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The Impacts of Tropical Biofuel Production on Land-use: The case of Indonesia

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Introduction

Human-induced climate change due to the increased emissions of carbon dioxide and other greenhouse gases in the past 100 years has impacted and continues to impact on ecosystems, societies and economies (Stern, 2007). The burning of fossil fuels has been the main cause of increased levels of greenhouse gas emissions in the atmosphere. In the context of climate change and global dependence on fossil fuels, the importance of biofuels as a sustainable alternative has been increasing in recent years. In the short to medium term biofuels are seen as a promising option in reducing greenhouse gas emissions while improving the security of energy supplies (European Commission, 2006). In the context of international collaboration on combating climate change, agreements like the UN Framework Convention on Climate Change (UN FCCC) and the Kyoto Protocol have been developed. According to these agreements, ratifying industrialized nations have to reduce their emissions according to their commitments (Grubb et al., 2001). Consequently, targets for biofuels in fuel blends have been introduced in national policies all over the world. Although industrialized countries produce some biofuels themselves, they are increasingly dependent on biofuel imports from less developed tropical countries, e.g. Brazil, Indonesia, Malaysia. Due to favourable natural conditions, increasing quantities of biofuels will be produced in these countries in the future. There are two emerging trends with regards to rising global demand for biofuels and land use. First, the production increase of biofuel feedstock demands more land thus placing direct pressure on potential agricultural land in forest areas. Second, the reallocation of agricultural land for biofuels along with other factors such as increasing human populations have led to rising demand and hence, higher prices for agricultural commodities and other foodstuffs. Thus, biofuel demand may be indirectly resulting in the expansion of food production into forest frontiers, leading to deforestation as one possible way of dealing with agricultural land scarcity.

The question therefore arises whether it is possible to increase tropical biofuel production without leading to increased deforestation in the tropics. Furthermore, this research seeks to better understand the direct and indirect effects of increased biofuel production, as well as the channels through which increasing biofuel demand affects forests.

Since much of the projected demand for biofuels may be met through increased feedstock production in tropical countries, research for this thesis focuses on the Southeast Asian Republic of Indonesia. Indonesia is shaped by an unstable resource based economy, mainly trading in oil,

gas, plywood and rubber and had major difficulties in overcoming the Asian financial crises. The country struggles with poverty, unemployment, underdeveloped infrastructure, corruption and bribery (Central Intelligence Agency, 2007). Fifty years ago Indonesia was densely forested, but between 1950 and 2000 forest cover declined from approximately 162 million hectares to 98 million hectares (FWI/GFW, 2002). Today a forest cover of approximately 90 million hectares remains (FAO, 2006). Although this forest area hosts a remarkable share of global biodiversity (Wakker, 2005), in the last twenty years it has been destroyed more rapidly than forests in Africa and Latin America (Rudel, 2005). Today the production of palm oil based biodiesel is seen by the government as a means of generating valuable foreign exchange. Since the beginning of palm oil production in Indonesia the sector's growth has been encouraged by the government (FWI/GFW, 2002; Wakker, 2005). Currently about 1.5 million people are employed in the Indonesian palm oil industry (Wakker, 2005), this corresponds to approximately 1% of the country's official labour force (Central Intelligence Agency, 2007). While there is suitable fallow land in Indonesia where plantations could be established (Reinhardt et at., 2007), forestland is much more attractive for plantation companies as there are timber stands that can be cut and sold first. Timber revenues are then invested in oil palm plantation, which will only generate returns after four to five years. A remaining problem is that many companies have little desire to establish plantations once they have harvested the timber in the standing forest (Nellemann et al., 2007; FWI/GFW, 2002). Hence, in Indonesia the increased demand for biofuel may result in increasing speculation over forestland and the issuance of additional forest conversion permits despite the risk that palm oil plantations may never be established. This would lead to a national lose-lose situation, leaving behind diluted, treeless landscapes: there would be a loss of environmental services from the forest as well as few benefits from oil palm plantations.

Methods and Analysis

The research questions are examined with a two level approach, focusing on the production of palm oil based biodiesel in Indonesia. By means of an independently constructed Scenario analysis the effects of increased palm oil production in Indonesia are examined at the household level. The changes are considered for three alternative households types, all involved in the palm oil industry. The grouping of the three household alternatives into landless workers, independent farmers and smallholders is derived from literature studies. These are analysed as three different scenarios. For each scenario an effect chain is constructed as a flow chart, which illustrates what might happen in each scenario when oil palm production rises. Each decision about an effect is justified by literature research results or by results gained from application of the economic household model as described by Sadoulet and de Janvry (1995).

The second approach aims to examine the impacts at an overview level, considering the national Indonesian production system. This analysis is concluded with a System analysis adapted from Vester (2002). The aim is to capture a complex system in its entirety in order to steer it in a sustainable direction. With the System analysis, the most important and influencing factors in the system should be detected in order to estimate what policy changes influence the system most. The palm oil production system is described with a set of 28 variables which cover all aspects (economy, resources, population) of the system. In a further step, a Cross-Impact-Matrix is constructed where the direct effects of the variables on each other are analyzed. The impact intensity is measured on a scale ranging from 0 to 3 (0=no impact, 3=strong impact). The results are recorded in a Cross-Impact-Matrix (Frischknecht and Schmied, 2002). With this process, the function of each impact factor in the system can be detected. The character depends on how strong a variable is affected by others and how influencing the variable is on other variables. It can then be estimated what effects policy implications might have on the system.

Discussion

Effects of the palm oil production increase
Regarding the outcomes of both applied methods, it is evident that changes in 'demand for land' and 'prices' such as prices for agricultural products or prices of palm oil are the major effects of increased palm oil production.

- The most important direct effect of the increased biodiesel demand is the increasing price of palm oil, as biodiesel feedstock. This effect is likely to occur so long as biofuel feedstock prices do not collapse due to overproduction.
- The most important indirect effect of increased biodiesel demand are increasing prices of other agricultural products. This price increase is caused by rising land scarcity since food production competes with the production of biofuel feedstock for land. If biofuel prices increase, farmers will produce more biofuels as revenues are expected to rise. This can lead to a shortage in food production, whereby agricultural food prices will rise. The overall effect will be increasing prices of other agricultural products.

Although the models are applied to the Indonesian case only, the effects are assumed to be similar for other tropical countries producing biofuels.

It would be of great interest to empirically asses, what exact impacts these price effects have on the behaviour and overall welfare of biofuel producing households. As prices are exogenous and changes have to be assessed empirically, the applied models only provide suggestions of household behaviour based on a literature review. To develop these models further and to test the resulting hypotheses with empirical data is a promising avenue of further research.

The channels influencing deforestation
'Palm oil production area', 'prices of agricultural products', 'revenue from palm oil production' and the 'level of education' are the channels influencing deforestation in Indonesia most directly and resulting congruently from both applied methods. Following the above explained:
- The increased demand for land to plant oil palm plantations leads most directly to deforestation, as forested land is more attractive due to the additional monetary value of the trees.
- Increasing prices of agricultural products create incentives for food growers to deforest in order to be able to increase production and revenue.
- With an increase in income, consumption - and thus also consumption of forest products - increases, with concomitant threats to forests.
- A higher level of education could help to reduce deforestation rates due to peoples higher awareness of the negative long-term consequences of deforestation. As long as education levels are low or decreasing, such effects cannot be expected.

Conclusion

Under the current political, institutional and economic circumstances in Indonesia, palm oil production encourages deforestation. Thus, in the Indonesian case the main research question has to be refuted. If, in the long-term, Indonesia can develop a more stable institutional environment, in combination with strictly limited forest conversion, plantation establishment on fallow land and compulsory sustainable palm oil production, e.g. according to principles of the Roundtable on Sustainable Palm Oil (RSPO), the chances for increasing biofuel production without deforestation could rise.

Further recommendations for the Indonesian palm oil sector are:
- The encouragement of small scale palm oil production. According to the analysis, independent farmers planting small proportions of palm oil benefit the most from palm oil production at the household level. Further small scale production encourages a poly-culture production style over monocultures, which may pose fewer threats to forest ecosystems and biodiversity.
- The strict prohibition of forest fires and slash and burn practices to generate arable land. This would protect air quality, lower carbon dioxide output to the atmosphere and reduce the rate of biodiversity losses.
- Encourage palm oil use for domestic biodiesel consumption more intensely, instead of exporting it overseas and importing fossil fuels. As Indonesia's fossil oil extraction has peaked, this point might gain importance in the future.

Studying the international development of transport energy and biofuels in particular, it is evident that the introduction and encouraged use of biofuels will not solve the world's energy problem. In the future, the diversification of energy sources will be inevitable. Biofuels in general and biodiesel derived from palm oil in particular can be one of many efficient, greenhouse gas reducing energy sources. To guarantee the environmental efficiency of palm oil based biodiesel the implementation of internationally accepted certification guidelines for the approval of sustainable produced palm oil, similar to existing FSC (Forest Stewardship Council) guidelines, is highly desirable. Furthermore, trade barriers for biodiesel should be reduced and a clear classification of all traded biofuels needs to be implemented at the international level. The short- to medium-term impacts of a rising biofuel demand show the need for internationally binding policies between biofuel producing and consuming countries to avoid further negative social, environmental and economic long-term impacts in producer countries. It is necessary to realize the efficiency differences among different biofuels, depending on their origin and production. Not all biofuels lead to a reduction of environmental impacts. Palm oil based biodiesel is a very efficient biofuel, as long as no slash and burn practices are used to create plantation land. If binding biofuel targets for transport fuels are continuously introduced in markets, it is thus essential to create distinct tax incentives depending on the type of biofuel, in order to encourage the consumption of the most environmentally friendly biofuels.

References

Central Intelligence Agency. (2007). Indonesia, The world fact book, Central Intelligence Agency (CIA), Langley, Virginia, USA. Available at: http://www.cia.gov/library/publications/the-world-factbook/print/id.html. [12.06.07]

European Commission. (2006). Biofuels in the European Union, An Agricultural Perspective. Directorate-General for Agriculture and Rural Development. Brussels. Available at: http://ec.europa.eu/agriculture/publi/fact/biofuel/2007_en.pdf [03.05.07]

FAO. (2006). Global Forest Resources Assessment 2005, Progress towards sustainable forest management. Food and Agriculture Organization of the United Nations, Rome. Available at: ftp://ftp.fao.org/docrep/fao/008/A0400E/A0400E00.pdf. [28.08.07]

Frischknecht, P., Schmied, B. (2002). Umgang mit Umweltsystemen, Methodik zum Bearbeiten von Umweltproblemen unter Berücksichtigung des Nachhaltigkeitsgedankens. München. Ökonom Verlag.

FWI/GFW. (2002). The State of the Forest. Bogor, Indonesia, Forest Watch Indonesia and Global Forest Watch, Washington DC. Available at: http://www.globalforestwatch.org/common/indonesia/sof.indonesia.english.low.pdf. [06.06.07]

Grubb, M. et al., (2001). The Kyoto Protocol: a guide and assessment. London. Royal Institute of International Affairs, Energy and Environmental Programme.

International Energy Agency (IAE) and Organisation for Economic Co-operation and Development (OECD). (2006). World energy outlook 2006. OECD/IAE, Paris.

Nellemann, C., Miles, L., Kaltenborn, B., Ahlenius, H. (2007). The last stand of the orangutan - State of emergency: Illegal logging, fire and palm oil in Indonesia's national parks, rapid response assessment. United Nations Environment Program (UNEP), GRID-Arendal, Norway. Available at: http://www.unep-wcmc.org/resources/PDFs/LastStand/orangutanreport_1to11.pdf. [20.08.07]

Reinhardt, G. et al. (2007). Regenwald für Biodiesel? Ökologische Auswirkungen der energetischen Nutzung von Palmöl. Frankfurt am Main, WWF Deutschland

Rudel, T. K. (2005). Tropical forests regional paths of destruction and regeneration in the late twentieth century. New York, Columbia University Press.

Sadoulet, E. and A. de Janvry (1995). Quantitative Development Policy Analysis. Baltimore and London, The Johns Hopkins University Press: 140-149.

Stern, N. (2007). The Economics of Climate Change, The Stern Review. Cambridge. Cambridge University Press.

Vester, F. (2002). Die Kunst vernetzt zu denken. Ideen und Werkzeuge für einen neuen Umgang mit Komplexität. München, Deutscher Taschenbuch Verlag.

Wakker, E. (2005). Greasy palms, The social and ecological impacts of large-scale oil palm plantation development in Southeast Asia. London, Friends of the Earth. Available at: http://www.foe.co.uk/resource/reports/greasy_palms_impacts.pdf. [20.08.07]