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Towards patterns of vulnerability

Export-oriented agriculture and the oil palm case

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Rapport in het kort

Naar patronen in kwetsbaarheid

Export georiënteerde landbouw en palm-olie

De landbouwproductie en de mondiale handel in landbouwproducten zijn de afgelopen decennia sterk gegroeid. De intensivering en uitbreiding van landbouwgebied hebben de natuurlijke ecosystemen en de bestaanszekerheid van lokale gemeenschappen die van deze ecosystemen afhankelijk zijn aangetast. De landbouw vormt tegelijkertijd ook een belangrijke basis voor ontwikkeling. De mondiale vraag naar palmolie, als spijsolie en voor de energievoorziening, stijgt sterk. De productie van palmolie is een belangrijke oorzaak van ontbossing. De analyse van de productie van palmolie in Indonesië laat een patroon van kwetsbaarheid zien waarbij het welzijn van lokale gemeenschappen wordt aangetast door conflicten, gezondheidsverlies, en ondermijning van de bestaanszekerheid. Tegelijkertijd is palmolie een belangrijke economische factor geworden in Indonesië en een bron van werkgelegenheid en inkomen. De productie van palmolie gaat momenteel vaak gepaard met milieuproblemen (verlies van biodiversiteit, landdegradatie en vervuiling door pesticiden en kunstmest) en verslechtering van sociale aspecten als conflicten en gebrek aan landrechten. In dit rapport is het kwetsbaarheidconcept toegepast om deze patronen zichtbaar te maken. De formalisering in een systeemdynamische weergave van het kwetsbaarheidpatroon voor palmolie en andere landbouwproducten maakt verdere modelmatige analyses van de achterliggende mechanismen en de gevolgen voor welzijn en natuur en milieu mogelijk. Op basis van deze analyse kunnen in een volgende stap ook beleidsinstrumenten worden verkend die negatieve gevolgen voor mens en milieu zoveel mogelijk beperken.

Trefwoorden: kwetsbaarheid, handel in landbouwproducten, palmolie

Abstract

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Export-oriented agriculture and the oil palm case

Agriculture production and the global trade in agricultural products have strongly increased in the last decades. The intensification and extension of agriculture area have damaged natural ecosystems and undermined the livelihood of local communities depending on these ecosystems. At the same time agriculture also provides an important basis for development. The global demand for palm oil, as an edible oil and energy crop, has risen substantially. The production of palm oil is an important driver for deforestation. Palm oil production in Indonesia shows a pattern of vulnerability, in which the well-being of local communities is affected, for example, through conflicts, health loss, and increased insecurity. At the same time palm oil has become an important economic factor in Indonesia, providing employment and income. Current production practices of palm oil are paired with environmental problems (loss of biodiversity, land degradation and pollution by pesticides and fertiliser use) and the worsening of social aspects such as conflict and lack of land rights. This report applies the vulnerability concept to make these patterns visible. The formalization of this pattern of vulnerability into a systems-dynamic representation makes further model-based analyses of the underlying mechanisms and the consequences on the well-being and the environment and biodiversity possible. Based on this formalization, in a next step policy instruments that minimize negative impacts on people and the environment can be explored.

Key words: vulnerability, agricultural trade, palm oil

Contents

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This report forms part of MNP's contribution to the chapter on vulnerability in the UNEP Global Environmental Outlook IV (published in October 2007). This report aims to further elaborate ways to incorporate the vulnerability approach developed in GEO-IV into MNP's quantitative modelling approaches towards sustainable development.

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Summary

Agriculture production and the global trade in agricultural products have strongly increased in the last decades. The intensification and extension of agriculture area have damaged natural ecosystems and undermined the livelihood of local communities depending on these ecosystems. At the same time agriculture also provides an important basis for development. The global demand for palm oil, as an edible oil and energy crop, has risen substantially. The production of palm oil is an important driver for deforestation. Palm oil production in Indonesia creates a pattern of vulnerability, in which the well-being of local communities is affected, for example, through conflicts, health loss, and increased insecurity. At the same time palm oil has become an important economic factor in Indonesia, providing employment and income. Current production practices of palm oil are paired with environmental problems (loss of biodiversity, land degradation and pollution by pesticides and fertiliser use) and the worsening of social aspects such as conflict and lack of land rights. This report applies the vulnerability concept to make these patterns visible.

This analysis is also relevant for other agricultural commodities that are expanding rapidly in response to growing global demand. These crops are, for example, soybean, coffee and other bio-energy crops such as sugar cane. The case of palm oil is illustrative and can be done in a similar fashion for other crops. At the same time, analysis of other crops will help to further define and formalise this pattern of vulnerability. It will help to show that many of these mechanisms are common throughout the world and an integral part of the current agricultural sector. The formalization of this pattern of vulnerability into a systems-dynamic representation will be a step towards further model-based analyses of the underlying mechanisms and the consequences on the well-being and the environment and biodiversity.

A next step would be to identify a limited set of indicators to analyse the pattern and see in which typical ways this pattern of vulnerability manifests itself, and how these patterns may evolve over time under different scenarios. While doing this, it will be possible to further explore policy options that reduce vulnerability and at the same time managing ecosystem goods and services in a sustainable manner. The exploration of this (and other) archetypes can be done making use of simulation models. These simulations models are especially useful in analysing future trends of these patterns of vulnerability.

The importance of considering the intermediate factors on the national level in explaining vulnerability is an important lesson from the analysis of palm oil. If this is neglected there will be no clear understanding of the way in which vulnerability is shaped at the local level – also the level at which many policy responses are possible to realizing sustainable land use, including reducing the vulnerability of local people – but also a whole set of other issues that are relevant from a sustainability perspective. Further work could therefore focus on the intermediate factors between global drivers and global policies, and the local level. The incorporation of governance, institutions and social structures will help to improve the understanding of human vulnerability. The challenge for MNP modelling efforts will be to better understand how these links work in reality, as well as getting the data to support this.

1 Introduction

Agricultural production has grown significantly in the last half century. This has helped to secure food supply for many, in a period when the world population more than doubled and diets changed to higher meat consumption. In developing countries agricultural land has expanded significantly, although growth has been achieved mostly through intensification of production. Trade in agricultural products has increased even more rapidly. Agricultural products are transported over longer distances, detaching production and consumption (MNP, 2004; Millstone and Lang, 2003; FAOSTAT-data, 2005). Increasing agricultural production is inevitable if the increasing demand of a growing world population is to be sustained. This increasing production also raises questions from a sustainable development perspective. Current agricultural practices often put high pressure on the environmental resources. Agricultural intensification and expansion have already considerably affected natural ecosystems and local communities. Loss of biodiversity, land degradation and pollution (fertilisers, pesticides) form major environmental problems. These problems will increase if the current trends continue. This may ultimately threaten the supply of ecosystem goods and services people depend on. There is also a question of competing claims on land, will sufficient land be available for future food production, preserving biodiversity, urbanisation and for the production of bio-fuels (UNEP, 2007; MNP, 2007). Last but not least, there is also the issue of unequal distribution among the global population of the benefits of ecosystem goods and services itself (UNEP, 2007; MEA, 2005).

Trade is an important driver of economic development, and will continue to be important in a globalised world. Through trade in agricultural products, industrialised countries indirectly use large areas of land in developing countries. Agriculture is one of the most important topics for developing countries in the current trade negotiations within the World Trade Organisation (WTO), which is explicitly meant to serve development (Doha round). Agricultural trade can bring countries additional welfare benefits to developing countries, on the one hand, yet, on the other, can also leave them with the social and environmental problems, especially when trade liberalisation is not performed with care. Van Vuuren and Bouwman (2005) analysed the ecological footprint (to indicate the dependency on imports from other regions) of consumption dependency on land use. Here they showed that this footprint had increased due to population growth, raising consumption levels and changes in human diets. Furthermore, they emphasised the importance that bio-fuels will gain in the future with respect to the ecological footprint. Considering possible future scenarios, Africa, Asia and to a limited extent, Latin America, are expected to see an increase in total agricultural land in both globalizing and regionalizing scenarios. In globalising scenarios, this expansion is somewhat compensated due to an increase in agricultural productivity. Analysis also shows that especially in Latin America and Asia, the expansion of arable lands will immediately lead to more agriculture on marginal lands, and that the implementation of trade policies can be a decisive factor in doing this (Eickhout et al, 2004).

Agricultural expansion not only has impacts on biodiversity and the environment, but also creates problems when it causes conflict with the original users of the land. Loss of access to ecosystems possibly undermines the livelihood of people directly dependent on these ecosystems. These groups of people become more vulnerable as their livelihood base is threatened by a reduction in ecosystem goods and services. This raises the question of equity: who benefits and who loses from expansion in agricultural production and trade.

Kessler et al. (2007a) assessed the socio-economic and biodiversity impacts associated with the production of selected agro-commodities in their production countries and areas. Analysing areas with a strong increase in soy, palm oil, beef and coffee over the last 5-8 years and using biodiversity and socio-economic indicators on a sub-national level, they found a decline of these indicators in about half of the areas studied. They also found that the relationship between socio-economic trends in selected production areas in 44% is worse than in the country as a whole, in 34% it is better and in 32% it is variable. The vulnerability of the local population also increases for indicators such as violence, inequity and autonomy. So a part of the population does not benefit from the production of these agro-commodities in that particular region. This raises the question about the direct benefits of export-oriented agriculture for development. An important distinction they make is between agricultural production areas already established for a long time, areas where agriculture rapidly expands and the frontier regions where new agricultural areas are added. Vulnerability appears to be highest in the frontier and expansion areas (Kessler et al., 2007 a and b).

In sustainability analyses of production chains the social conditions of local populations in the areas the resources and raw materials come from is one of the issues to look into, but also one which is difficult to include. For the rapidly emerging market of bio-energy, social conditions of the local population is recognised as one of the criteria for sustainable biomass production – but also one that is not operationalised yet. For example, a Dutch advisory committee on the sustainability of bio-energy production did not find any concrete indicators to include this criterion in a proposed certification system. Therefore the committee suggested a reporting obligation to deal with this element of sustainable biomass production and recommends developing a protocol for such reporting and minimum standards for the longer run. Sustainable bio-energy systems are expected by this committee to provide local benefits and these should be reported upon (Projectgroep duurzame productie van biomassa, 2006; 2007). UN Energy has put forward a framework for decision-makers to realise sustainable bio-energy that includes addressing the risks for indigenous people, but this too lacks a clear set of indicators and benchmarks to compare with (UN Energy, 2007).

Another important sustainability issue is the link between agriculture and food security. This was analysed previously by MNP (Lucas and Hilderink, 2004), who developed a general indicator framework for vulnerability analysis and applied this to food security. Lucas and Hilderink also note that many of the problems that constitute food insecurity take place at community, household or individual level recognising though that global (environmental) changes (might) also have a substantial impact. The sub-national dynamics, as captured by the analysis of Kessler et al. (2007 a and b), for example, are not included in the methodology

of Lucas and Hilderink (2004). There is thus a need to link the global, national and local levels in vulnerability analysis. The question is to what extent it is possible and desirable to include this local/national dynamics in (model-based) analytical frameworks for vulnerability analysis, as applied at MNP.

This report explores the vulnerability of communities in the face of expanding agriculture in developing countries. It does so with the aim of identifying 'an archetypical pattern of vulnerability' in relation to export-oriented agriculture. The pattern assumed to take place is the following: 'export (cash-crop)-driven agricultural land-use change undermines the livelihood of natural-ecosystem dependent communities, because they do not have sufficient alternatives to overcome the loss of livelihood base and little sharing of the benefits from the resource exploitation'.

The expansion of palm oil is analysed as a case study to explore if this pattern indeed exists in this particular situation and to further formalise the assumed pattern. Oil palm was taken because its production is growing rapidly, driven by rising global demand for it as an edible oil and energy crop. The expansion of oil palm plantations is a major cause of deforestation. These forests are often used by local communities and indigenous people, highly dependent on the goods and services the forests supply. Loss of access takes away an important part of their livelihood base, increasing their vulnerability.

The idea behind looking at archetypical patterns of vulnerability is that they can be used to describe the relation between environmental change, other societal changes and the impacts of these changes on human well-being. The idea of patterns of vulnerability originates from the production process of Global Environment Outlook 4 (GEO-4) of the United Nations Environment Programme (UNEP, 2007) in 2007 (see also Wonink, Kok and Hilderink, 2005; Kok et al., 2006; Jäger et al. in UNEP (2007) and Jäger and Kok [eds.], forthcoming).

This report is aimed at making a methodological contribution to vulnerability analysis. It is divided into 6 chapters. The archetype approach is elaborated further in chapter 2, following this introduction. In chapter 3 the global trade in agricultural products is overviewed as a basis for the analysis of the global dimensions of agriculture in this report. The example of oil palm in Indonesia is taken as a case study in chapter 4, using the framework presented in chapter 2. On the basis of this analysis, chapter 5 formalises the archetypical pattern of vulnerability for export agriculture into a system-dynamics representation. Chapter 6 discusses if this methodology can be used for further work at MNP on vulnerability, especially as way to better capture sub-national issues. The analysis in this report has been mostly qualitative; more in-depth quantitative analysis should be performed in a subsequent step.

2 Methodology: patterns of vulnerability

This chapter elaborates the methodological basis on which the idea of archetypical patterns of vulnerability is built. First, the concept of vulnerability is presented; second, the syndrome approach is elaborated and, third, the step is made towards archetypical patterns of vulnerability. The archetype approach was developed during the preparation of GEO-4 (Jäger, Kok et al., in UNEP, 2007; Jäger and Kok [eds.], forthcoming), largely to overcome some of the problems associated with vulnerability assessments on a global scale. Bridging different scales is one of the main challenges for global vulnerability assessments, as vulnerability is a highly local (place-based) phenomenon. Archetypes of vulnerability provide a method for more detailed and elaborate analysis of the way in which issues such as poverty, institutions and governance, science and technology, trade and globalisation and conflict influence or interact with environmental changes and determine specific patterns of vulnerability that are globally relevant.

2.1 Vulnerability approach

Many different approaches to assess vulnerability have been developed, differing in how they define vulnerability, the scale of analysis, or their thematic focus. In general terms, vulnerability refers to the potential of a system to be harmed by an external stress (i.e. threat). However, depending on the context different definitions are being used. In GEO-3 (UNEP, 2002a), for example, vulnerability was defined as ‘the interface between exposure to physical threats to human well-being and the capacity of people and communities to cope with these threats.’ The Intergovernmental Panel on Climate Change (IPCC, 2001) defines vulnerability in relation to climate change as ‘the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability.’

Vulnerability research can be broadly divided in two main fields. The first concentrated on the field of natural hazards research, looking at human vulnerability related to physical threats and disaster reduction (e.g. Cutter (1996) or World Bank (2005)). It has focused on vulnerability in relation to environmental threats, such as flooding, droughts or earthquakes. Vulnerability to these extreme events depends on their likelihood and the place where they occur. A second strand of research looked at socio-economic factors in relation to human vulnerability, e.g. Adger and Kelly (1999) and Watts and Bohle (1993).

This research has shown that in the face of (non-)environmental threats, socio-economic factors are equally important. The impact of a threat is to a large extent determined by socio-economic factors, so as the ability to cope with those threats. Poverty, conflict or lack of entitlements, are, for example, important factors in determining the impacts of a threat for different communities and people. Recently, the research focus has shifted to combining these strands of research, in recognition that both aspects, namely, natural hazards and environmental changes and socio-economic factors collectively determine human

vulnerability to environmental change. This more comprehensive approach looks at multiple exposures (stresses) from different domains and in this way comes close to the concept of sustainable development, which requires integrating the economic, environmental and social dimensions within one framework. Integrated studies have, for example, looked at the vulnerability of communities in dry lands in West Africa to climate change (Dietz et al., 2004) or the vulnerability of Indian agriculture to global change (TERI, 2003).

The different analytical frameworks for vulnerability analysis generally distinguish between exposure, sensitivity and coping capacity as the main components. Exposure refers to the external stress (e.g. threat) to the system (community or individual). This can be caused by extreme events such as flooding, but also by changes in the magnitude and intensity of the hazardous events (e.g. floods) as a consequence of climate changes. It can also be caused by such socio-economic 'events' as economic collapse or price changes of commodities. Sensitivity determines the extent to which each system is susceptible to exposure to that external stress – for example, entitlement or proximity of an environmental threat, such as a floodplain. Coping capacity determines the ability to deal with or recover from the impact of an external stress. Depending on the topic, factors such as education and insurance are important. This is also referred to as resilience. The complementary concept of resilience has been used to characterise a system's ability to bounce back to a reference state after a disturbance (Pimm, 1984) and the capacity of a system to maintain certain structures and functions despite disturbance (Holling, 1973). If the resilience is exceeded, collapse can occur (see, for example, Diamond, 2004). Although resilience is also used as a component of other vulnerability concepts, the resilience approach focuses particularly on this characteristic of a system. It determines the capacity to cope with the impact of a stressor, depending on, for example, institutional capacity or financial resources. This approach is not focused on the desired future outcome, given that drivers are largely unpredictable, but on creating a system that is able to cope with this unpredictability in many different situations.

A framework that incorporates all these different aspects was developed by Turner et al. (2003). It assesses the human–environment system as a whole, describing its vulnerability as a combination of exposure, sensitivity and resilience. It also takes a multi-scale and multi-dimensional perspective, making it an elaborate framework to use (see Figure1).

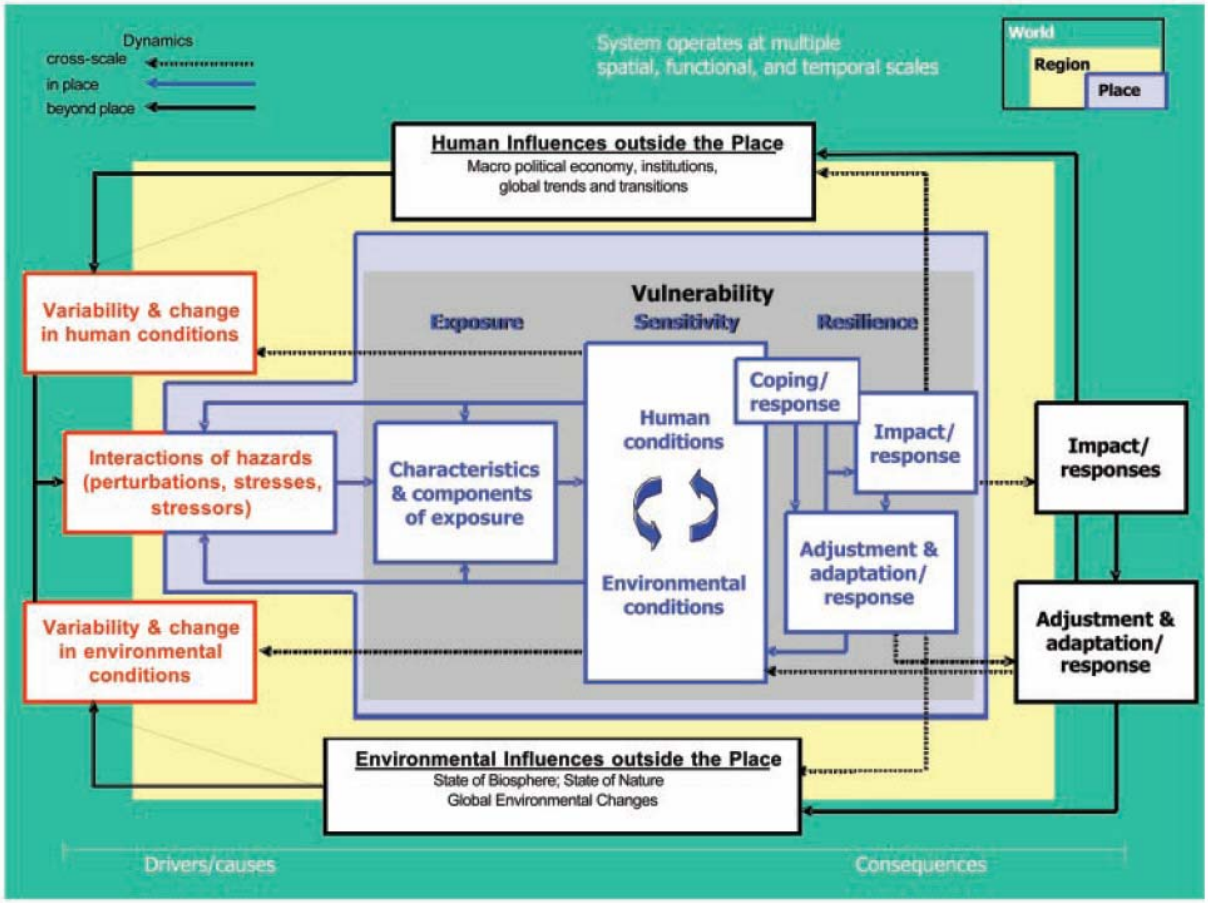

Figure 1: Vulnerability framework developed by Turner et al. (2003).

A disadvantage is the complexity of the framework. Combining all these different elements in a multi-scale and multi-dimensional way requires a large amount of data, which are often not available. Including all elements of this framework in one analysis is also probably not feasible. A more simplified framework, where some of the elements have been dropped, is presented in Figure 2.

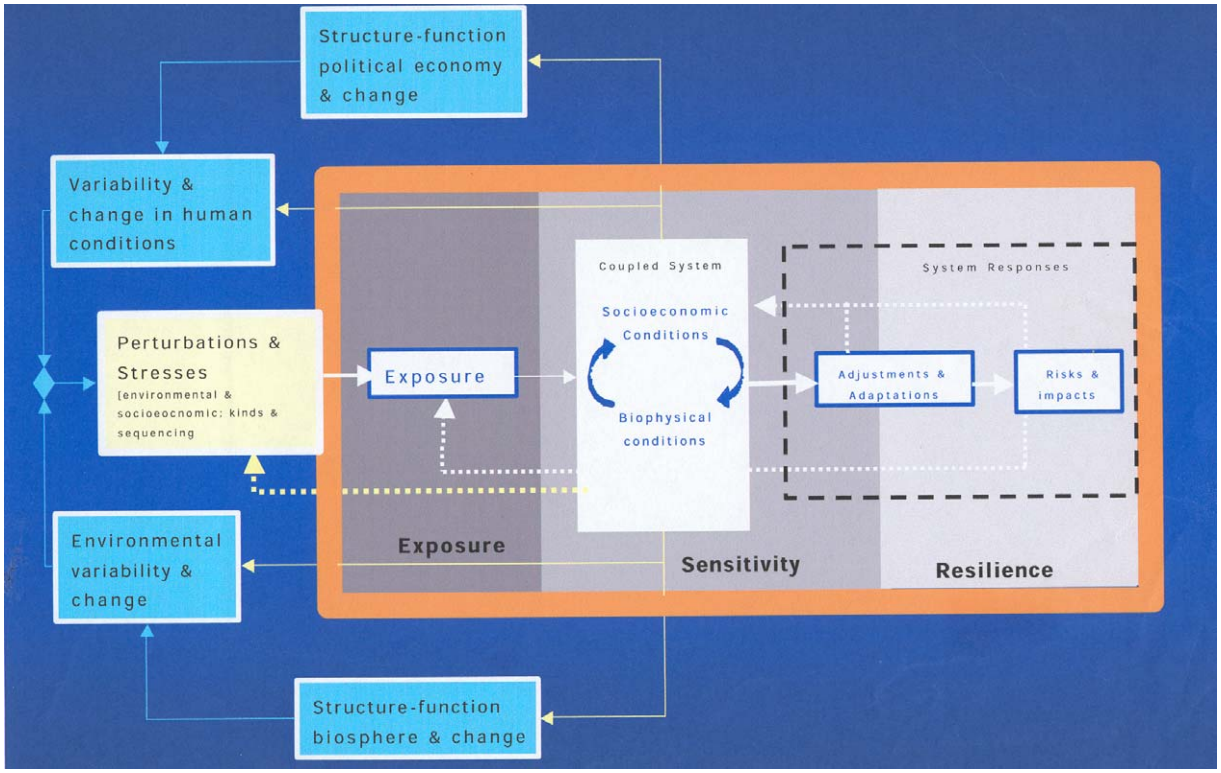

Figure 2: The simplified vulnerability framework: coupled human-environment system and linkages (presented by Roger Kasperson; source is Wonink et al., 2005).

Another comprehensive framework was developed by Lucas and Hilderink (2004). It was used to assess food security on a global scale by combining environmental and socio-economic indicators. The focus on food insecurity as a specific form of vulnerability enables a much simpler analysis framework to be used for analysis (see Figure 3). This framework also has the advantage that it can be applied easily by selecting available indicators that can serve as proxies for the different elements in the framework. However, it leaves out scale-specific issues such as local aspects that might influence vulnerability. This makes it less suitable to pinpoint specific groups or people as the most vulnerable, since it does not deal with local socio-economic and cultural aspects.

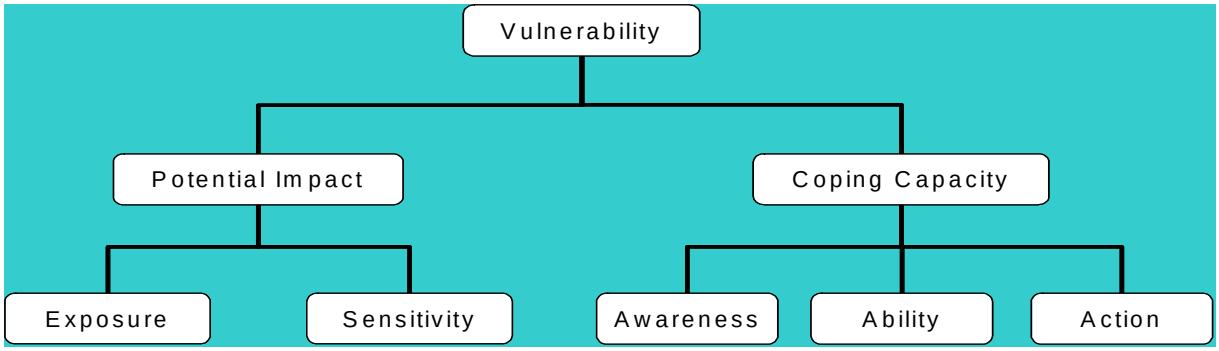

Figure 3: Vulnerability framework developed by Lucas and Hilderink (2004).

An important aspect of vulnerability analysis is that socio-economic and environmental stresses that shape human vulnerability vary among communities and individuals, making human vulnerability inherently different for each community or individual (Vogel and O'Brien, 2004). Vulnerable people tend to be in specific places. Aggregated data masks much of this variation, which is more than pertinent for analyzing human vulnerability to environmental change. Vulnerability analysis should therefore consider human vulnerability as being:

- *Multi-dimensional*. Communities and people can be subject to different stresses at the same time. For instance, climate change and globalisation cause multiple stresses to farmers who face changing weather patterns and a new economic reality (O'Brien and Leichenko, 2000).
- *Scale-dependent*. Factors determining vulnerability operate over different time and space scales. They can be global and take place over a longer period (e.g. climate change or trade liberalisation) or at local or individual level (e.g. lack of entitlement) and take place during the short time scale of extreme events (e.g. earthquakes).
- *Dynamic*. Vulnerability is also a dynamic process. Stresses on the human – environment system are constantly subject to change in response to environmental change and socio-economic developments.

Vulnerability analysis has to be able to deal with these characteristics properly in order to produce relevant results. This poses huge challenges for modelling approaches that start from the global level.

2.2 The syndrome approach

Much vulnerability analysis is only able to include part of the elements of the vulnerability framework as identified by Turner et al. and hence only deals partially with the multi-dimensional and dynamic character of vulnerability, usually not covering different scales. An interesting approach that is able to link sub-global and global analysis is the Syndrome Approach, developed by the German Advisory Council on Global Change (WBGU) and the Potsdam Institute for Climate Impact Research (PIK) (Lüdeke et al., 2004).

The Syndrome Approach looks at non-sustainable patterns of human–environment interaction, and analyzes the dynamics behind them. Differences in the economy, the socio-political regimes, and the natural environment bring about a plurality of human–environment systems. The Syndrome Approach defines a typology of human-environment systems that are non-sustainable. Table 1 presents a catalogue of the syndromes that have been identified by WBGU and PIK.

Table 1 A catalogue of syndromes and their basic characteristics.

Syndrome name	Short description of the mechanism
Utilisation syndromes	
Sahel syndrome	Overcultivation of marginal land
Overexploitation syndrome	Overexploitation of natural ecosystems
Rural exodus syndrome	Environmental degradation due to abandonment of traditional agricultural practices
Dust bowl syndrome	Non-sustainable agro-industrial use of soils and water
Katanga syndrome	Environmental degradation due to depletion of non-renewable resources
Mass tourism syndrome	Development and destruction of nature for recreational ends
Scorched earth syndrome	Environmental destruction due to war and military action
Development syndromes	
Aral sea syndrome	Environmental damage to natural landscapes as a result of large-scale projects
Green revolution syndrome	Environmental degradation due to un-adapted farming methods
Asian tiger syndrome	Disregard for environmental standards in the context of rapid economic growth
Favela syndrome	Environmental degradation due to uncontrolled urban growth
Urban sprawl syndrome	Destruction of landscapes due to planned expansion of urban infrastructure
Disaster syndrome	Singular anthropogenic environmental disasters with long-term impact
Sink syndromes	
High stack syndrome	Environmental degradation as a result of large-scale dispersion of emissions
Waste dumping syndrome	Environmental degradation due to controlled and uncontrolled waste disposal
Contaminated land syndrome	Local contamination of the environment at industrial locations

Lüdeke et al., 2004

The key elements of the approach are:

- *Catalogue of syndromes*: to identify areas where there is a strong sense of un-sustainability (Table 1);
- *Network of interrelations*: to identify processes and mechanisms within a syndrome using a systems analysis approach;

– *Disposition*: to identify under which slowly changing conditions a syndrome can take place (e.g. climate, culture, economic structures, etc.);
– *Intensity*: to assess and indicate where and to what extent a syndrome has taken place in the recent past.

An advantage of the Syndrome Approach is that it is geographically explicit. The topology used to describe the human-environment interaction enables a geographical classification of these systems. Figure 4 shows the geographical distribution of the different syndromes over the world. Syndromes can overlap, which can be seen for example in Asia. The Syndrome approach is well able to identify locations where a combination of indicators point to an unsustainable situation. In doing so, it operationalises the vulnerability approach, making it easier to communicate with for example policy makers about areas at risk. Disadvantages of the approach are that interactions between syndromes, occurring at one place, are not included and that mainly qualitative analyses have been performed. The link between syndromes and policy responses, have furthermore, so far been mainly heuristic.

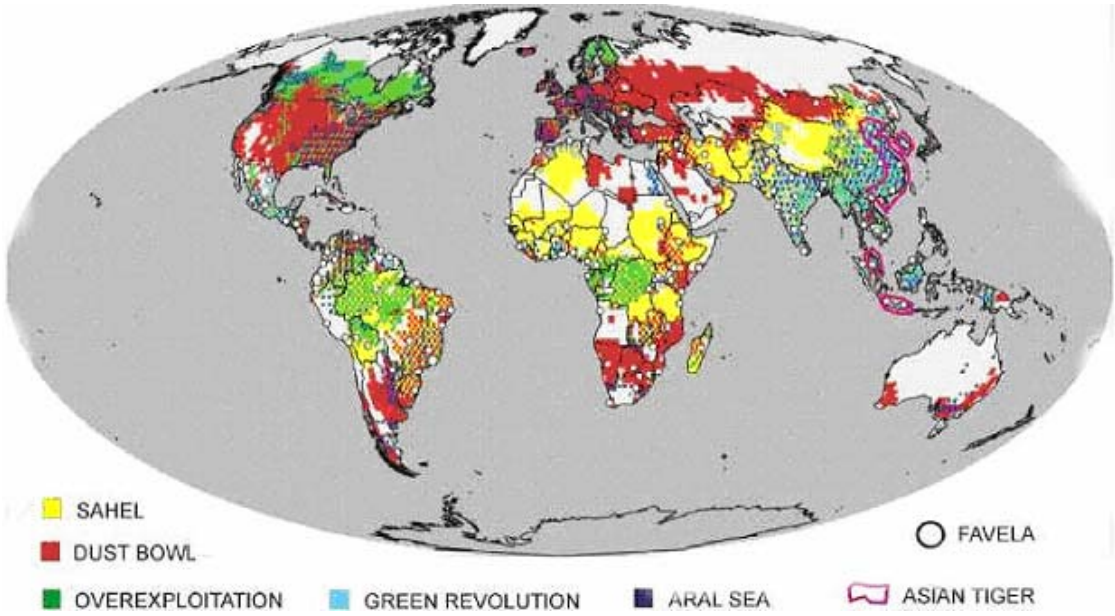

Figure 4: Global distribution of seven syndromes (Lüdeke et al., 2004).

2.3 Archetypes or patterns of vulnerability

The framework used in this report, identifying an archetypical pattern of vulnerability, builds on both the Vulnerability Approach and the Syndrome Approach. The archetype concept is based on the assumption that a certain combination of common characteristics shape human vulnerability in different human-environment systems and locations in a similar manner. This

combination of characteristics constitutes a pattern of vulnerability that threatens the well-being of people or communities in these human-environment systems. The aim of the archetype analysis is to show the vulnerability of human and/or social systems to natural and human-induced stresses. This will enable us to understand what determines this vulnerability, to link that vulnerability to changes in human well-being and to explore policy options for reducing vulnerability of the human-environment system to environmental and socio-economic changes.

An archetype is defined as *a specific, representative pattern of the interactions between environmental change and human well-being* (Jäger, Kok et al., in UNEP, 2007; Jäger and Kok [eds.], forthcoming). Within the diversity of human-environment systems throughout the world, some situations share certain vulnerability-creating conditions. These are broad patterns of vulnerability that can be found in numerous different places around the world, for example, in industrialised and developing regions, and urban and rural areas. The archetypes illustrate the basic processes leading to vulnerability. The archetypes, simplifications of multiple real situations, show the basic processes producing vulnerability within a context of multiple (non-)environmental stressors. This may allow policy makers to recognise their particular situations within a broader context – providing regional perspectives and important connections between regions, and the global context and insights into possible solutions. The patterns of vulnerability are also not mutually exclusive: in some ecosystems, countries, sub-regions, regions and globally, a mosaic of these selected (and other) patterns of vulnerability may exist. This makes policy responses a complex challenge.

The Archetype approach has many similarities to the Syndrome approach, from which the overall approach of looking at ‘patterns’ is largely adapted, but differs in its explicit focus on the (possible) impacts on human well-being in these patterns. By analyzing the vulnerability of human-environment systems to multiple stresses (drivers and pressures), challenges and opportunities for policy making within and beyond the environmental policy domain are identified. The Archetype approach also shows how vulnerabilities are determined by actions elsewhere and shows worldwide interdependencies. It thus reflects the different components of the Turner et al. (2003) framework of vulnerability; these components are depicted in Figures 2 and 3. The Archetype approach combines elements that define the exposure, sensitivity and coping capacity for a particular vulnerable group or community. Added to this framework are aspects of human well-being that are further introduced in Box 1. These aspects of human well-being are used as key indicators for identifying the effects that are attributed to the pattern of vulnerability described in the archetype.

BOX 1 Human well-being

Describing human well-being as representative of quality of life requires a multi-dimensional approach. Broadly speaking there are three broad categories of approaches for well-being (Robeyns, 2004; Gasper, 2004b). These are: (1) Inputs, with emphasis on mostly monetary aspects such as income; (2) Objective well-being: expressed in terms of the various objective aspects of living that are considered to be important, for example, life expectancy, education; and (3) Subjective well-being, expressing how people themselves feel about their lives. In practice, measuring human well-being often comprises a mix of aspects from all three domains. A well-known example is the Human Development Index, which includes leading a long and healthy life, acquiring knowledge and having the financial resources needed for decent standard of living. In this report, we built on the approach of the Millennium Ecosystem Assessment (MEA) (Millennium Ecosystem Assessment, 2005) to operationalise human well-being. The MEA tried to quantify the linkages between ecosystems services to the well-being of groups of people and individuals. Ecosystems services are categorised by provisioning (e.g. food, fresh water), regulating (e.g. climate-, flood- and disease regulation), and cultural (e.g. aesthetic, spiritual, recreational). Their conceptualisation is done through the multidimensional continuum of the two extremes of well-being and poverty. The selection of items is based on the Voices of the Poor studies (Narayan et al., 2000; Brock, 1999).These studies present the views of 60,000 individuals from 60 countries, both from new surveys and a synthesis of some earlier surveys. The following well-being elements are used in the MEA(2005):

- The necessary material for a good life (including secure and adequate livelihoods income and assets, enough food at all times, shelter, furniture, clothing and access to goods);
- Health (including being strong, feeling well and having a healthy physical environment);
- Good social relations (including social cohesion, mutual respect, good gender and family relations, and the ability to help others and provide for children);
- Security (including secure access to natural and other resources, safety of person and possessions, and living in a predictable and controllable environment with security from natural and human-made disasters) and
- Freedom and choice (including possession of control over what happens and ability to achieve what a person values doing or being).

3 Global trade in agricultural products

Here a short overview of trends in the agricultural sector and global trade in agricultural commodities is presented, these being relevant from a vulnerability perspective. This will provide a global context to the analysis of the palm oil case.

In the 20th century, a growing population and economy, changing diets and an increased per capita demand for food products led to a continued intensification and expansion of agricultural land throughout the world. This has enabled agricultural production to keep up with a rapidly growing world population. The world population doubled (from 3 to 6 billion) and food production increased about two-and-a-half times between 1960 and 2000 (MEA, 2005). This has helped to secure food supply for many, although around 800 million people were still undernourished in 2000 (FAO, 2005).

In the developed world growth in production has been achieved by the intensification of production methods. Recently some of the agricultural land has been abandoned, mainly for economic reasons. In developing countries, however, the area under cultivation has grown rapidly (see Figure 5a). This expansion still continues, often at the expense of natural ecosystems. Trade in agricultural products has grown even faster than the increase in production itself; the export has grown as much as tenfold in value in since the 1960s (see Figure 5b) has increased the distance between producers and consumers, thereby making the circumstances of production less visible to consumers (Millstone and Lang, 2003).

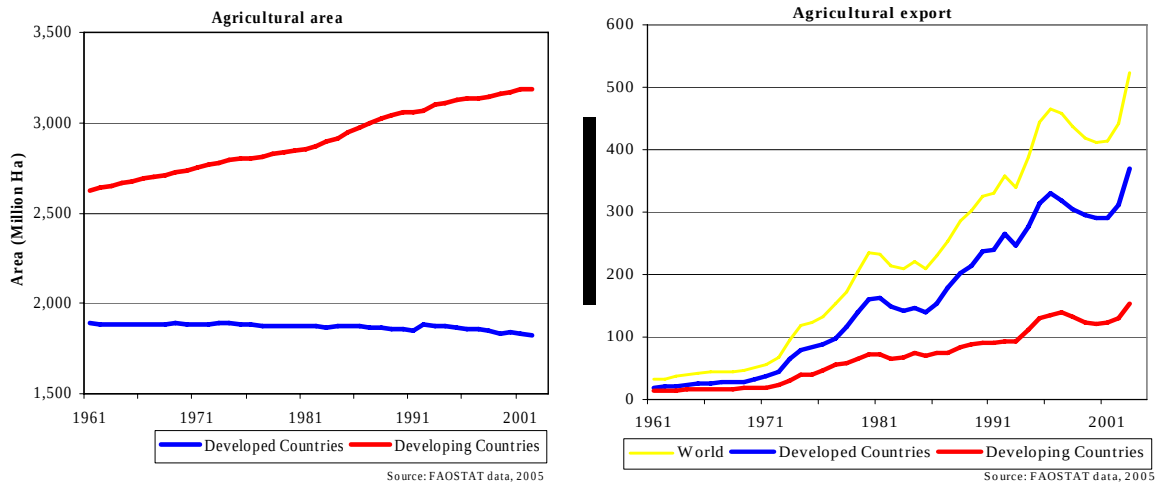

Figure 5: Agricultural area (a) and agricultural exports (b) in developed and developing countries.

The production of crops for export markets has become an important economic activity for many developing countries. Products such as shrimps, soybean, oil palm and wood generate many jobs and large amounts of export revenues. Often it is one of the primary export sectors. For as many as 43 developing countries a single agricultural commodity accounts for

more than 20% of their total revenues from foreign trade (FAO, 2004). Table 2 shows the figures for some African countries.

Table 2 Dependence of African countries on single commodities export (WRI, 2005).

Country	Commodity	Percent share of		
		Gross National Income	Total Merchandise Exports	Total Agricultural Exports
Malawi	Tobacco leaves	23.8	59	74
Sao Tome and Principe	Cocoa beans	16.9	69	97
Burundi	Coffee	7.2	75	83
Kenya	Tea	6.5	26	42
Guinea-Bissau	Cashew nuts	6.3	48	91
Chad	Cotton	5.7	37	71
Ethiopia	Coffee	5.4	62	69
Burkina Faso	Cotton	4.9	39	77

At the same time, the agricultural export sector is also associated with short-term exploitation, paying little attention to the long-term economic impact or interest in the long-term management of natural resources (Dewi et al., 2005). This has resulted in pollution, land degradation and the loss of large areas of natural ecosystems, such as forests and mangroves.

According to FAO, 2006 deforestation continues at a rate of 13 million hectares of forest annually, mostly due to the conversion to agricultural land taking place in developing countries. This loss is partly compensated by forest planting, landscape restoration and natural expansion of forests, making the net change in forest area 7.3 million hectares annually over the 2000–2005 period. The areas with the largest losses are situated mostly in tropical regions (See Figure 6).

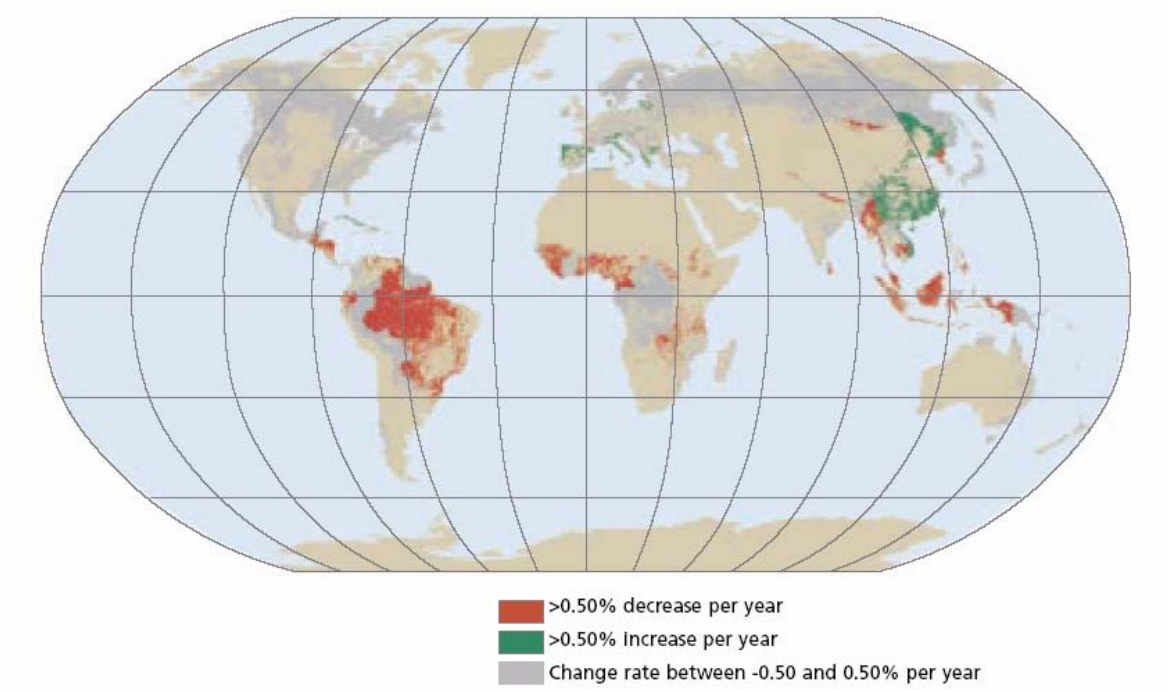

Figure 6: Areas with large net changes in forest area from 2000 to 2005 (FAO, 2006).

Deforestation has major consequences for communities that depend on the ecosystems that are lost or irreversibly damaged. The most vulnerable groups are often the indigenous population who have a direct dependence on ecosystem goods and services for their livelihood. Other communities also retain a significant share of their livelihood base from natural ecosystems. Forest ecosystems, for example, contribute to the livelihood of 90% of the world's 1.2 billion people living in extreme poverty, providing a host of ecosystem service, such as food, fire wood or freshwater (UN Millennium Project, 2005). Conversion of those ecosystems for agricultural, aqua-cultural or forestry use can have enormous consequences on the supply of these services. Without the traditional way to sustain their livelihood, alternatives have to be sought. Consequently, new areas for cash-crop production often cause problems with original users of the natural ecosystems.

A further growth in agricultural production in the near future will be necessary to feed the global population. Population growth is likely to continue well after 2050; around 800 million people do not have sufficient food to meet their daily minimal intake; per capita food consumption and meat consumption will increase as poorer countries become more prosperous; the bio-based economy might become more significant as well as demand for bio-fuels to reduce greenhouse gas emissions. It is very likely that increased agricultural production will be accompanied by an even larger increase in trade in agricultural commodities. Further trade liberalisation in the agricultural sector is also currently being negotiated in the WTO. Developing countries, especially those with a large agricultural potential such as Brazil, are increasing their export earning by tuning their agricultural sector to export markets. This offers many opportunities for developing their rural area and reducing

poverty. However this move to the creation of export markets also requires that the interests of those depending on natural resource are taken into account.

A commodity that provides a poster-child example of the sustainability issues related to agricultural trade, and illustrative for many other agricultural products such as soy and sugar cane, is palm oil. The palm oil case will be further analysed in the following chapter.

4 The example of oil palm expansion in Indonesia

The assumption underpinning the analysis in this report is that an archetypical pattern of vulnerability exists of ‘export (cash-crop)-driven agricultural land-use change that undermines the livelihood of natural ecosystem-dependent communities that do not have sufficient alternatives to overcome the loss of livelihood base and little sharing of the benefits from the resource exploitation’. In response to growing global demand, the area of oil palm plantations is rapidly expanding. This chapter analyses the expansion of palm oil in Indonesia as a case study to explore if such pattern indeed exists and to further analyse the dynamics behind it. It first provides a short introduction to oil palm, followed by an analysis of the drivers behind its expansion on the international and national levels; it next shows the impacts of this expansion on local communities and the environment. Sustainable palm production requires, for example, that both dimensions are taken into account in the further development of oil palm.

4.1 Oil palm

Oil palm is used for many different purposes, as a food additive, cooking oil and also for non-consumption purposes. Recently it also received increasing attention as a bio-fuel. With high oil prices it is becoming an increasingly economically attractive alternative to fossil fuels. It is a plantation crop grown in a number of tropical countries. Oil palm also has advantages over other vegetable oil crops. It has a very high productivity, many times more productive than other crops.

Oil palm is the leading (vegetable) oil traded on the world market, with a share of 46.9% of the global edible oil trade. In production it comes second after soy oil, with a 20.8% share of the world’s oil production (Basiron et al., 2004). Although trade in all other edible oils increased over the past four decades, the share of oil palm increased most significantly, with an average of 9.3% annually (Table 3).

Table 3 Growth of the oil palm trade ('000t).

Oils/fats	1962	% Share	2002	% Share	40-yr Avg. growth p.a. (%)
World oils / fats exports	5 938	-	40 994	-	5.0
Palm oil	547	9.2	19 236	46.9	9.3
Soybean oil	763	12.8	8 986	21.2	6.4
Rapeseed oil	39	0.7	1 278	3.1	9.1
Sunflower oil	246	4.1	2 324	5.7	5.8
Animal oils / fats	2 556	43.0	3 823	9.3	1.0

Basiron et al., 2004

The history of the oil palm sector in Indonesia is one of steady growth over the past 50 years. It was introduced in Indonesia in 1848 by the Dutch during the colonial period (Potter and Lee, 1998). Encouraged by the government in its plans to spur agricultural production and rural development, the production of oil palm really took-off in the 1960s. Production has increased rapidly since this period, making Indonesia currently the second largest producer next to Malaysia. To supply the growing global demand, oil palm plantations are expanding rapidly. This has led to a rapid increase in the area under oil palm production, in the last few decades extending to the less accessible areas and Indonesia's outer islands (see Figure 7).

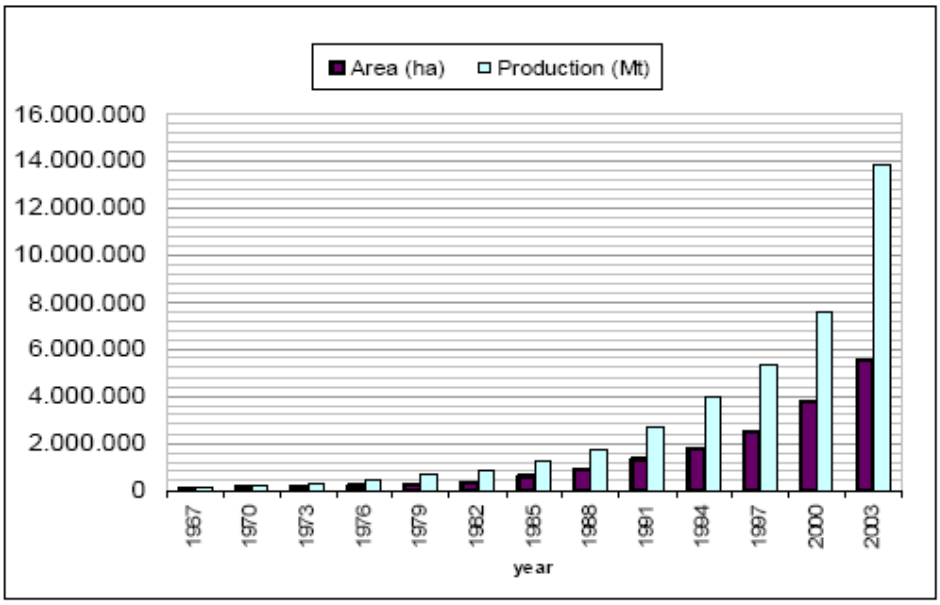

Figure 7: Production of palm oil in Indonesia 1967-2003 (Source: Kessler et al., 2007c).

4.2 Driving forces of oil palm expansion

The driving forces for the expansion of palm oil production can be grouped by global drivers that represent the increased demand for oil palm on the world market, and national drivers, which comprise mainly the (national) government, who anticipate and handle this increased demand by appointing locations where palm oil can be produced.

4.2.1 Global drivers

Some important factors are the driving demand for oil palm on the world market. The growth of population in combination with increased incomes, particularly in developing countries, has pushed up the demand for oil palm, in Indonesia itself but also in countries that do not produce oil palm, such as India, China and the EU (Casson, 1999). World demand for oil palm will continue to grow. It is projected to double before 2020 (growing from 19.2Mt in 2002 to 51.0Mt in 2020), with the bulk of future growth coming from Indonesia (Basiron et al., 2004).

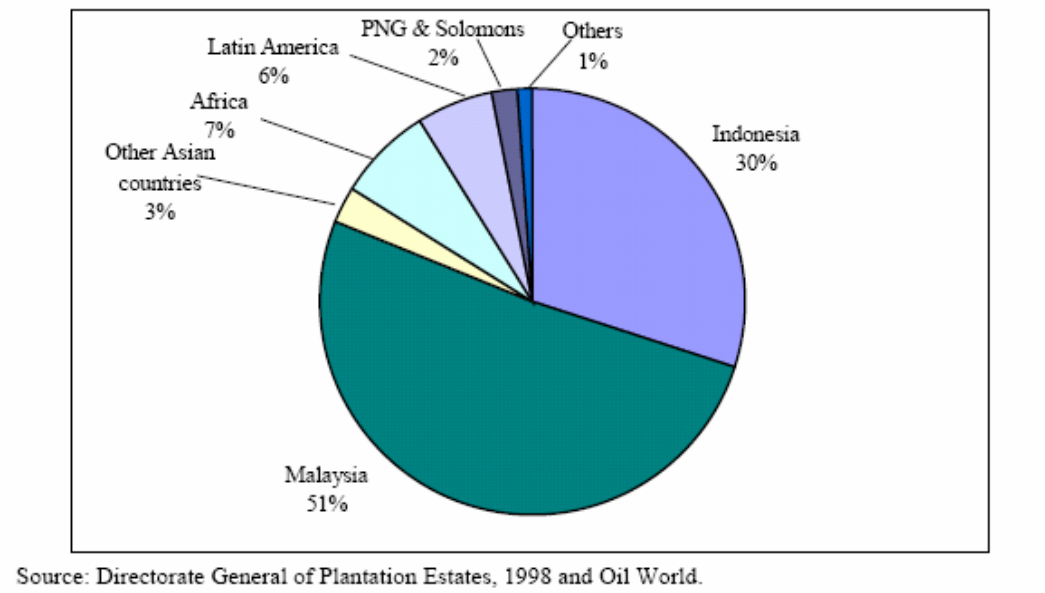

Figure 8: Global production of oil palm in 1997 (Source: Casson, 1999).

An increased consumer preference for oil palm over other vegetable and animal oils also increased demand on the global market (Casson, 1999). More recently bio-fuel use is becoming a new source of demand for oil palm. It is an attractive fuel for countries to meet their Kyoto targets on greenhouse gas emission reductions because as a bio-fuel it can be CO2 neutral. However, this is not the case if the palm oil is produced on peat lands that emit large quantities of carbon when they dry up (Hooijer et al., 2006). With the high prices of fossils fuels, oil palm also becomes attractive for countries wishing to diversify their energy sources. Finally, the rapid growth of oil palm demand compared to other oils can largely be

explained by the low price of oil palm, the cheapest of all vegetable oils. This might change if demand increases.

4.2.2 National drivers

The Indonesian government has always actively encouraged the development of oil palm plantations, as part of a broader agricultural development scheme. Aimed to increase agricultural production - to be more self-sufficient - and reduce rural poverty, it steadily increased the area under agricultural production. For some crops it was very successful, for example, rice. In 30 years Indonesia grew from a rice-importing country to a self-sufficient country. Oil palm is another success story in this respect (Astana, 2004). In 1997 Indonesia supplied 30% of the world oil palm production, second to Malaysia (see Figure 8).

Starting in the 1960s, the expansion of oil palm plantations was one of the government targets. The government facilitated the development of the sector through different approaches. The first approach was the establishment of large state-owned plantations via state-run companies. In the 80s the attention shifted to develop smallholder oil palm plantations. These so-called nucleus plantations were established by private developers, who set up the plantation. After three to four years, the operations were transferred to the smallholders. From 1986 onwards, much of the development was left to the private sector. This is done with government support through credits and new processing facilities (Casson, 1999). Foreign investors were also allowed to invest in the Indonesian oil palm sector, which took place on a large scale (Van Gelder and Wakker, 2006).

The oil palm sector employs many workers, which helps to reduce rural poverty; the sector also brings in foreign revenues. In 1997, the Indonesian oil palm industry employed more than 2 million people (Susila, 2004), which acts as a strong incentive for the Indonesian government to maintain its positive policy towards the oil palm industry and to encourage further development through the establishment of new plantations.

Indonesia still has large areas available where new oil palm plantations can be established. Although the most attractive areas are gradually being exploited, there are still large areas, such as low-lying peat lands which can be converted. This is in contrast to Malaysia, where there is little land left for the development of new oil palm plantations. Indonesia is expected to overtake Malaysia within a few years as the largest exporter of palm oil. In addition, Indonesia also pays its rural labourers low wages, making it the cheapest country in the world for oil palm plantations. See Table 4 for an overview of oil palm production costs in a number of countries, which shows Indonesia’s comparative advantages.

Table 4 Oil palm production costs in different countries (Casson, 1999).

US$ per tonne	Colombia	Cote d'Ivoire	Indonesia	Malaysia	Nigeria	World Average
Establishment	71.2	69.5	64.3	60.7	224.5	72.1
Cultivation	91.2	136.1	72.5	75.7	113.7	79.3
Harvesting/ transport	78.9	33.8	40.2	45.1	90.7	47.3
Milling costs	106.1	105.3	82.6	98.3	130.7	96.6
Kernel milling costs	6.9	7.7	7.2	7.6	8.2	7.5
Kernel oil and meal credits	(58.2)	(54.0)	(60.0)	(61.9)	(65.6)	(61.5)
Total	296.1	298.4	206.2	225.5	502.2	241.6

Source: PT Purimas Sasmita

Government policy is a significant factor driving the developments in the oil palm sector. Policy determines the locations available to oil palm development and provides additional resources through subsidies, for instance, on land clearing. Areas for oil palm development are designated by the Ministry of Forestry, based on a forest classification. A concession is issued to companies for a certain lease period, and often includes the right to clear-cut the area and sell the wood before establishing a plantation. In this way, the government has a primary role in directing development in the oil palm sector. However, many concessions do not actually result in new plantations being started. Concession holders are merely interested in clearing the forest, rather then starting oil plantations; in 2002 reportedly only 7.5% of all concessions resulted in new plantations (De Vries, 2007).

Over the past 40 years (since the implementation of the logging concession policy of 1967) indigenous people were substantially marginalised, where little attention was paid to the importance of natural forests for biodiversity and indigenous peoples. Resettlement programmes, with the purpose of aiding the development of indigenous groups were actually aimed at removing the people from areas valuable in timber and natural resources (King, 1993, citated in Maunati, 2005). The failure recognise the traditional livelihood of indigenous people and the central role played by the forest here, have, led to conflicts over land rights. These conflicts grew violent in the 1990s, when indigenous people protested against the development of new oil palm plantations.

Recent political changes in Indonesia have led to further decentralisation, so that more power is goes to the local authorities in granting concessions. This has shifted much of the authority for issuing concessions to regional governments, eroding the task of the central government, including the Ministry of Forestry, to actively steer these developments. So far it has brought little change in the policy towards the use of natural forest. The lack of enforcement can be added to this. Illegal logging and burning is common, contributing heavily to deforestation

within and outside concession areas. The result is that the impact of oil palm is determined by social, economical and political factors, which are to a certain extent independent from the oil palm production and export but have a strong impact on local communities. For example, concession policies by the government determine how the impact of oil palm expansion is transmitted to local communities. If the government does not take into account the dependence of local communities, it will not make any provision to counter the loss of livelihood.

4.3 Vulnerable communities

The impact of oil palm expansion has direct and indirect effects on the local population. The expansion of oil palm production might undermine the traditional livelihood base and threaten human well-being. We elaborate the following three aspects of human well-being: livelihood, security and conflict, and health.

4.3.1 Livelihood

The conversion of the natural forests is increasingly threatening the traditional livelihood of many indigenous people. Kalimantan forms the most visible case, where many indigenous people (the Dayak) live. On the whole island of Borneo, there are over 400 different tribes, each with its own language and customs (King, 1993, citated in Maunati, 2005). Traditionally their livelihood was based on shifting cultivation, with some tribes relying on hunting and gathering. The lack of clear land rights of the local and indigenous people and the ignorance of the government about their reliance on the forests for their livelihood provide these people with little protection against the ongoing deforestation. However, it is not only indigenous people who depend on forest resources for livelihood. The Ministry of Forestry and Plantations reported that 30 million people depend directly on the forestry sector for their livelihoods (Barber, 2002). According to Colchester et al. (2006) between 60 and 90 million people make a living from state forest areas in Indonesia, with some 5 million people involved in the palm oil sector. However, income in the forestry sector is also under pressure (Diemont et al., 2002).

In the last few years the position of forest-dependent communities has improved to some extent due the decentralisation, giving more autonomy to the regions. These communities were able to regain some of the rights over their forest (Maunati, 2005). The way forest concessions were granted was also changed, enabling local people to benefit more from their forest resources. However, it seems that in practice little has changed, with the effect that small-scale concessions have proliferated, leading to uncontrolled deforestation in some parts (Curran et al., 2004).

Loss of access to forest resources is most profound when plantations are established. Plantations have an additional disadvantage over logging, as noted by (Barber, 2002 cit. Barber 1997): ‘while the impacts of logging concessions on local communities can be quite onerous, people are still able to retain some access to forest resources in the concessions.

Plantations, however, and the clear-cutting that accompanies them, impose a much greater level of deprivation on communities who depend on the forest areas in question for livelihood resources.'

To compensate for the loss of forest resources, other types of economic activity have to be undertaken. Some of the local people have the possibility of becoming a labourer for enterprises and logging firms on rubber and oil palm plantations (Maunati, 2005). However, plantation labourers are often migrants from Indonesia's main islands who have moved to the newly developed plantations as part of the transmigration programme or do it independently in search of work. Other plantation workers are former smallholders who were unable to make a living from their own farming activities, and these include indigenous people. The first group is generally preferred by the plantation owner, especially to indigenous people. For those unable to find a secure alternative source of income, their livelihoods become much more vulnerable since there are no forest resources left to fall back on.

4.3.2 Security and conflict

Meeting basic material needs is an important prerequisite for security. Loss of communal forests reduces the number of ecosystem services available to people who depend on these forests for their traditional livelihood. However, income generated by oil palm also helps to support people in attaining their basic needs.

Changes in traditional livelihood can generate a feeling of insecurity, as traditional social structures breakdown and disappear. This is aggravated by the inflow of migrants from other parts of the country that accompany the arrival of newly developed oil palm plantations. This can lead to conflict between the local and migrant population, affecting the feeling of security of both. The development of new plantations and competition over forest resources has led to many conflicts over land rights and the use of communal forests (See Box 2). Since the resignation of President Suharto in May 1998, there has been a marked increase in social unrest in and around oil palm plantations. This has resulted in the consequent withdrawal and withholding of foreign investment (Casson, 1999). Table 5 provides an overview of conflicts attributed to palm oil.

Box 2 Conflicts related to oil palm plantations

The following pattern is reported by many on the conflicts surrounding the development of oil palm plantations on forest lands in Sumatra and Kalimantan. (1) Land to which local communities have longstanding claims (land often cultivated with tree crops or land harvesting non-timber forest products) are allocated to a company without consultation with the community. (2) People protest to the company and local officials, and often the company makes promises of compensation, participation in the plantation scheme, or other enticements. (3) The company does not keep its promises and the community again protests to local government and company officials. (4) Nothing is done to meet their demands, and local people take action, destroying or confiscating equipment and vehicles, occupying base camps, preventing plantation staff from working, and the like. (5) The company hires local police or military to retaliate, and more violence ensues (Barber, 2002).

Table 5 Oil palm conflicts by province 1990-2006.

	Area in conflict (ha)	Number of conflicts	Involved communities	Involved private palm oil companies	Involved state owned companies
Indonesia	**676 871**	**188**	**406**	**112**	**5**
North Sumatra – 'established'	5 732	18	24	9	1
Lampung	n/a	n/a	n/a	n/a	n/a
South Sumatra	166 884	51	170	34	1
Jambi	17 714	34	87	22	1
Sumatra 'expansion' region	**184 598**	**85**	**257**	**56**	**2**
West Kalimantan – 'frontier'	1 220	14	12	5	0
All selected provinces	**191 550**	**117**	**293**	**70**	**3**

Source: Kessler et al., 2007c

4.3.3 Health

Where basic human needs can not be met, health is under threat through malnutrition and poor health care. There is also a direct link between health and oil palm plantation, namely directly via the environment. The establishment of plantations is a major source of soil erosion and land degradation. This affects the water quality in the area. Exposure to

pesticides used on plantations is also a health risk for those who come into contact with it. Another health threat, partly to blame on the oil palm plantations, is the air pollution caused by forest fires. During September to November 1997 forest fires, which were very severe then, 527 deaths could be attributed to forest fires (very severe then); this was also valid for a large number of illnesses (Table 6).

Table 6 Health effects of forest fires (Barber and Schweithelm, 2000).

Health effects	Number of cases
Death	527
Asthma	298 125
Bronchitis	58 095
Acute respiratory infection (ARI)	1 446 120
Daily activity constraint (no. of days)	4 758 600
Increase in outpatient treatments	36 462
Increase in hospitalizations	15 822
Lost work days	2 446 352

Note: The provinces studied were Riau, West Sumatra, Jambi, South Sumatra, West Kalimantan, Central Kalimantan, South Kalimantan and East Kalimantan

Source: State Ministry for Environment and UNDP, 1998

4.4 The impact of oil palm expansion on the environment

The environmental consequences from oil palm plantations are primarily related to deforestation and biodiversity loss. Most of the oil palm plantation areas came from the conversion of natural forests (Kartidihardjo and Supriono, 1999, citated in Barber, 2002). Even if development of oil palm plantations is not taking place in natural forest areas – and therefore not directly contributing to deforestation –the increased demand for land will inevitably lead to further deforestation. Table 5 shows the extent of deforestation in different parts of Indonesia.

Table 7 Deforestation in Indonesia, 1985-1997.

	1985		1997		Deforestation		
	Forest	% total land area	Forest	% total land area	Decrease 1985-97	% loss	Ha/year
Sumatra	23 324 000	49%	16 632 000	35%	6 691 000	29%	558 000
Kalimantan	39 986 000	75%	31 512 000	60%	8 474 000	21%	706 000
Sulawesi	11 269 000	61%	9 000 000	49%	2 269 000	20%	189 000
Maluku *	6 348 000	81%	[>5 544 000]	?	>800 000	13%	67 000
Irian Jaya	34 958 000	84%	33 160 000	81%	1 798 000	5%	150 000
Total	115 885 000	68.5%	Ca.95 848 000	57%	20 505 000	17%	1 709 000

data for Maluku are preliminary

Source: World Bank, 2000. 'Deforestation in Indonesia: a review of the situation in 1999' Draft, Jakarta, May 5.

For example, lowland protected areas in West Kalimantan decreased by 63% from 1985 to 2001 primarily through logging. Although this is not done to create oil palm plantation, (Curran et al., 2004) found that the establishment of oil palm plantations outside the protected areas to increase the pressure on these areas.

Deforestation is an important cause of biodiversity loss and habitats destruction for many species. Many of the natural forests have become fragmented, reducing the ability to sustain a high level of biodiversity. Indonesia has a very high biodiversity, with many endemic species. It possesses about 10%of the world's flowering plant species, 12 % of the world's mammals, 17 % of all reptile and amphibian species, and 17% of all birds (Barber, 2002). Habitat loss is threatening many species with extinction (Figure 9). The orang-utan is one of these threatened species and the most visible symbol to the broader public.

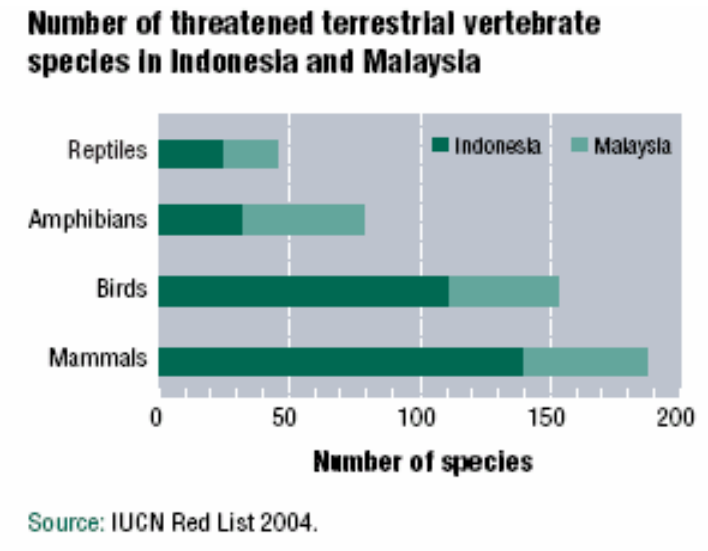

Figure 9: Threatened species (Brown and Jacobson, 2005).

Deforestation also causes soil erosion. This is particularly obvious directly after clear-cutting, when the soil is little protected by vegetation. The fertile topsoil is washed away, causing eutrophication of rivers and coastal areas. In addition to sediments washed into the river, other damaging substances from the plantation pollute the environment and the rivers. These include pesticides and crop residues originating from oil palm production.

Furthermore, the clearing of forest land leads to the emission of greenhouse gases. Carbon stored in the form of biomass in natural forests (above as well as below ground) is released when the vegetation is cleared. The planting of oil palm trees only partly compensates these losses. Greenhouse gas emissions are worsened when the land is cleared using fire. Part of the topsoil is also burned, especially when the subsurface consists of peat (Sargeant, 2001). A study of Wetlands International (Hooijer et al., 2006) shows an annual occurrence of 600 million tons of CO_2 and 1.4 billion ton from fires to clear the land. Peat fires smoulder for a long time, emitting large quantities of carbon into the atmosphere. Oil palm expansion has been held partly responsible for the 1997-98 forest fires that affected large areas in Indonesia (Casson, 1999). This resulted in smoke hazes for months, causing problems in nearby countries.

Box 3 Improving the sustainability of palm oil

Environmental and social problems associated with oil palm expansion have raised concern about its sustainability, in particularly voiced through international NGOs and local human rights and environmental groups, such as WWF and Friends of the Earth, see e.g. Wakker, (2005), Colchester et al. (2006), Forest People Programme and Sawitwatch (2006). The habitat loss '[[of orang-utans has become a prominent symbol in their campaigns to raise public awareness. NGOs have put pressure on investors and multinational by publicly linking them to the oil palm industry (see, for example, Van Gelder, 2001).

The establishment of the Roundtable on Sustainable Oil palm (www.sustainable-palmoil.org) bringing together different stakeholder in the oil palm industry and social and environmental groups, is one example through which the oil palm sector tries to move to a more sustainable production. RSPO has a membership throughout the palm oil sector and covers about 1/3 of the production and consumption chain The RSPO has developed a set of principles and criteria for sustainable palm oil production, some directly related to local communities:

Criterion 2.1 There is compliance with all applicable local, national and ratified international laws and regulations.

Criterion 2.2 The right to use the land can be demonstrated and is not legitimately contested by local communities with demonstrable rights.

Criterion 2.3 Use of the land for the oil palm does not diminish the legal or customary rights of other users without their free, prior and informed consent.

Criterion 7.5 No new plantings are established on local peoples' land without their free, prior and informed consent, dealt with through a documented system that enables indigenous people, local communities and other stakeholders to express their views through their own representative institutions.

Criterion 7.6 Local people are compensated for any agreed land acquisitions and relinquishment of rights, subject to free, prior and informed consent and negotiated agreements

5 Formalising the pattern of vulnerability

The previous chapter analysed the vulnerability of the local population caused by the growing demand for oil palm. The analysis in the previous chapter linked the growing demand for palm oil through an expansion of the oil palm plantations and deforestation to the vulnerability of forest-ecosystem dependent communities. Although the example elaborated is geographically limited to one country, the pattern assumed is not. Expansion of agricultural land is taking place in many other parts of the world and for the production of many other crops, e.g. soy in Brazil. Global developments in the agricultural sector, described in chapter 3, are important drivers of this expansion. The pattern of vulnerability will be formalised according to the analysis in chapter 4. This is done as a step towards analysing this archetypical pattern more broadly to include different types of crops worldwide.

Three important processes stand out in the analysis of oil palm. The first is deforestation, although deforestation is not only happening because of demand for oil palm. Growing demand for oil palm drives to some extend deforestation and the conversion of natural ecosystems into oil palm plantations. Logging itself is also a profitable business and permits for palm oil plantations are used to clear the forest, without ever starting the actual oil palm plantation. The second important process is the negative effect of the clearing and conversion of natural ecosystems (into oil palm plantations), affecting the human well-being of forest-dependent people. It is, however, also obvious that neither is linked one on one. The main question is to what extent they are linked, and how much of the observed socio-economic developments can be attributed to the growing export in oil palm. The third important process is the role of intermediate factors influencing the outcome in terms of impact on human well-being and the environment. Obviously, there are other important processes taking place between growing demand for oil palm and the impact of vulnerable communities (as is shown in Figure 10).

The pattern distinguishes between dynamics on the global, country and local level. On the global level, population growth, economic development, dietary changes and the emerging bio-energy market determine the growing demand for oil palm. Global demand and favourable national conditions result in the increasing foreign demand for Indonesian oil palm.

At the country level, national conditions mediate between global demand and local impact. Government policy determines the locations available for oil palm plantations and the level of attention paid to local communities in the selection process on the rights indigenous communities have over the land they use. As important is the role of maintaining the rule of law in the face of illegal activities. Much of the deforestation in Indonesia takes place illegally. In this respect, formal and informal institutions play an important role. International standards for palm oil production and trade will also come into play at this level. Best practices are being developed for sustainable palm oil production by the Roundtable on

Sustainable Palm Oil (RSPO). Compliance and verification to these standards is an issue of major concern for the RSPO (see also Box 3).

Colchester et al. (2006) concludes on the basis of six extensive case studies that indeed the rights from indigenous people are indeed being violated for the development of palm oil plantations in Indonesia. This also results from contradictory laws that fail to secure indigenous rights, while encouraging land expropriation for commercial projects in the national interest; an absence of regulations that recognise the collective land rights of customary law communities and weak institutional capacities nationally and sub-nationally that hinder recognition of customary rights and national and regional policies and spatial planning.

The local level is where the impact of growing oil palm demand is felt by vulnerable groups through the expansion of oil palm plantations. At this level it is felt that deforestation results in the loss of ecosystem goods and services. This endangers the livelihood base of ecosystem dependent communities, and threatens their well-being. In figure 10, the local level is analysed using the three elements that determine vulnerability. Deforestation is in this way regarded as an exposure on the livelihood of the affected communities. The extent of the impact of this exposure depends on the reliance of the affected ecosystems (sensitivity) and their ability to cope with the loss. The latter is determined by the coping capacity, which ranges from migration, the ability of switching to alternative sources of livelihood or to conduct more sustainable management practices of both forests and palm oil. This would include being part of the value-added in the production chain (UN Energy, 2007). The coping capacity is also influenced by national drivers, and through government policy or economic opportunities. The combination of the three elements finally determines the vulnerability and well-being impacts of forest-dependent people to the growing demand for oil palm.

The intermediate factors are situated mainly at the country level. Here government policy is designed and enforced for oil palm and (sustainable) natural resource management. Other policies too are designed at this level; these can have a large impact on the vulnerability of people, e.g. socio-economic policy or policies towards minorities. With this in mind, the question of what determines the marginalisation of indigenous people should be assessed.

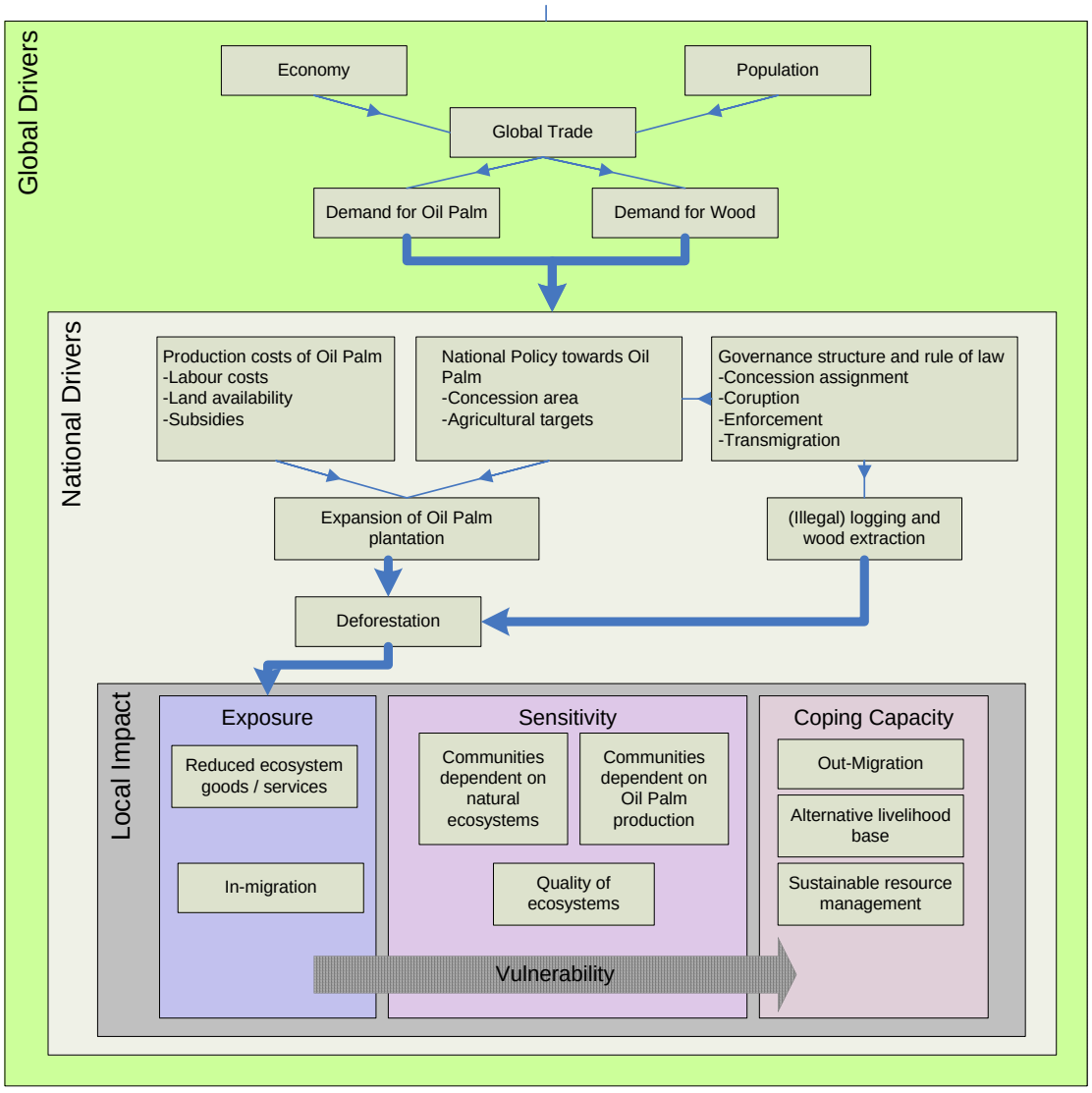

Figure 10: Pattern of vulnerability for oil palm expansion.

6 Discussion and conclusions

Vulnerabilities related to agricultural expansion driven by growing global demand have been analysed here. Focusing on oil palm in Indonesia, a pattern of vulnerability in which well-being of ecosystem-dependent communities deteriorates as a consequence of the production and export of oil palm is shown in a qualitative and semi-quantitative way and further formalised. The utilisation of environmental resources can bring great benefits to local communities and to a country as a whole by contributing to economic development. However, the way they are utilised determines 'if' and 'to whom' the resource brings benefits. That the utilisation of environmental resources for oil palm plantation brings few benefits to local communities can not simply be attributed to oil palm itself. Corruption, lack of legal enforcement, lack of land rights, discrimination against indigenous people and the tendency to focus on rapid profit from clear cutting are in many ways part of and perhaps even overriding the vulnerability creating pattern of oil palm plantation expansion. This does not mean that oil palm expansion does not contribute to undermining the livelihood and well-being of those communities affected, as it clearly does. However, these effects are also symptoms of a structural vulnerability based on socio-economic conditions that already exist.

This analysis is also relevant for other agricultural commodities that are expanding rapidly in response to growing global demand. These crops are, for example, soybean, coffee and other bio-energy crops such as sugar cane. The case of palm oil has been illustrative and can be done in a similar fashion for other crops. At the same time, analysis of other crops will help to further define and formalise this pattern of vulnerability. It will also help to show that many of these mechanisms are common throughout the world and an integral part of the current agricultural sector. This similarity is also recognised in the work of Kessler et al. (2005, 2007a and b), where a comparison was made between the socio-economic impact of different crops in a number of developing countries. Using the vulnerability concept (exposure, sensitivity and coping capacity) to describe the pattern of vulnerability linked to production of oil palm has proven to be useful. Especially the multi-scale characteristics (from global to local) are without a doubt present in this pattern.

A next step would be to identify a limited set of indicators to analyse the pattern and see in which typical ways this pattern of vulnerability manifests itself, and how these patterns may evolve over time under different scenarios. While doing this, it will be necessary to further explore possible policy options that reduce vulnerability and at the same time managing ecosystem goods and services in a sustainable manner. The exploration of this (and other) archetypes can be done making use of simulation models. These simulations models are especially useful in analysing future trends of these patterns of vulnerability. The Global Integrated Sustainability Model (GISMO) is currently being developed at MNP. GISMO is making use of existing simulation models on population and health, economy, energy and land use. The main purpose of GISMO is to analyze the distribution and continuation of

human well-being, based on the outcomes of these simulation models and exploring how policy interventions will influence well-being.

The importance of considering the intermediate factors on the national level in explaining vulnerability is an important lesson from the analysis of palm oil. If this is neglected there will be no clear understanding of the way in which vulnerability is shaped at the local level – also the level at which many policy responses are possible to realizing sustainable land use, including reducing the vulnerability of local people – but also a whole set of other issues that are relevant from a sustainability perspective. Further work could therefore focus on the intermediate factors between global drivers and global policies, and the local level. It will, for example, be relevant to see to what consequences the implementation of RSPO-standards will have for smallholders and the indigenous population. This is because Western governments rely increasingly on mechanisms such as the RSPO to make production chains more sustainable, but is usually not included in current (modelling) efforts. The incorporation of governance, institutions and social structures will help to improve the understanding of human vulnerability. The challenge for MNP modelling efforts such as the GISMO model will be to better understand how these links work in reality, as well as getting the data to support this.

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