



STRATEGY
& CHANGE

THE GLOBAL RESOURCE NEXUS

IMPACT ON SUSTAINABLE SECURITY
OF SUPPLY OF AGRI-FOOD IMPORTS
FOR THE NETHERLANDS

THE HAGUE CENTRE FOR STRATEGIC STUDIES AND TNO





TNO

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Cover image: workers at a cacao plantation remove the flesh covered seeds
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TNO and The Hague Centre for Strategic Studies (HCSS) program Strategy & Change analyzes global trends in a dynamic world affecting the foundations of our security, welfare, and well-being.

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MANAGEMENT SUMMARY

Supply and demand of resources are connected in multiple and complex ways. This interconnectivity has been framed as the global resource nexus and can conceivably include all types of resources. This study focuses on the nexus of five essential natural resources: land, food, energy, water, and minerals. Together they serve as a direct or functional input in the production process of many other resources. In order to meet the demand for resources from present and future generations, strategic thinking about interdependencies between the supply of and demand for resources is paramount.

OBJECTIVES

The goals of this report are twofold. First, it aims to provide insight into the complex interplay and trade-offs between land, water, food, energy, and minerals, and the challenges related to this interconnectivity. The nexus approach presented in this report aims to explain the interaction between resource supply and demand, global megatrends such as economic growth, climate change, urbanization and demographics, and broader nexus variables such as human resources, technology, governance, social and political factors and instability.

Second, the report aims to demonstrate the relevance of the global resource nexus to policymakers. The global resource nexus creates economic, social, and environmental impacts that are first and foremost felt in areas geographically remote from the Netherlands. Nonetheless, this is of relevance to the Netherlands, as it creates various risks to the sustainable security of supply of resources. To illustrate this, the report contains three case studies on agricultural commodities that are of high importance to the Dutch agri-food sector.

The results of this research can be used to strengthen existing initiatives for sustainable supply chain management, and to facilitate policy making in this field. To this end, the report contains a chapter with recommendations on how policymakers can use the global resource nexus framework proposed in this report.

METHOD

We first conducted a literature review, analyzing existing approaches to the global resource nexus. This helped shape our understanding of the nature of the relationships between various resources, global megatrends and other intervening variables, as well as the impact of their interaction on supply and demand. We then developed our own definition and visualization of the global resource nexus.

Next, we applied the global resource nexus approach to three major agri-food streams on which the Netherlands is import dependent: soy, cocoa and palm oil. The impact of the nexus on the supply of these commodities to the Netherlands was analyzed in three cases that focus on Brazil, Côte d'Ivoire, and Malaysia, the top supplier countries of soy, cocoa, and palm oil to the Netherlands respectively. For the analysis we combined quantitative and qualitative data drawn from public secondary sources.

THE GLOBAL RESOURCE NEXUS

We define the global resource nexus as the complex system of interdependencies and feedback loops between:

- 1) The supply and demand of five resources (water, energy, food, land, and minerals)
- 2) The four global megatrends that drive supply and demand of resources (urbanization, climate change, economic growth, and population growth)
- 3) The risks and opportunities that these trends generate
- 4) The wider nexus variables, such as human resources, technology, governance, social and political factors, and instability.

The goal of our conceptualization of the resource nexus is to capture its complexity, whilst remaining sufficiently practical to effectively define the next steps for actionable policy making.

The dynamics of the global resource nexus are likely to create some serious economic, social, political, and environmental challenges in the future. Interdependencies between resources may create several immediate pressing security-of-supply problems, such as ensuring enough food and safe drinking water for a growing population and ensuring water, land, energy, and minerals for agriculture and economic development. Volatility, and physical and relative scarcity of resources may also create competition and instability, and in the worst case, conflict. Bad governance, political and social instability may in turn contribute to resource scarcity and supply insecurity.

SUSTAINABLE SECURITY OF SUPPLY

The global resource nexus approach can be used to analyze risks to the sustainable security of supply of agricultural commodities that are of strategic relevance to the Netherlands. Soy, cocoa, and palm oil are widely used in the Dutch agri-food sector. The Netherlands is almost fully import dependent on these commodities, for which only limited substitutes and domestic sourcing options within the EU exist. This leaves the Netherlands vulnerable to risks associated with developments in the global markets for soy, cocoa and palm oil, such as increased competition over supply. In addition, sustainable security of supply is undermined by various economic, social, and environmental risks that may be influenced by the dynamics of the global resource nexus. Sustainable security of supply goes beyond the objective of merely securing sufficient resources to safeguard economic performance. The interaction effects and feedback loops between different resources mean that securing resources will require environmental and community stewardship.

SOY PRODUCTION IN BRAZIL

The dynamics of the global resource nexus affect the sustainable supply of soy from Brazil to the Netherlands. Brazil is the world's largest supplier of soybeans, one of the world's top agricultural commodities used in animal feed and a variety of manufacturing processes. Worldwide demand for soy is likely to increase as the global population grows and becomes wealthier, and meat consumption increases. This constant pressure on the resources required for soy bean production is likely to keep giving rise to social tensions and weakening of local ecosystems, which are important to tackling climate change globally. In this light, it is a positive development

that the Brazilian government and other international actors are initiating actions aimed at improving the environmental and social impact of Brazilian soy production.

COCOA PRODUCTION IN CÔTE D'IVOIRE

The nexus dynamics of cocoa production in Côte d'Ivoire are highly relevant for the Netherlands, as cocoa is an important ingredient for the Dutch chocolate industry and Côte d'Ivoire the largest cocoa supplier to the Netherlands. Global economic development and population growth contribute to an increase in global demand for cocoa. This encourages cocoa production in Côte d'Ivoire, but also increases demand for other resources, mainly land and minerals. Production is however undermined by political and social issues, such as bad governance, population pressure, conflict, and instability. The economic, social, and environmental problems of the cocoa sector in Côte d'Ivoire are likely to impact Dutch supply security in terms of price, volume, and quality. Since Côte d'Ivoire is not a priority country for the Netherlands in terms of diplomatic relations, the Dutch government has relatively few political instruments to address the problems in the cocoa supply chain and thus relies on public-private partnerships and civil society initiatives.

PALM OIL PRODUCTION IN MALAYSIA

Malaysia is among the world's biggest suppliers of palm oil, and the biggest supplier to the Netherlands. Economic development and population growth are likely to cause a sharp increase in the demand for palm oil. This implies increased competition for the Netherlands over supply. It also entails and increased demand for other resources that are necessary for palm oil production, which may add to environmental stress and social issues. Palm oil demand from the West may level off due to concerns about the health effects of palm oil in food, the controversy about biofuels, and the environmental costs associated with palm oil production. Having said this, palm oil is likely to remain one of the major global agri-food commodities and demand from emerging economies is expected to stay high. Their priorities lie with spurring economic development and lifting populations out of poverty and less with health effects and sustainability. This means that pressure caused by palm oil production in Malaysia on ecosystems, local communities, and human rights remain a concern for the Dutch sustainable security of supply.

POLICY MAKING

In light of the impact and urgency of these challenges, it is imperative to understand the interaction effects between supply and demand of different resources, to analyze the impact of the nexus, and build policy accordingly to promoting sustainable supply chain management. The Netherlands has become an international frontrunner on sustainable agricultural supply chains, including soy, cocoa, and palm oil. The Dutch approach shows an intense collaboration between public and private stakeholders, contributing to long-term change and improvements. The Dutch government takes mostly a facilitating and supporting role. The global resource nexus approach developed in this report can be used by the Dutch government to more proactively identify priorities for policy making with respect to a sustainable security of supply for the Netherlands.

We propose a strategy to systematically assess the effects of the nexus and of mitigating actions. This strategy can be conceptualized as a pyramid and consists of the six steps to be executed in sequence, partly in parallel and iteratively. These steps illustrate a practical way to apply the global resource nexus framework to methodical, effective policy making. It can be used on its own as a tool to support qualitative analysis and systematic thinking about the impacts of resource related trends and policy initiatives, or it can be complemented with quantitative assessment tools, such as exploratory system dynamics modelling and analysis (ESDMA), and a criticality index. The global resource nexus framework is also instrumental to policymakers in their efforts to promote sustainable resource management in international dialogue platforms, and contribute to an international database of existing and new policy initiatives that aim to address the challenges of the global resource nexus. The next step is to further develop this strategy and test it in practice in a pilot case.

1 INTRODUCTION

Resource supply and demand are impacted by a variety of factors. Global megatrends, such as economic development, population growth, and urbanization contribute to a growing demand for land, food, energy, water, and minerals. Other trends may relieve demand and boost supply, such as technological breakthroughs and innovations that increase resource efficiency. Sustainable alternatives or lifestyle choices may also temper demand for resources, whilst extreme weather or climate events may create additional stresses by causing temporary shortfalls.

The supply and demand of resources are connected in multiple and complex ways. This interconnectivity has been conceived as the global resource nexus and can conceivably include all types of resources. This study focuses on the nexus of five essential natural resources: land, food, energy, water, and minerals. Together they serve as a direct or functional input in the production process of many other resources.

The concept of the global resource nexus highlights that demand and supply of one resource are linked to demand and supply of others. This means that policy measures aimed at one aspect of the nexus carry consequences for others. For example, insights on the use of biofuels (see text box) show that understanding interrelations between resources is crucial to avoiding unintended consequences of policy interventions.

THE RISE AND DEMISE OF BIOFUELS

Worldwide concerns about global warming led to a globally agreed objective to reduce greenhouse gas emissions and fossil fuel use and countries set ambitious targets for switching to biofuels. EU member states agreed that 10% of transportation fuel must come from biofuel or

other renewable energy sources by 2020.¹ Biodiesel production in OECD countries increased by 92% between 2000-2010.² Biofuels were considered an environmentally friendly practice and biofuel programs were heavily subsidized. As a result large swaths of agricultural land were transformed into land for biofuel crop production. The boom contributed to a steep increase in the non-food demand for crops like soy and corn, and between 2007-2009 biofuels accounted for 20% of the global use of sugar cane, 9% for both oilseeds and coarse grains, and 4% for sugar beet.³

However, in the years that followed it became apparent that the promotion of biofuels had a negative effect on food security. The IMF and the World Bank assessed that 70%-75% of the increase in food prices during the global food crises of 2008 could be attributed to a growing demand for biofuels.⁴ As a consequence, many countries are now reversing their biofuel policies. Although the pressure on food availability from biofuels is lessening as the environmental benefits and mandatory blending of fossil fuels with biofuels are debated in the EU and US, global production of biofuels is, however, still expected to rise in the coming years.⁵

BOX 1 THE ENERGY-FOOD NEXUS AND THE UNINTENDED CONSEQUENCES OF BIOFUELS

In order to meet the demand for resources from present and future generations, strategic thinking about interdependencies between the supply of and demand for resources is paramount. Production, trade, and use of natural resources affect the resilience of our economy, society, and environment, and have at times caused problems ranging from:

- 1) **Economic problems** related to the availability, accessibility, or price of resources;
- 2) **Social problems** surrounding the production of resources, such as human rights issues, exploitation, and poverty;
- 3) **Environmental problems** caused by the production of resources, such as pollution, loss of biodiversity, etc.

Through corporate social responsibility (CSR) and sustainable supply chain management – centered on the three pillars of ‘people’, ‘planet’, and ‘profit’ – governments, businesses and knowledge institutes aim to mitigate these negative impacts of resource production and consumption.

The global resource nexus of land, food, energy, water, and minerals creates real challenges for Dutch interests, and addressing these challenges creates opportunities for international cooperation, out-of-the-box thinking, and technological innovation. Understanding of the global resource nexus can support policymakers and companies alike to develop strategies for the sustainable production, trade, and use of resources, and to avoid harmful economic, social and environmental consequences. Awareness of the interdependencies between resources is also necessary for recognizing the early warning signals of emerging problems triggered by supply and demand dynamics. The ability to interpret these signals aids the formulation of robust policy initiatives and governance strategies aimed at sustainable supply chain management.

1.1 OBJECTIVE

The goals of this report are twofold. First, it aims to provide insight into the complex interplay and trade-offs between land, water, food, energy, and minerals, and the challenges related to this interconnectivity. In addition, the nexus approach presented in this report highlights both the risks and opportunities created by economic growth, climate change, urbanization and demographics, as well as the interaction between them. This approach also aims to explain the interaction between resource supply and demand, human resources, technology, governance, social and political factors and instability.

Second, the report aims to demonstrate the relevance of the global resource nexus to policymakers with respect to the sustainable supply security of agri-food imports for the Netherlands. Resource supply and demand creates economic, social, and environmental impacts that are first and foremost felt in areas geographically remote from the Netherlands. Nonetheless, the global resource nexus is of relevance to the Netherlands, as it creates various risks that stand to undermine the long-term supply of resources. It also reveals a need for prolonged, multi-stakeholder efforts aimed at a more sustainable production of resources that are vital to the

Dutch economy. To illustrate this, the report contains three case studies on agricultural commodities that are of high importance to the Dutch agri-food sector.

By conceptualizing sustainable supply security in terms of people, planet, and profit, and by raising awareness about the urgency of sustainable supply chain management, this report fits well with the Dutch government's commitments to international development, the rule of law, and the environment. It also acknowledges that in the area of resources, the Netherlands has broader interests than merely securing resources at the lowest prices.

In sum, this report aims to provide a deeper understanding of the way in which the dynamics of the global resource nexus impact the sustainable supply of agricultural commodities for the Dutch agri-food sector. The results of this research can be used to complement existing initiatives for sustainable supply chain management, and to facilitate policy making in this field. To this end, the report contains a chapter with recommendations on how policymakers can use the global resource nexus framework of this report.

1.2 METHOD AND APPROACH

We first conducted a literature review, analyzing existing approaches to the global resource nexus. This helped shape our understanding of the nature of the relationships between various resources, global megatrends and other intervening variables, as well as the impact of their interaction on supply and demand. Assessing the strengths and weaknesses of existing models, we then developed our own definition and visualization of the global resource nexus.

To explore the impact of the global resource nexus on the supply security of agri-food imports to the Netherlands, we analyzed the Dutch import dependence for three major agri-food streams: soybeans, cocoa beans and palm oil. The impact of the nexus on the supply of these commodities to the Netherlands was analyzed in three cases that focus on Brazil, Côte d'Ivoire, and Malaysia, the top supplier countries of soy, cocoa, and palm oil to the Netherlands respectively. For the analysis we combined quantitative and qualitative data drawn from public secondary sources.

1.3 STRUCTURE

The report is structured in the following way. **Chapter 2** looks at the global resource nexus, its drivers and consequences. It summarizes several nexus frameworks that exist within the literature, followed by a proposal of our own first step toward a global resource nexus approach. It also discusses how a nexus approach can help identify strategies which can contribute to a secure and sustainable supply of resources.

Chapter 3 gives an overview of the impact of the global resource nexus on the sustainable supply security of Dutch agri-food imports. First it defines what we mean by sustainable security of supply, and then discusses the economic significance of soy, cocoa and palm oil for the agri-food sector. The analysis shows that the Netherlands is highly dependent from imports of soy from Brazil, cocoa from Côte d' Ivoire, and palm oil from Malaysia. Chapter 3 concludes with an overview of the various risks, originating from or exacerbated by the resource nexus, and which affect the sustainable supply of these commodities.

Chapters 4, 5, and 6 consist of case studies that explore how global resource nexus dynamics affect the sustainable security of supply of soy from Brazil, cocoa from cocoa from Côte d'Ivoire, and palm oil from Malaysia.

Chapter 7 looks at policy approaches to the global resource nexus, including the Dutch approach and the role of the government therein.

The concluding chapter, **Chapter 8**, zooms in on the relevance of global resource nexus dynamics for sustainable supply chain management, and supply security of commodities vital to the Dutch agri-food sector. It provides recommendations on how the global resource nexus approach can be used to develop actionable policies in six steps.

2 THE GLOBAL RESOURCES NEXUS

Awareness is growing amongst both researchers and policymakers that the challenges which emerge as a result of the growing global demand for land, food, energy, water, and minerals are interlinked.⁶ The complex interplay and trade-offs between resources has become known as the ‘resource nexus’. Research addressing this nexus indicates that a better understanding of the interdependences and feedback loops between resources is vital for sustainable security of supply. This chapter reviews nexus approaches available in the literature, on the basis of which we proceed in the remainder of the report with our own conceptualization of the global resource nexus.

2.1 ANALYSIS OF AVAILABLE NEXUS APPROACHES

In this section, we briefly review the history of proposed nexus approaches, discuss several prominent examples, and summarize similarities and differences between the various available nexus approaches.

A SHORT HISTORY OF NEXUS APPROACHES

A handful of “integrated impact assessments” analyses preceded what is now known as the global resource nexus. These assessments aimed to inform decisions on investments in, and use of, certain resources, or to solve specific resource challenges by showing (“assessing”) the broader (“integrated”) effects of resource use (“impact”).

The most famous early attempt was the study *The Limits of Growth* (1972), which explored how exponential economic and population growth interacts with finite resources. The authors examined five variables: world population, industrialization, pollution, food production, and resource depletion, seeking to determine whether altering growth trends would result in a more sustainable feedback pattern which could lead to a stabilized system. The study contributed important insights and increased awareness of

challenges related to exponential economic and population growth. Nonetheless, it was heavily criticized for its methodology and ‘doomsday prophecy’. For example, the model did not account for potential correcting mechanisms, such as changes in technology, knowledge or behavior, and price effects. Also, because it modeled the world as a whole and not a single country or local area, it was of little use to national policymakers.

Another early example is the impact matrix put forward by Grenon and Lapillonne (1976), which was built to compare energy strategies and options. It looks at water, energy, land, materials, and manpower (WELMM), and models trade-offs and gains in these five domains.⁷

Since these early studies in the 1970s, a range of models have been developed to address the challenges indicated by the early integrated impact assessments. The International Atomic Energy Agency (IAEA) points out that analyses of individual resource systems, such as energy of water, are undertaken routinely. However, a weakness of many of these models is that “they focus either on one resource and ignore interconnections with other resources, have overly simplified spatial representations or analyze scenarios which are impractical for the long term.”⁸

A more integrated approach that addresses all aspects of the resource nexus is therefore needed. Several international organizations, research institutes, government bodies, and private parties have started to develop such more encompassing approaches. The next section discusses two examples.

RISK-BASED VERSUS OPPORTUNITY-BASED APPROACH

One of the organizations that have been at the forefront of endorsing a nexus approach to resource challenges is the World Economic Forum (WEF). During the 2011 Davos Summit, and in its Global Risks report published in the same year, the WEF put the resource nexus in the spotlight by arguing that “any strategy that focuses on one part of the water-food-energy nexus without considering its interconnections risks serious unintended consequences.”⁹ The WEF focuses on food, water, and energy security challenges, which are considered chronic impediments to economic growth and social stability.¹⁰ As a consequence, the analysis strongly focuses on risks for governments, societies, populations, and businesses.

Figure 1 shows an adapted version of the WEF’s system diagram of the risks associated with the water-food-energy nexus. The framework intends to explain the interrelated nature of water, food, and energy. In addition, it points at economic growth and population growth as the most important drivers for the risks of water, food, and energy security challenges. In its latest Global Risk report of 2014, the WEF mentions water crises as the 3rd highest concern, and food crises as the 8th highest concern for the global community.¹¹

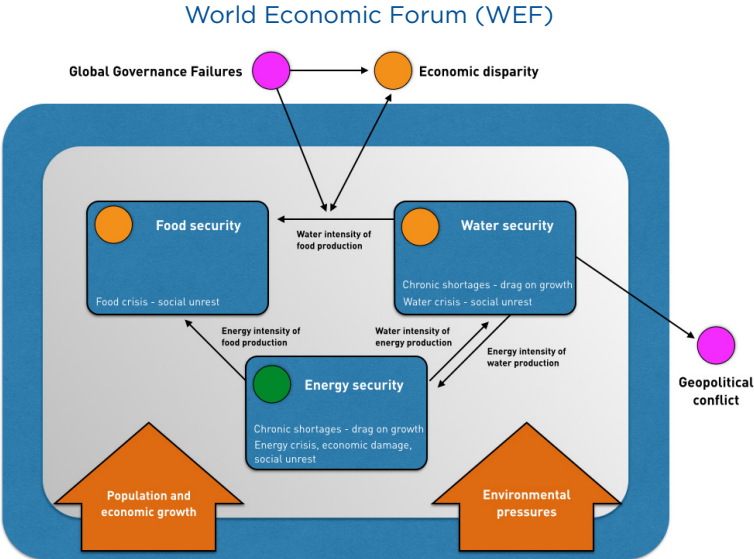


FIGURE 1 SYSTEM DIAGRAM FOR RISKS ASSOCIATED WITH THE WATER-FOOD-ENERGY NEXUS¹²

In contrast to the risk-centered approach of the WEF stands the nexus approach of the Stockholm Environmental Institute (SEI). Like the WEF, the SEI focuses on the interdependencies between water, energy, and food. However rather than stressing risks, the SEI links the objective of achieving water, energy, and food security to opportunities for innovation and the transition to a green economy based on equitable and sustainable growth.

Figure 2 shows an adapted version of the SEI's nexus framework. According to the SEI this nexus approach “identifies mutually beneficial responses and provides an informed and transparent framework for determining trade-offs and synergies that meet demand without compromising sustainability.”¹³ The distinguishing feature of the SEI framework is that it identifies society, the economy and the environment as action fields in order to promote water, energy, and food security for all, equitable, sustainable growth, and a resilient, productive environment. In addition, it mentions finance, governance and innovation as enabling factors. This framework is widely used, including by the Food and Agriculture Organization (FAO) of the UN, International Food Policy Research Institute (IFPRI), and the World Wildlife Fund (WWF), to comprehensively study information about relative resource scarcity and productivity, to identify trade-offs between resources, and the potential for sustainable intensification of production in different regions.

Stockholm Environmental Institute (SEI)

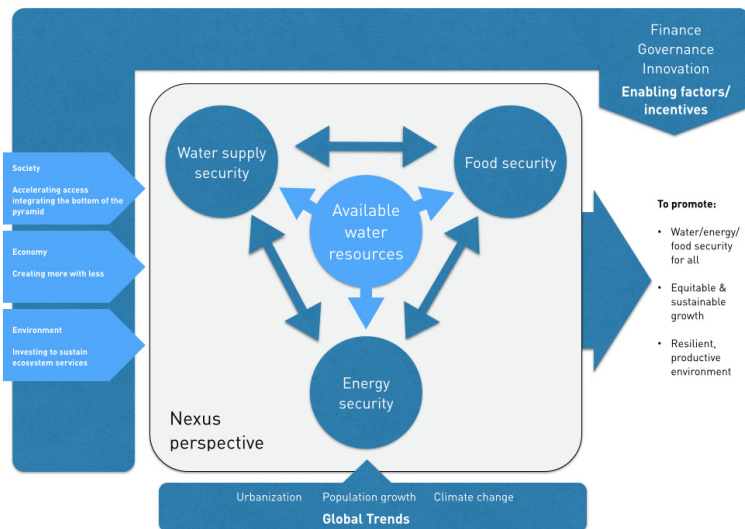


FIGURE 2 NEXUS PERSPECTIVE ON WATER-ENERGY-FOOD¹⁴

DIFFERENCES AND SIMILARITIES BETWEEN NEXUS APPROACHES

Many organizations have developed approaches and visualizations of the global resource nexus similar to those discussed above. Some of them are based on qualitative analysis, whereas others are based on quantitative assessments; some nexus frameworks are relatively simple, whereas others are highly complex. It is beyond the scope of this chapter to discuss all of them in detail. However, a few observations can be made about the similarities and differences between them. These relate mostly to three factors.

Number and type of resources considered. Both the number and kind of resources which are considered as part of the nexus vary between authors (see Table 1). The majority of frameworks are limited to interdependencies between three resources, most frequently water, energy, and food. However, there are some models which look at other sets of resources. For example, the nexus between land, water, and energy is used, among others, in the European Report on Development (ERD), by the International Food Policy Research Institute (IFPRI), and by the Pacific Northwest National Laboratory. Another variation is the nexus visualization proposed by A.T. Kearney, a global management-consulting firm, in which raw materials constitute one of the three components of the nexus, in addition to water and energy. Minerals are another resource category that is often put forward as part of the resource nexus. For example, the Netherlands Environmental Assessment Agency (PBL) looks at the relations between water, energy, food, and minerals. The Transatlantic Academy looks at five resources: water, energy, food, land, and minerals. These frameworks will now be discussed in some more detail.

| NUMBER AND TYPE OF RESOURCES | | EXAMPLES OF USERS |
|------------------------------|---|--|
| 3 resources | Water, energy, food | World Economic Forum Stockholm Environmental Institute |
| | Water, energy, land | European Report on Development International Food Policy Research Institute |
| | Water, energy, raw materials | A.T. Kearney |
| 4 resources | Water, energy, food, land | Netherlands Assessment Agency |
| 5 resources | Water, energy, food, land, and minerals | Transatlantic Academy |

TABLE 1 DIFFERENT RESOURCES NEXUS APPROACHES: COMPONENTS AND USERS (NON-EXHAUSTIVE)

Inclusion or exclusion of drivers and type of drivers. Although most organizations look at the drivers of the global resource nexus in their analysis, some visuals do not make reference to them. The visualizations of the Netherlands Assessment Agency and the Transatlantic Academy, for example, only depict the input and substitution relations between resources (Figure 3 shows the adapted versions).

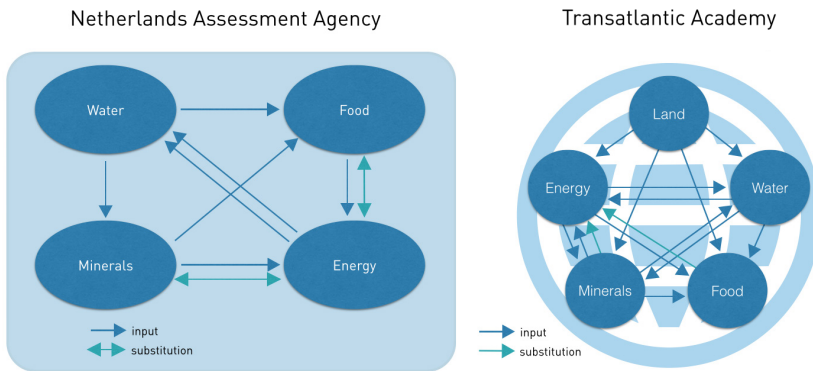


FIGURE 3 EXAMPLES OF NEXUS FRAMEWORKS THAT FOCUS ON INPUT AND SUBSTITUTION¹⁵

Other nexus diagrams, by contrast, emphasize the global trends which drive the dynamics of the resource nexus. One example of this is the visualizations of the Qatar Environment and Energy Institute (QEERI), which explicitly makes mention of various economic, demographic, environmental and social drivers. Another is the Environmental Change Institute (ECI), which utilizes global environmental change (GEC) drivers, natural drivers, and socio-economic drivers, to explain food security challenges (see Figure 4 for the adapted versions).

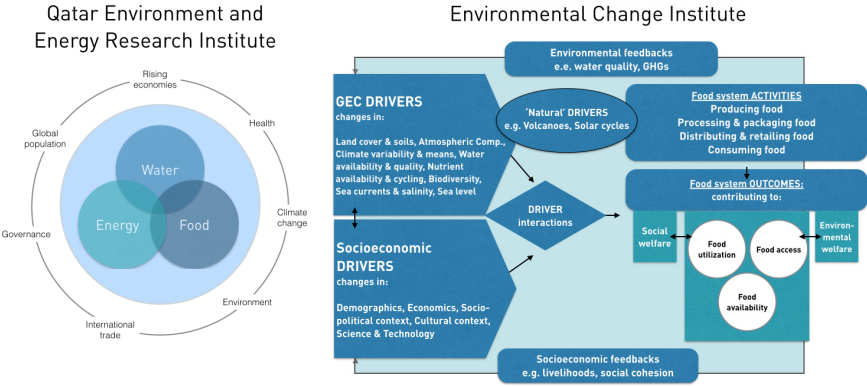


FIGURE 4 EXAMPLES OF NEXUS FRAMEWORKS THAT INCLUDE GLOBAL DRIVERS¹⁶

In terms of the type of drivers discussed in various nexus approaches, climate change is considered by many to be the central driving force behind the dynamics of the global resource nexus. An example of nexus approaches in which climate change is considered the central driver can be seen in Figure 5. The Pacific Northwest National Laboratory (PNNL) discusses the ‘climate-EWL nexus’, within which supply and demand of “each resource will also influence, and be influenced by, climate variability and change.”¹⁷

Pacific Northwest National Laboratory

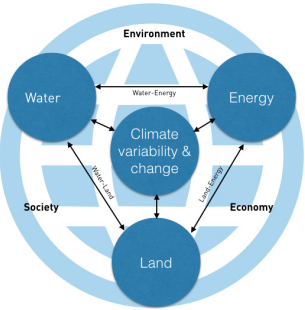


FIGURE 5 EXAMPLE OF NEXUS FRAMEWORK IN WHICH CLIMATE CHANGE IS THE CENTRAL DRIVER¹⁸

The International Atomic Energy Agency (IAEA) focuses on the linkages among climate, land, energy, and water. Its ‘CLEW’ tool consists of a reference system diagram, which is a commonly used tool to visualize relations that can be quantified by simplified mathematical expressions. Sets of relationships in the diagram can be “implemented in a software tool and used to determine scenarios of how future needs can be met within the constraints inherent in the system.”¹⁹ Figure 6 shows that this nexus framework visualization is more in depth, but as a consequence the feedback loops are harder to grasp.

Goals of the approach. Some frameworks merely aim to generate insights into the interlinkages between resources, some in combination with global megatrends others not. Meanwhile, others aim to assess impact of the resource nexus itself, or of policies that target (parts of) the resource nexus. The former type of analyses can contribute to creating more awareness of the causes and effects of certain challenges, such as resource scarcity, and create a sense of urgency to tackle these challenges. The goal of the latter type is to generate policy relevant output and to facilitate decision-making and policy assessments.

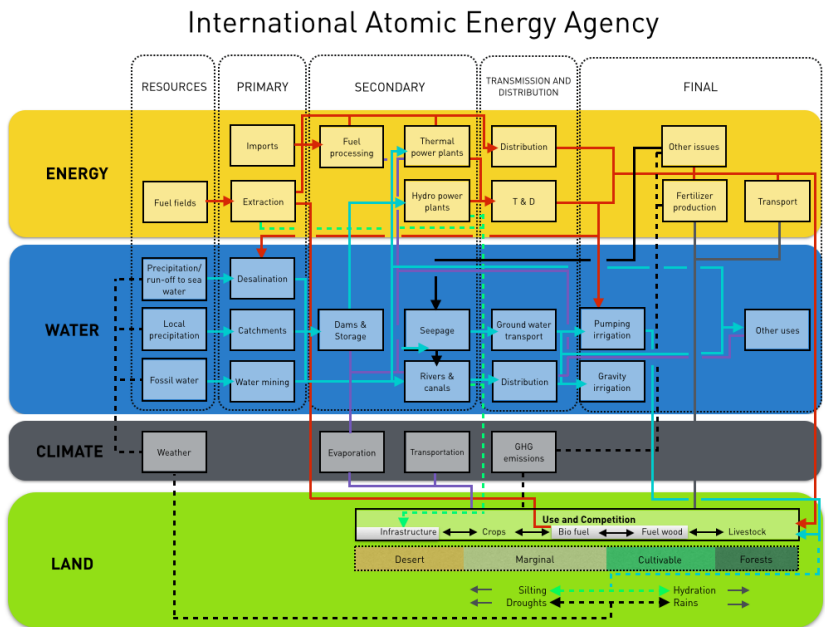


FIGURE 6 EXAMPLE OF A NEXUS APPROACH WHICH INCLUDES CLIMATE CHANGE²⁰

2.2 TOWARDS OUR OWN RESOURCE NEXUS APPROACH

Building on the existing nexus approaches within the literature, this study presents the global resource nexus in the following way. We define the nexus as the complex system of interdependencies and feed-back loops between the supply and demand of land, food, energy, water, and minerals. We also take into consideration the global megatrends that influence and are influenced by supply and demand of these resources, and the positive and negative effects that these interdependencies generate for the global economy, society and the environment.

The goal of our conceptualization of the resource nexus is to capture its complexity, whilst remaining sufficiently practical to effectively define the next steps for actionable policy making. A schematic overview of the nexus can be seen in Figure 7, which serves as the conceptual framework, and as a tool to facilitate analysis of resource challenges. The figure is basic yet comprehensive, integrating:

- Five resource systems (water, energy, food, land, and minerals)
- Four global megatrends that drive supply and demand of resources (urbanization, climate change, economic growth, and population growth)
- The risks and opportunities that these trends generate
- Intervening variables, such as human resources, technology, governance, social and political factors, and instability

At the heart of our framework are the five essential resources: water, land, energy, food, and minerals. Each resource has its own subsystem, which includes the forces that are driving supply and demand of each resource, and the processes influencing the quantity and quality of each resource. The global resource nexus framework highlights the interconnected nature of these subsystems, and their interaction with the broader global environment.

The arrows between different resources indicate that the supply and demand of one resource interact with the supply and demand of another. This interaction can be either direct or indirect. For example, the production of food requires large quantities of water, land, minerals and energy. This is a direct relationship. An example of an indirect relationship is that water is necessary to generate energy and to extract minerals, both of which are necessary inputs for food production.

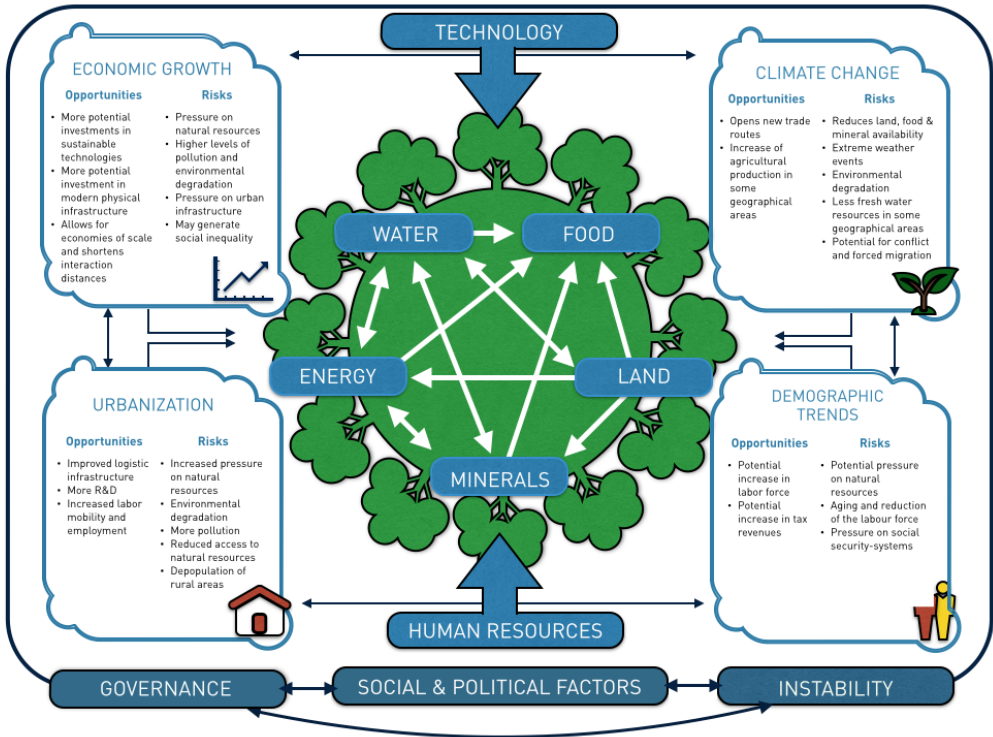


FIGURE 7 OUR CONCEPTUAL FRAMEWORK FOR UNDERSTANDING AND ANALYZING THE GLOBAL RESOURCE NEXUS

The supply and demand of each resource are driven by a set of global megatrends, which are listed in the four corners of the figure: urbanization, climate change, economic growth, and population growth. These drivers can have both positive and negative impacts on the quantity and quality of globally available resources. For example, climate change may have a negative impact the availability of food, due to extreme weather affecting harvests, or may have a positive effect, by making more arable land available in areas where the climate was previously unsuitable for agriculture. For each of these four megatrends some of the associated risks and opportunities are listed. The arrows between the megatrends indicate that they are also mutually dependent. For instance, economic growth contributes to urbanization, and vice versa.

The figure also shows that human resources and technology have an impact on natural resource supply and demand. Human resources are an important factor on the supply side, since without manpower resources would not be available for consumption. The same is true of technology; technological breakthroughs mean that new resources become physically and economically viable for extraction. Technology also has a strong effect on the demand side, as new technologies can generate increased demand for certain resources and decreased demand for others. For example, plastic has substituted metal in many applications, thereby decreasing the demand for iron ore and other metallic minerals whilst increasing the demand for oil and other fossil fuel products.

Finally, governance, political and social factors, and instability affect the supply and demand of resources both directly and indirectly. For example, resource scarcity can contribute to instability, which in turn can decrease supply and demand of resources. Governance, political and social factors, and instability also mutually influence on another. Instability can result from a mismatch between expectations of populations and the characteristics of their social, political, economic, and environmental environment. Social unrest may also occur in response to poor governance and corruption. In turn, instability may on the one hand negatively impact supply by impeding production and investments in the natural resource sector, and on the other hand lessen demand by stifling overall economic development.

The interrelatedness of different variables and the feedback loops between them render the global resource nexus a complex system. Such a system may exhibit relatively orderly and predictable behavior for prolonged periods of time, but may also become highly volatile, especially when different feedback loops happen simultaneously. It is this unstable and unpredictable behavior that makes this complex system so challenging and potentially threatening for economic, social and environmental stability.

Nexus dynamics may occur locally, but subsequently have an impact at a regional or global level. The local system, reflecting the use of resources in a specific geographic environment, is influenced by global drivers of resource demand and supply. Shocks in the global economy have an impact at the regional and local level. In response to changes in global demand for example, local producers may increase production or alter their production

methods, for instance by adopting more sustainable production strategies. In turn, local issues, such as protests from workers or environmental protection groups, clashes with indigenous populations, or declining yields due to pressures on natural resources, may have a global impact. Protests may raise awareness of the importance of standards for sustainable production. Declining yields may encourage the food industry to collaborate with producers to ensure their supply of resources. These examples indicate how changes at one level can have a ripple effect (see Figure 8).

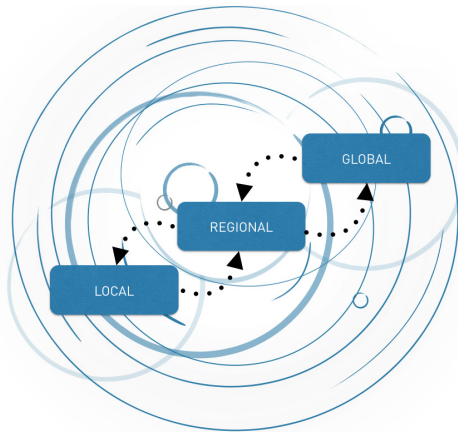


FIGURE 8 THE RIPPLE EFFECT, BROADENING THE IMPACT OF NEXUS DYNAMICS

2.3 GLOBAL TRENDS AND THE RESOURCE NEXUS

Global megatrends are important drivers of the global resource nexus as they shape the dynamics of resource supply and demand. Some of these trends primarily serve to increase global demand for resources, whilst others may relieve pressure on the supply side, meaning that a global megatrend may have positive or negative effects on the availability of resources. Policy solutions to global challenges stemming from the growing demand for resources may also have negative externalities and lead to unintended consequences on the supply side. These interactions are part of the complexity of the global resource nexus. The following sections look more deeply into the effects of the four global megatrends on the resource supply and demand.

When analyzing the impact of these megatrends, it is important to bear in mind that they have not only an undeniable global reach, but also an exponential nature and force of impact. This exponential nature means that all effects on the resource nexus are amplified over time. When demand for a certain resource grows by 7% per annum, that demand will double in ten years. This highlights the urgency of problems which arise from the global resource nexus.

DRIVERS OF GROWING RESOURCE DEMAND

Many of the nexus dynamics are caused by a growing demand for resources, for which several drivers can be identified. First of all, demographic trends, such as population growth and increasing life expectancy rates due to improvements in sanitation, health, and wealth, are contributing to a growing demand for resources. UN world population prospects assume a world population between 8.3 and 11.1 billion in 2050 (see Figure 9).²¹ Furthermore, according to Organization for Economic Co-operation and Development (OECD) figures, some 25% of the populations of OECD countries is projected to be over 65 years of age in 2050, compared with 15% in 2012.²² A larger population places more demand on all resources, particularly the availability of food. According to figures of the OECD Food and Agriculture Organization (OCED-FAO), meeting the needs of a growing population will require 60% more animal feed, one billion more tonnes of cereals, and 200 million more tonnes of meat by 2050.²³

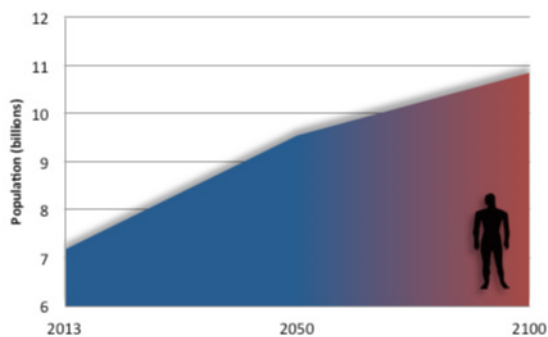


FIGURE 9 POPULATION OF THE WORLD, 2013-2100, ACCORDING TO MEDIUM VARIANT SCENARIO OF THE UNITED NATIONS.²⁴

Second, economic growth is a major driver of increasing demand for resources. The OECD expects an average annual global GDP growth of 3.5% until 2050.²⁵ Figure 10 shows that this rate is higher in the case of the BRIICS (Brazil, Russia, India, Indonesia, China and South Africa) and lower in OECD countries. The projections are based on the exogenous assumption that world GDP will be 2.5-fold the present one and per capita income will be 1.8-fold.

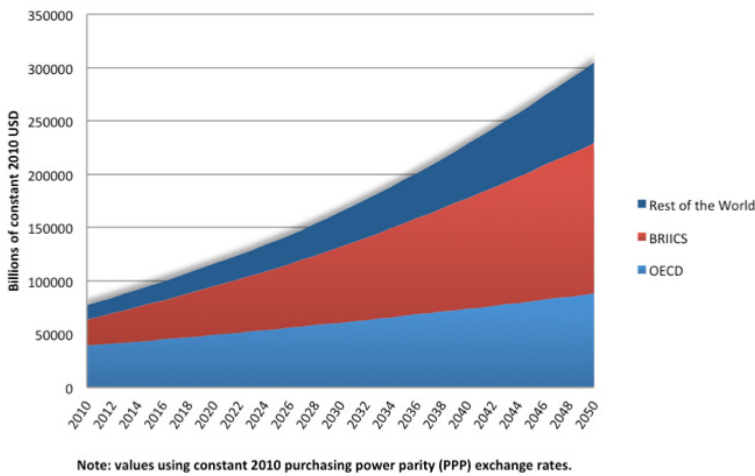


FIGURE 10 PROJECTIONS FOR REAL GROSS DOMESTIC PRODUCT: BASELINE, 2010-2050²⁶

As a consequence of economic growth, the middle class is growing globally. In 2050, it is expected that 80% of the global population will consist of those who have been lifted out of poverty and can make a decent living.²⁷ Increases in GDP per capita alter consumption patterns, and will result in a more luxurious lifestyle and greater demand for consumer goods, such as cars, cell phones, and computers. More people rising out of poverty will shift from plant-based diets to diets based on meat, eggs and dairy products. Figure 11 shows how the situation may develop between now and 2050, according to the OECD-FAO. Global average meat consumption is expected to increase from 37 kg per capita in 2000 to 48 kg per capita in 2050.²⁸ The production of meat and dairy products requires up to 7 times more grain and 10 times more water than the production of plant calories.²⁹ Although all projections are shrouded in uncertainty, expected developments in food demand are subject to less uncertainty than other variables.

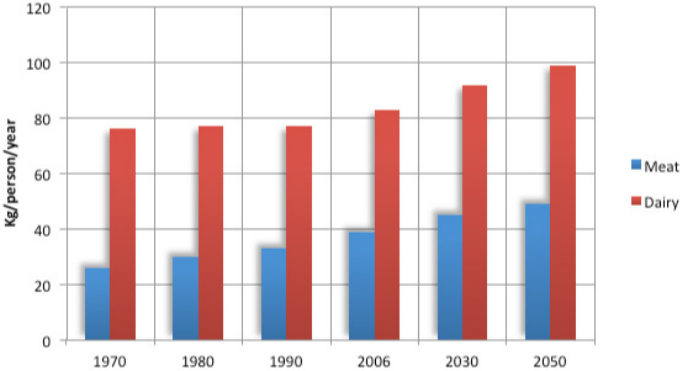


FIGURE 11 MEAT AND DAIRY CONSUMPTION, WORLD, 1970-2050³⁰

The third global megatrend is urbanization, which will spur the development of infrastructure for sanitation, water, transport and other public services that require energy, minerals, and other resources. Migration from the countryside to the city is contributing to the rapid rise of megacities with more than 10 million inhabitants, and this is expected to result in 2.7 billion more urban dwellers by 2050.³¹ Figure 12 shows UN projections for the global growth in urban residents. It is in large and rapidly expanding urban centers that resource pressures and related challenges will be felt most severely.³²

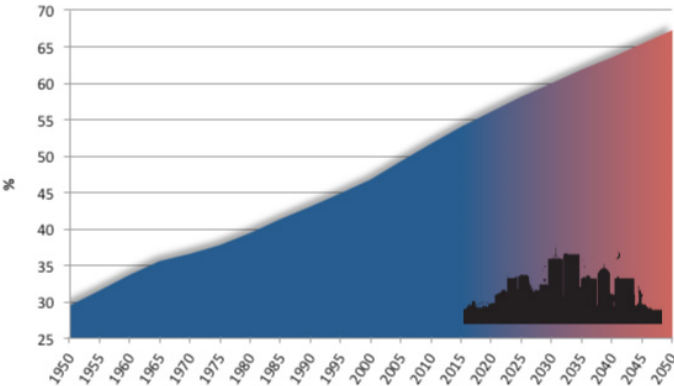


FIGURE 12 PERCENTAGE OF WORLD POPULATION RESIDING IN URBAN AREAS, 1950 - 2050³³

Finally, concerns about the sustainability of the economy and climate change are spurring the development of technologies that can help reduce our fossil fuel consumption and CO₂ emissions. However, the large-scale implementation of technologies for renewable energy and increased energy efficiency may also increase the demand for certain minerals and metals, for example those used in solar panels and wind turbines.

HAMPERING FACTORS ON THE SUPPLY SIDE

Pressure from trends that are contributing to growing demand is reinforced by trends that put pressure on the supply of resources. Climate change, for example, has serious effects on the environment from which we extract our resources. Increasingly frequent and more intense extreme weather events are occurring, which may negatively affect crops, livestock, and fishery systems. According to the Earth Policy Institute, global warming is an important contributor to food scarcity, as every single degree centigrade rise in global temperature reduces grain yields by 10%.³⁴ Climate change may also reduce the availability of land for farming due to rising sea levels or the deterioration of soil quality. In addition, water for agricultural purposes becomes increasingly scarce due to global warming.³⁵ The Middle East is the first region where grain production has started to fall due to water shortages, particularly in Syria and Iraq.³⁶

Resource scarcity may also result from, or be exacerbated by, failing global governance and market distorting policies of businesses and national governments. Motivated by concerns about growing resource scarcity, climate change, the depletion of fossil fuels, economic competitiveness, and innovation, governments around the world have started to formulate natural resource strategies. These policy interventions are often aimed at securing resources for future generations and ensuring future economic growth, whilst at the same time maximizing the current political and economic benefits of resource endowments and high commodity prices. Import dependent countries aim to gain access to overseas resources through policies of proactive acquisition, such as the acquisition of land abroad, a phenomenon often referred to as land grabbing, and stockpiling or vertical integration, which refers to a process in which large parts of the supply chain are brought under the ownership and control of a single firm. Producing countries aim to preserve and reap the benefits of their domestic resources through policy measures such as increased taxation on extraction

revenues, export quotas, and the limiting of foreign access to the domestic resource sector.³⁷ These policy measures can have a protectionist character and can thus undermine the free trade in natural resources.

2.4 GLOBAL CHALLENGES RELATED TO THE RESOURCE NEXUS

An increasing demand for resources means that the world will be faced with some serious challenges in the future. These challenges will affect populations, profits, and the environment, and are likely to cross two or more resource subsystems. In this section, we briefly discuss some of the most evident and pressing challenges.

Interdependencies between resource subsystems create several immediate pressing security of supply problems and volatility. Volatility and physical and relative scarcity of land, food, energy, water or minerals may create additional challenges for the functioning of society and the economy. For the poorest and most vulnerable populations it becomes more difficult to secure access to sufficient resources to make a livelihood. This can create competition and instability, and in the worst cases, conflict. In turn, geopolitical turmoil in supplier regions may create temporary resource shortages, or in the case of prolonged instability, exacerbate ongoing scarcity. Bad governance, political and social factors, as well as instability, may limit investment in the resource sectors of affected countries. Such temporary supply problems can create relative scarcity by driving up prices.

Paradoxically, high prices or access problems can act as a correcting mechanism, triggering investments and technological developments which can ultimately alleviate scarcity. High prices caused by resource scarcity may temper resource demand and encourage the development of resource efficient technologies and investments in new exploration activities. Innovation and exploration contributes regularly to new discoveries of fossil fuel and mineral deposits. This also holds true for arable land, of which more appears to be available than previously thought.³⁸ For example, the Brazilian Cerrado was once considered 'useless', but has now found new purpose as agricultural land. In the long run, physical scarcity issues are likely to become less stringent as technological and market developments may increase the technical and economic viability of

extracting new resources. Nonetheless, in the medium-term, price-inelasticity of supply may be a problem: time and investment levels are often limiting factors which can lead to scarcity, as opening up new production sites can require significant investment and can take a long time, especially in the mining sector.

FEEDING A GROWING POPULATION

Meeting the challenge of feeding a growing world population will require larger inputs of land, energy, minerals and water. However in many cases, these resources themselves become relatively scarcer. Urbanization, economic growth, and in some regions climate change, decrease the availability of land for farming. Water scarcity is also a key impediment for agriculture, as between 30% and 40% of the world's food comes from the 16% of the total of cultivated land which is irrigated.³⁹ Agriculture itself, however, is a major contributor to water consumption, accounting for 70% of all water withdrawn from aquifers, streams and lakes.⁴⁰ High energy prices also hamper agricultural production, and may translate into higher food prices (relative scarcity). Some minerals, especially phosphorus, may become increasingly scarce due to market forces, political decisions, and geopolitical developments.⁴¹ The growth of crops is dependent on phosphorus content in soil, and even if all other nutrients, such as nitrogen and potassium, are present, only phosphorus can make plants thrive. Increasing the world's food production depends on the availability of fertilizers containing phosphorus to enrich the soil. Therefore, increased demand is problematic, as there is no substitute for phosphorus, and phosphorus is a finite, non-renewable resource.

SAFE DRINKING WATER AND WATER SECURITY FOR AGRICULTURE AND INDUSTRY

Water is a key resource for human, animal and plant life. According to a UN report from 2012, 783 million people (11% of the world's population), lack access to clean drinking water.⁴² Improving this situation is increasingly difficult due to the competing demand from agriculture and industry, especially since water is also an input for the production of other resources, such as energy and minerals.

Water availability is crucial for the generation of hydro-electric power, especially in sub-Saharan Africa, where hydro-electric energy accounted

for about 70% of the total electricity generated in 2008 (excluding South Africa).⁴³ Yet thermal energy also requires ample availability of water, as nuclear, coal- and gas-fired power stations all are extremely water-intensive. Reduced water availability also affects energy costs, as less water may be available for hydroelectric power generation and cooling water, while rising temperatures increase the need for cooling water.⁴⁴ When water scarcity leads to insufficient energy production, it may also become an impediment to economic development, especially in sub-Saharan African economies.⁴⁵

The mining sector requires also large quantities of water for cooling, crushing, grinding, milling, slurry transport, and tailing storage. The growing demand for water has triggered forceful water legislation, higher costs, and stringent water-usage restrictions that may affect the availability of water to the mining sector, thereby increasing mineral scarcity. If water scarcity impedes the mining of phosphate rock and the production of fertilizer, or contributes to higher fertilizer prices, food security also could be threatened.

FUELLING THE ENGINE OF ECONOMIC GROWTH

Energy security is a high priority for policymakers around the world as it is a precondition for economic growth and the stable functioning of society. The functioning of modern economies and societies has become dependent on the availability of cheap energy. The increased demand for energy has caused concerns about the depletion of fossil fuel reserves and climate change, and has motivated countries to take measures to diversify their energy sources. The transition from an economy based on fossil fuels to one based on a more diverse energy mix however, also has consequences for the other resource systems. For example, biofuels have recently been encouraged as a cleaner form of energy. As illustrated in the introduction to this report (see Box 1), this has led to a competition over land between the cultivation of biofuel crops, and that which is used for food production. Thus, although biofuels may contribute to energy security, they may also negatively affect food security.⁴⁶ The same can be said for renewable energy technologies. While making a positive contribution to the reduction of greenhouse gas emissions, they may simultaneously contribute to relative scarcity (and therefore high prices) of certain metals and minerals.⁴⁷

THE GLOBAL GRAB OF LAND FOR FOOD, ENERGY AND MINERALS

The growing demand for food has triggered large-scale overseas acquisitions of land. This is particularly the case since food prices began to rise between 2006-2008, after which some countries purchased large swaths of land in Africa, Latin America, Central Asia and Southeast Asia to produce food, as an alternative to buying food on the international food market.⁴⁸ These land deals, concluded either directly through government to government deals, or via government owned enterprises, are usually welcomed by the target countries, as they bring foreign investment, technology, know-how, and infrastructure which may result in increased agricultural productivity. However, land deals also represent risks to local and global food security. The acquisition of land by foreign investors may compromise access to resources for locals. In addition, land deals can put local farmers out of business. Also, a large share of production is destined for export to the countries where the investments are coming from. As such, land deals can prevent food from reaching the global market whilst simultaneously contributing to local food insecurity issues.⁴⁹

The demand for land further increases because of a growing demand for energy, as land suitable for growing food crops may be used instead for the cultivation of biofuel crops, or to extract minerals and fossil fuels. Economic growth has contributed to land scarcity through increased tourism, foreign property investment, remittances of emigrants who are sending back their earnings to their families to buy land and houses, and an increased interest on the part of governments and companies in purchasing land for special economic zones, mining activities, or urban development. Climate change and other environmental stresses have paradoxically increased land scarcity in some regions, as NGOs have purchased land for nature conservation or to plant trees for carbon compensation.⁵⁰

INSTABILITY CAUSED BY RESOURCE SCARCITY

Resource competition and scarcity can lead to social and political instability, and in the worst case to conflict. Although no states have yet gone to war over the availability of food, and it is unlikely that they will do so in the future, there is ample empirical evidence of **food scarcity** contributing to intrastate conflict and regional instability. In January 2011, record high food prices were a contributing factor fueling protests in Tunisia, in which over 100 people died and which subsequently led to the

spread of popular uprisings in other North African and Middle Eastern states.⁵¹

Water scarcity also contributes to interstate tensions, for example in the Middle East, where disputes over the Euphrates, Tigris, and Jordan rivers are exacerbating existing hostilities. Also in the Nile area, upstream and downstream countries face disagreements. In the Aral Sea region water is at the heart of disputes between Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan, and Kyrgyzstan. According to the EU, tensions over access to water are likely to rise in the next decade, and water-related conflicts could endanger EU interests, as well as wider international peace and security.⁵²

Energy scarcity is a well-known geopolitical driver, and a source of tension. For example, the dependence of many countries on oil and gas supplies from the Middle East has been a major factor in the region's tumultuous history. Energy interests also play an important role in tensions and conflicts around the world, including in the Arctic region, the South China Sea, and the Eastern Mediterranean. Energy security problems can also act as "significant amplifiers of conflict that add to the stresses of already fragile states."⁵³

Instability or tension may also originate from **mineral scarcity**, especially those minerals that are considered critical or strategic, such as rare earth elements. The temporary freeze of rare earth exports from China to Japan in late 2010, resulting from – and possibly fuelling – political tensions in the East China Sea, is one example of the strategic use of non-fuel minerals in international relations today.⁵⁴ Ensuring and safeguarding access to mineral resources is quickly emerging as a strategic policy priority. As a consequence, mineral rich areas that are the subject of rival territorial claims are emerging as new potential conflict arenas, such as in the South China Sea, the Arctic region, and the Falklands islands.

Besides the obvious tension that may arise from land grabbing, **land scarcity** may also lead to instability, conflict, and increased migration. When migration is modest and gradual, security risks are minimal, as the receiving country can easily absorb the influx of people. However, land scarcity caused by environmental stresses may cause migration to reach new levels.⁵⁵ As a consequence, both the developing and developed worlds

will face new security risks and socio-economic challenges, ranging from resource scarcity to potential conflict.⁵⁶

RESOURCE SCARCITY CAUSED BY BAD GOVERNANCE, SOCIAL AND POLITICAL FACTORS, AND INSTABILITY

Social unrest, political instability and violent conflict also contribute to resource scarcity, as all have a negative impact on conditions for resource extraction, production, and accessibility. Instability may directly impede production or the ability to export if infrastructure is temporarily blocked. Indirectly, it may negatively impact GDP growth and stifle overall economic development. If the overall economic situation is dim, expectations about the future profitability of investments are also low. This may result in fewer investments in the necessary infrastructure at all levels of the resource value chain, such as road infrastructure to transport resources from the extraction to processing sites and then on to the retailer, or electricity and water infrastructure for farming.

Resource scarcity can create a vicious circle, in which social unrest or conflict induced by resource scarcity also weaken governance and lead to dysfunctional institutions. Bad governance, corruption, or lack of political freedom may spark social unrest, and are in turn at the root of the state's inability to deliver resource security for its people. Bad governance can also be the cause of other sources of instability, including social inequality, chronic unemployment (especially amongst youths), and sectarian/ethnic tensions. In the mining sector, for example, bad governance has been a source of social unrest due to poor mining conditions and the destruction of farmland, leading to disrupted mining activities in various African countries.⁵⁷ Weak governance also dissuades foreign investment in the natural resource sector. Meanwhile, good governance, strong institutions, and policy coherence can attract investment and innovations that can help raise production, improve resource efficiency, and minimize negative externalities.⁵⁸

2.5 CONCLUSION

To summarize, the dynamics of the global resource nexus create some serious economic, social, political, and environmental challenges. These challenges affect populations, businesses, and the environment. In light of the urgency of these challenges, it is imperative to analyze the impact of

the nexus, and build policy accordingly. This chapter gave a brief overview of various ways to conceptualize and represent the nexus, and proposed our own conceptualization that can help understand how the dynamics of the resource nexus may affect sustainable supply security. In the remainder of the report, we will demonstrate in three case studies how the global resource nexus approach can be used to analyze risks to the sustainable security of supply of agricultural commodities that are of strategic relevance to the Netherlands.

3 AGRICULTURAL COMMODITIES AND THE NETHERLANDS

We use the global resource nexus approach to analyze some of the risks to the sustainable supply of agricultural commodities to the Netherlands. The report comprises three case studies focusing on the risks to the sustainable supply of soy, cocoa, and palm oil respectively. As an introduction to these case studies, this chapter begins with a short overview of the economic relevance of the agri-food sector to the Dutch economy in general, and of soy, cocoa, and palm oil in particular. Next, this chapter defines what we mean by sustainable security of supply, and provides an overview of the various generic risks that impact the sustainable supply of the three commodities mentioned. These risks are then applied to the three cases in the following chapters.

3.1 THE STRATEGIC IMPORTANCE OF AGRICULTURAL COMMODITIES TO THE NETHERLANDS

The agri-food sector is of vital importance to the Dutch economy. The Netherlands is one of the largest producers of fruit and vegetables in the world, and is the second-largest exporter of agricultural products after the US.⁵⁹ Agricultural exports rose to a total value of € 75.4 billion in 2012, up 4.5% compared to the previous year.⁶⁰ The Netherlands also imports substantial quantities of agricultural products. Agri-food commodities accounted for 12% of total Dutch imports in 2011.⁶¹ Of all agricultural commodities imported, cocoa (8%), soy (7%) and palm oil (4%), including their derivatives, are among the largest import streams of the Netherlands.⁶²

In addition to the volume of imports, the strategic importance of soy, cocoa, and palm oil is related to their application in a wide range of agri-food products, the increased competition that the Netherlands is facing from other countries to secure these imports, limited possibilities for substitution, and limited alternative sourcing options in Europe.

SOY

Soy and its derivatives are used as a source of protein in a wide range of products, making soybeans one of the key commodities in the global food system. Soy is a major ingredient in processed foods, used for texturizing a product and as a protein rich filler ingredient. The largest share of soy meal and fibers are used as a protein source for livestock.⁶³ Of all animal feed, 11% consists of soy-based products. Soy has gained importance as a feedstock ingredient, especially since the ban on animal bone meal in the feed industry.⁶⁴

The Netherlands is the second largest importer of soybeans in the EU, accounting for 24% of total EU imports in 2012-13.⁶⁵ The Netherlands mainly imports soybeans from Brazil (39%), the US (29%), Paraguay (15%), Uruguay (7%) and Canada (7%) (see Figure 13).



FIGURE 13 MAJOR SOYBEAN SOURCES FOR THE NETHERLANDS AS % OF TOTAL DUTCH SOYBEAN IMPORTS, 2010⁶⁶

The Netherlands faces competition from a variety of states for the supply of soybeans. Of the total volume of soybeans exported worldwide in 2010, 59% was imported by China, 4% by Mexico and Germany, and only 3% by Japan and the Netherlands.⁶⁷ China not only holds the majority share of global soy imports, but it also sources the bulk of its soy from the same

supplier countries as the Netherlands. In fact, China accounts for 65% of all Brazilian soy exports, 59% of US exports and 67% of total Uruguayan soy exports.⁶⁸

If we examine the change in worldwide soybean imports between 2000 and 2011, it shows that Chinese soybean demand grew by 36% over the decade.⁶⁹ Some analysts expect Chinese demand for soybeans to increase even further in the future, with demand by 2020 predicted to be as much as 43% higher than that of the 2009 – 2010 average.⁷⁰ The United States Department of Agriculture (USDA) goes a step further, suggesting that Chinese soybean imports will rise by 59%, to 90 million tonnes by 2021-2022, accounting for over 80% of the projected growth in global soybean imports.⁷¹ Meanwhile, US production growth is limited by land constraints, whilst almost all of Argentina's soybean exports are already going to China.⁷² This means that competition over Brazilian soybeans is likely to increase, and a significant price increase cannot be ruled out. This carries the risk that the Dutch share of Brazilian soybean exports may be crowded out.

The strategic importance of soy imports for the Netherlands is also related to the fact that soy production in Europe is limited, with only around 2% of European soy consumption produced within the EU-27. Imported soy could be replaced by other plant-based proteins; however this may compromise the export of grains. The EU's dependence on the import of plant-based proteins (see Figure 14 and Figure 15) has prompted concern amongst EU-parliamentarians, a concern which was substantiated in a study that indicated that the domestic cultivation of protein crops is necessary to achieve sustainable agriculture in Europe.⁷³ EU soy production is expanding to a limited extent, with various cultivation programs currently underway to attempt to counteract the gradual decline of protein crops in Europe, and to tackle the decline in research and scientific knowledge on cultivation of such crops.

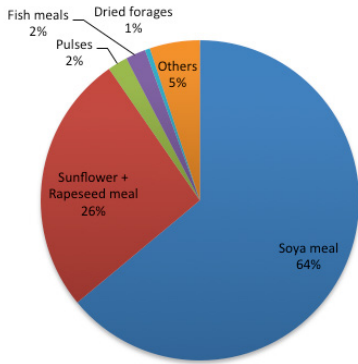


FIGURE 14 SOURCES OF PROTEINS USED FOR ANIMAL FEEDING IN THE EU-27 (IN % OF TOTAL PROTEIN USE FROM EU-PRODUCTS AND IMPORTS)⁷⁴

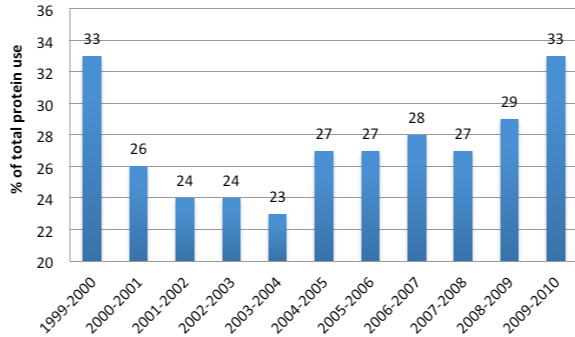


FIGURE 15 EU PROTEIN SUPPLY DEPENDENCY, 1999-2010⁷⁵

COCOA

Cocoa beans are the basic ingredient that is required to make cocoa, a dark brown powder that is used to make chocolate and to add chocolate flavor to food and drinks. In the worldwide trade in cocoa beans, the Netherlands is a significant player. It is one of the biggest importers of cocoa, and with 20-24% of global trade in cocoa beans passing through Amsterdam, is home to one of the biggest ‘cocoa port’ in the world. About a quarter of Dutch imports are then re-exported through Dutch ports to other European countries, mostly to Germany.⁷⁶ In 2011 the Netherlands imported 784,316 tonnes of cocoa beans, worth 2.5 billion USD.⁷⁷

The Netherlands also plays an important role in the processing of cocoa beans. Around 13% of the global cocoa processing industry is located in the Netherlands.⁷⁸ Imported beans are mainly processed into chocolate and semi-finished products like cocoa butter and cocoa powder. The Netherlands houses the largest cocoa grinding industry in the world, and is home to grinding facilities for several multinational companies, including ADM, Cargill, and Dutch Cocoa (owned by ECOM). This makes the Netherlands the largest producer of cocoa butter in the EU.

In light of this economic significance of cocoa for the Dutch economy, it is of strategic significance that the production of cocoa beans is heavily concentrated in only a few countries. Dutch imports of cocoa originate mainly from Africa, particularly Côte d'Ivoire (32%), Cameroon (24%), Nigeria (17%), and Ghana (15%). The Dominican Republic represents the only non-African sourcing country, accounting for 3% of Dutch imports (see Figure 16).⁷⁹ The Netherlands is the largest importer of cocoa beans from every major source country depicted in Figure 16.⁸⁰ Other large importers of cocoa are Germany (14%), Malaysia (10%), Belgium (6%), and France (4%).⁸¹ The Netherlands is in a particularly dominant position in two of its source countries, accounting for 77% of all cocoa exports from Cameroon, and 55% from Nigeria. The Netherlands also accounts for 29% of all cocoa exports from Côte d'Ivoire.

Competition in Côte d'Ivoire, the most important market for the Netherlands, is greater than in the aforementioned two countries. The US (23%), Germany (8%) and Belgium (7%) also make up a significant share of Ivorian cocoa exports.⁸²



FIGURE 16 MAJOR COCOA BEAN SOURCES FOR THE NETHERLANDS % OF TOTAL DUTCH COCOA IMPORTS, 2010⁸³

However, these trade patterns may be subject to change. Dutch demand for cocoa beans rose by 59% between 2000-2011. This coincided with a wider rising global demand, leaving a gap between supply and demand in cocoa on the world market.⁸⁴ Globally, cocoa demand is rising, as a consequence of global economic and demographic growth. Global demand for cocoa is expected to rise by 1 million tonnes in the next decade, in particular driven by Russia, Eastern European countries, and Brazil.⁸⁵ This may potentially negatively affect the Dutch import position.

The strategic significance of cocoa imports for the Netherlands is also related to the lack of a substitutes and domestic sourcing options. The Carob bean can be used as a substitute for cocoa, yet its global production is insufficient to meet even Dutch cocoa demand alone. As cocoa grows exclusively in tropical climates, sourcing from within the EU during a supply disruption is not an option.

PALM OIL

Palm oil is used, among others, for the production of margarine, potato chips, soups, various chocolate pastes and cookies, as input for the production of soap and other detergents, and for the production of biodiesel. Palm kernel oil is found in many cosmetic and cleaning products.

The Netherlands accounts for 9% of global palm oil imports.⁸⁶ It is also the largest importer of palm oil in the EU, accounting for 44% of total European palm oil imports between 2012-2013.⁸⁷ The port of Rotterdam is particularly important: in 2009, 36% of Europe's palm oil imports passed through Rotterdam, of which 56% was distributed to other EU Member States.⁸⁸

The Netherlands obtains most of its palm oil from Malaysia (50%) and Indonesia (39%). Smaller shares are obtained from Papua New Guinea (6%), Germany (1%) and Côte d'Ivoire (1%) (see Figure 17).⁸⁹

Globally, the main competitors of the Netherlands for palm oil are India and China. In Malaysia, 28% of the export market is controlled by China, 13% by Pakistan, 8% by the Netherlands and 7% by the US.⁹⁰ In Indonesia, India is market leader with 28% of the export market, followed by China with 19%, Malaysia (10%) and the Netherlands at 7%.⁹¹

Palm oil cannot be produced domestically in the EU. There are however various substitute oils available, including vegetable oils, animal fat, butter, olive oil, canola oil, coconut oil and cocoa butter, some of which can be sourced within the EU.



FIGURE 17 MAJOR PALM OIL SOURCES FOR THE NETHERLANDS AS % OF TOTAL PALM OIL IMPORTS, 2010⁹²

In sum, soy, cocoa, and palm oil are of great importance to the Dutch agri-food sector, and the Netherlands is dependent on imports of all three resources. The vulnerability associated with import dependence is compounded by numerous risks to sustainable supply security that are a result of, or may be exacerbated by, nexus dynamics.

3.2 SUSTAINABLE SECURITY OF SUPPLY

The increasing demand for resources, and its impacts on people, planet, and profit, warrants a transition towards a system that guarantees a more sustainable supply of resources. We use the definition of sustainability that was put forward in the 1980s by Norwegian Prime Minister Gro Harlem Brundtland: “meeting the needs of the present without compromising the ability of future generations to meet their own needs.”⁹³

Sustainable security of supply goes beyond the objective of merely securing sufficient resources to safeguard economic performance. In light of the dynamics of the global resource nexus, policies aimed at security of supply in such a narrow sense may be inadequate or even counterproductive in the long run. Furthermore, the interaction effects and feedbacks loops between different resources imply that securing resources will require environmental and community stewardship. This means that in order to achieve sustainable security of supply, resource policies should not only focus on the economic risks to the supply of resources, but also on the social and environmental challenges.

Broadly speaking risks to the sustainable supply of resources can be classified in three groups:

- 1) **Economic issues:** risks related to the availability, accessibility, or price of resources;
- 2) **Social issues:** risks associated with social problems surrounding the production of resources, such as human rights issues, exploitation, and poverty;
- 3) **Environmental issues:** risks created by environmental problems surrounding the production of resources, such as pollution, loss of biodiversity, etc.

The sustainable supply security of all three commodities suffer from similar types of threat. First, all commodities experience a fair to high level of global market concentration, limited to no alternative sourcing options from within the EU, and only fair to poor substitutability. This renders their supply vulnerable in case an interruption should occur. Second, at a local level, soy, cocoa, and palm oil producing countries all suffer from social challenges pertaining to land use, and land ownership rights of local communities. This means that the production of all three commodities carries a potential for social tension. Finally, from an environmental point of view the production of all three commodities is affected by a range of threats including deforestation, wildlife and habitat destruction, pollution due to the use of chemicals, and yield reduction caused by pests and diseases. This means that unless production becomes more sustainable in the long term, social tension or reduced quality of the product as a result of these issues is likely to hamper the availability of these commodities in the future.

3.3 CONCLUSION

Agricultural commodity imports are of strategic importance to the Netherlands. Soy, cocoa, and palm oil are widely used in the Dutch agri-food sector. The Netherlands is almost fully import dependent for these commodities, for which only limited substitutes and domestic sourcing options within the EU exist. This leaves the Netherlands vulnerable to risks associated with developments in the global markets for soy, cocoa and palm oil, such as increased competition over supply. In addition, sustainable security of supply is undermined by various economic, social and environmental risks that may be influenced by the dynamics of the global resource nexus. To achieve sustainable security of supply, it is important to assess the economic, social and environmental risks that may undermine supply in conjunction with one another, and not in isolation. A nexus approach enables policymakers to assess the various risk dimensions and feedback loops of the global resource nexus. The next three chapters delve deeper into the sustainable security of supply the three different risk dimensions above, and consist of case studies on the challenges pertaining to sustainable security of supply of soy, cocoa, and palm oil from the top-suppliers to the Netherlands, respectively Brazil, Côte d'Ivoire, and Malaysia.

4 SOY PRODUCTION IN BRAZIL

This chapter examines the nexus dynamics of the soy production in Brazil. Brazil is The Netherlands' largest supplier of soy, with 39% of Dutch soybean imports originating in the country. Soybeans are equally important to Brazil, comprising 68% of total national agricultural production. Brazil is currently the second largest producer of soy beans in the world, and its production is expanding. These factors together make Brazilian soy production a relevant case to analyze the implications of the resource nexus in relation to sustainable supply security of soy for the Netherlands.

The impact of global megatrends on soy bean production in Brazil is examined across several axes, along with the interaction effects between the resources and variables included in our nexus approach. This includes discussion of the local, regional, and global ripple effects (see chapter 2), as well as the economic, social, and environmental risks (see chapter 3). An overview of these effects is presented in Figure 18.

4.1 GLOBAL MEGATRENDS AND SOY PRODUCTION IN BRAZIL

The four global megatrends of economic growth, demographic trends, urbanization, and climate change all stand to have an effect on supply and demand of soy, and thus on Brazilian soy production. Below, we look at these four trends sequentially, but it is important to remember that none of the four can be assessed in isolation and that the interactions between these factors are at the heart of the global resource nexus.

Demographic trends. Population growth increases demand across the resource nexus, and stands to strongly affect Brazilian soy production. The global population is expected to reach around 9.6 billion by 2050, with Brazil's own population growing at an even more rapid pace.⁹⁴ Such growth inevitably means higher food consumption, and an increased demand for

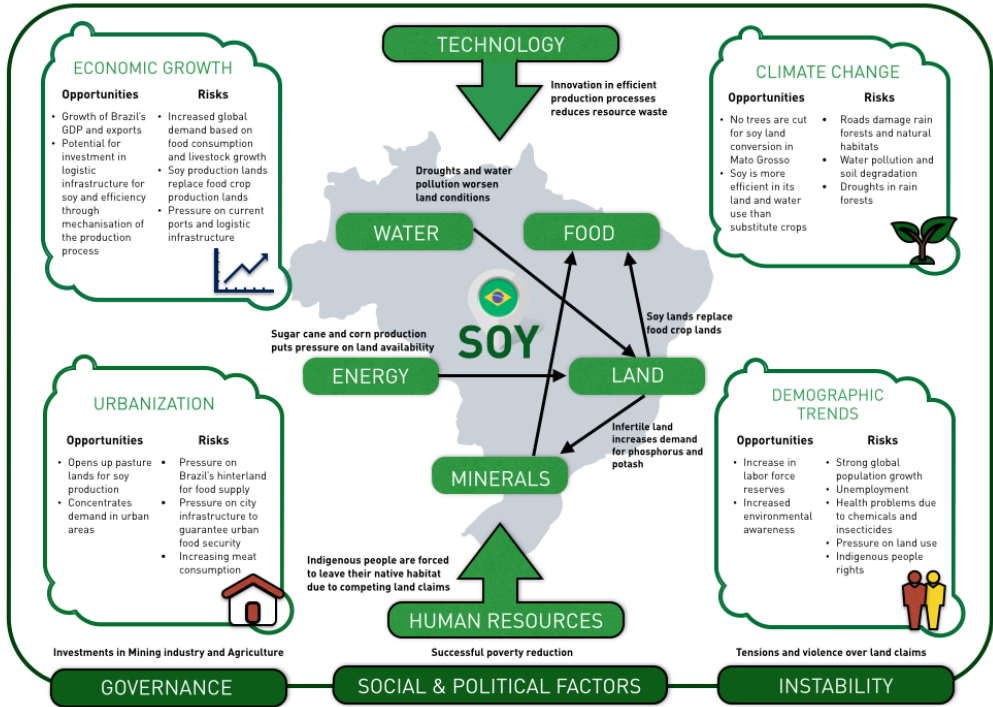


FIGURE 18 THE RESOURCE NEXUS OF SOY PRODUCTION IN BRAZIL

both agricultural produce and products used in food production. Soy is a key ingredient in both of these categories, used as a source of protein in food for human consumption and as an ingredient in cattle feed, so population growth is likely to have a direct effect on the demand for soy. This is particularly true of domestic consumption, as Brazil is relatively successful at lowering poverty rates, thus improving diets and increasing consumption levels.⁹⁵ Furthermore Brazilian cuisine is meat intensive (see Table 2), leading to higher meat consumption than might be expected given national income levels. This continues to increase Brazil's claim on domestic soy production.⁹⁶ These domestic demographic trends may also prove beneficial for the Brazilian soy industry, ensuring the supply of cheap manual labor needed to sustain farms.

Economic growth. As global economic growth continues to lift people out of poverty, more of the world's population will be able to afford affluent meat based diets, leading directly to higher demand for soy. Evidence of this can be seen in the dramatic rise in soy consumption in China over the past two decades, in line with the country's emergence as a global economic power.⁹⁷ As more states follow this trend of economic development, it is likely that the sharp increase in demand for soy witnessed in China will be mirrored around the world.

Furthermore Brazil has enjoyed rapid economic growth and development itself, posting a US\$ 77.5 billion trade surplus in 2011. Agricultural products play an important part in this success, accounting for 38% of Brazil's overall exports.⁹⁸ With this economic success has come an increased domestic demand for agricultural produce, with reforms enacted between 2003-2010 enabling more of the population to afford to consume more meat. Overall 79% of agricultural production is expended internally, with soy accounting for a large portion of this.

Beyond the direct economic benefits that soy production has had on the Brazilian GDP, the sector has also benefitted from increased mechanization and the development of a domestic bioethanol industry.⁹⁹ Furthermore, economic growth has allowed investment in agricultural research, which has resulted in a 151% boost in crop productivity over the past 30 years.¹⁰⁰

Urbanization. With an increasing global population and economic growth comes increased urbanization, and it is estimated that around 70% of the world's population will live in cities by 2050.¹⁰¹ This is important, as urban populations tend to consume more meat than those living in rural environs.¹⁰² As a result, global livestock numbers could increase by up to 23% by 2050, and global consumption of beef and mutton could rise by 30% (see Table 2).¹⁰³ This will inevitably increase demand for soy, as soy protein forms an important element of animal feed. Brazil is also witnessing a trend of urbanization internally, which has a twofold effect. First it frees up rural land for the expansion of soy cultivation, allowing the supply of soy to match the growing demand. This is also of benefit to the Brazilian economy, as the cultivation of soy offers profits of between US\$ 120 and US\$ 160 per acre. Second it simplifies the logistics of food distribution in Brazil itself, centering distribution networks around large urban populations.

Climate Change. The effects of climate change on Brazilian soy production are the least predictable of the global megatrends, although they have the largest potential impact. Brazil has seen several unusually dry periods over the past five years, including the first half of 2014. This has had a negative impact on soy production, as the crop suffers in particularly hot and dry weather.¹⁰⁴ The drought has also resulted in lower water levels in the Amazon basin, limiting the quantity of water available for irrigation of soy fields. However, the dry weather has improved the logistics of harvest, allowing for longer harvest days, more effective load processes, and easier travel for soy hauling trucks.

| REGION | LIVESTOCK (KCAL/PERSON/DAY) | | | BEEF AND MUTTON (KCAL/PERSON/DAY) | | |
|------------------------------|--------------------------------|------|----------|--------------------------------------|------|----------|
| | 2006 | 2050 | % CHANGE | 2006 | 2050 | % CHANGE |
| European Union | 864 | 925 | 7% | 80 | 75 | -6% |
| Canada & USA | 907 | 887 | -2% | 117 | 95 | -19% |
| China | 561 | 820 | 46% | 41 | 89 | 116% |
| Brazil | 606 | 803 | 33% | 151 | 173 | 15% |
| Former Soviet Union | 601 | 768 | 28% | 118 | 156 | 32% |
| Other OECD | 529 | 674 | 27% | 64 | 84 | 31% |
| Latin America (ex. Brazil) | 475 | 628 | 32% | 59 | 86 | 45% |
| Middle East and North Africa | 303 | 416 | 37% | 59 | 86 | 45% |
| Asia (ex China, India) | 233 | 400 | 72% | 24 | 43 | 79% |
| India | 184 | 357 | 94% | 8 | 19 | 138% |
| Sub-Saharan Africa | 144 | 185 | 29% | 41 | 51 | 26% |
| World | 413 | 506 | 23% | 50 | 65 | 30% |

TABLE 2 GLOBAL CONSUMPTION OF LIVESTOCK, BEEF AND MUTTON¹⁰⁵

4.2 INTERACTION EFFECTS BETWEEN BRAZILIAN SOY PRODUCTION AND OTHER RESOURCES

This section highlights some of the interaction effects between Brazilian soy production and the supply and demand of land, food, energy, minerals, and water. The major issues are the large quantities of land required to cultivate soy, as well as the large scale use of mineral fertilizers. Although

Brazil has both the land and water capacity to increase its current soy production levels, the ecosystems in which soy cultivation is taking place are some of the world's most complex.

Land is a key resource for Brazilian soy production, and its use has been a source of contention, particularly in rainforest areas such as Mato Grosso and the Amazon Basin. Soy production in these regions has been linked with deforestation, leading to a sustained level of anti-soy activism from environmental groups such as Greenpeace. The direct problems of deforestation for soy production were highlighted when an extreme drought hit Brazil in 2005.¹⁰⁶ Soy expansion into rain forest areas seemed to amplify the effects of the drought, leading the government to place a moratorium on this expansion in 2006.¹⁰⁷ Enforced by satellite monitoring, deforestation for the purpose of soybean production fell significantly in certain areas of the country.¹⁰⁸ Degraded lands have been reused for cattle ranging, with state of the art technologies used to monitor water pollution and soil degradation. The soy moratorium expired in January 2014, and deforestation is reported to have subsequently been on the rise.¹⁰⁹ Despite some success with land stewardship programs intended to minimize the environmental impact of soy production, the ecosystem remains brittle. Even if high priority is given to the protection of forestry and other natural resources, the vast expansion of soy fields cannot take place without impacting the country more widely.

Minerals. Brazil is one of the top importers of phosphorus and potash, together used as fertilizer for soy production.¹¹⁰ These imports are needed in Mato Grosso in particular, as soils in the region lack the required levels of phosphorus and other minerals to cultivate soy effectively. As a result, farms in the region require twice as much phosphorus fertilizer as their counterparts in more temperate regions, where the soils are younger and more fertile.¹¹¹ In an attempt to reduce mineral import dependency, and to strengthen its position as a global agricultural powerhouse, Brazil has invested heavily in its domestic fertilizer industry. Several companies have started projects making fertilizer from nitrogen and phosphorus in Cerrado and Mato Grosso, and potash in the Amazon basin.¹¹² However, domestic producers suffer a heavier tax burden than importers, which hinders the industry and has resulted in calls to raise a tariff on imported fertilizer.

However, any such tax increases on imported fertilizers could be passed on to the end consumer in the form of higher prices and higher inflation¹¹³.

Energy. Brazil has made a partial transition from traditional fossil fuels to ethanol biofuels produced from soy beans, sugar cane and corn. The challenge for Brazil's farm sector is to sustain production growth in order to meet increasing domestic demand and, at the same time, maintain its position as a major supplier of agricultural commodities to world markets. The growth of Brazil's biofuel industry affects the availability of grains and oilseeds used both for other domestic processes, and for export.

Water. Soy production is a water intensive process, although much of this comes naturally from rainfall as opposed to irrigation.¹¹⁴ In principle this limits the effect of soy cultivation on the availability of water. However, one major problem associated with soy production is the pollution of water through the extensive use of herb and pesticides. The effects of this will be discussed in the next section of this chapter.

Food. Despite being a foodstuff itself, soy production has had mixed effects on the availability of food in Brazil. Aside from contributing directly to food security through being used as a protein rich filler in food for animal and human consumption, the rise in popularity of 'double cropping', where a second crop is planted between soy harvests, has also led to an increase in corn production in parts of Brazil.¹¹⁵ This contributes to further food security. On the reverse side however, the increased use of soy for biofuel purposes has pushed up soy prices, causing a knock-on effect on food prices across the board.¹¹⁶ This is a contributing factor to the food insecurity which persists in parts of Brazil.¹¹⁷

4.3 BRAZILIAN SOY PRODUCTION AND WIDER NEXUS EFFECTS

The nexus effects of soy production in Brazil are not limited to interplay between resources. Soy production is also influenced by – and may, in turn, influence – a variety of other factors such as governance, technology, human resources, social and political factors, and stability.

To examine these effects in the case of Brazilian soy production, it is necessary to start with governance issues. These are incredibly complex,

and include local, national, and international laws and regulations. An obvious starting point, however, is the position of the Brazilian government regarding soy production. In general terms the government seems to be in favor of soy. A press statement released by the Brazilian Ministry of Agriculture in February 2014 noted with pride that the GDP of the agricultural sector stands to expand by 34% between 2005-2015.¹¹⁸ This is perhaps unsurprising given the massive part that agricultural products play in sustaining Brazil's trade surplus, with soy exports a major contributor to this. The Brazilian government has also invested heavily in necessary infrastructure for the expansion of the soy industry. Brazil is currently close to the limits of its export ability, with roads and ports already operating at 100% capacity. This has led to the aforementioned new highway system under construction in Mato Grosso, which will link soy fields with new ports and ease pressure on current infrastructure.¹¹⁹ However until that time, Brazil risks delays in delivery, and the cancelling of major orders, mainly from China.¹²⁰ This has impacts on the wider Brazilian economy.

However, despite this positive attitude the Brazilian government has not blindly allowed the expansion of soy, particularly into the politically sensitive Amazonian regions. The soy moratorium mentioned above shows that a balance is being sought between increased economic growth and environmental concerns. However despite attempts at balance, soy farming still has adverse effects on the environment and local peoples. For instance the use of strong pesticides and herbicides on soy crops is legal, and their use on soy farms has increased. This includes the agrichemical herbicide glyphosate, which genetically engineered Round Up-ready varieties of soybean seeds, the most commonly used type, are designed to resist. However many other elements of the ecosystem have never been farmed before, and are not resistant to herbicides. Therefore when herbicide runoff from soy fields enters the water supply, it can adversely affect the wider ecosystem. The same can be said of insecticides. Soy production in tropical climates tends to be more susceptible to insect plagues, as many insects thrive in warm weather. Therefore, the use of insecticides is much higher here than in colder climate zones, having a polluting effect on the wider environment. On top of this the expansion of road works, logging, mining, poaching, ranging, and intensive farming places further pressure on the fragile ecosystem.

Soy farming also has wider adverse effects on local populations. The expansion of soy production has led to huge quantities of land being bought up, sometimes compulsorily, by large corporations. This adversely affects ecosystem management, and impedes the local populations' ability grow food for their own use. This ability is further impeded by the polluting effects of herb and pesticides mentioned above. Non-GM crops grown by local populations can be damaged by the use of water polluted by chemicals used on soy fields, whilst agrichemicals are known to pose health risks to workers and villagers in soy production areas. Aside from land use and environmental factors, the high levels of mechanization now present in soybean production can also contribute to local unemployment, as less labor is required in the growing and harvesting process.

These adverse effects have led to tensions between soy farms, the government, and local populations. Violence was particularly prevalent in 2013, when indigenous and local people, united as 'Occupy Mato Grosso', clashed with police on several occasions. The number of people killed due to land and environmental disputes rose over 20% in 2012, and 2013 is expected to show similar figures. This is a classic example of the ripple properties of second order effects of soy production. The purchase of land by large farming conglomerates, and the subsequent pollution of local habitats, has caused a relative scarcity of land and food for local populations. This in turn has caused instability through protest, and in the worst cases conflict.

Although these protests remained on a local scale in Brazil, such instability can easily have a wider effect. For example, protests have the potential to limit the production of a particular good, creating a shortage of that product. Such supply problems can then impact exports, driving up competition amongst international consumers, and hiking prices. This then means that what started as a local protest now has a global impact, an example of why understanding the nexus approach is so necessary to policymakers in consumer as well as production countries.

4.4 IMPLICATIONS FOR SUSTAINABLE SECURITY OF SUPPLY

These nexus dynamics of soy production in Brazil could impact long term sustainable security of supply for the Netherlands in a variety of ways, particularly given the magnification of the ripple effect from the local to global levels. This section will highlight some of these risks, in line with the definition of sustainable security of supply given in chapter 3. These risks highlight that we must go beyond the objective of merely securing sufficient resources to safeguard economic performance, and consider the interaction effects and feedbacks loops between different resources. This is at the heart of the nexus approach.

ECONOMIC ISSUES

The economic risks to the Netherlands of fluctuations in soybean supply stem chiefly from the Dutch agri-food sectors' reliance on imported soy products. As a large soy importing country, the Netherlands stands to lose out if soy prices rise, or if there is a shortage of soy globally. The ends to which fluctuations may affect the Netherlands are hard to predict, as it is not clear how much the supply and price of soy will change over the next decade. It is a fact that emerging economies are gradually using more soybeans, and demand for soy on global commodity markets is expected to grow for at least another five to ten years. This increased market competition places pressure on suppliers, and could drive up prices if demand exceeds supply.

However, this is of course also dependent on supply levels. In the case of Brazil, the aforementioned 40 billion acres of new production in Mato Grosso will act to sharply increase soybean production to the point where supply may actually exceed the growing demand. This would cause prices on the Chicago soybean market to drop, which may in turn boost demand, particularly from China. It should be noted here that Brazil is the only country which has the capacity to increase its soy production dramatically, with other soy producing states near their production ceilings. This means that soy importing countries worldwide, including the Netherlands, are depending on Brazil to increase supply levels.

Regardless of which of these two scenarios occurs, it seems clear that in the long term, a dependence on soy imports for our livestock and food processing sectors is a liability.

SOCIAL ISSUES

The social factors which could impact Dutch soy imports are twofold. First are the impacts of soy farming on the supply of soybeans from Brazil itself, and second are the Dutch domestic factors affecting demand for soy from Brazil. As with all elements of the nexus, these are interlinked, and it is the interplay between them which stands to have the greatest impact on sustainable security of supply.

In Brazil, indirect land use change (iLUC) has contributed to social unrest, as soy production is claiming large pieces of land otherwise used for other economic activities. This forces local peasants and indigenous people to move elsewhere. There is significant tension over this change of landownership, a topic which Oxfam addressed in their 2013 report on the so called 'land grab'.¹²¹ This report cast the international spotlight on the issue, and prompted the Brazilian state prosecutor to investigate the cases presented in the report.

The facts outlined also had social effects in the Netherlands. The revelations were of concern to the Dutch government, as human rights are a central theme in Dutch foreign policy. The Dutch Minister of Foreign Trade and Development, Lilianne Ploumen, was urged to respond to the claims of the Oxfam report on the Dutch news program 'Nieuwsuur' (One of the main television programs on Dutch television about daily news analyses and backgrounds). She also presented a letter to the Dutch parliament in response to a request to explain the involvement of Dutch banks in relation to land grab in Brazil.¹²² This led to the initiation of a round table conversation with Dutch banks to discuss their role in encouraging better land governance. One of the conclusions of these discussions was a policy letter in which the banks stated a positive desire to engage in multi-stakeholder dialogues on ways to improve land management. In addition the topic is regularly broached by Dutch representatives in diplomatic meetings with Brazil. Dutch representatives at the Round Table on Responsible Soy (RTRS) also emphasize human rights and social effects of soy production as important in their aim to improve sustainability and fair trade standards in the industry.

This type of revelations increasingly causes the Dutch public to demand more 'sustainable' and 'fair' alternatives. This naturally has an effect on demand for Brazilian soy, with Dutch companies seeking either to show that their suppliers are sustainable through initiatives such as RTRS certification, or by looking for new import markets.

ENVIRONMENTAL ISSUES

The environmental effects on the supply and demand of soy to the Netherlands are also both local and global, and linked with public opinion. Environmental constraints are serious in the Amazon basin, where large scale and prolonged logging of tropical forests has affected local ecosystems and the global climate system. This habitat is one of the most politicized in the world, and there is considerable concern amongst the publics of many Western states over the continued destruction of the area. The Netherlands is no exception, and the close ties between Dutch businesses and Brazil only stand to amplify these effects.

As with the social effects, the strength of public opinion on the issue has encouraged Dutch suppliers to take these issues into account. There has been some movement on this, with the environmental impacts of soy production becoming more widely understood in policy circles within Brazil. Recent developments such the soy moratorium in Mato Grosso aim to minimize the negative environmental impact of production. Ecosystem monitoring projects, such as Global Forest Watch by the World Resource Initiative and partners, are being more widely applied to prevent logging and poaching in order to cut deforestation rates.¹²³

Direct ecosystem degradation is also not the only issue of concern for Western publics. The use of genetically modified (GM) crops also faces strong resistance, particularly in Europe. The use of GM crops for animal feed purposes means that humans are consuming GM crops indirectly, a point of particular concern for the Dutch public. Currently, Brazilian soy producers grow both non-GM and GM soy, with the non-GM crop being sold mostly to the European markets. However in the near future it is conceivable that Brazilian producers will no longer see the need to focus on producing GM free soy for Europe, as demand for regular GM soybeans from other countries will be substantially larger and more profitable. This could impact the supply of soy to the Netherlands hugely, and several

Dutch feedstock providers have already started programs seeking alternatives, such as non-GM European soy.

4.5 CONCLUSION

Brazil is the world's biggest supplier of soybeans, one of the world's top agricultural commodities used in animal feed and a variety of manufacturing processes. Worldwide demand for soy is likely to increase as the global population grows and becomes wealthier, and meat consumption increases. Brazil is crucial to the global soy market as it is the only country that has the capacity to substantially increase soy production, with plans underway for 40 million acres of new soy fields in the Mato Grosso region. However in doing so the country faces challenges from local indigenous populations, problems with infrastructure and port expansion, and further damage to its fragile ecosystems. This constant pressure on the resources required for soy bean production is likely to keep giving rise to social tensions and weakening of local ecosystems, which are important to tackling climate change globally.

These dynamics may eventually affect long-term sustainable security of supply to the Netherlands, with two price scenarios possible. If expansion of soy production in Brazil increases at such a rate that it outmatches demand, the price of soy may drop. However if global demand, notably from China and other developing states, grows as expected it could also outpace supply, causing a rise in soy prices. Either of these scenarios will inevitably have an effect on the Dutch agri-business sector. Beyond issues of price, social and environmental issues also undermine the sustainable security of supply of the Netherlands. In this light, it is a positive development that the Brazilian government seems willing to improve its environmental and social performance, assisted by new technologies such as satellite monitoring, GPS farming, and enhanced ecosystem monitoring.

5 COCOA PRODUCTION IN CÔTE D'IVOIRE

Cocoa and its derivatives are Côte d'Ivoire's largest export commodities, accounting for 37% of all exports in 2011.¹²⁴ Around 20% of these are destined for The Netherlands, which itself is the single largest importer of cocoa beans and derivatives in the world.¹²⁵ Of Dutch cocoa imports, 35% originate from Côte d'Ivoire, with cocoa accounting for 95% of the €1.74bn annual trade between Côte d'Ivoire and The Netherlands.¹²⁶ Furthermore, a large proportion of cocoa exported from Côte d'Ivoire bound for other countries comes onto the international market via the port of Amsterdam, and many Dutch companies operating in the cocoa sector are represented in Côte d'Ivoire. This makes cocoa production in Côte d'Ivoire a relevant case study to illustrate the nexus approach and its implications.

This chapter starts with discussion of the impact of global megatrends on Ivorian cocoa production, before moving on to interplay between nexus resources, the wider nexus effects, and the risks to the security of supply of cocoa to the Netherlands. Figure 19 provides an illustrated overview of these effects.

5.1 GLOBAL MEGATRENDS AND COCOA PRODUCTION IN CÔTE D'IVOIRE

The four global megatrends of economic growth, demographic trends, urbanization, and climate change, all stand to affect cocoa production in Côte d'Ivoire. The visualization above outlines the basic opportunities and risks presented by each, and it is these on which this section will elaborate. None of the four should be assessed in isolation, and the interaction between these factors is at the heart of the global resource nexus.

Demographic trends. Whilst cocoa is not a staple foodstuff, demand for the product will inevitably grow as consumption of cocoa based foods increases due to global population growth. On a local level, cocoa

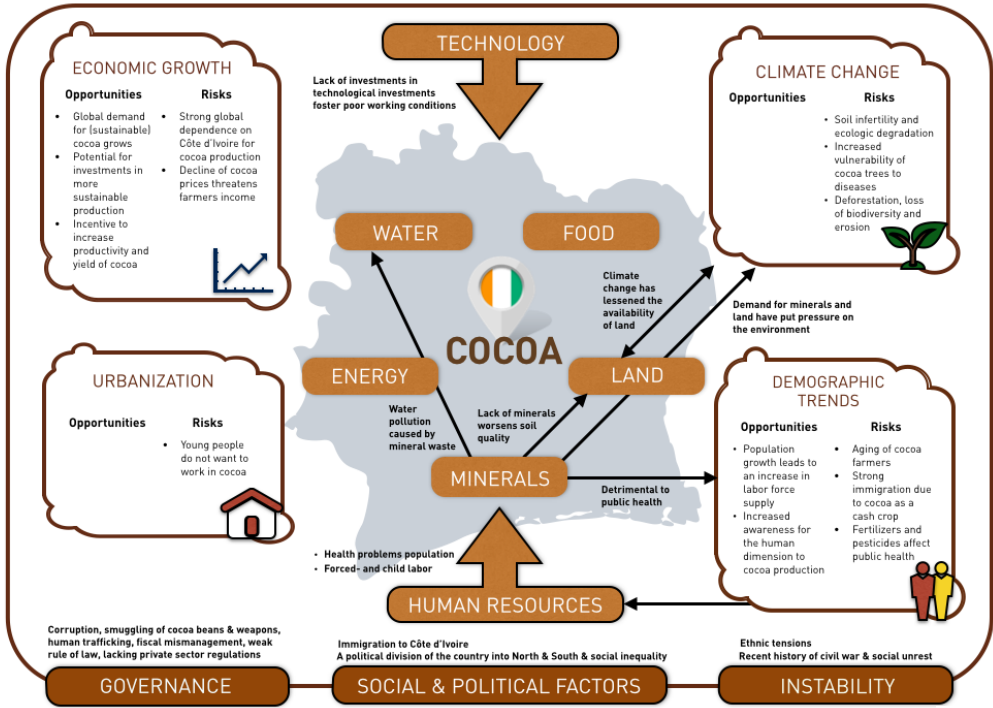


FIGURE 19 THE RESOURCE NEXUS OF COCOA PRODUCTION IN CÔTE D'IVOIRE

production areas in Côte d'Ivoire are witnessing population growth, partly through a high birth rate amongst rural populations, and partly due to urban expansion into previously cocoa producing areas.¹²⁷ The Ivorian cocoa sector is also at risk of a shortage of cocoa workers due to an ageing population amongst farming families. The average age of cocoa farmers in West Africa is around 50 years and, with a life expectancy of around 60, the current generation will soon start passing away. The poor living and working conditions make the cocoa sector unappealing to younger generations, who hope to find better employment elsewhere.¹²⁸

Economic growth. As economic growth continues to increase wealth in developing countries, more of the global population will be able to afford luxury foods such as chocolate. This is evidenced by world cocoa consumption (as measured by grindings of cocoa beans by the industry)

increasing on average by 2.9% per year between 2002-2010.¹²⁹ Demand growth is not uniform globally, with growing demand for cocoa in the past decade driven largely by emerging markets in Brazil and Eastern Europe. Meanwhile, demand from India and China is not as strong as expected, but forecasts predict that in time Asia will become an important global export market for Ivorian cocoa.¹³⁰ Brazil is a good example of how economic growth affects supply for cocoa. In the past the country was a major cocoa exporter, yet as the country has developed economically domestic consumption has increased to the point where Brazil now consumes as much cocoa as it produces. A similar pattern may emerge in Côte d'Ivoire: as the country prospers economically, less Ivorian cocoa may become available for export.

Urbanization. On a global basis urbanization is likely to increase demand for cocoa, as urban populations tend to consume more chocolate and other cocoa based products than rural populations, particularly in developing countries.¹³¹ Furthermore the rate of urbanization within Côte d'Ivoire itself is higher than the average for the region, with the urban population growing significantly over the past two decades, to a total of over 52% in 2012.¹³² This reduces the availability of labor in for cocoa production rural areas, a highly labor intensive crop, thus potentially limiting the quantity harvested. It also expands the amount of land taken up by cities, which have encroached into cocoa producing areas, limiting the land available for cocoa cultivation.¹³³

Climate Change. Scarcity of arable land in Côte d'Ivoire is further aggravated by climate change and weather variability. Rainfall in the country has dropped by 15% over the past four decades, and wet periods have become more sporadic.¹³⁴ This has led to unpredictable harvests, with some years seeing a low yield and others witnessing a bumper crop. Cote D'Ivoire is also forecast to get warmer over the next four decades which might affect the availability of water for cocoa irrigation.¹³⁵

Overall, the global trend is that demand for cocoa is on the rise. This has pushed Ivorian cocoa farmers to take steps to increase cocoa yields, whilst only addressing sustainability concerns in passing. Between 2002 and 2012, world cocoa production has risen at an average annual growth rate of 3.3%. Africa's share of this also increased from around 69% to 72%, with the

maximum being 75% during the record harvest in 2010-2011.¹³⁶ In 2011, Côte d'Ivoire produced 1.6 million tonnes of cocoa beans. In the past 10 years its production has fluctuated between 1.2 and 1.6 million tonnes, with a slightly rising trend line. Despite these gains however, Côte d'Ivoire's yield capacity (hectogram/hectare) has decreased by 11% from 2000 to the present date. This decrease contrasts with the rising yields in other cocoa producing countries from which the Netherlands imports.¹³⁷

5.2 INTERACTION EFFECTS BETWEEN IVORIAN COCOA PRODUCTION AND OTHER RESOURCES

The production of cocoa in Côte d'Ivoire has implications for the demand of other resources in the nexus, and this in turn affects the sector as a whole. The most notable effect of the growing demand for cocoa has been an increase in demand for land and minerals, which has led to negative environmental effects in cocoa producing regions. Furthermore cocoa production itself has a compromising effect on the environment, causing soil fertility problems and deforestation, which in turn negatively impact the quality and quantity of cocoa yields. Climate change is also exacerbating the pressure on the availability of land, as the country gets warmer and rainfall becomes less predictable. With harvests of between 200kg to 500kg of cocoa per hectare per season, cocoa yields in Côte d'Ivoire are amongst the lowest in the world due to these problems. By comparison, yields in Indonesia range between 1000kg and 2000kg per hectare.¹³⁸

Land. The expansion of cocoa production has historically led to the clearing of virgin forests to make way for cocoa plantation, whilst most of the fertile land in Côte d'Ivoire that is suitable for cocoa production is already being exploited. The production of cocoa has led to a major loss of biodiversity, as many of the cocoa producing areas have no original forest left. The Ivorian forest has been drastically reduced from 16 million hectares in 1900 to about 3.5 million hectares in 2009 (including parks, reserves and classified forest).¹³⁹ Deforestation is also contributing to declining soil fertility, particularly through soil erosion and depletion of nutrients. Deforestation has also led to an increase in full sun cocoa plantations, which generally yield a lower harvest those grown in the shade. Shade trees are beneficial for the growth of cocoa, helping conserve habitat and hydrological functions.

A factor contributing to declining yields is the aging of cocoa trees. Around 60% of the cocoa trees in Côte d'Ivoire are aged between 11 to 30 years. This ageing of trees, coupled with a lack of adequate input of nutrients, has resulted in the spread of cocoa diseases, particularly swollen shoot and black pod diseases.¹⁴⁰

Minerals. The cost of fertilizers in Côte d'Ivoire is high compared with other cocoa producing countries. Limited application of fertilizer and pesticides has diminished soil fertility, making cocoa plantations more susceptible to diseases, low yields, and poor quality harvests. Nonetheless there is an increased demand for fertilizers and pesticides, as farmers seek to increase yields. This rise in the use of fertilizers stands to have detrimental environmental and public health effects.¹⁴¹ An increase in the use of fertilizers also has wider regional effects, as phosphorous mining for use in fertilizers has the potential to degrade the ecology of African regions where the minerals are mined. The prohibitive cost of fertilizers and pesticides within Côte d'Ivoire itself is also an economic barrier to cocoa production expansion.

Energy. Energy consumption for cocoa harvests mainly comes at the drying stage, for which farmers traditionally use wood burning stoves. This adds to greenhouse gas emissions, and has an effect on deforestation in the country. To attempt to combat this, large scale solar powered drying solutions are now used by several cocoa companies in Côte d'Ivoire.¹⁴² Even small scale smallholders can benefit from cheap and easily built solar driers which do not rely on electricity and utilize greenhouse type apparatus to improve the drying process. This sort of drier would help reduce the negative effects of wood burning.¹⁴³

Water. Changes in rainfall patterns have had detrimental effects on cocoa production, with droughts in recent years causing low yields. Meanwhile irrigation in the country is lower than the regional average, despite increasing at a rate of around 3.2% per year for 30 years.¹⁴⁴ Over decades this amounts to a large increase in the amount of irrigated land, placing pressure on water available for other uses, especially during dry periods. Pesticide use is also increasing in within Côte d'Ivoire, which may deteriorate the quality of local water resources, contributing to health hazards.

Food. The majority of arable land in Côte d'Ivoire is dedicated to food production, although the country does not enjoy full food security. The number of daily kilocalories available per capita is lower than neighboring Ghana, but higher than other countries in West Africa.¹⁴⁵ The cultivation of cocoa does not seem to have much of an effect on food availability, and despite a rise in the cultivation of cash crops such as cocoa and rubber over the past decade, yields of traditional food crops such as cassava and yams have also increased.¹⁴⁶

5.3 IVORIAN COCOA PRODUCTION AND WIDER NEXUS EFFECTS

Governance instability and conflict have been recurring factors in within Côte d'Ivoire, and have acted as the most consistent factors dictating policy and performance of Ivorian cocoa production. The economy of Côte d'Ivoire was brought to its knees at the end of the last century by falling commodity prices, along with government corruption and fiscal mismanagement. At the same time, a coup d'état and the installation of a military junta caused the termination of foreign assistance. Private foreign investment declined sharply while the internal and external government debt ballooned. As a result the Ivorian economy contracted by 2.3% in 2000.¹⁴⁷

Thereafter the economic situation further worsened as the political situation deteriorated into a civil war in 2002, resulting in the de facto division of the country between the rebel held North and government held South. Stability has gradually been restored since the election of a civilian government in 2010, although further turmoil erupted after the 2010 presidential elections when former president Laurent Gbagbo refused to acknowledge electoral defeat. In response the internationally recognized winner of the elections, Alassane Ouattara, banned all cocoa and coffee exports in order to choke off funding to his rival. As a result of the export ban, world cocoa prices jumped to a 30-year high in March 2011.¹⁴⁸ After assuming office, Ouattara implemented an agriculture program which entails a US\$ 4.5 billion investment in the sector between 2012 and 2016, aiming to create 2.5 million jobs. The cocoa sector needs serious investment to recover from the damage done by the conflict.¹⁴⁹

Aside from conflict and governance issues, cocoa farmers face other challenges. Whereas cocoa production represented a viable source of income for farmers during the first decades of the second half of the 20th century, cocoa prices declined during times of over production. The economic recession of the 1980s, the liberalization of cocoa markets, and instability in many producing countries also affected the price of the product.¹⁵⁰ The average income of most cocoa farmers is now far below the level of absolute poverty, with most cocoa farmers never having tasted chocolate as they cannot afford it. The majority of cocoa is produced by smallholders, and working conditions on these small farms remain very poor. The harvesting, fermenting, and drying of the beans are often hazardous, non-mechanized processes which require hard manual labor and long working hours.

As mentioned earlier, the average age of cocoa farmers is increasing as younger generations seek better prospects in other sectors. This is likely to have an effect on output, as families which have traditionally farmed cocoa cease doing so. Furthermore cocoa smallholders are sometimes forced to rely on unpaid workers due to insufficient income and shortages of young workers in rural areas. These unpaid workers are often family members, including children, who work excessive hours under conditions close to forced labor. Cocoa farms are reported to abuse labor and human rights, sometimes engaging in human trafficking, slavery, and gender and ethnic discrimination.¹⁵¹ Corruption in government circles is high, and officials have close ties with the cocoa industry, making it difficult to address these issues.¹⁵² Furthermore, since the early days of cocoa being cultivated as a cash crop, cocoa producing regions have witnessed immigration, with around 25% of the workers in these regions consisting of immigrants and in-country migrants. This has contributed to social tensions.

In an attempt to improve the quantity and quality of cocoa production in Côte d'Ivoire, the government re-established the Conseil du Café-Cacao (CCC) in 2012. This council, which had been disbanded 20 years prior, aims to regulate the country's cocoa industry by implementing transparent and reliable trade structures, strengthening cooperatives and the cooperation of the different players along the cocoa value chain, and guaranteeing farmers 60% of the world market price for their cocoa.¹⁵³ Although international initiatives to promote sustainable production have found their

way to the country, the lack of transportation, roads and accommodation prevent the implementation of sustainability pilots in remote areas.¹⁵⁴

The risk of instability remains high. Côte d'Ivoire suffers from endemic corruption, an ineffective and weak government, poor rule of law, a lack of strong and reliable private sector regulations, and a limited possibility for the population to voice their grievances and to hold governmental action to account.¹⁵⁵ Through the dynamics of the resource nexus, cocoa production – which could be a source of wealth and wellbeing for the Ivorian population – paradoxically also contributes to resource scarcity and environmental degradation, and increase the likelihood of instability and conflict.

5.4 IMPLICATIONS FOR SUSTAINABLE SECURITY OF SUPPLY

As cocoa is one of the tropical commodities for which the Netherlands is fully dependent on producers elsewhere in the world, growing global demand may threaten the sustainable security of supply of cocoa to the Netherlands. Increasing cocoa yields in the number one supplier of cocoa to the Netherlands is a necessity, but doing so in a sustainable manner is vital to ensuring security of supply. This section highlights some of the economic, social and environmental risks to the sustainable supply of cocoa from Côte d'Ivoire to the Netherlands.

ECONOMIC ISSUES

The main economic issues affecting the future security of supply of cocoa to The Netherlands are centered around growing demand, price fluctuations, and temporary supply disruptions due to instability.

With the global demand for cocoa rising, there is an increasing gap between demand and supply on the world market.¹⁵⁶ Dutch demand alone rose 59% between 2002 and 2011, although it should be stressed that the Dutch domestic market for chocolate confectionery is relatively small.¹⁵⁷ Nonetheless the European Union as a whole shows a strong demand for cocoa products, and consumers are increasingly demanding sustainably produced and fair trade merchandise.

Furthermore, none of the countries outside the current top 5 producers are capable of meeting demand for cocoa beans of the Dutch industry. This means that any interruption in supply from Côte d'Ivoire would have to be offset by imports from multiple countries. Countries which could partially cover a drop in supply are Indonesia, Brazil, Ecuador, and to a lesser extent Togo and Colombia.¹⁵⁸

Côte d'Ivoire is also expanding its domestic processing capacity. In 2009-2010 Côte d'Ivoire surpassed the US and Germany to become the second largest cocoa processing country in the world, just behind the Netherlands. In order to encourage domestic processing the government is taking several of fiscal measures, the largest of which has been to reduce export taxes on cocoa powder to levels much lower than those of unprocessed cocoa beans.¹⁵⁹ This means Dutch imports from Côte d'Ivoire may increasingly consist of processed rather than raw cocoa, which entails paying the price for the value added.

SOCIAL ISSUES

A sustainable supply of cocoa from Côte d'Ivoire is also compromised by the social conditions under which cocoa is produced. As in other West African cocoa producing countries, social issues are a major problem in the Ivorian cocoa sector.¹⁶⁰ A growing trade in cocoa has not improved working conditions and livelihoods of those working in the areas where cocoa is grown. Poverty, hunger, disease, child labor, and discrimination against women remain endemic among workers in the cocoa industry. These problems affect Dutch ambitions to source cocoa sustainably. Though many national and international projects aim to deal with these social issues, most efforts focus on improving yields and income for farmers. Fair trade goods are an example of this philosophy. However it is not guaranteed that increased revenues will resolve some of the social wrongs in the cocoa sector, which are more structural than cosmetic.¹⁶¹

ENVIRONMENTAL ISSUES

The production of cocoa in Côte d'Ivoire has a negative impact on the environment, which negatively affects the sustainable supply of cocoa. This happens for example via the aforementioned interactions between increased demand for cocoa on the one hand, and the increased demand for mineral fertilizers and land on the other. Deforestation and declining soil

fertility are also putting serious pressure on the sustainable supply of cocoa. The loss of biodiversity increases the exposure and vulnerability of cocoa plantations to pests and diseases, which is worsened by the aging of trees and a lack of adequate inputs.¹⁶²

However these risks have to a certain extent been mitigated by efforts such as cocoa certification schemes, which have increased worldwide in recent years.¹⁶³ This has been driven largely by demand from consumers who have become increasingly aware of issues surrounding cocoa production. Numerous NGO campaigns have focused on child labor, discrimination against women, and other social wrongs associated with the cocoa supply chain. Heightened public awareness pushes chocolate producers to do more in this area, in order to improve their brand reputation and credibility. In the long term these certification schemes are likely to prove vital to ensuring the sustainable supply of cocoa to the Netherlands. Cocoa grown under the schemes is less damaging to the local environment, which in time may help increase the yield per hectare. This will increase output, ensuring that Dutch demand can be met.

5.5 CONCLUSION

This chapter has illustrated that from the perspective of sustainable supply security, the impact of the resource nexus on cocoa production in Côte d'Ivoire is highly relevant to the Netherlands. Cocoa is an important ingredient for Dutch industry, and Côte d'Ivoire is the largest cocoa supplier to the Netherlands. The global resource nexus influences cocoa production in Côte d'Ivoire in various ways. First, external drivers, such as economic development and population growth, contribute to an increase in global demand for cocoa. This encourages cocoa production in Côte d'Ivoire, which in turn increases demand for other resources, mainly land and minerals.

The increased demand is also considered an opportunity for cocoa producing countries to increase jobs, revenues, and exports. Despite these opportunities the economic, social, and environmental problems of the cocoa sector in Côte d'Ivoire are rooted in the dynamics of the global resource nexus. The political and social issues of bad governance, population pressure, conflict, and instability create an additional layer of issues influencing nexus dynamics. In sum, these interrelated issues may

ultimately undermine the sustainable supply security of cocoa to the Netherlands.

The dynamics described in the chapter indicate that economic, social and environmental challenges are likely to impact cocoa price, volume, and quality. In addition, they clearly undermine general Dutch policy priorities regarding development, human rights, and the environment. The Netherlands does not aim only for security of supply of cocoa at the lowest price, but also attaches value to the social and environmental dimensions of sustainability. Therefore, the Dutch government and businesses have already taken steps to address the problems in the cocoa supply chain, setting up several initiatives in this direction. Internationally the Netherlands is among the frontrunners in promoting certified cocoa production and sustainable chocolate (see also chapter 7). Nonetheless, Côte d'Ivoire is not a priority country for the Netherlands in terms of diplomatic relations. This means that the Netherlands has relatively few political instruments with which it can secure its sustainable supply of cocoa from Côte d'Ivoire, and instead must focus on public-private partnerships and civil society initiatives.

6 PALM OIL FROM MALAYSIA

Palm oil is the most traded vegetable oil in the world, comprising 60% of the market¹⁶⁴. It is used as an ingredient used in a variety of goods, from foodstuffs to cleaning products, as well as being one of the largest sources of biodiesel. The Netherlands uses a large quantity of the oil in many industrial processes, and accounts for approximately 4.5% of global palm oil imports. Over half of these Dutch imports originate in Malaysia, making Malaysian palm oil a useful case study to apply our nexus approach.¹⁶⁵

The chapter starts with discussion of the impact of global megatrends on Malaysian palm oil production, before discussing the interplay between nexus resources, the wider nexus effects, and the risks to the security of supply of palm oil to the Netherlands. Figure 20 provides an overview of these effects.

6.1 GLOBAL MEGATRENDS AND PALM OIL PRODUCTION IN MALAYSIA

The four global megatrends of economic growth, demographic trends, urbanization, and climate change, all stand to affect supply and demand of palm from Malaysia. The visualization above outlines the basic opportunities and risks presented by each, and it is these on which this section will elaborate. None of the four should be assessed in isolation, and the interaction between these factors is at the heart of the global resource nexus.

Demographic trends. Palm oil is one of the cheapest types of vegetable oil, making it a staple, particularly in emerging economies. As the global population grows, so too will demand for palm oil, with forecasts projecting that demand is expected to double between 2010 and 2050.¹⁶⁶ Presently, the Asia-Pacific region forms the largest global palm oil market, in terms of both production and consumption, driven by the growing population and

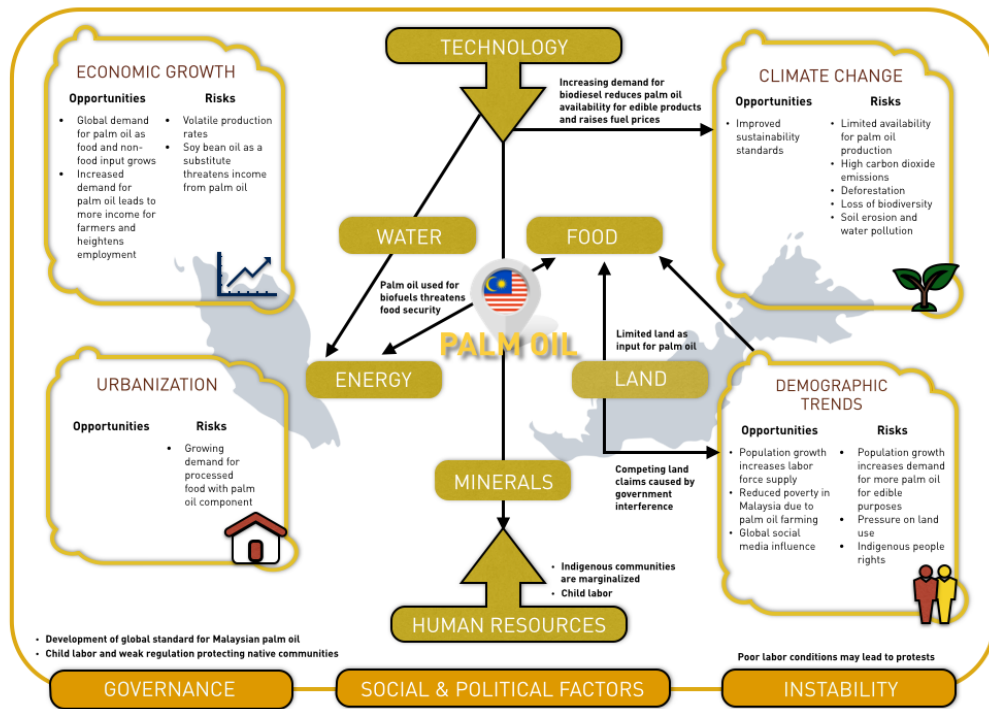


FIGURE 20 THE RESOURCE NEXUS OF PALM OIL IN MALAYSIA

increasing disposable income levels across the region. This is unsurprising given that the region is home to more than half of the world’s population (4.2 billion or 60%), with China (1.3 billion) and India (1.2 billion) between them accounting for 36% of the global population.

The effect of this growing population is clear, with India already the world’s largest importer of vegetable oils, a large proportion coming from Malaysia.¹⁶⁷ Furthermore, the combined populations of Indonesia (240 million), Pakistan (180 million), Bangladesh (150 million), and Japan (127 million) constitute another set of large markets for the palm oil industry.¹⁶⁸ The Middle East and North Africa (MENA) are also emerging markets for palm oil and related products due to limited vegetable oil production capabilities in the region, and the competitive commodity pricing of crude palm oil. The region is also one of the fastest growing in terms of population, with consumption levels rising accordingly.¹⁶⁹

Economic growth. Global economic growth in developing economies, notably India and China, are causing a growing middle class to develop in these countries. This pushes demand for palm oil up, as these homes consume more food and non-food palm oil products (mainly biodiesel). This trend has emerged since 2000, with palm oil demand from these countries increasing significantly in the second half of the 2000s.¹⁷⁰ Demand and supply forecasts suggest that this trend will continue. Meanwhile the latest FAO/OECD agricultural prognosis indicates that the global consumption of vegetable oil will increase by over 19% between 2013 and 2022, whilst demand for biodiesel is expected to increase globally by over 40% in the same period.¹⁷¹

Urbanization. The global demographic and economic megatrends outlined above are causing increased urbanization, particularly in South East Asia, the largest market for palm oil. As people migrate to cities their diets change, and urban populations tend to consume more processed foods.¹⁷² Furthermore as many new urban dwellers live on a low income, for example in slum-like conditions, the demand for cheap, poor quality, processed food rises. As palm oil is the cheapest vegetable oil, it is a key ingredient in many of these cheapest foods. Therefore increasing demand for the oil as more cheap processed foods are consumed.

Urbanization is also placing pressure on the availability of workers for palm oil plantations. Much of the harvest work on Malaysian palm forests is conducted by domestic and international seasonal workers, mainly from Indonesia. However, the number of applicants for these positions is declining as unskilled workers prefer to migrate to cities in search of work. This has already affected Malaysian palm oil output, with labor shortages accounting for around 5-10% of Malaysian palm fruit being left un-harvested.¹⁷³

Climate Change. A report by the Malaysian government in 2000 suggests that the palm oil sector is likely to be affected by climate change. Although a rise in average temperature stands to have little effect on palm output, the report finds that a 1% reduction in rainfall corresponds approximately with a 1% reduction in palm yields.¹⁷⁴ This is important to Malaysia, as climate change is already affecting rainfall patterns in the country, with monsoon rains coming more sporadically.¹⁷⁵

6.2 INTERACTION EFFECTS BETWEEN MALAYSIAN PALM OIL PRODUCTION AND OTHER RESOURCES

The production of palm oil in Malaysia has implications for the demand of other resources in the nexus, and this in turn affects the sector as a whole. This section highlights some of the interaction effects between Malaysian palm oil production and the supply and demand of land, food, energy, minerals, and water.

Land. The availability of land for palm oil cultivation in Malaysia is already at near-maximum levels.¹⁷⁶ However more land is being converted to palm plantations, leading to the destruction of peat lands and deforestation. With palm oil plantations encroaching further into forested areas, biodiversity and the functioning of ecosystems are threatened. Rare and endangered species of animal are under threat from this practice, as their natural habitat is reduced. The indiscriminate use of poisons to eliminate rats within oil palm plantations also poison other animals attempting to recolonize plantations.

The process of converting lands to palm oil also causes the release of large quantities of greenhouse gasses.¹⁷⁷ Peat lands are significant natural carbon sinks, and as they are converted they release stored carbon dioxide. In 2010 the NGO Wetland International carried out a study that claims that between 2005 and 2010, almost 353,000 hectares of peat swamp forests were cleared – a third of Malaysia's total – largely for palm oil production. Their satellite imagery combined with existing data and field surveys show that deforestation as a result of palm oil production was now far greater than the government claimed.¹⁷⁸

Minerals. Palm cultivation in Malaysia is heavily reliant on fertilizer, as the soil in the country tends to be acidic. Most of the fertilizer used in Malaysia is produced abroad. In recent years, Malaysia and Indonesia have emerged as significant potash consuming countries for the palm oil industry. Imports of potassic fertilizers have increased equally with the rise in palm oil plantations.¹⁷⁹ Fertilizers are expensive, and can make up 60% of production costs. The increased demand for fertilizer for intensive palm oil production has increased the risk that nutrients and other elements are lost to the environment where they may contaminate water and land.

Energy. Palm oil is a main ingredient in biofuels, with 4.6% of global transport fuel coming from biofuels.¹⁸⁰ Global energy demand is projected to increase by one-third by 2035, likely to result in higher oil prices driven by demand in emerging markets. This will encourage further adoption of biofuels as a cheaper alternative, simultaneously pushing up prices for palm oil. In Malaysia, the palm oil industry is also considered as having great potential for supporting the economy through the provision of renewable energy.¹⁸¹

Water. Palm oil processing requires large quantities of water in mills where oil is extracted from the palm fruits, placing pressure on water resources.¹⁸² Furthermore the processing of palm into palm oil produces a highly polluting effluent, known as Palm Oil Mill Effluent (POME). This is a costly and difficult waste product to deal with, and it has been known for mills to simply allow it to drain into rivers, causing significant water pollution.¹⁸³ Cultivation of palm itself is also causing some concern, as deforestation to make way for palm plantations leads to soil erosion, and fertilizers and pesticides used on palm plantations run off from plantations and enter the groundwater.

Food. Growing demand for food due to global population growth and economic developments will increase demand for palm oil. The growing per capita consumption of fats and oils in food may increasingly be met by palm oil, which is nutritious and calorie rich with no trans fats. Demand for trans fat free oils may grow as scientist believe that trans fats have more harmful health effects than saturated fats, which has led various governments to restricted or ban the use of trans fats. Increasing use of palm oil for biodiesel is also likely to increase the price of palm oil and push up the price of foods which contain palm oil. This is particularly true in developing countries, which may face a double shock of high energy and food prices in the coming years.¹⁸⁴ There are concerns amongst some organizations representing palm growers that the environmental demands placed on the industry unduly affect palm oil price, which in turn pushes up the price of food.¹⁸⁵

6.3 MALAYSIAN PALM OIL PRODUCTION AND WIDER NEXUS EFFECTS

The nexus effects of palm production in Malaysia are not limited to interplay between resources. Palm oil production is also influenced by – and may, in turn, influence – a variety of other factors such as governance, technology, human resources, social and political factors, and stability. This section illustrates the wider nexus effects and explains why the production of palm oil and palm kernel oil in Malaysia is not without controversy.

In recent years, palm oil production has been the subject of debate in light of its large claim on arable land, converting natural rainforest, peat swamp forest, or other land types into palm oil plantations.¹⁸⁶ This land use change (LUC) is not without environmental and social implications, such as the loss of biodiversity, emission of greenhouse gasses and human rights conflicts.¹⁸⁷

Arguably one of the biggest challenges regarding palm oil production is the fact that it can be both grown for food, as well as non-food purposes. There is an inherent tension in governance of the palm sector between ensuring a stable and reasonably priced supply of palm for food production and encouraging the development of cleaner biofuels. Given the prevalence of malnutrition in areas where palm oil is most consumed, the large-scale conversion of palm oil to biodiesel instead of food is viewed by some as an unwelcome imbalance.¹⁸⁸ This is exacerbated by increasing demand for palm oil for industrial uses, projected to increase by 30% between 2011 and 2020.¹⁸⁹ The European Commission is a big market for industrial use palm oil, as the Commission maintains the ambition of increasing the use of biofuels to 20% of our European gasoline mix.¹⁹⁰ On average 20% of the biofuel in the cars on Europe's roads originates from palm oil.¹⁹¹ Malaysia has recently increased the concentration of palm oil in its biodiesel fuel blend to 7%, up from the current 5%.¹⁹² Meanwhile, several NGOs have blamed the rapid expansion of palm oil biodiesel for the escalating prices of oil and fats in the world commodity market.¹⁹³ Palm oil production by Malaysia and Indonesia combined are projected to increase by 45%, commanding some 68% of the vegetable oils total exports.¹⁹⁴

Controversy also exists with respect to the effect that palm oil production has on the prevalence of poverty and the fair distribution of land rights within Malaysia itself. Oil palm cultivation is said to have played a significant

role in poverty alleviation among smallholders and the rural population in Malaysia.¹⁹⁵ However, notwithstanding the increased incomes of some indigenous oil palm smallholders, the government's policies on oil palm development in the Beluran District of Sabah State have resulted in many concerns about land rights. In large part this is due to the gap that exists between traditional rights as perceived by the indigenous groups and how this is interpreted by the government.¹⁹⁶ The protection of Native Customary Rights (NCR) is provided through the Sabah Land Ordinance. However, provisions are weak and at times not complied with. The result is that in spite of extensive palm oil expansion in Sabah, indigenous communities often remain marginalized.¹⁹⁷ The Malaysian state of Sarawak, which has a substantially lower coverage of palm oil plantations, saw a much greater reduction in poverty rates since the 1980s than did palm oil rich Sabah.¹⁹⁸

Labor unions in Malaysia also claim that child and forced labor are common practice in palm oil plantations.¹⁹⁹ The low per piece prices that workers receive leaves them little choice other than to employ the help of their family. Children born from migrant workers in the palm plantations often do not have papers and thus no civil rights, nor access to education or health care. Against this background they frequently end up working as child laborers.

The palm oil sector is also the focus of several environmental campaigns, given its role in deforestation and peat-land conversion. This pressure is applied to both the Malaysian government through campaigns by organizations such as the Rainforest Alliance, and to international companies which consume palm oil. For example, Nestle was the target of a Greenpeace campaign aimed at reducing the companies' use of unsustainably sourced palm oil from Malaysia and Indonesia in its chocolate bars.²⁰⁰

In response to these issues, the Round Table of Sustainable Palm Oil (RSPO) was formed in 2004. A multi-stakeholder initiative between the World Wildlife Fund, the Malaysian Palm Oil Association, and several multinationals, the group aims to encourage sustainable palm production to mitigate negative effects of the industry. This led to a certification program which awards producers sustainable status. However, It is mainly focused on environmental issues, giving rise to protests amongst workers,

labor unions, NGOs, and others who want labor issues to be taken up by the RSPO.²⁰¹ The environmental campaigns have also resulted in new European regulations prescribing that from December 2014 onwards food product labels should mention the type of oil used in the product. Thus, palm oil will be on the label and sustainable palm oil can be recognized by the label and pictogram of 'Greenpalm'²⁰² and the Round Table of Sustainable Palm Oil (RSPO).²⁰³

6.4 IMPLICATIONS FOR SUSTAINABLE SECURITY OF SUPPLY

ECONOMIC ISSUES

The global market for palm oil is one that consists of several producers and can be characterized as competitive with a high degree of end-use substitutability. For example, the last months of 2013 saw a lower than expected demand for palm oil due to high yields of soy bean oil, a substitute vegetable oil in the food industry. Therefore, economic risk to the Netherlands in the form of supply interruptions is considered moderate.²⁰⁴ Nevertheless, the strong rise in demand for palm oil worldwide in the first half of the 2000s contributed to a significant increase of the prices for Malaysian palm oil, as can be seen from Figure 21.

Future production is hampered by an important constraint, namely the availability of land. Research undertaken by the Global Harvest Initiative (GHI) estimates that in order to accommodate future demand the total available crop area in Malaysia would have to expand by half a million hectares.²⁰⁵

The problem however is that Malaysia has little land left for expansion in order to meet growing demand.²⁰⁶ This lack of available land is further compounded by the October 2013 decision by the Malaysian government to increase the palm oil component of its biodiesel, in response to growing demand.²⁰⁷ In the absence of an ability to increase available acreage, a significant acceleration in yield growth is necessary. GHI estimates that palm oil yield growth in Malaysia should double in order to meet global food demands until 2050.²⁰⁸



FIGURE 21 PRICE OF MALAYSIAN PALM OIL IN US\$ PER METRIC TON, 2003-2013²⁰⁹

Overall then the future of Malaysian palm supply to the Netherlands is uncertain. The oil can be easily replaced in the production chain, and there are other countries from which palm oil could be sourced. If Malaysia is to remain a large supplier of the oil to the Netherlands, it needs to increase yields significantly, something which is not necessarily reliable.

SOCIAL ISSUES

Palm oil production is marred by a number of different social dilemmas, which are also influencing the public debate on palm oil in the Netherlands. These issues have an impact on consumers' preferences, and pressure the industry and politics to raise the standards for sustainable and fair production. Child and forced labor, plus threats levelled against unionized workers, are gradually being picked up by Western news media. NGOs such as Oxfam Novib continuously address these issues in the RSPO. But their ambitions in improving social issues reach further than current RSPO standards. Therefore, they try to get their message amplified in the public debate internationally.²¹⁰

Currently, the Malaysian government responds to the concerns of NGOs by writing a global standard for its palm oil through the Malaysian Palm Oil Board (MPOB), launched three years after Indonesia launched its international standard.²¹¹ The MPOB standard is less stringent than that of the RSPO standard. By adopting the MPOB standards, Palm oil producers can thus address sustainability without having to commit to the relatively more ambitious RSPO standard. NGOs such as Oxfam Novib however, want to raise the bar for sustainable production and fair trade even higher. This public perception of palm production has the potential to impact demand, particularly as large companies seek to switch to sustainably produced palm oils.

It is also conceivable that the Western world may turn against palm oil as a food ingredient for health reasons. For instance the Belgian Health Council advises against overconsumption of palm oil, based on research evidence that palm oil is an 'unhealthy fat'.²¹² These kind of studies and advice from authorities may add to a negative health image. And with explicit labeling coming in late 2014, the food industry may no longer be so keen on relying heavily on palm oil. Something similar has happened with the use of trans fats in the food industry. Trans fats have been effectively 'banned' as they appeared to be unhealthy and indeed, have been replaced by palm oil.²¹³

ENVIRONMENTAL ISSUES

Unsustainable palm oil production is obviously a threat to the long term sustainable supply security of the Netherlands. However, the trend is towards increased awareness about the negative externalities and increased consumer demand for sustainable oil. Palm oil production is controversial for environmentally minded western publics due to its impact on large ecosystems, both locally and globally. The large-scale destruction of ecosystems in Malaysia and Indonesia are publicized by NGOs, successfully raising awareness about the environmental costs of consumer demand for products that contain palm oil. One example is that of the effects of palm oil on deforestation with relation to the habitat of the orangutan. The BBS reports that the International Union for Conservation of Nature estimates that the orangutan population has declined by 50% in recent decades.²¹⁴ The human resemblance of the orangutan, which is often referred to as humans' closest relative, has helped to make the animal a successful symbol of NGO campaigns against unsustainable palm oil production.

In addition, with the rise of eco-tourism, many people start to see with their own eyes how palm oil plantations have impacted the land of Malaysia and Indonesia. The barren hills, cleared peat lands and endless rows of oil palms have been a harsh sight for tourists and other visitors. Furthermore, combatting the effects of climate change is one of the major challenges of the international community. As mentioned, draining peat lands and transforming them into palm plantations releases a significant amount of carbon dioxide, which is counteracting global efforts to mitigate climate change.

If unsustainable production of palm oil is put to a halt as a consequence of the increased consumer awareness of the negative impact on the environment and consumer demand for sustainable palm oil, this would ultimately positively impact the sustainable supply security of the Netherlands.

6.5 CONCLUSION

Malaysia is among the world's biggest suppliers of palm oil and the biggest supplier to the Netherlands. This chapter has illustrated the implications of the resource nexus of palm oil production in Malaysia for the Netherlands from the perspective of sustainable supply security.

Palm oil is an essential oil for the food industry and is present in products is consumed by millions of people worldwide. Due to economic development in Asia, (North) Africa and the Middle East, the Western diet is expected to become more common in these parts of the world. In combination with population growth, this is likely to cause a sharp increase in the demand for palm oil. This growing demand for palm oil implies increased competition for the Netherlands over supply. It also entails and increased demand for other resources that are necessary for palm oil production, something which may contribute to additional environmental stress and social issues that are associated with palm oil production and that undermine the sustainable security of supply of the Netherlands.

However, this may be circumvented if the food industry starts to replace palm oil by other vegetable oils, such as sunflower oil. There are indications that this is a plausible scenario. For instance, in December 2013 for the first time in sixteen years, the palm oil exports of Malaysia dropped in response to high yields of soybeans in Latin America.²¹⁵ Second thoughts about the use of palm oil as a biofuel may be one of the several contributing factors to the relatively smaller increase in demand and the recent drop in Malaysian palm oil exports. Palm oil, essentially a food crop, but used as a biofuel has sparked strong opposition in Europe. If regulations for the percentage of biofuels in the gasoline mix are adjusted downwards, this will probably further slow down industrial demands in the EU.

Also, the increased pressure on land use and the widely heard call for the conservation of ecosystems may encourage the global food industry

together with their palm oil suppliers to work towards sustainable production. By making degraded lands suitable for oil palm plantations in a sustainable way with respect for the local population and wildlife, sustainable supply security will be enhanced.

Having said this, palm oil is likely to remain one of the major global agri-food commodities and demand is expected to stay high, even if Europe's demand would level off due to concerns about the health effects of palm oil in food, concerns about biofuels and the environmental costs associated with palm oil production. Emerging economies, whose priorities lie with spurring economic development and lifting their populations out of poverty, may be less concerned about health effects and the social and environmental impacts of unsustainable palm oil production. This means that pressure caused by palm oil production in Malaysia on ecosystems, local communities and human rights, remain a concern for the Dutch sustainable security of supply.

7 POLICY APPROACHES TO THE GLOBAL RESOURCE NEXUS

The case studies on soy, cocoa and palm oil illustrate that crucial relationships and interdependencies exist between resource supply and demand, and other factors, including environmental and social issues, and broader nexus effects such as instability. The case studies show that a global resources nexus approach can help to identify and analyze some of the risks to the sustainable supply of agricultural commodities that are of strategic importance to the Netherlands. A better understanding of the complexity of the global resource nexus, and the risks associated with its dynamics and interdependencies, can help to formulate actionable and robust policy for the sustainable supply of resources.

7.1 POLICY RELEVANCE OF THE GLOBAL RESOURCE NEXUS

The dynamics of the global resource nexus generate serious economic, political and environmental challenges. Awareness is growing that in order to anticipate and solve these challenges, an integrated approach that takes into consideration interdependencies and feedback loops is necessary. Various organizations have developed frameworks to conceptualize and operationalize the global resource nexus, as discussed in chapter 2, which have helped to put the global resource nexus on the agenda of policymakers.

To arrive at an integrated policy approach, some persistent barriers in the institutional landscape must be overcome. In most national governments and international organizations, policy regarding different resources is traditionally dealt with in separate departments. In the Netherlands, for example, energy policy is primarily the responsibility of the Ministry of Economic Affairs, whereas water policy falls under the mandate of the Ministry of Infrastructure and the Environment, and the Ministry of Foreign Affairs is closely involved in policies aimed at securing access to minerals. Internationally, global public goods are governed by separate laws and

treaties, such as the United Nations Convention on the Law of the Sea (UNCLOS) for the seas and oceans.

Differentiation may in many cases be an effective way of cutting through the complexity of the resource nexus and to create actionable policy responses to some of the easiest to solve challenges. However, differentiation may also lead to actions, investments and policies with a too narrow focus. By considering each resource in isolation, important interactions and feedback loops may – consciously or unconsciously – be ignored. As a consequence, many differentiated policies, while effective locally and in the short-term, may be ineffective or counterproductive globally and in the longer term.

In fact, it becomes more and more clear that many of the present and future challenges related to sustainable resource security can not be solved without taking into account the interdependencies and feedback loops between resource supply and demand. Many organizations have adopted the idea of the global resource nexus to inform policy making. Differentiated policy agendas are increasingly tied to and complemented with integrated policy approaches that consider the nexus between different resources, and consequently also shed light on the indirect effects of policy actions. Integrated approaches can help formulate strategies that aim to secure resources in ways that limit or avoid short-term behavior with harmful economic, social and environmental effects, such as described in the case studies on soy, cocoa, and palm oil. Approaches that integrate considerations about people, planet, and profit could dampen volatility effects that originate from the complexity of the resource nexus. Strategies that aim to develop a sustainable security of supply are thus a form of enlightened self-interest.

7.2 DUTCH APPROACHES TO SUSTAINABLE SUPPLY CHAIN MANAGEMENT

Since the mid-nineties, the Netherlands has recognized the importance of such integrated approaches. In the Netherlands, the ecological footprint is the most widely used integral approach. With its successful public-private partnership approach, the Netherlands has also become an international frontrunner on sustainable management of agricultural supply chains.

ECOLOGICAL FOOTPRINT

The concept of the ecological footprint, originally developed by the World Wildlife Fund (WWF) and applied in various fields, such as international food chains and water management. Although it doesn't explicitly refer to the global resource nexus, this concept builds on the same principles discussed in this report. The Netherlands Environmental Assessment Agency (PBL) has translated the ecological footprint of the WWF into a set of twelve indicators to describe the effects of resource consumption. The PBL can measure the size of the ecological footprint, by looking at the effects of resource use on global stockpiles (energy, food, minerals, and water), environmental pressure, and on climate, biodiversity, ecosystem services and water shortages.²¹⁶ The set of indicators used by the PBL enables to generate specific data whilst the original WWF framework relied heavily on aggregated data and worldwide averages. While the original focus of the PBL was on the Dutch footprint in relation to planetary boundaries, it has been recognized that the framework is more widely applicable to analyze the impact of global resource production, trade and consumption.²¹⁷ Therefore, the framework has been used to identify policy options for reducing the Dutch ecological footprint in the global resource chains for the three most important agricultural commodities for the Netherlands: soy bean, palm oil and cocoa.

PUBLIC-PRIVATE PARTNERSHIPS

Awareness in the public and the private sector of the global resource nexus dynamics and the risks this creates for sustainable supply of resources has resulted in close collaboration in project related to these issues between ministries, industry, research institutions, and NGOs. In 2007, businesses, trade unions, NGOs, and the former ministries of Development Cooperation, Economic Affairs and Agriculture, Nature and Food Quality acknowledged the necessity of joining forces in stimulating sustainable trade, which led to foundation of the Sustainable Trade Initiative (IDH).

This public-private initiative focuses on promoting sustainable trade by building coalitions of front running companies, civil society organizations, governments and other stakeholders that will deliver impact on the Millennium Development Goals 1 (poverty reduction), 7 (safeguarding the environment), and 8 (fair and transparent trade).²¹⁸ IDH is involved in many projects concerning a multitude of agricultural commodities, including soy,

cocoa, and palm oil.²¹⁹ Box 2 highlights a few examples of what the Netherlands already does in order to mitigate some of the risks described in the previous chapters.

SOY

Dutch public and private sector representatives have been the founding fathers of the Round Table on Responsible Soy (RTRS). Dutch producers, traders, processors and NGOs are active members of the round table. IDH has a program which aims to transform the soy sector towards a more sustainable and institutionally responsible one. IDH is also a partner in a project of the Dutch soy industry (unified in the “Stichting Ketentransitie Duurzame Soja”), which aims at 100% sustainable soy for the Dutch market in 2015. Part of the approach is supporting producers in Brazil and Argentina to comply with the RTRS standards.

COCOA

IDH is engaged in several programs on the ground in West Africa to improve the conditions of cocoa farmers, including the Certification Capacity Enhancement project (CCE) and the Cocoa Improvement Program, which seek to improve the cocoa industry in Côte d'Ivoire. The CCE is focused on education for farmers and farmer organizations to ensure that their cocoa is produced in line with the international standards of UTZ Certified, Rainforest Alliance and Fairtrade. This allows farmers to command a higher price for their produce. The Cacao Improvement Program focuses on increasing demand of sustainable cocoa, by offering certification schemes and bringing sustainable cocoa production on the agenda of a coalition of the most powerful industry players in the biggest producer countries.²²⁰ Fertilizers are also a key issue in improving cocoa supply. IDH and the Dutch ministry of Infrastructure and Environment have facilitated various projects aimed at making sufficient and adequate fertilizer available for cocoa farmers in West-Africa.

PALM OIL

Similar to what has been done for soy, Dutch stakeholders in the palm oil supply chain have been actively involved in promoting sustainable supply chain management in Malaysia and Indonesia. A Task Force

Sustainable Palm Oil has been established, consisting of companies that represent the palm oil processing industry in the Netherlands, and which has agreed on 100% sustainable sourcing by the end of 2015.²²¹ The role of IDH in realizing this ambition is to get banks to finance palm oil producing smallholders in Malaysia and Indonesia. Financing is necessary for the rehabilitation of plantations, which includes replacing poor yielding and replanting of aged trees.²²²

BOX 2 EXAMPLES OF DUTCH INITIATIVES ON SUSTAINABLE SOY, COCOA AND PALM OIL PRODUCTION

All these projects, in one way or the other, consider the broader economic, social and environmental risks associated with resource supply and demand, and intend to implement sustainable solutions aimed at increasing quality and quantity of yields, better input management, better income for farmers, access to premium international markets and other positive spin off effects.

ROLE OF THE DUTCH GOVERNMENT

The Netherlands Environmental Assessment Agency (PBL) has described several strategic roles for the Dutch government in improving sustainable supply chain management.²²³ Summarizing, the following roles and associated tasks can be identified:

- **Launching customer, setting examples.** As a large contractor and potential purchaser, the government may create and increase demand for sustainable produced goods as launching customer.
- **Opinion maker.** The government is able to raise awareness about the importance of sustainable supply chain management. NGOs can support this.²²⁴
- **Stage manager.** The government can set targets for sustainable production for certain commodities. Such targets can help give direction and focus to industries and NGOs.
- **Referee.** The government can determine requirements for sustainable production. As a purchaser, it can set the norm by abiding to guidelines and standards.
- **Financer and supporter.** Financial support from the government can help to establish initiatives such as IDH.
- **Creating a legal framework.** The government can create a clear legal framework, which can serve as the baseline for voluntary initiatives that aim to set even higher standards for sustainability than legally required.

PBL has recently evaluated the role of the Dutch government and its efforts of achieving sustainable supply chain management of agricultural commodities.²²⁵ The main conclusion is that initiatives are primarily originating from the private sector and NGOs, and not from the government. The Dutch government is leaning on the initiatives of other stakeholders and limits itself to a facilitating and supporting role. This approach has advantages and drawbacks. The advantages are that a bottom-up approach creates wide-range support from diverse stakeholders and that it uses the economic power of the private sector parties. The drawback is that there is a relatively weak coordination structure and that many initiatives are voluntary or selective.

7.3 CONCLUSION

Both researchers and practitioners are aware that understanding interaction effects between supply and demand of different resources is key to solving the challenges generated by the dynamics of the global resource nexus. As a consequence, various approaches and frameworks have been developed in order to analyze the dynamics of the global resource nexus and their economic, social and environmental effects. Some approaches are explicitly named after the global resource nexus, such as the ones discussed in Chapter 2. Some other integrated approaches, such as the ecological footprint, may not explicitly refer to the global resources nexus but, in effect, build on the same underlying principle that resource production and consumption patterns are interconnected and have interrelated affects on people and planet.

Policymakers have become aware that integrated approaches offer a better way to effectively improve the sustainability of supply chains in the long-run than differentiated approaches. The Netherlands has become an international frontrunner on sustainable management of agricultural supply chains. The Dutch approach shows an intense collaboration between public and private stakeholders, contributing to long term change and improvements of sustainable supply chain management, including soy, cocoa, and palm oil. PBL has evaluated the efforts of the Dutch government in promoting sustainable supply of agricultural commodities. This analysis is part of an ongoing political debate of government versus market based policy making and recent thinking on network governance in relation to sustainability.²²⁶ PBL concludes that in practice, the Dutch government

takes mostly a facilitating and supporting role and points out that this approach has advantages and some disadvantages. The following chapter further elaborates this by proposing how the resource nexus approach can be used by the Dutch government to identify priorities for policy making with respect to a sustainable security of supply for the Netherlands.

8 CONCLUSIONS AND PRACTICAL POLICY APPLICATIONS OF THE NEXUS APPROACH

This research used a nexus approach for studying the implications of an anticipated sharp increase in global demand over the next decades of agricultural commodities that are of key importance for the agri-food sector of the Netherlands. The study focused on the nexus dynamics - both on a global and local level - that are triggered by changes in supply and demand of soy, cocoa and palm oil in the broader context of economic growth, urbanization, demographics and climate change. It described the implications of the production of these commodities on supply and demand of other resources, namely food, land, water, energy and minerals. The study also outlined some of the main consequences for economies, societies, and ecosystems, and related these to risks to the sustainable supply security of the Netherlands.

In this concluding chapter we discuss some steps that can contribute to integrating the knowledge about the global resource nexus into the practice of policy making and sustainable supply chain management. We first highlight some of the key findings of the report, showing how the global resource nexus dynamics contribute to risks to the sustainable security of supply of soy, cocoa and palm oil to the Netherlands. Next, we present various public and private initiatives that have a positive effect on sustainable production of agricultural commodities, but that the government could take a more proactive role. Finally, we recommend a strategy that can help policymakers to assess the risks of unfavorable consequences of production of agricultural commodities in order to identify potentially successful interventions to reduce those negative impacts. This strategy relies heavily on the nexus framework as a means to understand the interplay of drivers that contribute to the impacts on food, land, water, energy and minerals, thereby informing and shaping integrated policy approaches that acknowledge the importance of the global resource nexus.

8.1 RISKS TO SUSTAINABLE SUPPLY SECURITY OF SOY, COCOA AND PALM OIL

Securing a sustainable supply of agricultural commodities is highly important for the Dutch agri-food sector, which is a major contributor to the overall Dutch economy. Table 3 summarizes the main risks to the sustainable supply security of the Netherlands for soy, cocoa and palm oil that have been discussed in this report. First of all, as Chapter 3 pointed out, the economic significance of soy, cocoa, and palm oil is significant: of all agricultural commodities imported, soy, cocoa, and palm oil, including their derivatives, are among the largest import streams of the Netherlands.²²⁷ This makes the Netherlands relatively vulnerable to global and local trends and developments that affects demand and supply of these commodities.

Furthermore, the table shows various economic, social and environmental issues that affect the sustainable security of supply of soy, cocoa and palm oil. Many of these issues are caused by or exacerbated by the dynamics of the global resource nexus which have ripple effects that occur at the global, regional and local level, and which were described in Chapter 2.

Chapters 4, 5 and 6 zoomed in on these dynamics. All three case studies showed that increased demand for the selected commodity led to increased claims on other resources. The production of soy, cocoa, and palm oil lead demand large amounts of agricultural inputs, such as land, water, energy, and minerals. The use of these inputs is necessary to keep up and increase production levels, but also undermines long-term production growth by causing environmental problems, such as deforestation, soil and water degradation, and loss of biodiversity. The production of the selected agricultural commodities is also surrounded with social issues, such as tensions over land use with indigenous people, migration, forced labor, child labor and other kinds of poor working conditions.

As a result of the negative social and environmental externalities, the production of these agricultural commodities that are of great importance for the global agri-food industry, including the Dutch, has a bad image in the eyes of the general public, especially in Western societies. Understanding the global resource dynamics is key to identifying strategies aimed at mitigating the negative effects and promoting sustainable supply chains.

| | | SOY | COCOA | PALM OIL |
|-----------------------|--|--|---|---|
| ECONOMIC SIGNIFICANCE | IMPORT VOLUME | High (7%) of all agri-food imports | High (8%) of all agri-food imports | Fair (4%) of all agri-food imports |
| ECONOMIC RISKS | GLOBAL MARKET CONCENTRATION | High. Strong market concentration, land use constraints, GM regulations create segmented market. | High. Few producer regions, strong market concentration. Furthermore some producing countries, such as Cote d'Ivoire, are politically unstable. | Fair. Several producer regions, land use constraints. |
| | SOURCING OPTIONS IN THE EUROPEAN UNION | Fair. However, EU supply is insufficient to meet EU demand. | None. Tropical produce cannot be cultivated in the Netherlands or elsewhere in the EU. | None. Palm oil is not produced by any EU countries. |
| | AVAILABILITY OF SUBSTITUTES | Fair. Available, but not sufficient to replace all soybeans. E.g. cheese whey, single cell proteins, lupine, field beans and peas. | Poor. Carob pods are the only plausible substitute. Although most carob is produced in Europe, supply is far lower than Dutch demand for cocoa. | Fair. There are substitute vegetable oils, animal fat, butter, olive oil, canola oil, coconut oil and cocoa butter available. |
| SOCIAL RISKS | | High. Violent clashes with local communities and clans in Latin-America over land rights, impact of deforestation on local wages, reduction of wildlife, food supplies for indigenous communities, placing land pressure on regular food production, increased mechanization and thus less employment for local farmers. | High. Reported child labor, exploitation of farmers through low prices paid for cocoa. There are many factors threatening the productivity and longevity of the cocoa industry: low levels of adult literacy, health risks including malaria and HIV/AIDS, lack of access to quality education for children. | Low. Although land has been taken without permission and in conflict with national nature trusts, leading to conflict with local communities. Palm oil has allowed for small farmers to cash in on world trade. |
| ENVIRONMENTAL RISKS | | High. Forest degradation, deforestation, wildlife reduction, the use of chemicals leading to air and water pollution. All these factors also affect availability of land for future soy production. | High. Use of pesticides in the production of cocoa. There are many factors impacting the productivity of the cocoa industry: low yields attributed to pests, aging trees and diseases that attack trees, difficulty obtaining farming supplies, unfamiliarity with modern farming techniques, limited access to credit and insurance. | High. Water pollution, additional greenhouse gas emissions, deforestation, habitat destruction, and reduced biodiversity. |

TABLE 3 OVERVIEW OF ECONOMIC SIGNIFICANCE AND RISKS TO SUSTAINABLE SUPPLY SECURITY OF SOY, COCOA AND PALM OIL

Many initiatives have already been taken to address and mitigate some of the risks mentioned above and to promote sustainable supply chains. Chapter 7 discussed the Dutch approach to sustainable supply chain management and highlighted some public-private initiatives for soy, cocoa, and palm oil. Many of these initiatives are a favorable development to counteract the harmful impact of expanding production of agricultural commodities to meet the growing demand from the global market. Nevertheless, the analysis also reveals that in practice the role of the government remains limited to a primarily facilitating and supporting role. This is at odds with the strategic relevance and urgency of the challenge of sustainable security of supply of agricultural commodities which this report has highlighted. Therefore, the next section looks at ways in which the Dutch government could use the framework of the global resource nexus for more proactive strategic policy making.

8.2 USING THE GLOBAL RESOURCE NEXUS FRAMEWORK IN POLICY MAKING

The Dutch government could take a more proactive role in promoting sustainable security of supply of agricultural resources. We propose a strategy which uses the global resource nexus framework as a tool for policymakers to identify risks and mitigate the negative impact of the dynamics of the global resource nexus and to assess and prioritize policy interventions that aim to improve the sustainability of supply chains. This strategy can be conceived as a pyramid, see Figure 22. The pyramid visualizes a number of steps to be taken partly in sequence, partly in parallel and iteratively, to arrive at concrete interventions. These steps are described below.

INSTRUMENT FOR EX-ANTE AND EX-POST EVALUATIONS

The global resource nexus framework discussed in this report offers policymakers a tool to systematically review envisaged policy measures in qualitative manner. Since the global resource nexus framework contains many variables and displays which interactions should be taken into consideration, it can be used as a talking board by policymakers in the policy preparation phase to review a potential policy measure from different angles and to consider the scope and range of its direct and indirect effects. This contributes to robust policy making and reduces the likelihood that policies have unintended consequences.

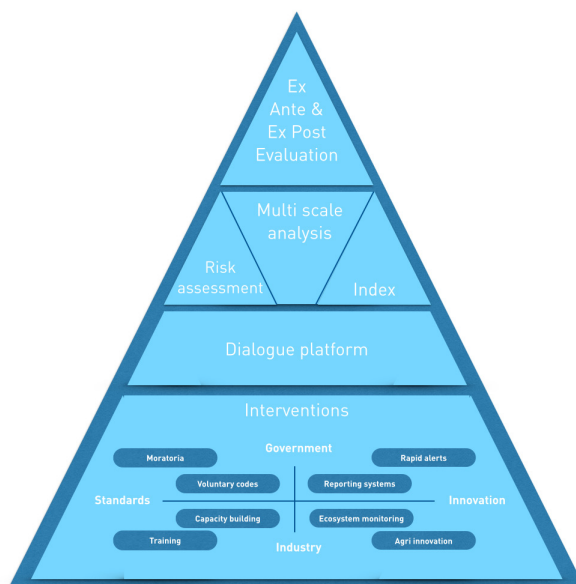


FIGURE 22 USING THE GLOBAL RESOURCE NEXUS FRAMEWORK IN POLICY MAKING

This review may be repeated once a policy measure has been implemented. In the post-implementation stage, the actual impact of the intervention can be compared to the effects that were discussed during the ex-ante evaluation. Using the resource nexus framework reduces the likelihood that parts of the impact of the policy measure are being overlooked, thereby allowing policymakers to make a more thorough evaluation on whether to continue, adjust or discontinue the policy.

Such systematic and comprehensive ex-ante and post-evaluations can also be used for comparative analysis of the effectiveness of multiple policy initiatives, helping policymakers to decide whether money is spent on those measures that yield the biggest results in term of sustainable supply security.

Ex-ante and ex-post comparisons also allow to differentiate between policies with different economic, social or environmental emphasis and to assess the consequent effects of different foci on the long-term sustainable supply security.

The qualitative evaluations can be supported quantitatively with a combination of analytical methods and tools, such as risk assessments, multi-scale analyses and a criticality index.

RISK ASSESSMENT

The various variables and interdependencies in the global resources nexus framework can be used to make qualitative and quantitative risks assessments of the growing demand for resources and the implications for sustainable security of supply of agricultural commodities of the Netherlands. The focus may be on the economic, social and environmental risks associated with policies, trends in supply and demand, or unsustainable production and consumption patterns. These risks assessments can help to bring home the urgency of the challenges and to identify priority areas for preventive, adaptive and mitigating policy interventions. The risk assessments can focus on different time horizons (short, medium and long term) and thereby help policymakers with strategic planning, capacity building, and budgeting. More specifically, risk assessments can comprise indicators that allow identifying thresholds for unsustainable consumption of the five critical resources.

MULTI-SCALE ANALYSIS

The framework can be used to systematically analyze the effects and interactions at different levels, ranging from the global to the local level. Since the interactions between resources are complex, modelling can help to integrate information across several scales. Quantitatively modelling the dynamics of the global resource nexus can support the narrative analysis and qualitative analysis of risks to the sustainable security of supply by generating internally consistent plausible future scenarios following the Scenario Discovery methodology.²²⁸ This is a suitable approach to understand and assess complex relationships in a quantitative manner. The global resource nexus framework presented in this report may be modelled as a set of mathematical equations that allow policymakers to quantitatively analyze the interplay between supply and demand of land, water, food, energy, and minerals, as well as the wider nexus variables that affect the sustainable security of supply of these resources. Multi-scale analysis, like Robust Decision Making, may be used to understand how different policy interventions score on a combination of economic, environmental and social criteria.²²⁹

CRITICALITY INDEX

The sort of analyses mentioned above can be used to build a criticality index for resources that are crucial to the Dutch economy. At the European level, a criticality index already exists for raw materials crucial for industries of strategic importance to the EU's economy combined with a high risk associated with their supply, for example because of high import dependence.²³⁰ The criticality of materials is assessed on the basis of a quantitative methodology that applies two criteria: the economic importance and the supply risk of the selected raw materials. However, this lists looks at materials that are critical to the EU as a whole. This means that certain materials that are considered critical for the EU may not be critical for the Netherlands and vice versa.

We recommend building a criticality index for materials that are of high economic importance to the Netherlands combined with a high risk associated with their sustainable supply. The global resource nexus framework allows to expand the typical criticality assessment method beyond economic risk and to take also the social and environmental dimensions into consideration. Policymakers can use the criticality index for the Netherlands as an instrument to determine priority countries for policies aimed at improving sustainable supply chain management. The criticality index should focus on those resources and countries for which the Netherlands is a significant trading country. Only then interventions aimed at improving sustainable supply chains could carry enough weight to have a meaningful impact. Of course, the impact could be wider when collaborating with third countries, both in the context of the supplying country and in the context of importing countries.

DIALOGUE PLATFORMS

The unprecedented demand for food, water, land, energy and minerals is a global challenge, and the dynamics of the resource nexus have global ramifications. In the same vein, addressing this challenge requires trans boundary solutions, international cooperation, and effective global governance. National policymakers cannot improve their national sustainable security of supply without engaging intensively with countries where resources are produced and imported from and the broader international community.

To improve the sustainable supply security of the Netherlands, Dutch policymakers should continue to invest in and reinvigorate multi-stakeholder dialogue platforms that cover resource related challenges, such as the various round tables for soy, cocoa and palm oil. Many existing platforms have received criticism from various angles for not being effective enough or for protecting vested interests of the established businesses. However, these platforms remain necessary to unite a global network of stakeholders and to find solutions via mechanisms of participatory governance and based on common ground. Given the influence of global megatrends on resource demand and supply, it is paramount that policymakers engage new global players, such as rapidly growing developing countries, in the dialogue platforms. Since many of the effects play out at the local level, efforts should also be made to engage representatives from local communities.

Dutch policymakers can use the data on the global resource nexus generated in the previous steps to facilitate an informed debate and to improve the quality of decision-making in these dialogue platforms. A combination of qualitative analysis and quantitative data on the global resource nexus provide policymakers with a convincing tool to increase public awareness and dialogue about the urgency of the challenges and the consequences of inaction or continuation of unsustainable production and consumption patterns. A data driven approach can also facilitate decisions on joint investments in international mitigation measures and research and innovation programs aimed at establishing sustainable global supply chains. In turn, such measures may raise the profile of the dialogue platforms and contribute to their legitimacy and acceptance in the global business community, among policymakers, and in civil society.

INVENTORY OF POLICY OF INSTRUMENTS AND INITIATIVES

Both internationally and in the Netherlands, many initiatives are already in place to address challenges related to the global resource nexus and to promote sustainable supply chain management. We recommend that Dutch policymakers, in cooperation with policymakers from other countries, build an international inventory of the existing policy instruments and initiatives. The inventory could organize the multitude of interventions along two axes. One axis indicates whether the initiative is market or governance oriented; the other axis distinguishes between standards and

innovation. Organizing initiatives in such a framework can help policymakers navigate the large variety of existing policy initiatives. In addition, an inventory can serve several other purposes.

First, there is need to share knowledge about the effectiveness of policy measures and initiatives. Especially in times of austerity, policymakers face tight budgets and need to provide convincing arguments to implement new measures and demonstrate their cost-effectiveness. An inventory can help policymakers to learn from best practices, to compare between different approaches, and to identify the right measures for particular situations and objectives.

Second, with the aid of an international inventory, policymakers can strengthen synergies between existing initiatives and create positive multiplier effects. Currently, many initiatives may be implemented at a local or regional scale, and policymakers in other countries may not be aware of them. Although each of these initiatives may have considerable positive impact in targeted areas and on the targeted supply chains, their impact could possibly be expanded if they were connected to or complemented with other initiatives. An inventory of existing policy initiatives could help policymakers identify such opportunities.

Third, in addition to existing initiatives, the inventory could also comprise a data base with ideas and plans for new policy measures and initiatives that have not yet been implemented due to a lack of funding or suitable pilot case. Countries or communities that face specific problems could use this database to find new solutions and connect with parties that can help with the implementation.

8.3 SUMMING UP

This study presented a framework to analyze the global resource nexus and zoomed in on three important agricultural commodities. The analysis highlighted the interactions between supply and demand of various resources, the impact of production, trade and consumption, and both the favorable and unfavorable consequences of global megatrends for people, planet and profit. The expected increase in demand for agricultural commodities underlines the urgency to improve sustainable supply chain management. The nexus dynamics reveal the interconnected consequences,

showing that integrated systems thinking is needed to prioritize interventions in order to address these issues.

Therefore, we proposed a strategy to systematically assess the effects of the nexus and of mitigating actions. This strategy can be conceptualized as a pyramid and consist of the six steps described above, to be executed in sequence, partly in parallel and iteratively. These steps illustrate a practical way to apply the global resource nexus framework to methodical, effective policy making. It can be used on its own as a tool to support qualitative analysis and systematic thinking about the impacts resource related trends and policy initiatives, or it can be complemented with quantitative assessment tools, such as a criticality index. The global resource nexus framework is also instrumental to policymakers in their efforts to promote sustainable resource management in international dialogue platforms, and contribute to an international database of existing and new policy initiatives that aim to address the challenges of the global resource nexus. The next step is to further develop this strategy and test in in practice in a pilot case.

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