment by the private sector may not be attainable on degraded lands. There is an urgent need to

improve jatropha yields through breeding and by addressing knowledge gaps in jatropha feedstock production [13].

The low level of agronomic information currently available in many developing countries means that it is difficult to gauge whether a plantation will be high yielding. Failure of a plantation to live up to expected yields may have a significant effect, as local communities may have been promised improved living conditions or farmers may have invested their livelihoods [38].

3.6.3 Employment creation

Because of the variable timing of the ripening, Jatropha seeds are currently harvested by hand. This translates into high labour costs and substantial job creation [38].

3.6.4 Transitions in agricultural land

Currently, in Africa, Jatropha cultivation is generally led by small scale peasant farmers, normally involving family farm holdings. Harvesting and seed collection is mainly undertaken by farm owners themselves or by women seed collectors who are contracted by the farm owners, which is consistent with traditional farming practices. A move towards large-scale, more centralized production may have an impact on these traditional practices [38].

3.6.5 Natural resources and its values

There is an opportunity to increase the value of the natural resource asset base of the rural poor by utilizing jatropha's ability to grow on poor and saline soils in dry regions. The use of seed cake as fertilizer and jatropha's potential to reduce erosion can halt or reverse land degradation. The use of seed cake for livestock feed is a potential opportunity to improve the efficiency of rearing livestock, if non-toxic varieties are developed. However, if seed cake is used for feed or energy production instead of fertilizer, the capacity of jatropha growing for land reclamation will be lessened [13].

Jatropha cultivation is unlikely to reduce access to water supplies, as jatropha uses little water compared to other biofuel crops. However, large-scale biodiesel production will create a local water demand that may create conflict with other water users. Accidental pollution of potable water may also be a concern, given the large quantities of methanol required in the biodiesel production process [13].

3.6.6 Food (in-) security

Though it is possible for Jatropha to grow on low-productivity land, the yields increase on high-productivity lands have the potential outcome of farmers switching land currently under food production to Jatropha production [38].

Using land to grow jatropha in place of food crops may threaten local food security if there is an absolute shortage of land. This risk will be reduced by using land unsuited to food crops for jatropha cultivation. However, there will be a tendency for private concerns to utilize better land to increase the return to capital invested and to situate plantations in areas with better transport links, neither of which are pro-poor in a production sense [13].

Marginal lands are considered as a potential production area for Jatropha production. Marginal lands are considered to provide little economic or ecological benefits (although this is still under discussion). The Government of India aims to bring around 400,000 hectares of marginal land under cultivation for non-edible energy crops (Jatropha). As shown in several studies, these lands (so-called common property resources) represent an integral part of the livelihood of the rural poor, to which they supply essential commodities as food, fuel or fodder [10].

Marginal lands are particularly important for women. On marginal lands, women have traditionally grown crops for household consumption, medical uses, etc. The conversion of these lands to plantations might therefore cause the partial or total displacement of women's agricultural activities towards increasingly marginal lands [10].

3.6.7 Impact on traditional uses and resources

Jatropha can be used for local soap production, insecticide, medicinal applications, firewood and fuel. However, the increasing value of Jatropha for biofuel may risk diversion for these traditional uses. For example, competition for seeds supply between a local NGO for soap production and a fuel company has been reported [38].

3.6.8 Land tenure and ownership conflicts

Land conflicts are common phenomena in Africa, especially when a large parcel of land is being earmarked for large scale commercial projects such as commercial plantations of Jatropha for example. This is because boundaries of many properties are not clearly demarcated and land title ownership is generally not documented, instead existing as common historical knowledge among elders of the community. It is therefore likely that one of the key constraints that large scale commercial plantations may face is land ownership conflicts [38].

The economies of scale favoured by biofuels encourage the acquisition of large areas of land by private concerns. This threatens access to land by the poor in rural areas where land tenure systems are weak. Improved land administration systems that harmonize formal and customary land tenure will be required [13].

3.6.9 Workers rights and relationships

Both the centralized and decentralized production model has its advantages and disadvantages. The large-scale contract farming may reduce the risk for price falls throughout the year. An example of large-scale production in Kenya facilitated the use of drip irrigation and mechanization. Note that this could have significant impacts on the workers currently engaged in manual harvest. Other risks include production failures, manipulation of quotas, and monopoly position of sponsoring companies leading to exploitation [38].

While large-scale production will create jobs in rural areas, these will be mainly low-skilled and seasonal. The labourers face the possibility of poor employment conditions and unsafe working practices for which government and pro-poor civil society institutions will need to establish checks [13]. Out-growers under contract to supply large processors may face unfair business practice with lack of legal redress in the event of reneged contracts. Small farmers will have little negotiating power for settling sales terms and conditions with large private concerns unless they form effective cooperatives and producer organizations [13].

3.6.10 Gender

Women may benefit from Jatropha production (if locally used), because milling machines powered by diesel engines fuelled with jatropha oil reduce the amount of tedious work they must do. Using jatropha oil as a replacement for traditional biomass cooking fuels is also healthier, as cooking is done in a smoke-free environment, and women do not have to spend time gathering fuel wood [13].

3.6.11 Health and Safety

The toxicity of the seeds, oil and seed cake is a potential risk to human health, although clearly manageable if given proper attention [13]. The toxicity of the seeds has been raised as an issue for workers. This needs to be addressed by appropriate safety measures. The fruits contain irritants affecting pickers and those who remove the seeds by hand [38].

Addressing energy poverty by growing jatropha and using its oil within rural communities for diesel-powered electricity generation offers benefits for health, education and information. Examples given are the improvement of health because of the provision of power for refrigeration of vaccines [13].

3.7 Impacts of biomass production for 2nd generation biofuels

IEA Bioenergy Task 39 describes 2nd generation biofuels as 'those biofuels produced from cellulose, hemicellulose or lignin. A 2nd-generation biofuel can either be blended with petroleum-based fuels; combusted in existing internal combustion engines, and distributed through existing infrastructure or is dedicated for the use in slightly adapted vehicles with internal combustion engines (e.g. vehicles for DME). Examples of 2nd-generation biofuels are cellulosic ethanol and Fischer-Tropsch fuels' [9].

Second-generation biofuels can be broadly grouped into those produced either biochemically or thermo-chemically, either route using non-food crops, Lignocellulosic feedstock is biomass from woody or fibrous plant materials, being a combination of lignin, cellulose and hemicellulose polymers interlinked in a heterogeneous mix. Possible feedstock resources are [39]:

- Agricultural feedstock and residues are likely to offer some of the lowest cost lignocellulosic feedstock available. Examples are bagasse or cereal straws;
- Forest feedstock as wood or forest processing residues;
- Purpose grown energy crops as grasses (e.g. Miscanthus, switchgrass) or short rotation crops (willow, poplar).

The report from indicates that, based on the announced plans of companies developing 2nd-generation biofuel facilities, the first fully commercial-scale operations could possibly be seen as early as 2012 if demonstrations prove successful. However given the complexity of the technical and economic challenges involved, in reality, the first commercial plants are unlikely to be widely deployed before 2020 [39].

2nd generation biofuels can be produced in developing countries and in developed countries. Various large demonstration projects are under development in developed countries as in the European Union and in the US. Some examples are mentioned in. The setting to develop 2nd generation biofuels technologies in developing countries is completely different: Poor infrastructure, lack of R&D activities and a shortage of skilled labour are currently significant obstacles to develop 2nd generation biofuel activities. Considerable investment is therefore required to improve these situations, as is currently the case in Cameroon and Tanzania. Therefore, feedstock trade might be a feasible option for these countries, since it is less capital intensive and can be undertaken with existing capacities. Foreign investment in land for feedstock production could offer an option for developing countries to profit from the growing biomass market for 2nd generation biofuel production outside their borders, provided that transport infrastructure is suitably developed [9].

Given the different frameworks of developing and developed countries and the different impacts expected from residues and dedicated energy crops for 2nd generation biofuels, we will make this distinction in the discussion on the possible socio-economic impacts from 2nd generation biofuels.

3.7.1 Competition of land: Land use changes

Land is needed for the production of **energy crops** used for 2nd generation biofuels. Feedstock production for second generation biofuels may reduce competition on the level of land use at a first glance. A critical point is, however, the level of intensification of agriculture and the quality of land required for 2nd generation bioenergy feedstock. Theoretically, fertile land and water resources could be dedicated to food production (which will in turn yield more residues) while the remainder of the available land could be used for dedicated energy crop plantations [9].

Due to the large amounts of lignocellulosic feedstock required for large-scale commercial production of 2nd generation biofuels, it seems currently very difficult to integrate biomass production into existing food production via so-called "integrated food and energy systems" (e.g. hedges between fields that are harvested for biofuel production).

The competition of land and land use changes are expected to be limited when **residues** are used for 2nd generation biofuels.

3.7.2 Job creation and employment

Job creation and regional growth are considered as two of the main social drivers for the implementation of biofuel projects. For **dedicated energy crops** (including first-generation feedstock), feedstock production involves an agricultural workforce for soil preparation, cultivation, harvesting, on-field transport, etc.

The socio-economic impacts of large-scale export-oriented bioenergy production from Eucalyptus in Argentina have been analyzed by Wicke [14] with the use of an input–output model and focusing on the variables GDP, trade and employment (direct and indirect). Wicke has estimated the total employment generation (direct and indirect) for a Eucalyptus pellet production chain (chain 1) and a Eucalyptus pellet FT production chain (chain 2). The results show that, beside the direct employment generation from these chains (23%), a substantial amount of extra jobs can be generated by indirect employment (30–31%) and induced impacts (46–47%). The high share of indirect impacts is explained by the large amount of machinery and equipment needed for pellet production.

The intensification of agriculture in the future may lead to a decrease in jobs. Wicke [14] has estimated that 96.000 jobs are lost in chain 2, due to agricultural intensification. This loss of jobs in the traditional agricultural sector is, however, by far compensated by an increase of 2.960.000 jobs in the new economic activity of bioenergy production from Eucalyptus pellets.

Collection of agricultural and forestry **residues** could be done by the same workers involved in the main agricultural and forestry products; therefore, the number of new jobs in this part of the production chain would be limited. But the subsequent collection of residues after the harvest of the main product could extend seasonal occupation and improve job opportunities at least in manual harvesting systems [9].

It should be considered, though, that increasing opportunity costs for agricultural and forestry residues could lead to relative income losses for traditional buyers of these residues [9].

3.7.3 Contribution to local economy

Wicke has estimated that the introduction of a Eucalyptus-pellet (based on dedicated **energy crops**) production chain in Argentina will generate (based on overall impacts) a 20% increase in GDP and a 24% increase in imports. The Eucalyptus pellet-FT fuel production chain will generate a 27% increase in GDP and a 44% increase in imports respectively [14].

In terms of income creation, adding value to **residues** could increase and diversify rural incomes, while providing added value to the local agricultural sector. Use of these residues for 2nd generation biofuels could be one option to create additional market opportunities and to achieve this diversification. Depending on the type of residues there is an income increase in different parts of the chain and to the benefit of different actors; for example, farmers can profit from selling primary residues, while plant operators profit from increasing demand for processing residues. In the long term, additional income means that more money would flow into the region, therefore more indirect and induced jobs would be created.

Focus on developing countries: The (foreign) investments are (partly) required to improve infrastructure and capacity building to establish **energy crop** production for 2nd generation biofuels. In the short term, these improvements could help to revitalize rural economies. Profits could be invested in the rural sector to improve infrastructure and the overall economic situation, and to develop skills for feedstock cultivation and handling [9].

The use of **residues** could provide an additional source of income in the agricultural and forestry sector with positive impact on local economies and rural development. However, constraints exist whereby increasing opportunity costs for agricultural and forestry residues could lead to income losses for traditional buyers of these materials and affect poor farmers who cannot afford alternative fodder for their cattle [9].

3.7.4 Transitions in agriculture and land use changes

Second-generation biofuels produced from agricultural or forestry **residues** do not require cultivation of additional land.

When discussing potential areas for the production of **energy crops** for second-generation biofuels, "degraded" or "marginal" land is often mentioned as an option for sustainable feedstock production. However, while these areas might in fact be unsuitable to food production, they still provide other functions.

On the "2nd Joint International Workshop on Bioenergy, Biodiversity Mapping and Degraded Lands", hosted by the UNEP in Paris in 2009, many of the participating experts agreed that current land use data are in many cases not accurate enough to classify land as "degraded" or "unused" . During the discussions at the workshop, it was suggested that "social mapping" should become a pre-requisite for any feedstock production scheme on "degraded" or "unused" land in order to assess its current function and to avoid negative impact on local communities [40].

In developing countries: Africa has been targeted as a region with abundant under-utilized land. Although not extensively utilized, this land has long been and continues to be the only source of income for some local farmers and pastoralists. Furthermore, much of this land is of low quality as a result of soil degradation and climatic conditions [9]. Another example is the high biodiversity and/or the occurrence of endangered species on certain marginal lands. Expectations to cultivate degraded land should be considered carefully and conservative assumptions on its availability should be followed to avoid overestimation [9].

3.7.5 Impact on traditional uses and competition of resources and products

Residues from the agricultural and forestry sector can be used for 2nd generation bioenergy production. They are often considered to have no economic value, but in fact may be already used for other functions. The utilization of residues may compete with traditional uses of the biomass (fodder, bedding, etc.). This should carefully be considered, since the exploitation of limited resources may imply changes in agricultural production, markets and uses, and even lead to additional land demand to produce fodder [9].

As mentioned before, the use of degraded or marginal land for **energy crop** production may provide (even when unsuitable for food production) other functions or traditional uses.

3.7.6 Impacts on land rights

Given the uncertainty concerning land ownership and other factors, the area of marginal or abandoned land in a country might be misleadingly large, implying that all such land waits to be exploited, while this is practically not possible [9].

3.7.7 Food (in-) security

In developing countries: In countries where food supply is not secured, cultivating **energy crops** for bioenergy production on arable land can further weaken food security and thus have serious social impacts. Considering that cultivation of energy crops for 2nd generation biofuels could be more profitable, farmers may opt for growing a bioenergy feedstock instead of growing food for the national market. However, these arguments are also true for opting to plant cash crops (e.g. coffee and cotton) instead of food crops. In general, profitability of the crops will be decisive for the decision of the farmers.

If agricultural **residues** would be used as 2nd generation biofuel feedstock, this could increase the profitability of the crop cultivation and diversify the farmer's income. Moreover, residues from the agricultural and forestry sector do not compete with food crops and would help dedicate fertile lands to food production [9].

3.7.8 Smallholder integration

For 2nd generation plants, economies of scale and economic viability of facilities require scaled-up plant sizes and large annual biomass demands. This signifies a challenge in the integration of smallholders, since individual production outputs cannot cover the large

feedstock demand. This issue can be resolved by forming larger cooperatives among smallholders and, from a logistic point of view, by establishing various collections points and gathering the feedstock in the plant area. However, prerequisite for that is a good and reliable transport and infrastructure network, which does not exist in many developing countries [9].

In developing countries: There is risk that small landholders' interests in developing countries are ignored when large investments are undertaken by foreign companies (from developed countries) to establish **energy crops** for 2nd generation biofuels and this concern needs to be carefully addressed by sound policy regulations. The African Biodiversity Network has pointed out that displacement of smallholders might occur if large-scale land acquisition is not planned carefully. This is a concern particularly in Africa (e.g. Cameroon and Tanzania), where land ownership is often not secured.

Given the social concerns about land use and local populations, it is widely accepted that integration of local farmers into the overall scheme would be beneficial for all parties involved. This integration should be sealed with contractual agreements, securing farmers from the potential failure of bioenergy projects and allowing them to stop living under uncertain land-tenure condition. This integration could not only be limited to biomass production, but also allow farmers and their families to enjoy benefits from the entire value chain (e.g. jobs in the downstream industry, free use of the product, exploitation of by-products), which will increase the interest and willingness to engage in second-generation bioenergy projects [9].

The concerns mentioned above are comparably small for the utilization of agricultural and forestry **residues** as 2nd generation biofuel feedstock [9].

3.7.9 Health

In developing countries: Through traditional (and inefficient) use of biomass, like uncontrolled burning for cooking and heating, the indoor health situation is compromised and health problems occur more frequently in many developing countries [9].

4 Overview of socio-economic impacts of biomass production

This report provides a first overview of the most relevant socio-economic impacts of raw material from biomass production for a set of selected case studies in the Global BIOPACT project, based on available literature.

We can conclude from this review that the availability of literature on socio-economic impacts differs per biomass feedstock. Obviously, the socio-economic impacts from soy and palm oil production has gained a lot of attention in the last years, while the socio-economic impacts from biomass (from residues or short rotation crops) for 2nd generation biofuels have been researched only on a limited scale.

However, based on the available information, we can come to a set of relevant socio-economic impacts for the relevant feedstock for bioenergy production. The term 'relevant' should in this context taken with care as it is partly influenced by the attention that is given for this feedstock in terms of socio-economic performance in the last years.

Table 1 gives an overview of possible socio-economic impacts per feedstock type. Table 2 differentiates these impacts to a geographical level to indicate whether these impacts are expected on a local (company), regional or national scale.

Note that the information from this review will be combined with a screening of the socio-economic criteria and indicators which are principally used in existing and developing certification systems and legislation to safeguard the sustainability of bioenergy.

The information from both reviews will provide a sound basis to select a set of relevant impacts that can be used to analyze the socio-economic issues of biomass production on a local, regional and national level.

Table 6: Overview list of impacts and its relevance for defined feedstock types
*** Indicated with ● are the impacts mentioned in literature references (so far!). It is not self-evident that the indicated impact is of high relevance or not for the feedstock types; this also largely depends on the availability of literature. If the impact is not marked with ●, it does not mean automatically that the impact is not relevant for the feedstock. ** Based on general studies and international declarations. (G): Gender issues are mentioned as relevant for this impact.**

List of impacts	Impact of feedstock type mentioned in literature*:					
	All**	Soy	Palm oil	Jatropha	Sugarcane	2nd gen
Working conditions and rights						
Freedom of association and collective bargaining	●					
No forced labour	●				●	
No child labour	●					
No discrimination (including equal payment in work) (G)	●					
Wages • For temporal, seasonal workers • For fixed jobs	●	●	●		●	
Adequate standard of living (e.g. food, shelter and health services)	●				●	
Safe and healthy working conditions (G)	●	●	●	●	●	
Reasonable limitation of working hours	●	●				
Social security for (migrant) workers	●					

List of impacts	Impact of feedstock type mentioned in literature*:					
	All**	Soy	Palm oil	Jatropha	Sugarcane	2nd gen
(Vocational) training possibilities	•					
Protection against unemployment	•					
Economic aspects						
Reduced poverty rate	•					
Contribution to economy		•	•	•	•	•
Improved incomes and/or revenue (activities) in production areas	•					•
Improved cash flow for consumption and savings	•					
Equality in income and distribution (G)	•					
Employment creation (improved employment rate) (G)	•	•		•	•	•
Employment structure (G)						
Impact on community infrastructure		•				
Impact on availability and access to health and education services	•					
Land competition: impact on land prices	•	•				•
Access and availability of energy resources	•					
Competition and availability of natural resources						
Less access to land (reduced availability)	•	•	•			
Loss of land and natural resources	•	•	•		•	
Loss of crops and cleared arable land	•					
Loss of natural resources and grazing land	•	•			•	
Disruption of relationship land and natural resources	•					
Environmental sustainability (general)	•	•	•	•	•	•
Impact on available water resources	•					
Impact on available wood resources	•					
Social aspects and welfare						
Promote gender equality (G)	•					
Impact on availability traditional knowledge (G)	•			•		
Increased needs for basic infrastructure and services	•					
Access to education	•					
Existence of social conflicts	•	•	•			

List of impacts	Impact of feedstock type mentioned in literature*:					
	All**	Soy	Palm oil	Jatropha	Sugarcane	2nd gen
Impact on graves or other cultural heritage sites	•					
Disruption of structure of settlements	•	•	•		•	
Increased crime	•					
Competition with traditional uses	•			•		•
Disruption of social networks and relationships	•	•	•			
Health impacts						
Health impacts – general (G)	•	•	•	•	•	•
Access to sufficient potable water	•					
Increased risk of HIV/Aids or other diseases	•					
Food security (G)	•				•	
Impact on food availability in producing region	•			•		•
Food access	•					
Food distribution	•					
Impacts on food and feed prices		•				
Ability to maintain household food production	•					
Ability to purchase food	•					
Smallholder aspects						
Transition (rate) of small scale to large scale farming	•	•		•	•	
Access and dependency on required inputs (G)		•	•			
Risk for exploitation on market (too low prices)			•			
Policy and governance aspects:						
Compliance with national policies	•					
Compliance with national programs or plans	•					
Management of resettlement	•		•			
Changes in administration of land rights and use	•		•			
Management of (increased) social tensions	•		•			
Land tenure and rights						
Respect land rights and avoid displacement (G)	•	•	•	•		•
Land right conflicts	•	•	•			
Tenure security / insecurity	•	•	•	•	•	•
Loss of land rights and entitlements	•	•	•			•

List of impacts	Impact of feedstock type mentioned in literature*:					
	All**	Soy	Palm oil	Jatropha	Sugarcane	2nd gen
Compensation of land	•		•			
Respecting rights of Indigenous people	•		•			
Participatory aspects						
Women's participation in planning (G)	•					
Community participation in planning	•					
Smallholder integration in business models	•					•
Community inclusion in business models	•					
Skills transfer (G)	•					

Table 7: Overview list of impacts and the geographical level of impact

List of impacts	Local (Company)	Regional	National
Working conditions and rights			
Freedom of association and collective bargaining	•		
No forced labour	•		
No child labour	•		
No discrimination (including equal payment in work) (G)	•		
Wages • For temporal, seasonal workers • For fixed jobs	•		
Adequate standard of living (e.g. food, shelter and health services)	•		
Safe and healthy working conditions (G)	•		
Reasonable limitation of working hours	•		
Social security for (migrant) workers	•		
(Vocational) training possibilities	•		
Protection against unemployment	•		
Economic aspects			
Reduced poverty rate		•	•
Contribution to economy • Direct effects • Indirect and induced effects		•	•
Improved incomes and/or revenue (activities) in production areas		•	
Improved cash flow for consumption and savings	•	•	
Equality in income and distribution (G)	•	•	
Employment creation (improved employment rate) (G)	•	•	
Employment structure (G)		•	•
Impact on community infrastructure		•	
Impact on availability and access to health and education services		•	
Land competition: impact on land prices		•	•
Access and availability of energy resources		•	•
Competition and availability of natural resources			
Less access to land (reduced availability)		•	
Loss of land and natural resources		•	•

List of impacts	Local (Company)	Regional	National
Loss of crops and cleared arable land		•	•
Loss of natural resources and grazing land		•	•
Disruption of relationship land and natural resources	•	•	
Environmental sustainability (general)		•	
Impact on available water resources		•	
Impact on available wood resources		•	
Social aspects and welfare			
Promote gender equality [(G)]	•	•	
Impact on availability traditional knowledge [(G)]	•	•	
Increased needs for basic infrastructure and services		•	
Access to education		•	
Existence of social conflicts		•	
Impact on graves or other cultural heritage sites	•	•	
Disruption of structure of settlements	•	•	
Increased crime	•	•	
Competition with traditional uses	•	•	
Disruption of social networks and relationships	•	•	
Health impacts			
Health impacts - general [(G)]	•		
Access to sufficient potable water	•		
Increased risk of HIV/Aids or other diseases	•		
Food security [(G)]			
Impact on food availability in producing region		•	
Food access	•	•	
Food distribution	•	•	
Impacts on food and feed prices		•	•
Ability to maintain household food production	•		
Ability to purchase food	•		
Smallholder aspects			
Transition (rate) of small scale to large scale farming		•	
Access and dependency on required inputs [(G)]	•	•	
Risk for exploitation on market (too low prices)		•	

List of impacts	Local (Company)	Regional	National
Policy and governance aspects:			
Compliance with national policies		•	•
Compliance with national programs or plans		•	•
Management of resettlement		•	
Changes in administration of land rights and use		•	
Management of (increased) social tensions		•	
Land tenure and rights			
Respect land rights and avoid displacement (G)	•	•	
Land right conflicts	•	•	
Tenure security / insecurity	•	•	
Loss of land rights and entitlements	•	•	
Compensation of land	•	•	
Respecting rights of Indigenous people	•	•	•
Participatory aspects			
Women's participation in planning (G)	•		
Community participation in planning	•		
Smallholder integration in business models	•	•	
Community inclusion in business models	•	•	
Skills transfer (G)	•	•	

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