

Final Progress Report
Sustainability Science Program
Term: September 1, 2013 – August 1, 2014

Name:

Yosef Manik

Your field:

Sustainability Science

Your degree program, institution and graduation date:

PhD, Ecology and Environmental Sciences, University of Maine, 2013

Faculty host(s) at Harvard name and department:

- William Clark, Harvard Kennedy School
- Kira Matus, London School of Economics and Public Policy

Description of SSP-related research activity:

Toward Sustainable Palm Oil Biodiesel: Advancing Sustainable Pathways through Understanding the Complex Dynamics of the Supply Chain

Abstract:

Palm oil biodiesel, as a part of the biofuel program, has been integrated in Indonesia's energy policy since 2008. This study aims to analyze the challenges of the palm oil biodiesel program to meet the goals of sustainable development and to provide recommendations toward a sustainable palm oil biodiesel program using quantitative analysis of potential policy options based on a set of sustainability criteria. The criteria to which the development is assessed as being sustainable or not are adopted from the practical definition for sustainability suggested in Dasgupta (2001) and Arrow et al. (2012) as "non-declining inclusive wealth over time." The inclusive wealth is defined as productive based capital stock which can be classified as Natural Capital (C_n), Manufactured Capital (C_m), Human Capital (C_h), Social Capital (C_s), and Knowledge Capital (C_k). The analysis of the present trend indicates that an alarming situation is taking place in all sustainability criteria of the supply chain of palm oil biodiesel. This alarming trend happens as a result of (1) lack of pro-environmental policies, and (2) corruption, misuse of power, and weak law enforcement. In this study we explore several policy options to solve the problem. The options are (i) Business as Usual, (ii) Stringent Regulation, and (iii) Smallholder Empowerment. The evaluation is conducted using an agent-based model simulation. An agent-based model was chosen because of its ability to model complex interactions between agents with distinct and autonomous behavior (i.e., palm oil companies), and the environment, which consist of different attributes (i.e., landscape on which oil palm can be planted). Selected sustainability indicators, such as soil carbon stock, forest cover, plantation cover, biodiesel production, employment, customary land ownership, and adoption of best management practice, are used to represent the five types of the productive based capital stock (C_n , C_m , C_h , C_s , C_k) whose change are evaluated over time. The result of the simulation indicates that BaU scenario produces a growing rate on C_m , C_h and C_k and declining rate on C_n and C_s over time. Applying the "Stringent Regulation" scenario would shift the declining rates of C_n and C_s into a steady state and amplifying the rate of C_k with a slight reduction in C_m , C_h . Applying the "Smallholders Empowerment" scenario would further improve this situation causing an increase in C_m , C_h without sacrificing C_n , C_s and C_k .

Identification of the problem you address:

Oil palm crop (*Elaeis guineensis*) provides a huge opportunity as the most preferable feedstock for biodiesel due to its high oil content and yield, which is seen as a huge opportunity as a driver for economic growth and an alternative for energy diversification by major palm oil producing countries such as Indonesia and Malaysia. However, there are still some challenges surrounding palm oil supply chain. Deforestation,

biodiversity loss, marginalization of local community, and exploitative labor relationships are among the most profound issues surrounding palm oil production. Anticipation in the early stage of the development of palm oil biodiesel to avoid massive devastation in the future is the central objective of this research and Indonesia was selected as the focus because it is the largest producer of palm oil worldwide.

Key question asked about the problem:

What are the key issues and trends for the palm oil biodiesel program in Indonesia and what policy should be established to ensure an inclusive wellbeing for multiple stakeholders at multiple scales?

The methods by which you answered that question:

The analysis is conducted using a quantitative methodology to evaluate the impact of potential policy options for a set of sustainability criteria. They are adopted from the practical definition for sustainability suggested in Dasgupta (2001) and Arrow et al. (2012) as “non-declining inclusive wealth over time.”

Principle literature upon which the research drew:

- Conceptual framework on how sustainability is defined and measured as non-declining inclusive wealth (i.e, productive based capital stock) over time.
- Basic technique in solving policy problems using the “Eightfold Path” methodology.
- Literatures that assess and analyze the sustainability issues surrounding the past and current practices in palm oil in Indonesia.
- Fundamental concepts in modeling a complex system through an Agent Based Model and practical techniques in simulating an ABM using the NetLogo platform.

Empirical data acquisition description:

- Literature review on Indonesia’s laws, regulations, and policies relating to palm oil biodiesel and the related sectors.
- Personal interviews with stakeholders in the the palm oil biodiesel sector, including policy makers, value chain actors, and communities.

Geographical region studied:

Indonesia

Recommendations that might be relevant for your problem:

Actions that can be recommended to the Government of Indonesia are:

- Strengthen democracy, good governance, and law enforcement with particular attention aimed at eradication of power abuse in land tenure and licensing.
- Effective enforcement of national environmental regulations to restrict the issuance of permits on sub-optimal, non-productive and/or low conservation value lands is essential to stop the current trends of land expansion.
- While the adherence of private operators to follow voluntary sustainability standards (e.g. RSPO standards) should be encouraged, national legislation for mandatory standards should be enforced. This national standard is an important baseline parameter for all companies to comply with in ensuring sustainable and responsible practices. Once this baseline is achieved, companies will be better equipped to advance to more aspiring standards.
- Given that smallholder-oriented business models are likely to produce greater environmental and social benefits than large-scale firms, it is important to create regulations that open more access to smallholders. The role of public agencies in supporting the smallholder-oriented business models include provision of public infrastructure or more effective extension services, by enhancing smallholder access to quality and affordable inputs (e.g., seeds, fertilizers) and provision of financial programs.
- Acknowledging and protecting the rights of customary lands is essential to avoid social conflicts in the context of land acquisition for oil palm plantations. Therefore, it is necessary to continue policy and legislative reforms that simultaneously strengthen customary land rights. Constitutional Court decisions

that stipulate the removal of customary forest from state-owned category must be followed up by mapping the customary territories across Indonesia as a basis for formal legal recognition and protection.

A description of the final product(s) you have/are aiming to produce:

- “Sustainability of Palm Oil Biodiesel in Indonesia: A Policy Analysis” to be submitted to Energy Policy Journal
- “Overview, Design Concept and Details (ODD) of An Agent Based Model to Evaluate Sustainability of Expansion of Palm Oil” to be submitted to the Journal of Industrial Ecology

Description of major other intellectual or professional advancement activity(ies) over the past academic year, including working titles:

1. Presentation: Preliminary result of the review of Indonesian biofuel policy at Indonesia Fellow Seminar of the Ash Center for Democratic Governance and Innovation of Harvard Kennedy School, October 29, 2013.
2. Presentation: Preliminary result of the agent based model at Society of Environmental Toxicology and Chemistry (SETAC) North America Chapter’s 34th Annual Meeting, November 17-21, 2013.

Please list citations for reports, papers, publications and presentations that built on your fellowship research:

NA

Please describe any collaborative activities with other SSP Fellows that you are involved with:

NA

Principal collaborators outside Harvard:

NA