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Social Life Cycle Assessment of Biodiesel in South Africa: An Initial Assessment

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Abstract

Social impacts of anthropogenic activities are important factor in determining sustainability of production and consumption systems. This paper examines the production and consumption of biodiesel in South Africa, with a view to do an initial assessment of its life cycle social impacts. The methods developed by UNEP and its partners are incorporated. Competition between bio-fuels and food issues are found not to be straightforward especially when by-products of biodiesel production are used as animal feed. Particular social issues in South Africa include, low wage for farm workers, the use of illegal workers from neighboring countries, crime against commercial farmers and child labour. Some additional value addition in the sector can improve wages and living standards while indiscriminate land use can result in increased food prices. It is argued that more work needs to be done to examine these specific impacts and contribute to a better understanding of social LCA.

Keywords: social life cycle assessment, biodiesel social sustainability, biodiesel in South Africa

1. Introduction

A social life cycle assessment is a social impact assessment technique that aims to assess the social and socioeconomic aspects of products and their positive and negative impacts along their lifecycle encompassing extraction and processing of raw materials, manufacturing, distribution, use, re-use, maintenance, recycling, and final disposal. [1] Social Life Cycle Assessment (S-LCA) is generally in line with ISO14040 and ISO14044 standards for Life Cycle Assessment with a focus on social and socio-economic issues. The focus is on the impact on workers and communities at large, where production and consumption takes place. S-LCA is in the process of being developed and resolved to ensure comparability of results. The methodology is more qualitative due to the existence of minimal numerical databases. Interpreting the meaning of data is also problematic and difficult. The process is very expensive, challenging and creates subjective data. System boundaries are also more difficult to define through the entire product life cycle. [1]

Despite these challenges, this work is justified because there is growing customer/market pressure on the state of the social and economic circumstances of production and services for products like biodiesel. Issues like corruption, unionization of workforce, policies and laws in the creation of biodiesel and its by-products are increasingly important. The triple bottom-line of people, planet and profit or prosperity has become the focus of many development projects. In this, the environmental Life Cycle Assessment (E-LCA), Life Cycle Costing (LCC), Social Life Cycle Assessment (S-LCA) and Socio-economic Life Cycle Assessment (Social-LCA) have become very important aspects in sustainability assessment. This work therefore focuses on the last two, S-LCA and Social-LCA, covering its internalities and externalities. The internalities focus on people's health and safety at work, planetary social costs of pollution prevention, raw material costs, taxes, interest and costs on society. The externalities impact on human well-being due to the social impacts, planetary biodiversity, human health impacts of pollution and profit/prosperity loss due to for example yields reduction due to pollution. [1]

Many important economic and social impacts can results from long-term projects like biodiesel production in South Africa. There is great potential for bio diesel in the country and the great advantage of this renewable fuel is that it can be used in existing vehicles with little or no adaptation necessary. The biodiesel industry in South Africa is still in its infancy and a majority of players are small scale backyard operations. Total annual production is estimated to be around four hundred thousand litres. [2] It is estimated that the production is more and some players in the business conceal information about production levels in an effort to evade the fuel tax imposed on all production levels in the excess of thirty thousand litres per month. A total of 200 companies and organisations have been identified as biodiesel producers and/or manufacturers in South Africa. These are comprised of about 200 small scale biodiesel producers with production ranging from 16 to 100 thousand litres per day. All production is done using waste vegetable oil collected from food outlets as feedstock. [3]

The main goal of the study is to spot social hotspots and identify feasible alternatives in order to avert potential negative social impacts and risks of the biodiesel development supply chain. Within this broader framework, the key objectives of the study are to assess the social impacts throughout the product life cycle of biodiesel; promote and stimulate improvement of social conditions within and around the biodiesel production processes and to study the sustainability issues throughout the life cycle of biodiesel production in the South African context.

The growth of biodiesel production and use in South Africa can play a major role in job creation thus fighting poverty, improving environmental protection and economic growth. Bio diesel has the potential to contribute to job creation and skills development in both agricultural and

production sectors. It can spur economic development in disadvantaged rural communities, provide energy security, assist to mitigate the shortage and high cost of energy and can contribute to reducing greenhouse gas (GHG) emissions. The challenge is that the level of biodiesel and biodiesel feedstock development in South Africa is limited and not well coordinated.

This paper therefore discusses the initial social life cycle impact assessment of the biodiesel industry in South Africa and presents interesting information on issues pertaining to reduction of fossil fuel consumption, employment benefits related to the new industry, urbanisation of the targeted grain production areas in some of South's least developed communities.

2. Social Life Cycle Assessment Methodology application for Biodiesel Assessment

S-LCA uses tools from many disciplines. Biodiesel projects affect local economies, societies, geography, anthropology, the psychology of people affected, local management systems, agronomy, forestry and health and safety aspects. These fall within many fields of study and hence the assessment methods have to be multi-disciplinary. The analytical, monitoring, communication and reporting tools and used can complement each other. Positive and negative social, potential social and indirect impacts throughout the life cycle of a diesel production are identified in a way that informs incremental improvements of the product's social performance. The assessment methods used are similar to Environmental LCA (E-LCA) involving goal and scope definition, life cycle inventory analysis, life cycle impacts assessment and interpretation, but focusing of social and socio-economic impacts and information on organization-related aspects along the diesel production, consumption and disposal chain. This extends the assessment methods towards sustainability LCA. Data are collected for stakeholder categories for a specific site, location and lifecycle stage. Subjective data and variables are used and positive and negative social impacts identified for a given geographical location. [1]

Data on biodiesel social impacts are collected according to three main dimensions that capture the causes. These are the behaviour, social economic processes and capital dimensions. [1] Behaviour issues in biodiesel production in South Africa are to do with the formalisation of unions in a sector which is almost informal in nature at the moment and the interaction between employers and employees in such a setting. Socio-economic processes are to do with macro or micro levels like building infrastructure in the in a community for the proposed farming and biodiesel development projects. The capital dimension is human, social, cultural and to do with education level of individuals, group or societies in the Eastern Cape area that is targeted for the biodiesel production development. The projects in such an area will affect and be affected by the health of the local populations. The prevalence of diseases like AIDS and the spreading patterns after the implementation of the projects will be important. Legal issues, crime and robbery patterns will be of interest to the local community. Such projects that graduate a big part of the population could positively affect these issues.

Typical stakeholder categories that need data collection will be the workers, local communities, society, consumers and values actors in the biodiesel development projects. Examples of impact categories that will be affected and studied are human rights, working conditions, health and safety, cultural heritage, governance and socio-economic repercussions of biodiesel production. Furthermore subcategories will be developed, indicators identified, inventory collected and data gathered. The stakeholder categories are assessed at each geographical location and can include NGOs, provincial and local authorities, governments and future generations. The social impact of the current biodiesel production efforts and proposed projects on future generations will be a key indicator on social sustainability. [1] Subcategories like management, shareholders, suppliers and business partners will need to be considered. The target categories and subcategories are shown in Table 1.

Table 1: Stakeholder Categories and Subcategories [1]

Stakeholder "worker": Freedom of Association and Collective Bargaining, Child Labour, Fair Salary, Working Hours, Forced Labour, Equal opportunities/Discrimination, Health and Safety, Social Benefits/Social Security
Stakeholder "consumer": Health & Safety, Feedback Mechanism, Consumer Privacy, Transparency, End of life responsibility
Stakeholder "local community": Access to material resources, Access to immaterial resources, Delocalization and Migration, Cultural Heritage, Safe & healthy living conditions, Respect of indigenous rights, Community engagement, Local employment, Secure living conditions
Stakeholder "society": Public commitments to sustainability issues, Contribution to economic development, Prevention & mitigation of armed conflicts, Technology development, Corruption
Value chain actors* not including consumers: Fair competition, Promoting social responsibility, Supplier relationships, Respect of intellectual property rights

Attributional S-LCA, which traces how products are made, is used for the assessment of biodiesel in South Africa. Site specific data is collected for identified hotspots and where not available generic data is used and qualified. To make the study manageable, prioritization, estimation and criteria for cut-offs are set. Available primary data is captured.

Life Cycle Inventory Analysis involves collection of modeling of data to determine how the biodiesel production chain performs on social and socio-economic aspects. It was found out that there are generally no S-LCA databases on biodiesel production making it difficult to screen for hotspots and a desk screening using literature is proposed. Particular attention has to be paid to data status, quality, reliability and relevancy. A combination of on-site data collection and statistical methods is proposed. In the process inventory indicators are being developed for Biodiesel production in South Africa. Other methodologies employed include document audits, participative methods, directed and semi-directed interviews and questionnaires. [1] Data verification and triangulation for different stakeholder groups is planned. Information collected includes remuneration levels to classify them as living, minimum or average wages. Co-products are handled by

allocation methods. Data measurements methods, completeness, accessibility, documentation and uncertainty have been taken into account for primary or secondary (using databases) and generic sources. Geographical differences, scope and technological differences are taken into account and cross checking with other sources and industrial average done.

The Social Life Cycle Impact Assessment classifies, aggregates and characterizes the data on biodiesel social impacts for the different impact categories and some characterization applied. The inventory data is then linked to the impacts for different categories and subcategories. Quantitative, semi-quantitative and/or qualitative methods are used. For example the percentage of the supply chain that contributes to poverty in the local society. Classification is done by impact or stakeholder category. A combination of top-down or bottom-up approaches is used.

Life Cycle Interpretation reviews all parts of the South African biodiesel S-LCA study to identify significant issues, check for completeness and consistency, assess stakeholder engagement levels, report on the assessment and make some conclusions and recommendations. Improvement potential and the stages crucial for improvements are analysed to provide information on the social condition and preconditions of the production and consumption process in a scientific manner. Extensive data triangulation and sensitivity analysis is applied. The tendency for top-down approaches in S-LCA can cause stakeholder disenchantment. On the other hand stakeholder when involved can bring in bias in the results. [1] A fine balance is therefore consciously applied by the researchers to mitigate these negative aspects.

3. Biodiesel Production in South Africa

The government's contribution to the biodiesel industry in South Africa is through the Biofuels Industrial Strategy which was gazetted in 2007. [4] This outlines policy, regulations and incentives regarding biofuels in South Africa. Areas covered include water limitations, food security (availability and affordability), land prices and land restitution, environmental concerns, biofuels quality, technology choices and crop selection/ choices. The highlight of the strategy is a plan to achieve a 2% biofuel penetration of the transportation fuel market, representing about 400 million litres. The aim is to replace 240 million of petrol by ethanol and 160 million litres of diesel by biodiesel. The crops identified for bio-ethanol are sugar cane and sugar beet and for biodiesel are sunflower, canola and soybeans. The exclusion of maize and jatropha was based on food security concerns. The targeted land for these crops is underutilised. It is estimated about 14% of arable land, mainly in the former homelands, is underutilised. To meet the 2% interim market penetration target, only 10% of this underutilised land is required suggesting that this will have minimal impact on local society and on food production. However still, there is hesitancy by the South African government to approve such projects due to the food-fuel competition issue being brought to the fore by different stakeholders. [5] There is therefore a need to do a full sustainability life cycle assessment of biodiesel production in South Africa. This can be the basis for more favourable policy formulation towards biodiesel promotion that can attract investment.

Sasol and the Central Energy Fund (CEF) and Siyanda Biodiesel plan to build a 91 million litres a year biodiesel plant with the following ownership; Sasol 37.5%, CEF 36.5% and Siyanda 26%. [6] Studies on the viability of the biodiesel project have been conducted. The proposed plant would require 600 thousand tonnes of soybeans a year, necessitating imports while soybean farming in South Africa is developed to meet the demand. A main challenge is the level of government support for first generation biofuels and its position on the food versus fuel debate issues related to soybean production.

Rainbow Nation Renewable Fuels, owned by NatBioGroup of Australia has had plans to build a R1.5 billion dollar biodiesel plant in the Coega Industrial Development Zone in the Eastern Cape. [7]. It is estimated that 350 new permanent jobs and 725 upstream and downstream jobs and 800 construction jobs can be created by the implementation of this project. The facility could produce 288 million litres of biodiesel, consuming 1 million tonnes of soybeans a year making it the largest plant in Africa. 800 thousand tonnes of soy meal could be produced making South Africa a net exporter of the product. Currently some of the soy meal is imported.

First In Spec plans to build 3 used oil/ grease biodiesel plants [8](Biofuels Journal, 2009). The plan is to locate the plants in Richards Bay. The total annual production is targeted at 50 million litres per year to supply the mining industry. The expected construction cost is R1.5 billion and the plant will create up to 100 direct jobs and 5000 indirect jobs.

4. Some Preliminary Results on South African Biodiesel S-LCA

Soy bean is regarded as the most appropriate oil crop for biodiesel production in South Africa, since the residue oil cake is also a desirable by-product either for animal feed or for human consumption, alleviating protein deficiency. This makes it a good candidate that tends to be less controversial when the food-fuel debate in brought up. In addition excessive consumption of soy oil is not recommended and neither is there a shortage of cooking and edible oils in South Africa.

Information collected suggests that South African biodiesel feedstock practices generally comply with the acceptable standards for human rights, working conditions, health and safety, and socio – economic repercussions. [9] The majority of farm workers in South Africa are female indicating a gender imbalance. It was found out that the farm workers' knowledge of HIV prevention and sexually transmitted dieses recognition and treatment is very low. The development of new estates for soybean production for biodiesel should be accompanied with it total compliance of the above social issues and education of workers on HIV and AIDS.

Biodiesel's major impact is to address pressing energy needs. The bio diesel strategy seeks to boost the agricultural sector in farming areas previously marginalized by the apartheid system and to create sustainable income-earning opportunities especially for the rural poor. It is estimated that a 2% bio diesel penetration level will create

25 000 jobs reducing rural unemployment by 0.6% and boosting economic growth by 0.05%. [9] It is acknowledged that a negative economic factor is thet farmers are likely to receive subsidies in the early stages of the biodiesel based economy, but the situation will improve through economies of scale as the use of biodiesel gets more widespread approval and big projects are implemented.

One of the potential positive social impact is the black economic empowerment initiatives planned in the development of biodiesel in South Africa. On December 5, 2007 the South African cabinet approved a national bio-diesel industrial strategy whereby the new bio-fuel/biodiesel industrial strategy is driven predominantly by the need to address issues of poverty, rural development, and black economic empowerment (BEE). [3] The focus is on the promotion of farming in areas that were previously neglected by the apartheid system and in areas of the country that did not have market access for their produce. Most of these areas are in the former homelands areas that are characterised by underdevelopment and poverty.

Department of mineral and energy plans to have a 4.5% biofuels penetration by 2013, to contribute to energy security, create 55 000 jobs in rural farming, contribute to economic growth. It is estimated that R2 billion per annum will be added to the GDP from the sector. This would also contribute 75% towards meeting the renewable energy target. The strategy excludes the use of maize and jatropha as feed-stocks due to food security and environmental concern respectively. [3] Biodiesel and ethanol will be the target biofuels and the direct social impacts are estimated to be enormous. These need to be accurately and scientifically quantified.

The protection granted to farm workers by the Department of Labour has been found to be inadequate. The Department of Labour has only 800 labour inspectors for all workplaces in South Africa, compared to 70,000 farms in the country. [10] Working conditions on farms are therefore not regulated by law, but by the interests of the landowner. Farm workers have the lowest wages in South Africa varying from as little as R60 to R800 per month. Illegal farm workers from Mozambique and Zimbabwe are subject to extreme abuse and exploitation. These are preferred by the farm owners and they can arrange to have them deported without pay. Violence against illegal workers goes mostly unreported. Rural areas in the former "homeland" areas of South Africa today are characterized by high levels of poverty and HIV/AIDS infection, limited economic and employment opportunities, undeveloped infrastructure and limited services, with marginalized communities economically dependent on income from urban areas and social grants. [10] Interview of 500 farm workers showed a low rate of condom usage, with about 70 percent indicating that they never used them. About 29 percent of the farm workers in Mpumalanga were found to be HIV-positive - a prevalence rate almost 10 percent higher than the national average. [10]

6. Conclusion

An initial S-LCA of biodiesel production in South African has been done. Most of it assesses possible social impacts of planned projects. There is a need for creating databases of social, socio-economic information and data on all biodiesel production. Unique tools need to be developed to help in conducting S-LCA studies. The following laws and regulations that promote the rights of farm workers need to be effectively enforced: The Basic Conditions of Employment Act (BCEA); Sectoral Determination for Farm Workers and; Extension of the Security of Tenure Act. The data used needs to be complemented with more data collection from primary and secondary sources to enable a more complete social life cycle assessment. The information collected show how difficult it is to develop such studies. However the main hotspots identified are the social conditions of farm workers, the exploitation of immigrants, and the need for economic empowerment of previously disadvantaged groups in the process of biodiesel development.

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