



THE CONTRIBUTION OF SUSTAINABLE TRADE TO THE CONSERVATION OF NATURAL CAPITAL

The effects of certifying tropical
resource production on public and
private benefits of ecosystem services

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Mark van Oorschot et al.

Policy Report

**The contribution of sustainable trade to the conservation of natural capital:
The effects of certifying tropical resource production on public and private benefits of ecosystem services**
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MAIN FINDINGS

Summary

The contribution of sustainable trade to the conservation of natural capital and ecosystem services

Over the past decade in the Netherlands, a great deal of progress has been made towards making international supply chains of resources more sustainable, such as those of soya, palm oil, cacao and tropical wood. These resources are increasingly produced according to international market standards for certification of sustainable production. By using such market standards, companies and governments are trying to influence production conditions elsewhere in the world and to limit negative environmental effects.

PBL Netherlands Environmental Assessment Agency has conducted a study into the potential impact of certified sustainable production on natural capital and the related ecosystem goods and services. Forests are a well-known example of natural capital; they are valuable to society, among other things because they store large amounts of carbon.

The performed cost-benefit analyses show that certified resource production has several societal benefits, such as reductions in environmental pollution, soil erosion and health damage. However, for resource producers, the financial returns of more sustainable production methods are often limited. The uneven distribution of costs and benefits over public and private actors forms a barrier to any further scale up of sustainable production. Thus, there is a need for additional solutions, besides certifying trade to help conserve ecosystems elsewhere in the world.

These options include improvements in the way in which ecosystem services are addressed in market standards, additional funding of sustainable production methods by carbon markets, and stimulating integrated land use on a landscape level.

'Natural capital' provides a new approach for policies

PLB has started a research programme centred on the question of how the value of natural capital could be incorporated in certain policies and investment decisions. At the request of the Dutch Ministry of Foreign Affairs, a study was conducted into the role of ecosystem services in the sustainable development of international trade chains. These are the services provided by natural capital,

and are distinguished into production services (e.g. food, water and materials), regulating services (water purification and climate regulation) and cultural services (recreation and tourism). Putting a monetary value on these ecosystem services provides information about why nature and biodiversity should be conserved, and may provide new opportunities and impulses for both private initiatives and public policy on the sustainable management of ecosystems.

International supply-chains influence natural capital

The Dutch economy depends on resources that are produced elsewhere in the world, such as soya, palm oil, cacao and wood. The fertilisers and pesticides used in the production of these resources often cause considerable environmental pressure and pollution of soils and water. In addition, natural ecosystems are being lost due to further expansion of the agricultural area. For example, when forests are cut down, they can no longer store carbon and this contributes to climate change.

Environmental pressure and deforestation lead to the loss of ecosystems and the goods and services they provide. This, first and foremost, affects local communities in the producing countries, but because of the contribution to climate change, it also affects current and future populations on a global level.

Large role for sustainability standards

Producing resources in a more sustainable manner that takes ecosystem services into account, therefore, is important to various stakeholders, and is a subject for the international policy agenda. To make international trade more sustainable, voluntary market standards for more responsible and sustainable production methods are often used. On the basis of these standards, well-known sustainability labels are issued for traded resources, such as FSC for wood and UTZ Certified for cacao. The standards contain certain criteria, such as for operational management, production-related social issues and the environment.

Market shares of certified and sustainably produced resources have increased considerably in the Netherlands, over the past two decades. By using such market standards, companies and governments are able to

impose conditions on international trade and influence production methods elsewhere in the world.

The criteria of the investigated market standards can also help to conserve ecosystem services. So, by stimulating the trade in certified resources, the Netherlands can help to preserve ecosystem goods and services elsewhere in the world.

Purpose of this study

A previous PBL study examined the progress made with sustainable trade and the impacts this has had. The present report delves deeper, paying particular attention to the influence of sustainability approaches on the importance of ecosystem services – that is to say, on the values of natural capital.

The study makes a comparison between the costs and benefits of conventional resource production methods and those that comply with sustainability criteria for certification. This analysis includes the economic aspects at the production unit as well as the societal effects of improved farming practices on a broader level.

We therefore refer to the analyses as 'extended' cost-benefit analyses, as they have a narrower scope than most other cost-benefit analyses that include employment impacts or consumption shifts.

Attaching a monetary value to ecosystem goods and services may help to convince consumers and producers of the importance of sustainable production. The distribution of costs and benefits over various stakeholders can help to find a balance between market mechanisms and government policies to stimulate and fund sustainable, certified production.

Potential costs and benefits of certified production

A comparison was made between conventional production methods and those that carry a sustainability certificate, for four resources that are highly significant for the Netherlands: timber, cacao, soya and palm oil. For each resource, two different production locations were distinguished, as local conditions influence the value of ecosystem services. Local conditions may vary in soil (peat or mineral soil for palm oil production), natural vegetation (tropical forest or savannahs for soya production), forest type (tropical forests in either South America or Southeast Asia), or farm size (smallholder or large-scale farms for cacao production).

As there is only a limited amount of reliable data on the costs and benefits of resource production, several assumptions were made about the effects of certification. As a consequence, this report describes the potential benefits of certified production for a select number of resources at particular production locations. General

conclusions about the food and wood producing sectors are therefore not possible.

Benefits of certified production for different stakeholders

The cost-benefit analyses showed that certified production systems and the use of natural solutions may offer several benefits to various stakeholders, such as producers and both the local and global population.

First, there are benefits for resource producers and the processing industry, because the capacity of ecosystems to deliver the required resources can be sustained. Certified production may also bring direct financial benefits to producers, such as in market premiums for products with a sustainability label, and lower costs due to the reduced need for pesticides and fertilisers. These benefits can be the result of better soil management increasing soil fertility and reducing the susceptibility to natural pests. However, there are also costs involved in the certification process itself, as well as in management improvements and staff training.

On balance, certification may deliver financial benefits for producers; for example, in improving the generally low cacao production levels on smallholder farms by using better cultivation methods. For large-scale cacao plantations, shifting from monocultures to mixed agro-forestry systems can be beneficial. Although cacao revenues would go down, the costs for fertilisers and pesticides are also reduced, as a result of the shading trees planted and improved soil management. And there are additional revenues from tree products, such as timber and fruit. These benefits compensate the higher costs of certification and improved management.

Sometimes, however, the benefits are in the long term, while investments are required in the short term. For example, reducing the damage from logging in tropical forests will stimulate forest regrowth, thus enhancing future timber harvests. If better managed production systems lead to more carbon being stored in the soil or vegetation, there are possibilities to apply to carbon markets for additional funding in compensation for greenhouse gas emission reductions.

Certification does not always result in financial benefits for producers. The studied cases of soya production, for example, showed that the financial benefits of certification do not outweigh the higher costs involved. Having low or even no market premiums hampers a positive financial outcome.

Relatively large benefits were found in the prevention of deforestation and the related reduction in carbon emissions. Many market standards contain criteria to

prevent further deforestation. New plantations and farms can only become certified if they do not push out natural ecosystems. Stopping deforestation leads to a wide range of benefits for society as a whole. The monetary value of the amount of carbon that will remain stored in natural ecosystems is high, because of the worldwide and prolonged impact of climate change on society. Preserved forests also provide food, fuel and other materials which are a relevant or even essential supplement to the food supply and income of local populations. The monetary value of these forest ecosystem services is relatively low, especially when these groups are self-sufficient and not market their products.

Despite the fact that certified, sustainable production offers certain benefits, compared to conventional production, the societal costs of certification in a number of production locations continue to outweigh those benefits. For instance, in the case of palm oil production on tropical peat soils and soya production in regions with tropical forests. Such negative net results are particularly the result of high carbon emission levels, even under certified production conditions. On the basis of these cost-benefit analyses, such production locations would not be selected for agricultural production. In practice, this can already be seen in the *zero-deforestation, no peat* initiatives by large palm-oil processing companies.

Options for conserving ecosystem services

'elsewhere' in the world

Making resource production systems more sustainable is not easy, the limited possibilities for financial return form a barrier towards a further scale up of production. The costs and benefits of certified production are unevenly distributed over different stakeholders. This calls for new solutions and approaches. To ensure that ecosystem services that are valuable for various stakeholder groups can be preserved, this study looked at both private and public solutions for stimulating sustainable resource production and trade. Attention is paid to market standards, to markets for ecosystem services, and to government instruments.

Using and improving market standards for certification

The criteria of the studied market standards contain a number of ecosystem services. However, the standards' coverage of ecosystem services is far from comprehensive; there is direct attention for soil fertility and natural pest control, but services such as pollination and water management are only included to a limited extent. As these standards are widely used, this offers possibilities for stimulating the conservation of ecosystem services. The standards hold a central position in collaborations between companies, NGOs and government authorities, such as in the Dutch Initiative for

Sustainable Trade (IDH). Many of the standards require that areas with a high conservation value are excluded from agricultural exploitation. To identify such areas, the value of ecosystem goods and services must be taken into account in a much more explicit way. International platforms for market standards, such as the ISEAL Alliance, can draw attention to this issue. This platform also addresses the need for more specific research into the results of certification, like the impact on ecosystem services.

Complementary policies needed on larger spatial scales

Forest conservation has large societal benefits, especially because forests are able to sequester large amounts of carbon emissions. This is why reducing deforestation is an important target. An important question is whether deforestation can be reduced, in practice, by certification of individual producers and farmers, as deforestation occurs at a scale that is beyond their sphere of influence. Therefore, complementary policies are required that address a larger spatial scale. At present, for example, many efforts are being made in the form of landscape initiatives for integrated and sustainable management that include both productive and natural ecosystems. The Dutch Government currently supports a number of pilot projects in regions from which Dutch companies are importing their natural resources.

Markets for ecosystem services

The cost-benefit analyses particularly reveal the large benefits of carbon storage. The high social cost of carbon emissions is based on estimates of the worldwide and future impact of climate change on the economy. International payment schemes, such as voluntary carbon markets, already have been developed. If additional funding could be obtained through these markets, producers could be stimulated to apply for certification and make resource production more sustainable. However, the present market price for carbon is much lower than its societal value. In order for the carbon markets to function as an incentive, higher carbon prices are needed. National governments can play a large role, in this respect; for example, by implementing more stringent caps on emissions, which in turn would increase the need for compensation. In contrast to the situation for carbon, the market opportunities related to the supply of goods and services for local stakeholders are modest. The conservation of these services is important for the vulnerable groups in society, while their financial options are very limited. There are examples of regional markets for the provision of drinking water, but these often heavily depend on government support.

Dutch Government policies

The Dutch Government also could encourage companies to pursue ecosystem preservation in areas where resources are produced. To raise awareness of the value of ecosystems, the use of methods for natural capital accounting are being promoted. This could also help to identify possible improvements in production processes. In the short term, the government could incorporate the conservation of valuable ecosystem services into its criteria for the procurement of sustainably produced resources. It could also implement more stringent policies. For instance, companies that are listed on the stock exchange will be obliged to report on the use and origins of their natural resources, in non-financial performance reports. The use of these types of instruments could be further promoted by the government in guidelines for international corporate social responsibility.

The contribution of sustainable trade to the conservation of natural capital

Introduction: the value of natural capital and ecosystem services

Nature is increasingly seen in terms of 'natural capital'. Natural capital can be defined as a stock from which useful products (e.g. food and water) and services (e.g. water purification and climate regulation) can be derived. Nature supplies these services not only to the local population, but also to the population worldwide. Forests, for instance, store large amounts of carbon and that helps to reduce climate change on a global level. It is therefore crucial that stocks are managed properly and the supply of services are monitored carefully, in order to ensure natural processes are maintained.

The Dutch Ministry of Foreign Affairs requested that a study would be conducted into the role of supply chains in the valuation and conservation of ecosystem goods and services. In other words, whether it would be possible to influence production conditions in areas from which the Netherlands obtains the natural resources it needs, and in such a way that valuable ecosystem services are maintained.

The main questions for this study were:

- Can sustainable production contribute to the preservation and sustainable use of ecosystem services in areas that produce resources for the Dutch economy?
- How could the value of ecosystem services be integrated in the governance of international supply chains?
- What are the roles of the actors involved in this process?

The focus of this study is on the supply chains of four of the resources that the Netherlands depends on: cacao, soya, palm oil and tropical timber. A previous PBL study from 2013 examined the progress made with sustainable trade and the impacts this has had. That study focused on

the effects of certification on social and environmental conditions. The present report delves deeper, paying particular attention to the influence of sustainability approaches on the importance of ecosystem services – that is to say, on the value of natural capital.

This study is part of a larger PBL research programme on natural capital in the Netherlands. The importance of natural capital has already been recognised before; the European Commission requested the EU Member States to make an inventory of the ecosystem value for their national territories. In 2010, the then Minister for Agriculture decided to conduct a study into the economic value of nature, biodiversity and ecosystem services in the Netherlands. The PBL research programme is primarily focused on the question of how government, companies and social organisations can take the value of natural capital into account in their policies and investment decisions.

Methods and justification

To investigate the potential of sustainable supply chains managing and conserving ecosystem services, the market standards for responsible and sustainable production were used as a starting point. The standards used in this study included FSC for wood, UTZ Certified for cacao, RSPO for palm oil and RTRS for soya. For each resource, two production locations were distinguished, as local conditions may influence the value of ecosystem services. Local conditions may vary in type of soil (peat or mineral soil for palm oil production), natural vegetation (forest type; tropical forest or savannahs for soya production, tropical forests in South America and Southeast Asia), or farm size (smallholder or large farms for cacao production).

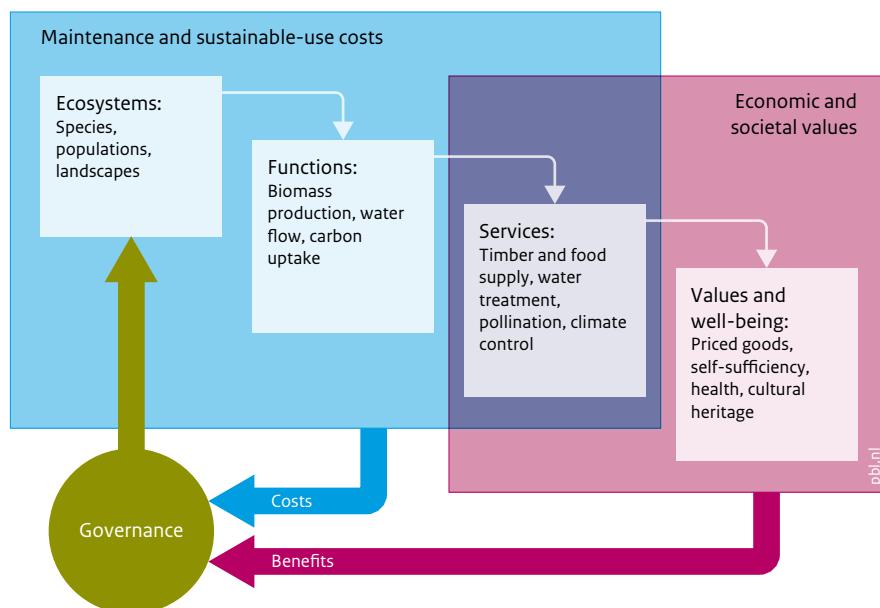
To address valuation-related questions, we analysed the costs and benefits of certified and sustainable production systems. To derive the net added value of sustainable production, results were compared with cost-benefit analyses of conventional production systems, which pay

The Economics of Ecosystems and Biodiversity: TEEB

Ecosystem services have value for everyone, but this value cannot always be expressed easily. The TEEB approach is developed for the valuation task (Figure S1). TEEB, *The Economics of Ecosystems and Biodiversity*, offers a method to determine the economic value and the costs and benefits of nature, biodiversity and ecosystem services.

The TEEB approach includes several analytical steps to determine the value of various, ecosystem services. First, ecosystems are characterised in terms of their structure and individual elements, such as species, populations and landscape elements. These elements are the carriers of natural ecosystem processes (functions) that deliver all kinds of services to society, such as biomass production and carbon sequestration. These functions provide a number of goods and services for society, such as food and timber, water purification and climate regulation. These goods and services represent a certain value and form part of the general well-being and economic welfare level of their recipients. The value can be made explicit by presenting them in monetary terms. This monetary value is an indication of the usefulness and necessity to conserve nature and biodiversity. In cost-benefit analyses, the financial costs of maintaining and sustainably managing ecosystems are compared against the societal and economic benefits these ecosystems provide. The balance between private costs and public benefits provides information which may improve decision-making on the governance of ecosystem management.

Figure S1
The TEEB approach to valuing ecosystem services



Source: Haines-Young and Potschin 2010, adapted by PBL

The TEEB approach includes several analytical steps that analyse both the costs of managing ecosystems and the value of the various ecosystem services. This provides information for better decision-making.

less attention to ecosystem services. The comparison is somewhat forced, since in practice there is no clear-cut difference between certified and non-certified production locations; production systems at a non-certified location can be managed sustainably, even though it is not monitored and verified through a certification process.

Since different stakeholders can have differing interests, it was necessary to make a distinction between the financial costs and benefits for resource producers and a wider range of costs and benefits for society. The analysis reveals that the market has possibilities to promote sustainable production, or that it is unrealistic to expect the market to offer the advantages without outside support, which would mean that governments need to play a complementary role to ensure the societal value of sustainable production is realised.

The cost-benefit analyses have been based on the TEEB approach (see text box and Figure S1). Various valuation methods were used to show the difference in the costs and benefits of sustainable resource production for various stakeholders. This way of analysing is referred to as 'extended' cost-benefit analysis. The focus of this type of analysis is on resource production processes and production location, and on how choices in production methods influence the interests of producers and other stakeholders involved. Such an approach is broader than that of standard cost-benefit analyses as it also takes externalities into account, but narrower in scope than cost-benefit analyses that also look at broader impacts, such as the effects on employment or shifts in consumption patterns.

A shortcoming of this study is that monetisation does not adequately reveal all those services that are considered to be valuable. Specific attention is still required for services that are not easy to monetise. The clearest example is biodiversity, as this has many widely varying aspects, ranging from purely functional to aesthetic. Because of welfare differences between western and tropical countries, there may also be differences in the monetary value awarded to certain benefits offered by nature. Methods that correct for these welfare differences can help to show the perceived value and the societal urgency to conserve ecosystem services, but corrected values are no indication of actual market opportunities.

Next to the cost-benefit analyses, a study was made of innovation in governance for sustainable supply chains to learn how decision-making processes can secure the values of sustainable resource production. With these insights, options were formulated to integrate values of ecosystem services into private and non-governmental

voluntary initiatives or in public policies for more sustainable supply-chains.

Research agenda for ecosystem services and sustainable trade

Due to the limited amount of published research data, for this study we needed to make several assumptions about the performance of certification and market standards; the identified benefits are therefore illustrative for the potential added value of sustainable production for the producers and other stakeholders, for a select number of resources at particular production locations. General conclusions for the food and wood producing sectors are not possible. Furthermore, results cannot be interpreted as the added value of the certification process, as that mostly depends on the starting situation and the number of improvements that have to be made in order to comply with the standards.

The cost-benefit analyses are performed with data from a series of separate studies. Well-designed, comparative case studies that incorporate the value of the various ecosystem goods and services are scarce, which means there is a research agenda for further investigation into how the social value of ecosystem services is affected by certification and market standards. The influence of certification and landscape initiatives on reducing deforestation also needs further investigation. Organisation that define, manage and improve the market standards can play a large role in this research agenda.

As this study was intended to provide insights for the Dutch policy agenda on development aid and trade, it did not include the possible substitution of resources with those from other regions; for instance, using rapeseed and wood from Europe to replace palm oil and wood from the tropics. However, it goes without saying that it would be useful to further investigate the substitution question, in order to secure the supply of resources for the Dutch economy and avoid production locations where the societal costs would be too high.

Costs and benefits of certified resource production

This section presents the business-economic and societal costs and benefits of sustainable production. First, the financial costs and benefits that are relevant for producers and, second, those for other stakeholders in society who are affected by resource production. From the four investigated resources (cacao, palm oil, wood and soya), we selected the case of soya production for a more detailed illustration. The societal benefits of carbon storage were found to dominate all other benefits. Therefore, non-carbon-related societal benefits were addressed separately.

Costs and benefits for producers and society

Certified resource production provides several financial benefits

Sustainable management of production systems has a positive effect on ecosystem production capacity; it ensures a future supply of ecosystem resources. Producers and the companies they supply both will feel the positive effect of the future availability of resources. Sustainable production can also help to reduce certain costs; for instance, in sustainable soya production on savannahs, where no-tillage practices help to build more organic soils that are more fertile and more resistant to pests and diseases. This, in turn, helps to reduce costs for fertilisers and pesticides. There may also be direct financial benefits; market premiums could be given for selling certified resources. Producers also enjoy the benefits of applying natural solutions, such as giving up tilling in soya cultivation, which leads to more fertile soils that require fewer pesticides. Here, the financial benefits arise from reduced expenses for fertilisers and pesticides. Financial benefits may also be obtained by certified farmers through market premiums for their produce and in joint purchases by cooperatively organised farmers. If carbon storage in the soil or vegetation could be increased, there are, in principle, possibilities for receiving additional payments from international carbon markets.

Costs for certification are not always compensated by financial benefits

The direct financial benefits do not always outweigh the additional costs of certification and sustainable production. Market premiums for soya are rather limited and many farmers, small-scale producers in particular, are unable to collect them. Ways to solve this could be by ensuring that independent bodies and stakeholders at the consuming end apply fairer prices, and by paying premiums directly to certified farmers.

In some cases, the net financial results for the producer are positive. For smallholder cacao farmers, it may be financially attractive to shift to more professional forms of management, increasing productivity and resource quality and, hence, their returns. But the farmer will have to be able to make the investment in improved and more sustainable management. In the sustainable exploitation of tropical forests for timber, improved extraction techniques cause less damage to the forest, while increasing forest regrowth. Here, the benefits for the producer lie in the future, while investments are required in the short term.

Certified resource production gives societal benefits

Apart from the direct financial benefits for producers and purchasing companies, certified production also has societal benefits for other stakeholders. At the farm level, the application of improved production methods will lead to a decrease in external environmental damage, which translates into lower costs for water purification and less health damage for the local population. Other benefits become evident when the effects at the regional scale are considered. If it is possible to avoid further deforestation when agricultural production areas are expanded, the local population as well as citizens around the planet can enjoy significant benefits. Preserving forest ecosystems has benefits for the local population, including an increased supply of food, fuel and non-timber forest products. Avoiding deforestation is also important to maintain carbon storage, which thus substantially contributes to limiting climate change, in the interest of citizens and businesses alike.

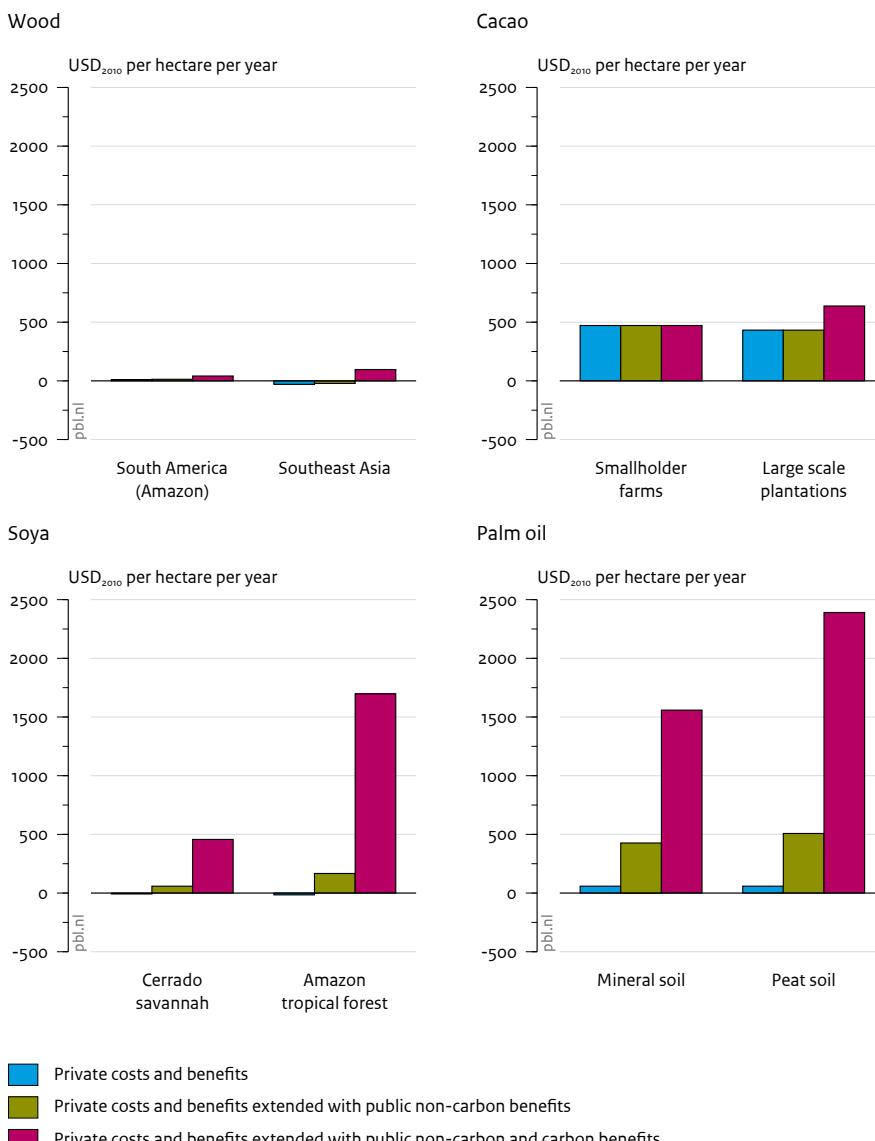
Societal benefits of stored carbon are dominating

When considering the monetary value of ecosystem services in the analyses, the high benefits of carbon sequestration attract attention. The societal value of avoided future carbon emissions is so high because climate change has effects around the planet and the influence of carbon dioxide in the atmosphere is long-lasting. It should be noted that the monetary value of carbon (the so-called social cost of carbon) is subject to intense debate, but even if much lower market prices would be applied, the benefits would still be relevant. Ecosystem services that are of local interest in the short-term are awarded a relatively low monetary value in cost-benefit analyses; among other things, due to the comparatively low standard of living of the local populations in tropical production areas. However, the preserved ecosystem goods and services are definitely valuable for these groups as a supplement to their income and, for example, as a source of food and energy.

What are the net benefits of certified production of palm oil, soya, cacao and tropical wood?

Whether certified production yields net benefits compared to conventional production is strongly determined by the specific production chain: palm oil, soya, cacao or tropical wood. Also the exact production location is of influence, as local production conditions differ greatly. The results of the cost-benefit analyses are presented here in a cumulative sequence (Figure S2). First, the net financial benefits for the producer are shown; these are then extended to include societal benefits of ecosystem services, and finally the societal benefits of avoided carbon emissions are included.

Figure S2
Potential net benefits of certified tropical resource production, 2010



Source: PBL

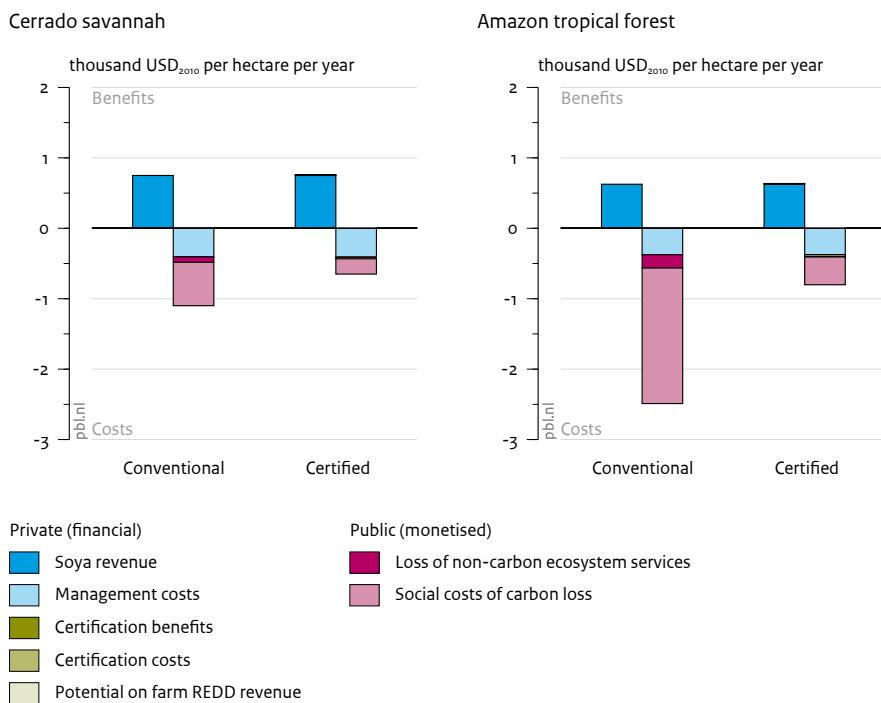
The net financial benefits of certified production for producers are generally modest in most instances and locations, although on small-scale cacao plantations, producers can enjoy significant financial benefits from increased productivity. The societal benefits offered by sustainable production are large, compared to conventional production methods, and they are especially high when the value of conserved carbon storage is taken into account as well. However, this would depend on what certification can contribute to reducing deforestation.

For producers, the net benefits are mostly modest, such as in the case of palm oil production. In soya production, the market premiums for responsibly produced soya are low or even absent, and are not enough to result in net positive results. The producers of tropical wood in Southeast Asia are confronted with harvest restrictions, and this results in lower wood revenues. For wood production in South America, there are modest positive results, but the benefits lie in the future while

investments for sustainable forest management are required in the short term.

Only in cacao production there are clear positive net financial benefits possible. For smallholder cacao farmers in Africa, it is financially attractive to shift to more professional forms of management, increasing productivity and resource quality, and hence their returns. On large-scale plantations, shifting from

Figure S3
Potential costs and benefits of soya production, 2010



Source: IVM 2014

For producers of soya, certified production does not provide many additional financial benefits compared to those of conventional production methods. Certification does have a positive effect on societal costs, as these are much lower.

monocultures to mixed agro-forestry systems with shading trees will lower revenues from cacao, but would also provide revenues from additional production sources, such as wood and fruit. These examples of financial benefits provide a stimulus for producers to shift to more sustainable production methods.

When we expand the cost-benefit analyses to also include the societal benefits of avoided environmental effects (externalities) and conserved ecosystem services, then there are clear positive net benefits related to the certified production of palm oil and soya. These benefits mostly concern issues that are relevant for local stakeholders in production locations. The results change strongly when the societal benefits of carbon storage are also taken into account. Especially for intensive production systems (for soya and palm oil), there are large net benefits that result from avoided deforestation and the related avoided high carbon emissions.

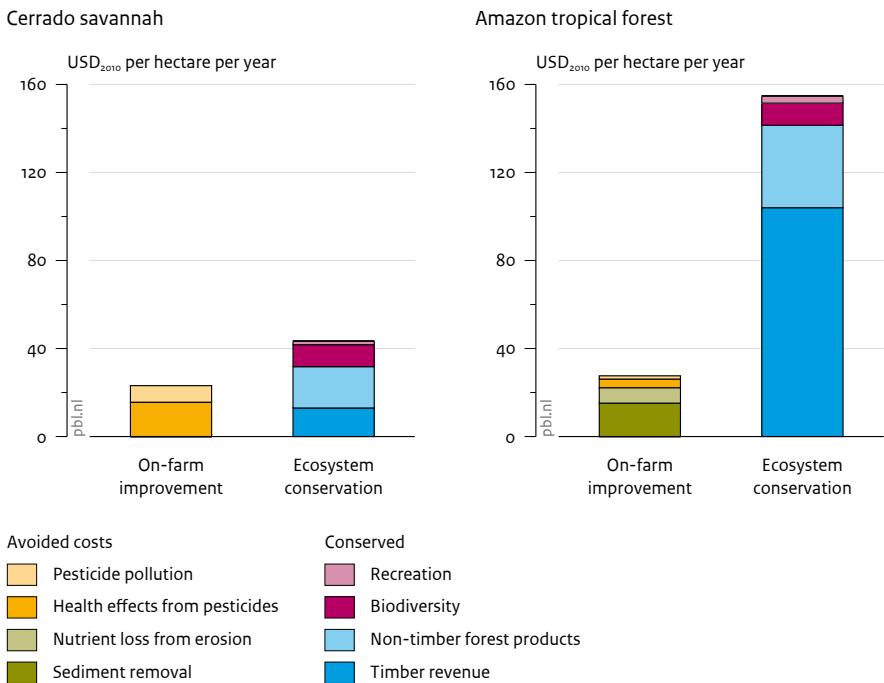
Although certified production yields net societal benefits, compared to conventional production methods, especially because of large carbon benefits, this way of

producing resources does not always result in a desirable situation. For some types of locations, such as palm oil on peatland and soya on tropical forest areas, the societal benefits of certified production still outweigh the societal costs. This is mostly related to the type of soil and vegetation; when palm oil is produced on peat soils there are still relatively high CO₂ emissions, even under certified conditions, and this is also the case when soya is produced in the Amazon region, in areas with tropical forests. Based on extended cost-benefit analyses, these types of production locations should be excluded from agricultural use.

Costs and benefits of certified and conventional soya production methods

Sustainable soya production in Brazil is taken as an example of the range of potential benefits and the spatial scales at which they may arise. Case studies have been carried out in the Amazon region and the Cerrado, two areas with markedly different natural vegetation and capacity for providing ecosystem goods and services (Figures S3 and S4).

Figure S4
Societal non-carbon benefits of certified soya production, 2010



Source: IVM 2014

Certified soya production has several non-carbon-related societal benefits, with a particularly high value for the Amazon region. These benefit other stakeholders than the producers of soya. Most benefits result from the avoided conversion of natural ecosystems, and they are especially large when tropical forests that deliver several goods and services can be conserved. There are also societal benefits from improved production methods at the farm level, as this is a way to avoid environmental externalities.

Conventional production

From a business perspective, it is sensible to produce soya since the financial benefits are much larger than the production costs. The financial costs and benefits of soya production are comparable between the two locations, with production taking place on land that, formerly, was either savannah or tropical forest. When the analyses are extended to also include societal costs and benefits, losses emerge in the form of environmental externalities, such as the effects of pesticide use. The conversion of natural ecosystems also leads to reduced carbon storage, which, in monetary terms, is by far the most serious loss for society. The total balance between costs and benefits for society is negative in both locations.

Certified production

Under certified production conditions, environmental externalities of production are reduced and natural ecosystems are not allowed to be converted into agricultural purposes. This results in several costs and benefits.

There are several benefits for producers that work according to certified production methods, such as lower costs for fertilisers and pesticides. These benefits result

from applying no-tillage soil management, in which ploughing and soil turning is not practiced. This increases the organic nature and fertility of the soil. Certification does not provide any direct major benefits in terms of market premiums for soya produced under the RTRS market standard. So the additional financial benefits are modest and not high enough to cover the related costs.

Improving production methods at the farm level is a way to avoid environmental externalities outside the production location, bringing about all kinds of positive effects for society, such as lower costs related to the damage to both the environmental and human health. However, these societal effects represent a relatively low monetary value (Figure S4). Substantial benefits do arise when the value of carbon storage related to avoided land conversion is included in the assessments. The societal value of avoided deforestation is particularly high in the Amazon region where tropical forests contain vast amounts of carbon (Figure S3).

In the Cerrado, net positive results can be achieved with certified production methods, but not in the Amazon region, because carbon emissions will be high even under

certified conditions. This means that excluding certain areas from exploitation is at least as important as the implementation of sustainable production methods for the preservation of valuable ecosystem services.

Societal non-carbon benefits

The cost-benefit analyses are dominated by the high societal value of carbon stored in vegetation and soil. That is why we also present the value of ecosystem services without the carbon effects. Figure S4 shows the non-carbon benefits of certified soya production, compared to conventional production methods. The societal benefits of certified soya production are mainly determined by the effects of certification on avoiding ecosystem conversion and, to a lesser degree, by the reduction in environmental externalities from on-farm activities. If deforestation in the Amazon region could be avoided, a number of ecosystem goods and services will be preserved, including the benefits derived from timber and non-timber forest products. In the Cerrado, the greatest benefits are related to avoided health issues and preserved supplies of non-timber forest products from the savannah. The conserved savannahs also deliver goods and services, but the value of those is much lower than for the Amazon region.

Options for using and securing the value of certified resource production

Cost-benefit analyses show that it is possible to conserve ecosystem services that have value for various stakeholders involved in sustainable resource production methods. To reap these benefits, a number of governance methods must be implemented for sustainable production and trade. These can take away some of the barriers, such as high costs or unequal distribution of costs and benefits; producers often have to make certain investments before they can obtain a sustainability certificate, although they are not compensated for any related societal benefits this may deliver. These benefits need to be identified so that producers can be compensated for any additional expenses, which will make investments in certified production more attractive to them. Existing initiatives and instruments for promoting sustainable production can serve as an inspiration here.

Active involvement of several actors required

Innovation generally requires initiatives from the business world, social organisations and governments. The first steps towards sustainability in supply chains are often made when society exerts pressure, denouncing questionable practices and calling for more sustainable

attitudes. The next phase often involves collaboration between businesses and social organisations to define and implement voluntary market standards for the certification of sustainable production and trade. Among consumers and businesses in the Netherlands, social awareness of the need for sustainable approaches has led to considerable growth in the application of these standards. However, to significantly extend the use of voluntary standards, governments need to take complementary measures, for instance by creating a level-playing-field. Instruments such as public sustainable procurement and general, applicable minimum requirements for production are already available. A similar combination of initiatives and actors is also required to stimulate the conservation of ecosystem services.

Involve stakeholders of ecosystem services in various ways

Involving the right stakeholders appears to be the key to achieving broad acceptance of market standards and certification. Based on their position and specific interests, stakeholders can put forward aspects to be included in sustainability initiatives. Stakeholder involvement is currently a regular feature of several decision-making processes, including integral land-use planning, assessments and revisions of market standards and appraisals of market standards to be adopted in government policies for sustainable procurement. This involvement also offers opportunities to improve the incorporation of the value of ecosystem services.

Market standards offer opportunities for the preservation and management of ecosystem services

Market standards offer promising options because consumers, market actors, social organisations and governments increasingly approve and use resources from verifiable sustainable production. Standards are also pathways towards the protection and preservation of ecosystem services, as they already take them into account implicitly or exert indirect influence. Since a number of ecosystem services are already covered, the adherents of market standards are implicitly taking them into account. Several companies are known to have no specific strategies or policies on ecosystem services; they see the preservation of biodiversity and natural capital as a part of their broader sustainability programme, based on generally available market standards. Although adherents of market standards may not see protection of ecosystem services as an explicit goal, the standards provide opportunities to link ecosystem protection to resources for consumer markets such as coffee, cacao and timber.

Use available procedures to improve market standards

To make valuable ecosystem services a permanent feature in the governance arrangements of supply chains, market standards must address them more explicitly and comprehensively. Presently, standards do not deal with all ecosystem services in the same systematic and practical way. The provision of drinking water and soil fertility, for example, are usually integrated into standards, whereas pollination and preserving and enhancing genetic diversity are only addressed indirectly. Many standards apply the HCVA principle of high conservation value area protection which may also cover the preservation of several ecosystem services, but the principle needs to be defined in more concrete terms and be implemented consistently.

Opportunities for these improvements can be found in the ISEAL Alliance collaboration platform for standards. This organisation functions as an initiator of discussion and innovation, and has drawn up generally applicable codes of conduct that are meant to increase the credibility and effectiveness of market standards. The codes regulate certain issues, such as multi-stakeholder involvement, both in the definition and revision of standards, and the upgrading of certification impact assessment. Involving stakeholders in the improvement procedures of criteria and principles offers opportunities to address different values of ecosystem services.

Payment mechanisms for individual services

International markets for ecosystem services could also be used for compensating producers for the costs incurred in sustainable resource production. The cost-benefit analyses show that carbon storage is the service that offers the best possibilities for obtaining additional funding. Increased on-farm carbon storage as a result of enhanced soil management may serve as a good example, but the greatest opportunities for carbon storage are linked to avoided deforestation. Payments for assured carbon storage can contribute to covering the costs of sustainable management and certification incurred by a resource producer.

The current market price for stored carbon is not high enough to create a strong impulse towards sustainable production and preservation of natural ecosystems. The carbon market is rather vulnerable due to fluctuating demand and the availability of a substantial number of technological alternatives for carbon mitigation. The search for additional funding from other markets, therefore, also remains important.

A new standard for forest services

The present impulse towards expanding sustainable forest management involves the certification of

internationally traded timber, according to the standards of the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC). An attractive innovation developed by the FSC is the new Forest Certification for Ecosystem Services (ForCES), a standard which provides the means to create markets for forest services, appealing to those sectors that are willing to pay for forest goods and services other than timber. This may lead to further contributions to sustainable forest management through the additional cash flow, but the payment system still needs to prove itself in every-day practice.

Combining ecosystem services with other interests

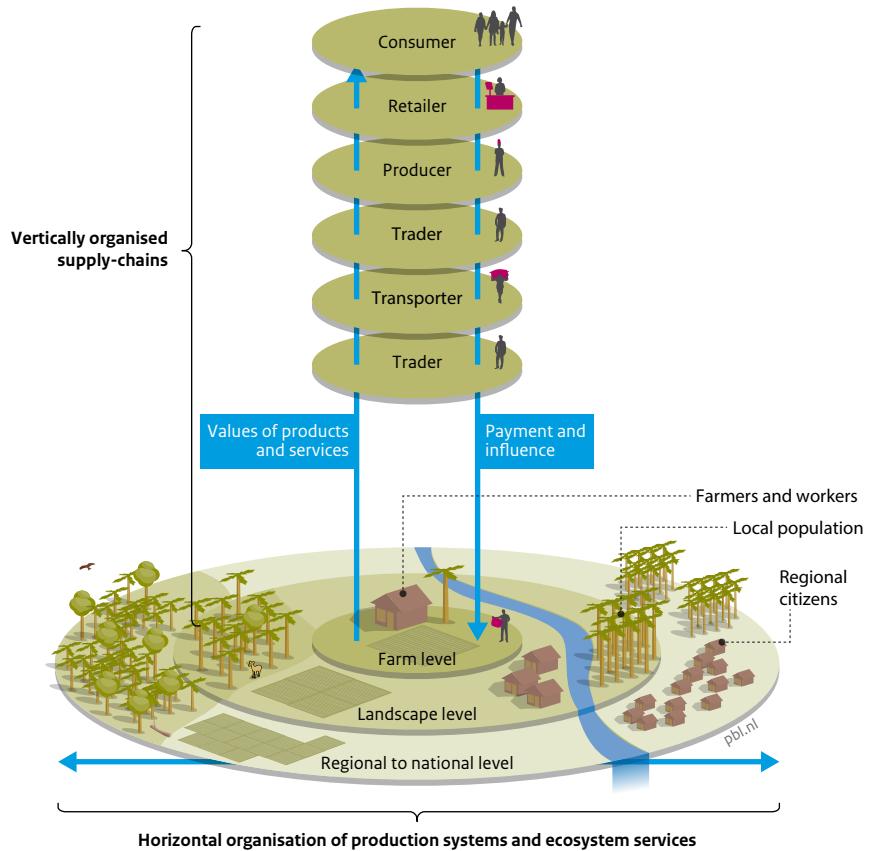
By combining ecosystem services, services that are socially important but for which people are reluctant to pay can take advantage of the market opportunities of other services for which there is greater willingness to pay. It would be possible, for example, for locally important services to benefit from carbon storage payments made. This would imply that carbon markets thus need to focus on several other interests besides carbon storage. That is in fact what also happens in market standards, trade in a specific resource is coupled to a set of production conditions that aim for sustainable ecosystem management.

Innovation in policies at larger spatial scales is necessary

A number of societal benefits of sustainable resource production can only be realised at spatial scales beyond that of the producer (Figure S5). As mentioned above, certification intends to slow down deforestation, but in practice individual producers have a hard time proving claims about avoided agricultural expansion and deforestation, since the effects are usually beyond the direct area of influence of the production site.

Another example of possible benefits at larger spatial scales is that of increased resource productivity. This occurs, for example, when smallholder cacao farmers increase their crop productivity or when forest plantations are established, leading to the so-called land-sparing effect in which, theoretically, more space is available for natural ecosystems providing several valuable services. Such effects on avoided expansion are difficult to claim and attribute to individual farmers and producers. Therefore, to realise these kinds of benefits of sustainable production, policies are needed that govern integral land use at a larger spatial scale. These can be in the form of broad initiatives at the level of landscapes or administrative territorial units. At present, new initiatives are being developed for production landscapes, in which decisions on integral land use are made in participatory processes that can serve several interests at the same time.

Figure S5
Interaction between supply-chain and production landscapes



Source: PBL

The adoption of sustainable production methods can be promoted through international supply chains that operate under voluntary market standards for sustainability. This makes it possible to preserve and enhance ecosystem services at the farm level, while it can also have far-reaching effects beyond farm or forest plantation, such as reduced environmental pollution and protection of valuable ecosystems.

Another possibility is targeting larger resource processing units, such as palm oil mills, to include all the relevant suppliers in an encompassing certification scheme, or setting up initiatives for all producers in a specific jurisdictional area. Cooperation at the regional governance level is required for this. Governments can also contribute to setting up compensation mechanisms for agricultural land use, to help farmers meet set-aside criteria to comply with market standards.

The complementary role of governments in scaling up initiatives

The Dutch Government can help with policies that facilitate and promote the scale up of the production and consumption of sustainably produced resources. The extent to which ecosystem services are taken into account in decision-making can be increased by:

- promoting consumer and company awareness of the societal value of ecosystem services;

- creating relevant frameworks to encourage transparency in corporate reporting on the effects of business activity on natural capital;
- adding more explicit references to the protection of valuable ecosystems to the criteria for sustainable procurement;
- supporting platforms such as ISEAL in defining a research agenda and a monitoring programme on the value of ecosystem services;
- assisting in capacity-building for integral spatial planning policies in producing countries.

The authorities need to focus mainly on the EU market, since the Dutch market share of certified resources is already relatively large. A common EU approach to sustainable resource production is required to establish a level playing field for companies and Member States; for example, by selecting reliable certification schemes that can be used for sustainable resource procurement by

European governments. In the long term, policy instruments should be developed to ensure that appropriate prices are established for resources. The first step towards this goal is encouraging companies to provide an overview of the costs related to externalities of production and measures to mitigate them. Cost-benefit analyses such as the ones performed in this study can help to raise public awareness of the need for fair and inclusive prices. This can also help in the short term to further the market for certified products.

Conclusions and recommendations

Implementing market standards is beneficial for society
The extended cost-benefits analyses show that certified resource production delivers several societal benefits, such as reduction in environmental pollution, soil erosion and health damage. The additional value of certification is the greatest in those cases where carbon storage can be maintained in natural ecosystems, which is highly valuable for people around the world. While in financial terms, the benefits for stakeholders living in the production areas are relatively modest and, although these benefits are highly relevant to them, they do not present opportunities for market solutions. The identified benefits of certified production do not include many direct financial advantages for the producer, but instead show all kinds of societal added value for other stakeholders, which are found to be the greatest. Thus, there is also a need for other solutions in addition to certifying trade to help conserve ecosystems elsewhere in the world. To promote and conserve the different types of value of natural capital and ecosystem services through supply chains, there is a need for complementary governance strategies, combining public and private options.

Improving and scaling up market standards

There are good opportunities for improvements, in the short term, by scaling up the adoption of market standards for sustainable production, along with specific revisions of the principles and criteria of the standards themselves. The Dutch Government can support scaling up efforts by communicating with other EU Member States about their policy approach that focuses on sustainable trade networks. Existing procedures for revising the standards can be used to make the required improvements to ensure ecosystem services are included as clear and prominent features. In addition, policies on sustainable procurement should focus more on innovations geared towards the preservation of valuable ecosystem services.

Use markets to generate additional funding

At the production end of the supply chain, several complementary sources of funding can be employed to promote sustainable management of production systems, which will generate possibilities to combine ecosystem services. For example, payment mechanisms for carbon storage or water provision can be used to enhance the protection of other services linked to them. However, these markets have not really taken off yet; higher carbon prices would provide more drive but this requires government intervention. New standards for sustainable forest management are under development, which offer possibilities to market a range of forest services.

Sustainable production as the new norm

A strategy that might be applied in the future is the promotion of sustainable production as normal practice. Europe can establish a level playing field on the demand side for all buyers and supply chains. Commonly agreed minimum requirements for production conditions are already being employed for timber import but at present these do not involve sustainable management of ecosystem services. At the supply side, producing countries can use voluntary standards as examples to follow or incorporate them into national legislation. This would serve to also cover producers who do not supply western markets only. Increased demand for and acceptance of sustainably produced resources can also be achieved if consumers – citizens as well as companies – become more aware of the societal costs of conventional production. But fairer and inclusive prices for resources cannot be set overnight; this requires time.

Spatial policy approaches at the level of production landscapes

Most of the additional values identified here are related to avoiding the conversion of natural ecosystems when agricultural production sites are expanded. In most market standards, avoiding deforestation is a major requirement. But the question remains whether certification of agricultural and forestry activities can contribute substantially to reducing deforestation, which needs to take place at a different scale from that of the individual farm. Additional governance measures at a higher spatial scale are required to stop deforestation and to secure the positive effects of avoided deforestation which have great societal value.

Therefore, apart from sustainable supply chains, minimum requirements and pricing strategies, attention should also be paid to territorial approaches that focus more directly on sustainable production. At present,

several experiments are being carried out with approaches that operate on a landscape scale, in which production and protection functions are served side by side. The Dutch Government is supporting several pilot studies in areas from which Dutch companies obtain their resources.

THE RESUME
FUTURE

Introduction

1.1 Applying the TEEB approach to international resource production and trade

Several natural resources are imported into the Netherlands to serve as inputs for production and consumption (Van Oorschot et al., 2013). With many economic sectors depending on them, continuing and securing the supply from foreign countries is an important policy target (Ministry of Foreign Affairs, 2011). The production of resources has a local impact on the environment, on nature and on socio-economic conditions for communities. More responsible and sustainable methods for producing wood and crops such as soya, palm oil, cacao and coffee, can partly mitigate the negative effects (Ministries of LNV, OS & VROM, 2002). In the Netherlands, private and public policies for sustainable trade promote the use of market standards for production and eco-labelling for consumption (Ministry of Foreign Affairs, 2013). These policies are motivated by issues such as resource dependence, risk avoidance, market demand, and social and environmental responsibilities (Van Oorschot et al., 2014a).

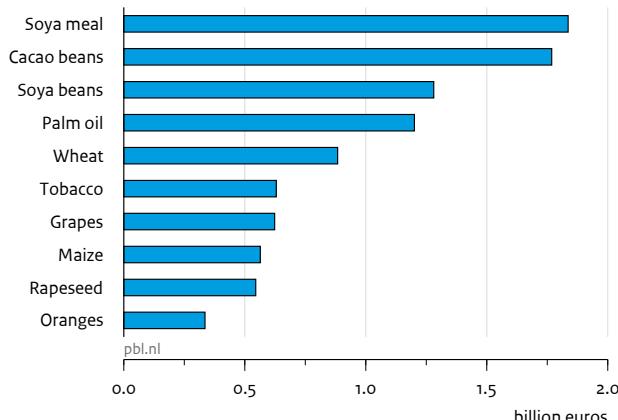
This report presents a study which applies 'The Economics of Ecosystems and Biodiversity' (TEEB) approach to the issue of sustainable trade. It identifies and maps the values of the range of ecosystems goods and services in consecutive analysis steps (TEEB, 2011). Based on the gained insights, suggestions are made on how to capture these values. International TEEB studies highlight the need for new public policies that are able to improve the appreciation of often overlooked public goods and social benefits and conclude that a transition in decision making is required to heighten concern across policy sectors for the many values of nature.

Applying this approach and way of thinking to supply chains and resource production provides knowledge that

can help to make Dutch trade more sustainable, by identifying opportunities to build a better business or social case for sustainable production. Reliable information on valuable ecosystem goods and services can contribute to the conservation and sustainable use of ecosystems and stimulate incentives to overcome some of the known barriers to expanding sustainable trade, such as the voluntary character of most initiatives and the high cost of certified and sustainable production. This is further complicated by the small possibilities of recovering the additional costs and the limited willingness of consumers to pay more for certified goods and products.

The study includes research on the private and social costs and benefits of conventional and sustainable supply chains for internationally traded natural resources. The results were used to explore the possibilities of integrating social ecosystem values into the governance of international resource supply chains, and to safeguard the provision of goods and services by improved management of production systems. The focus on ecosystem goods and services gives additional information about the multiple benefits of more sustainable production for public and private actors. This information can be used by decision makers, both public and private, in trying to make supply chains more sustainable. The report summarises results from desk studies on the costs and benefits of resource production, on innovation mechanisms in the governance of international resource supply chains, on coverage of ecosystem services in existing voluntary market standards for sustainable production and finally on perspectives for government authorities and market actors to promote the integration of ecosystem services into supply-chain governance and decision making. In the TEEB study for national and international policymakers, 'greening the supply chain' has been mentioned as a possible way to stimulate the protection of ecosystem services in areas where resources are produced and harvested (TEEB, 2011). Government authorities on all

Figure 1
Top 10 of agricultural commodities imported into the Netherlands, 2010



Source: FAO 2012

Agricultural commodities from tropical regions are important inputs in the Dutch economy in terms of their import value.

levels as well as public agencies and other organisations can implement 'green public procurement' policies to achieve rapid results in reducing pressures on biodiversity by driving markets and green supply chains. A market pull could be created through increased consumer awareness, while traders and wholesalers could implement responsible supply-chain management.

The dependence on foreign ecosystems in providing the economy with natural resources has also been stressed in the UK National Ecosystem Assessment (Weighell, 2011). However, in the TEEB literature, to date, there has not been an in-depth investigation of the practical integration of ecosystem service protection into supply-chain governance.

1.2 Building blocks

Importance of natural resource import for the Netherlands

The Netherlands has a relatively open economy, and trade is important for supplying resources to its economic sectors. The dependence on imported natural resources is high, not only for consumption but also for industrial production and export. This is especially true for food and feed resources, such as cacao, soya and palm oil, which top the list of agricultural imports from tropical regions in terms of monetary value (Figure 1; Van Oorschot et al., 2013).

Risks of ecosystem loss and the sense of urgency to act

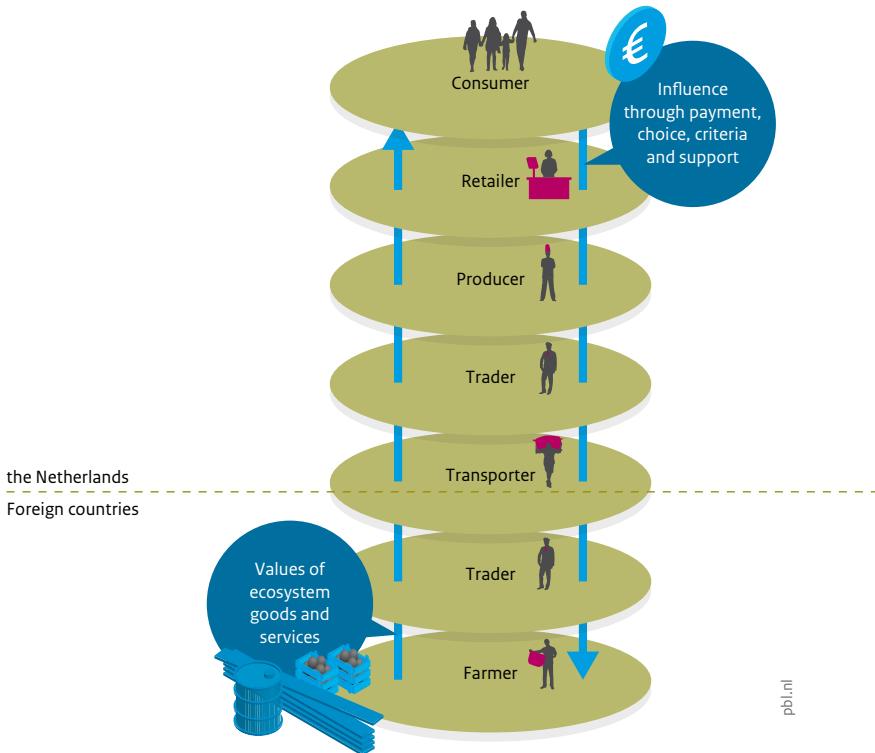
There are several risks attached to the production of natural resources, related to the impact on environment

and nature, and on social issues such as labour conditions and land rights. The food and wood producing sectors in particular lay strong claims on available land and water (Kok et al., 2014). In many cases, this has caused problems of deforestation, water scarcity and land conflicts with the local population. These problems present risks for companies that import resources into the Netherlands, such as wood, soya, palm oil, cotton, and inorganic resources from the mining industry (KPMG, 2014b). The following examples illustrate the risks of ecosystem loss for the agricultural sector, which affects the relationships between biodiversity, resource security and price stability (KPMG, 2014a). Due to deforestation, the local micro-climate in a tea-producing region in Kenya has changed. Extreme weather events have had a severe impact on tea harvests, and seem to be correlated with this forest loss. In Vietnam, the loss of forest area has led to an increase in the occurrence of plant diseases and has reduced the regional water supply. A large amount of the available water is used for growing coffee, and drought therefore presents a major risk. Drought has already led to sharp increases in coffee prices. Faced with these problems and the expected risks, such as reputational damage, increasing competition over resources, and future resource scarcity, companies respond with mechanisms for improved supply-chain management.

Using supply chains as a pathway for influence

Resource supply chains connect production areas in regions around the world with economic actors in the Netherlands, and vice versa, provide Dutch actors with a pathway to influence the production of resources. In addition to actually purchasing a specific traded good, influence can be exerted on production processes by

Figure 2
Influence through the supply chain



Source: PBL

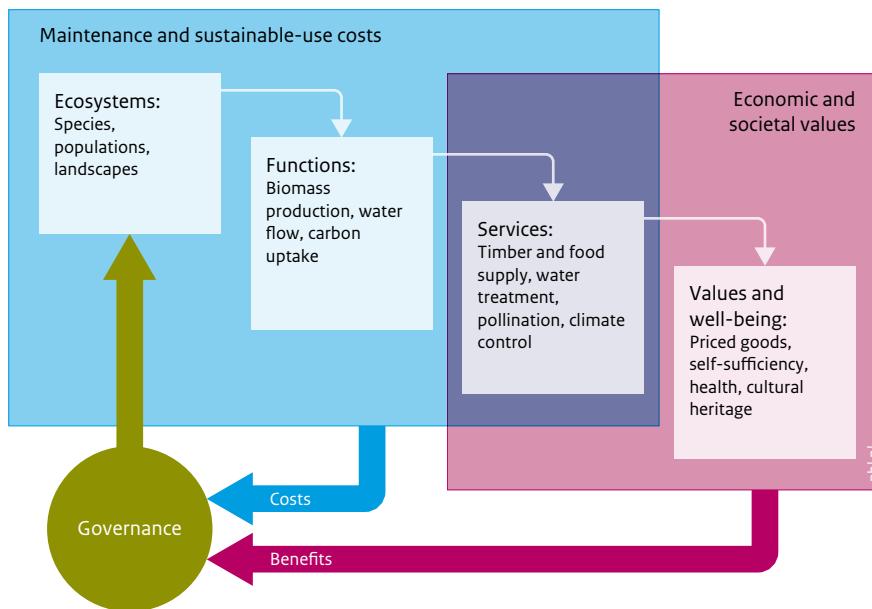
Supply chains connect producers in foreign countries to actors in the Netherlands, such as producers, retailers and consumers. They are forming a two-way infrastructure in which money and influence are exchanged for values of products and services. Various actors exert influence on the conditions of resource production elsewhere; for instance, by setting sustainability criteria, choosing certified products and by offering support (e.g. funding and know-how for sustainable production). In the other direction, producers not only supply a physical product for trade, but also manage ecosystems that supply services with values for actors in the supply chain and for other stakeholders.

choosing resources that are produced according to certain producer or consumer preferences (Figure 2). Different actors take part in the governance of international supply chains by formulating their conditions for production and trade. For instance, non-governmental organisations (NGOs) devise voluntary standards for socially and environmentally responsible production, companies use those standards in their sourcing strategy, consumers prefer products that are marketed as sustainable, and governments regulate trade; for example, by enforcing laws banning illegally produced wood (Van Oorschot et al., 2014a). This two-way route offers possibilities to stimulate responsible and more sustainable resource production and to capture the benefits and values for various supply-chain actors.

The TEEB approach to natural capital and valuation
Natural capital can be defined as the stock of natural ecosystems on Earth including air, land, soil, biodiversity and geological resources. This stock of resources underpins our economies and societies by producing

values for people, both directly and indirectly (NCC, 2015b). Ecosystem goods and services are produced by natural processes occurring in ecosystems (Figure 3). Or, in other words, ecosystem goods and services are the rent (the flow) that is derived from the capital (the stock). So, it is crucial to manage stocks carefully to maintain the natural processes that deliver these flows. There are several classifications of ecosystem services, but the main categories are provisioning, regulating and cultural services. Provisioning services refer to different goods, and therefore it is sufficient to talk about ecosystem services. People benefit from ecosystem services such as food, clean air and water, health, safety and enjoyment. Ecosystems in good condition possess their full potential to deliver ecosystem services. Ecosystem management and inputs refer to the labour, capital or energy investments needed to obtain certain benefits (e.g. harvesting crops or constructing and maintaining hiking trails for recreation). Ecosystem management is used to improve the delivery of a particular service, but this often comes at the expense of another service or of

Figure 3
The TEEB approach to valuing ecosystem services



Source: Haines-Young and Potschin 2010, adapted by PBL

The TEEB approach to valuing ecosystem services includes several analytical steps in a logical sequence. First, ecosystems are characterised in terms of their structure and elements. These elements are the carriers of natural ecosystem processes (functions) that produce all kinds of goods and services to society. These goods and services represent values to receiving beneficiaries, and form part of the general well-being and economic welfare level of beneficiaries. In cost-benefit analyses, the costs for maintaining and sustainable managing ecosystems are compared to the ecosystem benefits for human beneficiaries. The balance provides information for decision making on governance for ecosystem management.

the general condition of the ecosystem. For example, the stimulation of food production can have a negative effect on regulating services and will reduce the level of biodiversity. The focus on benefits and values implies that ecosystem services are open to economic and monetary valuation.

The Millennium Ecosystem Assessment (MA, 2005) concluded that approximately 60% of the distinguished ecosystem services are deteriorating, through loss of biodiversity, pollution, climate change and poor land use. Efforts to calculate the economic impact of natural capital degradation produced estimates of approximately USD 50 billion in lost goods and services per year from land-based ecosystems alone. This accumulates to an amount equivalent to 7% of global annual consumption by 2050 (Braat et al., 2008). Although the figures are very uncertain, such calculations have served to raise awareness about the value of ecosystems. Governments and businesses alike are recognising the importance of natural capital for economic productivity and the values of associated benefits. Greater transparency about resource use can enhance further awareness of individual company dependencies, the risks for supply-chain

security and ultimately business continuity. Individual companies are taking into account the impacts on natural capital through their operations, products and services. Hence, the term natural capital is more often used to frame ecosystem goods and services as a core input into an organisation's business model (NCC, 2015b).

Taking a different perspective; using supply-chain governance to secure the values of ecosystem goods and services

The main objective of this study has been to find possibilities to better integrate the multiple benefits and values of ecosystem goods and services into decision making for resource production. This is done by applying the steps of the TEEB approach to identify the benefits of sustainable resource production, and examining the potential of supply-chain governance as a mechanism to conserve and stimulate these benefits. The study provides an analysis of the interaction between vertically organised international supply chains and the sustainable management of ecosystems in production regions. Research is presented into the possibility of using sustainable production methods to secure long-term resource supply, and, at the same time, to safeguard

a broad range of ecosystem services that are of value for various stakeholders.

This involves comparing conventional resource production with methods that apply sustainable ecosystem management. Based on the delivered benefits and values, it may be possible to create national and international markets that help to finance certified and sustainable resource production and ecosystem management by organising a system of payments by parties enjoying ecosystem benefits to parties that make costs to deliver them. When private-sector actors willing to pay for the provided benefits cannot be found, there could be a task for other actors to safeguard the delivery of public ecosystem services that are relevant for their society. The supply-chain analysis also provides insights into the potential of sustainable trade to contribute to local development by promoting sustainable ecosystem management.

A TEEB approach on supply chains requires a view on resource production at different spatial scales, as some of the benefits of sustainable production may lie outside the production unit of the directly involved primary producers (Van Oorschot et al., 2014a). The system boundary for analysis therefore has been extended to include the surrounding landscape or even region.

Influencing ecosystem goods and services through certified supply chains

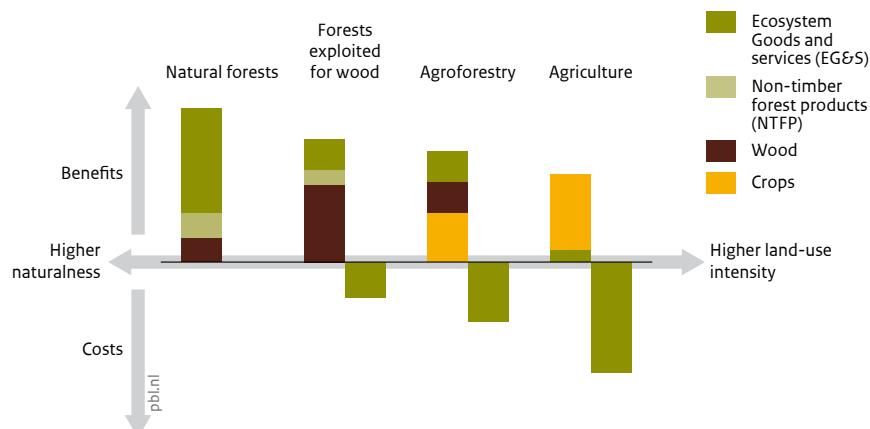
In the absence of regulation, such as national forest laws or an obligation to apply good agricultural practices, certifying production and trade according to the criteria of voluntary market standards for more responsible and sustainable production, is a much used mechanism to reduce the environmental and social effects of production processes. Over the past decades, the use of broadly accepted market standards for assuring and certifying sustainable production has become an important mechanism to promote socially and environmentally responsible trade (Van Oorschot et al., 2014a). The development of the standards has been initiated mostly by civil society organisations in cooperation with businesses. The primary reason for markets to voluntarily adopt product certification is the absence of government interventions in international trade (also referred to as the 'institutional void'; see Hajer, 2003), combined with deep social concern expressed by NGOs about deforestation in tropical areas and global biodiversity loss. Although governments mostly have not been involved in drawing up and revising market standards (Vermeulen et al., 2010), they do refer to them for their own benefit; for instance, in public procurement.

For many traded resources, both in forestry and agriculture, broadly accepted market standards have been developed to guide responsible and sustainable resource production. Several sustainability systems and labels exist, such as FSC and PEFC for wood, RSPO for palm oil, RTRS for soya, and Fair Trade, Rainforest Alliance and UTZ-Certified for cacao and coffee. In 2012, global production shares under these standards ranged from a poor 2% for soya to almost 40% for coffee (Potts et al., 2014). Implementing these standards may also conserve or enhance various ecosystem functions. Sustainable supply chains can mediate several incentives such as knowledge transfer or additional payments to responsibly operating producers and farmers. Payments can take different forms, such as the Fair Trade premium on consumer prices for coffee and cocoa.

Sustainability criteria cover a wide variety of concerns, including production, social and environmental issues. To date, there has been less explicit attention for integrating maintenance and protection of ecosystem services into supply-chain standards. A survey by the Convention for Biological Diversity highlighted that only 9 out of 20 standard setting bodies were confident that the coverage in their standards was adequate. Overall, it was recognised that further guidance is needed on the incorporation of ecosystem services into standards (sCBD and UNEP-WCMC, 2012). It is important to address questions of coverage (whether an ecosystem service should be included or not) and precision (the extent to which safeguards or measures for ecosystem services are articulated) to provide information on how standards can adequately be improved in this regard.

The study includes detailed supply-chain analyses of commodities that are given priority in Dutch Government policies. Soya and palm oil are chosen because of their large contribution to the Dutch economy, and wood and cacao because of the Netherlands' high trade dependence on them, even though only a relatively small part of imported wood comes from tropical regions (6% in 2010). Another consideration is the particular attention for the supply chains of palm oil and tropical wood in public debates on deforestation. For a long time, the Netherlands has been involved in policy-making to ensure the wood supply chain becomes more sustainable (Van Oorschot et al., 2015). In principle, a certain resource could be substituted by a different one or by one from another production area (e.g. replacing soya from Brazil by rapeseed oil from Europe), but these replacement options have not been examined here.

Figure 4
Costs and benefits of ecosystem services in production systems



Source: PBL

In this study, resource production systems are compared for their potential to deliver benefits in terms of ecosystem goods and services. Natural forests, forests exploited for wood, mixed agro-forestry systems, and intensively used agricultural systems are distinguished. The potential to deliver ecosystem services depends on the intensity of the applied land-use management and the presence of natural elements (the degree of ecosystem naturalness). Gradually, delivery of services (freshwater, carbon storage, non-timber products and biodiversity) is replaced by production of goods (crops and timber). Simultaneously, the types of ecosystem benefits are changing, from public values to private values.

1.3 Research questions and methodology

The main research questions for this study were:

- What are the private and public costs and benefits of production methods for resources, taking the values of ecosystem goods and services into account?
- How are costs and benefits of resource production distributed over the actors and stakeholders involved in and affected by resource production and trade?
- How does innovation in sustainability issues take place in the governance of international supply chains?
- Are voluntary market standards for certified production able to safeguard ecosystem goods and services?
- Are there, under sustainable resource production, ways for actors to capture the values of ecosystem goods and services for stakeholders, and integrate them into the decision-making processes of supply-chains?

To answer these questions, the analysis uses several methods which are described in detail below.

Comparing resource production systems

The study compares the characteristics of alternative resource production systems, focusing particularly on the presence of natural elements that determine their potential to deliver ecosystem goods and services.

The compared alternatives are conventional resource production and farming and forestry according to international market standards for sustainable and responsible production methods, here referred to as *certified sustainable production*.

Natural ecosystems are converted to accommodate agricultural use. The change from forest to agricultural land usually brings much higher financial revenues for the land manager, but at the same time, causes a major loss of ecosystem functions (Figure 4), along with social costs for dependent and downstream communities. Payments by service users to the ecosystem manager can help to make conservation of natural ecosystems and certified resource production the more attractive option since it is a way to internalise the negative effects known as the externalities of production (Engel *et al.*, 2008).

Resource production systems differ in the degree to which ecosystem services can be delivered at the production unit itself (on-farm), and in the degree to which they safeguard ecosystems on a larger spatial scale (off-farm, at landscape level). These broader considerations are also taken into account as in market standards for sustainable agricultural production, conversion is not allowed after an arbitrary cut-off date, such as 1994 for FSC certified forests, and 2005 for RSPO certified oil palm plantations (see Chapter 3 for further details). The comparisons between conventional and

certified sustainable production, therefore, not only cover enhanced ecosystem services at the production unit, but also conserved ecosystem services from avoided deforestation. This is illustrated in the case descriptions in Sections 2.5 and 2.6.

To further structure the comparison between conventional and sustainable production, the study distinguishes three production types according to their degree of naturalness: natural ecosystems which are exploited for wood, agroforestry systems for cacao and completely artificially managed agricultural systems for soya and palm oil (Figure 4).

- For wood production, mostly natural and semi-natural forests are exploited and managed, whereas artificial forest plantations, which produce wood more efficiently, are becoming more widespread.
- For products such as cacao beans and coffee, agroforestry systems are used with a mix of natural and managed elements. Monocultures are also used, but their share is relatively small.
- Palm oil and soya production takes place in completely managed agricultural systems, optimised for the mechanised production of a (single) agro-commodity.

Including ecosystem services in cost-benefit analyses of sustainable production

In cost-benefit analyses (CBAs), usually only the financial costs and benefits are considered. The results can be quite different, however, when social aspects are also considered. Therefore, the standard financial cost-benefit analysis is extended to include elements that cover the social aspects of production. This broader variant is referred to as an *extended cost-benefit analysis*. In the first step, commodity production in both conventional and certified production systems is quantified, as this is the main ecosystem function that provides revenues to the producer. The extended analysis also considers the effects of production systems on other ecosystem services, including carbon sequestration, biodiversity and water regulation. In the second step, the contribution of all of the identified ecosystem goods and services are expressed in monetary terms, using several economic and social valuation methods.

Changes in primary production are relevant for the producer, changes in water regulation affect the local population, and changes in carbon sequestration concern the global population. So it is important to recognise the difference between a cost-benefit analysis carried out from the perspective of society as a whole (societal or economic analysis) and one from the perspective of an individual, a group or firm (financial analysis) (Van Beukering *et al.*, 2007). In other words, the

assessment should reveal whether a certified production system is financially attractive to the producer, and also whether it generates more benefits to society than a conventional system. If a certified system is found to generate more benefits to society but is financially less attractive for the producer, the assessment goes on to evaluate to what extent and how the societal values can be captured, or how decreased revenue can be compensated for. Broader socio-economic issues such as employment are not included here and, therefore, the 'social' cost-benefit analysis is not as comprehensive as required by the Dutch general guidance for 'social' CBAs (Romijn and Renes, 2013).

The analyses distinguish three categories of effects: ecological, economic and social. They take costs and benefits into account at both the operational (financial considerations for the producer) and the external level (environmental and social considerations). For financial considerations, the scope of the analyses is the production unit, but external costs and benefits for society, such as the effects of increased carbon emissions, may be found beyond the production unit. Where possible, the effects of sustainable production are translated into costs and benefits for stakeholders such as plantation workers, the local population, the downstream population, resource traders, and citizens around the world. This makes it possible to distinguish between local financial and broader social costs and benefits. For more information on the applied methods, see the underlying technical case-study reports by Van Beukering *et al.*, (2014) and Arends and Veeneklaas (2014).

The identified costs and benefits can be broken down into several categories, differentiating between producers and other stakeholders.

Costs and benefits for the producer (farmer, forest owner):

- Financial aspects of conventional production: revenue from selling a commodity on the global market and the costs of producing a commodity, including expenditures on land, labour, capital and transport;
- Financial aspects of certified production: benefits enjoyed by the producer as a result of selling certified, sustainably produced commodities (e.g. a price premium or an input discount) and costs incurred by the producer to change the production system, and ensure the production process meets sustainability criteria.

Costs and benefits for society (local workers, local communities, citizens):

- Social costs of conventional resource production deriving from the environmental impact of

production processes on ecosystem goods and services;

- Social benefits of certified and more sustainable production deriving from a reduction in the impact on biodiversity, climate change and soil fertility. This category can be subdivided into direct on-farm effects, brought about by applying improved production methods, and off-farm effects that are created (directly and indirectly) in the wider production landscape.

A practical problem for desk studies is the limited amount of field-based and comparative impact assessment studies on ecosystem services and values, which means it is not possible to perform a meta-analysis. To move forward with a limited amount of data, stylised, hypothetical cost-benefit analyses are created by combining information from various publications on individual ecosystem services. Preferably, they all focus on the same region, or a comparable one, to guarantee uniform contextual influence on impacts and values. For several individual goods and services, such as carbon storage, non-wood products and erosion prevention literature sources were available that provide quantified data. However, other services, such as biodiversity, can only be described in general qualitative terms, while the services that include experience-related value (e.g. religious or spiritual), water provision, and eco-tourism are very location-specific. No formal value transfer methods are applied. Due to these limitations, the results from the cost-benefit analyses should be interpreted cautiously, and the presented quantified values will not apply to all actual situations. The analyses do provide general findings on potential values of delivered ecosystem services.

Innovation in supply-chain governance; capturing the values of ecosystem services

An important question for the TEEB supply-chain perspective is how to give ecosystem services a more explicit place in international supply-chain governance. The term *innovation* – new ways of doing things – does not only refer to new technologies, but also to organisation of tasks and changes in the political-institutional environment. Innovation studies are used here to explore how these changes take place in supply-chain governance (Van den Berg et al., 2013).

Cases of innovation are selected for examination if they give sustainable production standards an explicit place in governing supply chains originating in tropical areas. For each of the studied resources, an analysis is made of the innovation mechanisms applied by several initiatives to promote sustainable production and trade. Innovations are possible in policies and institutions, in corporate

business models, in products, in processes and in mechanisms such as collective action (e.g. by producers). For each commodity, market characteristics, such as supply shortages and product quality concerns, reveal specific points that require intervention, seeing them as an impulse for innovation. The study also identifies other triggers, stimuli, barriers, contextual factors and framework conditions that are relevant for decision making platforms, and relates them to governance options and the available policy instruments.

An important part of innovation studies is the identification of the conditions under which innovation takes place. They concern the meso- and macroeconomic context in which value chains operate and are embedded, including the macroeconomic environment (socio-economic, regulatory, institutional and political), market demand and consumer characteristics and trends, the business operating environment and the structure, composition and degree of evolution of the production systems. The identified mechanisms for innovation give insight into the possibilities to improve the incorporation of ecosystem service values into the way supply chains are governed. Depending on the net financial or social benefits, different roles and options exist for private and public actors. There could be synergies between financial (private) benefits and the social (public) benefits but also trade-offs and conflicts. This balance will determine the role of market-based versus government-led solutions. An analysis is also made of contextual factors that influence innovation, such as regulations, business environment and political developments. These factors provide information on how the Dutch Government can establish the right context for innovation in supply chains to take place.

Coverage of ecosystem goods and services in the standards

In view of the increasing global awareness of the importance of ecosystem services and the widespread use of market standards for sustainable production, a better understanding of how standards address ecosystem services is relevant. A quick scan assesses how ecosystem services are covered and articulated in a limited number of certification standards (see Table 1). This provides important information on missing or less well represented aspects of ecosystem services. The analysis of coverage of ecosystem services is based on a review of publications that describe the operation and content of the standards examined here.

Important questions are whether ecosystem services are safeguarded directly or indirectly, and whether the standard gives sufficient attention to building confidence in their conservation. Safeguards are defined as policy

Table 1

Production standards and certification schemes analysed on their coverage of ecosystem services

Production standard	Resource	Document
RSPO Roundtable on Sustainable Palm oil	Palm oil	Principles and Criteria for the Production of Sustainable Palm Oil 2013
RTRS Round Table on Responsible Soy	Soya	RTRS Standard for Responsible Soy Production 2.0 (2010)
PEFC Programme for the Endorsement of Forest certification	Wood	PEFC International Standard, PEFC ST 1003:2010
FSC Forest Stewardship Council	Wood	FSC International Standard FSC-STD-01-001 V5-1 EN (2014)
UTZ Certified	Cacao	UTZ Certified Code of Conduct – version 1.0 April 2009
Rainforest Alliance	Various, including cacao	SAN Sustainable Agriculture Standard
Fair Trade	Various, including cacao	Fairtrade Standard for Hired Labour, 15.01.2014_V1.0

The selection of standards is based on their relevance for Dutch supply chains.

requirements that are relevant for ecosystem service conservation. The analysis, loosely based on the methodology designed by (Morgan and Wenban-Smith, 2015), involves categorising all ecosystem goods and services according to typologies that describe the level of coverage and precision. The scan uses the TEEB list of ecosystem services (TEEB, 2010) which also served for a comparable analysis for the Convention for Biological Diversity (sCBD and UNEP-WCMC, 2012). The analysis is complemented by academic and grey literature and, where possible, checked against results provided by other experts and standard setting bodies. The methodology and especially the classification of ecosystem coverage and precision, is further described in Chapter 3.

1.4 Limitations of the used approach

Trade perspective versus ecosystem perspective

This study is inspired by the current interest in the combined trade and aid agenda of Dutch policy makers. Taking trade in natural resources as the starting point, it provides a comparison of alternative ways of producing these resources. The basic question is how to produce the resources imported into the Netherlands in a responsible and sustainable way, taking ecosystem services into account and assessing whether this can bring local benefits to the production end of the supply chain. Due to the focus on traded resources, this study differs from studies that compare production systems with natural systems. A higher total ecosystem value is usually found for ecosystems that contain more natural elements than production systems optimised for resource production. In several of these comparative studies, the case of conserving wild nature is made (Balmford et al., 2002; De Groot et al., 2010). These types of analysis provide information for choosing the ecosystem use that is

most beneficial for local development. But this leaves the global demand for food and international trade out of the picture. In this study, we tried to combine both agendas by analysing what the local and global benefits would be of resource production that complies with the criteria of internationally agreed standards of sustainable production. The issue of substituting resources was not addressed. However, certain insights are provided in studies based on life-cycle impact comparisons, for instance between palm oil from Malaysia and rapeseed from Denmark (Schmidt, 2010).

Uncertainties on impacts and valuation limit the general applicability of results

A major problem for desk studies such as this is the limited amount of field-based and comparative impact assessment studies on ecosystem services and their value. Especially, the lack of well-designed comparative studies on the impacts and added value of certified production methods is a well-known and recognised problem (Van Oorschot et al., 2014; IOB, 2014). Impact research guidelines and programmes are designed in networking platform such as ISEAL (Milder et al., 2015). To work with these limited amounts of data, we constructed stylised, hypothetical cost-benefit analyses by combining information from various publications on individual ecosystem services. Preferably, these all focused on the same or comparable regions, to ensure a uniform contextual influence on impacts and value. For several individual goods and services, such as carbon storage, non-wood products and erosion prevention, literature sources with quantified data were available. However, other services, such as biodiversity, can only be described in general qualitative terms, while the services that include experience-related value (e.g. religious or spiritual), water provision, and eco-tourism are very location-specific. No formal value transfer methods

were applied. Because of these limitations, the limited proof of impacts and scarcely available valuation studies, the results from the cost-benefit analyses should be interpreted with caution. The analyses only provided general findings on the potential additional value delivered by maintained ecosystem services in certified production, and the presented quantified value will not apply in all local situations.

Welfare differences

The assigned value supplies information on the contribution of each ecosystem good or service to the welfare of individual stakeholders. This value reflects stakeholders' willingness to pay for welfare improvement or represents the avoided damage of welfare deterioration. These values, therefore, were determined according to stakeholder income levels, as poor people cannot spend as much as those that are better off, for example, to prevent a reduction in water quality. Different stakeholders attach a different value to a certain ecosystem service, independent of its delivery. A criticism of the use of cost-benefit analyses is that all values are simply aggregated to produce overall net benefits, leading to results that are skewed in favour of the wealthier stakeholders who, compared to less wealthy groups, are more willing to pay for the avoidance of harmful changes.

It is possible to correct the imbalance by applying purchasing power factors (De Groot et al., 2010; Van der Ploeg et al., 2010). This will give a better idea of the relevance for specific stakeholders, but these weighted values will not translate into real market opportunities. No formal value correction methods are available, as it is hard to assign each good and service to a stakeholder's welfare level (Van Beukering et al., 2014). Moreover, weighing each stakeholder's welfare level is a normative exercise.

Present and future carbon values

The value of carbon is of special interest, as it turns out to be a dominant element in the cost-benefit analyses. In the calculations for agricultural commodities, an estimate of the social cost of carbon of USD 46/tCO₂ eq is used, as well as a 'market' price of USD 5/tCO₂ eq (Van Beukering et al., 2014). The monetary value of the social cost of carbon emissions is difficult to determine exactly as increased atmospheric carbon levels have mostly future impacts and cause damage which vary significantly between locations, and do not occur in a linear fashion. Moreover, the present-day value of future damage depends heavily on the applied discount rate. This rate expresses the weights of future damage in present-day values; the higher the discount rate, the less weight damages will have that lie further away in the

future. The Stern review (Stern, 2007) used a very low discount rate which resulted in a relatively high estimate for the social cost of carbon at almost EUR 100/tCO₂ eq. Overseeing all published values, the Stern value is an outlier because of the low discount rate applied. For this study, a value of USD 46/tCO₂ eq was used, which is the average (extracted by Van Drunen et al., 2010) from a meta-analysis of over 200 studies that modelled the marginal damage costs of greenhouse gases (Tol, 2008). A recent meta-study estimated the mean social cost of carbon at EUR 31/tCO₂ eq (Van den Bijgaart et al., 2013), which is close to the used estimate, given all the associated structural uncertainty and the large variation in individual estimates.¹

The present market prices for carbon offsets fluctuate greatly, depending on the types of projects and the expected level of permanency of the offsets. In addition, prices on voluntary markets also tend to be lower than on the compliance market. In the EU Emissions Trading System and similar schemes around the world, CO₂ allowances are traded at market prices that are not equal to the social costs. Recently, the price of CO₂ allowances in the European system has been around EUR 5 tCO₂ eq. Although these market prices may be poor proxies for the full social cost of carbon, they do give an indication of what the price of CO₂ emissions would be if producers of agricultural resources were involved in the international emissions trading system.

For this study, a market value of USD 10 tCO₂ eq was used in assessing the costs and benefits of sustainable forest management, which is relatively high compared to the current price of USD 5 per tonne on voluntary markets. But prices are expected to rise as soon as carbon mitigation from REDD² becomes formally accepted under the UNFCCC agreements (see Arends and Veeneklaas (2014) for further details and literature references). To assess the costs and benefits of sustainable production of the agricultural commodities, we used the lower voluntary market price of EUR 5 tCO₂ eq, as the corresponding carbon benefits are difficult to qualify for payment under the UN REDD compliancy rules.

Notes

- 1 Several numerical conversions are applied here. Van Tol gives an average of USD 127/tC at the 1995 rate. After adjusting for inflation to 2008 figures (USD 169/tC) and converting the carbon units (x12/44), this gives USD 46/tCO₂ eq. Applying an exchange rate of EUR 0.68 to the dollar gives EUR 31/tCO₂ eq.
- 2 UN Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries

Case studies – Ecosystem values of sustainable resource production

2.1 Introduction

This chapter presents a summary of the results of the extended cost-benefit analyses (Arends and Veeneklaas, 2014; Van Beukering et al., 2014) and the governance innovation studies (Van den Berg et al., 2013; Van den Berg et al., 2014). For several resources, conventional and certified production systems were compared with respect to production locations and local conditions, including soil type and climate. Table 2 and Figure 4 give an overview of the compared resource production systems.

2.2 The Value of Forests

For each production system, the naturally occurring ecosystem is the reference situation that determines which ecosystem services will be impacted by production activities, and which can be enhanced or conserved by applying sustainable production methods. In most of the studied areas, tropical forests are the naturally occurring ecosystems. Before turning to the results of the cost-benefit analyses, it is essential to recognise the economic values of forests, and the threats they face.

Economic value of forests is dominated by wood production

The Millennium Ecosystem Assessment (MA) stresses the importance of ecosystem services to human well-being, and especially their value for poor people who live in precarious conditions (MA 2005). This applies particularly to forest ecosystems. Worldwide, forests are home to 300 million people, with 1.6 billion people depending on them, to varying degrees, for their livelihoods.

Forests have both a socio-economic function for local communities and an important financial function for national economies. They provide goods, including food, fibre, fuel and medicines, as well as genetic resources (wild relatives of agricultural crop species), and ecosystem services, such as climate and water regulation,

and experience-related value (e.g. religious or spiritual) (Bozzano et al., 2014; CBD, 2009; FAO, 2014).

The production of wood is presently the most important economic use of forests worldwide. About thirty percent of the global forest area is used primarily for production purposes (FAO, 2010, 2015). The value of wood is important for all actors in the wood supply chain, from forest owners and managers, to workers, traders, processors, producers, retailers and consumers.

The number of jobs is estimated at 47 million, of which 30 million are in the informal forestry sector (Molnar et al., 2007). However, producing wood is not the only function of forests. About a quarter of the forest area has a multi-functional status, including a variety of uses such as erosion prevention, soil stabilisation and biodiversity conservation. Over the past 20 years, the proportion of the forest area enjoying a protected status to conserve and protect biodiversity has risen to about 12%.

Relatively little is known about the use of forests for social and cultural functions such as recreation, tourism, education and the protection of cultural values; estimates are in the order of a few percent (FAO, 2010, 2015).

The market value of wood is much higher than the market value of other forest products. In 2010, the total value of harvested wood amounted to about USD 150 billion, the major part while fuelwood represented a further USD 17 billion (FAO, 2015). The estimated total value of non-timber forest products, mostly food and plants, stood much lower at USD 21 billion. Since most of these forest products are collected informally and used locally, it is difficult to provide exact figures, but estimates put the non-monetary contributions of forests to households and national economies between three and five times the formal contributions (FAO, 2010). The economic contribution of forests to other sectors, such as tourism, industry, healthcare, water supply and agriculture, is not accurately accounted for either (Agrawal et al., 2013).

Table 2

The comparative study examines several production areas and systems for four tropical resources

Resource	Production area	Specific production settings	Compared resource production systems
Tropical wood	Southeast Asia / South America	High density / low density of commercial trees	Conventional selective logging / Reduced impact logging (RIL) / Wood plantations
Cacao	Ghana / Ivory coast	Smallholders/ large-scale plantations	Conventional / UTZ Certified
Soya	Brazil	Cerrado (savannah) / Amazon (tropical forest)	Conventional / RTRS certified
Palm oil	Indonesia / Malaysia	Peat soils / mineral soils	Conventional / RSPO certified

Forests are also important for storing carbon. It is estimated that forests contained about 650 Gt of carbon in 2010, about half in biomass and half as organic carbon in soil. Due to deforestation and forest degradation, about 10 Gt was lost between 1990 and 2010 (FAO 2010). Scientific literature affirms that yearly carbon emissions range between 0.8 and 1.5 Gt. Together, deforestation and forest degradation cause between 10 and 25% of yearly greenhouse gas emissions.

Impacts of wood production on forests and options for conserving forests

The wood production sector has many known impacts on forest ecosystems and biodiversity (Kok et al., 2014). Direct impacts are deforestation (the conversion into other types of land-use), degradation caused by selective extraction of trees and fragmentation, and the establishment of artificially managed wood plantations. Though the main driver of deforestation is agricultural expansion, part of the responsibility lies in the wood production sector as wood extraction makes forests prone to further degradation and eventual conversion (Hosonuma et al., 2012; Kissinger et al., 2012). Indirect impacts are due to environmental effects coming from outside the area managed for wood production. They are brought about by infrastructure development, the application of pesticides, and water and energy consumption. Harvesting, management operations and wood processing also impact the biodiversity of rivers and streams through pollution of water and the modification of riparian and riverine habitats. The use of fuels, chemicals and pesticides impacts biodiversity well beyond the immediate production areas (Kok et al., 2014).

Sustainable forest management is the main approach taken by the wood production sector to reduce biodiversity impacts (Kok et al., 2014). It aims to maintain or increase long-term productivity while reducing the impact on biodiversity and ecosystem services. Promoting sustainable forest management is an ongoing

process which started in the early 1990s, and is mediated by the use of market standards such as FSC (Forest Stewardship Council) and PEFC (Programme for the Endorsement of Forest certification). Sustainable forest management is achieved partly through government regulation, and partly through business adherence to voluntary production standards, often in the context of forest certification. Since 2009, forest conservation and sustainable forest management are acknowledged as options for carbon retention within the REDD+ mechanism (Arets and Veeneklaas, 2014).

2.3 Wood production in tropical forest ecosystems

Importance of tropical hardwood imports for the Dutch economy

The Netherlands is very dependent on imports of wood; the self-sufficiency rate was about 10% in 2013 (Probos, 2014), and even lower before the economic crisis set in. This is because the country's forest area is very small and has multiple functions. Moreover, a relatively low amount of the forest biomass stock is actually harvested. The level of import dependence is especially high for good-quality hardwoods from tropical regions that are needed in civil works. Imports peaked in 2006–2007, when the Netherlands purchased about 1.3 million cubic metres of tropical wood (round wood, sawn wood and plywood). Due to the economic crisis, imports declined to approximately 0.9 million cubic metres in 2011. About 90% of the imported tropical wood is used within the country, while the remaining 10% is re-exported (Probos, 2014). The share of certified tropical timber on the Dutch market meeting the sustainability criteria for government procurement increased to 39% in 2011 (Oldenburger et al., 2013). This was the result of voluntary initiatives by the wood importing and processing industry, awareness campaigns by NGOs, sustainable procurement by the

Case Summary

Sustainable forest management delivers both financial and societal benefits

The extended cost-benefit analyses on wood production show that there are several financial benefits of improved and sustainable forest management. In South America, applying damage reducing measures delivers benefits for wood production that are higher than the extra costs of improved management and certification. So even without taking other ecosystem services into account, applying so-called reduced impact logging (damage reducing logging techniques) offers financial opportunities to businesses in the wood supply chain. In Southeast Asia, these measures do not result in financial benefits for wood production, but reducing the damage to the forest does have advantages for the delivery of non-timber products, such as rattan, that are important for local stakeholders. To secure and capture the values of non-timber goods and services for the local population, additional incentives and funding must be found for sustainable forest management. Conventional forest logging that causes degradation and major losses of carbon stored in the forest ecosystem also come with high social costs. Sustainable logging methods can efficiently reduce the carbon losses, and financial benefits can be captured although at much lower market values than the estimated future costs to society. Sustainable forest management delivers mostly future benefits, such as larger future wood harvests and a reduction in climate change. This gives opportunities for companies with a long-term view to finance the short-term investments needed for implementing sustainable production practices.

Sustainability initiatives for forestry depend on voluntary market standards

In forest management, voluntary market standards can be a driving force to further the integration of ecosystem services into supply-chain governance, and to ensure their provision. These standards play a central role in supply chains that connect production areas with processing and consumption areas, and many supply-chain actors and sustainable trade initiatives apply them in their strategies and targets. Apart from serving private initiatives, broadly accepted market standards are also applied by governments when assessing whether resources available on the market are conform their criteria for public procurement. Companies also apply the standards in their procurement strategies; for instance, to support their corporate social responsibility strategy. Lastly, market standards are used in collaborative platforms such as public-private partnerships that are facilitated by the Dutch Sustainable Trade Initiative (IDH). Thus, market standards for sustainable forest management have huge potential to help integrating ecosystem services into supply chains. Nevertheless, the standards still have to improve their effectiveness in environmental performance, and especially in stimulating or at least maintaining ecosystem service levels.

A special example of innovation is ForCES, a new standard developed by the Forest Stewardship Council that explicitly addresses sustainable forest management for ecosystem services. The recognition that much of the socio-economic values of the forest ecosystem exceed those of goods such as timber is the main argument for the new standard. The goal is to create a business case for ecosystem service provision, by introducing certification into markets that are willing to pay to protect valuable ecosystem services. The market standard needs to cover all goods and services at a level that can be maintained, and enable the marketing of specific services. Hereto, ForCES uses the concept of *service bundles*, which may increase their market attractiveness. At the moment, several pilot projects are being carried out. This certification innovation is a way to implement the concept of *payments for ecosystem services*.

Dutch Government, and the supporting role of public-private partnerships set up specifically for tropical timber programmes (Van Oorschot et al., 2015).

Local value of forest products

Non-timber forest products (NTFPs), such as food, medicines and other materials, are important for people's subsistence in many tropical regions (Arets and Veeneklaas, 2014). They are also relevant for employment and household income. In the Amazon region, Brazil nuts,

fruits and palm hearts are among the most significant examples. In Pando, Bolivia, collection and trading of Brazil nuts represent up to 43% of the total household income (Duchelle et al., 2011). In Southeast Asia, rattan is considered one of the more valuable products from agroforestry (timber and non-timber products), generating substantial foreign exchange earnings for the producing countries. A review of valuation studies concluded that non-timber forest products constitute a major share of total household consumption and income,

Table 3
Characteristics of forest management systems (Arets and Veeneklaas, 2014).

Forest management system	Selective logging	Reduced Impact logging	Forest plantations
Yield	1-4 m ³ /ha/yr	1-4 m ³ /ha/yr	5-20 m ³ /ha/yr
Management	Focused on logging process	Extensive pre- and post-harvest management	Intensive stand management (planting, thinning)
Certification for SFM	No	FSC – PEFC	FSC – PEFC (not replacing primary forests when established after 1994)
Wood products	Harvest of slow growing hardwoods	Harvest of slow growing hardwoods	Mostly fast growing species, both softwood and hardwood

especially in poor communities without ready access to markets (Ferraro et al., 2012). For these communities, forest products are an important safety net against economic instability and periods of scarcity of foodstuffs from other sources.

2.3.1 Cost-Benefit Analysis

The following categories of forest ecosystem goods and services are considered in the cost-benefit analysis of wood production:

- Timber wood, as the primary tradable good produced in forests;
- Non-timber forest products, such as wild food, fish, nuts, fuelwood and others that can be gathered in the forest;
- Carbon sequestration and maintenance of a carbon stock;
- Water control, including watershed protection, erosion control, provision of drinking water, reduced risks of flooding, and maintenance of downstream water quality;
- Biodiversity that can be exploited to attract eco-tourism.

To calculate present-day values for future costs and benefits, a discount rate of 4% is applied, according to the Dutch General Guidance for cost-benefit analyses (Romijn and Renes 2013).

Comparison of forest management types

To shed light on the financial and social benefits of sustainable forest management, the study performs a cost-benefit analysis of alternative management types for tropical forests in Southeast Asia and South America. These regions differ strongly with respect to tree species, with Southeast Asia having about twice as much commercially harvestable wood as South America (Arets and Veeneklaas, 2014). Three forest management systems for wood production are compared. Two of these involve selective tree logging in semi-natural mixed forests (conventional and certified), while the third alternative uses artificially established and managed forest plantations. The analysis encompasses a 60-year period for typical forests in both regions, covering the

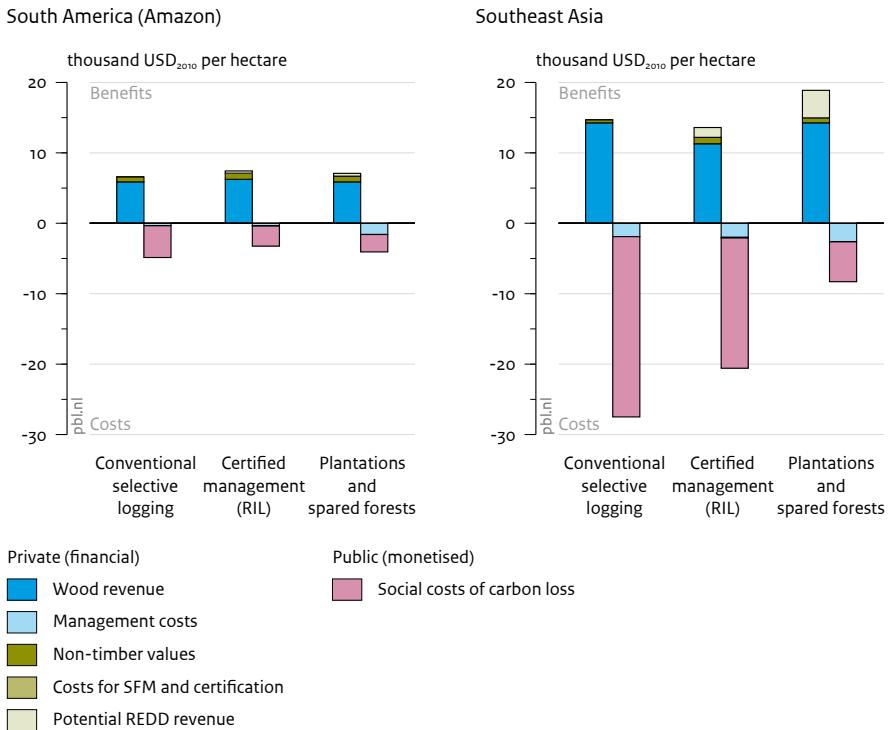
revenues of consecutive forest rotation cycles (two for selective logging, and four for fast-growing forest plantations). The comparison enables the identification of possibilities to compensate for the higher costs of sustainable forest management, either through private-sector mechanisms or public interventions. For a complete description of this case, see (Arets and Veeneklaas, 2014).

Selective logging is the most widely practiced wood harvesting method in the tropics. Mixed tropical forests are characterised by a wide diversity of tree species, most of whose wood properties are unknown or unsuitable (Lindenmayer and Laurance, 2012). Consequently, only a small proportion of the forest tree species with actual economic importance are harvested. Under conventional selective logging, harvesting practices cause damage to the surrounding stands. This leads to degradation of the forest, reduces its regrowth capacity, and affects a number of goods and services such as the provision of non-timber products that are important for the livelihood of the local population (Rist et al., 2012). The intensity and sustainability of selective logging practices determine future timber yields and thus future financial benefits.

Reduced Impact Logging is a method of selective harvesting used in sustainable forest management. This alternative is specifically designed to reduce damage and retain more living trees and biomass, which is beneficial for carbon sequestration and future timber harvests. Several studies show that timber yields after the first rotation cycle are consistently higher under reduced impact logging than under conventional logging (Medjibe and Putz, 2012; Putz et al., 2012). Sustainable forest management is also beneficial for a number of non-timber forest products (Guariguata et al., 2010). Reduced impact logging is required for certification according to the criteria of market standards for sustainable forest management (e.g. FSC and PEFC).

Artificial forest plantations are often established in the form of monocultures of exotic tree species. In these intensively managed forests, wood production is more

Figure 5
Potential costs and benefits of wood production, 2010 – 2070



Source: Alterra 2014

Costs and benefits of hypothetical cases of tropical forest management. The figures present net values in USD/ha (2010 price levels) and cover a 60-year management period.

efficient than in mixed natural forests because less area is needed to obtain the same amount of commercial timber, taking wood quality and prices into account. In this way, forest plantations may reduce the pressure on semi-natural or primary forest. Wood production on plantations may also qualify for certification of sustainable management, provided that the plantation has not replaced natural primary forests after the 1994 cut-off year (FSC, 2015b). Plantations do not offer many ecosystem goods and services other than wood, so the main contribution to conserving goods and services is provided by forest areas that have been spared thanks to the establishment of a plantation.

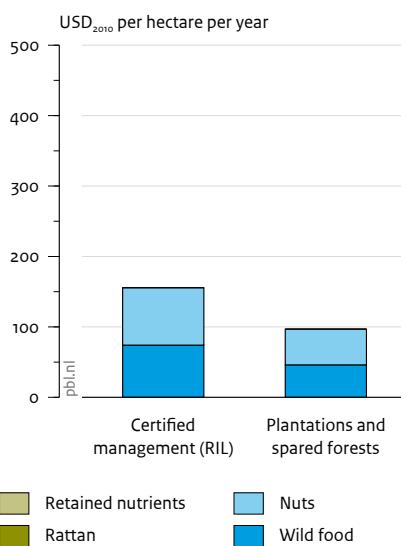
Revenue from selective logging under different management regimes

Specific regional values of wood yields and effects of sustainable forest management are taken from relevant publications (Arets and Veeneklaas, 2014). In the case of South America, future timber harvests, under selective sustainable management involving reduced impact logging, are expected to be higher than harvests under conventional logging. Over a 60-year period, the

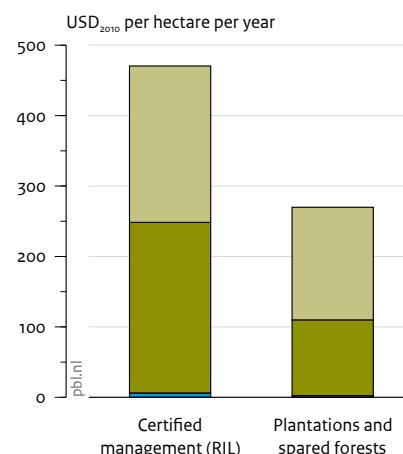
additional wood revenue is about USD 350/ha, which is about 20% higher than revenue from conventional logging (Figure 5). This is more than enough to compensate for the higher financial costs of sustainable management. Therefore, even without taking the social or financial benefits of ecosystem goods and services into account, sustainable management performs better. The results are different for Southeast Asia because yield under conventional management is much higher and revenue roughly triples that of South America. Reduced impact logging results in a 20% drop in wood revenue of USD 3000/ha over a 60-year period, mostly because the corresponding sustainable management criteria put restrictions on the harvest regime. This effect of reduced harvests under certified sustainable methods has been reported in several publications (Cerutti et al., 2014; Cerutti et al., 2011; Chen et al., 2010; Knight and Sarshar, 2007). In Southeast Asia, the benefits of sustainable forest management must be sought in other ecosystem goods and services, such as the value of non-timber products and carbon storage (Arets and Veeneklaas, 2014).

Figure 6
Non-carbon benefits of certified wood production, 2010 – 2070

South America (Amazon)



Southeast Asia



Source: Alterra 2014

The non-carbon benefits of certified sustainable forest management are quite different for the two production regions. This partly depends on the specific forest products found locally. In Southeast Asia, rattan is an important forest product that provides additional community income; in South America the Brazil nut is a highly valued forest food. The presented values on the benefits of sustainable forest management are calculated as differences relative to the benefits of conventional selective logging.

Values of non-timber forest products in selectively logged forests

Most studies assessing the effect of selective logging on non-timber forest products report a negative impact, but only a few have quantified it (Arets and Veeneklaas, 2014). This study assumes that the loss of these products in selectively logged forests is proportional to the logging damage the forest suffers. In reduced impact logging, trees that are valuable for non-timber products are marked in the pre-harvest phase, reducing logging damage to them and securing future harvests of non-timber products. Reduced impact logging provides additional goods and services. In South America these include nuts and wild food which amount to about 20% of the total value of non-timber products under conventional logging. In Southeast Asia, retained nutrients and rattan production are the additional non-timber forest products (Figure 6), representing a value of twice that of the non-timber output under conventional logging. In South America, the Brazil nut is a highly valued forest product that is collected locally. In Southeast Asia, rattan is an important non-timber forest product that is also traded on international markets.

Water and soil services can be maintained by protecting forests, but are not easy to relate to sustainable forest management

Well managed forests are able to maintain the supply of freshwater to downstream users and communities, and to reduce sediment loads to waterworks (Blackman and Woodward, 2010). When forests are converted to farmland, the storing and buffering capacities of their soils are lost. A high forest cover is beneficial for several hydrological processes, such as water infiltration, streamflow availability and flood mitigation (for further details, see literature cited in (Arets and Veeneklaas, 2014). Several cases exist in which payment for water delivery has been established between water consumers and forest managers (OECD, 2010; Wunder et al., 2008). Costa Rica has successful examples of regional payment schemes for water supply services from forests (Pagiola, 2008). The water services could create additional incentives for forest conservation, but it is not possible to relate this provision directly to the effects of certified forest management. So this study does not attribute an additional monetised value to the certified alternative. There is, however, limited information on the effects of sustainable forest management on sediment loads at hydropower plants, and in the list of benefits for the case of Southeast Asia a modest contribution by this water service.

The values of water-related forest functions are generally high. Values of over USD 200 per hectare per year have been calculated for watershed conservation in the tropics, including soil protection and reduced flooding (see Table 4.1 in Van Beukering et al., 2009). Natural forest ecosystems are usually more efficient in controlling erosion than forest plantations, where the understorey or litter layer is removed. It is difficult to state the positive effects of forest presence on water service values in general terms, as the service provision differs from place to place and values vary according to the specific context (Brujinzeel, 2004). Moreover, it is not possible to identify the additional effects of sustainable forest management on the potential of forests to deliver water functions to downstream communities. A search for comparative studies on the issue provided no results (Arets and Veeneklaas, 2014).

Sustainably managed forests can store more carbon

Forests where conventional selective logging takes place cause substantial CO₂ emissions. In South America, the social cost of carbon loss amounts to about 75% of the revenue from logging (Figure 5). In Southeast Asia, the social cost is about 80% higher than the wood revenue. This loss is the result of the high harvesting intensity and the damage suffered under conventional selective logging. Carbon losses can be reduced to about two thirds by applying reduced impact logging practices. Mitigation of carbon losses through sustainable forest management may qualify the producers for compensation payments under the UN REDD+ programme (Arets and Veeneklaas, 2014). It is therefore assumed that it is possible to generate additional revenue that can be used as funding for sustainable forest management. This means an increase in revenue of about 5% in South America, and 12% in Southeast Asia (Figure 4). The amount of carbon stored in wood products such as furniture and building material is not taken into account here.

The present market prices for carbon offsets fluctuate greatly depending on the types of projects and the expected permanency of the offsets. Prices on voluntary markets also tend to be lower than on the compliance market. To assess sustainable forest management, this study uses a market value of USD 10 per tonne of CO₂ eq, which is relatively high compared to the current price of USD 5 per tonne on voluntary markets. But prices are expected to rise as soon as carbon mitigation from REDD is formally accepted under the UNFCCC agreements (see Arets and Veeneklaas (2014) for further details and literature references).

Plantations for efficient wood production can also create benefits for society, but only when spared forests can be effectively protected

Plantations for wood production are efficient production systems that can help to avoid further exploitation of natural forests. This effect is referred to as *sparing* (Carle and Holmgren, 2008). Wood production on plantations is much higher than in semi-natural forest (Table 3). Timber species that are grown on plantations, such as acacia and teak, provide wood with qualities and practical applications that are different from those of the hardwood species harvested from semi-natural forests, and their prices are generally much lower. To obtain meaningful figures, the study compared plantations combined with spared areas of natural forest to *equally sized* exploited forests that are conventionally logged, both delivering the same economic value in harvested wood.

In South America, forest plantations yield the same revenue as can be obtained by conventional selective logging, while using a production area of only 20% of that of conventional selective logging. In Southeast Asia, plantations require about 40% of the area used for conventional selective logging to bring in the same revenue. The costs of establishing and managing forest plantations are relatively high compared to the operational costs in selectively logged forests (Figure 4), and moreover, plantation revenues lie mostly in the future as planted forest needs time to mature. This makes it relatively attractive and cheap in the short term to produce wood by exploiting natural forests.

Monoculture forest plantations, generally, do not deliver many ecosystem goods and services, such as non-timber forest products (although sometimes they do; see Bauhus et al., 2010). Larger ecosystem benefits can be provided by natural forest areas that have been spared from exploitation, as explained above. These benefits derive mainly from additional carbon storage, assuming that REDD payments are applicable (Figure 5). In practice, capturing the value of carbon stored in spared forests may be difficult for actors involved in wood supply chain. For REDD projects it is essential to define the exact property boundaries and ownership status (Robledo, 2014). In the case of plantations, the costs of establishing and managing highly productive exploitations and the benefits of stored carbon in spared forests are distributed over different owners and economic agents, both private and public. Another option is to establish plantations as reforestation projects, but this is not explored further here.

There are several ways to capture the financial and social benefits of sustainable forest management

The analysis shows that the costs and benefits of sustainable forest management are unequally distributed over a number of stakeholders and also over spatially different forest ecosystems. Ecosystem services that are the result of sparing natural forests are enjoyed by the regional population, and carbon storage benefits citizens worldwide, while investments in certified plantation management are made by the forest concession holder. These unequal distributions can be corrected by using market mechanisms (i.e. paying for ecosystem services that connect different spatial scales); by including sustainable forest management in business models for Corporate Social Responsibility; and by including management rules for ecosystem services in the market standards for sustainably produced wood (see Chapter 3). Market standards can ensure that the local and global societal benefits of sustainable forest management are maintained. In this way, the societal benefits can be coupled to the forest's main economic product, namely wood. However, end-consumer reluctance to pay more for certified wood is a known obstacle for further market uptake of certified wood resources and products (Chen et al., 2010; PWC and IDH, 2012). Additional incentives to adopt sustainably produced wood and additional finances from for instance compensation programs might help to overcome this obstacle.

Improved carbon storage offers opportunities to stimulate sustainable forest management

In all of the above comparisons, the higher carbon storage levels achieved by sustainable forest management stands out as a benefit in terms of avoided social costs. This provides an opportunity to generate additional funding to cover the higher costs of sustainable forest management and wood production. Such opportunities are especially relevant for countries that currently have low deforestation rates, and where management of forests and carbon storage provides the main opportunity to claim REDD+ funding; for example, in Guyana and Surinam in South America and Laos in Southeast Asia. A condition attached to this funding is the provision of sufficient safeguards for the permanency of the ecosystem store. Procedures and baselines have been established recently to support applications for funding (Robledo, 2014; Sandker, 2014). In the conclusions of this report, the possibilities for carbon payment schemes are further discussed.

Capturing the sparing effect of plantations is not easy

There are serious doubts about the 'land-sparing' effect of more efficient resource production. In land-use model studies, sparing is the logical result of assuming constant regional production. A review of several case studies

on agriculture shows that increased productivity does not always result in less deforestation. On the contrary, technological progress makes agriculture more profitable and gives farmers an incentive to expand production areas (Perfecto and Vandermeer, 2008). A similar process can be envisioned for the establishment of plantations, which can only capture the non-timber and carbon benefits of spared forests if the local forest governance includes the regional forested landscape (Figure 2). This requires that local government and land-use authorities are involved in capturing those sparing benefits, as is for instance the case in governance initiatives for sustainable production landscapes (Scherr and McNeely, 2008b).

2.3.2 Innovation in wood supply-chain governance

An innovation analysis performed by Van den Berg et al. (2013) looked at governance processes and conditions in the following initiatives for promoting sustainable forest management via the supply chain the Forest Stewardship Council initiative on standards for sustainable forest management; public-private partnerships convened by the Dutch Initiative for Sustainable Trade; the Dutch TPAC public system for assessing the criteria for public procurement in the Netherlands; and the UN REDD+ initiative for Reducing Emissions from Deforestation and Forest Degradation.

Sustainability initiatives in the forestry sector linked to voluntary market standards

In forest management, voluntary market standards can be a driving force to further integration of ecosystem services into supply-chain governance, and to ensure their provision. These standards play a central role in supply chains that connect production areas with processing and consumption areas, and many supply-chain actors and sustainable trade initiatives apply them in their strategies and targets. The main objective of market standards for wood production and supply-chain certifications such as FSC and PEFC is the promotion of sustainable forest management. Thanks to the broad acceptance of sustainably produced wood in consumer markets, the share of forests where wood is produced under sustainable conditions has risen in the last few decades to 23% of the total forest area currently exploited, although progress has been much less for tropical wood production (Potts et al., 2014). Apart from serving private initiatives, broadly accepted market standards are also applied by governments when assessing whether resources available on the market are produced conform their criteria for public procurement. Companies also apply the standards in their procurement strategies; for instance, to support their corporate social responsibility strategy (Simula, 2010). Lastly, market standards are also used in collaborative platforms such as public-private partnerships that are facilitated by the

Dutch Sustainable Trade initiative (IDH) as part of the Dutch Sustainable Trade Action Plan. For each of the tropical wood producing regions, specific targets are set for increasing the forest area under Forest Stewardship Council management (IDH, 2013). Thus, the potential of market standards for sustainable forest management to help in integrating ecosystem services into supply chains is large. Nevertheless, the standards still have to improve their effectiveness in environmental performance, and especially in stimulating or at least maintaining ecosystem service levels. Practical proof that shows these benefits can actually be delivered is crucial for building credibility and trust in voluntary standards and certification (Milder et al., 2015). Suitable indicator sets for impact assessment need to be defined; for instance, by using standard discussion platforms, such as the ISEAL Alliance (ISEAL Alliance, 2015b).

Multi-stakeholder involvement is crucial

Involving multiple stakeholders from the supply chain and the production landscape is seen as a crucial condition for the acceptance of sustainability initiatives (Van den Berg et al., 2014). The multi-stakeholder process for establishing principles and criteria gives legitimacy to market standards such as that of the Forest Stewardship Council. This contributes to the potential of market standards to attract other initiatives and actors to build upon them. For instance, social organisations concerned with conservation and development (e.g. WWF) use sustainable forest management standards (and even have helped to develop them) as an important element in their strategies. Support by NGOs has largely contributed to the successful implementation and broad acceptance of voluntary standards in the wood sector.

The Dutch public procurement system has created a public consultation process, where stakeholders can submit complaints about the principles or performance of specific market standards. Where there is insufficient proof of multi-stakeholder involvement or concern for local issues, a market standard may not be accepted for government procurement. This was for instance the case for the Malaysian Timber Certification Council. Presently, this standard has been granted temporary approval under the condition that improvements are made on issues such as local consultation of stakeholders and adequate mapping to monitor forest conversion and verify land ownership (lenM, 2013).

Ecosystem services are not always explicitly mentioned or specifically addressed

Some standards that are used to promote sustainably produced wood on the market cover the ecosystem services under consideration here implicitly, while others

are more explicit. A comparison using the terms of the Millennium Environmental Assessment (MA) and the TEEB study, reveals that the criteria and indicators of the FSC standard are much more explicit on ecosystems services than the Programme for the Endorsement of Forest Certification (PEFC; Van den Berg et al., 2014). An analysis of the coverage of market standards (see Chapter 3) shows that not all ecosystem goods and services are sufficiently addressed and safeguarded.

In other innovative governance initiatives examined here, forest management promoting valuable ecosystem services is not explicitly addressed either. In the Dutch Sustainable Trade initiative, whose definition of sustainability does not mention ecosystem services, sustainability is more or less equated with certification. But there is indirect reference to ecosystem services as the initiative builds on the FSC standard, while the PEFC system is not seen as sufficiently robust. In the Dutch assessment system for sustainable procurement, ecosystem services are also only indirectly addressed because of the use of existing market standards. Both FSC and PEFC have now been accepted for procurement purposes, but the MTCC system for tropical wood from Malaysia has not (Van den Berg et al., 2014). Up to now, carbon storage is the only ecosystem service that enjoys an international service payment system. The UN REDD programme explicitly targets this specific ecosystem service. Several co-benefits are possible; by requiring attention for more aspects than just carbon, the initiative can enhance other services as well, hence the term REDD+. Forest conservation provides services such as maintaining water levels and protecting soils from erosion. It is also expected to produce economic benefits, such as poverty reduction, livelihood support and promotion of economic development (Van den Berg et al., 2014). However, the potential of REDD+ projects to address social issues is much discussed, and additional safeguards must be put in place (IIED and IUCN, 2015; Proforest, 2010).

ForCES, an innovative standard to bring forest ecosystem services to markets

Market mechanisms that promote sustainable forest management are at present directly linked to the demand for wood, the main economic product from forests. In an innovative multi-stakeholder pilot project, a management standard has been developed to enable certification of the provision of certified forest ecosystem services to markets. An initiative of the Forest Stewardship Council, the project is named ForCES, which stands for 'Forest Certification for Ecosystem Services' (FSC, 2015a). It can help to stimulate financing of sustainable forest management by broadening the offer

Practical examples

Minimising the impacts of forest exploitation

The Dutch company Wijma (Wijma 2015) is a chief importer of tropical wood and a major supplier to the Dutch civil works sector. It is a pioneer in FSC certification in the Congo Basin. According to the managing director, ‘It is vital to minimise and control the environmental and social impacts of forest exploitation in tropical Africa. FSC certification has allowed Wijma Cameroun to considerably reduce these negative impacts’.

Eight years of sustainable forest management and certification have yielded several social and environmental improvements. Thanks to compliance with FSC standards and the company’s own social codes, working and living conditions of employees and communities living in the forest have improved. Local people are involved in decision-making about forest management. The forests are effectively managed for the protection of high conservation values (10% of the concession is dedicated to biodiversity conservation), including water courses, future timber trees, and rare and underrepresented species (FSC, 2014). At present, wood processing takes place in the country of production, which adds to its national economy.

In the past, actions by NGOs stimulated the company to develop these initiatives and in a later phase, the role of the Dutch Government became increasingly important, as they are the leading public purchaser of tropical wood for civil works. The sustainability criteria of the Dutch public procurement system have helped to shift Wijma’s activity to certified sustainable production (Van Oorschot et al., 2014b).

The right wood at the right place

The Dutch wood processing company Foreco develops and markets innovative wood products. Foreco is promoting the use of selected wood types from either forest plantations or managed semi-natural forests. Compared to forest plantations, semi-natural forests support greater species diversity and provide a range of services that are important to local communities. Awarding more economic value to semi-natural forests is crucial for their maintenance and the biodiversity they support.

Foreco is a member of the Dutch Platform for Biodiversity, Ecosystems & Economy, in which a wide range of companies (Natural Captains) have formulated the challenges of better integrating the protection of biodiversity and sustainable use of natural capital into their businesses. The experiments are supported and facilitated by the Dutch Government in the form of a ‘Green Deal’ (Platform BEE, 2015). Foreco’s marketing and innovation manager sums up the challenge as follows: ‘The sector needs indicators that show the ecological and social impacts of using different wood types and production methods. Such methods can help companies to make the right choice, and make the best use of limited amounts of slow-growing hardwood species’ (NKN website).

The possibility for promoting a diversity of wood types depends on the levels of quality required by various market segments. At present, there is a high demand for only a few, uniform types of wood, which are mostly obtained from highly productive forest plantations. Plantations are an efficient way of producing wood, but do not provide many other ecosystem services or types of value. When natural forests are only used for supplying a few specific wood types, an important part of their economic potential remains unused. This increases the economic incentive to convert forest land for other uses, such as agriculture. Therefore, there is a need to focus more on the lesser known species that natural forests can supply. The challenge, reflected in the phrase ‘the right wood at the right place’, is to make good use of the diversity in wood sourcing possibilities.

Foreco also actively develops eco-innovations that provide alternatives for tropical hardwood, and increase possibilities for wood recycling and cascading. An example is the upgrading of fast-growing softwood, such as pine, with bio-based residual products from sugar production. The company also performs experiments to investigate the long-term possibilities of processing upgraded softwood into new bio-based resources. These innovations can be further developed for other wood types.

A major obstacle that Foreco faces is how to make good use of complex concepts, such as biodiversity and natural capital in its communication and marketing towards customers. The company has already adopted a range of market labels required by customers, but these do not explicitly highlight the added value of diversifying wood sourcing for biodiversity. It is no easy task to convey to customers the benefits of efforts to maintain natural capital. Public procurement should reward these innovations, but current practice mainly drives uniformity (personal communication Foreco).

on the market with non-timber forest goods and services. By formally stating that the societal values of forest services exceed those of marketable goods (e.g. timber), the importance of addressing ecosystem services is explicitly recognised. Publications on ForCES refer to the 'untapped value of various tropical forests', which in TEEB studies is estimated to lie at around USD 60 per hectare for fuelwood, USD 50 for pollination, USD 1000 for water supply and up to USD 2200 for climate regulation (TEEB, 2010).

The ForCES initiative aims to put ecosystem service certification in place, obtain support for ecosystem services stewardship, and create a market for the claimed benefits.

Newly developed indicators and methodologies, which assess the impact of supply and management of ecosystem services, can be used to demonstrate the positive outcomes and the achievement of social and environmental objectives.

To test the applicability and market potential of certified forest ecosystem services, ten pilot projects are in progress at forest sites with different socio-political and environmental conditions; for instance, in Vietnam, Indonesia and Nepal. The project partners are researching innovative ways of evaluating and rewarding the provision of critical ecosystem services, such as biodiversity conservation, watershed protection and carbon storage and sequestration. For example, the Dutch development organisation SNV, is examining ways to link their existing projects with REDD+ and the national Payments for Ecosystem Services market.

The role of the Dutch Government can be made more explicit in public procurement and business transparency

The mostly indirect role of the Dutch Government in the initiatives under study here and the relative success of forest certification, confirm that it is possible to make international supply chains more sustainable under governance models that are not characterised by conventional forms of command and control. Nevertheless, the Dutch Government could stimulate potentially promising initiatives by addressing ecosystem services more explicitly. This could be done by including them in the criteria for public procurement, to prompt innovations in standards of sustainable forest management.

2.4 Cacao production in agroforestry systems

2.4.1 General introduction: Impacts of cacao production and challenges

Cacao import is a major economic input for the Dutch economy. About a sixth of global cacao production, some 600,000 tonnes, enters the port of Amsterdam each year. From there, it is transported to processing companies in the Netherlands and other European countries (Van Beukering et al., 2014). The economic value of cacao imports is relatively high compared to other agricultural commodities (see Figure 1).

Cacao beans are produced by farmers in Africa, Asia and Latin America where socio-economic problems such as poverty, inequality of rights, child labour, poor working conditions, and limited market accessibility are persistent. The expansion of cacao farming by poor smallholders is an important driver of deforestation in the humid tropics. In West Africa, cacao production is the most widespread land-use system, having expanded by about 2.3 million hectares over the last two decades. With this loss of forest area, their ecosystem services are lost as well. Most cacao farms in this region are run by smallholders, but there are also large-scale monoculture plantations which made up 20% of the total cacao production area in 2001 (Gockowski and Sonwa, 2011).

Several market standards have been developed to stimulate more sustainable production of cacao and to certify trade. They focus on several areas, such as improving farmers' socio-economic circumstances, promoting organic production and environmental protection and improving production efficiency and product quality. For instance, the UTZ Certified sustainability initiative focuses especially on smallholder farmers to help increase productivity and product quality (Waarts et al., 2015). Further scaling up of certified production is difficult, in particular due to the precarious position of the primary producers. Certification is costly for them, and operational costs involved may exceed earnings from selling certified products. International markets are not always easily accessible for smallholders. Acquiring knowledge and capital is difficult, and the possibilities for obtaining credit for investment are usually very limited. Supporting programmes that focus on local enabling conditions and knowledge extension are needed to reach smallholders and to make sustainable production a success (Waarts et al., 2014). Improving the farmers' livelihood is also a crucial aspect of national government plans for reducing poverty in countries such as Ghana.

Case Summary

The cost-benefit analysis of certified sustainable cacao production shows that it is possible to make financial improvements while also helping ecosystem services

The implementation of sustainable cacao production methods has different effects on large-scale exploitations than on smallholder farms. In smallholder farms, which represent the largest part of cacao production, incentives for improving the production target increased crop productivity and higher product quality. The effects can increase the financial performance of cacao farming, which may help to avoid further forest conversion. Avoiding deforestation can help to maintain ecosystem services, but individually certified farmers cannot easily safeguard such off-farm benefits. For capturing the benefits of avoided deforestation, suitable land-use governance arrangements must be in place. In large-scale cacao monocultures, shading practices are encouraged to favour the creation of additional ecosystem goods and services. Although primary revenue from cacao decreases, this production system can still be profitable since the loss is compensated for by lower cost for agricultural inputs and by additional revenue from produced wood or fruits.

Initiated by social organisations, innovations in cacao certification are accelerated by business concerns

Over the past decades, several developments in the cacao supply chain have created a situation that opens the door to governance innovations at different parts of the supply chain. Due to trade liberalisation, governments in producing countries have gradually lost control over supply chains. Public campaigns by NGOs have raised awareness of the unfavourable environmental and socio-economic conditions associated with cacao production. To fill the institutional gap, several market standards for sustainable production have been drawn-up in multi-stakeholder processes. Simultaneously, cacao processing companies faced increasing competition for stable resource supply and quality. By adopting market standards and certification systems such as UTZ-Certified, Fair Trade and Rainforest Alliance, multinational corporations have invested in sustainable cacao production with the dual aim of securing their supply and simultaneously taking environmental responsibility. Increased productivity and product quality are the main reasons for cacao farmers, and especially smallholders, to adopt certification schemes and the corresponding organisational and training facilities. Using resource risks as a main driver, these innovations can create benefits for several actors in the supply chain.

2.4.2 Cost-Benefit Analysis

Improving cacao farming systems

Shading is a crucial issue in making cacao production more sustainable, because it positively affects habitat quality (and thus biodiversity) and reduces the need for inputs such as pesticides and fertiliser. Certification organisations lay down requirements in their codes of conduct. UTZ Certified, for example, requires at least 18 mature shade trees per hectare (UTZ Certified, 2015). If producers need to plant new shade trees, they should preferably use native tree species that form multiple canopy levels. The use of shade trees is also an important way to introduce more natural elements into cacao farming. Shade trees provide natural services to crops, such as natural pest control, protection of saplings, and improved soil quality. It is assumed that agroforestry systems also harbour other indigenous forest species that can provide services to crops such as pollination, although it is hard to find experimental proof for this claim. Besides cacao, agroforestry systems provide additional products such as fruit and timber. Crop diversity contributes to a more reliable provision of local food and a more stable family income (Van Beukering et al., 2014; Waarts et al., 2015).

Large-scale, full-sun monoculture plantations make considerable use of agrochemicals. Under certified management, favourable agricultural practices are stimulated, including the use of shade trees and the reduction of agricultural inputs to more moderate levels. Increased shading is particularly beneficial for maintaining soil fertility and avoiding soil degradation. It is true that these changes will result in lower short-term yields, but the expected long-term benefits consist of less environmentally harmful effects, and better farming prospects due to improved product quality and soil conditions. There are also health benefits related to reduced pesticide use.

On smallholder farms, an important issue for improvement is the application of good agricultural practices and optimal use of agrochemicals such as fertilisers. Although fertilisers may impact the environment if applied in excess and not managed properly, they can also significantly improve the productivity of cacao plantations, especially mature ones with relatively old trees. This can be achieved by stimulating farming improvements involving better seedlings planting material, pruning, weed control,

Table 4
Characteristics of the prototype cacao farming systems

Farming system	Small scale	Small scale certified	Large-scale Monoculture	Large-scale certified
Size	1 ha	2.5 ha	100 ha	100 ha
Yield	350 kg/ha	600 kg/ha	900 kg/ha	700 kg/ha
Farm type	Traditional	Traditional / planted shade	Hi-tech	Planted shade
Certification	No	UTZ Certified	No	UTZ Certified
Pesticides	No	Moderate	Intensive	Moderate
Inorganic fertiliser	No	Moderate	Intensive	Moderate
Good Agricultural Practices applied	No	Yes	Yes	Yes

appropriate harvesting techniques and targeted use of fertilisers. These changes may also reduce soil degradation and increase soil fertility, helping to create a more stable farming system and securing a higher farm income (Gockowski et al., 2013; Cerdà et al., 2014).

Distinguished farming systems selected for analysis
When comparing the cost-benefit analyses of different cacao farming systems, it is important to realise that various current practices have totally different starting points. This desk-study makes a distinction between smallholder farms and large-scale monoculture plantations, as their production characteristics and options for improvement are radically different (Table 4). To enable comparisons, prototype farming systems are defined, with a series of assumed crop yields falling within the typical productivity range. Certified production methods are found to have opposite effects on productivity in the two systems, with increases in small-scale farming, and decreases in large-scale farming (Figure 7). See Van Beukering et al. (2014) for a full description (based on field data by Gockowski et al. (2013), Gockowski and Sonwa (2011) and KPMG (2011)). For comparability, the analyses list revenues on a per-area basis expressed in US dollars per hectare.

Financial costs and benefits of sustainable cacao production

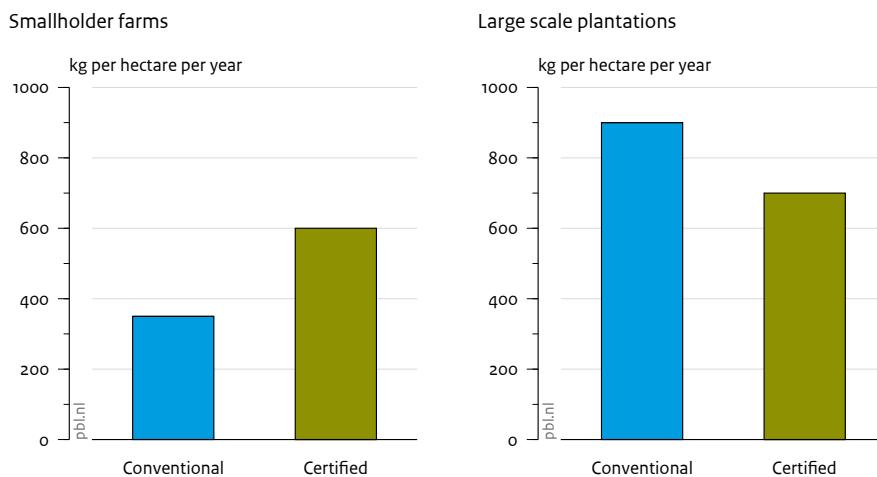
The cost-benefit analyses of small-scale farming show that the main financial benefit of improved production practices comes from enhanced yield (Figure 8). In this stylised analysis, the higher cacao revenue outweighs the extra investment in certification and operational costs. It is assumed that yield increases from 350 kg/ha to 600 kg/ha, which is relatively modest when compared to field data (Van Beukering et al., 2014). This assumption is still very uncertain, measured results on productivity improvements of GAP implementation in a recent study on effects of UTZ certification are far lower (Waarts

et al., 2015). The market premium for certified cacao also adds to the financial advantages, but this alone does not compensate the extra investment in certification and improved farming practices, which is almost twice the premium. There is no difference in additional revenue from selling other products such as wood and fruit, as both types of small-scale farms use shade trees. But much depends on the farmer's access to markets. Possible additional revenue from the required use of local tree species only, could not be quantified due to data constraints.

In large-scale certified cacao farms, shading is enhanced by planting trees. However, this lowers the cacao yields by more than 20% and the market premiums for certified production do not compensate for the drop in revenue and the investment in shade trees. Additional sources of income are found in new shade tree products such as timber and fruit which in the cost-benefit analysis represent almost a third of the revenue from cacao. Furthermore, in shaded plantations the cost of the required agricultural inputs is reduced to about half those in conventional production (Van Beukering et al., 2014).

Lack of pollinators is a typical productivity concern in large-scale unshaded plantations. Cacao cultivation depends strictly on pollination by midges, an ecosystem service provided by natural surrounding forests, meaning the local context is of major importance (Klein et al., 2008). Some monetary pollination values have been published for agroforestry systems and coffee production, but these are valid only for relatively small forest areas in the vicinity of the plantations (Van Beukering et al., 2014). Securing the pollination service is an important motivation to maintain mosaic landscape of agriculture or plantations interspersed with patches of forest, but the lack of data means the pollination service cannot be quantified in monetary terms.

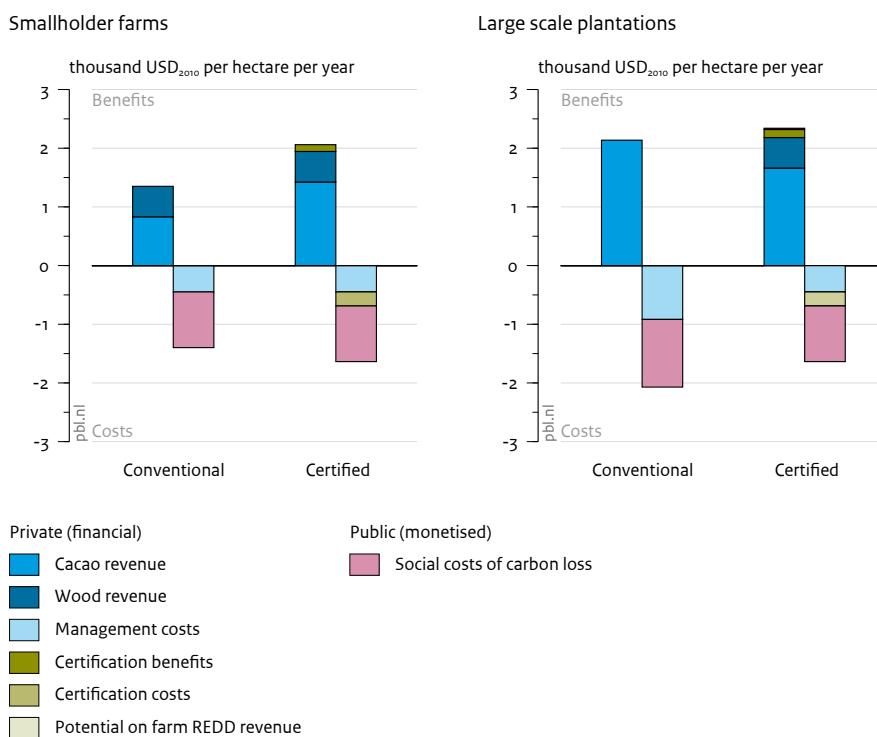
Figure 7
Effect of certified cacao production on yield, 2010



Source: IVM 2014

The potential effects of better farming techniques on productivity are different for small-scale and large-scale cacao farms. The scale of the cacao production site determines revenue, which is a major element in the cost-benefit analysis of the inclusion of more natural elements in certified production systems.

Figure 8
Potential costs and benefits of cacao production, 2010



Source: IVM 2014

The benefits of changing to certified cacao farming are different for smallholders and large-scale producers. For smallholders, applying more professional farming practices leads to higher yields and therefore better financial performance. In large-scale production, revenue from cacao decreases because of the switch from monoculture to agroforestry. The loss can be compensated for by lower management costs and new sources of income, such as revenue from wood produced in agroforestry systems. Certification premiums further add to the financial advantages. Improved carbon management may provide an opportunity to qualify for REDD payments.

Costs and benefits of on-farm carbon storage and deforestation

Promoting the use of shade trees will increase on-farm carbon storage, and even more so where monocultures are transformed into agroforestry systems. Depending on the number of trees, the farming system can more than double its carbon content. This additional on-farm store is a market opportunity that can add to the financial business case of certified production, provided it can qualify for REDD payments. Based on the applied assumptions for the farming systems, REDD payments would produce extra income of around USD 20 per hectare. At present however, these payments are not very substantial as current market prices are relatively low (see Chapter 1.3).

In the past, the conversion of tropical forests into cacao farming systems resulted in a loss of stored carbon.

Monoculture cacao farming, which is responsible for substantial historical losses of stored carbon, causes the total C stock to decrease from 220 tC/ha to about 25 tC/ha (Gockowski and Sonwa, 2011). The social costs of this loss are relatively high compared to other costs and benefits (Figure 8). Next to requiring good agricultural practices such as planting shade trees, certification systems contain criteria also on plantation establishment and in this way try to avoid deforestation and the loss of carbon and biodiversity. Certification systems for wood, soya and palm oil typically include a cut-off date for land conversion, but this is not normally the case in cacao standards. To compare certified and conventional production forms of all four investigated products, the effects on ecosystem carbon storage is also taken into account.

Theoretically, increased productivity and intensification could help in avoiding further expansion of the cacao production area – an effect referred to as *land sparing*. But the relationship between productivity and deforestation is not obvious. On small-scale farms, the main benefit of better agricultural practices is that more income is generated on the same amount of land. Moreover, soil degradation is avoided which would reduce the need to shift production by slash and burn practices. On certified large-scale plantations, the lower cacao yields entail a risk of stimulating further conversion of natural forest ecosystems to meet the total demand. It is also possible that the appeal of improved farming practices, improved income and long-term prospects, will cause more forest area to be converted for cacao production. The individual certified cacao farmer has no control over regional cacao plantation expansions and risks, and, therefore, the only way to reap any societal benefits from avoided deforestation is to involve actors that operate on wider spatial scales, such as regional

government authorities, who can steer and regulate land-use planning. Therefore, although improving farming practices is a necessary step to reduce poverty among smallholders at the farm level, this not necessarily means that deforestation will automatically be reduced.

Concluding remarks on certified cacao production

An important question is whether certification of cacao production reduces inequalities in the value chain, and helps to reduce poverty among farmers. Certification schemes are set up to improve the livelihoods of cacao farmers, but in practice they may not always be effective. For example, due to the lack of demand for certified cacao, part of the production cannot be sold, and the certified farmers miss out on the market premiums. Furthermore, the relatively high cost of certification schemes impedes the participation of poor farmers who do not have access to financing for the needed investments. Development programmes are necessary to provide agricultural knowledge and access to funding (Waarts et al., 2013).

Due to the limited data on the environmental externalities of conventional and certified sustainable cacao farming, it is not possible to evaluate all the benefits of improved production and the inclusion of more natural elements, such as pollination services. It is therefore difficult to draw general and definite conclusions about the economic and social feasibility of certified cacao production and its contribution to reducing deforestation. There has been recent progress on measuring the effects of UTZ certification, and it turned out that not all of the assumed effects could be confirmed (Waarts et al., 2015). More quantitative impact research is needed on these issues, and on the effects of other standards for sustainable cacao production.

2.4.3 Innovation in cacao supply-chain governance

Initiated by social organisations, innovations in sustainable cacao, are accelerated by business concerns

Over the past decades, several developments in the cacao supply chain have created a situation that opens the door to governance innovations. Due to trade liberalisation, governments in producing countries have gradually lost their ability to regulate cacao production and markets. Public campaigns by NGOs have raised awareness of the unfavourable environmental and socio-economic conditions associated with cacao production. At the same time, competition intensified between cacao processing companies for stable resource supply and quality. To fill the institutional gap, several market standards for sustainable production have been drawn-up in multi-stakeholder processes with the aim to reduce the environmental and socio-economic impacts of production.

These developments have led multinational corporations to adopt broadly accepted certification systems such as UTZ-Certified, Fair Trade and Rainforest Alliance and invest in sustainable cacao production with the dual aim of improving their corporate social responsibility strategy and securing their supplies. At the beginning of the supply chain, increased productivity and product quality are the main reasons for cacao farmers, particularly smallholders, to adopt certification schemes and organisational and training facilities (Van den Berg et al., 2014). The creation of an institutional framework for public-private partnerships, such as the Dutch Initiative for Sustainable Trade has also contributed to enhanced cooperation between supply-chain actors. As a result of all these developments and conditions, the production of certified cacao has increased substantially in the last decade (Potts et al., 2014).

Options to capture ecosystem benefits

There are different ways to capture and institutionalise the benefits of sustainable cacao production. They can be integrated into existing certification schemes, captured in markets for specific ecosystem services and captured by initiatives on landscape level. The following is a summary of the findings by Van den Berg et al., (2014) on innovations in cacao supply-chain governance that cover these approaches.

References to ecosystem services in supply-chain innovations are mostly indirect

The concept of natural capital and its values has up to now only played a marginal role in initiatives and market standards for sustainable cacao production. Natural capital and ecosystem services have not been explicitly mentioned in the Dutch Sustainable Trade action plan and strategy for public-private partnerships or the cacao improvement program (IDH, 2012a, b). Specific innovations related to the role of ecosystem services seem limited, as the main focus of these initiatives is on reducing poverty. But references to ecosystem services do exist, for instance in the UTZ certification system, which plays a central role in these initiatives. The UTZ criteria take ecosystem services into account in its references to Good Agricultural Practices, both directly (integrated pest management, limiting pesticide and fertiliser use, maintaining soil fertility, preserving forests and biodiversity) and implicit or indirectly (more natural forests will supply more pollinators, and applying shade trees will enhance carbon storage). Other certification schemes for the cacao market, such as Rainforest Alliance, are more explicit on ecosystem services and have a slightly different focus on environmental issues and crop production (Van den Berg et al., 2014). There

is an obvious need for a more explicit treatment of ecosystem services and the adoption of criteria to safeguard them (see also Chapter 3).

Carbon markets can be created in the cacao chain, but government involvement remains necessary

The potential to create carbon markets for cacao supply-chains has been tested in an experiment with payment schemes, funded by the Dutch Ministry of Economic Affairs (Felperlaan et al., 2011). A pilot project explored the possibilities of Payments for Ecosystem Services as a supporting market feature for cacao farmers who conserve biodiversity, improve the delivery of ecosystem services such as clean drinking water, and stop deforestation. Larger cacao processing companies in particular were willing to make additional payments to farmers for carbon services, backed up by their strategies for corporate social responsibility. The main reason for these companies to engage in payment projects is to stop deforestation, maintain future productivity, improve farmers' income and increase biodiversity. At the end of the pilot phase, the willingness of the companies to continue proved to be very low, which is mainly due to the fact that there are no grants, subsidies or other forms of support to incentivise participation and cover costs. In this example of Payments for Ecosystem Services, civil society and non-governmental organisations are the implementers and promoters of the idea, but power and control lie mainly with businesses and governments as financers of the scheme. Farmers, governments of producing countries and research organisations concerned with ecosystem services have less influence over developing the PES approach (Van den Berg et al., 2014).

Landscape initiatives and supply chains require different levels of governance arrangements

Another way of capturing benefits of ecosystem services is presented by the landscape approach in which integrated land-use planning can safeguard the potential off-farm benefits of increased productivity. Landscape level approaches seem very promising due to their integrated view, but also face challenges as they have to overcome barriers between multiple actors (Horn and Meijer, 2015). Landscape level certification is being investigated by organisations such as the International Union for the Conservation of nature (IUCN) and the Rainforest Alliance (Schroth and McNeely, 2011). However, the sheer scale of such a system and embracing and rewarding multiple (small-scale) stakeholders presents practical difficulties. Most smallholders are not members of established organisations, which means reaching them is difficult and costly (Van den Berg et al., 2014).

EXAMPLES FROM PRACTICE

Carbon-neutral chocolate

The chocolate brand SWISS (available in Dutch supermarkets, and owned by the Halba company) actively markets its chocolate bars as carbon-neutral. Consumers can find sustainability information on the inside of the product wrappers, and more extensively on the company website (Chocolates Halba, 2015). A carbon footprint analysis was performed for the company according to Greenhouse Gas Protocol guidelines, taking all operational activities into account. It showed that energy consumption, electricity and gas for heating in particular, was by far the largest source of carbon emissions from operational activities. By switching from conventional electricity to hydropower, the company was able to cut the operational CO₂ emissions by 27% in 2010, which meant the carbon footprint per chocolate bar was reduced by almost half.

To achieve full climate neutrality, Halba offsets all remaining operational emissions in its supply chain by partnering with cacao cooperatives to plant trees for reforestation projects in Ghana, Peru and Honduras. Smallholder cacao farmers also plant hardwood trees in agroforestry systems to obtain additional sources of income while also benefitting the cacao crop. Planting trees is therefore a financially positive business case that adds to local prosperity. However, the published data do not make clear whether this can take farmers' incomes to above poverty levels. In a reforestation project in Peru, Halba planted two million hardwood trees in and around the region's cacao plantations. The project was certified for emissions trading under the UN Clean Development Mechanism and the company published a sustainability report describing the targets and commitments, and results achieved, according to the Global reporting Initiative (GRI) guidelines (Chocolates Halba, 2012).

The impact assessment and the measures implemented by the company make it clear that the company is taking responsibility for its activities. Furthermore, they use their corporate social responsibility strategy for product promotion and in their communications to consumers. The additional carbon revenue from reforestation is worked into the company's financial model.

Socially responsible chocolate

The Netherlands-based chocolate manufacturer Tony Chocolonely follows a different approach. Abolishing forced labour is central in its mission, strategy and marketing. To ensure this, it prefers to use segregated supply chains which are more expensive, but enhance resource traceability, enabling the company to build credibility for their slave-free production claims. Tony Chocolonely also uses the traceability system for their 'from Bean to Bar' marketing activities.

To efficiently reduce slavery and child labour, crucial factors are improving the productivity and the income position of smallholder farmers. Special programmes and certification standards promote improvements in farming practices and additional actions and projects address specific issues. The company adheres to the Fair Trade certification system, which focuses on social issues and training to support farmers in applying sustainable production methods. On top of the Fair Trade premiums for sustainable cacao, farmers receive additional bonuses, which should make it possible to take their income above the poverty level (Tony's Chocolonely, 2014). While building supply chains with preferred suppliers, the company also develops close, long-term relationships with cacao production cooperatives and commits itself to working together with them on sustainability programmes.

The company undertook a pilot project on social and natural capital accounting in their cacao supply chain, to identify possible blind spots in its sustainability strategy (Tony's Chocolonely and True Price Foundation 2013; Ingram, 2014). The costs of a range of environmental and social externalities were calculated for a single chocolate bar, and compared to a conventionally produced bar. In conventional production, most impacts occur at the beginning of the supply chain, whereas most added value is captured at the end, where manufacturers and retailers operate. The project also revealed that in conventional production, the largest social costs by far are the insufficient wages (calculated as difference between actual and decent living wages), followed by costs related to health and safety issues and further by the costs of land use (valued by the costs of tropical forest restoration). In 2013, the costs of externalities for bar of dark chocolate produced according to Tony's social and environmental criteria were about 40% lower than those of a conventional bar. This is the result of the paid premiums and the positive effects of Fair Trade conditions on labour issues. The calculations do not incorporate or explicitly mention the costs of lost ecosystem services.

The company's marketing activities do not refer to the reduced costs of externalities, as this type of cost-benefit analyses is thought to be too complex for use in communications to consumers. Nevertheless, Tony's pilot project provided information which point to clear priorities for further action such as additional premiums, education programmes and improvements in crop productivity. It also concluded that it is cheaper for society to invest in preventing negative impacts rather than repairing external damage or compensating for losses afterwards.

In this example, increasing farm productivity is an instrument that helps in achieving the company's main target of socially sustainable production. This is done by giving farmers training and knowhow on using more efficient farming techniques. In principle, this could also help to reduce deforestation, but the company does not explicitly mention this or other possible benefits of agroforestry systems for cacao farming, such as improvements in soil conditions, micro-climate, pest control, and pollination. The issue of avoiding deforestation, which helps to conserve ecosystem services with possible local values for stakeholders in the surrounding areas, is also not mentioned explicitly in the company strategy. The use of broadly formulated sustainability standards can help to expand the scope to better ecosystem management. Tony Chocolonely could also integrate ecosystems services into its standard by strategically coupling supporting targets to its primary objective of abolishing forced labour.

2.5 Soya production in South America

Certified production of agro-commodities such as soya and palm oil provides benefits at the on-farm and the off-farm levels

Certified production according to international market standards involves several types of improvements. By stimulating the application of good agricultural practices and techniques that maintain or stimulate natural soil processes, farm management can incorporate elements of natural capital which may partly substitute the high artificial inputs of conventional farming that cause several externalities. Historically, natural ecosystems have been converted to make place for farming systems to produce commodities such as soya and palm oil. The issue of deforestation is therefore prominent in debates on responsible and more sustainable production. To combat further deforestation, most certification systems for soya and palm oil production apply criteria that do not allow farm and plantation establishment by converting primary ecosystems. The benefits of avoided deforestation in terms of conserved forest ecosystem services are here referred to as the *off-farm benefits*. So along with the benefits of such on-farm improvements, there can be benefits at higher spatial scales. Given the different characteristics of on-farm and off-farm benefits and the governance arrangements to capture their values, it is important to distinguish different spatial scales.

Impacts of soya production and challenges for sustainable development

The production of soya beans has increased rapidly in recent decades, growing by a factor of 10 between 1960 and 2012. This large increase in produced volume was the result of a rapid expansion of the area devoted to soya cultivation, rather than improved productivity (Nassar

and Antoniazzi, 2011). Globally, the area dedicated to soya cultivation increased to over 100 million hectares in 2012, and it is expected to continue expanding, driven by global population growth and rising income. Economic development will probably lead to higher animal protein consumption, especially in developing and emerging countries. Most of the world's soya supply comes from just three countries: Brazil, the United States and Argentina. Soya expansion in South America has led to deforestation and conversion of native habitats, as vast areas of forest, grassland and savannah are being converted for soya production, either directly or indirectly in a cascade of consecutive changes in land use, combined with increasing land use intensity. As natural ecosystems are lost, ecosystem goods and services are also lost and biodiversity declines (WWF, 2014). Furthermore, agricultural inputs such as fertilisers and pesticides also have several environmental impacts.

Comparison of farming types for producing soya

The desk-study compares the costs of conventional and certified soya farming in the Amazon and in the Cerrado regions. Both regions are examined as their farming practices and natural ecosystem references differ substantially, and therefore also the effects of certified soya production. For both farming systems, the comparison uses specific reference data on system characteristics, carbon dynamics, operational costs and values of ecosystem services. The data were compiled by Van Beukering *et al.*, (2014) and derived from previous studies such as Castanheira and Freire (2013) on carbon dynamics, KPMG (2012) on operational costs, and TEEB for Business Brazil (2014) on ecosystem services.

The differences in farm size are relevant for the analysis, as the benefits of good agricultural practices depend on

Case Summary

Certified soya production in tropical areas gives different types of benefits

Market standards for responsible soya production aim at implementing better agricultural techniques and at avoiding further deforestation. Applying good agricultural practices can deliver benefits to the producer, such as the effects of better soil management. However, certified soya production is costly, and in the analysed cases in Brazil the direct financial benefits, such as price premiums and lower input prices, do not outweigh the additional financial costs. When the broader societal benefits of applying good agricultural techniques are taken into account, the case for certification is more compelling. And society can enjoy even higher benefits where it is possible to avoid the conversion of natural habitats into agricultural land, which would result in a loss of stored carbon. However, these positive effects cannot be achieved by individual farmers alone; they can only be captured through additional governance incentives. While in the Amazon it is hard to bring down the full societal costs of soya production by stimulating certified production, in the Cerrado savannah a net benefit for society is possible.

Complementary governance arrangements are required to produce off-farm benefits and to ensure compliance with deforestation criteria

The RTRS market standard established by the Round Table on Responsible Soy is an important governance innovation which stimulates several on-farm practices that help to enhance a series of ecosystem functions, such as those related to soil quality. But when it comes to capturing the broader off-farm benefits, land use planning and complementary forestry laws play an important role. Government led compensation and payment incentives can help soya producing companies to comply with the deforestation criteria laid down in voluntary market standards such as RTRS. A good example is the establishment of a trading system for surplus forested land, but the effectiveness of this mechanism is still unknown.

the scale of the production site and operational processes (KPMG, 2012). Farms in the Amazon tend to be smaller family-run exploitations which generally use less agricultural inputs, whereas farms in the Cerrado region are usually large-scale industrial plantations with a higher level of mechanisation to reduce labour costs (see Table 5). The natural vegetation in the Amazon is moist tropical forest, while the Cerrado has the drier savannahs. These natural references largely determine the losses in carbon storage and functions caused by conversion processes.

To estimate the potential costs and benefits of certified soya production, the study makes several assumptions which are based on the RTRS market standard. Developed by the Round Table on Responsible Soy, it is the most widely used standard for Dutch soya imports.

Two principles in particular are relevant for managing ecosystem services. Principle 4, concerning environmental responsibility, aims at reducing environmental impacts by minimising pollution and carbon emissions both on-farm and off-farm. Principle 5, which deals with the application of good agricultural practices, stimulates the application of no-tillage farming practices which help to enhance natural soil functions and reduce on-farm soil carbon emissions. Farms applying for certification under the RTRS principles can only be established on former pasture land, as conversion of primary ecosystems is not allowed after the 2009 cut-off date.

To sum up, the ecosystem services and environmental impacts that are assumed to be affected by certified production methods are: enhanced on-farm soil carbon storage by no-tillage practices; prevention of ground and surface water pollution by improved handling and reduction of agricultural inputs; prevention of soil erosion and sedimentation in water courses by improved streamside cover and soil management; and preservation of native vegetation and carbon storage in areas with high conservation values (Van Beukering *et al.*, 2014).

2.5.1 Cost-Benefit Analysis

Financial costs and benefits of certified soya production

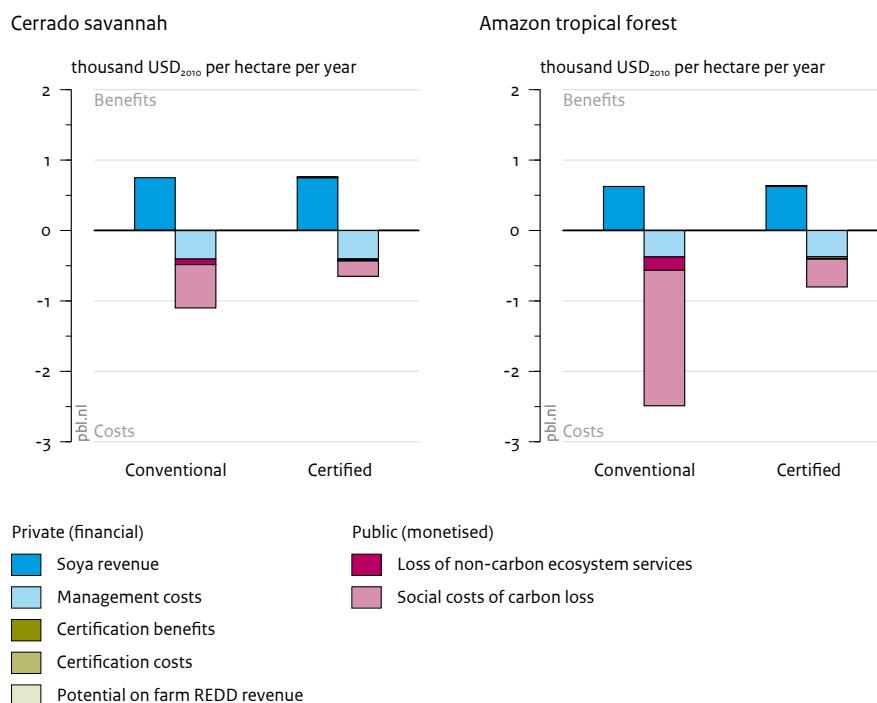
From a purely financial perspective, it is worthwhile to convert forest to farm land for soya production as typical soya revenues largely outweigh the production costs (Figure 9). Revenues are also much higher than yearly wood revenues from unconverted forests (Figure 5 gives figures for a 60-year management period). Certified soya production provides several additional financial benefits to the producer, such as fewer expenses on inputs and modest price premiums for certified soya, but certification also comes at a cost. In the cases studied here, the financial benefits costs of certification do not completely outweigh the financial costs (Van Beukering *et al.*, 2014).

Table 5
General characteristics of the four distinguished farming systems for soya production

Farming system	Amazon conventional	Amazon certified	Cerrado conventional	Cerrado certified
Size and type	Small scale (75 ha average), rotation farming		Large scale (5000 ha average), industrialised monocultures	
Soya yield	2.5 – 3 t/ha		≥ 3 t/ha	
Certification	No	RTRS	No	RTRS
Agricultural practices	Conventional tillage	No-tillage	No-tillage	No-tillage
Pesticide and fertiliser use	Relatively Low	Relatively low	Intensive	Reduced
Former land use	Forest	Cattle ranching	Savannah	Pasture

See Van Beukering et al. (2015) for further details

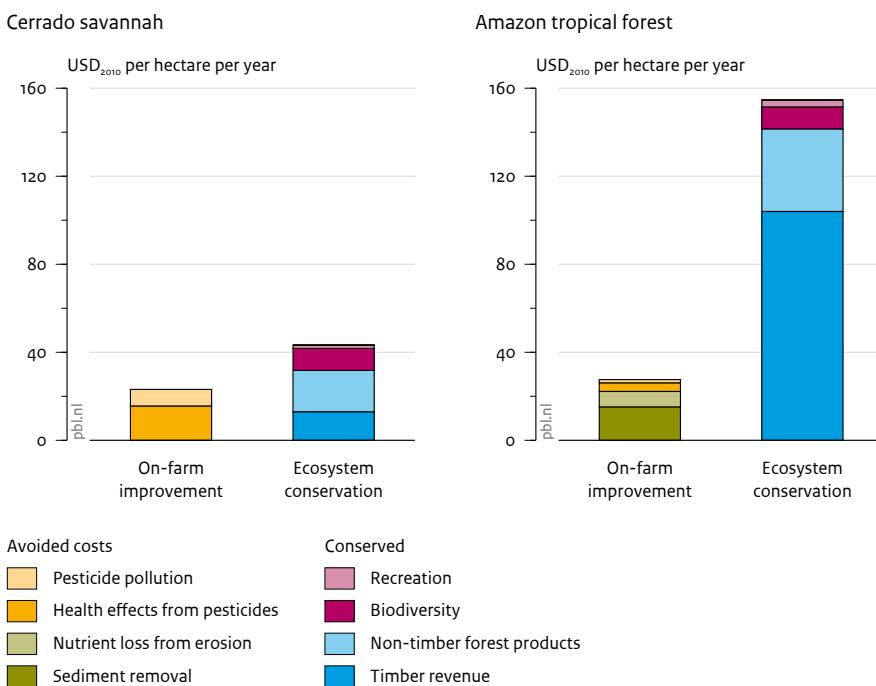
Figure 9
Potential costs and benefits of soya production, 2010



Source: IVM 2014

From a private perspective it is worthwhile to convert savannah or tropical forest land into soya land, as the financial revenues are much higher than the management costs for the investigated cases of farming systems in the Cerrado and Amazon region. There are some direct financial benefits of certification for the producer, but these do not outweigh the costs of certification. When the analyses are extended with the societal costs of environmental externalities and especially with the social carbon costs of habitat conversion, conventional agricultural production leads to net losses for society. When certified soya production is able to avoid conversion of natural habitats, a net positive societal benefit is possible for the Cerrado region, but not in the Amazon as carbon losses are still high under certified conditions.

Figure 10
Societal non-carbon benefits of certified soya production, 2010



Source: IVM 2014

The societal non-carbon benefits of responsible soya production are mostly determined by the ability of certified farming systems to avoid natural habitat loss, and to a lesser extent by on-farm improvements that can mitigate the environmental externalities of conventional production. By avoiding further deforestation, several forest goods and services can be conserved. The largest financial benefits in the Amazon are conserved tropical timber and non-timber forest products; in the Cerrado, the largest benefits are made up of avoided health problems from reduced application of pesticides, and the conserved supply of non-timber forest products.

For each farm, the costs of certification and compliance also depend on its starting position with respect to meeting the certification criteria. An analysis of financial costs and benefits of small, medium-sized and large-scale producers in Brazil and Argentina concluded that 'producers will receive payback on their investment in certification at different times, depending on the sophistication of internal controls and the size of the business. The best prepared large producers can recoup their investment within 1 year while less-prepared medium-sized producers can achieve return on investment in less than 5 years' (KPMG, 2012). The analysis did not include values of ecosystem services. There is still a general lack of information regarding the RTRS certification procedure, and the costs and benefits of operating under RTRS criteria (Nassar and Antoniazzi, 2011).

Non-carbon benefits of certified production

Habitat conversion for conventional soya production causes a number of environmental impacts and losses in ecosystem goods and services leading to costs related to health problems from pesticide use, erosion (soil and nutrient loss) and sedimentation (the so called

externalities). These non-carbon costs affect both the producer and society, and can be valued in terms of costs for mitigation measures such as water treatment, sediment removal, and medical treatment. Good agricultural practices and especially no-tillage techniques to improve soil conditions are on-farm improvements which can result in significant off-farm cost reductions of up to 65% in the Cerrado and up to 80% in the Amazon (Figure 10). The non-carbon losses from deforestation are especially large in the Amazon region, and are made up of lost revenues from timber and other forest products, and decreased biodiversity and recreation values. When it is possible to avoid habitat conversion under the RTRS criteria for certified production, these ecosystem goods and services can be conserved.

The benefits of certified production in these analyses are based on several assumptions on benefit values. Various publications confirm the effects described above but there is a lot of uncertainty about the exact values of the benefits (Van Beukering *et al.*, 2014). Some cannot be quantified easily, such as freshwater delivery and the provision of pollinators by surrounding forests.

Conserving the pollination function is not relevant for soya, as the plant is self-pollinating, but it can be important for other crops such as coffee and cacao.

On-farm and off-farm carbon effects of certified production

Standards for responsible soya production, such as RTRS, include the requirement to avoid habitat conversion and stimulate good agricultural methods to enhance on-farm carbon storage. This involves no-tillage practices that increase soil fertility and leaving remnants of the original vegetation intact on farms.

The farming type with the highest carbon costs for society is conventional soya production in the Amazon region on land gained through deforestation. In these cases, the carbon cost is calculated to be USD 1900 per hectare. In the Cerrado, conversion of the original savannah ecosystem also leads to high carbon losses which are quantified at USD 600 per hectare, about a third of the figure for the Amazon. As explained in Section 1.3., the monetary value of carbon loss is based on the expected future climate-change-related costs for society.¹ When land conversion can be avoided under the RTRS criteria, the carbon loss caused by soya production is obviously much lower for both the Amazon and the Cerrado (Figure 9). But some carbon emissions also occur under certified conditions due to the change in land-use from grazing to soya production. In the Cerrado, the carbon loss can be reduced to about 35% of the emissions from conversion, and in the Amazon to about 20%. Certified production may still affect deforestation indirectly through displacement of cattle ranching to regions with primary tropical forests. The indirect effects are not included here, as they cannot be attributed to the individual certified farmer.

The carbon benefits produced by no-tillage methods are much smaller than those of avoided habitat conversion. No-tillage provides about 5 to 7 additional tonnes of carbon per hectare compared to tillage practices, while the total ecosystem carbon content of a tropical forest is about 250 tonnes C/ha, and that of a savannah is 110 tonnes C/ha (Castanheira and Freire, 2013). The social costs of lost (or avoided) carbon storage are monetised by using the values of the future global effects of climate change, while additional on-farm carbon storage can be offered to compensation markets by farmers and are valued with the much lower carbon market price.

Capturing the on-farm and off-farm benefits of certified soya production

From a strictly financial point of view, soya production is very attractive so additional measures need to be put into place to avoid environmental externalities and to conserve off-farm ecosystem goods and services. Certified soya production provides some modest direct

financial benefits in the form of market premiums and discounts on agricultural inputs. The direct benefits of certification only cover around 40-50% of the certification costs. There are also opportunities for additional revenues if on-farm carbon storage is increased through the application of no-tillage techniques. If certification assures these on-farm carbon benefits, the farmer may qualify for REDD payments leading to a modest additional source of income that helps to compensate for the certification costs.

To increase the financial business case for certified soya production, market payments could be created for some of the mitigated off-farm environmental externalities. This depends on the likelihood the attained effects are brought about by certified farmers, and on the possibilities for commoditisation of this service for which a number of conditions must be met. For carbon storage in forests, these conditions are generally favourable (Meijaard *et al.*, 2011). Carbon storage baselines and carbon sequestration can be quantified and compared among different management systems. To assess forest use, methods and procedures have been developed which provide proof and assurance to REDD markets (Sandker, 2014). For other benefits such as health improvement and reduced sedimentation this is not so easy. For a farmer to be eligible for REDD payments, an issue which is probably even more important is the requirement that improvements made during the certification process clearly add to the positive off-farm effects (additionality criterium). Compared to long-established initiatives such as those for certified wood production, this relatively new type of certification does not yet have a well-developed system for impact measurement (Van Oorschot *et al.*, 2015).

Though responsible soya production only brings modest financial benefits, certification is promoted to enhance and conserve ecosystem goods and services (see Chapter 3). This is driven by the wish to behave in a more socially responsible way, with the farmer enjoying benefits other than strictly financial advantages. Measures on the demand side are important here to create a higher demand for certified soya, as this may motivate producers to comply with the criteria of the standard under which they operate (Nassar and Antoniazzi, 2011).

2.5.2 Innovation in soya supply-chain governance

The interaction between market and government initiatives is crucial for governance of the soya supply chain (Van den Berg *et al.*, 2014). The impacts of soya production and the expected increase in demand have led to the development of several market initiatives for more responsible and sustainable cultivation. Promoting

responsible farming methods and limiting further agriculture expansion into valuable and vulnerable ecosystems are central issues in the debates on soya production. Alongside voluntary initiatives such as RTRS (Round Table for Responsible Soya) as the most relevant for Dutch imports, there are developments in soya producing countries aimed at introducing new national legislation and revising existing rules. At the demand end of the supply chain, market standards play a central role in both voluntary and government supported initiatives which promote sustainable trade and certified imports.

Initiatives by consumer markets and the Dutch Government

Soya imports are of considerable economic importance for processing sectors in the Netherlands, topping the list of imported agro-resources. But unlike the cacao sector, there is no sign of short term problems with resource availability or quality. It is not expected that governments in producing countries will drastically limit the increase in soya production (KPMG, 2014a). Therefore, incentives to improve sustainability of soya production have a distinctive character. They are less driven by self-interest of the production sector for supply risks and resource security. The main driver for governance innovation is the demand for responsible soya by consumers and retailers, which has triggered market initiatives for sustainably produced soya. These consist mainly of market-based voluntary certification standards such as ProTerra, EcoSocial, SojaPlus, non-GM and RTRS (Van Gelder *et al.*, 2014).

Due to the economic importance of the soya supply chain, Dutch involvement in making it more sustainable has been substantial (Ministry of Economic Affairs, 2015). The Dutch Government has actively supported the establishment of the RTRS standard, and promotes it in Dutch importing and processing sectors, for instance by creating public-private partnerships and by closing sector agreements. In 2011, the major stakeholders in the Dutch soya value chain combined their efforts by signing a declaration of intent, stating the aim of using only responsible soya for the production of meat, dairy products, eggs and other food products in the Netherlands by 2015. This translated into a sector-wide goal of ensuring the import of 2 million tonnes of certified soya (under RTRS or equivalent standards) into the Netherlands in 2015, with intermediate targets for the years leading up to full achievement. In 2011, the first year that RTRS soya entered the market 140,000 tonnes were purchased and in 2013 the amount increased to 417,000 tonnes (CBS, 2015). Although progress has been made, achieving the goal for full coverage remains a challenge (Ministry of Economic Affairs, 2015; Van Oorschot *et al.*, 2014a).

In the current initiatives for making the soya sector sustainable, the role of ecosystem services is mostly implicit (Van den Berg *et al.*, 2014). The declaration of intent on fully sustainable imports by the Dutch feed and food industry, covering most of the soya processing in the Netherlands, gives RTRS a central role in activities and targets, but does not mention ecosystems services explicitly. The soya programme of Dutch Sustainable Trade initiative (IDH) makes no explicit reference to ecosystem services either. The RTRS market standards does mention the 'good agricultural practices' approach which does include an indirect reference to ecosystem services. At the EU level, there has also been a major development in policies related to soya imports as a source of biofuels. In the RED Directive (EC, 2009), the EU has laid down a sustainability criterion to prevent the conversion of areas with high biodiversity values or high carbon storage. In response, RTRS has developed a specific scheme which complies with the directive, and this has helped to create a larger market for responsibly produced soya.

The relationship of the RTRS standard for responsibly produced soya with ecosystem goods and services

The Round Table for Responsible Soya is a multi-stakeholder initiative where businesses and NGOs share decision making power. The organisation was first proposed in 2005 by WWF after some agribusiness multinationals abandoned the more stringent Basel Criteria for Responsible Soy Production. Soya producers, traders and processors work together with banks and social organisations to ensure the worldwide cultivation of responsible soya and promote the social responsibility of the soya sector (Van Beukering *et al.*, 2014; Van den Berg *et al.*, 2014).

The RTRS community has developed a standard which includes requirements for the preservation of areas with high conservation value (the HCVA approach, see Chapter 3), the promotion of best management practices, the guarantee of fair labour conditions and respect for land tenure claims. The principles of the standard refer to ecosystem services implicitly, by requiring and encouraging certified producers to place a higher value on areas with natural vegetation. But ecosystem services are also mentioned explicitly in one occasion, in relation to their function in high conservation value areas, which are defined as areas that are valuable for ecosystem services. However, the potential contribution of the approach depends on the mapping process which was added in the third revision of the standard (Van den Berg *et al.*, 2014). The mapping project was started in 2012, in an attempt to guide responsible soy expansion in Brazil. A necessary and appropriate mechanism, it defines which land types or habitats are subject to conservation,

expansion or restrictions. The definition of valuable areas includes an explicit reference to areas providing environmental services to several stakeholders. Identifying and measuring ecosystem services in relation to land use changes seems to be an adequate way to incorporate environmental costs and benefits into land use planning decisions (Barral and Oscar, 2012; Van den Berg *et al.*, 2014).

Along with the mapping project, RTRS also started a Payments for Ecosystem Services (PES) project in 2014. The aim is to develop a payment scheme for areas that are mapped as critical to preserving biodiversity or as having a high conservation value. The project operates mainly within the framework of the new Brazilian Forest Code, and other applicable global PES mechanisms. These projects concerning land use, conservation maps and payments systems are envisaged to provide the supply chain actors with a tool to maintain biodiversity conservation and environmental services. The projects may also provide tangible benefits to those soya farmers who want to improve their livelihoods and seek opportunities to act as environmental service providers by preserving forests, critical biodiversity areas and high conservation value areas (Van den Berg *et al.*, 2014).

However, while the RTRS standard enables protection of ecosystem services, there is also criticism against the lack of rigour in its implementation. Several NGOs have published a critical assessment in which they argue that RTRS is taking a watered down approach, illustrating their point with several examples, such as a weakening of the requirements surrounding deforestation (Van den Berg *et al.*, 2014).

Government involvement at the supply side

In the cost-benefit analyses presented here, the loss of carbon storage represents the highest social cost of all ecosystem services. Avoiding deforestation is therefore a crucial aspect of conserving valuable ecosystem goods and services. The off-farm carbon benefits of certified production are much higher than the direct carbon benefits of on-farm improvements. This imbalance between public and private benefits asks for the involvement of a regulatory body in land-use issues, and of other agricultural production sectors besides soya. Several changes in government regulation are already taking place in Brazil, Argentina and Paraguay.

Government led reforms in land use planning and revisions of national forest laws have helped to create conditions to avoid further conversion of natural and high conservation value habitats. In Brazil, the soya moratorium that was in force between July 2006 and January 2014 helped to increase the protection of the

Amazon forest, but also led to displacement of agricultural expansion to areas such as the Cerrado. Under the 2012 amendments of the new Forest Code (Vieira *et al.*, 2014), landowners are obliged to maintain a certain amount of original vegetation (80% in the Amazon and 20% in Cerrado). In Argentina, a forest law in force since November 2007, protects and manages native forests and their services and participatory planning processes are required for changes in land use (Van den Berg *et al.*, 2014). Paraguay has recently approved a new Payments for Ecosystem Services policy Law which will support efforts to reduce deforestation when it becomes effective. Landowners whose land has a forest area which exceeds the legal minimum of 25% can obtain certificates of environmental services for the excess surface. These certificates can then be sold to for instance soya farmers who are not in compliance, as a means of meeting the 25% minimum.

In addition, these 'environmental service providers' will benefit from rebates on their property tax. Smallholders with less than 20 hectares, owners of indigenous lands and protected areas can also apply for the certificates (WWF, 2014).

All these examples of government regulations in soya producing countries have helped companies in the supply chains to comply with standards such as RTRS that lay down criteria to avoid direct land conversion by farmers (e.g. RTRS Principle 4.4 on limiting expansion into native habitats, and 4.5 on preserving on-farm biodiversity in native vegetation; see also Chapter 3). The development of a national trading system for natural vegetation on farms may help to guide large-scale spatial processes as it offers a payment mechanism to soya producers who leave natural elements on their land intact, although criticism has been expressed on the efficiency and effect of these market regulations for regions where there is now a surplus of forested land that may legally be cleared. The balance between deforestation and reforestation could be improved, by establishing clear priority areas for conservation and identifying regions where reforestation should take place (Thomson, 2015; personal communication).

2.6 Palm oil production in Southeast Asia

Impacts of palm oil production and challenges

The consumption of palm oil has increased significantly over the past decade, driven by the demand for biodiesel and the use of palm oil in a wide range of consumer products, from margarine to washing powders. Most palm oil is produced in Malaysia and Indonesia where

Case Summary

Replacing natural forests by palm oil plantations has considerable costs for society

From a purely financial perspective, it is worthwhile to convert tropical forests into land for palm oil production. The typical financial revenues largely outweigh the management costs, making it a profitable business. Conventional ways of establishing oil palm plantations are associated with extensive forest conversion and loss of locally important ecosystem services. The social costs of lost forest carbon are relatively high, making this production system unfavourable from a societal perspective. The direct financial benefit of certified production is the market premium that can be obtained for offering RSPO certified palm oil to consumer markets, making certification a viable business choice. For the certified alternatives, a requirement is that no primary forest be cut. Using abandoned agricultural land for new plantations is a preferable option. Certified palm oil production can deliver considerable net benefits to society if deforestation can be avoided. However, this applies only to mineral soils; on peat soils it is not possible to obtain a net positive outcome for society as a whole due to the carbon emissions caused by draining the soil. Certified production has several other benefits that are not monetary, but can be decisive in causing a switch to certified practices. For instance, conserved forest ecosystems provide locally important benefits such as water-related services and non-timber forest products. The monetary value of these benefits might be insignificant when compared to the palm oil revenues and the societal costs of avoided carbon loss from deforestation, but it still has local relevance which provides an argument for certified production based on social responsibility.

Multi-stakeholder involvement is crucial for acceptance of palm oil market standards and representation of the beneficiaries of ecosystem services

The most important innovation in the palm oil supply chain was initiated by market actors, and led to the establishment of the Roundtable on Sustainable Palm Oil (RSPO). Nevertheless, governments have played an important complementary role in innovation and sector uptake by setting criteria on the carbon performance of palm oil production for biofuel use. The success and acceptance of market standards such as RSPO now mostly depend on balanced multi-stakeholder involvement. The open revision process and multi-stakeholder voting system offer possibilities to improve the criteria related to protecting and enhancing ecosystem goods and services relevant for different stakeholders. Notwithstanding the representative multi-stakeholder organisation form, the existence of a code-of-conduct, and a procedure for registering complaints, much criticism is presently voiced about the credibility and effectiveness of the RSPO market standard. To increase credibility, it has to provide more proof of positive impacts and guarantee effective action against misuse.

huge areas of rainforest have been cleared to create plantations. In 1978, Indonesia had about 250,000 hectares of oil palm plantations, which quickly grew to 5,000,000 hectares by 2005. It is expected that expansion will also occur in other regions with tropical forests, such as the Congo Basin and Brazil. Palm oil production and expansion has several impacts and poses a number of challenges (Kamphuis *et al.*, 2011; Van Beukering *et al.*, 2014).

The high rates of deforestation in Indonesia and Malaysia have been associated with the rapid expansion of oil palm plantations (Fitzherbert *et al.*, 2008). The large scale conversion of primary and secondary forests into oil palm plantations has significant negative impacts on forest biodiversity and reduces the capacity of the ecosystems to deliver goods and services. Though it is hard to establish how palm oil production contributes to deforestation relative to other activities, such as logging, the evidence of the correlation between plantation

expansion and deforestation is overwhelming (Van Beukering *et al.*, 2014).

Comparison of production systems for palm oil

The cost-benefit analysis compares conventional and certified production systems for both mineral and peaty soils. The choice is based on the important differences between the two soil types regarding carbon storage and the impacts of production practices on ecosystem services. Establishing oil palm plantations on drained peat leads to extremely high amounts of CO₂ release, due to the oxidation of large amounts of organic material stored in the soil (Hooijer *et al.*, 2010). The cost-benefit analyses for palm oil production make several assumptions about the effects of management practices (Van Beukering *et al.*, 2014) based on the RSPO principles (see also Chapter 3). Principles 4, 5 and 7 are particularly relevant for ecosystem goods and services and include references to appropriate best practices by growers, environmental responsibility, conservation

Table 6
Actual and assumed characteristics of the four stylised palm oil production systems

Farming system	Mineral soil conventional	Mineral soil certified	Peat soil conventional	Peat soil certified
Size and type	Large scale privately owned		Large scale privately owned	
Palm oil yield	4 tonne CPO/ha		4 tonne CPO/ha	
Certification	No	RSPO – Mass balance	No	RSPO – Mass balance
Drainage	Not restricted	-95 cm	Not restricted	- 60 cm
Former land use	Primary tropical forest	Degraded forest	Primary tropical forest	Degraded forest
Pesticide and fertiliser use	Standard	Standard	Standard	Standard

CPO = Crude Palm oil

of natural resources and biodiversity, and responsible development of new plantations (RSPO, 2007). The cost-benefit analyses take into consideration the practical management procedures deriving from these principles. On peat soils, drainage must be limited to maintain water tables at sufficiently high levels to reduce the emission of soil carbon to the atmosphere. Oil palm plantations established after 2004 may not replace primary forests or areas with a high conservation value or a high carbon store. Certified oil palm plantations are therefore mostly established on degraded or abandoned agricultural land. The analyses do not take differences in pesticide and fertiliser use into account (Van Beukering *et al.*, 2014).

Due to the short track record of the practical application of the RSPO criteria, there is a lack of reliable data illustrating the impacts of better production methods on economic, social and environmental performance (Laurance *et al.*, 2010) which makes it difficult to compare certified and non-certified growers. Values for different ecosystem goods and services are therefore taken from a range of individual field and model studies. Just as for the other resources in this study, the cost-benefit analyses provide only a general picture of the potential benefits of certifying palm oil production. Moreover, basic data on the economics and the environmental impacts of oil palm plantations are hard to come by and it is not sure how accurate they are.

Financial information on costs and revenues is taken from several studies on the economics of oil palm plantations in Malaysia and Indonesia (see Van Beukering *et al.*, (2014) for a detailed description). These values are representative for plantations on degraded land or young secondary forest. Development and operational costs are higher for plantations on peat soils than for plantations on mineral soils, which affects their profitability. The data on ecosystem services come from modelling studies of land use in Indonesia (Van Beukering *et al.*, 2003, 2009). As in the soya analysis, the results can be grouped into

on-farm improvements and the off-farm effects of conserved natural ecosystems. In this analysis, the on-farm improvements are limited to water table management. The study makes another major distinction between carbon and non-carbon effects, because the social costs of carbon are a dominant factor in the calculation, overshadowing all the other effects. The included costs and benefits are expressed as discounted flows at a 6% discount rate over a complete plantation life cycle of 25 years (Van Beukering *et al.*, 2014).

2.6.1 Cost-Benefit Analysis

Financial costs and benefits of palm oil production

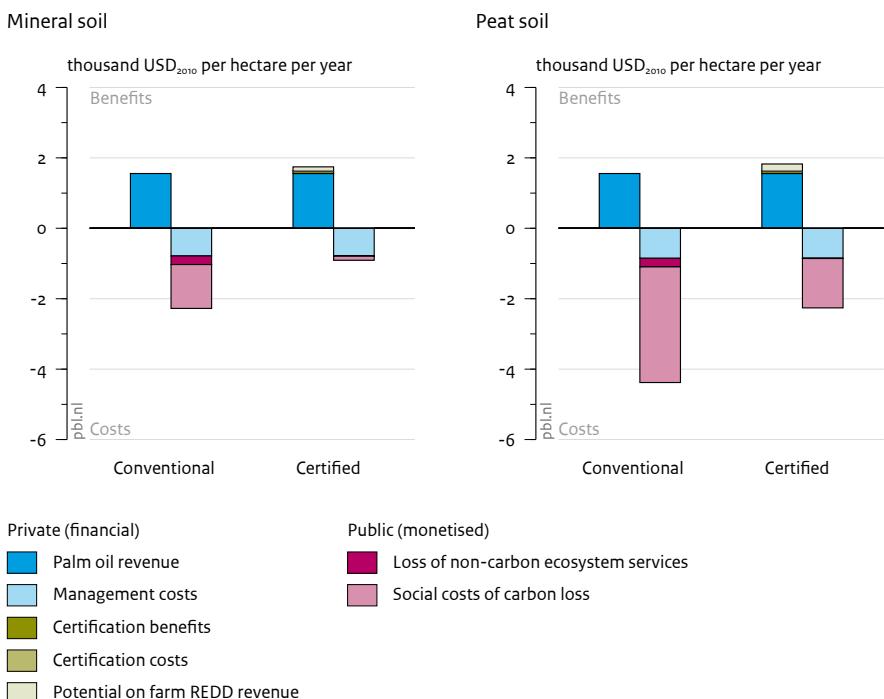
From a purely financial perspective, it is worthwhile to convert tropical forests into land for palm oil production. The typical financial revenues largely outweigh the management costs, making palm oil production a profitable business (Figure 11). Operating costs for plantations on peat are about 8% higher than for plantations on mineral soils, because of the greater development and labour costs. This means the financial performance of plantations on mineral land is somewhat better.

Trees that are felled during the conversion process may add to the financial revenues. This one-off wood harvest is not included in the cost-benefit analysis as revenue, as there are no palm oil case studies that mention this source as a revenue (Van Beukering *et al.*, 2014). It can be an important source of income in the plantation establishment phase, as its value is in the same range as the development costs (about USD 3,500-4,000 per hectare).

The costs and benefits of palm oil certification

Implementing certified production and management methods involves several expenses at the plantation level, consisting of the costs of the certification process, the implementation of required corrective

Figure 11
Potential costs and benefits of palm oil production, 2010



Source: IVM 2014

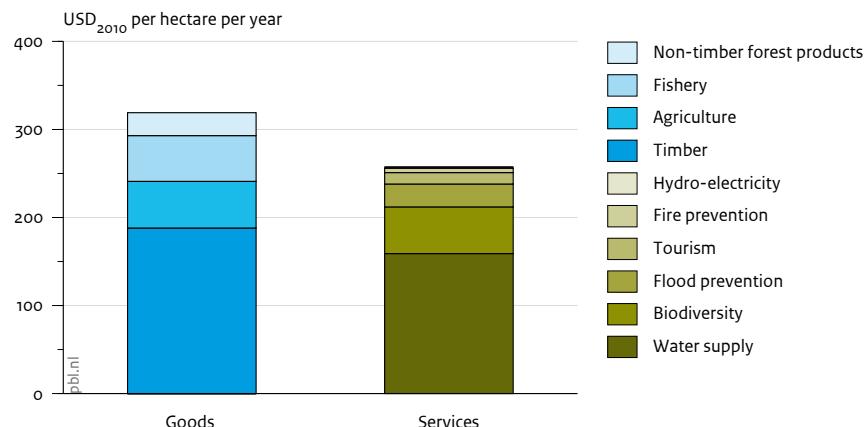
Extended cost-benefit analyses for palm oil production in Indonesia and Malaysia. From a strictly financial point of view, conventional palm oil production is an attractive economic activity. However, when the full societal costs are also taken in to account, the net benefits are lower due to the costs of deforestation, ecosystem function loss and, notably, the loss of stored carbon. In contrast, when RSPO certification is able to prevent deforestation and ecosystem loss, net benefits for society are possible, but only on mineral soils. Certification costs are relatively low, and are compensated for if market premiums can be obtained. Carbon losses are calculated with the social cost estimates, while REDD benefits are based on current market prices for carbon.

actions, staff training and managing the conservation of high-value areas (according to the HCVA set-aside criterion). Together they amount to about 1 to 5% of the conventional management and production costs (Van Beukering *et al.*, 2014). The direct financial benefit of certified production consists of the market premium that can be obtained for offering RSPO certified palm oil to actors further along the supply chain. The premiums depend on the system used to guarantee certified production. This cost-benefit analysis applies the average values of the relatively frequently used mass balance system (USD 17/tonne CPO) which are more than sufficient to compensate for the certification costs, making certification a viable choice. The premiums can be either higher, for the trading system that uses completely segregated supply-chains, or lower, when certificates are traded (Van Kersen, 2015). In practice, it is not always possible to collect these premiums especially for the group that would benefit most, the (poor) smallholders who do not have the means to invest in RSPO certification (WWF *et al.*, 2012).

Non-carbon benefits of certified palm oil production

There is only limited information on the effects of certified management on the biodiversity of the oil palm plantations – for example the effects of increasing the undergrowth beneath the palm canopies, and how this enhances ecosystem goods and services. Therefore, the impact of certified palm oil production on ecosystem services is mostly determined by the ability to avoid large-scale conversion of primary and logged-over forests (Van Beukering *et al.*, 2014). When tropical forests are lost and replaced by oil palm plantations, many valuable ecosystem services are lost or become severely degraded. These processes are referred to here as the off-farm effects of palm oil production, and are included in the analysis as foregone or lost conservation benefits (Van Beukering *et al.*, 2014). The total value of all lost non-carbon services under deforestation adds up to about USD 250 per hectare per year (discounted over the plantation life cycle), which is about 15% of the palm oil revenue (Figure 11). The most important ecosystem service loss in monetary terms is the water supply function (Figure 12). Depending on the conservation

Figure 12
Non-carbon benefits of avoided deforestation in Indonesia, 2010



Source: Alterra 2014; IVM 2014

The benefits of conserving native tropical forest ecosystems in Indonesia can be divided into several categories of goods and services, such as timber, other forest products and forest services. Avoiding deforestation in palm oil expansion helps to conserve these forest benefits. The values presented here are taken from modelling studies on land use scenarios (Van Beukering *et al.*, 2003, 2009), and from the case on benefits of sustainable wood production (Section 2.3).

status of a forest, the amount of wood that can be harvested in a sustainable way (see Section 2.3) adds another considerable amount to its value.

Deforestation has an important impact on the hydrological cycle and many related ecosystem services with a value for the local and regional population, such as freshwater supply, flood prevention and supporting a population. Furthermore, natural forests provide a range of non-timber products to local communities, such as fuel wood, food and medicines. These are usually harvested on a small scale, and serve as an additional resource for local livelihoods. By only using degraded lands for plantations, deforestation can be avoided and this study assumes that these losses of ecosystem goods and services are effectively mitigated and conserved for use by local and global communities.

The total value of non-carbon goods and services from forests is based on a modelling study of land use in Indonesia, which compares scenarios of forest conservation and forest exploitation. The values assigned to the individual services are based on an extensive literature survey by (Van Beukering *et al.*, 2003; Van Beukering *et al.*, 2009). In the exploitation scenario, unsustainable wood harvesting and the collection of non-timber forest products gradually led to conversion into agricultural land. The comparison of the scenarios, made it possible to derive conservation benefits per hectare (Figure 12). The high biodiversity level of tropical forests may further provide indirect services to surrounding agricultural areas, for instance natural pest control and

pollination of fruit trees. However, in the specific case of oil palm plantations, pollination does not depend on the presence of natural forests. To guarantee pollination of the oil palms, the producers have successfully introduced a specific insect which is able to reproduce and maintain its population on the plantations. Therefore, this study does not quantify the forest's pollination service in monetary terms.

Carbon dynamics under sustainable palm oil production

Converting natural forests to oil palm plantations leads to substantial carbon emissions from the vegetation and the soil. The difference in stored carbon between a dense tropical forest and an oil palm plantation is estimated to be around 160–200 tonnes C/ha (Chase and Henson, 2010; Danielsen *et al.*, 2008). When plantations are established on wet peat soils, draining operations lead to peat oxidation which causes major carbon emissions. The study assumes that no primary forest is cut for certified production and therefore plantations are established on degraded secondary (logged) forest, resulting in a smaller loss in carbon storage. When the initial situation is a degraded secondary (logged) forest the loss in carbon storage will be smaller. Positive effects on carbon storage are also possible if oil palm plantations are established on abandoned grasslands (Schmidt, 2010). The cost-benefit analyses also take into account the positive effects sustainable production has on stored carbon, under the assumption that the farming practices qualify for payment mechanisms such as REDD. The carbon emissions in the processing phase of palm oil can also be reduced, for

instance by capturing CH₄ emissions from palm oil mill effluent and using them to generate electricity. Projects to promote this are presently being financed under the facilities of the UN Clean Development Mechanism.

The cost-benefit analysis for mineral soils shows that the total financial and societal benefits of certified production exceed the total costs. On peaty soils however, the costs of carbon emissions are significant, even from soils where drainage is reduced to more moderate levels. This is confirmed by a comparative study of different plantation types, which found that plantations established on mineral soils with a low initial carbon stock, can generate more revenues at relatively low carbon costs (Dewi, 2012).

Whether certified oil palm plantations will be able to benefit from REDD-credits for avoided CO₂ emissions, is still under extensive discussion. A possible argument is that use of non-forest areas to establish oil palm plantations reduces the pressure on the remaining forest and avoids deforestation. However, as discussed above, it is hard to provide convincing proof that practical applications of this land-sparing theory actually produce the described effects (Perfecto and Vandermeer, 2008). Land-use governance at higher spatial scales is required to steer regional land use and effectively conserve natural forest ecosystems.

Further remarks on certified palm oil production

Certified production has several benefits that cannot be easily valued in monetary terms, such as improved company efficiency, improved access to capital from financers, and maintained access to the secured EU market. They can, however, be decisive for producers to change to certified production. An in-depth analysis of the profitability of RSPO certified palm oil production (WWF *et al.*, 2012) also identified several benefits, such as a reduction of social conflicts, improved business administration, improved staff morale and reduced labour turnover, and, as mentioned above, access to markets and capital. The analysis found that although market premiums serve as the initial appeal of certification, each individual major category of benefits has the potential to outweigh the costs of RSPO implementation, often through unexpected and indirect channels.

The destruction of native habitats with a high biodiversity value (such as that of the orang-utan) has received considerable media attention. Secondary or harvested forests are often seen as degraded lands whose conversion results in a limited loss of biodiversity, and so, conversion of these areas is allowed under palm oil certification schemes. However, depending on the way

they are managed, secondary forests can still be home to large populations of species living in primary forests (Edwards and Laurance, 2013; Edwards *et al.*, 2012; Putz *et al.*, 2012). In fragmented landscapes, degraded forests can still play an important role in conserving biodiversity and carbon stocks (Lucey *et al.*, 2014). In all, therefore, abandoned agricultural land is the preferred option for the establishment of oil palm plantations.

2.6.2 Innovation in palm oil supply chain governance

Dutch supply-chain actors are committed to making palm oil production more sustainable

As in the case of soya, the Netherlands is an important link in the global trade of palm oil. In 2012, about 10% (5.6 million tonnes) of the global palm oil production was shipped to the EU, a large part of which via the Netherlands (Van den Berg *et al.*, 2014). In 2010, palm oil was the third most important agro-resource in terms of import value, after soya and cacao (Van Oorschot *et al.*, 2014a). The economic importance of palm oil and the existence of a large processing industry which depends heavily on the resource (Van Kersen, 2015), mean the Netherlands has an important role to play in improving the sustainability of the palm oil supply chain. The Dutch Government has formulated targets and policies to make the commodity more sustainable (Ministry of LNV, 2009). Due to the institutional void in international trade on sustainability issues (Hajer, 2003), the formulation of sustainability criteria such as those of the RSPO is largely left to market-based initiatives (Van den Berg *et al.*, 2014). Dutch multinational companies are among the founding and active members of the Roundtable for Sustainable Palm Oil. In 2010, the major stakeholders in the Dutch palm oil sector agreed on the target of only trading in certified palm oil for the Dutch market by the end of 2015 (Taskforce Duurzame Palmolie, 2010). The Dutch Government is also stimulating the food sector to adopt sustainable palm oil, for instance through the programmes of the Dutch Sustainable Trade Initiative (IDH), which concentrate on support to smallholders for whom it is much more challenging to meet sustainability criteria. The targets of the IDH programme are to improve the agricultural practices of smallholders in Indonesia, improve the productivity of existing plantations and develop traceable sustainable palm oil trading systems (Van den Berg *et al.*, 2014).

Multi-stakeholder involvement is crucial for acceptance of market standards

The Roundtable for Sustainable Palm Oil is at this moment the leading initiative for transforming palm oil production and trade into sustainable operations. The roundtable started as a partnership between an NGO and private businesses, but has evolved over time

Example from practice

Using the natural capital concept in company procurement policies to influence supply-chain actors

Nestlé, one of the largest food companies in the world, buys palm oil as an ingredient for several of its products. Active on sustainability issues, the company is a member of several platforms that promote sustainable use of natural capital, and it has formulated its own business commitment on the issue. It is one of the few companies that actively use the concept of natural capital in their strategy and communications (Van Kersen, 2015).

The Nestlé company is a member and active supporter of RSPO and also an engaged business partner of the Natural Capital Coalition (NCC). It has actively contributed to formulating the NCC targets. Nestlé has also joined the Natural Capital Leaders Platform, run by the Cambridge Institute for Sustainability Leadership (CISL). This NCLP platform works to highlight the commercial opportunities that arise from investing in natural capital, which they define as 'nature's goods, and services that underpin global supply chains'. At the Rio+20 summit in 2012, Nestlé and other CISL members published a business statement that urges governments around the planet to commit themselves to a global policy framework on the responsible and sustainable use of natural resources. Besides actively contributing to sustainability platforms, Nestlé has published its own commitment on natural capital, which they define as 'the total sum of nature's resources and services, [and] the basis upon which economic activity is built'. It distinguishes three aspects of natural capital: biodiversity, ecosystem services and abiotic resources (e.g. fossil fuel and minerals). As a large company, it uses its purchasing power to influence the resource suppliers. This involves assessing the performance of suppliers against the company's own responsible sourcing guidelines, which are to guarantee certified, traceable sources that are 'zero deforestation' and 'no peat'. Nestlé has made a formal commitment to source 100% certified palm oil. It uses several certification schemes, including RSPO and Rainforest Alliance, but these do not cover all the company requirements and therefore it asks suppliers to go beyond these schemes. In addition to palm oil, the company applies its sourcing strategy to several other key commodities, such as cacao, tea, milk and shea nuts.

Ecosystem services are not explicitly mapped in its supply chains, but Nestlé has mapped the land area that is needed to produce its resources and identify dependencies for its factories. These exercises help the company to better understand the relationship between conservation and use of ecosystem services. For instance, Nestlé is active on the issue of water use, monitoring the withdrawal of groundwater and associated water resources (aquifers, spring flows, and surface water) to ensure long-term sustainability of watersheds and their ecosystems.

Nestlé has also formulated a No Deforestation Commitment, pledging that its products will not be associated with the practice of deforestation. It deals with the issue by taking a proactive role on improved traceability and supplier engagement and also works with partners to compile reliable data on areas where deforestation is occurring and to identify important bodies of water near its plantations. To this end, Nestlé supports the Global Forest Watch mapping initiative, which offers a publicly accessible online mapping application that provides information about forest use and status. This can help to identify the no-go areas, and support claims of 'deforestation-free' resource production. Nestlé also participates in RiLeaf, a reforestation programme in the Borneo Kinebantan area, involving smallholders and trying to improve their farming techniques.

into a multi-stakeholder platform with representatives from all actors in the supply chain, including producers, processors and traders, product manufacturers, retailers, investors and environmental and social NGOs. After extensive discussion, it was decided to give all these different stakeholder groups a seat on the Executive Board (Schouten and Glasbergen, 2011). Governments cannot be a member of the RSPO to prevent the decision making process from becoming too politicised. This balancing of voting power to defend the interests of all stakeholders is a crucial condition for broad acceptance of the RSPO guidelines. Public consultations on draft criteria and indicators are also used to encourage participation

in the RSPO process, allowing input from any interested person or group.

The RSPO principles and criteria must be revised every five years, which allows for the incorporation of newly-acquired knowledge and new insights on sustainability issues. The manufacturers of consumer products play an important role in these revision and innovation processes, as they bear the risk of reputational damage. Campaigns by NGOs, communicating unsustainable practices, have often stimulated manufacturers to take appropriate action such as suspending imports. Consumers seem to play no direct role in this innovation

process. Instead they are mostly indirectly involved through their support to NGOs and their consumption patterns (Van den Berg *et al.*, 2014).

Market standards can protect ecosystem services

There are several ways in which the RSPO guidelines can help to reduce the impacts of palm oil production on the capacity of ecosystems to deliver valuable goods and services to society. Limiting deforestation is an important issue and the RSPO principles and criteria ban the clearing of primary forests and areas with a high conservation or carbon stock value; from November 2005, new plantations may not be established on land gained by the conversion of primary forests (Guideline 7.3). But the RSPO guidelines do allow the conversion of degraded or secondary forest areas, even when considering they may still be important for biodiversity and ecosystem services which are relevant locally (water regulation) or globally (carbon storage). Furthermore, RSPO explicitly uses ecosystem services as a criterion to identify areas with a high conservation value and as an argument for their maintenance and protection. The concept of high conservation value applies to areas of exceptional social, cultural or biological importance, including those that are critical for the delivery of ecosystem goods and services to local communities (Brown *et al.*, 2013). Among high conservation value typologies are forms of land use that directly affect the conservation of ecosystem services. To establish an area's importance with regard to critical ecosystem services, community needs and cultural values, it is important to inform and consult local communities. The high conservation value concept is not only used in the RSPO criteria, but is also referred to in other standards, such as FSC, and can be seen as an independent innovation with a broader application. Besides reducing deforestation at the regional level and protecting high conservation value areas at the landscape level, there are possibilities to enhance ecosystem services at the farm level as well. For instance by stimulating a vegetation cover below the palm canopies and preserving biodiversity in the plantation surroundings, which may favour pollination and natural pest control. The RSPO standard can improve its criteria by incorporating this inter-cropping practice.

Government involvement has stimulated the adoption of criteria for carbon performance and deforestation

Governments are not directly involved in the RSPO governance process. There is, however, a major role for governments in the issue of carbon performance.

Articles 17 and 19 of the EU Renewable Energy Directive contain strict sustainability criteria which apply to the use of palm oil as a biofuel (EC, 2009). According to Article 17, it is not allowed to use primary ecosystems or ecosystems with a high biodiversity value or carbon stock for palm oil production. Article 19 formulates specific carbon performance criteria and calculation procedures, specified per type of biomass. These criteria describe in detail what reductions in greenhouse gas emissions should be obtained by using palm oil as a biofuel, compared to fossil fuels. The RSPO has responded by laying down an additional guideline for carbon performance (RSPO, 2012). Another standard developed specifically for compliance with the EU RED Directive is the International Sustainability and Carbon Certification (ISCC, 2015). The use of palm oil as a form of bio-energy has stimulated the import of certified palm oil, leading, at the same time, to the uptake of certified palm oil in the food and feed sectors as the biofuel industry can only use specific palm oil fractions produced by chemical refinement in palm oil processing (Van Kersen, 2015).

At present, market-based initiatives face a great challenge to improve their credibility and the way they deliver impact

The credibility of the RSPO control system is a major concern in debates about the sustainability of the palm oil supply chain. The issues of continued deforestation and plantation establishment on carbon-rich land in particular raise serious doubts among several stakeholders such as retailers who face reputational risks. In addition, the RSPO system falls short on the promises made in relation to high conservation value areas, where the most direct references to ecosystem services are found. It is also necessary to promote actions at the landscape level to expand the horizontal influence of the standard. As in the case of soya production, this requires the involvement of local authorities and land use planning bodies. The Roundtable is currently experimenting with procedures for better impact assessment, including explicit ways to address ecosystem services and their values (Van den Berg *et al.*, 2014).

Note

- 1 Using a value of USD 46/tCO₂ eq; this is almost half that of the much criticised Stern value of USD 100/tCO₂ eq; see Section 1.3 on methodology.

Coverage of ecosystem services in market standards

3.1 Introduction

Over the past decades, the use of broadly accepted market standards to certify and guarantee sustainable production has become an important mechanism to promote socially and environmentally responsible trade (Van Oorschot *et al.*, 2014a). The standards perform a central role in many different initiatives that try to promote the use of sustainable resource production, examples of which have been described in this report. The standards address a range of issues, such as avoiding deforestation, protecting valuable habitats, reducing child labour and providing decent incomes. Up to now however, the standards have been less explicit on the integration of ecosystem service maintenance and protection. A study for the Convention for Biological Diversity highlights that many standard-setting bodies are not confident that ecosystem services are adequately included in their requirements, and concludes that further guidance is needed (CBD and UNEP-WCMC, 2012). Only a few standards explicitly refer to the concept of ecosystem services, some contain implicit references, and others apply principles whose influence on ecosystem service maintenance is arguable (Van den Berg *et al.*, 2014).

Including ecosystem service protection and maintenance in certification standards could enhance the impact and added value of certification schemes (Tscharntke *et al.*, 2015). Sustainability standards offer good opportunities for ecosystem service governance, as acceptance under different stakeholders is broad, and standard managing organisations have organised formal learning processes for improvement and evaluation that could be used for ecosystem service inclusion (Van den Berg *et al.*, 2014; and Chapter 2). Standards offer opportunities for better integration of ecosystem services through structured learning and stakeholder involvement, but there is no certainty about their coverage and precision (DeClerk *et al.*, 2012), let alone the effectiveness of the related

certification processes to protect and maintain ecosystem services. In view of this limited information and the increasing global awareness of the importance of ecosystem services, a better understanding of how standards address ecosystem services is relevant.

3.2 Methodology

This study includes a quick scan to assess how ecosystem services are covered and articulated in a small number of certification standards (see Table 1). The scan, performed on the TEEB list of ecosystem services (TEEB, 2010), reveals important information on missing or less well represented components. Safeguards are considered to be present when the reviewed certification standards specify sufficient requirements for ecosystem service maintenance. When reviewing standards, it is easy to distinguish between explicit and implicit references to ecosystem services. Standards do not necessarily have to mention ecosystem services explicitly, but can contain concrete measures and criteria which may safeguard conservation of the services in question. The scan results are refined by looking for the presence of direct and indirect safeguards, where the first are clearly linked to specifically mentioned services, and the latter provide a link but offer less assurance that the service will indeed be maintained. In addition, the quick scan considers whether direct safeguards are included with very exact requirements and whether they cover the conservation of the ecosystem service as a whole or only partially. The coverage categories in Table 7 are loosely based on the distinctions made by (Morgan and Wenban-Smith, 2015). An example of a limited degree of precision is found in the PEFC and FSC standards for wood, which explicitly refer to the contribution by forest resources to carbon sequestration, but do not consequently impose measures directly aimed at the issue. In cases such as these, the quick scan categorises the safeguards for this ecosystem service as *limited*.

Table 7

Scoring categories for market standards for sustainable resource production with regard to their coverage and precision in the maintenance of ecosystem goods and services

Insufficient safeguards for ecosystem services	The standard does not have any elements that can be expected to make a significant contribution to the ecosystem service in question, or, the elements are mentioned in an extremely vague way, with no indication of how certification applicants are expected to put the standard into practice.
Indirect safeguards	The standard does not explicitly address the ecosystem service and, although it does have requirements for other, broader or vaguely defined purposes that are beneficial to conservation of the service, it does not give enough detail to build full confidence about consistent conservation.
Limited direct coverage or precision in safeguards	Limited Coverage applies to standard which explicitly addresses elements of the ecosystem service in relevant requirements, but, at the same time, overlooks several other significant elements Limited precision is used for a standard which explicitly addresses the ecosystem service but whose related requirements are too imprecise to build full confidence of consistent conservation of the ecosystem service.
Substantive direct coverage and precision in safeguards	The standard substantively and comprehensively addresses the ecosystem service and provides sufficient detail on the specific requirements resulting in full confidence about effective and consistent conservation of the ecosystem service

3.3 Results

The quick scan results show a high inclusion of ecosystem services across the studied standards, especially for freshwater supply, biodiversity (through habitat protection) and maintenance of soil fertility (Table 8). However, it also is clear that other ecosystem services can be safeguarded more effectively if the standards would address them directly with more explicit references. The standards need to provide more precise and direct requirements on the maintenance of ecosystem services, particularly those for which only indirect safeguards are found, such as genetic diversity, natural pollination and tourism. It also appears that many ecosystem services are indirectly addressed in references to other concepts and practices, such as the 'HCVA approach' (related to protecting special high conservation value areas), 'Good Agricultural Practices' (which includes measures to prevent erosion and to maintain soil fertility) and integrated pest management as substitutes for applying agrochemicals (which includes techniques for biological pest control and natural pollination). Also, biodiversity is served by referring to protecting habitats and genetic diversity.

The HCVA approach in particular provides many safeguards for ecosystem services. Several standards such as FSC, Fair Trade, RSPO and RTRS use this independent method which protects areas of special importance and bans production activities on them and, as a consequence, furthers several ecosystem services. The approach defines several conditions to class an ecosystem as *valuable*, taking into account biological, ecological, social and cultural values. These conditions overlap to a large extent with the general ecosystem service categories. It is important to note that not all

standards integrate the HCVA approach with full rigour. RTRS, for instance, does not require an HCVA assessment prior to expanding soya cultivation in designated areas, if it considers that legislation to control expansion is already adequate. As a result, the quick scan gives RTRS a Limited Coverage score for the protection of ecosystem services along HCVA lines. Likewise, the Fair Trade standard receives a Limited Precision score for the application of the HCVA approach, because, although it does require companies to avoid negative impacts, its terms for assessment and identification of the areas are rather limited; the procedure may use available knowledge in the company and neighbouring communities, but no requirements are in place for field inspections and biological surveys.

Although the quick-scan identifies a large number of safeguards for ecosystem services in the standards, many are indirect, imprecise or fail to deal with significant elements of the particular ecosystem service. The requirements to conserve the ecosystem services are often set out, but conservation may benefit from greater emphasis and more explicit measures. Particular attention is needed for those ecosystem services that have less tangible or no value at all for the certified commodity. For instance, erosion prevention and maintenance of soil fertility are often substantially and comprehensively addressed by standards. This is logical as these services are essential to agriculture and biomass production (TEEB, 2010). On the other hand, Table 8 shows that many standards have only indirect safeguards to cover the less tangible and less beneficial services for the commodity producer, such as medicinal resources, and local climate and air quality regulation, and require no specific measures to address related issues. The quick-scan also indicates differences in the level of precision

Table 8

Coverage and precision of the TEEB ecosystem services in sustainability standards

Category	Ecosystem Service (TEEB, 2010)	Standard						
		PEFC Wood	FSC Wood	RTRS Soya	RSPO Palm oil	UTZ Cacao	FT Various	RA Various
Provisioning services	Food			LC		X		LP
	Raw materials			X	X			
	Fresh water							
	Medicinal resources					X		
Regulating services	Local climate and air quality regulation							
	Carbon sequestration	LP	LP			X		
	Moderation of extreme events			LC		LC	LP	
	Waste water treatment	LP	LC	LC	LC	LC	LP	LC
	Erosion prevention and maintenance of soil fertility							
	Pollination							LP
	Biological control	LP	LP	LP	LP	LP	LP	LP
Supporting services	Habitats for species							
	Maintenance of genetic diversity							
Cultural services	Recreation and mental and physical health					X		
	Tourism					X		
	Aesthetic appreciation and inspiration for culture, art and design			LC		X		
	Spiritual experience and sense of place			LC		X		

This table provides an insight into the standards' coverage – whether they act as an overall safeguard for ecosystems services or only to a limited extent – and precision – the clear-cut nature of the safeguards through precise requirements and specific measures.

LC: limited coverage green: direct safeguards for ecosystems services conversion

LP: limited precision orange: indirect safeguards for ecosystems services conversion

applied in the standards to ensure concrete and measurable results. The issue of carbon sequestration illustrates this very clearly. RSPO requires very precise measurements of the carbon stock on production sites to avoid areas with high carbon-stock levels or areas with sequestration potential. PEFC also addresses the issue, but only refers to maintenance and enhancement of forest resources and their contribution to the global carbon cycle and does not suggest further measures to protect them, such as the identification and conservation of carbon rich areas. FSC proposes more precise

safeguards for carbon sequestration, but there is no consensus yet on how to incorporate them into the standard's Principles and Criteria (Brown *et al.*, 2013).

An example of limited coverage, meaning significant elements of ecosystem services are not explicitly addressed, is failure to deal with those ecosystem functions that protect against extreme events. For instance, the UTZ cacao standard requires maintenance and planting of shade trees as a protection against adverse weather conditions, but it does not have an overarching

requirement to assess the need for protection against other extreme events, such as forested slopes as a protection against landslides. Standards that adequately incorporate the HCVA approach *do* identify these functions, because it includes an identification of areas that provide basic ecosystem services in critical situations.

This quick scan provides a tailored insight into the coverage of ecosystem services in current versions (Table 1) of standards for agricultural commodities and wood in particular, identifying unresolved issues in each standard. Overall, the quick scan confirms insights provided by previous research (CBD and UNEP-WCMC, 2012; Van den Berg *et al.*, 2014) which concludes that certification processes can greatly enhance the protection of ecosystem services. Despite the obvious need for improvement, all reviewed standards provide a wide range of safeguards that benefit the conservation of ecosystem services. Improvement may be sought through better articulation of the direct and indirect links between existing safeguards and associated ecosystem services, the adoption of a more systemic approach in overarching standard principles based on the TEEB list and the inclusion of underlying criteria and indicators to ensure that all ecosystems service elements are covered with high precision.

3.3.1 Options for improving the coverage of ecosystem services in market standards

The ISEAL platform for standards promotes multi-stakeholder involvement

Collaborative approaches on defining and harmonising sustainability standards can lead to considerable improvements. The International Social and Environmental Accreditation and Labelling (ISEAL) alliance develops meta-standards and provides a network and a discussion platform that is useful for incorporating ecosystem services and harmonising guidelines. ISEAL is primarily concerned with the overarching credibility principles that guide standard setting organisations on how to establish and improve credible and effective standards and principles. The focus of ISEAL is essentially procedural with no direct reference to ecosystem services (Loconto and Fouilleux, 2014). This is reflected in the established codes of good practice on: requirements for transparent and accountable preparation; adoption and revision of sustainability standards; assurance on compliance with the sustainability rules of a standard; and a code on monitoring and evaluating of impacts.

Membership of ISEAL is only granted after a peer review focussing on compliance with various codes of conduct. Standards that are accepted as ISEAL members, include FSC, UTZ Certified, Rainforest Alliance and since recently also RSPO.

ISEAL provides an indirect link to safeguarding ecosystem services

In the ISEAL codes, there is no direct definition of a good standard in terms of covered sustainability issues. The ISEAL board voted against the application of a content filter to assess the sustainability norms of standards that want to apply for membership. This is regarded as crucial for the targets of ISEAL as there is no single model of sustainability standards than can be applied to a wide range of sectors, commodities and stakeholder groups. There is a need for different approaches that act in parallel to produce a shift towards more sustainable practices (Loconto and Fouilleux, 2014).

The ISEAL codes do provide an indirect safeguard for valuable ecosystem services, as they contain the requirement to involve and consult stakeholders and include them in the governance structure of the standards. For instance, the codes require that stakeholders, including local communities and indigenous groups, verify their views are reflected in decision making processes (ISEAL, 2014). The procedures allow users of ecosystem services that may be negatively affected to voice their interests with regard to the formulated safeguards. With the exception of UTZ, the standards reviewed here incorporate consultative processes, particularly where (indigenous) communities are concerned.

In line with the importance it awards to multi-stakeholder involvement, ISEAL presents an organisation model that offers ways to adopt a more coherent approach for covering ecosystem services. A first step could be the provision of a voluntary guideline on sustainability which includes ecosystem services more specifically. This would respond to a clear demand by standard setting bodies, many of which recognise a need for stronger safeguards of ecosystem services and further assistance. New policies could respond to challenges such as the considerable costs certification bodies bear for monitoring activities, and the difficulties of defining, assessing and regulating impacts on ecosystem services (CBD and UNEP-WCMC, 2012; Meijaard *et al.*, 2014).

Conclusions and perspectives

4.1 General conclusions from the case studies

This chapter draws conclusions from the presented case studies and analyses in Chapters two and three. The main questions for this report are:

- What are the costs and benefits of alternative resource production methods, taking the values of several ecosystem goods and services into account?
- How are the costs and benefits of sustainable resource production distributed over the stakeholders involved in production and trade?
- How is the governance of international supply chains organised and how does innovation address new sustainability issues?
- Are market standards for certified production able to safeguard the ecosystem goods and services?
- What ways are there to capture the values of ecosystem goods and services under sustainable resource production, and integrate them into the decision making processes of the supply chain actors?
- Does the TEEB approach provide useful data and insights for the supply chain perspective?

4.1.1 Benefits of certified agricultural production

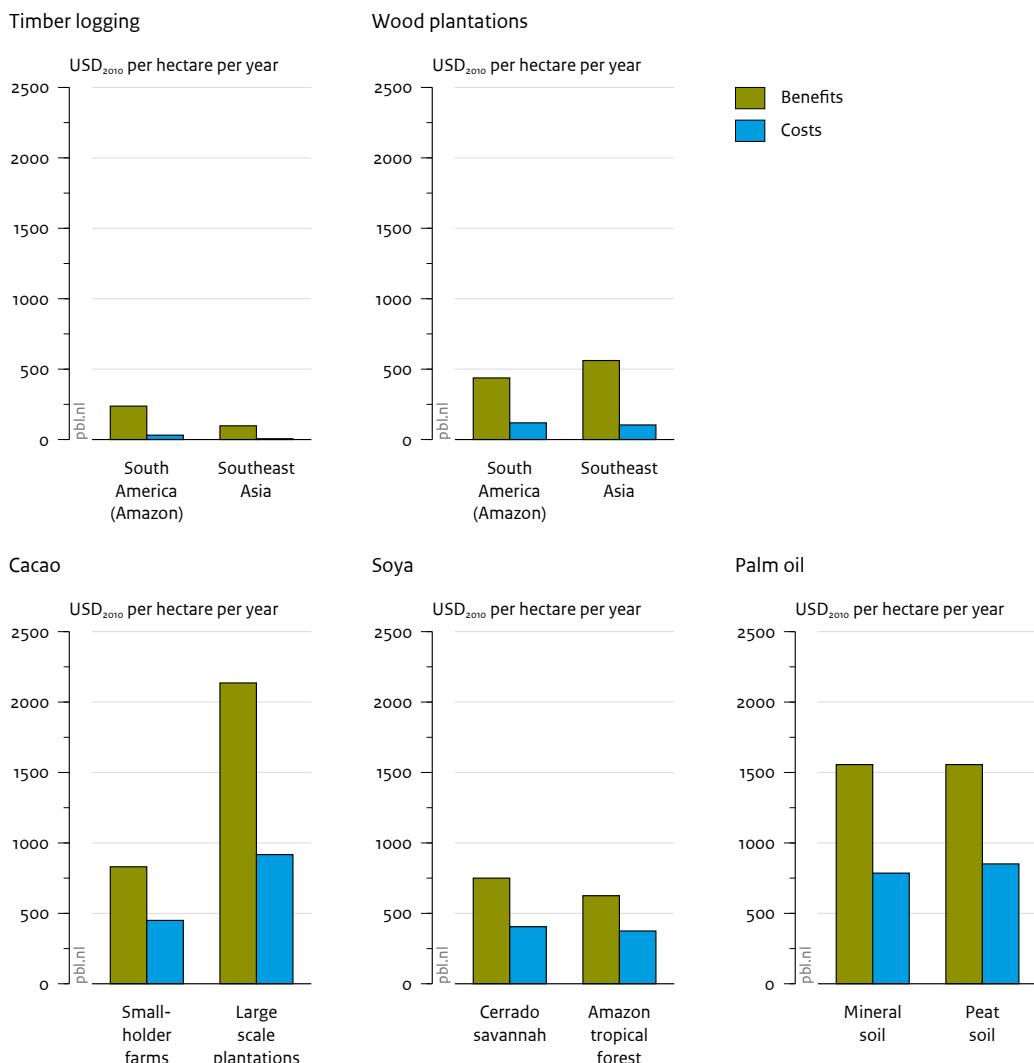
Financial costs and benefits of conventional and certified production of agricultural crops

Producing agricultural resources is a profitable business for the primary producer, as the financial revenues for agro-products clearly exceed the costs of production (Figure 13). The highest yearly revenues per hectare are attained in conventional palm oil and large-scale cacao production. The yearly revenues of selective logging in forests are much lower (taking the 60-year rotation cycle into account). The relatively high net private benefits of agricultural production are an important incentive for converting natural systems to production systems. In the conversion process, the natural character of ecosystems changes and many ecosystem processes and services are

lost. Historically, commercial and subsistence agriculture jointly account for a large part of deforestation and forest biodiversity loss. Wood production in managed forests is not considered the major direct driver of deforestation and associated biodiversity loss in the tropics, but it is associated with degradation of forest quality (Kissinger *et al.*, 2012; Hosonuma *et al.*, 2012). Both deforestation and ecosystem degradation cause a loss of valuable ecosystem services.

Changing from conventional to certified production can increase the financial benefits for the producer, for instance through price premiums, reduced costs for agricultural inputs, and improved crop productivity and quality. But there are also several investments involved in implementing operational changes and in the certification process itself. In the case of smallholder cacao production, certified production can give better net financial revenues (Figure 14; blue bars) through productivity increases and relatively high price premiums. These positive net benefits make certified sustainable cacao production an attractive alternative for smallholders, provided they are able to invest in the required management and market premiums are effectively transferred. Changing large-scale cacao monocultures to agro-forestry systems will reduce the revenues for cacao, but these losses are compensated for by lower costs for agricultural inputs and additional revenues from produced wood and fruits. In the case of palm oil, the net financial benefits of certified production are relatively modest. Whether the benefits will make a difference for primary producers also depends on the proportion of the market premiums that actually reaches them, an issue which is especially relevant for poor smallholders. In the soya case studies, the benefits of reduced inputs and price premiums are not sufficient to cover the additional costs of certified production. In conclusion, the additional financial benefits of certified production can create a better business case for the producer, but do not always weigh up against the higher costs of certified production.

Figure 13
Financial costs and benefits of conventional tropical resource production, 2010



Source: Alterra 2014; IVM 2014

The relatively high financial revenues of conventionally produced tropical resources make agriculture an attractive business, especially with high-yield and valuable crops such as palm oil and cacao. The net revenues for harvesting wood in selectively logged natural forests are much lower.

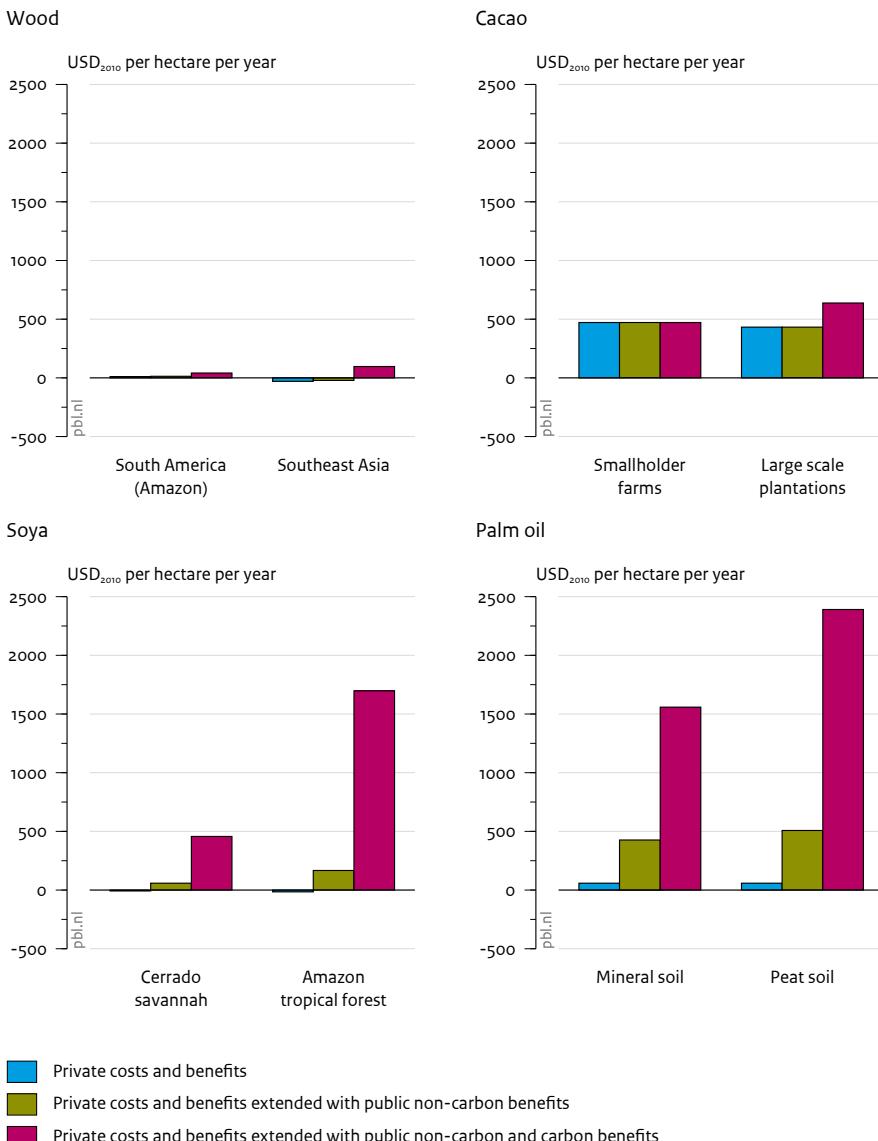
The information that was used in these cost-benefit analyses is generic (not location specific) and based on assumptions supported by a limited number of literature sources. Nevertheless, the analyses' results confirm the often mentioned financial barrier for scaling up and mainstreaming certified production, and the problems concerning the payment and transfer of market premiums (Chen *et al.*, 2010; PWC and IDH, 2012; SCSKASC, 2012). The actual market uptake of certified produce is limited for most commodities, between one third and a half of the produced volumes (Potts *et al.*, 2014), and this reduces the finances that can be obtained through premiums from consuming markets. To make a convincing business case for certified and sustainable

resource production, benefits other than mere financial ones should be taken into account as well.

Extending the cost-benefit analyses with reduced externalities and ecosystem conservation

The extended cost-benefit analyses also take into account the values of avoided externalities and conserved ecosystem goods and services that are relevant for stakeholders other than the producer. The extension exercise is carried out in two steps, the first including the non-carbon ecosystem goods and services, and the second taking in the carbon benefits as well. This is done to keep all effects visible as the relatively high carbon values dwarf other effects.

Figure 14
Potential net benefits of certified tropical resource production, 2010



Source: PBL

The difference between the total financial benefits of certified and conventional production is the net direct financial benefit of certified production for farmers, represented by the blue bars in the figure. In most case studies, the net benefits are modest but they can become significant in smallholder cacao production if productivity can be enhanced to give higher cacao revenues. In large-scale cacao production, shifting to agro-forestry reduces the cacao revenues but this loss can be compensated for by additional revenues from wood and fruits. Extending the analysis with the monetary value of public (non-carbon) benefits gives a positive net effect for certification (green bars). Here, reduced externalities and conserved goods and services add to the positive outcomes. High net effects become apparent when the values of avoided carbon emissions from preserved tropical forests are also added (purple bars). However, certified production alone cannot easily capture the potential off-farm carbon benefit as stopping deforestation depends on supporting land-use policies. (The bars represent cumulative results - from left to right more types of costs and benefits are added: financial, non-carbon and carbon).

In the expanded view, certified production performs better than conventional production. For instance, conventional large-scale production of soya requires several artificial inputs such as fertilisers, pesticides and irrigation water. These inputs lead to impacts and social costs in areas surrounding the farms (off-farm externalities). In all the investigated cases, changing to certified resource production results in higher net societal benefits (Figure 14; green bars). The assumption is that a large part of the environmental externalities can effectively be mitigated by on-farm improvements and good agricultural practices, such as no-tillage in soya production and reduced soil drainage in palm oil production. This is relevant mostly for local stakeholders who otherwise would bear the burden of the environmental effects and lost natural resources.

When the carbon benefits of better on-farm carbon storage and avoided deforestation are also included, the picture changes completely (Figure 14; purple bars). This effect is especially large where intensive agricultural production is associated with deforestation. The amount of lost carbon is much lower under certified land management, a consequence of applying no-deforestation criteria. But in the case of soya in the Amazon and palm oil on peat soils in Southeast Asia, this reduction in carbon emissions is not large enough to deliver a net positive result for society (Figures 9 and 11). This means that certified production cannot sufficiently mitigate the negative effects of agriculture in locations with high carbon stores. These carbon hotspots therefore represent no-go areas for agricultural expansion. The peat exclusion and the no-deforestation policies of several soya and palm oil processing companies are examples of ways to avoid these effects (see text-boxes with examples of ways to avoid these effects (see text-boxes with examples from practice in Chapter 2).

4.1.2 Benefits of certified wood production

Wood revenues from natural forests and artificial plantations

The financial revenues from harvesting wood from selectively logged forests are relatively high compared to the management costs. This is mostly the result of the low costs of exploiting semi-natural ecosystems for a resource that grows naturally. When artificial plantations for wood production are established, higher operational costs need to be met for planting, thinning and other practices, but the wood revenues per hectare are also higher (Figure 13). This means exploiting a natural forest is an attractive business activity when financing for investments is difficult to obtain. When funding is available, it is more profitable to establish plantations.

Sustainable forestry gives mostly long-term benefits, but requires considerable short-term investments

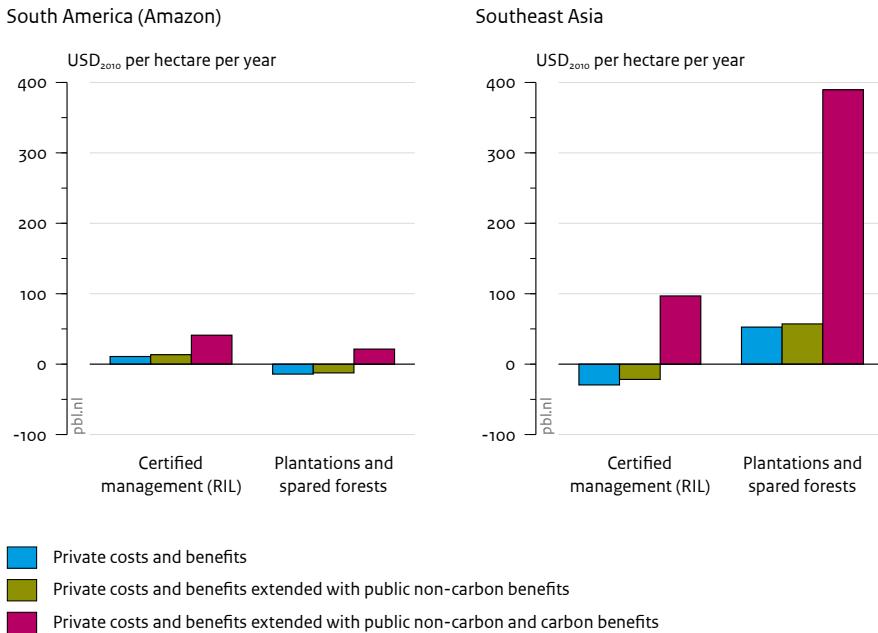
Changing from conventional to certified selective logging has several financial consequences (Figure 15; blue bars). In the Amazon region, applying reduced impact logging techniques results in additional future revenues due to better forest regrowth. But considerable investments are also needed in the short term for improved forest management. In the Southeast Asia region, in contrast, applying sustainability criteria results in lower future wood revenues, as the amount of wood that is allowed to be logged under certified conditions is much lower than that which is harvested conventionally. This results in a financially less attractive net result of certified production in this region.

When the cost-benefit analyses of selective logging are extended with local societal values of ecosystems services, the results for certified production and applying reduced impact practices improve, especially because of the avoided forest damage. The higher availability of non-timber forest products such as wild food and other materials have a considerable local value (Figure 15; green bars). When the social costs of carbon losses are also taken into account, certified selective logging performs much better than conventional logging since forest damage and degradation are mitigated (Figure 15; purple bars). In the Amazon region, the net societal benefits of certified logging are made up of higher future wood harvests, higher availability of non-timber forest products and forest food, lower carbon emissions and REDD revenues from reduced forest degradation. But in Southeast Asia, even though certified production performs relatively better than conventional production, the balance for society is still negative (Figure 5). Here, the levels of logging still remain high and this leads to significant social carbon costs.

For certified plantations, the extended analysis also takes the values of spared natural forest into account. The benefits of non-timber products and reduced carbon emission make this 'forest sparing' option more attractive for society. In practice this depends on the actual potential of certification to effectively and permanently spare natural forests. To capture this potential benefit of plantations, a high level of land-use governance is required, that covers forested areas beyond the spatial and temporal limits of certified forest concessions (Van Oorschot *et al.*, 2014a).

The varying results for certified forestry show, once again, that the choice between a strategy of sharing (mixing natural elements with production systems) and one of sparing (intensifying productivity to avoid

Figure 15
Potential net benefits of certified tropical wood production, 2010



Source: Alterra 2014

The net benefits of certified wood production, calculated as the difference between the total benefits of certified and conventional wood production, vary according to production regions and strategies. Sparing forests by producing wood on a small area with plantations is beneficial in regions with high logging intensities. Applying reduced impact logging in semi-natural forests is a sharing strategy that is beneficial in areas where logging intensity and damage are relatively low.

deforestation) depends on the specific location and the ecosystem characteristics. In South America, where both the logging intensity and forest degradation are relatively low, certified selective logging gives good results, whereas in Southeast Asia harvesting intensity and damage from logging are much higher, which means establishing plantations and sparing non-degraded forests is the preferable option combination.

4.1.3 Lessons from case studies on innovation in supply chain governance

Introduction

Once the public and private benefits of certified production have been identified, it is worth analysing supply chain governance arrangements that can be used to enhance or safeguard the benefits of ecosystem goods and services (Figure 2). The innovation cases analysed here show several institutional arrangements which make supply chains more sustainable, and may also be used to better integrate values of goods and services into government policies. After looking at how current Dutch policies frame the issue of safeguarding ecosystem services, the main innovation drivers and conditions from the case studies are summarised.

Current Dutch policies on ecosystem services focus on market-based solutions

An analysis of how Dutch policy discourses frame sustainability issues shows that there is currently a clear preference for market-based solutions for the conservation and sustainable use of ecosystem services (Van den Berg *et al.*, 2014). Recent policy documents on nature and natural capital (Ministry of Economic Affairs, 2013, 2014) stress that sustainability challenges offer opportunities for businesses to strengthen the competitive position of the Netherlands. Degradation and loss of valuable ecosystem services are attributed to market failures to incorporate the full costs of biodiversity loss. It is left to businesses to take the leading role in innovating supply chain governance, with the Dutch Government in a supporting and facilitating role. This is, for instance, done by creating public-private partnerships and multi-stakeholder platforms, and by stimulating cross-sector collaboration. A government position such as this can be seen as the logical consequence of the global context of international market policies which leave little room for additional regulation at the national level (Kamphorst, 2009). The use of public-private partnerships is also in accord with the paradigm of the energetic society which

Table 9
Characteristics of the studied innovation cases

Supply-chain	Innovation initiative	Strategy	Business role	Government role	Stakeholder inclusion	Mandates
Cacao	IDH and UTZ Certified	Partnership using standard	Co-funding and commitment	Partnering and co-funding	Smallholder programmes	Dutch STAP programme
	PES	Service payment mechanism	Create new market infrastructure	Subsidy for experiments	Implicit through ES conservation	
Soya	RTRS	Market standard	Stakeholder and user	Supporting the round table	Standard element for good conduct	
Palm oil	RSPO	Market standard	Stakeholder and user	Supporting the round table	Standard element for good conduct	
Timber	IDH	Partnership using standard	Co-funding and commitment	Partnering and co-funding	Indirectly through use of FSC standard	Dutch STAP programme
	FSC and ForCES	Explicit standard for ES	Stakeholder and user	Scaling up through procurement	Standard element for good conduct	EU Timber regulation
	Public procurement	Example setting	Supplier	Example setting by lead customer	Public and open consultation	EU Timber regulation
	REDD+	Service payment mechanism	Create new market infrastructure	Achieving national GHG targets	Required for acceptance	UNFCCC

Most strategies use market standards directly or indirectly. The government roles are mostly indirect, except in public procurement. Source: Van den Berg et al., 2014. For abbreviations, see Chapter 2.

holds that non-governmental actors take the lead in finding solutions to public problems (Hajer, 2011), and this view has received general support from the Dutch Government. The government has not taken part in efforts to define standards, to allow stakeholders to reach consensus without administrative and political interference. This gives governments the possibility to formulate policies based on societal discussions and agreements about sustainability definitions.

Innovation in supply chain governance is driven by both private and public initiatives

The general conclusion from the case studies is that both private and public actors are needed to drive and support innovation (Table 9). Initially, pressure from civil society plays a large role in addressing the need for sustainable practices. Companies and NGOs often work together in establishing and defining production standards (Van den Berg et al., 2014; Vermeulen and Kok, 2012). To stimulate the acceptance of these voluntary initiatives and a broader use of market-based solutions, complementary government incentives are needed. This can for instance be done by carbon price-setting to make forest-based carbon trading more attractive, and by formulating compulsory minimum standards for a level playing field in the EU. These complementary and more coercive incentives are needed to spur a transformation of the market towards completely sustainable trade, as voluntary initiatives by frontrunners will not be able to involve or stimulate all market actors (Van Oorschot et al., 2014a).

Multi-stakeholder involvement is crucial

Organising multi-stakeholder involvement is a critical factor for the success and acceptance of sustainability initiatives such as voluntary standards and certification, with different roles for NGOs, the private sector, research organisations and governments (Van den Berg et al., 2013, 2014). Multi-stakeholder arrangements are found, for instance, in integral land-use planning, in defining and revising market standards, and in open consultation processes to assess whether standards comply with public procurement criteria (see sections on innovation in Chapter 2). Governance solutions seek to secure the benefits for several stakeholders, making multi-stakeholder involvement both logical and effective.

The actual involvement of stakeholders depends on the existence of a well-designed and representative decision making body, such as a tri-partite chamber for defining and improving market standards (Vermeulen and Kok, 2012). Consumers have generally not been involved in these innovations, but have been important in creating the initial demand for certified products that ensure producers take responsibility for environmental issues. Public procurement processes also apply criteria for multi-stakeholder involvement to select standards that can build on the broad acceptance amongst the parties involved.

References to ecosystem goods and services are mostly implicit or completely lacking

The strategies used in the examined innovations include creating partnerships, stimulating the use of standard

definitions, and promoting certification and awareness. In most innovation schemes, hardly any explicit reference is made to ecosystem goods and services or their values, and ecosystem services are considered only as a part of the broader objective to increase sustainability in all of its domains. The public-private projects under the Dutch sustainable trade initiative IDH, also make use of standards with multi-stakeholder arrangements, and therefore contain only indirect references to ecosystem services. In public procurement, where the government has a more regulating role, there is currently also no explicit attention for conserving ecosystem goods and services. Enhancing and conserving ecosystem services is mentioned explicitly in innovations where payment for a specific service is a core feature, such as PES for carbon storage, and the ForCES certification for ecosystem services in forest management (see Section 2.3). A more explicit treatment of ecosystem goods and services can be met by using standard system's improvement processes to address the conservation of the values that ecosystems have for different stakeholders.

Government roles, involvement and options

Government involvement is mostly indirect in the analysed cases, primarily through supporting, financing, facilitating and partnering (Table 9). Along with the relative success of, for instance, forest certification, this proves that effective governance models, other than the conventional command-and-control style, are possible for international supply chains. It also means that governments can stimulate promising initiatives by mainstreaming and addressing ecosystem services more clearly in their interactive regulation policies.

Governments embed market standards in their policies, for instance by including them in public procurement procedures (Brack, 2013). Reviewing existing standards for compliance with government criteria is therefore a strategy that can be used to promote the integration of ecosystem goods and services. Governments could more explicitly formulate natural capital concerns in procurement criteria to stimulate innovation, one of its prime objectives. A way to ensure that standards cover ecosystem goods and services more comprehensively is to support cross-standard platforms such as ISEAL to address this issue, or organisations such as FAO and ITTO that provide certification guidelines for several sectors.

Another option for interactive government policies is promoting company transparency on supply chains and the external effects of resource production. This is currently done in the Netherlands by closing Green Deals with businesses, for instance on platforms for company impact assessment on biodiversity and natural capital,

and for stimulating transparency on the use of social and natural capital (Ministry of Economic Affairs, 2013). These experiments will increase knowledge and company awareness of lost private and public ecosystem values. Once greater levels of awareness have been achieved, companies can choose to implement measures to reduce external effects, and look for business opportunities for enhanced or conserved ecosystem services.

It can be expected that interventions with an interactive and experimental character will only stimulate frontrunners to better integrate ecosystem goods and services. The next challenge is gaining broad market acceptance of the developed approaches and instruments. Voluntary market-based approaches all have limits in terms of effectiveness and general market uptake. Companies, whether primary producers or processors further along the supply chain, will opt for mainstreaming the integration of values of ecosystem goods and services on their own account when clear benefits are possible.

Governments have a more distinctive role to play where specific policy objectives can be coupled to supply chain management, preferably supported by EU directives. This is for instance the case in policies for replacing fossil fuels with bio-based fuels. In the EU-RED Directive on biofuels, carbon performance is a crucial factor and existing standards are being expanded to include it. Criteria for certain ecosystem services, such as carbon storage, have already been incorporated into existing standards (e.g. ForCES for sustainable forest management and ISCC for carbon performance of palm oil production).

The legality definition links demand-side and supply-side measures

To create a level playing field for all market parties, governments may have to turn to regulation. A present example is the EU Timber regulation to ensure no illegally harvested wood enters the European market. The link with the conservation of ecosystem services in producing countries is still very indirect. The legality definition in the EU FLEGT policy (Forest Law Enforcement, Governance and Trade; EU FLEGT, 2015) includes an obligation to consult stakeholders when setting up voluntary bi-lateral partnership agreements. This means that the government of a timber-exporting country has the responsibility for building consensus among local stakeholders.

Stakeholder interests and possible conflicts in a country's forestry sector can be identified in the early stages of the consultation processes. The FLEGT action plan offers producing countries support for building capacity to develop and enforce national policies and laws.

4.1.4 Capturing the benefits of certified production

The benefits of non-carbon ecosystem goods and services for local development are variable and uncertain; more focused research is required

The TEEB approach provides guidance in identifying ecosystem values for different stakeholders, and in this study monetary evaluation is used to do that. It has proved useful to apply the TEEB approach to certified resource production systems, as it reveals the potential benefits of certified and more sustainable resource production. Especially when the benefits are differentiated by type (such as financial and societal values), stakeholder (producer, local population and global citizen) and scale (on-farm and off-farm; local, regional and global), more insight is gained into the possible private drivers, public benefits, and the required government incentives for certified production and trade. The analysis presented here provides arguments and stimuli for sustainable trade, mostly with regard to the societal benefits.

Though the identification of the societal non-carbon benefits of sustainable production has been a complex process with considerable uncertainties, it has still produced useful insights. The data on the societal values of goods and services was compiled and combined from a limited number of publications on regions that are roughly comparable to the cases studied here. There are hardly any existing case studies that examine all the values of ecosystem functions in relation to their specific local context. In several cases, some local and societal benefits were frequently mentioned, but not valued in monetary terms due to a lack of comparative data from the field. A clear example is sustainable cacao production, where the potential of enhanced pollination services from surrounding forests could not be backed up by published data (Van Beukering *et al.*, 2014). In the same way, enhanced freshwater supply from forests could not be linked to sustainable forest management practices (Arets and Veeneklaas, 2014).

The extended cost-benefit analyses presented here should therefore be seen as demonstrating the potential of certification, based on assumptions about effects that are occurring simultaneously. There is still a clear need for well-designed field studies on the environmental and social impacts of certified resource production (Milder *et al.*, 2015), and especially on the valuation of local ecosystems with regard to non-carbon goods and services. Expanding the monitoring framework for impact measurement with the values of ecosystem services could be valuable for improving the credibility of certification standards, although it makes impact

assessment even more complex. More insight is also needed into the relationship between certification and the prevention of further deforestation, and into the complementary role for governments in creating the right enabling environment for capturing ecosystem values.

The global monetary value of carbon prevails over local monetary value for non-carbon ecosystem services that are relevant for poor communities

The loss of ecosystem carbon storage presents the highest costs to society in most of the studied production systems. When agricultural expansion is accompanied by deforestation, in monetary terms over 80% of the loss of ecosystem goods and services is due to carbon losses. The predominance of carbon values also highlights the relatively low monetary value assigned to non-carbon ecosystem services, which is partly due to the low income levels of the local population in developing regions. This means that a supply chain perspective that groups together stakeholders with different standards of living into a single analysis will provide a skewed or even unfair picture of the distribution and allocation of monetary value. This shows the difficulty of determining ecosystem benefits for the poor in monetary value, especially where solutions are based on market instruments such as certification.

Poor communities with a high level of self-sufficiency may depend directly on local ecosystems, for instance for the provision of food and clean water. Using monetary valuation factors such as 'willingness-to-pay' underestimate the true value of ecosystem services for such vulnerable communities due to their limited financial resources. There are methods to account for welfare differences, for instance GDP deflators and parity indices based on purchasing power (PPP), which give a much fairer representation of natural values that are worth protecting and maintaining (de Groot *et al.*, 2012). A correction for welfare differences will give a better picture of the values perceived by the various stakeholders. This will not, however, provide a real picture of market opportunities and potentials for additional payment schemes. Moreover, the national PPP indices do not usually account for large welfare differences within developing countries. Another possibility to treat this distribution and development issue is to determine how certification and ecosystem services contribute to decent living wages (Komives, 2015).

Great potential for integration into market standards

The results of the quick scan show that all the studied voluntary market standards cover ecosystem goods and services to a high degree, especially services such as freshwater supply, biodiversity, and maintenance of soil fertility (Chapter 3). However, it also is clear that some

ecosystem services can be safeguarded more adequately if they are directly addressed in the standard. This applies particularly to services for which only indirect safeguards were found, such as genetic diversity, natural pollination and tourism. Standards should provide more precise and direct requirements on the maintenance of these ecosystem services. It also appears that many ecosystem services are indirectly addressed by references to other concepts and practices, such as 'biodiversity' (served by protecting habitats), the 'HCVA approach' (protecting areas of special High Conservation Value), the application of 'Good Agricultural Practices', and the use of Integrated Pest Management techniques as substitutes for applying agro-chemicals.

The HCVA approach (Brown *et al.*, 2013) in particular provides many safeguards for ecosystem services. This independent concept is used in several standards, such as FSC, Fair Trade, RSPO and RTRS. It ensures that areas of special importance are protected and excluded from production activities, and as a consequence several ecosystem services may be served. The HCVA definition distinguishes several reasons to appraise ecosystems as valuable, taking into account biological, ecological, social and cultural factors. These reasons overlap to a large extent with those behind the categorisation of general ecosystem services. This provides a potential mechanism to capture ecosystem values and benefits, but it is important to note that the HCVA approach is not always integrated into standards with a sufficient amount of rigour.

Many of the safeguards found in the quick scan are indirect and imprecise. Particular attention is needed for those ecosystem services that have less value or no value at all for the certified commodity. For instance, while services that are essential for agricultural production are often substantially and comprehensively addressed, such as erosion prevention and maintenance of soil fertility, the less tangible services such as medicinal resources, and local climate and air quality regulation, are largely covered by indirect safeguards only, without any specific measures being proposed.

Complementary governance mechanisms are needed to capture the benefits of 'sparing' natural ecosystems

Under the criteria for certified agricultural production, a large part of the identified non-carbon ecosystem benefits are related to the conservation of natural forest ecosystems outside the specific production sites. In addition, in the case of establishing wood plantations, most of the non-carbon benefits come from sparing forests from further exploitation and conversion.

Capturing these ecosystem conservation values depends on the effectiveness of certification and sustainability

schemes in avoiding further deforestation and habitat conversion. As the societal benefits of sparing lie outside the farm or concession borders and therefore outside the sphere of influence of individual farmers, governance arrangements for higher spatial scales must be put in place.

This can for instance be done through the strategic protection of natural habitats, which is a task for local and regional government bodies. For this, a mapping of hotspot areas is necessary: identifying areas where high levels of ecosystem functions coincide with high values for local communities. Local population access to these natural areas is crucial for capturing the values, but often the local communities are barred from entering protected areas, and this entails the risk of increasing poverty levels (Schaafsma *et al.*, 2014). Another way of capturing the benefits of ecosystem sparing is to direct plantation establishment to degraded or abandoned agricultural land. This avoids deforestation while agriculture can still expand. Governance mechanisms that facilitate these practices can help producers to comply with the non-deforestation criteria of market standards (Van den Berg *et al.*, 2014). In a Brazilian study on soya production, most ecosystem values were captured through the legal obligation for landowners to protect native habitats (TEEB for Business Brazil, 2014).

Several examples of well-designed case studies highlight the difficulties of capturing spared ecosystem goods and services in practice. According to a study on a mountainous area in Tanzania, the total flow of forest products (e.g. charcoal, firewood and thatch) provided an important source of additional income for local communities, particularly for the poorest households, who mainly depend on subsistence agriculture. Spatial mapping of economic forest values shows that benefits vary widely across locations, and are correlated with population density, infrastructure and resource availability. Earlier studies concluded that it is necessary to have location-specific forest protection programmes that take the flow of non-timber forest products into account. This will ensure the maintenance of the local benefits and address the additional challenge of reducing extraction activities in forests to sustainable levels (Schaafsma *et al.*, 2014).

A study on forest management in Congo analysed the social impacts of FSC certification, and in particular the treatment of the customary rights of the local communities, such as hunting and the collection of non-timber forest products. Several positive social effects of certification were noted, but no positive effect of certified forest management was noted on the provision of forest products to local communities. On the contrary, people

living around certified forests felt themselves constrained in accessing forests. Forest managers kept access to their forests for local people to a minimum because of the legal obligation to prevent forest degradation from informal and illegal activities. But certification under FSC criteria also provides forms of compensation for the limited access, for instance by sharing the benefits of forest exploitation and the provision of alternatives for using fuel wood (Cerutti *et al.*, 2014).

So it seems that socio-economic benefits are more likely to arise when protected areas are managed with the aim of promoting the use of sustainable resources¹ rather than enforcing strict protection of biological resources. Protected areas are frequently reported to have negative impacts on local people and socio-economic development goals, for instance by displacing populations to other regions. An extensive literature review on access to protected areas shows that biodiversity and support for local livelihoods can be combined when land governance is co-organised by the local people (Oldekop *et al.*, 2015). In a Mexican case, certified wood production appeared to be a good alternative for strict forest protection (Hughell and Butterfield, 2008). Sustainable wood production helped to keep the forest in good condition by giving it an economic value. Forest fires and informal forest use leading to forest degradation were more frequent in the strictly protected forest zones. Strict protection may be needed in certain situations, but conservation initiatives should always consider whether enforcing strict protection is required for protecting biodiversity (Oldekop *et al.*, 2015).

These examples show that solutions need to be designed specifically for each location, taking the local context into account. Securing the local values of ecosystem goods and services can be based on allowing sustainable use in ‘multi-use’ protected areas, or on more strict protection combined with compensation schemes, such as payments for conserved carbon stores or for producing commodities for certified sustainable trade.

Experiences with payment schemes for ecosystem services

Initiatives for payments for ecosystem services (PES) are increasingly being implemented in both developed and developing countries. PES programmes are voluntary agreements whereby a user or a beneficiary of an ecosystem service makes payments to individuals or communities that manage ecosystems which provide the service (see also Figure 3). PES programmes are made up of ‘conditional agreements between at least one “seller” and one “buyer” over a well-defined environmental service – or a land use presumed to produce that service’ (OECD, 2010). The payments serve to compensate

‘sellers’, such as farmers, foresters and fishermen, for the additional costs of conserving biodiversity and using ecosystem services sustainably.

There are today more than 300 PES programmes in operation worldwide, most of which to promote biodiversity, watershed services, carbon and protect landscapes (Blackman and Woodward, 2010; OECD, 2010; Wunder *et al.*, 2008). An exhaustive review of the potential of PES is beyond the scope of this study, but some lessons from past experiences are illustrative. Much knowledge with PES has been gained in Costa Rica (Pagiola, 2008), with the implementation of an extensive payment system for environmental services. Progress has been substantial in the field of charging water users, and more limited for payments by users who benefit from preserved biodiversity and carbon sequestration. While the systems are regarded as successful, it should be noted that payments are mostly not voluntary, and are largely paid for from (fuel) taxes. Consequently, since government involvement is still direct, these are not true examples of market-based instruments.

The OECD has studied past PES experiences and formulated several conditions for successful implementation of PES, such as clearly defining the property rights of ecosystems, developing reliable monitoring systems for measuring actual performance, allowing differentiated PES prices, ensuring the long-term protection of the ecosystem status and optimising the delivery of co-benefits (OECD, 2010). A main problem in making PES a market instrument is that the involved costs and benefits vary widely. It is not easy to establish standard prices, for instance a fixed per hectare price, as the costs for individual landowners differ sharply and the existence of co-benefits may vary as well. Another problem is the issue of additionality. To ensure that a given payment will indeed lead to additional ecosystem services, as compared to what would have occurred under the conventional scenario, payments should only be made for ecosystem services that are at risk of being lost, or to enhance their provision (OECD, 2010).

Developing international trading mechanisms for ecosystem services such as water purification, flood control and carbon sequestration is not as straightforward as for commodities such as coffee and wood. Several conditions for commodification must be met, and mechanisms must be created to ensure the building of confidence in the permanency of service delivery. In addition, reasonable prices must be established, even if they do not reflect the true social value of a service. Another important aspect is the need to quantify the service to aid monitoring, verification and trade. These conditions for commodification are met in new

certification schemes for ecosystem services (Meijaard *et al.*, 2011), such as the ForCES system developed by FSC (see Section 2.2).

Using international carbon payment schemes to bring about forest ecosystem benefits

The monetary benefits for society of carbon storage are relatively large in the extended cost-benefit analyses (Chapter 2). Contrary to the non-carbon ecosystem benefits, carbon storage can be quantified with a good level of precision. Assessments of alternative land-uses around the world have led to a large body of knowledge on carbon storage under different ecosystem management regimes. Studies on carbon storage have revealed characteristics which, along with the availability of methods, monitoring and baselines, make carbon especially suitable for commodification (Meijaard *et al.*, 2011). An international market mechanism for voluntary certified carbon payments is already in place, with numerous sellers and buyers of the ecosystem service actively operating, including actors who are not involved in the primary commodity supply chain. Most importantly, while it is expected that certification of other services will remain a minor affair (Meijaard *et al.*, 2014), there are possibilities to couple them to carbon storage, creating bundles of mutually benefitting ecosystem services, something which is very much worth considering further.

At present, most demand for carbon mitigation comes from private companies and consumers on the voluntary carbon trading market, where the supply is now much larger than the demand. To enhance carbon trading, much is expected from compulsory markets that aim at reaching national targets for reduction of greenhouse gas emissions. In the REDD+ mechanism established under the UN climate convention land-use based options for emission reduction are now included. Forest conservation and sustainable forest management have been acknowledged since 2009 as options for carbon retention (Arets and Veeneklaas, 2014). So there are possibilities to include avoided deforestation and mitigated forest degradation under this UN initiative. Some of the improvements in the PES mechanisms mentioned above are also applicable to forest-based measures, such as the requirement to provide proof of additionality and the permanence of carbon stores, and the establishment of clear land rights.

So REDD+ is now regarded as a promising approach. It provides new economic incentives, brings new actors to the table and opens the door for coalitions, but it also faces major challenges (Angelsen *et al.*, 2012). To be effective in reducing forest degradation and deforestation, it is imperative to coordinate REDD

implementation across various government levels, balance and distribute benefits amongst stakeholders, set up reliable measurement, reporting and verification systems and properly address land right issues. There are programs in place that help countries to prepare for the implementation of forest-based projects for REDD+. The Readiness Assessment Framework comprises several aspects that cover these challenges (Minang *et al.*, 2014).

A main problem in making carbon payment schemes work for certified forest management is obtaining funding, especially with the present low market prices for carbon trading. The high social value of carbon storage and retention depend on the future effects of climate change on economy and prosperity (see Chapter 1). Estimates about this future value are highly speculative, and therefore uncertain. The present market value of carbon in international trading schemes is much lower and varies between USD 5 and USD 12 per tonne CO₂ eq, depending on the type of trading scheme (Peters-Stanley and Gonzalez, 2014). Carbon mitigation markets in the energy sector for compensating industrial emissions show there is now a low degree of acceptance of forest-based carbon measures under these prices. Transaction costs for the reduction of forest-based carbon emissions have proven to be considerable. Many technical alternative options exist for carbon reduction which, in financial terms, perform better than ecosystem storage, meaning initiatives in forests are easily outcompeted (McKinsey and Company, 2009). So higher and more stable carbon prices are required to promote this particular market for ecosystem services.

Bundling ecosystem services and combining payment mechanisms

The analysis of ecosystem service coverage in market standards (Chapter 3) shows the huge potential of covering and bundling the identified ecosystem goods and services into a single management system. But this still does not solve the often mentioned poor financial performance of certified production.

Combining payment schemes covering ecosystem services and wood production are an obvious option to improve the financial performance of certified forest management (Meijaard *et al.*, 2011). Financing under the REDD+ mechanism requires a management system that lowers carbon losses through reduced impact logging or by completely ruling out logging. Forest certification for sustainable wood production also requires a good forest management system. A stimulus to pursue this combination of incentives is a logical step. The new ForCES standard on forest ecosystem services will help to capture the ecosystem service benefits of FSC certification, and broaden market options with new beneficiaries and payers.

Biodiversity values can also be served by identifying 'high conservation value forests', which is not only required for FSC certification but also for other certification systems for agro-commodities (see Chapter 3). However, even if benefits for both biodiversity and other forest ecosystem services are found in certification schemes, the two benefits are not always linearly related and spatial trade-offs between co-benefits are possible (Venter *et al.*, 2009).

Integrated production landscapes provide opportunities at higher spatial scales

An alternative for market instruments oriented to a single sector or a single service is integrated landscape management which captures benefits of ecosystems specifically for multiple stakeholders at the regional or landscape scale (Horn and Meijer, 2015; Kusters and Lammers, 2013). Integrated landscape management offers a promising means of serving multiple goals, as rural landscapes are considered the nexus where the linked challenges of food and water security, energy production, economic development, nature conservation and climate change converge. Specifically developed tools and strategies focus on realising synergies among different landscape objectives, involving public and private as well as local and global stakeholders, to identify and manage trade-offs and incorporate benefits from public goods such as biodiversity and ecosystem services (Horn and Meijer, 2015).

An examination of nearly 500 projects reveals that integrated landscape management is becoming a standard feature of mainstream policy development by national governments (Estrada-Carmona *et al.*, 2014; Milder *et al.*, 2014). However, the concept remains unclear to many, most impact evidence is still qualitative, and there are few clear guidelines for policymakers on implementation at a scale that can achieve the multiple goals, for instance by regional land use planning with the involvement of multiple stakeholders.

A related innovation is the tailoring of certification processes at the jurisdictional level. In jurisdictional sourcing, sustainability performance is approached from a geographical viewpoint, instead of certifying specific certified farms and plantations. It links certification to politically defined territories such as districts and provinces. Potential benefits of this approach are the inclusion of a large number of stakeholders, including smallholders, and the capturing of off-farm, watershed and avoided deforestation benefits (Wolvekamp - Both ENDS, personal communication). A good example of these jurisdictional initiatives is found in the palm oil producing region of Sabah in Southeast Asia, where the government has decided to set up a region-wide initiative

to produce 100% certified palm oil (Borneo Post online, 2015; Rakyat Post, 2015). This jurisdictional approach has already been proposed for REDD+ initiatives (Meyer and Miller, 2015).

4.2 Perspectives for integrating values of ecosystem goods and services into supply chain governance

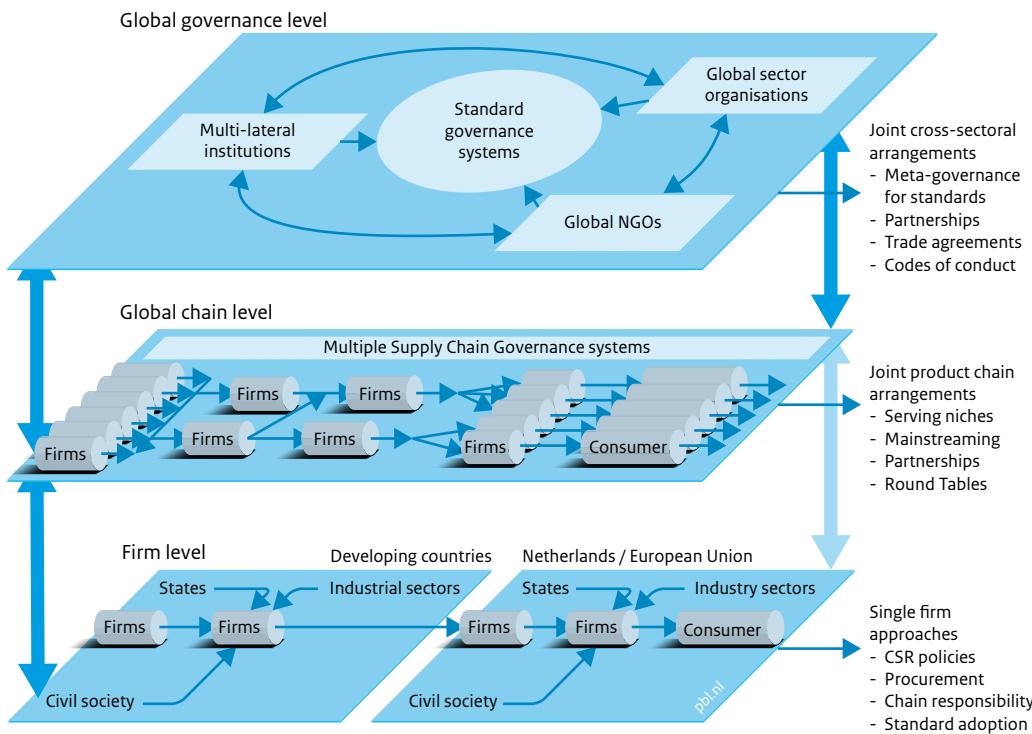
Perspectives for integrating ecosystem goods and services into multi-level governance

This section discusses three perspectives for integrating ecosystem goods and services into governance models that contain several of the options discussed above, that specifically aim at capturing the values and benefits of sustainable production in the sourcing regions of Dutch imports. There are different ways forward for making international trade more sustainable. The options described above can be single-firm, cross-sectoral, national and supranational at either the demand and supply side of product chains. Some of the options and the corresponding instruments provide feasible solutions in the short-term, where other, more structural changes are harder to implement (WBCSD, 2012). Combinations of options provide perspectives that outline complementary sets of arrangements encompassing several supranational levels of governance (Figure 16; Van Oorschot *et al.*, 2014a). The balance between market-based solutions and government incentives, whether to challenge frontrunners or stimulate slow adopters, is different for each of the three perspectives.

The first perspective concerns the potential of voluntary market-based initiatives to initiate and produce improvements. The stimulation of demand for certified and labelled products and resources on the Dutch market creates supply chain incentives for producers to operate in accordance with the criteria of production standards. Market standards can capture the ecosystem benefits of sustainable production if they are improved with criteria and mechanisms to treat and safeguard ecosystem goods and services.

However, this type of innovation will mostly target frontrunners at both ends of the supply chains. Because of the numerous obstacles and limitations that have been identified in voluntarily initiatives, slow adopters are not expected to join the transition process (Van Oorschot *et al.*, 2014a). So, if sustainable production and consumption are to become the new norm, then promoting voluntary initiatives is not sufficient. A level playing field is needed to enhance the performance of the slow adopters, as well as more structural changes in pricing and payment

Figure 16
Three levels of supply chain governance



To improve the integration of ecosystem services into supply chain governance, various complementary private and public options need to be considered. The interaction between the options for improving the sustainability of supply chains, is illustrated through the concept of multi-level governance. Governance arrangements are required at the firm, the farm and the landscape levels, in and across sectors, and finally at the global level where supranational institutions operate (adapted from Vermeulen et al., 2010).

schemes to better include the value of ecosystem conservation and to avoid harmful environmental effects. This constitutes the second perspective of sustainable production as the new norm.

The third perspective, focussing on expanding efforts to the landscape level, is oriented towards overcoming the limitations of single-sector approaches in resource producing regions and presents a combination of sectoral approaches and government involvement at a higher spatial scale.

However, bearing the global operating space in mind, along with the expected growth in population, welfare and consumption, it is clear that making supply chains and production landscapes sustainable is not sufficient to feed a growing population and keep environmental pressures within safe limits (Kok et al., 2014). A fourth perspective for action, addressing this issue, has led to a broader and more encompassing strategy for sustainable production and consumption (Van Oorschot et al., 2014a),

but is not elaborated upon here, as it lies outside the scope of this study. For a more complete overview of obstacles, solutions and perspectives in supply chain governance, see other publications such as the extensive Resolve review (SCSKASC, 2012).



Perspective 1: Improve

Improve existing voluntary sustainability standards

Given the potential of certified production to deliver social benefits, it is useful to have a perspective that builds upon the central position that most of the present market initiatives and sustainable production standards already have: they offer opportunities for improvement in the short term because of their market acceptance, the involvement of a broad range of stakeholders and their procedures for innovation, leading to gradual and incremental change, driven by demand-side markets in Western Europe and North America.

Explicitly deal with ecosystem goods and services in market standards
 Several ecosystem goods and services have already been integrated into market standards, though they are not always covered in a direct, precise or explicit way, which limits the effectiveness of the initiative. As a result, a need exists for a more systematic approach to adequately cover all the identified ecosystem goods and services. It is possible to make considerable improvements in the fields of genetic diversity, natural pollination and tourism. Other ecosystem services, such as medicinal resources and regulation of the local climate and air quality have a less tangible value, or no value at all, for agricultural producers and consequently, they are mostly covered by indirect safeguards without any specific measures. To initiate an improvement process, standard, supranational discussion platforms such as the ISEAL Alliance can be used. This platform is working on harmonising and increasing the credibility of standards, and offers possibilities for cross-standard cooperation. This podium also offers an opportunity to address better safeguarding valuable ecosystem goods and services. Issues for improvement are addressed by the ISEAL members. Members are the standard managing organisations that have implemented the ISEAL codes of conduct for credible standards on: defining the standard, assuring compliance to criteria, and measuring impacts.

Include the values and benefits of ecosystem goods and services in impact measurement

To maintain their credibility, standard-setting organisations are aware of the need to provide better impact information (ISEAL Alliance, 2015b). A TEEB approach to assess the values of ecosystem goods and services for different stakeholders gives additional information on the potential of certification in delivering local benefits. The ISEAL alliance has issued a Code of Good Practices for impact assessments, and provides guidelines for setting up frameworks to monitor and evaluate both short and long-term outcomes. There are no specific references to ecosystem goods and services, as ISEAL leaves the content definition (intended effects) up to the standards organisations themselves. The recommendations of a broad group of monitoring and evaluation experts have already led to a research agenda with explicit issues for impact assessment. They aim to 'maintain or improve the on-farm natural resource base and associated ecosystem services for agriculture' and to 'mitigate negative off-site environmental impacts on off-site beneficiaries' (Milder et al., 2015). Improving impact measurement helps to convince both institutions and individual consumers that companies which promote the use of market standards are creating benefits for a range of stakeholders.

Create impulses for innovation through Dutch and European public procurement

Given their position as major customers, governments can influence markets by using sustainability criteria for procurement. One of the goals of public procurement is to drive innovation in the desired direction. At present however, public procurement is mostly focussed on selecting existing standards (Hanemaaijer and Kruitwagen, 2015). By making the sustainability criteria more challenging, procurement can become a more dynamic instrument to stimulate innovation and expand the range of ecosystem services covered by sustainability standards.

A good example from the Netherlands is the public procurement of sustainably produced tropical wood, a much used resource in civil works. A public consultation process on the selection of standards to be applied in Dutch procurement provides a way to address the values and benefits of ecosystem conservation for different stakeholders. Such a public consultation is a specific characteristic of the Dutch wood procurement system (Brack and Bailey, 2013), and it could be applied for other commodities where the government influence as a consumer is relevant, for instance for coffee.

Harmonisation of public procurement criteria applied by EU Member States is also needed for scaling up the market demand for sustainably produced resources. By taking the value of ecosystem goods and services into account, the EU green procurement criteria can also help to achieve EU targets, such as ensuring there is no net loss of ecosystems and their services (Action 7b of the EU Biodiversity Strategy; EC, 2011). And they can serve to integrate awareness of sustainability issues into patterns of consumption and production, even with regard to commodities that are produced outside the EU (EC, 2008).

Enable the coupling of multiple benefits to payment mechanisms for individual services

Payment mechanisms to compensate for the delivery of specific services have already been developed and implemented, although with varying degrees of success. A good example is the payment scheme for water services, carbon storage and biodiversity in Costa Rica (Pagiola, 2008). To create broader support for the concept, it is worth exploring how payments for specific services such as carbon storage can also benefit stakeholders other than the receiver. This study has shown that ecosystem conservation can safeguard the high carbon values, and that carbon accounting methods offer good possibilities for creating and stimulating carbon trade. By using service bundles, the available carbon funding can be used more efficiently as it safeguards those goods and services which have less potential and for which the actors in the supply chain

are more reluctant to pay. The mapping of services and values in specific local situations is important to identify the potential of coupling ecosystem services.



Perspective 2: Normalise

Integrate the value of ecosystem goods and services into regulations for supply chains

The use of market standards and voluntary initiatives has its limitations and faces obstacles that make it difficult for markets to reach sustainable levels of operation. To overcome issues such as the limited consumer acceptance of more expensive certified products and the lack of a level playing field for companies in the EU, the second perspective focuses on more structural change in supply chain governance. This perspective applies more coercive and market-based instruments while still taking advantage of the broad acceptance of sustainability standards.

Specify inclusive prices to make companies and customers aware of the environmental costs

Integrating the externalities of production into market prices presents an ambitious option, with an explicit role for the monetisation of lost or conserved ecosystem services. Part of the societal benefits of certified production is attained by reducing the environmental externalities of conventional resource production. Implementing better production methods creates direct financial costs to the producer, which are not easy to earn back as there is limited willingness to pay extra to contribute to reducing externalities or to provide price premiums to certified producers. To tackle this issue, the financial costs of reducing externalities should be integrated more adequately into the prices of resources. This type of economic solution for market failures has been a recurring theme in policy studies for quite some time, and is now promoted as a required condition for Green Growth (Hanemaaijer *et al.*, 2012).

But in practice it is not easy to establish 'inclusive' prices in a world where global trade connects nations with different standards of living and levels of environmental awareness and protection. As a first step, showing the real costs of sustainable production can help consumers to get accustomed to fairer and inclusive prices and open the way to setting a new social norm in favour of sustainable production. The TEEB approach to the valuation of ecosystem goods and services at the company and production level is a useful instrument for this. The Dutch Government has signed voluntary agreements with innovative companies, known as Green

Deals, to experiment with social and natural capital accounting (Ministry of Economic Affairs, 2013).

Present initiatives to define protocols and establish guidelines for natural capital accounting and true pricing at the company level are primarily meant to promote awareness among producers and customers of impacts, environmental values and inclusive prices (NCC, 2015a; True Price *et al.*, 2014). There are examples of environmental profit and loss accounts from major brands such as Puma's report on shoe manufacturing (PUMA, 2010). While helpful to identify mitigation measures, awareness initiatives are not directly aimed at raising price levels. The value of engaging in true pricing lies in being in control of the required mitigation measures to avoid risks, in identifying areas for innovation, and in enhancing the company's reputation (True Price *et al.*, 2014). Many more companies need to follow the example of the early adopters so consumers are able to make informed choices between products, which helps to set a new social norm for pricing.

Stimulate transparency on companies' non-financial performance
 Another option for government involvement is promoting transparency in the business world on supply chains and the external effects of resource production. The EU Directive 2014/95/EU on 'disclosure of non-financial and diversity information by certain large undertakings and groups', establishes an obligation for large and multinational companies to comply with adequate levels of transparency in their reporting (EC, 2014). Promoting transparency about the environmental effects at the company level and throughout the supply chain can stimulate responsible businesses to mitigate their impacts, improving their environmental performance and possibly increasing their market share. Transparency offers possibilities for non-government stakeholders, such as banks, investors and consumers, to react and interact with companies. The extent to which this is effective is still unknown, and more research is needed on the relationship between transparency and company performance (Maas and Vermeulen, 2015).

Include criteria for market standards in national policies for sustainable production

An alternative to establishing inclusive prices is government regulation to reduce the externalities of resource production (Hanemaaijer *et al.*, 2012). For international supply chains this is not easy, as the producing regions are not under the jurisdiction of consumer countries. In fact, the voluntary market standards have evolved to fill this institutional gap. Now that standards receive broad acceptance, producing countries increasingly take advantage of the standards for national regulation, to serve purposes such as

securing export possibilities to western markets. Several interesting examples exist of supply-side nations integrating criteria of voluntary standards into their policies and regulations (ISEAL Alliance, 2015a).

At the demand side, private standards can also be integrated into public policies. Regarding the use of biomass as an energy source on the EU market for example, statutory regulations have been formulated (EC, 2009) and several market standards have been accepted to verify compliance. Recently, the Corbey Commission established by the Dutch Government, advised to expand this approach to the entire agricultural and food sector (Dutch Sustainable Biomass Commission, 2014). The same strict EU criteria should apply to the import of all forms of biomass and all its uses, also to tackle the indirect effects of bio-energy production, leading to displacement of food crop production. To develop a sustainable market for food products the Corbey Commission proposed to increase trade tariffs on biomass that does not meet sustainability criteria, but it seems very unlikely that the EU will support such an initiative (Brack and Bailey, 2013).

Set a common bottom-line and offer support to producing countries
 Lastly, general minimum requirements for production can be formulated to create a level playing field for all. This step has already been taken in the EU FLEGT policy (Forest Law, Enforcement, Governance and Trade) which aims to guarantee legality of wood imports in the EU. Specific market standards have been developed to serve this common EU bottom line. The minimum requirements may also stimulate sustainable production, as the sustainability criteria for wood production overlap to a great extent with the criteria for legality. Early adopters on the EU market may decide to stick to using the full standard (PWC and IDH, 2012), but there is also a risk of others limiting themselves to adhering to the minimum standard in which the coverage of ecosystem goods and services is probably less extensive. The FLEGT policies also provide support for capacity building in supply-side countries, to stimulate national law making and law enforcement. Regionally developed market standards which are accepted by local stakeholders can help to shape general nation-wide regulations with a wider scope of application than trade flows to western markets.



Perspective 3: Expand

Expand sustainable production initiatives to higher spatial scales
 Sustainable resource production has advantages for people outside the production location through reduced environmental externalities. This study also shows that

the most significant benefits of certified production are obtained when deforestation is avoided. However, it is not always possible to capture the potential benefits of avoided deforestation through supply chain governance of traded commodities. The effectiveness of forest certification in reducing or ending deforestation has been questioned. The sphere of influence of individual supply chain actors and single-sector instruments is limited and therefore, governance arrangements are necessary that include several actors, sectors and spatial scales (see Figure 16). Though the direct influence of certified forest management on regional land-use dynamics at the concession level is not easy to assess (Auld et al., 2008), properly functioning governance systems have been identified as a prerequisite for successful certification (Cashore and Auld, 2012). So local governments have an important role to play in providing safeguards for conserving forest land, for instance by adopting national forest laws and developing land use planning instruments.

Possibilities to engage companies in ending deforestation

There is also room to engage companies more directly in reducing deforestation, such as compensation measures which offset company impacts on ecosystems. Paying for additional carbon storage in the form of reforestation is a way to mitigate company greenhouse gases. Compensation can also be offered for company impacts in the field of land use. Company awareness about land use is growing through company footprint assessments. However, there are doubts about the effectiveness of offsets, and concern has been expressed on greenwashing practices. Stricter conditions have been formulated for compensation schemes, in cases where they are the last option available in a series of mitigation measures (WBCSD, 201).

Building sustainable production landscapes which integrate ecosystem services that are of value for different stakeholders

In the last few years, a lot of interest has been attracted by the concept of sustainable production landscapes, in which sustainable land use is pursued at a higher spatial scale. The landscape approach aims to integrate the objectives of several stakeholders at the scale of landscapes or watersheds, which creates the need for Integrated Landscape Management (ILM). The appropriate spatial scales are determined by bio-physical flows and interactions between several landscape elements. The objectives are sustained economic and social development, combined with local biodiversity conservation. Integrated Landscape Management could lead to improved interactions between actors and sectors delivering solutions for multiple sectors (Horn and Meijer, 2015; Scherr and McNeely, 2008a).

The involvement of multiple stakeholders is required in the planning processes. However, aligning the objectives of several stakeholders and creating win-win situations is not easy with a landscape approach. In practice, landscape approaches are often driven and dominated by stakeholders from a single sustainability domain – people, the planet, or profit (Horn and Meijer, 2015). If a particular domain is not represented, the other domains run the risk of not reaching their objectives, and there is a high probability of trade-offs arising (Howe *et al.*, 2014). Another issue to be tackled in landscape approaches is the unequal distribution of costs and benefits. For instance, farmers who invest in biodiversity conservation often bear a disproportionately large share of the costs, while enjoying a much smaller share of the societal benefits. Reorganisation of local land use planning and new ways of distributing costs and benefits among stakeholders are required to achieve synergy across a range of actors and their objectives in an integrated way. The expertise of the Netherlands with regard to spatial planning can be used to support pilot projects and experimental studies.

Jurisdictional approach with a high level of government involvement
A related innovation is the tailoring of certification processes at the jurisdictional level. In jurisdictional sourcing, sustainability performance is approached from a geographical viewpoint, instead of certifying specific certified farms and plantations. It links certification to politically defined territories such as districts and provinces. Potential benefits of this approach are the inclusion of a large number of stakeholders, including smallholders, and the capturing of off-farm, watershed and avoided deforestation benefits. A good example of these jurisdictional initiatives is found in the palm oil producing region of Sabah in Southeast Asia, where the government has decided to set up a region-wide initiative to produce 100% certified palm oil (Borneo Post online, 2015; Rakyat Post, 2015). The jurisdictional approach has already been proposed for REDD+ initiatives (Meyer and Miller, 2015).

Note

- 1 This can for instance be done by assigning the IUCN categories V and VI to protected areas (Dudley 2008)

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Background studies

This study builds upon several detailed investigations which were commissioned to value ecosystem goods and services and assess their integration in international supply chain governance:

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