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Quantification of Companies' Demand for Ecosystem Services from Tropical Forestry

By
Sandro Glanzmann

Supervisors:
Dr. Thomas Köllner, ETH, Switzerland
Joachim Sell, ETH, Switzerland

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Abstract

Market mechanisms for ecosystem services provide attractive business options for market players. Additionally, they enhance the economic value of tropical forests. Also market approaches to ecosystem services may substantially foster the sustainable management of forestry projects. However, a major constraint for the establishing of markets is the lack of reliable and comparable economic value associated with ecosystem services. The goal of this thesis is to quantify the demand of companies for ecosystems services derived from tropical forestry in monetary terms. We considered the following ecosystem services: Biodiversity conservation, carbon sequestration, scenic beauty and watershed protection. Additionally, it is important to raise knowledge of the underlying motivations and constraints in the decision making process of market players for the future management of tropical forests. Motivations and constraints as well as the willingness to pay (WTP) of market players were elicited by a contingent valuation (CV) questionnaire. The survey was directed to companies from Australia, Canada, Europe, Japan and the USA. Participants represent 13 companies from different industry sectors including energy, health care, materials, utilities and consumer staples. The results of the study suggest that respondents are willing to pay annually 1.40 US$ per hectare tropical forest providing ecosystem services (7 US$/ha, if zero dollar answers were excluded) for biodiversity conservation, 24.40 US$/ha (46.80 US$/ha) for carbon sequestration, 1.27 US$/ha (7 US$/ha) for scenic beauty and 2.36 US$/ha (8.67 US$/ha) for watershed protection. For actual engagement with respect to ecosystem services from tropical forestry socio-environmental criteria were indicated as main motivations, but do not have relevance for WTP. In case of biodiversity conservation and scenic beauty, relationship between image benefits and WTP was observed and seemed to support the demand. Other important factors are the provision of a measurable commodity and a reliable trading framework.

Keywords: ecosystem services, tropical forestry, market players, motivations, contingent valuation, willingness to pay

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Glossary and Abbreviations

Biodiversity: The variety of all life forms (biological diversity). This is a function of diversity within a single species, between different species, and between ecosystems.

Bioprospecting: The search for commercially valuable biochemical compounds or genetic material in the wild.

Carbon Sequestration: A process that removes carbon dioxide from the atmosphere through the absorption and storage of carbon in vegetation or other matter.

Economic value: The monetary measure of the wellbeing associated with the change in the provision of some goods.

Ecosystem function: Biophysical process that takes place within an ecosystem.

Ecosystem goods: Biophysical elements that are directly or indirectly consumed by humans.

Ecosystem services: The outcomes from ecosystem functions that are to the benefit of human beings.

Externality: A product or action whose creation by one party affects the wellbeing of others without being reflected in market prices. Externalities can be negative or positive.

Property rights: An entitlement to use a particular good or service in a certain way. This entitlement may be restricted to specific aspects of the good or service.

Scenic Beauty: The general appearance of a place and the features of its views or landscape.

Stated preference technique: Technique to uncover the economic value attached to non-marketed goods and services by asking people what economic value they attach to those goods and services.

Total economic value: Total economic value of an environmental resource is made up of i) use values and ii) non-use values. Use values are composed of a) direct use value, b) indirect use values and c) option values, whilst non-use values are made up of a) existence values and b) bequest values.

Valuation: The process of estimating the willingness of individuals to sacrifice or pay to achieve some goal or outcome.

Abbreviations

CDM	Clean Development Mechanism
CER	Certified Emission Reductions
CM	Choice Modelling
CV	Contingent Valuation
CXX	Chicago Climate Exchange
ES	Ecosystem Services
EU ETS	European Union Emission Trading Scheme
FAO	Food and Agriculture Organisation of the United Nations
FONAFIFO	Fondo National de Financiamiento Forestal
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
NGO	Non-Governmental Organisation
TEV	Total Economic Value
WTA	Willingness to Accept
WTP	Willingness to Pay

1 Introduction

Forests are one of the predominant terrestrial ecosystems. The world's forest heritage cover an estimated 3'870 million hectares, which means 30% of earth's land area. Plantations make up only 5% of all forests, the rest is of primary and secondary forest. Tropical forests comprise 47% of world's forest, which equals an area of 1'820 million hectares (FAO, 2001). Forests are not only an abundant ecosystem but also an important one for many creatures including human being. It has been estimated that up to 50% of all species on earth depend on forest ecosystems (Brand, 2005). There is great uncertainty of numbers of people, who especially depend on forests. Estimates ranges from 1 million to over one billion (Byron et al., 1997). Much of the discrepancy can be explained by lack of a clear definition who these forest-dependent people are, and where they can be found. Some studies refer to the number of people who derive their entire existence from forests, others use the term "numbers of people practising shifting cultivation" (Byron et al., 1997). Due to the role as support system for biotic and abiotic processes probably anyone depend on forests. These figures emphasise that forests are of high importance in earth's ecosystems and play a significant role in the economic and social system. Forests are thus a critical global resource.

In the past decade forests came under pressure through increased human activity. Deforestation, afforestation and plantation lead to changes in forest coverage. Assessments have shown since many years that the area of the world's forests is shrinking. During the last ten years the global annual net change in forest area was -9.4 million ha whereas tropical forest lost an area of 12.3 million hectares annually (FAO, 2001). These findings show a substantial loss, particularly in the tropics. The causes of deforestation are many and complex and cannot be discussed here in detail. Nevertheless we will provide an overview over the main reasons. Nasi et al. (2002) outlines beyond the political factors five general development trends, which could be responsible for the forest loss:

a) *High population growth:* The population increase creates a strong demand for agricultural land and forest products. The consequence is that one major pathway will be to convert more forests to agricultural land.
b) *High and rising consumption levels:* Concurrent with the expanding population, economic advances will lead to increase in per capita consumption of natural resources and thus forest products.
c) *Trade:* The globalisation of trade and investment flows enables consumers in developed world to expand the use of paper, timber, energy etc., without suffering the environmental consequences of their expanding consumption levels.

d) *Specialisation and homogenisation:* In forest areas, the rapid and total conversion of forests into cash crops is an advancing phenomenon, fuelled by better transport access and expanding markets.

e) *Deficiencies in knowledge and in its applications:* Scientific knowledge about forest services lags behind the increasing capacity of humankind to change and convert forests. Even where scientific or traditional knowledge exists, it does not flow efficiently to decision-makers.

All these factors lead to unsustainable use of forest ecosystems. In response to uncontrolled clearing of forests and to stop this negative trend, a new field of sustainable forestry has emerged that seeks to work with the natural complexity of forest ecosystems to derive and profit from the full range of goods and services forests provide, including not only wood but biodiversity conservation, carbon sequestration, scenic beauty and watershed protection.

2 Ecosystem services

In this chapter, the concept of ecosystem goods and services is explained. Furthermore the four ecosystem services biodiversity conservation, carbon sequestration, scenic beauty and watershed protection which are prioritised in the thesis are introduced.

Natural ecosystems provide a range of ecosystem services and goods that benefit humankind. These goods and services can be extractive like food and timber and non-extractive services like carbon sequestration, watershed and recreation services. The quantity and quality of these goods and services depend on the wealth of ecosystems providing the services. When the components that contribute to the availability of ecosystem services are damaged or altered, human welfare may suffer. A critical factor is the maintenance of adequate stocks of environmental resources to ensure an adequate flow of ecosystem services (Batabyal et al., 2003). Some goods and services from natural ecosystems cannot be produced simultaneously at a single location. For example cutting down trees at one time and place releases sequestered carbon, which may alter the climate system. The negative impacts would have consequences on global scale.

Environmental systems are complex in structures and processes. In order to reduce this complexity De Groot et al. (2002) associated the environmental systems into a more limited number of ecosystem functions. These ecosystem functions represent a subset of ecological processes and ecosystem structures. Each function is the result of the natural processes (biotic and abiotic) of the ecological subsystem of which it is a part. Therefore ecosystem functions provide the ecosystem goods and services, which are valued by humans. For example through water purification processes of forests, the ecosystem function of water supply assures the provision of water for consumptive use, which is the ecosystem service.

Table 2-1: Classification of ecosystem services from tropical forestry including a few examples.

Ecosystem services		
Provisioning services	Regulating services	Cultural services
• Timber • Food • Biodiversity conservation	• Carbon sequestration • Watershed protection	• Scenic beauty • Social relations

Source: Adapted from Millennium Ecosystem Assessment, 2005

In table 2-1 the main categories of ecosystem services based on the Millennium Ecosystem Assessment (2005) are presented. It also contains a variety of examples for ecosystem goods and services. Ecosystem goods and services, subsequently we use only the term ecosystem services, are defined as the benefits people obtain from ecosystems. In this thesis we focus on the four ecosystem services biodiversity conservation, carbon sequestration, scenic beauty and watershed protection.

2.1 Biodiversity conservation

Biodiversity is currently an important issue and the loss of biodiversity is increasingly seen as a problem. The conservation or sustainable use of biological diversity presents challenges for decision-makers because of its complex nature. Therefore it is important to clarify what we mean by biodiversity. The Convention on Biological Diversity (Article 2) defines biodiversity as: "...the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". According to this definition, biodiversity can be measured at different levels: genetic, species and ecosystems. However, measuring biodiversity under each category is not always straightforward. Because of this uncertainty of what is the appropriate method it still does not exist an universally accepted classification of different ecosystems (Nasi et al, 2002). This fact makes it difficult to arrive a common unit for biodiversity and as a result a variety of different commodities is used in emerging markets, from protected areas, to biodiversity credits and bioprospecting rights.

Biodiversity is integral to sustainable ecosystem function and vital for the availability of ecosystem services. Biodiversity influences energy and material fluxes directly or may alter abiotic conditions that regulate ecosystem processes. Besides the contribution to current functioning of ecosystem, biodiversity influences the resilience and resistance of ecosystems (Chapin et al., 2000). Pearce (2001) mentioned that the essence of the value of diversity is that it embodies the value of information and insurance. Biodiversity provides a valuable stock of genetic and chemical information that keep options open for future use. The insurance value is derived from greater resilience of diverse environment (portfolio effect) to external shocks (e.g. flood control, storm protection, CO_2/O_2 stabilisation). Pest and disease control functions can in a wider sense also be counted under the insurance value.

A variety of different parties are interested in this ecosystem service. The market was traditionally dominated by the public sector. But on the demand side an increasing Involvement of

international NGO's and private corporations is observed (Landell-Mills and Porras, 2002). Biodiversity is of high importance for research as well as for the pharmaceutical, the seed and the crop industry. These sectors are searching and testing biochemical compounds or genetic material, which can lead to the development of commercial products (Bioprospecting). Biodiversity includes also cultural, aesthetic and spiritual values.

The ecosystem service biodiversity is valued by local as well as by global communities. In the FAO study (1997) it is shown that the deconstruction of biodiversity increases the net poverty of rural and indigenous people, the majority of which depend on biodiversity as a source of food and traditional medicines. Biodiversity loss or invasive species has caused negative economic impact all over the world due to, for example, flooding events because of less absorption capacity of deforested forest ecosystem from Central America to Bangladesh (Barrington, 2001).

2.2 Carbon sequestration

Trees and forests store carbon. By means of the photosynthesis process plants and trees remove carbon dioxide from the atmosphere and incorporates it into organic material. Carbon sequestration refers to the provision of long-term storage of carbon in the biosphere, the underground or the oceans so that the build-up of carbon dioxide in the atmosphere will reduce or slow. But carbon stored in forests is at continuous risk of being released into the atmosphere, for example by a forest fire or a storm. In other words, the removal of carbon into biomass is of temporary nature. Beside the non-permanence, a second field of uncertainty regarding afforestation and reforestation projects can be outlined. The Intergovernmental Panel on Climate Change (IPCC) stated concerns about the environmental and socio-economic impacts of afforestation and reforestation projects. Concerns exist about possible negative impacts on biodiversity and natural ecosystems as well as on social issues such as local or indigenous communities, land tenure and local employment due to implementation of the projects (Caparros, 2003). Facing these problems project participants are requested to submit documentation on the analysis of these impacts.

The International Panel on Climate Change (IPCC) estimates that the global mean temperature of the earth's surface has increased by 0.3 to 0.6°C over the past 100 years (IPCC, 2000). Predictions are that global warming will cause significant variations in climatic patterns over the next century. That may have negative impacts on regional and global biomes. By removing the greenhouse gas (GHG) carbon dioxide from the atmosphere, carbon sequestration plays a significant role in regulating the global climate system. The carbon sequester potential differs between different

forest types and species. Typical sequestration rates are between 4-60 tonnes of carbon dioxide per hectare per year (Ziltener, 2005). It has been suggested that the terrestrial biosphere could be managed over the next 50 years to conserve or sequester 60 to 87 Gt of carbon in forests (FAO, 2001).

Carbon sequestration can be traded by means of Certified Emission Reductions (CERs) within the Clean Development Mechanism (CDM) of the Kyoto Protocol. But the forestry activities under the CDM are restricted to afforestation and reforestation. The FAO report "a review of carbon sequestration projects" (2004) summarises a few projects, which were already realised. The Kyoto Protocol provides a framework for trading emission rights. Beside this international framework a few other markets were developed such as the Emission Trading Scheme of the European Union with a market prize between 20 € to 30 € in 2005 or the Chicago Climate Exchange with market prize between 1.4 $ to 2.4 $ (2005, http://www.ecosystemmarketplace.com). Furthermore it is to observe that the private sector is increasingly involved in the market (Landell-Mills and Porras, 2002).

Because of the role in reducing the greenhouse gas carbon dioxide and therefore its function in regulation of the climate system the ecosystem service carbon sequestration is valued by global communities.

2.3 Scenic beauty

Derived from the definition from Galliano et al. (2000), Scenic beauty can be defined as the general appearance of a place and the features of its views or landscape – the natural scenery, which affording beautiful views. For centuries people have been realised the benefits of scenic beauty to society. But for a long time research, scenic beauty was a field of social science and landscape architects. Situation changed as efforts to assess the monetary value of ecosystem services showed the economic value of scenic beauty (for an overview see Krieger, 2001). Because of the growing demand of people for recreational opportunities in the nature (ecotourism), scenic beauty is of high importance for tourism industry.

Scenic beauty is important for human well-being and has a positive influence to physical and psychological performance (Driver at al, 1992). Natural ecosystems have important value as a place where people can come for rest, relaxation, refreshment and recreation (De Groot et al., 2002). Furthermore this ecosystem service provides a range of cultural services. Nature is used as a motive and source of inspiration for art such as literature, photography, paintings and music. Scenic

beauty has also a function in cultural identity and personal use. It provides a sense of continuity and understanding of our place in the universe, which is expressed through the spiritual value (De Groot et al., 2002).

As mentioned above nature offer and support recreational activities and ecotourism. According to the International Ecotourism Society ecotourism is one of the fastest growing sector in the world with annual growth rates of 10% to 30% (Ecotourism Statistical Fact Sheet, 2000). The ecosystem service is mostly paid by charging visitors for the access to scenic beauty. Entrance fees for scenic natural destinations offer one possible mechanism of financing scenic beauty. Costa Rica for example charged entrance fees for all national parks with 6$ for foreign tourists and 1.25$ for national residents during 1999 (Hearne, 2002). While traditionally governments have been the main caretakers of scenic beauty through the creation of protected areas, participation of the private sector is increasing (Landell-Mills and Porras, 2002). This is a result of expanding demand and increasing charges in governmental protected areas, which allow the private sector to compete.

Scenic beauty has local and national associated values. On the one hand, local communities profit from the positive influence of scenic beauty on their health. On the other hand, protection of natural areas refer to values that are captured beyond local users.

2.4 Watershed protection

The term watershed describes an area of land that drains downslope to the lowest point. According to this, watershed protection can be defined as the conservation of that area, so that all processes can be performed in ways that maintaining local and downstream environmental conditions. Watershed protection includes a range of services such as the provision of filter functions for water, regulation of water flow and prevention of erosion. The knowledge of scientific interrelation between these factors is poor. The World Resource Institute writes in the report on forest ecosystem (2000): “The relationships between forest cover, forest type, and hydrological regimes are still inadequately understood”. A second problem is that studies focus on single attributes of the protective functions rather than the totality of protection functions (Pearce, 2001). Due to this lack of a scientific basis it is difficult to develop markets. Further problem for market development is the variety of services, which are included in the ecosystem service watershed protection. For defining a commodity it is essential to make it clear, which service is being demanded by users of watershed services. By now many different commodities for different services exist (for an overview see Landell-Mills and Porras, 2002).

Watershed protection is important for good water quality due to purification processes and the prevention of erosion. This ecosystem service controls the nutrient, chemical, salinity and sediment load of waters. Watershed protection is associated with water flow regulation. For example forests regulate the volume and periodicity of water flow by soaking up the rainfall and releasing it in a controlled and regular way. A regular distribution of water along the surface is quite essential since it prevents dry seasons as well as flood events.

This ecosystem service is important for rural, urban, as well as for industrial and agricultural use. A common market scheme is that upstream landowners receive payments from downstream water consumers for protecting their land. Watershed markets are characterised by high levels of cooperation because of watershed protection services cannot be easily parcelled out to buyers. Private individuals and corporations account for 60% of buyers and over 65% of the sellers (Landell-Mills, 2002). Whereas sellers are often individual landowners, buyers are a quite heterogeneous group, from hydroelectric power plants over users of irrigated water to fishery industry.

These services cannot be quantified at a global level. Information on watershed conditions is most relevant at the basin, subbasin, and site-specific level, thus watershed protection are valued by local communities.

3 Markets for ecosystem services

Forest goods and services benefit both local and global societies, but not all forest uses generate financial returns that reflect the „true economic value“ (Landell-Mills and Porras, 2002). This occurs because the vast majority of ecosystem services are not traded in markets and have no explicit price (Landell-Mills and Porras, 2002). In the following section the issue of market failure and creation for forest ecosystem services is outlined. Firstly, it is explained why ecosystem services are normally external to the market system. Furthermore the impacts of the absence of markets for ecosystem services are explained. In the last part, it is outlined what can be done for the absence of markets for ecosystem services, that is to say, how markets for these services can be created.

3.1 Why markets for ecosystem services fail

Ecosystem services from forests, such as biodiversity conservation, carbon sequestration, watershed protection and scenic beauty can normally not be bought and sold on a market (Landell-Mills and Porras, 2002). The main reason is, that these services provided by forests are positive externalities or public goods. „In economic terms, environmental benefits are referred to as externalities, or products external to the market system“ (Wenming, 2002). A positive externality is an uncompensated benefit. Facing forests, positive externalities may be erosion control, reduced risk of flooding downstream or water quality maintenance. The reason why markets fail to compensate those who produce positive externalities is because of the absence of legal rights or other legal means (Landell-Mills and Porras, 2002). Ecosystem services from forests can also be defined as public goods, which are a special type of positive externalities. Their characteristics are their non-excludability and non-rivalry. That means that no consumer can be excluded from enjoying the good or service and that the consumption of a good or service by one individual does not reduce the amount available to others (Landell-Mills and Porras, 2002). Facing economic theory, there is a clear cut between public goods and private goods. Paul Samuelson (1954) said that „the defining characteristic of a public good is that the same units of the good are consumed by, or give utility to, more than one individual“ (Sugden, 1999). This presence of externalities matters because it can lead to what is known as market failure (Murtough et al., 2002). Arrow 1970 said, that „an externality occurs because there is no market for something that people care about“(Murtough et al. 2002). There are a couple of reasons why markets don’t exist. If one ore more of the following factors applies there exists a high possibility for a market to fail. First, if the transaction costs are too high. Second, if there exists a high uncertainty about the attributes of a good or service. Third, if there occurs asymmetric information, for example if the seller is much

better informed than the buyer. Fourth, if there exists only a few buyers and/or sellers. Fifth, if ownership cannot be defined and enforced, or it is very costly to do (Murtough et al., 2002).

3.2 Why the failure of markets for ecosystem services matters

What are the consequences of the absence of markets for public goods such as ecosystem services provided by tropical forests? The absence of markets for forest ecosystem services means that ‚producers' of forest ecosystem services normally don't get paid, and ‚consumers' are rarely asked to pay (Landel-Mills, 2002). Therefore, the lack of payment for these ecosystem services results in under-investment in protection, management and establishment of forests (Landell-Mills and Porras, 2002). Therefore, forestal landowners or actors don't have incentives to protect and sustainable manage their forests.

3.3 What can be done against the absence of markets

The problems, which arise from the absence of a market for public goods can be remedied by governmental intervention (Murtough et al., 2002). This means that the government takes responsibility for the provision of these goods and services (Landell-Mills and Porras, 2002). The government does this in form of regulation and/or market-based approaches (Murtough et al., 2002). In the following, only market-based approaches are going to be outlined. „Market-based approaches change financial incentives in favour of the supply of ecosystem services" (Murtough et al., 2002).

3.3.1 Taxes and subsidies

The idea of taxes and subsidies is to change the incentives of market players, so that they reflect the costs and benefits to society of certain actions. A present example is taxes on carbon dioxide emissions in Switzerland. These taxes can be imposed so that emitters bear the cost of any climate change they cause. On the other hand, subsidies for GHG could reward market players for their contribution to stop climate change. The advantage of this approach is, that at a certain point in time, parties will be willing to provide an ecosystem service. This happens because at that point, it is more cost effective to provide the good or service than paying the taxes that would otherwise be incurred (Murtough et al., 2002).

3.3.2 Market creation

The core idea of the described form of governmental intervention is to clearly define property rights. Through this approach externalities can be removed (Murthough et al., 2002). Examples for this kind of policy are tradable permits for carbon emissions and sequestration. The core of this approach is to transfer a non-excludable ecosystem service into something that is excludable and therefore, can be traded in a market (Murthough et al., 2002). This transformation is done in the following manner. One has to define a new commodity that is excludable and therefore a proxy for a non-excludable ecosystem service. Furthermore, a market is generated for this proxy commodity, which means, that effectively a market is created for the corresponding ecosystem service. The proxy commodity is defined by constructing a new property right such as Carbon Certificates (Murthough et al., 2002). There exists four different forms of market creation, which are characterized whether the property right is tradable and if it involves an offset arrangement (Murthough et al., 2002). A tradable property right is characterized, that it can be bought by one party and sold to another one. On the other hand, a non-tradable property right cannot be exchanged more than once. An offset arrangement means, that one party can undertake an action that reduces ecosystem services if it also undertakes action that increases ecosystem services by at least the same amount. Under a non-offset arrangement these conditions don't exist (Murthough et al., 2002).

Examples according to Murthough et al. (2002):

- **Non-tradable and no offsets:** This situation is found in an auction, where farmers compete to receive biodiversity conservation grants for maintaining native vegetation on their land. The farmer who offers the most ecosystem services per dollar receives the grant.
- **Non-tradable and offsets:** This situation is found, when a firm increases emissions from one factory, but reduces them by at least the same amount at another factory.
- **Tradable and no offsets:** This situation is found when tradable permits to emit carbon dioxide are launched.
- **Tradable and offsets:** This situation is found, when one firm increases its carbon emissions and pays another party (via a broker) to sequester at least as much carbon in a forest plantation.

In sum, it can be said that motivations of development for ecosystem services can be split in two groups. On the one hand, those who increase demand for ecosystem services and on the other

hand, those who increase investment and supply of these services. For the success of a market it is necessary that increased demand should raise rivalry while supply side advances should increase excludability. In summary, these factors transform a public environmental good or service into a private good (Landell-Mills and Porras, 2002).

The first step to transform public goods or services into private ones is to attribute them an economic value. Because these goods and services don't have an access to markets yet, it is necessary to rival market values indirectly, to establish the value of a non-marketed good or service (de Groot, 2002). This valuation mechanism is outlined in the following section.

4 Methods for valuing nature

While „valuing the environment“, one has to note that valuing means different things to people, depending on their individual worldview. In this thesis the focus is set only on the economists view (Turner, 1999).

In this section the issue about valuing the nature and its non-marketed goods and services is outlined. The aim of the first part is to give a brief overview about the term of valuing the nature and their ecosystem services. In the second part, the Contingent Valuation Method is explained. This stated preference technique is the core method of this thesis to reach the empirical data set needed to testing the hypothesis outlined in section 6.2.

4.1 Valuing the nature

„In economics, a good or service is valuable if it increases human well-being. This implies that goods and services have no value in their own right. Rather, their value is defined only in the context of human welfare“ (Krieger, 2001).

Costanza et al. (1997) estimated the value of the entire biosphere to be in the range of US $ 16-54 trillion per year, with an average of US$ 33 trillion per year (Costanza et al., 1997). The estimate of the total value of forest ecosystem goods and services is set on US$4.7 trillion annually (Costanza et al. 1997). This means that, if one would try to replace all the services from ecosystems, one would need to increase global GNP by at least US$ 33 trillion per year, facing the global arithmetic. But because ecosystem services are largely outside the market and uncertain, they are too often ignored or undervalued. Therefore, these estimates give an idea of the importance of ecosystem services (Costanza et al., 1997).

The revealed preference technique evaluates the economic value by seeing if the goods or services influence actual markets for some other goods (Bateman et al. 2002). There are a variety of valuation methods to establish the value of a non-marketed good, due to the revealed preference technique (de Groot, 2002). To find out the value of a service de Groot et al. (2002) mentioned the following methods:

- **Avoided Cost**: When a service avoids cost to the society, this can be measured by this method. For example flood control and waste treatment by wetlands, which avoid property damages and health costs.
- **Replacement Cost:** This method is used when services could be replaced with human-made systems. For example, natural waste treatment by marches, which partly can be replaced with costly artificial treatment systems.
- **Factor Income:** When an ecosystem services increases individual's income, this method can be used. For example, if water quality is improved, commercial fisheries are increasing and thereby the income of fishermen.
- **Travel Cost:** A commonly method to estimate the value of non-marketed goods relies on travel expenditures when visiting a site. This method relies on site-specific resources, that necessitates travel costs to experience the site providing the environmental service (Krieger, 2001). When using this method, the value of an environmental service must be at least what an individual is willing to pay to travel to the site.
- **Hedonic Pricing:** This approach applies to situations where the price of marketed goods (for examples a house) relates to an ecosystem service. Therefore, if a homebuyer is aware of ecosystem services, housing prices in good air quality areas should be higher than in urban areas (Krieger, 2001).

The stated preference techniques evaluates the economic value by asking people what economic value they give to a specific good or service (Bateman et al., 2002). The most frequently used methods of the stated preference technique are Choice Modelling (CM) and Contingent Valuation (CV) (Bateman et al., 2002). In the following, the focus is set only on the stated preference technique.

4.1.1 Eliciting willingness to pay

The term stated preference technique is used for any technique, which has the aim of eliciting individuals' motivations. Therefore, we are interested in techniques, which, directly or indirectly, elicit individuals' money valuations of costs and benefits of non-marketed goods (Bateman et al., 2002).

This can be reached through two different forms of asking questions. Either it can be reached through the willingness to pay or the willingness to accept compensation approach question. Whether WTP or WTA is the appropriate measure depends on the property right to the good. WTA

is taken, if the consumer already has a legal entitlement to the good and is asked to give it up. WTP is taken, if the consumer does not have a legal entitlement to the good and therefore, is asked how much he is willing to pay for it (Carson, 2000).

In this study consumers don't have any legal entitlement to the ecosystem services yet. Therefore, the focus is set on the willingness to pay technique only. Therefore, what is of interest is how much an individual is willing to pay for a described change in the provision of a good (Hausman, 1996). In other words, the willingness to pay if the individual prefers the change to the status quo of the provided good or services (Bateman et al., 2002).

The interesting point is now to find out how estimates of individuals WTP are made. Generally, the estimated willingness to pay for an environmental good depends on motives (Bateman and Willis, 1999). These motives are described in the following section.

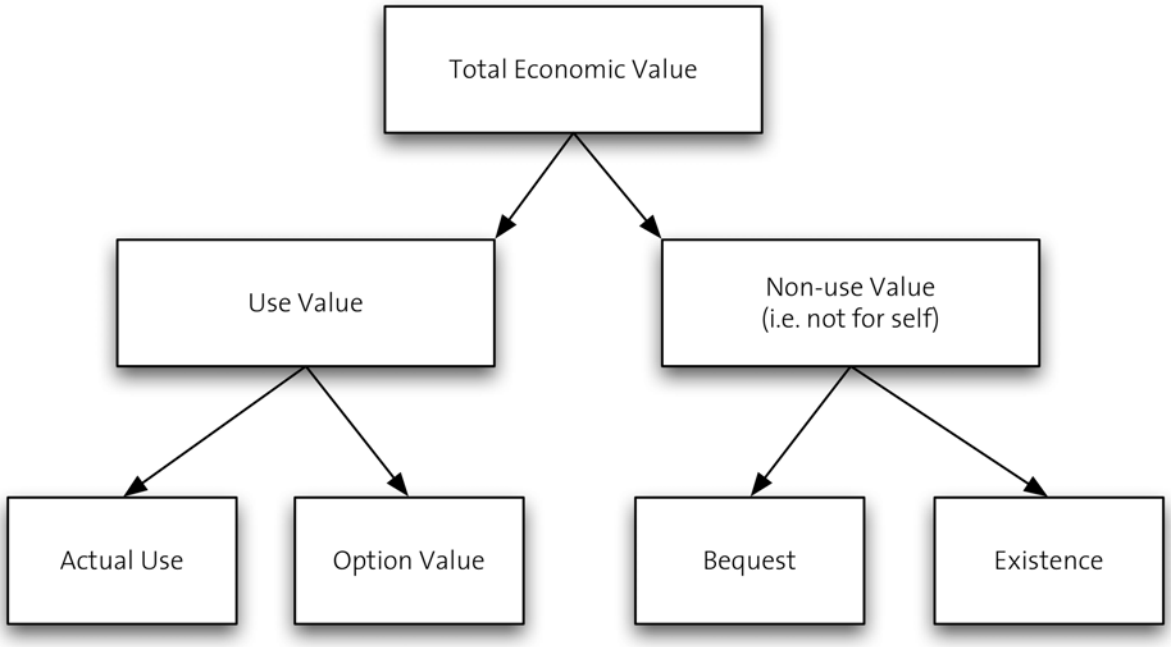
4.1.2 Total economic value

The term „valuing the environment" is referred to the total economic value (TEV) (Turner, 1999). The total economic value is defined through the sum of all the WTPs and WTAs of any changes in wellbeing due to a policy or project (Bateman et al., 2002). Normally the total economic value is divided in use and non-use values (Bateman et al., 2002*).*

The use value refers to the actual use of a good. It can also relate to the intended use or the possible use of a good. Examples for an actual and planned use value are, a visit to a national park or a planned visit in the future. The possible use of a good refers to the fact, that people want to maintain a good in existence in order to preserve the option of using it in the future (Bateman et al., 2002).

The non-use value refers to the willingness to pay for a good, to maintain it in existence even though there is no actual, planned or possible use (Bateman et al., 2002). There exist several classifications of non-use values. A convenient one is in terms of existence value and bequest value, as mentioned in figure 4-1. The existence value refers to a good, which has no actual or planned use value to the individual or for anyone else. But the individual is willing to pay to maintain this good in existence. Motivations for this could be various. For example, one can just feel responsible to keep this good in existence (Bateman et al., 2002). The bequest value refers to the concern of an individual, that the good should be available to others in next and future generations (Bateman et al., 2002).

Figure 4-1: The total economic value.



Source: Batemann, 2002

As mentioned above, in this thesis we focus only on stated preference techniques. Stated preference technique is suited to eliciting all kinds of use values shown in figure 4-1 (Bateman et al., 2002). Next step is to decide which economic valuation technique to use. The main choice, when using stated preference technique is between choice modelling (CM) and contingent valuation (CV) (Bateman et al., 2002). In this thesis, the focus is set on the contingent valuation method to value the ecosystem services. This decision has been made because the gain of this study is to measure the total willingness to pay for the ecosystem services. CM would have been taken if WTP for individual attributes were required (Bateman et al., 2002).

4.2 Contingent valuation method

In this chapter, the contingent valuation method is briefly outlined. The aim is to give an overview of the method and its development. In this chapter only general comments of the method are made. Any information directly related to the conducted questionnaire is given in section 7.

The Contingent Valuation method relies on hypothetical questions (Hausman, 1996). The goal is to find out individuals' willingness to pay (WTP) or willingness to accept (WTA) for changes in some environmental amenity (Hanemann, 1999). The key element of the contingent valuation method is a properly designed questionnaire (Bateman et al., 2002). Therefore, CVM is a survey-based method to quantify the benefits of non-marketed ecosystem services and attributes. Through this method ecosystem services and attributes can be entered directly into cost-benefit calculation (Bateman and Wills, 1999).

4.2.1 Brief description of contingent valuation method

„Contingent valuation (CV) is a survey-based technique for eliciting preferences for non-marketed goods, such as environmental amenities, in a form which allows one to estimate how survey respondents trade-off private consumption for a non-marketed good in monetary terms" (Carson, 1998). Therefore, the goal of a contingent valuation survey, is to obtain a valid economic value of environmental goods or services (Mitchell, 2002). Normally, this economic value is elicited through a willingness to pay or willingness to accept question. This kind of approach is most commonly used for giving non-marketed environmental resources a monetary value. In recent studies researchers have valued improving water quality, restoring wetlands, preventing oil spills, preserving natural areas, and reducing health risks. In developing countries the research subjects were principally basic public services such as water delivery an waste removal (Carson, 1998).

The contingent valuation method differs substantially from other survey methods (Mitchell, 2002). The most important difference lies in the core of the survey. The core is in form of a „scenario". This scenario is in form of a narrative and provides the consumer with all the information needed. It describes the ecosystem service to be valued, how it will be provided and paid for, and the need for the respondent to make his decision (Mitchell, 2002). The constructed scenario consists of a hypothetical market and payment vehicle for the ecosystem services (Carson, 2000). The exact survey design is explained in section 4.2.3.

4.2.2 Development of the method

The roots of contingent valuation are dated back to an US study conducted in 1958. During the 1960s CV studies were released only sporadically and exclusively in the US. This didn't change substantially during the 1970s. However, by the end of the 1970s, the CV method was given official recognition by the US Water Resources Council as a recommended valuation technique (Bateman and Willis, 1999). It was during the 1980s when the number of conducted CV studies exploded in the US. But also in Europe the method began to establish. During this period also the first study in a developing country was applied (Bateman and Willis, 1999). The increasing academicals and institutional interest made the CV method one of the leading techniques for the valuation of non-market environmental costs and benefits (Bateman and Willis, 1999). The most important and best-known survey study was the one about the Exxon Valdez oil spill. In March 1989 the oil tanker Exxon Valdez ran ground in Prince William Sound, Alaska. In this disaster, about 258,000 barrels of crude oil were released in to see (Hausmann et al., 1996). As a consequence, the polluted had the potential to lower the use value to receptionists such as fishermen, kayakers, hikers and hunters (Hausmann et al., 1996). A governmental funded group of researchers were engaged in valuing the damages from the injuries to natural resources caused by the oil spill. This was the turning point facing the acceptance of the contingent valuation method (Mitchell, 2002). At the present, institutional acceptance is already high in the US and steadily expanding in Europe (Bateman and Willis, 1999). However, arguments over the contingent valuation method have not ended and doubters are not mute.

4.2.3 Survey design

The main problem while conducting a CV study is the construction of a high quality questionnaire. The challenge is to design the survey in a way, that enough information is provided to the participant to make an informed decision. On the other hand, not too many information must be given, to not confuse the participant (Carson, 2002).

A good contingent valuation survey normally consist of 1) an introduction, where the general context is outlined. 2) In this section the description of the good which is to be valued is explained to the participant. 3) Then the institutional setting in which the good will be provided is outlined (Carson, 2002). This section is also called the „Scenario" and here the constructed market is explained (Bateman et al., 2002). 4) In the next part of the CV questionnaire the manner in which the good will be paid for is described. This part is called the „payment scenario" and normally it is provided together with the market scenario (Carson, 2002, Bateman et al., 2002). 5) In this section

the monetary values are elicited. In this part respondents are asked questions about how much they would value the good under the specific terms and conditions. Here normally the willingness to pay questions are asked (Bateman et al., 2002). In a further section 6) debriefing questions are asked. They are important to find out why the respondents answered the questions the way they did (Carson, 2002). In a last section 7) a further set of questions is asked. These questions are to find out respondents characteristics such as age, education, job and income. These answers are important for the analysis of the WTP and how this varies between different socio-economic and demographic groups (Bateman et al., 2002).

In sum, Carson (1998) outlined three essential conditions to conduct a good CV questionnaire: First, the non-marketed good must be very well defined. Second, the scenario must provide a plausible means of provision. Third, there must exist a plausible mechanism for making the trade-off between the consumption of private goods and the non-marketed good of interest (Carson, 1998).

5 Niche of the study

Up to now, contingent valuation studies where willingness to pay is asked for ecosystem services are very onesided. In previous studies the focus was set on one ecosystem service predominantly. Furthermore, there is a lack of studies involving companies' view and their motivations such as possible market prices of the different services. The existing studies are focused on the public view predominantly. A set of conducted contingent valuation studies eliciting willingness to pay of the public for a specific ecosystem service or a bundle of services are the followings: Biodiversity: Stanley 2002, Garber-Yonts et al. 2004, Carbon Sequestration: Alavalapati et al. 2004, Watershed Management: Alavalapati et al. 2004, Casey et al. 2005, Wilson and Carpenter 1999, Loomis et al 2000, Scenic Beauty: Fanariotu and Skuras 2002, Loomis et al. 2000.

Market approaches to ecosystems services may substantially foster the sustainable management of different types of forestry projects. But at the time, most transaction involving ecosystem services are still based on bi- or multilateral projects (Landell-Mills, 2002). Experts believe that markets for the four ecosystem services are likely to grow in the coming years (Castro et al., 2000, Keipi, 2002, Landell-Mills, 2002). Markets for biodiversity and scenic beauty are still dominated by the public sector whereas markets for carbon and watershed private sector involvement are still growing (Landell-Mills, 2002). Markets evolve in response to actions by economic agents who have their own objectives. The most significant factor driving demand has been increased public recognition of the role played by ecosystem services, keeping future options open and insuring against unexpected shocks or negative impacts. Therefore even companies that are not directly associated with ecosystem services have been expressed their desire to invest in ecosystem services to improve public relations (Landell-Mills, 2002). However, companies are the main players in the economic system and tough it is important that they get involved in developing markets for ecosystem services. But how can larger private investment capital be attracted? Will the investment community be open to the efforts of emerging markets?

Reliable and comparable economic values associated with ecosystems are still missing. Because of the central role of companies, it is highly important to investigate the basic requirements and motivations of market players and involved stakeholders. That is to say, that an overall study of companies' motivations and interests is highly essential regarding the future of market development for ecosystem services.

6 Research objectives and hypotheses

6.1 Goal of the thesis

The goal of this thesis is to quantify the demand of companies for ecosystem services derived from tropical forestry. One core task is to monetarize the four ecosystem services, which is done by eliciting specific willingness to pay. With the investigated amount of willingness to pay, we would like to give a first approximation of a market price for each ecosystem service. Further we intend to analyse and articulate knowledge on motivations and constraints of demand side market players regarding an investment in ecosystem services. We want elicit the criteria relevant for decision-making and determine their importance weights.

6.2 Hypotheses

Derived from these overall goals, we intend to analyse the following hypotheses:

H1: Companies with sustainability reporting are willing to pay more than companies without sustainability reporting

H2: The demand will be higher the more comprehensible (e.g. legal frame, measurability) a service is defined

H3: Image reasons are the most important motivation to pay for ecosystem services derived from tropical forestry projects

H4: The support of the different ecosystem services are motivated by different reasons

H5: The highest WTP is set on carbon sequestration, followed by biodiversity conservation, watershed protection and finally scenic beauty.

7 Method

For quantifying the demand of companies by posing specific willingness to pay questions as well as to elicit motivations and constraints of an investment in ecosystem services, Contingent Valuation is the appropriate method. The following chapter describes the design of the study.

7.1 The sample

The target group of the survey are the 1550 international Companies of the MSCI world. Out of these companies five groups are selected due to the companies' operations sectors. We choose the following sectors to be of interest for our survey: Energy, Financials, Health Care, Materials and Utilities. Furthermore we decided to restrict the survey in a first step on companies whose headquarter is located in Europe or the United States of America. From the resulting list of 440 market players, known as the sample frame group, the sample would be drawn. The allocation target was to select 60 companies out of each sector. This was done with simple random sampling in which every element of the sample frame is given an equal chance of being selected. The selection procedure involved the use of a computer-generated list of random numbers, then, where necessary, 60 companies were extracted. Table 7-1 provides an overview of the resulting sample.

Table 7-1: The sample of the survey.

Sector	MSCI Sector Size	Sample
Energy	35	35
Financials	194	60
Health Care	83	60
Materials	74	60
Utilities	54	54
Total	440	269

In a second step an additional 120 companies located in Australia, Canada, Japan and New Zeeland were asked to participate in the survey. In a third step the questionnaire was sent to 450 companies of other sectors, but these are mainly used for a forthcoming paper publication. The completed questionnaires, which have been sent back before the end of the statistical analysis, were included.

7.2 The survey method

The choice of the appropriate survey method depends on several factors such as cost, time necessary to collect the data, quantity of the data or the degree of complexity. Because the master thesis is timely limited to six month we were forced to restrict the time for realizing the questionnaire on four weeks. This is a relatively short time period for launching telephone interviews because the time required on average for an interview was thought to be two hours. This would have been led to only maximal 80 possible interviews in four weeks. This means that only 30% of the sample could be interrogated. Therefore the quantity of the sample was the second reason due to that we decide to conduct an e-mail survey. The questionnaire was sent to the sample of respondents by e-mail. Respondents then completed the questionnaire themselves and sent them back to us. The questionnaire could be filled in directly on the computer.

7.3 The questionnaire

The questionnaire must be consistent with the chosen data collection method. This means in the case of e-mail survey, that the questionnaire's structure has to be clear and the wording comprehensible and as precise as possible because respondents have no possibility to query to avoid misunderstandings. Writing unbiased questions, which respondents can understand and answer is of high importance. This requires an iterative development and critical review of the questionnaire.

Translating the information needed to answer the research issue in a clear manner is not the only challenge. The questionnaire should also be adopted to the target group. As we survey market players, we decide to design the questionnaire as short as possible because respondents probably do have little time. The time required for filling in was estimated to be half an hour.

The questionnaire starts with an introductory section in which we described the general topic and the goals of the survey. Further we provided information of the benefit participants receive, and organisational details such as the deadline for the completion, the time required and the e-mail destination for sending back the questionnaire. The goal of this part was besides giving background information on the study to motivate the addressed persons to participate in the survey.

The design of the real questionnaire comprises five stages. The first stage consists of the structure of the questionnaire and hints for its completion. The following part contains brief description of

terms related to forestry and ecosystem services used in the questionnaire. Subsequently, we asked for the relevancy of forest types and ecosystem services for the company. Afterwards the valuation scenario is presented. The fourth stage is the question part. In this section we posed the willingness to pay questions for the provision of each of the four ecosystem services. Then follow up questions about the motivations and constraints regarding an investment in ecosystem services from topical forestry are added. In order to compare answers from different participants stage five asked about further information about the company as well as about the respondent.

Table 7-2: Stages of the questionnaire.

First stage: • Structure of the questionnaire • Hints for the completion
Second stage: • Forestry types description • Ecosystem services description • Relevancy of forestry types and ecosystem services
Third stage: • Valuation scenario • Description of the constructed market

Fourth stage:
• WTP-questions
• Follow up questions:
  • Motivations
  • Constraints
  • Framework conditions
  • External Factors

Fifth stage: • Company information • Personal information

7.3.1 Key expressions

In the second stage of the questionnaire we described the different forest types and the four ecosystem services, which were used in the survey. Following a short explanation of the terms related to forestry and ecosystem services, we asked about the companies' engagement and experiences in the mentioned forestry type respectively in ecosystem services. Tropical forestry embraces several types of forests and plantations, which contribute to the provision of ecosystem services to a different degree. For example primary forest is more related to biodiversity conservation and scenic beauty, whereas plantations are more related to carbon sequestration. The questionnaire focused on primary and secondary forest, exotic and native species plantation as well as mixed plantations. Then we described the four ecosystem services, biodiversity conservation, carbon sequestration, scenic beauty and watershed protection, which we later wished to value.

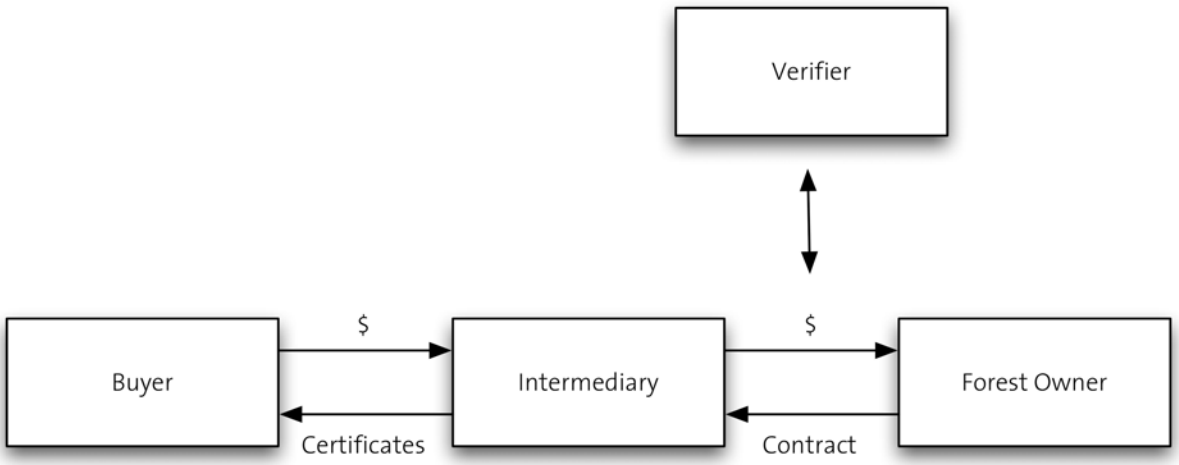
The aim of this section was to make respondents familiar with some key expressions of the survey and to set the context of the survey and place the following valuation scenario in this context.

7.3.2 Valuation scenario

The valuation scenario is the core part of every contingent valuation study. This section should provide the respondents with all information needed to make a meaningful decision. This includes a description of the constructed market and the method of payment. The design of the valuation scenario and the payment mechanism is of crucial importance for the elicitation of accurate and reliable responses.

In order to enhance the reliability our valuation scenario is modelled on the Costa Rican program of Payment for Environmental Services and the Environmental Service Certificate, projects developed by the Fondo National de Financiamiento Forestal (FONAFIFO). Figure 7-1 shows the operational principle of the framework for payments for ecosystem services, which was also provided in the questionnaire.

Figure 7-1: Framework for payments for ecosystem services.



Source: FONAFIFO, 2004

A number of elements of the valuation scenario are of importance (adapted from Carson, 2002):

- The Institution: An intermediary is responsible for providing the services. This can be a governmental agency, a NGO but also a private entity.
- Political feasibility: We stated in the questionnaire that respondents have to assume that the legal and institutional framework for the transaction is given.
- Conditions for the provision of the ES: The questionnaire provides a short description of the different actors and their roles as well of the transactions between them.
- Timing of the provision: According to the example of the FONAFIFO example we stated that the good would be provided for five years.
- Who will have to pay and who will benefit: In our constructed market local landowner of natural forest or forest plantations receive payments from the buyer.
- Payment vehicle: The effective payment vehicles are certificates for the four ecosystem services, which represent one hectare sustainable managed area.

In order to prevent any frustration by the respondents, we stated, that we are aware that the questionnaire contains not all information necessary for a good investment decision and that we kept the description general.

7.3.3 Eliciting willingness to pay

Following the valuation scenario the willingness to pay questions are asked. This survey contains of two dependent variables, the specific WTP for one hectare sustainable managed forest providing the demanded ecosystem service and the amount of certificates companies are willing to buy. Or in other words we wanted to investigate the marginal as well as the total WTP.

The elicitation question can be asked in a number of different ways. For this survey we chose the open-ended direct elicitation format. This is the most straightforward way of uncovering values and is very informative as maximum WTP can be identified for each respondent. Open-ended format allows also for relatively straightforward statistical techniques because of the metric scale. But, open-ended questioning leads to large numbers of non-response, zero dollar answers and outliers. This is because it may be difficult for respondents to come up with their true WTP for a good or service, which they are unfamiliar with or have never thought about valuing before. For this reason we gave an example of what buyers pay for one certificate in the Costa Rican Program of Environmental Service Certificate.

Following the WTP question we gave the respondents the possibility to express their uncertainty regarding the above mentioned answer. The aim of that was on the one hand to make respondents feel more confident about their declaration on the other hand it enhances the reliability of the data.

7.3.4 Eliciting motivations and constraints

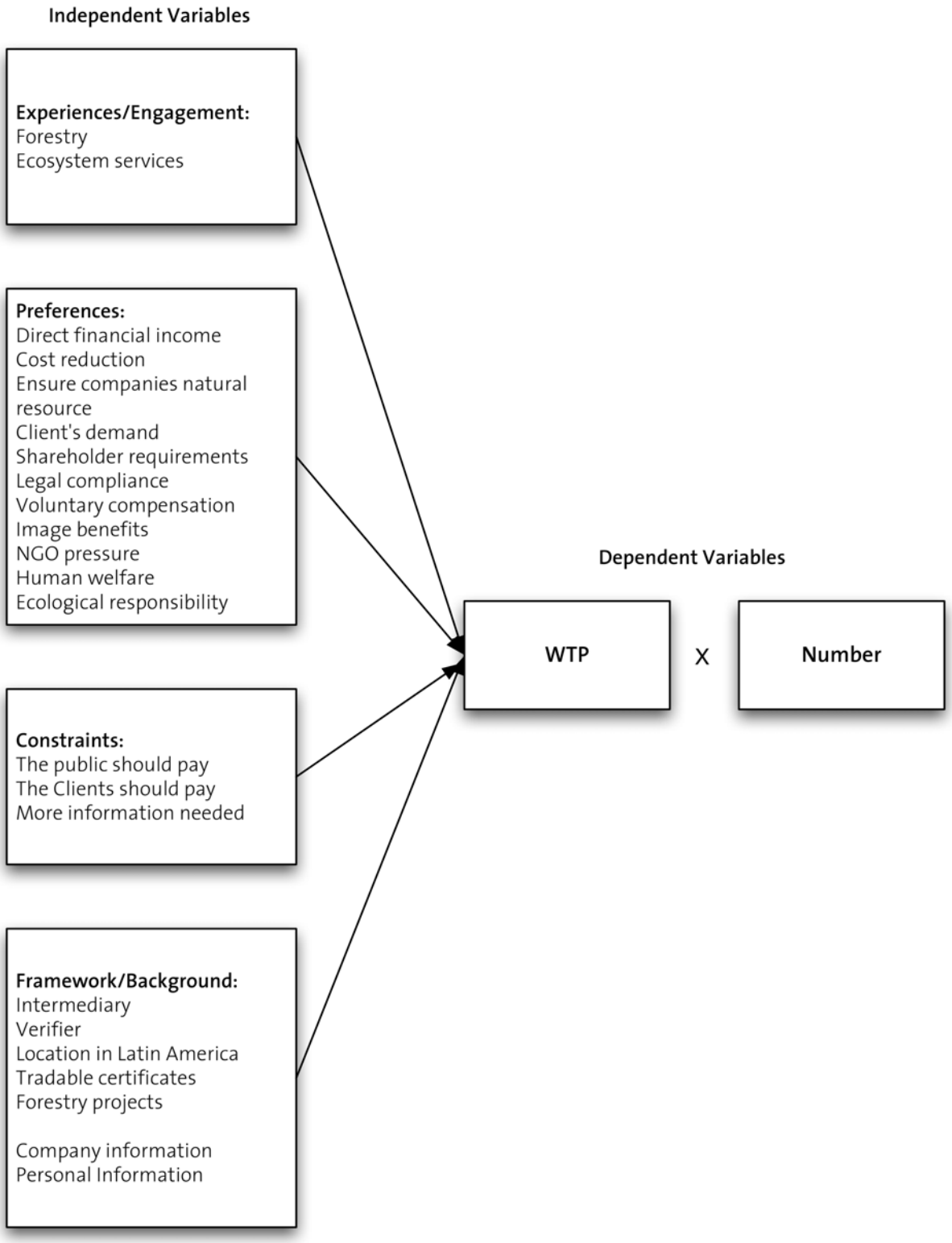
Another important part of the questionnaire is the eliciting of incentives and constraints with respect to the willingness to pay and the number of certificates. With this follow-up questions it is possible to explain why respondents were or were not willing to pay for the ecosystem services. Furthermore, we wanted to measure respondent's respectively their company's motivations and assessment about the subject. They provide valuable qualitative and quantitative information that may help to interpret the monetary valuations.

Additional we posed questions about the framework conditions (valuation scenario) and some exclusive external factors. On the one hand, these are to assess the credibility and meaningfulness of the CV scenario presented in the survey and on the other hand they are of interest regarding the provision of ecosystem services from tropical forestry respectively the development of trading schemes.

The survey also includes questions about the company and the demographic characteristic of respondents such as company size, sustainability reporting and working position. Additional respondents have to assess their knowledge with regard to the four ecosystem services as well as social, environmental, political and economic aspects. These data are used to study how WTP varies according to respondent's respectively company's characteristic.

Figure 7-2 summarises in a diagrammatic way the experiences, motivations, constraints, framework and background variables, which the questionnaire contains and shows the influence on the dependent Variables willingness to pay and the number of certificate.

Figure 7-2: Influence of the independent variables on the dependent variables.



7.4 Pre-test

Pre-testing refers to testing out the questionnaire on a small sample of respondents to identify and correct potential problems. In this pilot survey we sent the draft questionnaire to a sample of three persons. Two of them were experts in the field of forestry and also do have experiences in conduction contingent valuation studies. The third person was a respondent similar to the ones that will be asked to participate in the final survey.

In the debriefing interview open-ended question format in the willingness to pay questions was criticised. They had to little experience in the field of ecosystem services as they could give a proper answer. As a result we decided to give an anchor by outlining the example from the Costa Rican Program of Environmental Service Certificate.

7.5 Analysis methods

The data were analysed by a variety of statistical methods. For the presentation of the criteria weights and the amount of willingness to pay we used descriptive statistics, mainly mean values and their standard deviations. For differences within and between groups (e.g. ecosystem services) a number of non-parametric tests were conducted (Kruskal-Wallis, Friedman). To test significant interactions between groups ANOVA applying the repeated measurement method was used (for example between "sustainability reporting" and WTP). The linear relationship of criteria performance and WTP for each ecosystem service was modelled by means of linear regression. For the reduction of the data we conducted a factor analysis, which clustered the 11 motivations criteria into four factors. All analysis were performed using SPSS V 11.0.3 for Mac.

8 Results

8.1 Survey participants

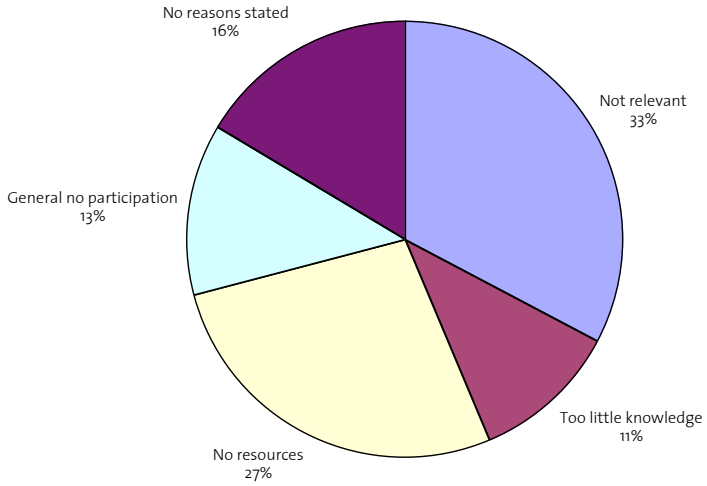
Out of the sample of total 269 companies 13 participated in the questionnaire survey. Table 8-1 presents the respondents ordered into the following groups: Country, region and industry sector. The distribution of participants is relatively even in all groups, but because of the low number of participants it is difficult to state differences or uniformities within the groups. Groups with less than five participants we consider to be problematic for profound statistical analysis. Thus, we only used the aggregated group region for statistical calculations.

Table 8-1: Participants of the survey

Groups	Frequency	Groups	Frequency
Total	13		
Country		Region	
USA	3	Europe	8
Japan	1	Other	5
Australia	1	MSCI Sector	
UK	3	Energy	2
Germany	1	Materials	4
Greece	1	Health Care	4
Austria	1	Utilities	2
Denmark	2	Consumer staples	1

The response rate of 4.5 per cent is low. Mail surveys of the general public tend to elicit response rates between 25-50 per cent. Survey of special target groups should generate even higher rates. The reasons for this low response rate are outlined in figure 8-1.

Figure 8-1: Reasons for not participation.



The most mentioned reasons for not participating in the survey were, that the companies do not operate in both tropical forestry and ecosystem services and thus the topic was not relevant. 27% of respondents declared that they have no resources, personal and time, to fill in the questionnaire. Another 16% did not participate without stating a specific reason. Further reasons were that the company's policy is not to participate in any survey (13%) and that the respondents had too little knowledge to provide meaningful answers (11%). They didn't want to speculate and were concerned that they only bias the results.

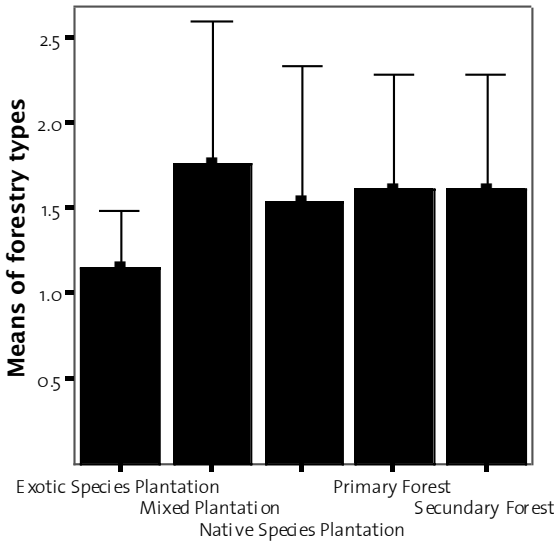
8.2 Engagement in forestry types and ecosystem services

In this section we investigated to which degree the companies are engaged in one of the five forest types, primary forest, secondary forest, exotic species plantation, native species plantation and mixed plantation. The given scale reached from one (no engagement at all) to seven (main field of engagement).

Figure 8-2 shows that the difference between the mean values of forestry types is comparably small (Exotic species plantation=1.15; Mixed plantation=1.77). In general, it can be stated that the engagement in forestry is low (<2). The observed maximum value is at 4, which means medium engagement.

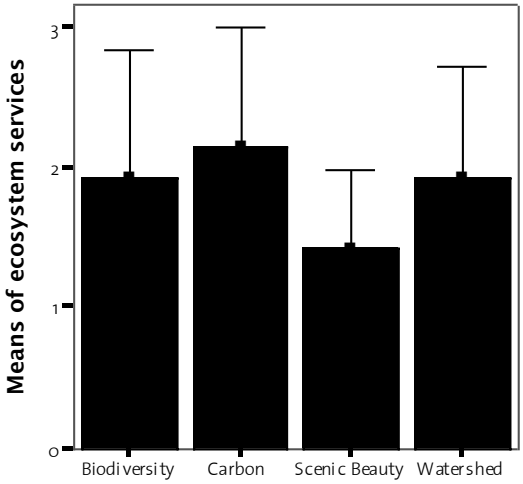
With a non-parametric test (Kruskal-Wallis) we found that the companies with experiences in forestry projects assess the engagement in primary (N=13; df=1; Chi-square=4.420; p<0.05) and secondary forests (N=13; df=1; Chi-square=4.420; p<0.05) significantly higher than those without experiences in this field. No significant difference is observed in the other forest types.

Figure 8-2: Mean values of the degree of engagement in forestry types. Range of scale reached from 1 (no engagement at all) to 7 (main field of engagement).



Analogous to the forestry types we let the participants assess the degree of engagement in ecosystem services. The mean values are comparable with those of the forestry types. Companies are also engaged in ecosystem services to a low degree (figure 8-3). Carbon sequestration (Mean=2.15) was rated highest and scenic beauty (Mean=1.42) lowest. The standard deviations are quite uniform. Within a non-parametric test (Kruskal-Wallis) we did not find significant differences between the companies with and without experiences in paying for ecosystem services regarding the degree of engagement.

Figure 8-3: Mean values of the degree of engagement in ecosystem services. Range of scale reached from 1 (no engagement at all) to 7 (main field of engagement).



8.3 WTP

Survey participants had to state their willingness to pay for one certificate of each ecosystem service. A certificate ensures the sustainable management of one hectare forestal land in a way that the particular ecosystem service is of high value (biodiversity) respectively, is in the area a company is interested in (scenic beauty and watershed protection). In order to compare the different units we did translate one hectare forest providing carbon sequestration into unit used under Kyoto regime, which is defined as tonnes CO_2 per year. The potential for carbon sequestration between the different forest types differ to a wide range (4-60 t CO_2/ha*year, Ziltener, 2005). In the questionnaire we assume that one hectare of tropical forest sequesters 32 t CO_2/ha*year on average.

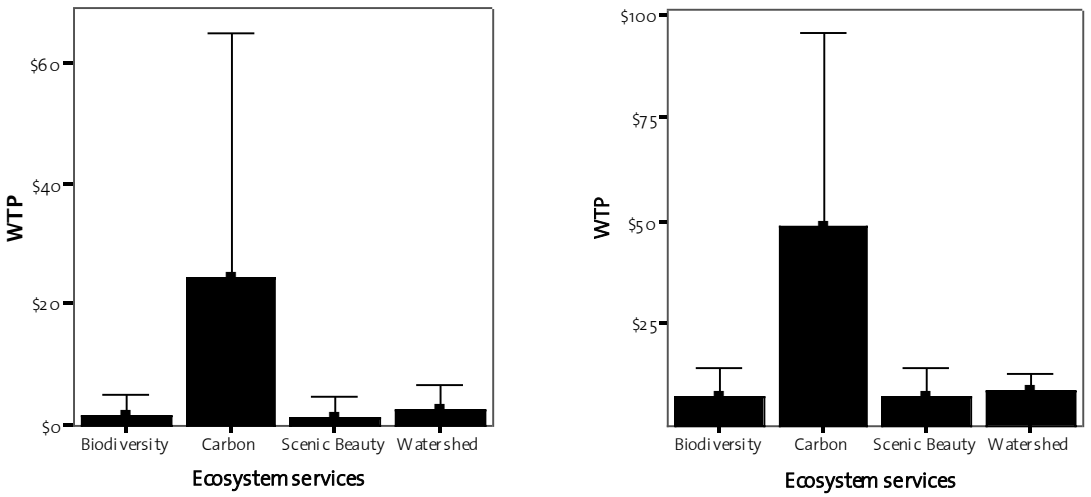
Figure 8-4 shows the mean values and standard deviations of the elicited willingness to pay with zero dollar answers on the left side and without zero dollar answers on the right side. Zero dollar answers are excluded because it is not clear if respondents valued whether or not to buy the ecosystem services rather than stating their true willingness to pay. Trough the exclusion of zero dollar answers the number of valid data would be reduced (see Appendix table 12-3, annexe B). The percentages of zero dollar answers versus non-zero dollar answers were 80% vs. 20% for biodiversity, 50% vs. 50% carbon, 81.8% vs. 18.2% for scenic beauty and 72.7% vs. 27.3% for watershed.

The willingness to pay including zero dollar answers was assessed highest for carbon sequestration (mean=$24.40). The second highest value was set on watershed protection (mean=$2.36). On the contrarian end of the spectrum is scenic beauty with a mean value of $1.27. Biodiversity was rated only somewhat higher (mean=$1.40). The difference to the assessed willingness to pay of carbon sequestration compared to the other ecosystem services appears to be quite obvious. Standard deviations are comparable, except carbon sequestration showing a much higher value (Carbon=$40.65).

The elicited willingness to pay without including zero dollar answers leads to higher mean values. The calculated mean values ranges from $46.8 (carbon sequestration) to $7 (biodiversity conservation and scenic beauty). The mean value of watershed is at $8.67. This means approximately double (carbon) up to nearly six times (scenic beauty) the amount of willingness to pay compared with the ones with zero dollar answers. Nonetheless except for watershed protection the comparison of the means (T Test) reveals no significant differences between the sample with and without zero dollar answers (watershed: df=12; t=-2.195; p=0.049).

Within an analysis of variance (ANOVA, repeated measurement) we did not find significant differences between ecosystem services in both groups. Paired t-tests of carbon sequestration with the other ecosystem services leads also to no significant differences.

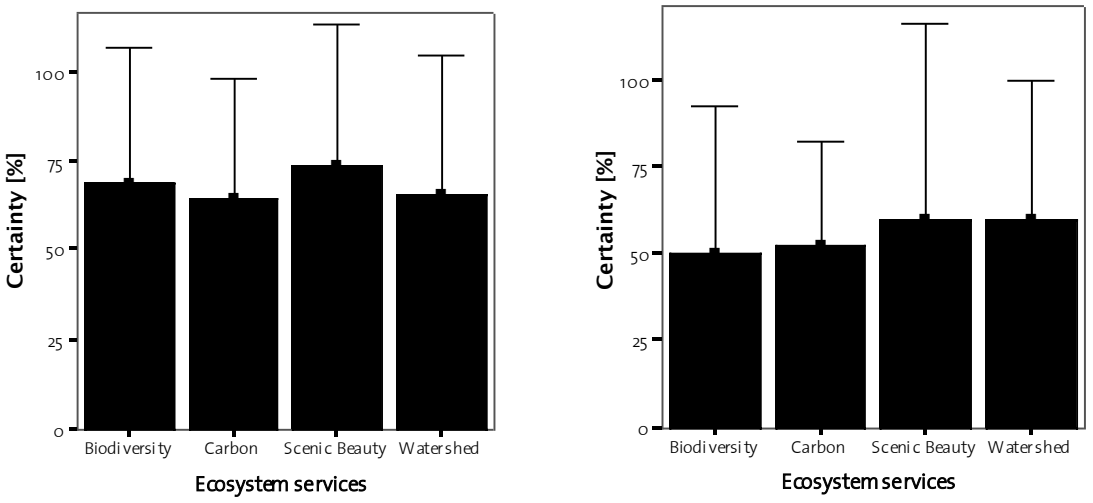
Figure 8-4: Mean values of WTP with (left) and without (right) zero dollar answers in US$ per hectare of sustainable managed forest.



Following the WTP question we asked the respondents to specify the certainty of their given answer with respect to the willingness to pay. They had the possibility to distinguish between six categories ranges from 0% (not certain at all) to 100% (completely certain). Figure 8-5 outlines the outcome assigned to with (left) and without (right) zero dollar answers in the WTP questions.

The sequence of means of indicated certainty for each ecosystem service is in the opposition to the one of willingness to pay amounts. Generally, it could be observed that the calculated mean values and standard deviations are comparable and relatively high. Mean values ranges between 64.62% (carbon) to 73.83% (scenic beauty) for the group with zero dollar answers, respectively 50% (carbon) to 60% (scenic beauty) for the group without zero dollar answers. With a T Test, no significant difference between the two groups was found but the respondents, who stated an amount of willingness to pay, tend to judge the certainty lower.

Figure 8-5: Mean values and std. deviations of certainty of the WTP answer with (left) and without (right) zero dollar answers in per cent. Range of scale reached from 0% (not certain at all) to 100% (completely certain).



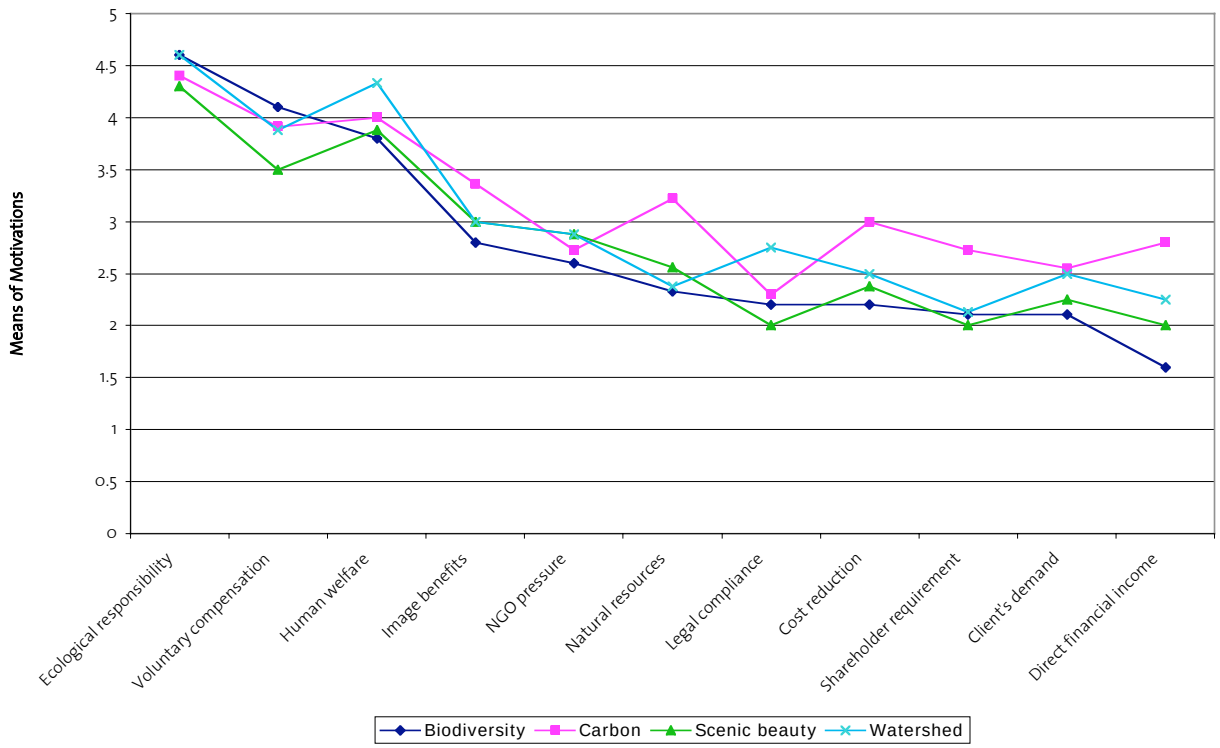
8.4 Motivations

In the questionnaire we established 11 criteria to investigate which incentives influenced the answers with respect to the willingness to pay. Respondents were requested to rate 11 assertions regarding the above mentioned criteria whether they apply or not. They had to do so for each ecosystem service. This was assessed by means of scales reaching from one (not true at all) to seven (very true).

Figure 8-6 shows criteria's means of influence weights assigned to ecosystem services. The importance of the criteria vary only a little between the four ecosystem services. A non-parametric Kruskal-Wallis test confirms this because no significant differences were found.

Of interest is also the relative weight of the criteria among each other. The "ecological responsibility" (means between 4.67 and 4.38) criterion was judged highest throughout the four ecosystem services. "Human welfare" (means between 4.33 and 3.8) and "voluntary compensation" (means between 4.1 and 3.5) was also rated relatively high. On the contrary, there are a couple of criteria with mean values around two, which is low (see Annex B tables 12-5;12-6;12-7;12-8). Non-parametric Friedman tests show that the motivations differ significantly within the ecosystem services except carbon sequestration (Biodiversity: $N=8$; $df=10$; Chi-square=28.51; $p<0.05$, Scenic beauty: $N=8$; $df=10$; Chi-square=26.32; $p<0.05$, Watershed: $N=8$; $df=10$; Chi-square=22.1; $p<0.05$).

Figure 8-6: Mean values of motivations assigned to ecosystem services. Range of scale reached from 1 (not true at all) to 7 (very true).

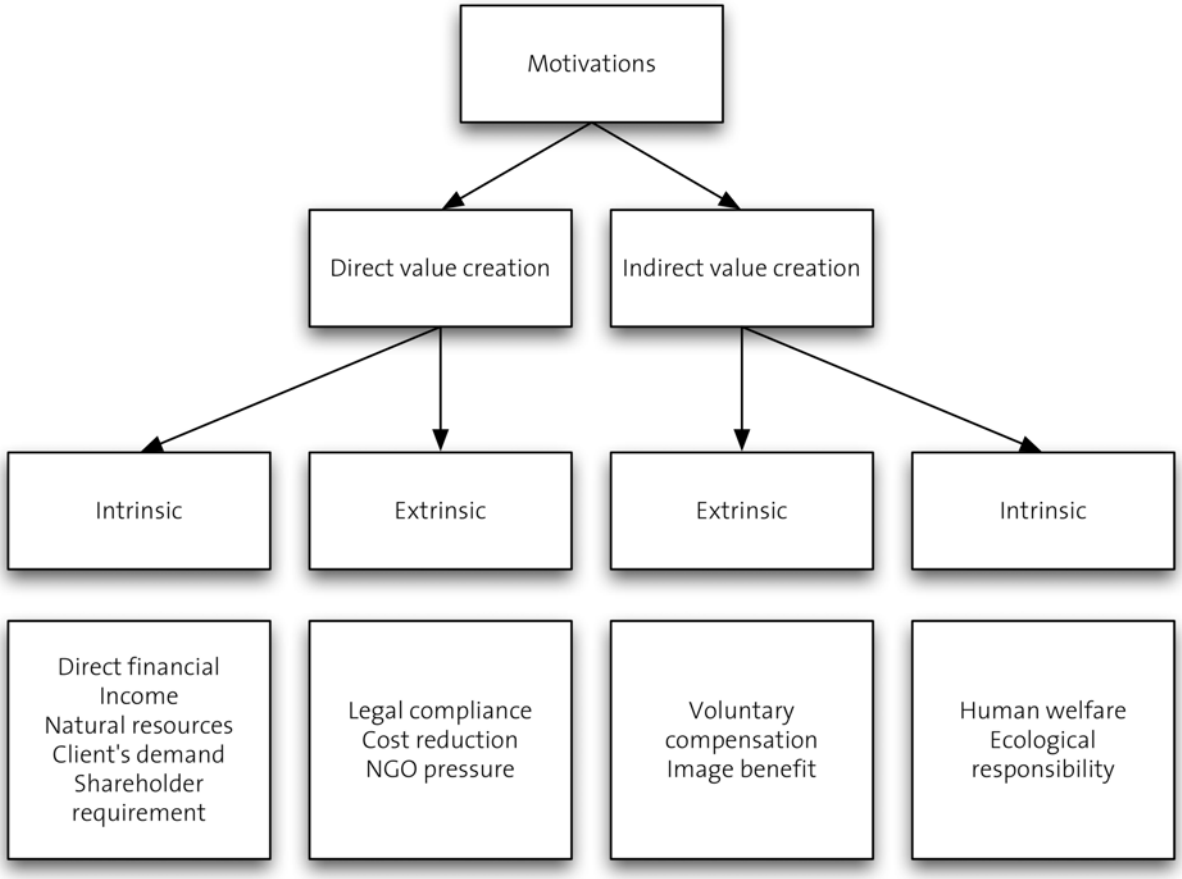


Because of the many criteria, which influence the dependent variable "willingness to pay" we reduced the data for further analysis, especially for the analysis of variances between ecosystem services and the motivations. Furthermore we wanted to discover the criteria with strong correlation among each other. The data reduction was done by a factor analysis (principal components; rotation by varimax).

All factors with an eigenvalue higher than one were extracted, which results in four factors. The four factors together explain 94.6% of the total variance of all 11 criteria. In the case of the "direct interior" factor the explained variance is 52.4%. If we included an additional factor, another 19.8% of the variance in the case of "indirect public" factor and 13.1% in the "direct public" factor respectively 9.4% in the "indirect interior" factor was explained. The specific factor loads of the criteria were all above 0.68, which expresses a quite strong correlation to the particular factor. The groupings of criteria largely support the criteria groups that we suggested by our hypothetical model description. Nevertheless there are two exceptions. We suggested that the criterion "cost reduction" was rated similar to the criteria clustered in the direct-interior factor. The second exception was "voluntary compensation", which we suggested to be rated similar to the criteria clustered in the indirect-interior factor. Figure 8-7 shows the composition of the four resulting

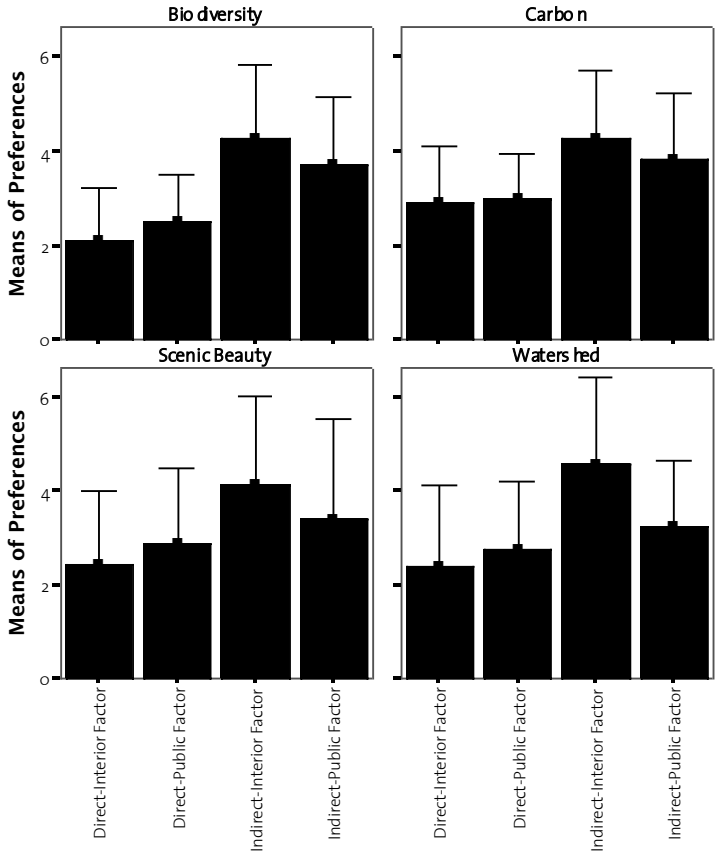
factors and the contextual connection. The sum of motivations was divided into two sub-groups, the motivations, which create direct values and the ones, which create indirect values to the company. These two sub-groups were split up once again, into factors, which are extrinsic motivated and factors, which are intrinsic motivated.

Figure 8-7: Composition and schematic context of the four factors.



After the factor analysis, we calculated the aggregated mean values of the criteria within each factor. Then we compared the mean values of the four factors. The indirect-interior factor, which contains the two criteria “ecological responsibility” and “human welfare”, was rated highest (means: Biodiversity=4.3, Carbon=4.27, Scenic Beauty=4.13, Watershed=4.56). The direct-interior factor was evaluated as the lowest of the four factors (means: Biodiversity=2.1, Carbon=2.91, Scenic Beauty=2.44, Watershed=2.38). These results are presented in figure 8-8. For the study of interactions of the four factors on ecosystem services, an ANOVA (repeated measurements) was conducted but showed no significant results. The factors are weighted quite uniform throughout the ecosystem services.

Figure 8-8: Mean values of the four factors categorized by the ecosystem services. Range of scale reached from 1 (not true at all) to 7 (very true).



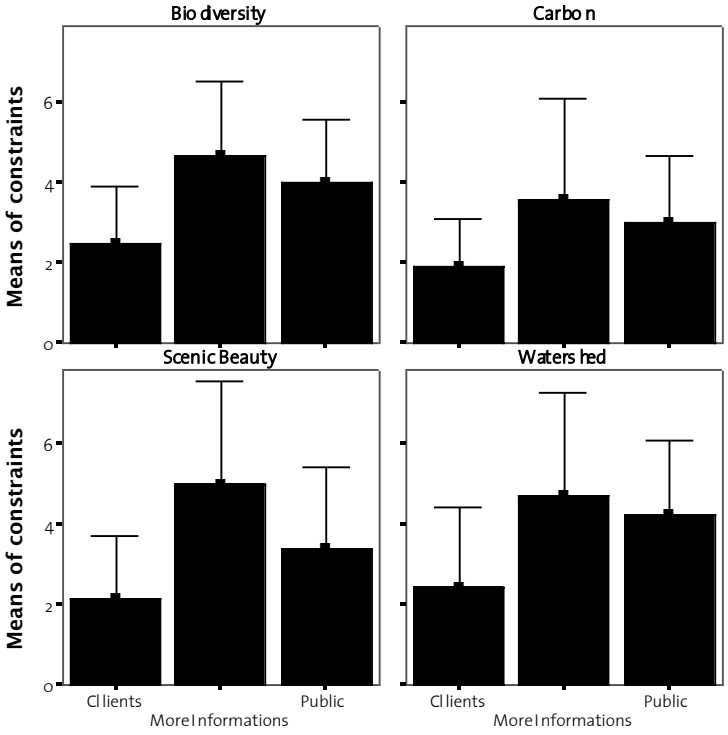
8.5 Constraints

The influence of constraints on the given WTP answer was asked in the same manner as the motivations. Assertions were stated and respondents had to weight the criteria on a scale ranging from one (not true at all) to seven (very true). We provided three criteria in the questionnaire. With the "public" and "clients" criteria we wanted to survey if companies are of the opinion that the public, respectively their clients should pay for ecosystem services. The third criterion asked if they need more information on the issue, both on a specific forestry project as well as on trade with ecosystem services.

Figure 8-9 illustrates the mean values and the standard deviations assigned to biodiversity conservation, carbon sequestration, scenic beauty and watershed protection. The participants assessed the influence of constraints similar. The ranking of the three items remains the same throughout the ecosystem services. Although a non-parametric Kruskal-Wallis test reveals no

significant differences of criteria weights between ecosystem services a tendency is observable. Respondents rated all criteria lowest within carbon sequestration. Within an analysis of variances (ANOVA, repeated measurement) no significant interaction with the four ecosystem services as factor are detected.

Figure 8-9: Mean values of constraints, which influenced WTP answer, assigned to ecosystem services. Range of scale reached from 1 (not true at all) to 7 (very true).

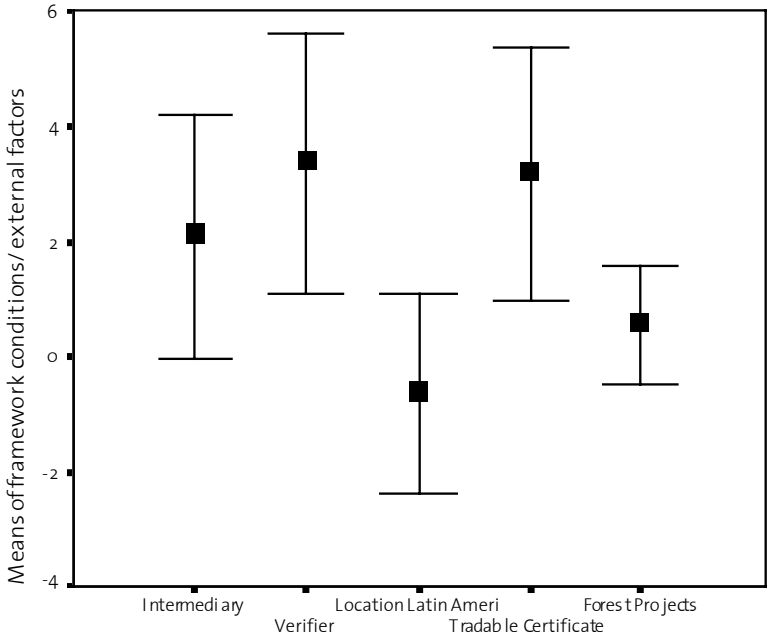


8.6 Framework and external factors

In this section we asked for the importance of several framework conditions and external factors for the company's engagement in ecosystem services from tropical forestry. Participants were asked to evaluate the influence of these aspects on the decision for an engagement. The evaluation occurred by means of scales reaching from minus five (negative influence) to plus five (positive influence). Following this assessment, respondents had to mark whether they are able to quantify an internal rate of return or not. This rate of return would be for a service or product for which they would buy certificates for ecosystem services. In the case they marked "yes", we asked which rate of return would be required.

As outlined in figure 8-10 “verifier” and “tradable certificate” were assessed highest (means: verifier=3.36, tradable certificates=3.33). The existence of an intermediary (mean=2.09) was also evaluated to have a positive influence on the decision for an engagement even though less strong than for the “verifier” and “tradable certificates”. That the certificates are based on forestry projects and the project is located in Latin America was judged to have a nearly indifferent influence on engagement decision. However, the mean value of the “forestry project” criterion is slightly positive whereas the one of “location in Latin America” slightly negative. Standard deviations are comparable, with verifier showing the highest discordance and forestry project the lowest. A non-parametric test (Friedman) confirms that the five criteria differ highly significant (N=11; df=4; Chi-square=43.265; p<0.001).

Figure 8-10: Mean values of framework conditions and external factors. Range of scale reached from –5 (negative influence) to 5 (positive influence).



Only one respondent answered the question of quantifying a rate of return with “yes”. The others are unable to state an amount. The one participant amounted a required rate of 20%.

8.7 Background

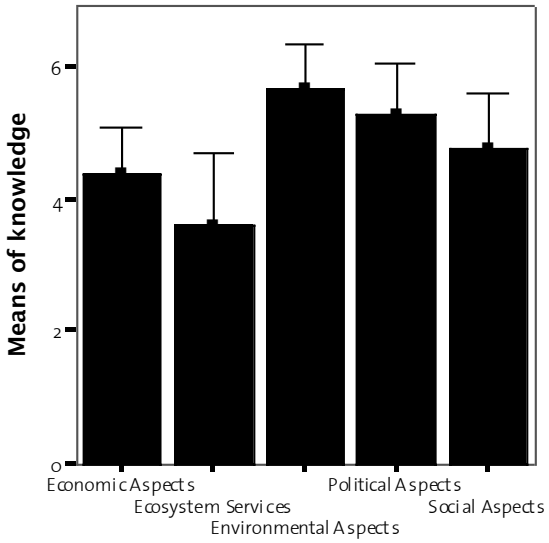
In the questionnaire we posed several questions to characterize the company on the one hand and on the other hand the person who filled in the questionnaire. First we asked if the company provide a sustainability and/or environmental report. Second, we asked if they have an environmental management system.

Significantly more companies, which provide a sustainability and/or environmental report, participated in the survey (Binomial, N=13; $p<0.05$). The question of having an environmental management system answered all respondents with "yes", which means that only companies, which have an environmental management system, completed the questionnaire.

In the following part, participants assessed their knowledge with regard to ecosystem services, economic, environmental, political and social aspects. This was evaluated by means of scales ranges from one (very little expert knowledge) to seven (very high expert knowledge) for ecosystem services respectively from one (very low) to seven (excellent) for the assessment of knowledge of the other four aspects.

The mean values of estimated expert knowledge ranged from 3.62 for ecosystem services to 5.69 for environmental aspects. Figure 8-11 provides an overview of the mean values of the particular aspects. The standard deviations are comparable. They range between 1.805 (ecosystem services) and 1.109 (environmental aspects). A non-parametric Friedman test shows that the differences in knowledge between the aspects are highly significant (N=13; df=4; Chi-square=23.212; $p<0.001$).

Figure 8-11: Mean values of knowledge. Range of scale reached from 1 (very low) to 7 (excellent).



8.8 Influences on WTP

According to the model in section 7.3.4 (see figure 7-2) we investigated the influence and the effect of independent variables on the assessed willingness to pay, namely the dependent variable. For the statistical analysis of this issue we used variance analysis and linear regression. The following chapters describe the analysis and the results received in detail.

8.8.1 Engagement and experiences in forestry and ecosystem services

First we wanted to study if there is a significant relation between companies, which have experience in forestry projects and the elicited willingness to pay. For this we conducted an ANOVA test (repeated measurement) but no significant interaction can be observed (df=7;F=1.234; p=0.340). The same was done with the experience in ecosystem services as factor but no significant interaction revealed as well (df=7; F=2.345; p=0.166).

Afterwards the influence of the degree of engagement in the different forest types on WTP of each ecosystem service was analyzed by means of linear regression, whose results are summarized below.

For the model of the relation between engagement in forestry projects and WTP for biodiversity resulted an R^2 value of 0.895. The R squared value measures the goodness-of-fit of a linear model. It

is the proportion of variation in the dependent variable explained by the regression model. It ranges in value from 0 to 1. Small values indicate that the model does not fit the data well, thus the calculated value of 0.895 is very high. Then the acceptability of the model was statistically tested by an ANOVA and revealed significant relation (df=4; F=12.803; p<0.01).

The results for the model for scenic beauty are quite similar to the ones of biodiversity. They also show a strong relationship between the model and the assessed WTP for scenic beauty. The R^2 value of 0.897 shows that nearly 90 per cent of the variation in WTP is explained by the model. The following analysis of variances (ANOVA) confirms that the model is significant (df=4; F=15.188; p<0.01).

The models for predicting the willingness to pay for carbon and for watershed were not significant, which means that the variation explained by the model is due to chance (Carbon: R^2=0.536; df=4; F=1.730; p=0.260, Watershed: R^2=0.680; df=4; F=3.725; p=0,062).

Table 8-2 shows an overview of the standardized regression coefficients (beta) and the significant levels of them. In grey accented are coefficients of variables with a significant influence on willingness to pay and a significant underlying model. It can be seen, that both variables "mixed plantation" and "native species plantation" have significant and a quite strong influence on WTP, which is indicated by the beta value. A few other factors are only slightly above the significance level. "Secondary forest" was excluded due to collinearity. Collinearity is the undesirable situation when one variable is a linear function of other variables. Because the data of "primary forest" and "secondary forest" are identical, secondary forest can be explained to 100% by other variables, in this case by "primary forest".

Table 8-2: Standardized coefficients and significant levels of forest types.

	Biodiversity		Carbon*		Scenic Beauty		Watershed*	
	Beta	p	Beta	p	Beta	p	Beta	p
Primary Forest	0.126	0.824	2.750	0.052	0.126	0.749	1.460	0.063
Exotic Species Plantation	0.341	0.119	-0.422	0.327	0.340	0.074	0.157	0.599
Native Species Plantation	-1.373	0.048	-2.985	0.043	1.375	0.014	-2.332	0.016
Mixed Plantation	1.511	0.000	0.474	0.332	1.527	0.000	1.238	0.010

Note: * no significant underlying linear model; Secondary forest excluded

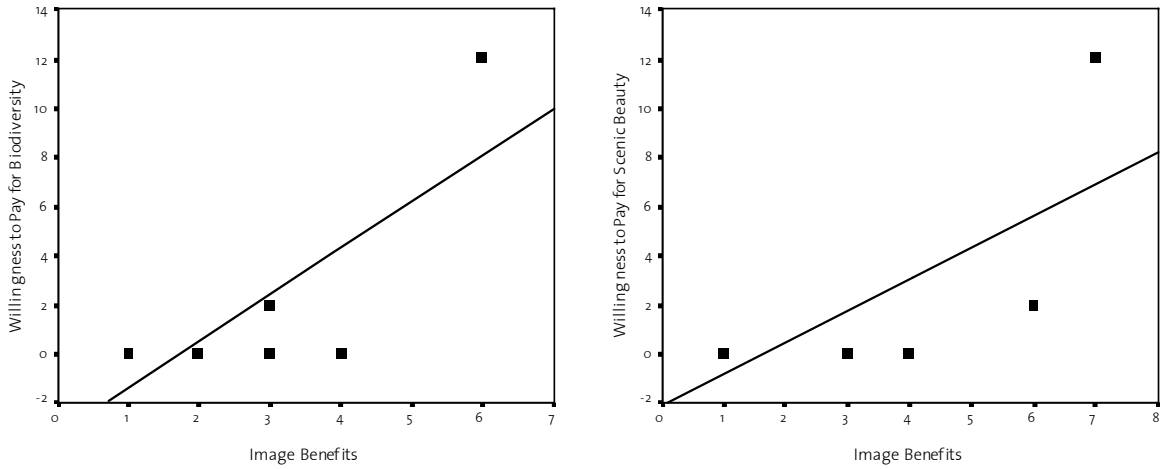
8.8.2 Motivations and constraints

This chapter highlights, which motivations and constraints did influence the decision regarding willingness to pay for ecosystem services from tropical forestry. In a first step we did a linear regression of the four clustered factors mentioned in chapter 8.4. None of these factors could either predict WTP nor a significant model could be established for the four ecosystem services. The models were far away from being significant. ANOVA tests calculated probabilities between 0.590 for biodiversity and 0.969 for watershed.

Due to these results we decided to use the stepwise method for all motivations provided in the questionnaire. Stepwise analysis controls the variable entry and removal. At each step, the independent variable not in the model, which has the smallest probability of F is entered, if that probability is sufficiently small. Variables already in the regression equation are removed, if their probability of F becomes sufficiently large. The method terminates when no more variables are eligible for inclusion or removal. Or simply said, only the independent variables, which have a significant influence of the dependent variable, are included in the model.

The probability of F to enter the model was $p <= 0.050$, the probability of F to remove $p >= 0.100$. This analysis produced only two significant results. “Image benefit” has a significant influence on willingness to pay for biodiversity and scenic beauty. The models fit each data set well with a R^2 value of 0.630 for biodiversity respectively 0.562 for scenic beauty. Within ANOVA we found that the models are significant (Biodiversity: df=1; F=10.209; $p<0.05$, Scenic beauty: df=1; F=7.704; $p<0.05$). The standardized regression coefficients are with a beta of 0.794 (biodiversity) respectively 0.750 (scenic beauty) relatively high, which means that the variable “image benefit” has strong relationship on WTP. The results are visualized in figure 8-12.

Figure 8-12: Linear relationship between image benefit and WTP for biodiversity (left) and scenic beauty (right).



A linear regression was also conducted with the three criteria, which measured the influence of constraints with respect to the willingness to pay. But all four models could not be statistically accepted because ANOVA resulted in highly not significant values (p between 0.254 and 0.876).

8.8.3 Framework and background

Within a linear regression no significant models could be estimated for biodiversity, scenic beauty and watershed (biodiversity: df=5; F=1.641; p=0.364, scenic beauty: df=5; F=0.219; p=0.937, watershed: df=5; F=0.716; p=0.644). But an ANOVA showed a significant result for carbon (df=5; F=32.954; p<0.01). The calculated model explains nearly 100% of the variances (R^2=0.982). The criteria "intermediary" and "verifier" predict the willingness to pay for carbon. The strength of the relationship is high, which is indicated by high beta values (table 8-3).

Table 8-3: Standardized Coefficients and significant levels of framework conditions. Dependent variable WTP for carbon.

	Beta	p
Intermediary	-2.041	0.003
Verifier	2.524	0.002
Location Latin America	-0.065	0.7
Tradable Certificates	-0.024	0.882
Forest Projects	-0.165	0.263

Now the relationship between the company specific indicator "sustainability reporting" and WTP was investigated. Additional we are interested if there are any differences observable regarding WTP if the company is located in Europe or in other parts of the world. But within an ANOVA we did not find any significant interactions nor main effects using these to factors (Region: df=2; F=1.296; p=0.332, Sustainability reporting: df=2; F=0.142; p=0.870).

A linear regression with the five aspects of knowledge and WTP was done. The results are familiar to the ones we received from "engagement in forestry types" (see chapter 8.8.1). The models for carbon and watershed do not reach the significant level within ANOVA (Carbon: df=5; F=0.916; p=0.549, Watershed: df=5; F=1.707; p=0.286).

Biodiversity and scenic beauty showed both a linear relationship to WTP. The calculated linear models are significant (Biodiversity: df=5; F=12.556; p<0.05, Scenic beauty: df=5; F=6.386; p<0.05). The R^2 values are high, which indicate that the linear model fit the data very well (Biodiversity: R^2=0.940; Scenic beauty: R^2=0.865). The knowledge about ecosystem services, economic aspects and political aspects have a significant influence on WTP for both biodiversity and scenic beauty. The strength of the relationship is outlined in Table 8-4 below. Political and economical aspects contribute more to the model than ecosystem services because they have a larger absolute standardized coefficient.

Table 8-4: Standardized coefficient and significant level of knowledge.

	Biodiversity		Carbon*		Scenic Beauty		Watershed*	
Knowledge	Beta	p	Beta	p	Beta	p	Beta	p
Ecosystem services	-0.771	0.008	0.198	0.677	-0.792	0.016	-0.095	0.806
Economic aspects	1.026	0.008	-0.925	0.184	1.064	0.012	0.668	0.206
Environmental aspects	-0.308	0.214	-0.761	0.262	-0.260	0.919	-0.603	0.203
Political aspects	1.027	0.022	-0.820	0.355	1.145	0.027	0.401	0.542
Social aspects	-0.188	0.612	1.665	0.156	-0.534	0.257	0.245	0.737

Note: *no significant underlying linear model

9 Discussion

The elicitation of the data for statistical analysis did meet little response. This is reflected by the small number of companies, which participated the survey (N=13). Mainly four reasons for not participating were stated: the topic is not relevant for the company, they have no capacity (time and personal), general no participation and too little knowledge of the topic. Although we explained in the additional letter to the questionnaire that their expertise is also valuable to us if the presented topic is not relevant due to companies business, respondents still had concerns to complete the questionnaire. Various companies refused to speculate on a topic, which was not familiar to their activities. The small sample causes risks of low representativeness so the results cannot necessarily be generalized. Additional it was difficult to conduct a profound statistical analysis. Nevertheless, few results emanate from the study, which are able to explain some interesting relationships and facts.

9.1 Willingness to pay

We tried to describe a hypothetical business situation in a way, which did provide respondents with all information needed for a meaningful and realistic decision. However, we received a high number of zero dollar answers. This can be interpreted in two ways: Firstly companies see no business opportunity and thus stated zero. The second possible reason why they stated no willingness to pay is that the topic is not relevant to companies' activity.

The assessed amount of biodiversity was 1.40 US$ per hectare. This is a low value in comparison with findings from, for example, market for Voluntary Deals and other studies (e.g. Stanley, 2002). The market for Voluntary Deals covers a wide range of transactions. These are for example from corporate biodiversity mitigation to wildlife sponsorship, nature recreation to access to genetic and chemical resources. If the total volume of the market is divided into the total land protected, an average price per hectare of 57 US$ would be the result (average price over 57 transactions between January 1, 1987 to August 12, 2005, www.ecosystemmarketplace.net). This is in line with the findings from Stanley (2002), which stated an annual willingness to pay of around $50-60 per household for local endangered species. Even if we excluded the zero dollar answers it remains a low value of 7 US$/ha.

For carbon sequestration respondents stated a willingness to pay of 24.40 US$ per hectare respectively 46.80 US$ per hectare without the zero dollar answers. To compare this with existing carbon markets we had to convert this amount into tons of CO_2. With an average sequestrations

rate of 32 t CO_2 per hectare (Ziltener, 2005) the assessed amount would be 0.76 US$/t CO_2 respectively 1.46 US$/t CO_2. In the EU Emission trading scheme the price per t CO_2 is 22.75 € (September 28, 2005, www.ecosystemmarketplace.net), which means 19.70 US$ with an estimated exchange rate of 0.86 US$/€ (October 3, 2005, www.credit-suisse.com). In Chicago Climate Exchange (CCX) a t CO_2 costs 2.48 US$ (September 23, 2005, www.ecosystemmarketplace.net). In Kyoto protocol transactions, which allows afforestation and reforestation projects under the CDM and JI, a ton CO_2 costs 0.58 US$ (average price over 24 transactions between September 1, 2003 to March 2, 2006, www.ecosystemmarketplace.net). The assessed amount is therefore more likely underestimated.

The lowest amount of WTP was assessed for scenic beauty with a mean value of 1.27 US$ per hectare. The value is six-fold higher if zero dollar answers were excluded (mean=7 US$/ha). These amounts are comparable with other studies. For example in Costa Rica marginal willingness to pay for an increase in protected area for recreation and scenic beauty was 0.24 US$ per month for Costa Ricans and 3.10 US$ for foreign tourists (Motte, 2002). Rekola and Pauta (2005) elicited in their study of two sub samples WTP for forest amenities of 9.25 € (7.95 US$) and 13.29 € (11.43 US$).

The Mexican Government funded a program to pay forest owners for maintaining and preserving forest cover in order to obtain hydrological benefits. The program aims to find downstream beneficiaries of the water service to pay for the forest conservation in the future. The downstream users paid an average of 74 US$ per hectare to forest owners (average price over 47 transactions between October 1, 2003 to October 1, 2004, www.ecosystemmarketplace.net). In the Costa Rican Environmental Service Program Payment (PSA) the Hidroelectrica Aguas Zarcas paid 30 US$/ha per year to the FONAFIFO (Fondo Nacional de Financiamiento Forestal, October 7, 2005, www.ecosystemmarketplace.net). The participants of the survey do have a willingness to pay of 2.36 US$/ha, respectively 8.67 US$ per hectare without zero dollar answers. Compared to the just mentioned transaction this is a quite low rate.

Although the differences between the ecosystems were not significant, tendency is observable. The mean value of carbon sequestration was the highest, followed by watershed protection. For biodiversity and scenic beauty respondents assessed the same value. This tendency was heightened if the zero dollar answers were excluded. This leads to the conclusion that those ecosystem services are valued higher, for which it is clearer how commodities are measured. Carbon sequestration rates can be quantified, it is also possible to measure water quality or stream flow reduction. From a statistical point of view the hypothesis (H5) “the highest WTP is set on

carbon sequestration, followed by biodiversity conservation, watershed protection and finally scenic beauty " has to be rejected. According to the observed tendency it could be partially accepted.

9.2 Criteria performance of independent variables

According to the presented model in chapter 7.3.4 (figure 7-2), we investigated several criteria, which we thought to be relevant for the decision of a possible engagement in ecosystem services derived from tropical forestry. This chapter describes the assessed weights of these criteria and which are important factors for a company to decide whether they get involved in the issue or not.

9.2.1 Engagement and experiences

The degree to which companies are engaged in the five forest types is very low (mean values <2). This indicates that the examined companies' activities are outside forestry and that the topic is rather unfamiliar to them. But more than half of the respondents stated that they have experiences in forestry projects (N=7). A possible solution for this seeming divergence is that they have experiences in forestry but to a low degree. The group of companies with experiences rated primary forest and secondary forest significant higher, this leads to the conclusion that companies with experiences are mainly involved in primary and secondary forestry.

The degree of engagement in ecosystem services is also very low. As expected, carbon sequestration was rated highest but had also a low mean value, which was surprising to us. Only four out of thirteen companies had experiences in paying for ecosystem services. The investigation of group differences was not significant. We expected that if companies have experiences they would have been engaged manly in carbon sequestration, which was not the case.

9.2.2 Motivations and constraints

We did not find any significant differences between ecosystem services with respect to the motivations and constraints. The lack of significant differences suggests a consensus between respondents on relative criteria performance. But the weights of motivations within the ecosystem services differ significantly except for carbon sequestration. Because the direct-interior, direct-public and the indirect-public criteria were rated higher than in the other ecosystem services, the differences were not significant.

The criteria "ecological responsibility" and "human welfare", which were clustered in the indirect-interior factor received a high performance score (means between four and five on a scale from

one to seven). Contrary, the factors, which assessed the direct value creation for the company, were assessed low. This can be interpreted in the way that in the decision-making process of companies socio-environmental reasons are more important motivations for an engagement in ecosystem services from tropical forestry than economic reasons. This is in line with findings from Sell et al. (2005), where European market players weighted the criteria social benefits, environmental benefits and sustainability highest. Another possible interpretation is, that companies do not see business opportunities at the moment and thus rated the direct-interior factor low.

The constraints were also rated similar throughout the services and no significant differences could be found. The results suggest, that companies don't think that their clients should pay for ecosystem services and also the public is not responsible for paying these services. The high value of the criterion "more information" indicates, that paying for ecosystem services is a new field for companies.

9.2.3 Framework/Background

For attracting companies of getting involved with paying for ecosystem services derived from tropical forestry an independent monitoring by a verifier is of high importance. Buyers must be certain, when paying for a given commodity that they will receive that commodity. The survey confirms this by a high value of the criterion "verifier". Respondents also rated the existence of an intermediary relative high. A strong and trustworthy (local) partner seems to support an engagement with respect to ecosystem services from tropical forestry, which was also confirmed by other studies (Landell-Mills, 2002). Another supportive factor are tradable certificates, which are highly valued by respondents. This can be an argument to foster efforts to develop markets. In contradiction the criterion "forestry projects"had no influence and "location in Latin America" has a slightly negative effect on companies decision of engagement. The reason may be that the political situation in these countries is uncertain and thus causes investment risks. In general, we can observe that companies rated those factors best, which reduces the risk of an investment and vice versa.

With only one exception all respondents are working in the environmental, sustainability or related departments. Because of that it was not surprisingly that they estimated themselves having very good knowledge regarding environmental aspects. The knowledge with respect to the four ecosystem services was assessed lowest. This is consistent with the findings of the high value given for the criterion "more information", and shows that the issue is relatively unknown and new for the surveyed companies. But in general the degree of expert knowledge was high, which speaks

for the reliability of the assessed data because respondents were quite familiar with environmental subjects.

9.3 Relationship between WTP and the influence factors

Biodiversity and Scenic beauty showed the same relationships between WTP and the predictors. The engagement in native species plantation and mixed plantation can explain the WTP to a high degree (Betas >1.3). Apparently, these two forest types seem to support the demand of companies, as the data shows. Companies with a high degree of engagement stated higher amounts of WTP. In line of the hypothesis are the findings from the stepwise linear regression of motivations. Image benefits have an influence on stated WTP. The mentioned hypothesis (H3) "image reasons are the most important motivation to pay for ecosystem services derived from tropical forestry projects" can be partially approved. The degree of expert knowledge of respondents in ecosystem services, political and economic aspects have also an influence on the stated WTP for biodiversity and scenic beauty. Participants, who have assessed to have a greater expert knowledge in the mentioned fields, had stated more WTP or in other words they have a greater demand on biodiversity and scenic beauty.

Willingness to pay for carbon sequestration can be explained by the two criteria "intermediary" and "verifier". Both predictors have a very strong effect on WTP (Betas >2). This means that these two criteria not only support the decision regarding an engagement but also have an influence on the demand respectively the price paid per certificate. This reflects the high importance of a transparent trading framework, where risk of an investment is low. Other criteria do not have an observable relationship with WTP for carbon sequestration, which means that WTP could not be explained by these variables and thus were not discussed in this thesis.

No influences on watershed protection by any criterion could be found. This was not necessarily because of the lack of relationships. In fact the models do not reach significant level and thus the calculated coefficients are unreliable.

By the review of the above-discussed partial results of linear regressions a few results are remarkable. On the one hand the results for carbon sequestration were quite similar to the results from watershed protection (except for framework) and on the other hand biodiversity and scenic beauty were rated similar. This could be because commodities for carbon sequestration and watershed protection can be easier defined than for biodiversity and scenic beauty.

We did not find interactions of the groups “region” (European or Non-European) and “sustainability reporting” (yes or no) with WTP, as we expected. European and Non-European companies assessed a comparable WTP. We expected that there are differences especially for carbon sequestration because European companies are treated under the EU Emission Trading Scheme. According to the hypothesis (H1) stated in chapter 6.2, we also expected differences between the companies, which provide a sustainability report and those, which do not have such a report. We used this criterion as an indicator of the environmental sensibility. But this had no influence on assessed WTP. This can be interpreted twice. On the one hand, the generally low values of WTP and the high standard deviation let the differences disappear. On the other hand all surveyed companies have an environmental management system and thus the supposed differences in environmental sensibility are lacking. Therefore we have to refuse the hypothesis, which mentioned that there are differences between these groups.

10 Conclusions

In this survey we wanted to find out the demand side perspective concerning ecosystem services from tropical forestry. Of special interest was the quantification of this demand to give a first idea of a possible market price or more generally, which economic value ecosystem services have from a market player point of view. Additionally, it is important to raise knowledge of the underlying motivations and constraints in the decision making process of market players for the future management of tropical forests. These two core tasks were done by eliciting willingness to pay on the one hand and on the other hand by the following debriefing questions.

The study suggests that the demand for ecosystem services from tropical forestry is relatively low. The elicited willingness to pay of market players tends to be underestimated in comparison to existing market activity or transactions and the number of zero dollar answers was high. This emphasis, that companies judged this business opportunity to have a low attractiveness for an engagement. The results indicate, that the availability of a measurable, clearly defined commodity may enhance the demand. A second possible conclusion of the low values of willingness to pay is, that this is a new field for companies and the issue was not familiar to them. For this reason it is important to take further steps in sensitise companies for the opportunities related with the developing markets.

The study gives insights into motivations and constraints, which influence the decision regarding an engagement with respect to ecosystem services from tropical forestry. The economic or direct use value of ecosystem services did not influence the decision regarding willingness to pay. This shows that investment in ecosystem services were done due to other reasons than to create financial income. For actual engagement socio-environmental criteria was indicated as main motivations, but do not have relevance for willingness to pay. In the case of biodiversity conservation and scenic beauty, reasons for an involvement in projects, which generate certificates for ecosystem services, were due to improve public relations. Other important factors are the provision of an independent verifier and an intermediary, which is responsible for undisturbed transaction and establish trust between partners. For selling certificates for carbon sequestration a good trading framework is supportive for enhancing demand. In general the study show that criteria, which lower the investment risk to investors, are essential on the way to greater private participation in markets of ecosystem services.

The findings may give insights into some obstacles and supportive factors concerning the decision-making process of private investors regarding ecosystem services. It may provide useful information on general supportive factors of tropical forest projects providing ecosystem services.

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12 Appendix

Annex A: The questionnaire: Market players' perspective on Ecosystem services from Tropical Forestry

Annex B: Tables

Annex A: The questionnaire

Market players' perspective on Ecosystem Services from Tropical Forestry

An international survey conducted by

Swiss Federal Institute of Technology Zurich

Natural and Social Science Interface (NSSI)

www.nssi.ethz.ch

In cooperation with:

Tropical Agricultural Research and Higher Education Center (CATIE), Costa Rica

Contact:
Sandro Glanzmann
Natural and Social Science Interface
ETH Zentrum, HAD
CH-8092 Zurich
Phone: +41 1 632 63 20
Fax: +41 1 632 10 29
e-mail: gsandro@ethz.ch

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

NSSI
Natural and Social Science Interface

Dear Sir/Madam:

The Swiss Federal Institute of Technology – Natural and Social Science Interface (NSSI) conducts an international survey on the demand side perspective concerning ecosystem services from tropical forestry. Participation is not limited to companies whose core business is ecosystem services. Your expertise is also valuable to us when the presented topic is supplemental, marginal, or a matter of future plans to you.

Market mechanisms for ecosystem services provide attractive business options for market players. Additionally, they enhance the economic value of tropical forestry. Accordingly, market approaches to ecosystem services may substantially foster the sustainable management of different types of forestry projects.

At the time, most transactions involving ecosystem services are still based on bi- or multi-lateral projects – the markets just begin to develop. Markets for some ecosystem services (i.e. biodiversity conservation, carbon sequestration, scenic beauty, watershed protection) are likely to grow substantially in the coming years. Given this background, the perspective and decision making processes of market players become increasingly important for the future management of tropical forests. However, a major constraint for the establishment of markets is the lack of reliable and comparable economic values associated with ecosystem services.

The goal of this questionnaire is to analyze and articulate knowledge and preferences of demand side market players concerning ecosystem services form tropical forestry. One core task is to monetarize ecosystem services, which is done by posing specific willingness to pay questions.

We kindly invite you to participate in this questionnaire survey. The time required for answering it is approximately 30 minutes. All participants will have access to the results of the survey, including willingness to pay-values of an international panel of market players. Note that your name and that of your institution will be treated confidentially.

The questionnaire is a word document that you can **fill in right on your computer (no hardcopy needed)**. We kindly ask you to send the completed questionnaire back via **e-mail** to **(gsandro@ethz.ch) by the end of august, 2005**. If you prefer to work on a hardcopy, we kindly invite you to send the completed questionnaire to Sandro Glanzmann, post address on cover-page).

We gratefully thank you for your participation and support!

Sincerely,

Prof. Dr. Roland W. Scholz Madeleine Guyer Sandro Glanzmann

A Structure of questionnaire and hints for its completion

The format of this questionnaire is in Word for Windows or Mac. The questionnaire can be filled in directly on the computer. Please answer this questionnaire as a representative for your company. To answer the questions, click the box that best matches your opinion. If you decide you'd like to change your answer after clicking the box, simply click the box again and the mark will disappear. Some parts include text fields for comments or lists. These are indicated by blue lines. Please click on the field and then write your text.
The questionnaire contains four sections. Please answer them in the appropriate order. Every section contains a short description of its aim and content. Rules of how to use the scales are given. If several answers or marks can be filled in, this is indicated by a remark. If you have any queries or problems while processing the questionnaire contact Madeleine Guyer/Sandro Glanzmann at ETH Zurich.

B Explanation of forest types and ecosystem services

This section contains brief descriptions of terms related to forestry and ecosystem services used in the questionnaire. Subsequently, we ask for the relevancy of forestry types and ecosystem services for your company.

Tropical forestry embraces several types of forests and plantations. In this questionnaire, we focus on the following five forestry types:

1. Primary forest: Forestland of native species, where there are no clearly visible indications of human activities.
2. Secondary forest: Forestland of naturally regenerated native species where there are clearly visible indications of human activities.
3. Exotic species plantation: Forestland of mono-specific, introduced, and fast growing species (e.g. Teak, Eucalyptus) intensively managed.
4. Native species plantation: Forestland of mono-specific, native species intensively managed (e.g. Mahogany, Pochote)
5. Mixed plantation: Forestland of introduced and native species managed environmentally friendly.

Below, please mark to which degree your company is engaged (e.g., purchase, investments, credits, trade of products, services or certificates) in the mentioned forestry types.

	1= no engagement at all			4= medium engagement			7=main field of engagement
	1	2	3	4	5	6	7
Primary Forest	☐	☐	☐	☐	☐	☐	☐
Secondary Forest	☐	☐	☐	☐	☐	☐	☐
Exotic species plantation	☐	☐	☐	☐	☐	☐	☐
Native species plantation	☐	☐	☐	☐	☐	☐	☐
Mixed plantation	☐	☐	☐	☐	☐	☐	☐

In the following parts of the questionnaire, the provision of ecosystem services is not distinguished between the forestry types. We simply use the umbrella term "sustainable forest management." This is done in order to reduce the complexity of the questionnaire.

We focus on four ecosystem services:

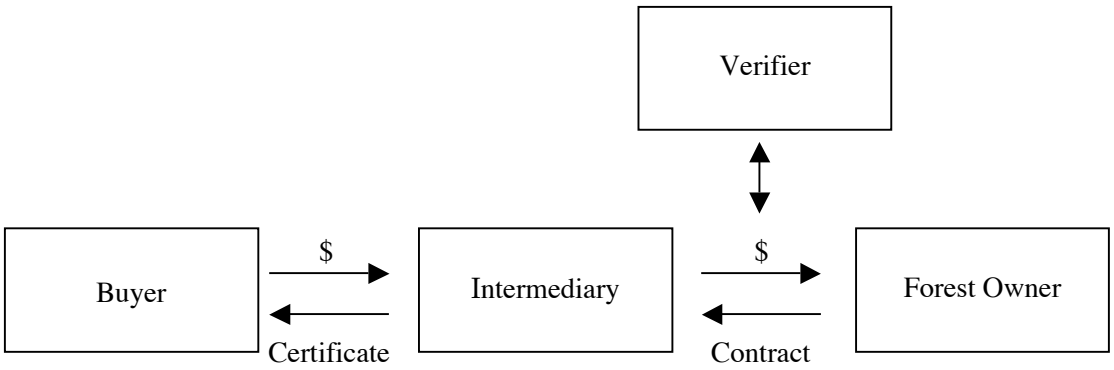
1. Biodiversity conservation: Tropical forests provide and conserve diversity with regard to genes, species, habitats, and ecosystems. Biodiversity is an important service, e.g. for the pharmacy industry (bioprospecting) and tourism. Biodiversity is often attached to other products, e.g. in case of certification of sustainable forest management.
2. Carbon sequestration: Tropical forests remove carbon dioxide from the atmosphere through the sequestration and storage of carbon. Carbon sequestration can be traded by means of "certified emission reductions" (CERs) within the Clean Development Mechanism of the Kyoto-Protocol or "verified emission reductions" (VERs) outside of the Kyoto regime.
3. Scenic beauty: Tropical forests provide visual aesthetic values. That is important, e.g. for recreation and tourism. This ecosystem service provides a range of cultural services, such as personal use and cultural identity. Entrance fees (e.g. for national parks) offer one possible mechanism to finance scenic beauty.
4. Watershed protection: Tropical forests provide filter functions for water, regulation of water flow, and prevention of erosion. This ecosystem service is important for good water quality for rural, urban, as well as for industrial and agricultural use. Upstream forest owners receive payments from downstream water consumers (e.g. hydroelectric power plant) for protecting their forests.

Below, please mark to which degree your company is engaged (e.g., purchase, investments, credits, trade of products, services, or certificates) in the mentioned ecosystem service.

	1= no engagement at all			4= medium engagement			7=main field of engagement
	1	2	3	4	5	6	7
Biodiversity conservation	☐	☐	☐	☐	☐	☐	☐
Carbon sequestration	☐	☐	☐	☐	☐	☐	☐
Scenic beauty	☐	☐	☐	☐	☐	☐	☐
Watershed protection	☐	☐	☐	☐	☐	☐	☐

C Example framework for payments for ecosystem services

This section briefly describes an exemplary framework for payments for ecosystem services. This is important in order to contextualize the following questions concerning willingness to pay. The scheme focuses on different involved actors and shortly describes their roles. Assume that the legal and institutional framework for the transactions of ecosystem services is given. Please note that the description is kept general. It does not contain all information necessary for a good investment decision. Instead, its aim is that all participants refer to a similar type of payment mechanism.



In the scheme, the ecosystem services are provided through sustainable management of forests by local forest **owners**. A **verifier** controls and monitors the sustainable management of forests and the provision of four ecosystem services: biodiversity conservation, carbon sequestration, scenic beauty, and watershed protection. The verifier controls the transparency of the transactions and assures their credibility. An **intermediary** issues certificates for the ecosystem services. Please imagine your company representing **the buyer** of certificates from the intermediary**.** The intermediary is in charge of the transaction of certificates to your company and the payments for the local forest owners. Accordingly, local owners of natural forests and forest plantations receive payments from your company. **The certificates** provide access to the ecosystem services for 5 years. During this period, your company is informed about the state of the forest each year. One unit of sustainable managed area always consists of one hectare of forestal land.

Does your company have any experience in forest projects?

Yes ☐ No ☐

Does your company have any experience in paying for ecosystem services?

Yes ☐ No ☐

D Question Part

In this section, we pose several questions concerning the willingness to pay for provision of ecosystem services. Please answer the question, to whatever degree possible, as representative for your company. If you do not know the exact willingness to pay please provide an estimate.

Imagine your company as the buyer of certificates for the four ecosystem services (biodiversity conservation, carbon sequestration, scenic beauty, and watershed protection). One unit of the certificate represents one hectare of sustainable managed forest. The types of forest mentioned in section B provide ecosystem services to a different degree. Please imagine that each ecosystem service is provided by the most appropriate forest type.

1. Below, please mark your company's annual willingness to pay for each ecosystem service.

In order to give an example, please note that in the Costa Rican Program of Environmental Service Certificates, buyers pay 60 US$ for one hectare of sustainable managed forest per year.

1.a Biodiversity conservation

How much are you willing to pay in average per year for one certificate of biodiversity conservation? The payment ensures that one hectare of forest is managed in a way that its biodiversity of high value is protected.

US$ per certificate _____

Please assess how certain you are with the answer just given.

0%= not certain at all — 100%= completely certain

0%	20%	40%	60%	80%	100%
☐	☐	☐	☐	☐	☐

1.b Carbon sequestration

*How much are you willing to pay in average per year for one certificate of carbon sequestration? The payment ensures that one hectare of forest is managed in a way that carbon is sequestered. The potential for carbon sequestration between the above mentioned forest types differ to a wide range (4-60 t CO2/ha*year). In order to reduce the complexity of the questionnaire, assume that one hectare of tropical forest sequesters 32 t CO2.*

US$ per certificate _____

Please assess how certain you are with the answer just given.

0%= not certain at all — 100%= completely certain

0%	20%	40%	60%	80%	100%
☐	☐	☐	☐	☐	☐

1.c Scenic beauty

How much are you willing to pay in average per year for one certificate of scenic beauty? The payment ensures that one hectare of forest is managed in a way that it maintains its scenic beauty? Assume that your company can choose the location of the unit of forestal land you are paying for.

US$ per certificate

Please assess how certain you are with the answer just given.

0%= not certain at all — 100%= completely certain

0% ☐ 20% ☐ 40% ☐ 60% ☐ 80% ☐ 100% ☐

1.d Watershed protection

How much are you willing to pay in average per year for one certificate of watershed protection? The payment ensures that one hectare of forest continuously provides watershed protection? Assume that the forestal land you are paying for is located in the watershed area you are interested in.

US$ per certificate

Please assess how certain you are with the answer just given.

0%= not certain at all — 100%= completely certain

0% ☐ 20% ☐ 40% ☐ 60% ☐ 80% ☐ 100% ☐

2. Below, please write how many certificates, each representing one hectare of sustainable managed forest, your company is willing to buy on average per year between 2005 and 2010.

Referring to the price mentioned above, how many certificates for biodiversity conservation would you buy on average per year?

Certificates

Referring to the price mentioned above, how many certificates for carbon sequestration would you buy on average per year?

Certificates

Referring to the price mentioned above, how many certificates for scenic beauty would you buy on average per year?

Certificates

Referring to the price mentioned above, how many certificates for watershed protection would you buy on average per year?

Certificates

3. Below, please mark which incentives and/or constraints influenced your answers with respect to the willingness to pay and the number of certificates.

Which of the following values influenced your decision concerning <u>biodiversity conservation</u>?

	1= not true at all						7= very true
	1	2	3	4	5	6	7
The service creates *direct financial income* for my company.	☐	☐	☐	☐	☐	☐	☐
The service reduces *costs* for my company.	☐	☐	☐	☐	☐	☐	☐
This ecosystem service ensures my company's *natural resources*.	☐	☐	☐	☐	☐	☐	☐
We are active in this field due to our *clients'* demand.	☐	☐	☐	☐	☐	☐	☐
It is a requirement by our *shareholders*.	☐	☐	☐	☐	☐	☐	☐
We do mandatory compensation due to *legal compliance*.	☐	☐	☐	☐	☐	☐	☐
We compensate our impacts on a *voluntary* basis.	☐	☐	☐	☐	☐	☐	☐
We expect *image benefits* in the public.	☐	☐	☐	☐	☐	☐	☐
We perceive high pressure by *NGOs*.	☐	☐	☐	☐	☐	☐	☐
We want to contribute to *human welfare*.	☐	☐	☐	☐	☐	☐	☐
We want to act *ecologically responsible*.	☐	☐	☐	☐	☐	☐	☐
Not we, but the public should pay for the service.	☐	☐	☐	☐	☐	☐	☐
Not we, but our clients should pay for the service.	☐	☐	☐	☐	☐	☐	☐
I need more information to answer the questions.	☐	☐	☐	☐	☐	☐	☐
Others:							

Which of the following values influenced your decision concerning <u>carbon sequestration</u>?

	1= not true at all						7= very true
	1	2	3	4	5	6	7
The service creates *direct financial income* for my company.	☐	☐	☐	☐	☐	☐	☐
The service reduces *costs* for my company.	☐	☐	☐	☐	☐	☐	☐
This ecosystem service ensures my company's *natural resources*.	☐	☐	☐	☐	☐	☐	☐
We are active in this field due to our *clients'* demand.	☐	☐	☐	☐	☐	☐	☐
It is a requirement by our *shareholders*.	☐	☐	☐	☐	☐	☐	☐
We do mandatory compensation due to *legal compliance*.	☐	☐	☐	☐	☐	☐	☐
We compensate our impacts on a *voluntary* basis.	☐	☐	☐	☐	☐	☐	☐
We expect *image benefits* in the public.	☐	☐	☐	☐	☐	☐	☐
We perceive high pressure by *NGOs*.	☐	☐	☐	☐	☐	☐	☐
We want to contribute to *human welfare*.	☐	☐	☐	☐	☐	☐	☐
We want to act *ecologically responsible*.	☐	☐	☐	☐	☐	☐	☐
Not we, but the public should pay for the service.	☐	☐	☐	☐	☐	☐	☐
Not we, but our clients should pay for the service.	☐	☐	☐	☐	☐	☐	☐
I need more information to answer the questions.	☐	☐	☐	☐	☐	☐	☐
Others:							

Which of the following values influenced your decision concerning <u>scenic beauty</u>?

	1= not true at all						7= very true
	1	2	3	4	5	6	7
The service creates *direct financial income* for my company.	☐	☐	☐	☐	☐	☐	☐
The service reduces *costs* for my company.	☐	☐	☐	☐	☐	☐	☐
This ecosystem service ensures my company's *natural resources*.	☐	☐	☐	☐	☐	☐	☐
We are active in this field due to our *clients'* demand.	☐	☐	☐	☐	☐	☐	☐
It is a requirement by our *shareholders*.	☐	☐	☐	☐	☐	☐	☐
We do mandatory compensation due to *legal compliance*.	☐	☐	☐	☐	☐	☐	☐
We compensate our impacts on a *voluntary* basis.	☐	☐	☐	☐	☐	☐	☐
We expect *image benefits* in the public.	☐	☐	☐	☐	☐	☐	☐
We perceive high pressure by *NGOs*.	☐	☐	☐	☐	☐	☐	☐
We want to contribute to *human welfare*.	☐	☐	☐	☐	☐	☐	☐
We want to act *ecologically responsible*.	☐	☐	☐	☐	☐	☐	☐
Not we, but the public should pay for the service.	☐	☐	☐	☐	☐	☐	☐
Not we, but our clients should pay for the service.	☐	☐	☐	☐	☐	☐	☐
I need more information to answer the questions.	☐	☐	☐	☐	☐	☐	☐
Others:							

Which of the following values influenced your decision concerning <u>watershed protection</u>?

	1= not true at all						7= very true
	1	2	3	4	5	6	7
The service creates *direct financial income* for my company.	☐	☐	☐	☐	☐	☐	☐
The service reduces *costs* for my company.	☐	☐	☐	☐	☐	☐	☐
This ecosystem service ensures my company's *natural resources*.	☐	☐	☐	☐	☐	☐	☐
We are active in this field due to our *clients'* demand.	☐	☐	☐	☐	☐	☐	☐
It is a requirement by our *shareholders*.	☐	☐	☐	☐	☐	☐	☐
We do mandatory compensation due to *legal compliance*.	☐	☐	☐	☐	☐	☐	☐
We compensate our impacts on a *voluntary* basis.	☐	☐	☐	☐	☐	☐	☐
We expect *image benefits* in the public.	☐	☐	☐	☐	☐	☐	☐
We perceive high pressure by *NGOs*.	☐	☐	☐	☐	☐	☐	☐
We want to contribute to *human welfare*.	☐	☐	☐	☐	☐	☐	☐
We want to act *ecologically responsible*.	☐	☐	☐	☐	☐	☐	☐
Not we, but the public should pay for the service.	☐	☐	☐	☐	☐	☐	☐
Not we, but our clients should pay for the service.	☐	☐	☐	☐	☐	☐	☐
I need more information to answer the questions.	☐	☐	☐	☐	☐	☐	☐
Others:							

4. The provision of ecosystem services from tropical forests depends on several framework conditions and external factors. Below, we ask for the importance of some of these factors for your company's engagement. Please answer the questions by marking one box of each scale.

How would the following aspects influence the decision for an engagement with respect to ecosystem services from tropical forestry?

	-5= negative influence					0= no influence					5= positive influence
	-5	-4	-3	-2	-1	0	1	2	3	4	5
There is an intermediary.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
There is an verifier.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
The project is located in Latin America.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
The certificates are tradable.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
The certificates are based on forestry projects.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Can you quantify an internal rate of return for a service or product for which you would buy certificates for ecosystem services?

Yes ☐ No ☐

If yes, which rate of return is required?

_____ %

Which other factors would support the decision of your company to engage in ecosystem services from tropical forests?

Which other factors would hinder a decision of your company to engage in ecosystem services from tropical forests?

E Background

In order to compare answers from different participants, we need further information about you.

Note that the answers of this section are for statistical analysis only and that your name and the name of your company will be treated confidentially.

1. We kindly ask you to answer these questions about your company.

How many employees does your company have?

Does your company provide a sustainability and/or environmental report?

Yes ☐ No ☐

Does your company have an environmental management system?

Yes ☐ No ☐

If your company invests in or donates money for tropical forestry projects, how high were these contributions in the year 2004?

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2. We kindly ask you to answer these questions about yourself.

What is your position in the company?

For how long have you worked in this position?

In which department do you work?

Please mark below, to which degree you consider yourself expert with regard to the mentioned types of expert knowledge.

With regard to the four ecosystem services, I estimate myself having

1= very little expert knowledge						7=very high expert knowledge
1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Compared to others, I estimate my knowledge with regard to economic aspects to be

1= very low						7=excellent
1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Compared to others, I estimate my knowledge with regard to environmental aspects to be

1= very low						7=excellent
1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Compared to others, I estimate my knowledge with regard to political aspects to be

1= very low						7=excellent
1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Compared to others, I estimate my knowledge with regard to social aspects to be

1= very low						7=excellent
1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐

Thank you very much for your participation. We will send you the results of the study as soon as possible.

This survey is part of a three years long international project "Demand and Supply for Ecosystem Services from Tropical Forestry", financed by the Swiss Centre for International Agriculture (ZIL) and the Commission for Research Partnerships with Developing Countries (KFPE). The Project is conducted at the Natural and Social Science Interface (NSSI) at the Department of Environmental Sciences (DUWIS), Swiss Federal Institute of Technology (ETHZ). Main partners are the Tropical Agricultural Research and Higher Education Center (CATIE), Costa Rica, and the Center for International Forestry Research (CIFOR), Indonesia.

For more information about the project, please visit our websites:

http://www.uns.ethz.ch/res/ssedm/eco
http://www.uns.ethz.ch/res/ssedm/eco/tropfor

Annex B: Tables

Table 12-1: Mean values of the degree of engagement in forestry types. Range of scale reached from 1 (no engagement at all) to 7 (main field of engagement).

Forest type	N	Mean	Std. Deviation
Primary forest	13	1.62	1.121
Secondary forest	13	1.62	1.121
Exotic species plantation	13	1.15	0.555
Native species plantation	13	1.54	1.330
Mixed plantation	13	1.77	1.363

Table 12-2: Mean values of the degree of engagement in ecosystem services. Range of scale reached from 1 (no engagement at al) to 7 (main field of engagement).

Ecosystem services	N	Mean	Std. Deviation
Biodiversity	13	1.92	1.498
Carbon	13	2.15	1.405
Scenic Beauty	13	1.42	0.900
Watershed	13	1.92	1.320

Table 12-3: Mean values of WTP with and without zero dollar answers in US$ per hectare of sustainable managed forest.

	With zero dollar answers			Without zero dollar answers		
Ecosystem service	N	Mean	Std. Deviation	N	Mean	Std. deviation
Biodiversity	10	$1.40	$3.78	2	$7	$7.07
Carbon	10	$24.40	$40.65	5	$46.8	$49.18
Scenic Beauty	11	$1.27	$3.61	2	$7	$7.07
Watershed	11	$2.36	$4.46	3	$8.67	$4.16

Table 12-4: Mean values of certainty of the WTP answer with and without zero dollar answers in per cent. Range of scale reached form 0% (not certain at all) to 100% (completely certain).

	With zero dollar answers			Without zero dollar answers		
Ecosystem service	N	Mean	Std. Deviation	N	Mean	Std. Deviation
Biodiversity	13	69.23%	37.961%	2	50%	42.426%
Carbon	13	64.62%	33.817%	5	52%	30.332%
Scenic Beauty	13	73.85%	39.484%	2	60%	56.569%
Watershed	13	66.15%	38.63%	3	60%	40.00%

Table 12-5: Mean values of motivations for biodiversity conservation. Range of scale reached from 1 (not true at all) to 7 (very true).

	N	Mean	Std. deviation
Direct financial income	10	1.6	1.578
Cost reduction	10	2.2	1.874
Natural resources	9	2.33	1.803
Client's demand	9	2.11	1.965
Shareholder requirement	9	2.11	1.965
Legal compliance	10	2.2	1.814
Voluntary compensation	10	4.1	2.183
Image benefits	10	2.8	1.751
NGO pressure	10	2.6	1.506
Human welfare	10	3.8	2.348
Ecological responsibility	10	4.6	2.171

Table 12-6: Mean values of motivations for carbon sequestration. Range of scale reached from 1 (not true at all) to 7 (very true).

	N	Mean	Std. deviation
Direct financial income	10	2.8	2.394
Cost reduction	10	3	2.309
Natural resources	9	3.22	2.539
Client's demand	11	2.55	1.864
Shareholder requirement	11	2.73	1.954
Legal compliance	10	2.3	1.767
Voluntary compensation	11	3.91	2.166
Image benefits	11	3.36	2.014
NGO pressure	11	2.73	1.679
Human welfare	11	4	2.324
Ecological responsibility	11	4.45	2.252

Table 12-7: Mean values of motivations for scenic beauty. Range of scale reached from 1 (not true at all) to 7 (very true).

	N	Mean	Std. deviation
Direct financial income	8	2	1.927
Cost reduction	8	2.38	1.996
Natural resources	9	2.56	2.128
Client's demand	8	2.25	2.053
Shareholder requirement	8	2	1.927
Legal compliance	9	2	1.803
Voluntary compensation	8	3.5	2.673
Image benefits	8	3	2.449
NGO pressure	8	2.88	1.356
Human welfare	8	3.88	2.295
Ecological responsibility	8	4.38	2.387

Table 12-8: Mean values of motivations for watershed protection. Range of scale reached from 1 (not true at all) to 7 (very true).

	N	Mean	Std. deviation
Direct financial income	8	2.25	1.909
Cost reduction	8	2.5	2.138
Natural resources	8	2.38	2.066
Client's demand	8	2.5	2.138
Shareholder requirement	8	2.13	2.1
Legal compliance	8	2.75	2.315
Voluntary compensation	8	3.88	2.416
Image benefits	8	3	1.852
NGO pressure	8	2.88	1.356
Human welfare	9	4.33	2.449
Ecological responsibility	9	4.67	2.398

Table 12-9: Mean values of the four factors for the ecosystem services. Range of scale reached from 1 (not true at all) to 7 (very true).

Factors	Ecosystem Services	N	Mean	St. Deviation	Median
Direct-interior Factor	Biodiversity	10	2.1	1.595	1.5
	Carbon	11	2.91	1.814	2
	Scenic Beauty	9	2.44	2.007	1
	Watershed	8	2.38	2.088	1
Indirect-interior Factor	Biodiversity	10	4.3	2.163	5
	Carbon	10	4.27	2.195	5
	Scenic Beauty	9	4.13	2.295	4.5
	Watershed	8	4.56	2.455	5
Indirect-public Factor	Biodiversity	10	3.7	2.058	3.5
	Carbon	11	3.82	2.136	4
	Scenic Beauty	8	3.38	2.066	3
	Watershed	8	3.25	1.669	4
Direct-public Factor	Biodiversity	10	2.5	1.434	2
	Carbon	11	3	1.414	3
	Scenic Beauty	8	2.89	2.615	2
	Watershed	9	2.75	1.753	2.5

Table 12-10: Mean values of constraints, which influenced WTP answer, assigned to ecosystem services.

Constraints	Ecosystem services	N	Mean	Std. deviation	Median
Public	Biodiversity	10	4	2.16	3.5
	Carbon	10	3	2.309	2
	Scenic Beauty	8	3.75	2.252	4
	Watershed Protection	8	4.25	2.188	5
Clients	Biodiversity	9	2.44	1.878	2
	Carbon	9	1.89	1.537	1
	Scenic Beauty	7	2.14	1.676	1
	Watershed Protection	7	2.43	2.149	1
More Information	Biodiversity	9	4.67	2.398	4
	Carbon	7	3.57	2.699	4
	Scenic Beauty	7	4.43	2.699	4
	Watershed Protection	7	4.71	2.752	6

Table 12-11: Mean values of framework conditions and external factors. Range of scale reached from –5 (negative influence) to 5 (positive influence).

Factors	N	Mean	Std. Deviation
Intermediary	11	2.09	2.119
Verifier	11	3.36	2.248
Location Latin America	11	-0.64	1.748
Tradable Certificates	12	3.33	2.146
Forest Projects	11	0.55	1.036

Table 12-12: Means values of knowledge. Range of scale reached from 1 (very low) to 7 (excellent).

Knowledge	N	Mean	Std. Deviation
Ecosystem services	13	3.62	1.805
Economic Aspects	13	4.38	1.193
Environmental Aspects	13	5.69	1.109
Political Aspects	13	5.31	1.251
Social Aspects	13	4.77	1.423