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Addressing the Knowledge – Practice Gap of Ecosystem Service Valuations

Understanding the Barriers to Building Social-Ecological Resilience in Kalimantan, Indonesia

Wolfgang Emanuel Haider

Supervisors

Philip Peck

Jonas Sonnenschein

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Tel: +46 – 46 222 02 00, Fax: +46 – 46 222 02 10, e-mail: iiiee@iiiee.lu.se.

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Abstract

Knowledge acquired through ecosystem service valuations can provide valuable information to stakeholders making land-use decisions. Effective use of ecosystem service valuation knowledge with a cost-benefit analysis can create resilient social-ecological systems. There is an increasing number of valuations being conducted, yet only one third of the studies are thought to be used in some form to aid in decision-making. The purpose of this thesis is to determine the barriers preventing more prolific use of this knowledge in decision-making processes, and to create a framework which identifies strategies to increase the use of ecosystem service valuation data and results. The use of this knowledge is applied to tropical forest ecosystems in Kalimantan, Indonesia where forests are being logged and converted to palm plantations. A literature review, systematic review of ecosystem service case studies, questionnaires and interviews were conducted in order to assess the knowledge-practice gap in ecosystem service valuations in Kalimantan. Identified barriers to the use of valuation knowledge in practice include lack of trust in data, lack of knowledge on how to use the scientific information, lack of a platform to apply the scientific results, short-sightedness of development projects and corruption. To overcome these barriers recommendations that follow from this thesis include: NGOs can promote the use of valuation data and results to stakeholders and provide training for their use, governments can create norms and laws to enforce the use of the knowledge, research donors can promote the use of applicable knowledge in funding applications and academics can engage decision-making stakeholders through the process of conducting the valuation. Further results in the context of Kalimantan illustrate that the economic benefits of conserving tropical forest ecosystems outweigh the benefits of converting the land to palm plantations in the long-run. Literature supports the fact that conservation creates more resilient social-ecological systems, meaning these valuation results can be beneficial for making decisions that increase the well-being of the people of Kalimantan.

Keywords: Ecosystem Service Valuation, Land-use decision-making, Knowledge-practice gap Resilience, Social-Ecological Systems

Executive Summary

Introduction

Human interaction with natural systems has occurred throughout history, however in recent history, a new epoch widely known as the Anthropocene has risen. Human disturbance has caused greater impacts to ecosystems resulting in a reduction of access to ecosystem services for humans. Land-use decision-making has become an issue in regions such as Kalimantan, Indonesia where tropical forests are disappearing in favour of palm plantations. The ecosystem service valuation (ESV) concept brought hope to help make more informed decisions around land-use by giving monetary values to non-market goods and services for use in cost-benefit analyses. In practice however, much of the data being produced is being ignored by decision-making stakeholders. This paper offers a strategical framework to narrow this knowledge-practice gap, illustrating how the use of ESVs can create resilient social-ecological systems, specifically in the context of Kalimantan.

Research Questions and Design

The aim of this thesis is to answer the following research questions based on the introduced problems:

i. Why are ESV data and results being neglected by land-use decision-making stakeholders?
ii. How can the knowledge-practice gap of ESVs be narrowed?
iii. Can ESVs be used as a tool to increase social-ecological resilience through the curbing of deforestation of tropical forests in Kalimantan, Indonesia?

The research questions are based on what was observed in the field in 2014 and a literature review on the ecosystem service valuation topic. To answer the first two questions a systematic review of ESV case studies was performed with follow up information acquired from the authors of the studies through a questionnaire. The final question was answered using the information acquired from the aforementioned results, complimented by interviews conducted with local stakeholders from Kalimantan. The accumulated data was used to create a scenario illustrating how the benefits of curbing deforestation and conserving tropical forests outweigh the benefits of logging, clearing and growing palm in terms of economics and creating resilient social-ecological systems.

Key Findings and Discussion Points

The current barriers to the under-use of ESVs in the context of Kalimantan include the lack of scientific knowledge to apply scientific data to decision-making processes; lack of credibility and legitimacy in data; favouritism to market over non-market values; lack of platform for ESV data to be used in decision-making; not yet accepted in the region as it is a relativity unproven and new concept; development projects are typically short-sighted; and corruption of stakeholder in a position of power.

To increase the potential use of ESVs, both decision-making and non-decision-making stakeholders should be involved in the process of conducting valuation studies by academics. Local academics should be involved in the entire process to gain acceptability, local inhabitants should be involved in finding non-market values in a deliberative process, decision-makers should help scope the project as they can determine what kind of information is important for them. Academics should create easily understandable scenarios and results with tangible outcomes, in addition to providing information to the stakeholders in a transparent and open

manner to allow for easy to use and find information. NGOs can provide training to stakeholders to help them learn how to use the knowledge while promoting its use to various decision-makers at all levels. Governments can set up norms to encourage informed land-use decision-making; ESVs could be an avenue to achieve this. Donor research institutions can offer funding to academics doing research thinking about the practical use of the knowledge they aim create.

Results showed that conservation of tropical forests yields greater economic benefits to the general population than conversion to palm plantations in the long-term and conservation can lead to more resilient social-ecological systems through greater access to various ecosystem services for the general public, a diversified economy, poverty alleviation and the conservation of biodiversity.

Conclusions

Universal agreement that ESVs can solve the deforestation problem in Kalimantan and create social-ecological resilience does not exist, however some strategies can be taken to increase the chance of their usage and potential resulting resilience, as the successful application of optimising land-use with the help of ESVs does exist. The challenge lies in getting all of the potential players who could increase the usage of ESV knowledge to buy-in and play their part in promoting the concept. Similarly, the challenge in the context of applying ESV knowledge in the context of Kalimantan lies in the fragmented and decentralised decision-making structure. Individual stakeholders could successfully apply ESV knowledge to their decisions, however due to the multiple players making decisions on overlapping parcels of land, each level would need to embrace the concept to have effective outcomes of resilience. Further evaluation of the effectiveness of the laid-out strategies is required along with the monitoring of outcomes to assess the resulting level of social-ecological resilience.

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Abbreviations

CBA – Cost-Benefit Analysis

ESV – Ecosystem Service Valuation

MEA – Millennium Ecosystem Assessment

NGO – Non-Governmental Organisation

NTFP – Non-Timber Forest Product

TEV – Total Economic Value

1 Introduction

The Anthropocene has widely been accepted as a new epoch in the Earth's history. It is defined as the era of human activity leaving a pervasive and persistent signature on Earth systems (Waters et al., 2016). The planet has boundaries, which are being stressed by this anthropogenic change. Some regions' boundaries are more severely impacted by the human induced changes than others. Biodiversity loss as a result of land-use change is a serious problem, in which Indonesia is identified as one of the regions with the highest degree of risk involving the impacts of land system changes (Steffan et al., 2015). The land-use changes in Indonesia predominantly come in the form of deforestation and conversion to palm oil, resulting in the loss of biodiversity. Globally, Dirzo et al. (2014) found that 322 species of terrestrial vertebrates have become extinct since 1500, with the total number of existing vertebrate populations having declined by 25%. Invertebrate populations have suffered even more in comparison. The impact of these losses comes in the form of reduction of ecosystem functions and services. For example, the loss of biodiversity results in a reduction of seed dispersal, pollination, nutrient cycling, water quality and much more. This all results in the decline of access and availability to the resources humans require for optimal well-being and basic survival. As humans continue to develop and convert landscapes to feed and power human needs, the world's natural systems will become more threatened, creating a paradox between providing for and threatening humankind. Responsible decision-making resulting in sustainable land-use is essential to stop or at least slow the rate at which we deplete our resources.

To combat the issues above, the concept of ecosystem services has become a specific area of interest to help decision-making stakeholders make informed and effective choices concerning land-use. If ecosystem services are not considered in the decision-making process, humans will need to create and pay for systems that nature currently provides free. Knowledge concerning the benefits of the conservation of nature in that sense, creates social-ecological resilience (Berkes and Turner, 2006), as it ensures the free provision of ecosystem services. This is especially important in regions hosting traditional land-users who are dependent on the forest ecosystems who live within and near tropical forest ecosystems, including Kalimantan, Indonesia.

1.1 Background Information

Ecosystem services can be broadly defined as "the conditions and processes associated with natural ecosystems that confer some benefit to humanity" (Van Wilgen et al., 1996). They can be broken down into four distinct types (see Table 1-1), outlined by the Millennium Ecosystem Assessment (MEA) (2005): provisioning, regulating, cultural and supporting. These, to varying degrees, contribute to the necessities of life in the form of the basic material required for survival, health, security and social relations. Without ecosystems and their services, humans would cease to exist (MEA, 2005). Therefore, it is imperative to understand how humans' interaction with the environment alter the social-ecological systems that we are a part of (Guerry et al., 2015). According to Folke (2006), successful understanding, management and adaptive governance of these systems, of which ecosystem services are an integral part, lead to the creation of resilience. It is believed that conceptualising and mapping various ecosystem services can be a helpful tool to achieve resilience (Fisher et al., 2013).

Table 1-1 Types of Ecosystem Services, Definitions and Examples. Source: MEA (2005).

Type of Ecosystem Service	**Definition**	**Examples**
Provisioning	Provide the basic necessities for human survival	Food (Berries) Water (River) Shelter (Wood) Fuel (Wood)
Regulating	Regulate potential problems through natural processes	Flood control (Forest) Water quality (Peat soil) Climate Change (Carbon storage)
Cultural	Spiritual, recreational and educational provision	Spiritual (Traditions) Recreation (Exercise) Education (Hunting)
Supporting	Combinations of supporting services combine to create other types of services	Nutrient cycle Pollination Deposition of nutrients from a river

Moreover, ecosystem services can be given a monetary value through ecosystem service valuations (ESVs). These are one way that ecosystem services can be used as a tool to help key stakeholders make more informed and strategic decisions, assessing the economic trade-offs of varying economic activities, resulting in more sustainable and efficient land use strategies (Adams, 2014; Carrasco et al., 2014; Costanza et al., 2017; Ferreira et al., 2017; Fisher et al., 2010; TEEB 2010). As the capitalist paradigm currently dominates politics, economic data is most familiar and easily understood by decision-makers, therefore some experts believe that expressing ecological data in monetary terms simplifies the understanding of the importance of the ecosystems services a healthy environment can provide (Zhang et al., 2017).

A thorough understanding of the value of ecosystem services can be essential to impede the deforestation problem in tropical forests, and specifically in Kalimantan, Indonesia. Kalimantan is the Indonesian portion of the island of Borneo (see Figure 1-1). It is especially important to increase awareness and use of ESVs involving the tropical forests of Kalimantan as they provide essential services to local, regional and global citizens alike. According to Krieger (2001), there are eight types of services with value, which can be derived from forest ecosystems specifically. These services and specific examples of each are described in Table 1-2.

Figure 1-1 Map illustrating Kalimantan's location on the island of Borneo. Source: Google Earth Pro.

Table 1-2 Forest ecosystem services and their economic values to humans. Source: Krieger (2001).

Forest Ecosystem Service	**Examples of Economic Value**
Climate Regulation	Reduced risk of flooding, drought and heat waves
Waste Treatment	Clean water provision, breakdown of biological waste, nutrient cycling
Food Production	Reduces food dependency
Recreation	Place of tourism, education, fun
Raw Materials	Provides timber, NTFPs
Soil Formation	Allows formation of fertile soils, reduces soil erosion and degradation
Biological Control	Reduces risk of pests and disease
Cultural	Spiritual value, retention of traditions, recreation and education

Assigning values to these services can be challenging, however a number of methods exist, each with benefits and drawbacks. For example, some services such as food production are beneficial and quite simple to measure through the market price of the consumed goods that do not need to be purchased, yet extracting value from cultural services for example, can be more challenging (Hirons et al., 2016), as they are not sold on an open market. They still have value to the local population in the form of traditional knowledge retention, health, general well-being, etc. These cultural services can actually benefit more people in society than the few people involved in monoculture practising palm plantation can; furthermore, cultural values can create more resilient social-ecological systems, as knowledge of how to survive during times of shock can be ingrained in traditional land-use practices (Folke 2004). More often than not however, decisions made by the elite landowners and prevailing institutions are short-sighted, as the current economic system rewards earning income as rapidly as possible (Guerry et al., 2015). Therefore, it can be concluded that the long-term well-being of humankind is put at risk for short-term profits, and it is in these situations that the values of conserving tropical forests is overlooked.

Tropical deforestation has both local and global impacts on humankind. First and foremost, clearing of forests creates warmer and drier conditions locally, while altering weather patterns on a more regional scale, creating drought and more vicious storm cycles (Lawrence and Vandecar, 2015). These climatic changes can alter agricultural productivity around the world as well. Temperature change, soil moisture content and precipitation patterns change the viability of growing certain plants in a given region. Furthermore, land-use change has been identified as the largest threat to biodiversity (Sala et al., 2000), with the logging of forests and conversion to palm oil being identified as the most detrimental (Philips et al., 2017) and prevalent in the Kalimantan context. The logging of pristine forests has detrimental impacts to biodiversity (Burivalova et al., 2014). Table 1-3 illustrates the impacts of varying intensities of logging. Summarised briefly, birds are not affected by logging, however mammals and amphibians are increasingly impacted as logging intensifies. The maintenance of high levels of biodiversity is important for the resilience of humans (Sunderland, 2011). Sunderland (2011) states that protein intake stems from wild ancestors, and that rural communities are still dependent on wild meat for nutrition. Furthermore, it is a food security safety net for times of shock, when crops fail from drought, soil erosion, pests or when disease strikes domesticated animals. Ecosystem services and biodiversity also enable agriculture through the many processes and cycles it provides, namely through watershed retention, pollination, seed dispersal, nutrient cycles etc.

Table 1-3 Logging intensity implications on different classes of fauna. Data source: Burivalova et al (2014).

Logging Intensity	**Birds (Impact to species richness)**	**Mammals (Impact to species richness)**	**Amphibians (Impact to species richness)**
Logging intensity < 10 m^3/ha^{-1}	No Impact	No Impact	No Impact
Logging intensity > 10 m^3/ha^{-1}	↑	Minimal impact	Minimal impact
Logging intensity > 38 m^3/ha^{-1}	Further ↑	~50% ↓	~30% ↓
Logging intensity > 63 m^3/ha^{-1}	Further ↑	~65% ↓	~50% ↓

Deforestation on the island of Borneo is happening at unprecedented rates. In 1973, 76% of the island was considered to be old-growth rain forest; today, that proportion has dropped to less than 50% (Gaveau, 2017). The tropical forests of Kalimantan, are biodiversity hotspots with a plethora of flora and increasingly rare fauna inhabiting the remaining parcels of forest (Meijaard et al., 2017). Amongst the fauna are the iconic orangutan (*pongo pygmaeus)*, elusive clouded leopard (*neofelis diardi borneensis)* and local food source bearded pig *(sus barbatus)* (see figure 1-2). Limiting the encroachment of destructive economic activities into these remaining ecosystems is essential for the survival of both the local and global population of plants, animals (Barlow et al., 2016) and humans alike, as tropical forests are the most significant climate regulating biome on Earth (Lewis et al., 2015). In addition to ensuring suitable habitats for biodiversity, tropical forests provide goods and services for the local people, in the form of employment, resource provision and options for future generations, as an intact forest provides the opportunity to decide from a variety of economic activities rather than one limited activity from a cleared landscape. If decision-makers are made aware of the economic values of standing forests, and incorporate the values of the ecosystem services they provide in their decision-making process, then the destruction of these invaluable lands could potentially be slowed, stopped or even restored (Bullock et al., 2011). The ecosystem services concept can be a useful tool to help people in this region of the world make more informed decisions by understanding the irreplaceable value of tropical forests, versus alternative short-term economic activities such as logging, palm and rubber plantations and mining (Laurans et al., 2013; TEEB, 2010; Daily et al., 2009; De Groot et al., 2006).

Figure 1-2 Important fauna of Kalimantan.

1.2 Problem Definition

Landowners and governments tend to favour decisions based on what can earn them monetary income in the fastest manner (Meijaard et al., 2017). Logging was and still is seen as a profitable activity and Borneo's forests were a seemingly inexhaustible resource. As the accessible old-growth forests disappeared, the landowners naturally sought opportunities to earn more from the land. Due to the necessary time of waiting 50 to 100 years for lowland forests to regrow, regeneration was not seen as an option able to deliver short-term cash flows. Therefore, they began to plant fast growing trees such as pine and eucalyptus, which could be harvested within 10 years (Meijaard et al., 2017). Finally, over the past 40 years, palms have become the crop of choice, as they begin to yield kernels for oil processing within 3 years of being planted. The quick profit from planting oil palms is a major contributing cause to the central problems associated with deforestation. The values of standing forests on the other hand, are derived among others, in avoided costs, which people tend to forget about or neglect until it becomes too late. An example is the cost of repairing homes from flood damage as a result of a lack of peat forests which can absorb excess water (Ming et al., 2007; Dommain et al., 2010), or the need to purchase clean water as the rivers become contaminated with highly polluting chemicals such as palm oil mill effluent from the ever-expanding palm industry (Liew et al., 2015). Another such example is the loss of certain species from substituting and fragmenting tropical forests with palm plantations. Animals which eat fruit and disperse seeds can be impacted by the loss of suitable habitat (Elmqvist et al., 2004) and thus plant species eaten by the bearded pig become sparser and their populations decline two-fold as their habitat and food source decline. The list of examples goes on, from regulating flooding, ensuring water quality, climate regulation, food production, sourcing raw materials, controlling pests and diseases etc. Therefore, it is believed that ESVs can play a role in illustrating to key stakeholders the value of standing forests, as ecosystems services are given values that can be easily compared to other economic values. The end result can then become more resilient social-ecological systems.

The ecosystem services and ESV concepts were popularised about 20 years ago with Costanza *et al's.* (1997) paper estimating the value of the world's ecosystem services. It gained more notoriety in 2005 with the MEA (2005) and again in 2010 with the publication of TEEB (The Economics and Ecosystems and Biodiversity) (2010). Numerous, more localised studies followed, with some yielding overwhelming success (Guerry et al., 2015), helping stakeholders make more effective land-use decisions based on economic data, optimising human well-being and conserving the environment. For example, one valuation study illustrated the billions of dollars New York City would and did save by conserving upstream watersheds rather than building and maintaining a filtration system in the city (Appleton, 2002). Although such valuation data can help make more effective land-use decisions involving any type of ecosystem beyond just tropical forests, data is often collected but not used to make more informed decisions (Cowling et al., 2008; Liang et al., 2017; Posner et al., 2016). Many studies illustrating this gap between knowledge and action exist.

Currently, ESVs are not being used as common practice in decision-making processes. Knight et al. (2008) found that two thirds of all conservation assessments did not result in any specific conservation action, in large part due to a lack of implementation planning. Considering the lack of financial resources available for conservation, allocating funding to research without considering implementation is essentially wasted time and money. A further example specific to ESVs, found that only 17% of valuation studies in the Caribbean were actually used in a stakeholder decision-making process (Waite et al., 2015).

As a result, experts have been calling for the creation of a framework or model to follow, which would increase the use and comprehension of ESV data which can be useful for conservation in real life practice (Bennett et al., 2015; Paudyal et al., 2015). Effective incorporation of ESV

data in decision-making remains an exception not a rule (Guerry et al., 2015). Therefore, this paper aims to discover why ESV results are being neglected by decision-makers with the purpose of creating a strategic framework to increase the probability of the application of ESVs in land-use decision-making. As a specific case used to provide focus and context to the work, the aim and purpose will be developed around and applied to the curbing of deforestation and increase of social-ecological resilience in Kalimantan, Indonesia.

1.3 Research Questions

Given the provided information, the following research questions will be answered:

i. Why are ESV data and results being neglected by land-use decision-making stakeholders?
ii. How can the knowledge-practice gap of ESVs be narrowed?
iii. Can ESVs be used as a tool to increase social-ecological resilience through the curbing of deforestation of tropical forests in Kalimantan, Indonesia?

1.4 Scope and Limitations

There are some assumptions that need to be made before the outlined problem is explored further. These assumptions are based on interviews with local stakeholders from Kalimantan and on my own previous experience in the field (2014). They are required to be outlined as they must be considered when making a framework about the topic at hand.

First, the Indonesian government sees palm oil as 'development' as it is viewed as alleviating poverty and growing the economy (Susila, 2004), although some scholars disagree (Van Beukering et al., 2009; Turnet et al., 2003). Palm oil expansion has occurred all over Kalimantan and is now pushing on to the island of New Guinea (Palm Oil Employee interview, 2018).

Second, the Indonesian governance structure is decentralised and disorganised (NGO Founder interview, 2018; Bubandt, 2006). Following the fall of Suharto in 1998, decentralisation of power began which led to the local elites grabbing for power (Bubandt, 2006). There are multiple levels of bureaucratic governments making decisions and plans about the same pieces of land, as one level has jurisdiction about palm oil and coal mines while another makes decisions about forestry. With a lack of proper communication and cooperation between the governments one can imagine how confusing the land-use decision-making process can be when conflicting decisions are being made about one parcel of land (NGO Founder interview, 2018).

Third, corruption is a real problem, where policies and laws are often ignored for personal monetary gain. Large land-using companies are lobbying to the different levels of government to gain access to new land despite customary law of the indigenous people indicating the protected status of the same parcel of land (Indigenous Dayak, interview, 2018). Relationships between deforestation, corruption and the palm oil industry were established by Eldeeb et al. (2015), further backing up the assumptions made in this paper.

Fourth, the indigenous customary law of the Dayak people in Kalimantan is recognised by the national government but is still very weak when they interact with more local levels of government (Indigenous Dayak interview, 2018; NGO Founder interview, 2018). According to Transparency International's (2018) most recent corruption perception index, Indonesia is currently ranked 96th out of 180 countries with a score of just 37 out of 100 (0 being most corrupt, 100 being least corrupt). These issues may be up for debate, however for the purpose

of the research I will assume these to be true while analysing qualitative and quantitative data to help answer the research questions.

Fifth, some terms need to be clarified to reduce confusion. Decision-making involves any stakeholder who can alter the landscape through their decisions in a legal manner. This involves the private sector and public sector from national, regional and local governments and small-scale land owners. In the context of this paper, ESV results are specific outcomes from ESV studies that create scenarios or recommendations for stakeholders to use in their decision-making process. ESV data is information or knowledge within valuation studies, that do not directly guide decision-makers, but give information or values about land that can be independently interpreted by stakeholders. Social-ecological systems are the human-nature interactions that should not be delineated as separate, as the boundary is artificial and arbitrary (Folke et al., 2016). The change of one component automatically impacts the other. Resilience in this thesis. refers to how well a social-ecological system can adapt to a change or shock from a variety of sources (Woods and Cook, 2006).

Limitations to the quantity and quality of data available to make the most effective analysis possible existed for this study. The time allocated for the MSc thesis project did not allow for large data sets to be collected and analysed in the systematic review. The interviewed persons were from contacts made while working in the field in 2014, mostly from the province of East Kalimantan, from which the results are being generalised to Kalimantan as a whole. Further email questionnaires were to the authors of the case studies, however the lack of responses and lack available email information to send questionnaires was a problem, therefore the response rate is quite low. Some interviews were conducted in Indonesian. The author's Indonesian language is at working level but is not fluent, therefore some limit to the depth of the conversations existed.

1.5 Outline

This thesis is outlined as follows:

Section 2 shows the methodological framework used to answer the research questions, along with the specific processes used to obtain data, conduct each research method and how the results were analysed.

Section 3 presents the results from the literature review which ties together the concepts presented in chapter 1. Furthermore, it rationalises why the research is important and identifies the potential problems with ESVs and the manner in which they should be conducted to yield optimal results. It illustrates (1) why ESV data is being neglected; (2) how the knowledge-use gap of ESV data can be narrowed; and (3) how the ESVs can in theory help curb deforestation, resulting in social-ecological resilience in the context of Kalimantan.

Section 4 presents the findings of the research. It illustrates the results of the systematic review, questionnaires and interviews, and concludes with an analysis of the results.

Section 5 discusses the implication of the findings on the research questions. A best practice model is presented for future ESVs to maximise the positive impacts they can have on deforestation and their surrounding communities by optimising the potential use of the data they produce to make informed decisions about land use involving the conversion of tropical forests, creating resilient social-ecological systems.

Section 6 concludes the research, summarising the problem, results and way forward for all stakeholders involved in the process of ESVs and decision making. Ideas for further research based on the apparent gaps are suggested.

2 Methodology

The objective of this study, is to determine if there is evidence supporting the use of ESVs to build resilient social-ecological systems, and how ESV knowledge can best be applied in practice relevant to land-use decision-making processes in Kalimantan, Indonesia. The specific motivation behind the research comes from field experience working for a small grassroots NGO in East Kalimantan. The experience exposed me to the problems associated with land conversion from tropical forests to mostly palm plantations. I witnessed first-hand how deforestation and the resulting palm plantations degraded the environment and reduced the access to the forests ecosystem services for the indigenous Dayak people of the region. Working alongside the Dayak, in protecting a parcel of forest, I saw the struggle for power to save what little piece of their ancestors' way of life remained, sitting in meetings with palm and logging companies, and community level governance meetings. The aim of this research is how ESV knowledge is or is not mobilised to promote conservation of some of the region's last remaining tropical forests.

The first step in the research was to conduct an in-depth literature review on the topic of ESVs in Kalimantan, which helped to refine the research questions of this thesis and provide an overview of the problem space. To answer research questions 1 and 2 a systematic literature review of 24 case studies involving ESVs in the Southeast Asian context was completed. Stemming from the information acquired from the literature review and the results from the systematic review, a questionnaire was created to follow-up with the authors of the case studies for additional information. The questionnaires were structured with the same questions being asked to each of the authors. Additionally, in-depth interviews were conducted to link the knowledge from the literature reviews to the context of Kalimantan, to give the research a more practical focus in addition to eliminating potential bias about some of the assumptions I made based on the field experience. Three key informant interviewees were selected based on a snow-ball methodology from a key contact (Miles and Huberman, 1994) based on previous field experience. The interviews were semi-structured with customised and pre-defined questions for each interviewee, with space for open discussion and follow-up questions. Stakeholders that were interviewed included a local indigenous Dayak person involved in the local tropical forest conservation effort and involved in a small-holder family owned palm plantation, an environmental officer of a large-scale palm oil company and the former founder and CEO of a conservation NGO. Each of the people interviewed were involved in the Kalimantan context. A flow chart (see Figure 2-1), visualises the path taken to reach the results and how one portion of the research process led to the next. The darker the shade of the box represents the more recent point in time of the research. Each of the methods are discussed in detail in the sections below. They are indicated with stars in the flow chart.

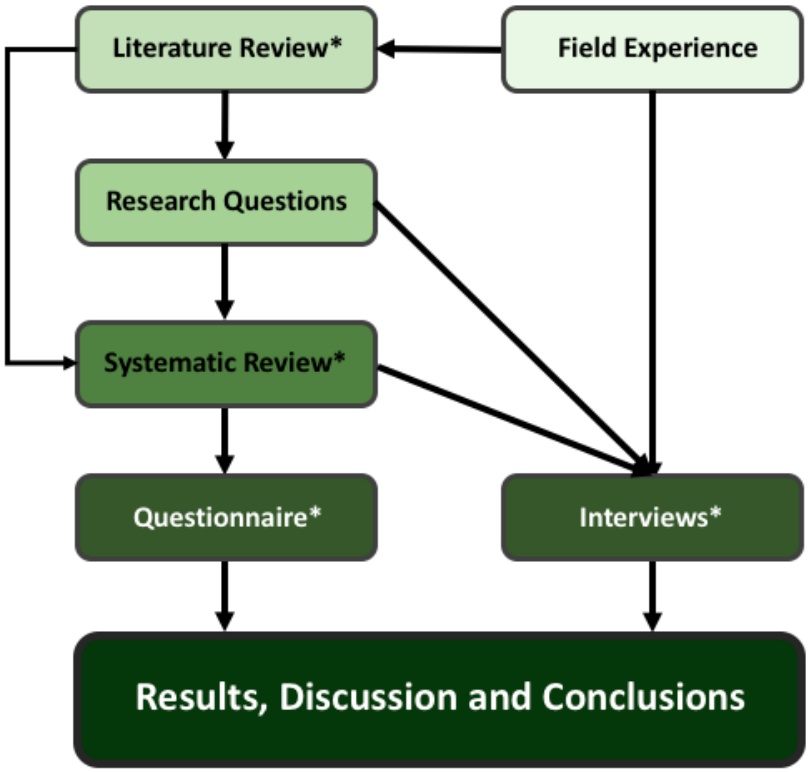

Figure 2-1 Flow of methods used to arrive to results for discussion. The time frame of when each activity occurred is illustrated by the lighter shades of green (earlier) to the darker ones (later).

2.1 Literature Review

An initial broad literature review was performed to give background information about how ESVs work, how they can vary, validate the use of ESVs in decision-making arenas for the mitigation of deforestation, and exploring the potential positive socio-economic impacts of having a healthy and intact tropical forest in the proximity of a community. Furthermore, ESVs and their connection to social-ecological resilience is demonstrated. The research questions outlined in section one were created by using the literature around multiple topics, namely ESVs, ecosystem services, deforestation, social-ecological resilience, palm oil and land-use decision-making. Finally, as the arrow between the literature review and systematic review shows, the parameters used to review the case studies were determined through understanding ESVs and the knowledge-practice gap between ESVs and land-use decision-making. Literature was retrieved using the search terms "ecosystem service valuations, decision-making, land-use, resilience, social-ecological systems" with the "Google Scholar" search engine along with the Central European University and Lund University databases. Further literature was acquired from contacts involved in consulting and research institutions informed on the topic of ESVs and the case of Kalimantan.

2.2 Systematic Literature Review of Case Studies

A second, more systematic literature review of case studies of ESVs was completed primarily to help answer the first two research questions, pertaining to the under-use of knowledge acquired from ESVs in decision-making and how to bridge the gap between this knowledge its use in practice. Furthermore, information from this systematic review helped to create economic data illustrating that conservation over other economic activities such as oil palm agriculture are favourable.

To find the case studies the terms "Ecosystem Service Valuation" combined with regions or countries in Southeast Asia were searched, initially from "Google Scholar". Reference lists from studies already evaluating other ESV case studies were used to snowball research and find additional sources. Any valuation study found that was referring to tropical forest ecosystem in in the Southeast Asian region, was added to the list of potential case studies to be used and analysed in the systematic literature review.

Overall, 33 ESV case studies relating specifically to forests, predominantly in Southeast Asia were selected. For example, case studies were chosen if there was mention of ESVs and forests in or near Southeast Asia. The Southeast Asian cases were chosen to maximise the similarities of the forests, economic activities and geopolitical situations of the cases to be most easily applicable to the context of Kalimantan. Following the filtering of case studies by location, further elimination of cases to be used for the analysis occurred while reading the documents. From the initial 33 caste studies, 9 were eliminated, leaving 24 with sufficient and relevant information to be analysed. The elimination process was dependent on the papers' relevance to the context, availability of data to be analysed, the ecosystem services being valued, the quality of the report (one report had poor English and was difficult to follow) and if the main focus was the valuation itself (some studies involved a valuation but lacked information regarding the ESV itself). Initial literature review readings from the first step, were aimed to determine a number of parameters to be evaluated during reading of the case studies which were based on their relevance to help evaluate data to answer the research questions. These parameters included the results of the valuations, whether conservation of land or landscape conversion was recommended, the valuation methods used, how many ecosystem services were valuated and if the study was a Total Economic Value (TEV), if there were any mentions of land-use and most importantly if they mentioned decision-making with a sub-parameter to determine if any attempt or measures were taken to ensure use of the valuation data in decision-making processes. In total, valuations from 11 different countries were analysed, ranging from the years 1995 to 2017. See table 2-1 for basic information regarding the case studies including, their country, publication year, if it was used in the analysis, if authors were contacted for the questionnaire (those who mention decision-making as practical use of the study) and if they provided a response. Table 2-2 provides information regarding the parameters used in the analysis, their definitions and examples of the results. The full systematic review results and parameters can be found in appendix A.

Table 2-1 List of case studies details, including rejected papers for analysis, authors contacted for questionnaires and responses.

No.	Country / Region	Publication Years	Rejected for analysis and Reason	Attempted to make Contact for Question-naire	Answered Question-naire
1	Malaysia (9)	1995, 2005, 2007(x4), 2009(x2), 2011	2– Product specific, old, lack of data to analyse	5	1
2	Indonesia (8)	2003; 2004; 2008; 2009; 2010; 2011(x2); 2015	2 – Main point not ESVs, no ESV data to analyse	5	2

3	Vietnam (4)	1999(x2); 2003; 2006	1 – Missing details about study, focus Payment for Ecosystem Services	1	0
4	China (3)	2011; 2017(x2)	1 – Poor quality, content did not make sense	2	0
5	Nepal (2)	2012; 2015	0	2	0
6	Laos (2)	2005; 2009	1 – Product specific, lack of data to analyse	1	0
7	India (1)	2016	0	1	0
8	Iran (1)	2010	0	1	1
9	Japan (1)	2013	0	1	0
10	Philippines (1)	1996	1 – Old and outdated methods	N/A	N/A
11	South Pacific (1)	2013	1 – Not specific to region, not purely forest related	N/A	N/A
Total	**n = 33** **n = 24 after rejections**	**N/A**	**9**	**19**	**4**

Table 2-2 Definitions and example of parameters used in systematic literature review of case studies.

Parameter	Definition	Example
Methods used	Which methods were used to deduce an economic value of the ecosystem services of the study area.	Market Value (MV); Market Price (MP); Contingent Valuation (CV), Equivalent Value Factor (EVF); Hedonic (H); Production Function (PF); Revealed Preference (RP); Opportunity Cost (OC); Stated Preference (SP); Willingness to Pay (WP); Avoided Cost (AC); Damage Cost (DC); Travel Cost (TC); Benefit Transfer Approach (BT), Employment; Replacement Cost; Net Revenue; Residual Price

Result of TEV (if applicable), if high and low range was provided an average was used	Value derived for the given area of study in 2015 Euros per square kilometre.	Min – 16546 Euros/km^2 Max – 46026557 Euros/km^2 Median – 508 999 Euros/km^2
Recommendation of land-use by author	Determines if results of study showed more benefits for conversion of landscapes or conservation of forests.	Conservation wins; Both; Conservation loses ; or N/A
Mentions of decision-making	Counted how many times decision-making was used. Counted for each point made about decision-making.	Results shown as a range of 0, 1-3, 4-6, 7-9, 10+
Mentions of knowledge-practice gap in decision-making	Counted if the application of data in decision-making was addressed.	Results was considered as "Yes/No"
Mentions of land-use	Counted how many time land-use was used. Counted for each point made about land-use.	Results shown as a range of 0, 1-3, 4-6, 7-9, 10+
Ecosystem services valued	Determined which ecosystem services were being valued or if ESV used a TEV.	Results were either TEV or the specific ecosystem services valued.

2.3 Questionnaires

The short questionnaire, consisted of six questions and was sent to all of the relevant authors of case studies (those who mention decision-making as practical use of the study). Authors from studies that were very old, for example from the 1990s were also not contacted. There were 4 valuations studies with similar authors from Ayer Hitam Forest in Malaysia, each evaluating different ecosystem services, therefore only the one focusing on a TEV was contacted, including some secondary authors. The questionnaires were sent via e-mail with a link to the questionnaire page created using "google forms". Unless the authors indicated that they were willing to be mentioned, they were told their answers would be kept anonymous, therefore the respondents' answers will be coded as "Questionnaire, A, B, C and D". The questions asked to the authors can be found in appendix B. The primary purpose of the questions was to follow up the systematic review, to see if the authors were aware of their valuation data and results being used for decision-making, which was not mentioned in the papers at the time of publication. Additionally, it was asked if the data was used for any purpose other than decision making, if locals were involved in the process of decision-making, if they had any ideas about how to increase the use of ESV knowledge in decision-making and why they think the current knowledge-practice gap between ESVs and land-use decision-making exist. The questions were formulated based on the gaps in research identified in the literature review and on information that required additional information not published in the case studies (i.e. asking if the knowledge from the ESV was used in decision-making after the study was completed). The questionnaire helped primarily to answer the first two research questions. The questions were

asked in an unbiased manner, giving the respondents the opportunity to explain their answers in paragraph form. Out of 19 identified authors to be sent a questionnaire, only 4 responded. Lack of contact information made it challenging to track down valid email addresses of the given authors, in addition to a lack of responses of emails, despite sending questionnaire completion request two times. A thorough search was conducted using the contact information provided in the publications, Google, LinkedIn and university websites to track down the authors when possible. Appendix A shows which authors were attempted to be contacted and if they responded or not. Those responses that were received provided rich and plentiful information, which backed up many hypotheses.

2.4 Interviews

The interviews were a combination of structured and semi-structured, conducted using a variety of methods depending on the person being interviewed (Miles and Huberman, 1994). The original questions for each person interviewed can be found in appendices, C, D and E. The discussion elaborated from the original questions in each of the interviews. Facebook was used to contact and ask semi-structured questions to an indigenous Dayak person of Kalimantan who is involved in the local conservation effort of a 38 000-hectare forest protected by customary law, his family also owns a small-scale palm plantation. The platform was used as it is the only type of contact able to be used to reach the interviewee. It also allowed for time to be taken between questions to ensure questions and responses were understood, given the slight language barrier. Second, a structured interview was conducted via email with an employee of a large-scale palm company who has worked in both Kalimantan and Papua. Lastly, Skype was used to interview the former CEO and founder of a conservation NGO in East Kalimantan; this interview was semi-structured to allow for discussion about the geopolitical climate of the area. Questions were laid out and then followed up with additional questions as necessary. If a point arose that required clarification or elaboration, follow up questions were asked. These interviews were conducted in both English and Indonesian. The respondents were chosen based on the connections made while working in the region. They are people familiar with the decision-making process for governments, companies and locals in the Kalimantan context. The indigenous interviewee was chosen due to his knowledge on the issues being discussed and proficiency in English. The palm oil employee was chosen as he had interaction with decision-makers in the region and was educated on the topic of palm oil and sustainability science. The NGO founder had worked conservation in Kalimantan for 5 years and was familiar with the geopolitical climate and the social-ecological systems and ecosystem services concepts. See table 2-3 for a clarification of how the interviewees' opinions are relevant and valid to help answer the all three of the research questions. They primarily helped to clarify ESV use in the context of Kalimantan.

Table 2-3 Interviewees, method of interaction and relevance to topic.

Interviewee	Method of Interaction	Relevance to Topic
Local Indigenous Dayak Involved in Conservation Effort and Small-Holder Palm Oil Plantation	Facebook Messenger	Involved in decision-making on Indigenous Land / Knowledge of Geo-Political Situation / Opinion on Viability of ESVs
Former Large-Scale Palm Oil Employee	Email	Insight to inner workings and plans of large company
Founder of NGO working in community conservation project	Skype	Familiar with Geo-Political Situation / Opinion of on Viability of ESVs

2.5 Analyses

The systematic review of ESV case studies and the questionnaires helped answer the first two research questions while the third was answered using data from each of the methods. The data from the systematic review was analysed in Microsoft Excel. The frequency of mentions of decision-making and the knowledge-practice gap were counted, using tabulation graphs to illustrate the data. The absolute values of the ecosystem services, and the results, concluding whether it was more favourable to convert or conserve the ecosystem was evaluated through the calculation of per km^2 value in 2015 Euros. The recommendations were interpreted to evaluate whether the authors concluded that conservation or conversion of the forest landscapes was more economically profitable in terms of ecosystem services provided. The questionnaires were analysed by summarising the responses, then synthesised to generate a list of reasons why ESV data is currently under-used and what strategies can be taken to increase the effective use of ESV.

The interviews were used to complement the understanding of the first two research questions. Given that the systematic review and the questionnaire focused on knowledge generation of ESV, the interviews were used as a complementary methodology to better understand the barriers of implementing ESV knowledge creating the knowledge-practice gap. No formal coding technique was used for the interviews, but rather an inductive approach (Miles and Huberman 1994) was followed in which relevant statements regarding the ESV knowledge implementation gap were pulled out to deepen and contextual understanding of the results from the systematic review and questionnaire in the context of Kalimantan.

Finally, using results from the systematic and literature reviews and interviews, a scenario was created to evaluate whether conversion to palm plantation or conservation of tropical forest was economically more favourable. Data about the potential market and non-market values generated by logging an area then planting oil palm was graphed against the potential profits from ecosystem services provided by conservation. By combining the quantitative data from the systematic review with the qualitative data from the questionnaires and interviews, conclusions were made regarding if conservation was economically a preferable option, how it could increase social-ecological resilience and how the ESV knowledge can be applied in real-life decision-making more effectively.

3 Literature Review

The aim of the literature review is to clarify the process of conducting ESVs and how they can help make informed land-use decisions. To understand how ESVs work and can help land-use decision-making, it is necessary to understand certain components of conducting and using ESVs. First, the types of values that can be given a monetary worth and how they can be applied to a Cost-Benefit Analysis (CBA) or a Multi-Criteria Decision Analysis needs to be understood. Moreover, the methods that can be used to give a monetary value to ecosystem services and the biases that can occur from them and from discounting future land uses must be comprehended. The ways ESVs can help make informed decisions is reviewed in detail, countered with the limitations involved with using ESVs. The section then reviews why ESV data and results are relatively neglected by decision-making stakeholders and summarises the strategies that can be applied to make its use more prolific. The section concludes with a review of the potential benefits ESVs can have in the case of curbing deforestation and increasing social-ecological resilience in Kalimantan.

3.1 Understanding ESVs

To understand how economic data surrounding ecosystem services and land-use scenarios created through valuations can be helpful to make informed decisions, specifically in reducing deforestation in the biodiversity hotspots of the tropical forests of Kalimantan, one must know what an ESV is. To explain, different value types and the process of acquiring these values to effectively give ecosystem services monetary values are reviewed.

3.1.1 Value types

There are numerous types of values able to be derived from ecosystems. Different types of ecosystem services can end up with different types of values. A TEV is the desired value to use when considering ESV studies for land-use decision-making through a CBA (Admiraal et al., 2013). It is the preferred value as it encompasses all, or at least most, of the monetary values provided by ecosystem services. Figure 3-1 illustrates how each of the values are interlinked: **TEV = Use Values + Option Values + Non-Use Values.** Within use values are direct use and indirect use values. Within non-use values are the existence values and bequest values, which give value to conserving an ecosystem in its current state. Within option values are insurance values, which can become any of the other types of values in the future. By not taking action to convert land and leaving it in a pristine state, the ecosystem has the chance to increase in value as other land develops. Pristine land may increase in value as its resources become scarcer within the region. The CBA can be used to compare different land-use options. For example, if you cut down trees for raw material use, you lose out on other services such as climate regulation, biological control, recreation, soil formation and culture retention. It is important to remember that values can be negative. These values are called dis-services which are incorporated in the TEV. Each of these terms are explained in detail below.

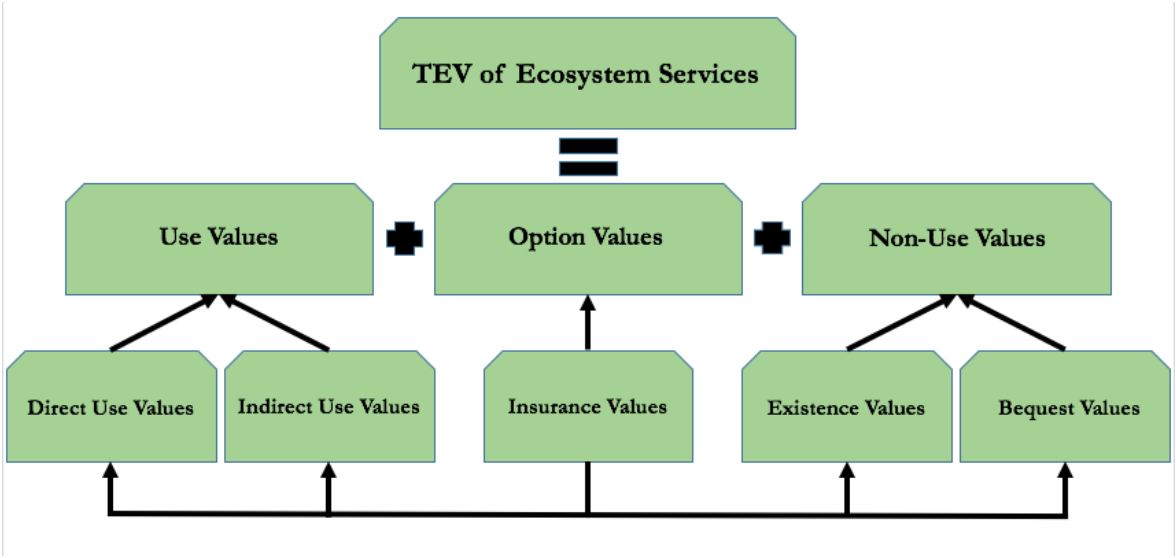

Figure 3-1 Equation for calculating TEV based on the interpretation of multiple sources.

To begin, every forest ecosystem has a use value. This can include the extraction of a good or the use of a service from the ecosystem (Kuchelmeister, 2003). Use values include direct and indirect use values. Direct use values are the result of primary extraction or use of a service for oneself. For example, someone cutting down a tree and using the wood to either build a home or sell that wood on the market for their own gain is considered a direct use value. An indirect use value is a good or service at least once removed from the user of that resource. For example, a hunter who shoots a bearded pig, has an attached indirect use value from the plants eaten by that pig to grow into the source of nutrition for that hunter and his family.

Second, non-use values, such as the existence and bequest values are values that exist in leaving an ecosystem unchanged. For example, if someone has no direct benefits or future desired benefits from an ecosystem on the other side of the planet, they still may value knowing that it exists (Plottu and Plottu, 2007), this is the existence value. For example, although they may never want to see an Orangutan in the forest of Kalimantan, they may put a value on how much they are willing to pay to know that the species continues to exist in the wild. The bequest value can also be put into this non-use value category, as there is value in the conservation of the ecosystem services for future generations to use as they please (Grant et al., 2013). These values can be more challenging to evaluate, as they are not a tradeable commodity, but people still may be willing to pay a sum for the continued existence of an ecosystem, therefore their monetary value can still be estimated.

Third, the option value can be considered to be both a type of use or non-use value. The conservation of an ecosystem in its original state gives people the option to do something with the ecosystem later on, or not (Plottu and Plottu, 2007). For example, someone who has not visited a tropical forest, but would someday like to, would be willing to take actions to conserve it, to give them the option to visit one in the future, or they could decide to preserve it in its pristine state or cut it down at a later time. Maintaining this option value, gives the ecosystem an insurance value. This type of value puts a price on conserving an areas ecosystem services. It allows an area to maintain its adaptability potential for future needs (Admiraal et al., 2013), thus reducing the risk to shock for people around the given ecosystem (Baumgartner and Strunz, 2014). Hence, the insurance value transforms to other types of values over time, illustrated by the arrows at the bottom of figure 3-1. For example, leaving a portion of forest pristine, provides locals with the potential to diversify their economic activities in the future, should something go wrong with the economic activity they have converted the land for, say for example palm

plantations. If there is a shock to the price of palm oil, or a disease that kills palm trees, the remaining forests provide resilience for the community as they can rely on that forest for NTFPs as an alternative source of income for survival. Additionally, from a purely ecological perspective, the given area will still have pollinators and have the ability to reproduce fertile soil if other crops are lost and soil becomes degraded.

Fourth, are negative ecosystem service values called dis-services. Dis-services are things that provide additional costs to humans or make life more challenging. They can be found within each type of value. They change depending on the economic activity being undertaken in the given ecosystem. For example, these may include forests being breeding grounds for pests or diseases, which could provide negative values to the economic value of conserving ecosystems (Zhang et al., 2007). Or, conserving a forest may include the payment of forest rangers to keep illegal logging and hunting from encroaching on the protected area. Conversely, converting a landscape from tropical forest to palm oil for example, also provides numerous dis-services felt by the surrounding communities while economic benefits are accrued by the landowners (Anderson, 2008). In the case of palm oil local inhabitants could experience increased river siltation, flash flooding, decline in fisheries etc. creating increased costs for them to bare. It is evident then, that benefits, and drawbacks can be positive ecosystem services for one stakeholder and negative for another. These negative costs must be subtracted from the TEV to give an accurate value.

Fifth, there are both market and non-market values, which can fall into any category. The decision to convert land is typically based on market values as they produce hard capital for stakeholders to earn. These market values are typically represented in direct use values. Non-market values are the more challenging type of value to give a monetary worth to, for which a number of methods exist. Non-market values may not produce income, yet they can be just as valuable as they can reduce the cost of other potential needs such as, flood damage control, the need to acquire clean water, storing carbon etc. and giving options for potential future uses.

Finally, each of these come together to create a TEV, which can be used in a CBA. As mentioned CBAs can help to make effective land-use decisions in a transparent, formalised and consistent manner (Langemeyer et al., 2016). The main point of conducting a CBA is to weigh the net benefits of one activity over another, rather than only measuring the benefits, which can create misleading data (De Groot et al., 2010). With the help of ESV data, more comprehensive scenarios to be evaluated in decision-making can be made. By monetising ecosystem services, common values can be applied to a CBA, to see exactly which ecosystem services are worth what. As a result, scenarios can be created and evaluated dependent on what kind of economic activity occurs on the land, as the ecosystem services have been given a common denominator to compare. In principle, stakeholders can compare the trade-offs between economic growth and environmental quality (Fanny et al., 2015), which yields cost reductions in addition to some lower use values.

3.2 Common Valuation Methods for Tropical Forests

As described, the purpose of ESVs are to give a monetary value to ecological services which most markets fail to account for (TEEB, 2009). The most common valuation methods are discussed below. It is important to note that supporting ecosystem services are typically not counted toward TEVs. This avoids the double counting of the same ecosystem service. Although, often omitted or forgotten in valuations, the aforementioned dis-services need to be considered in the valuations to perform a comprehensive ESV when calculating a TEV.

3.2.1 Productivity, market price and net factor income methods

This method is typically used to give an estimated value to provisioning services which yield or contribute to a marketable or commercially sold good. Before the final product is produced, the estimated value of the input goods can be assumed from their original raw material forms. Each ecosystem service as an input, can be given an estimated value as a proportion of the cost of the final good (Sander and Haight, 2012). This method can contribute to creating a TEV, but cannot yield a TEV itself as cultural services for example cannot be quantified through market prices when estimating the potential value of a given parcel of land. These methods can become complicated when taxes, subsidies and transportation costs are taken into consideration. To avoid these complications, the price of a final good is used toward the TEV rather than the cost at the time of extraction. For example, the price of a piece of wood as construction material is the price considered, which has these other costs incorporated within the price. Therefore, the added value of the final producer is considered rather than the price of the wood sold to the person or company processing the product. This can be misrepresentative for owners of forests, especially in places like Kalimantan, where the cost of the woods added-value occurs long after the extraction from the forest. Regardless, these methods are commonly used in ESVs and data is easy to access and readily available.

3.2.2 Avoided cost method

The avoided cost method can be applied to ecosystem services that prevent the cost of an action in the absence of a particular ecosystem service (De Groot, 2006). For example, forested peatlands, which are common in Kalimantan, help residents, communities, businesses and governments save money in more than one way. Peatlands can serve to mitigate the cost associated with sewage treatment, as bacteria found in humid peatlands can anaerobically breakdown organic waste, naturally purifying water. Without peatlands, effluents cause problems for locals who may use local water for other purposes such as agriculture, drinking or recreation. Furthermore, peatlands can mitigate the potential cost of flood damage during periods of heavy rain, as they often have the capacity to absorb large volumes of excess runoff, reducing the potential amount of flood mitigation measures to be taken or damage costs related to floods to be paid by residents and business (Lele, 2009), in particular insurance companies.

3.2.3 Replacement or substitute cost methods

The replacement cost method gives value to ecosystem services by calculating the cost of substituting a naturally provided service with a human-engineered system or measure (SCBD, 2007; De Groot et al., 2002). For example, a tropical forest providing food to locals in the form of fish, wild boar, or forest plants creates income and a source of cheap nutrition for local inhabitants. Without these resources, a cost would be incurred to run a fish farming, breeding or stocking program, tending to domesticated animals or growing their own berries to provide replacement services. In terms of land-use, investing in costly man-made infrastructure over conservation of natural areas that provide the same service, can often have far greater costs. This method is relatively straight forward as it is easy to calculate the potential cost of replacing a service with human engineered solutions. Back to the New York City example, the municipality invested 1 billion US dollars in conserving an upstate watershed which provided clean drinking water for the city's inhabitants, instead of building a 4-6 billion US dollar water purification plant (SCBD, 2007). Moreover, they avoided the costs of maintaining and operating the facility.

3.2.4 Stated preference or contingent valuation methods

This method has a distinct strength and a few weaknesses. The strength being, it gives a non-market value to the actual existence of an ecosystem. On the other hand, the method creates hypothetical values for ecosystem services. Briefly stated, locals around a particular ecosystem

are asked in a survey to offer their willingness to pay for a given service (Loomis, 1989). The prospective questions can be asked in numerous ways, which intend to yield similar results, yet in practice, large variations can occur. Depending on how the questions are posed, the respondent answers with how much they would be willing to pay for access to a service near their home, or conversely, how much money they would be willing to accept for that service to be taken away from their vicinity (DEFRA, 2007). The surveyor could also ask the respondent which ecosystem services they would choose at varying costs compared to another. For example, the respondent can choose access to a hypothetical patch of forest for x amount of money, or they can choose the clearing of the forest for agricultural purposes at y amount of money. Another drawback of this method is the hypothetical nature of the survey. Unbiased and informative answers are hard to come by, as people may say they value a certain service less than they actually do, because they may not have a full understanding of all of the services an ecosystem may provide, or how much it would cost them to replace a missing service they once took for granted. Moreover, they may overstate how much they are willing to pay for something as they do not actually need to pay the amount they state. Additionally, despite these pitfalls, land-use decision-makers can use information from these types of surveys to make decisions based on what the majority of the population values; this can be extremely effective on a local level for decision-makers to gain support for their decisions from the general public, as they base decisions on what the masses chose in their stated preferences.

3.2.5 Hedonic pricing method

Hedonic pricing is most effective to promote conservation in urban settings but can also be useful in the context of tropical forests. It can be applied to measure the cost of ecosystem services that affect market prices, typically in the real estate market. As a result, local ecosystem characteristics are represented (Sander and Haight 2012). The value of the services can be estimated by how much people pay for homes in a given area. Typically, areas with a greater number or more valuable ecosystem services have a higher value. In the context of tropical forests, access to forests for non-timber forest products can be seen as favourable. This method can be extremely effective to help with land-use decision-making, as there is plenty of transparent and available data at the disposal to policy makers. However, in the Kalimantan context data is more challenging to come by, especially in indigenous Dayak communities where book keeping is not always consistently performed. In the context of conservation, this method can quantify arguments in favour of conserving green-space for policy makers, as homes surrounding palm plantations may be less desirable and thus, worth less.

3.2.6 Travel-cost method

This method takes into account the time and cost of traveling to an area with access to ecosystem services. It estimates the human perceived value of the service through time and money spent to reach it. The number of trips, time it takes to complete the trip and the actual cost of taking the trip are considered to estimate the monetary value of the ecosystem service (Van Berkel and Verburg, 2012). This can be applied to land use policy-making with extensive survey studies. For example, a subject visiting a protected area could be asked how often they visit, how far they travelled and how much it cost to travel to the destination, to determine the value of that area to the individual. Evidently useful for tourism, this method can also be applied to people travelling to the forested areas to gather NTFPs.

3.3 Selecting Discount Rates and Performing Sensitivity Analyses

When considering option values and non-use values, the future is being contemplated. Therefore, when valuing future use or non-use of ecosystem services, a discount rate should be

applied to assess the trade-offs between harvesting the goods or services immediately versus later. The practise of selecting a discount rate is challenging and controversial because it is subjective. It is challenging because the current and future value of the ecosystem service needs to be estimated and how much more the present harvesting of those services is worth versus the future harvesting. It is controversial and subjective because everyone may have a different value for immediate or future use. For example, cutting down a forest now is perceived to be worth more than it would be if it were to be cut down ten years later. This is because immediate monetary gain is seen as more valuable to that stakeholder. Moreover, in the ten years that the forest is not harvested, it could have already begun to regenerate to be harvested again a few years down the road. The higher a discount rate the more the future generations are being disregarded. In essence, the lower the discount rate, the greater the future use is valued, as its future use is discounted less. Some experts have called for negative discount rates, as they believe the need to conserve tropical forests is vitally important for the long-term survival of humankind. According to TEEB (2010), discount rates should be chosen dependent on the nature of the assets being valued, the timeframe and uncertainty of the study and the scope and policy being evaluated for the study.

To get optimal results with the least amount of bias possible, various discount rates can be applied to ESV results, which take both high and low values of future use into consideration. This is called a sensitivity analysis (TEEB, 2010). By using scenarios with different discount rates, one can identify if immediate use outweighs conservation for future use. If the results do not vary greatly between discount rates than the immediate and future use of resources is not a large issue. Conducting a sensitivity analysis through the use of multiple discount rates can give the decision-making stakeholders the power to choose how much they value the future versus the present (Van Beukering et al., 2009).

3.4 Criticisms and Limitations of Ecosystem Service Valuations

There is an inherent issue with the monetary valuation of ecosystem services: the commodification of nature. Although translating natural capital to understandable figures can be a helpful tool in decision-making, nature cannot be substituted for or bought (Hahn et al., 2015). If valuations are taken literally, problematic situations could arise. Elites may believe they can buy the right to do whatever they please on a given parcel of land following a valuation study, by purchasing the ecosystem services it provides from the rest of society.

In addition to the main criticism of using ESVs in land-use decision-making, there are limitations for their practical use that must be considered. Table 3-1 lists the limitations and pitfalls of ESVs in the context of decision making (Laurans et al., 2013) and are elaborated on below.

Table 3-1 List of limitations and pitfalls of ESVs.

Limitations and Pitfalls of ESVs
1. Valuations can be subjective due to intrinsic values
2. Valuations can be incomplete
3. Valuations can be based on assumptions
4. Valuations create winners and losers due to variable preferences dependent on individual necessities
5. Conducting valuations can be costly and time consuming
6. Useful application of valuations requires a certain degree of economic and ecological background knowledge
7. Local level decision-makers may not have a platform to analyse data
8. Corruption can taint data and yield unfair decisions

First, evaluating the costs and benefits of ecosystem conversion can be subjective, as ecosystems have intrinsic values, resulting in valuations which may not be completely accurate or vary depending on who is being asked to give a value to the ecosystem service. Furthermore, estimates may consist of a wide range of values from various sources. This is especially true for methods reliant on human respondents over market prices (Laurans et al., 2013).

Second, valuations are sometimes seen as incomplete, yielding them inadequate to make decisions based on them for society. ESVs using TEV are adequate, yet many studies only give values to those ecosystem services with available data. Other studies only monetise one ecosystem service, therefore completing a CBA based on that data would be insufficient (Bunse et al., 2015).

Third, valuations may have assumptions incorporated in their results. For example, the assumptions may be based on previous studies from different locations, therefore the data may not be fully representative of the given situation. Even site specific studies have assumptions and generalisations that can alter the outcome of valuations.

Fourth, people value ecosystem services differently, therefore decisions made about land-use will create winners and losers. Some benefits are aggregate, reaching everyone in the region while others can be distributed unevenly. Conflicts of interest of what to do with land often exists. For example, one person may want to use the land to farm soy beans, while another would like to use the land to attract tourists by conserving the forest. Both see a potential to earn an income, yet only one will be able reap the benefits (TEEB, 2009). Despite valuations having the ability to help maximise the potential value of the given land, certain groups will always be losers, making it challenging to make decisions based solely on valuations. All stakeholders should be considered and briefed during decision-making. Stakeholders however, also have the power to sway decision-making through the creation of outside pressures on

decision-making. Therefore, it can be concluded that ESV data can be a helpful tool, but should not be solely depended on to make decisions. Additional variables need to be considered by decision-makers; political, socio-cultural and ecological factors must complement economic variables for holistic land-use policy-making (De Groot et al., 2002; De Groot, 2006).

Fifth, the cost of performing valuation studies can be quite high, especially considering that every ecosystem can be slightly different, with variable stakeholder involvement; therefore, it may not always be feasible to use the ESV method to help make informed decisions around land-use policy. Decision-makers may resolve to making decisions based on cheap and readily available data over more accurate primary data (SCBD, 2007). Additionally, decision-makers may attempt to use studies of similar characteristics and apply them to local areas. Every ecosystem has different dynamics, making it impossible to effectively apply one valuation to another geographic region (Lele et al., 2013).

Sixth, decision-makers are often not economists. As a result, the application of ESV results may not be performed appropriately in decision-making arenas due to a lack of knowledge on the topic. Moreover, valuation methods may not be used at all due to a lack of confidence in the data by decision-making stakeholders (Laurans et al., 2013).

Seventh, the decision-making process often does not allow valuation analysis to occur (Liu et al., 2010). Some levels of government make land-use decisions in small groups behind closed doors. There are no laws or directives in place to encourage the use of ESVs. Especially at more localised levels, there may not be a platform in place for valuation, or analysis of valuation results to occur. Sometimes, stakeholders may not even be aware that ESVs exist, let alone how to integrate one into the decision-making process.

Last, governments may have hidden agendas as lobby groups or large companies can sway land-use decision-makers to make certain compromises in exchange for land rights (Laurans et al., 2013). Unfortunately, ESVs may be ignored or not even considered, if politicians have been corrupted and data shows evidence opposing their personal desires.

3.5 Why are Results and Data being Neglected?

ESV results can help decision-makers see the difference in value between alternative ecosystems and their services and assess the trade-offs of land conversion for alternative economic activities, yet as mentioned in the introduction, results and data are in large part being neglected and ignored. This section will summarise a few points from experts who mentioned relatively low use rate of ESV data.

Bennett et al. (2015) believe that humans collectively lack an understanding of ecosystem service distribution, preferences and access across different stakeholders, making ESV data somewhat difficult to apply without studying and gaining knowledge about these other variables. Furthermore, the real impact of changing access to ecosystem services to different stakeholder groups is unknown other than in theory.

Torres and Hanley (2017) argue that the under-use of data is attributed to a lack of understanding of the grave consequences of biodiversity loss. As those in power are typically driven by capital gain and quick profits, ESV results are often ignored if the data favours conservation over conversion to other economic activities yielding more marketable provisioning services. As the world become more urbanised, people are becoming more disconnected from nature and this amplifies the problem as people take the access to food, water and energy for granted. The recognition of the importance of nature and its services is under-valued as people cannot see or experience first-hand, all of the things nature does for

them. (Guerry et al., 2015). For example, someone who goes to a store to purchase groceries and has never done work in a garden, will not know the amount of physical effort, water and time that is required for those fruits and vegetables to grow. Therefore, stakeholders often ignore ESV data which illustrates the value of conservation in favour of the quick profits and hard capital created by land conversion. As ESV data is not entrenched in the decision-making institutions, stakeholders can decide when they wish to use ESV data, if at all.

There is a set of institutional problems limiting the proficient application of ESVs in decision-making as well (Saarikoski et al., 2017). First, despite having knowledge of the importance of healthy ecosystems, other political issues take priority to make progress on promises made by certain political candidates. Once again, this is a short-term view reinforced by short political cycles in which short-term profits benefit decision-makers. Second, the method of governance and power relations impact decision-making. Those in charge of making decisions for land-use policy have power which can be abused, and these often tend to be forest owners and forestry industries, rather than locals living around forests. Third, various studies of the same area can yield different results depending on the assumptions made and methods used by the person conducting the assessment. This can create conflicting knowledge from which stakeholders do not know which to use for the decision-making process. Fourth, property rights issues often give the right to the owner of the land to do what they please with the land. Fifth, there is a lack of vertical and horizontal integration of ESV data in decision-making. Different levels of government may have norms or directives to use ecosystem assessments in decision-making yet other levels who are in charge of making decisions lack these rules and have no instruction on how to properly use the data for land-use planning and decision-making. Finally, notwithstanding the promise and acceptance of the ecosystem services concept, the idea is sometimes considered to be too, abstract, descriptive and difficult to understand, or did not capture what really matters to the stakeholders (Saarikoski et al., 2017).

3.6 Bridging the Knowledge-Practice Gap of ESVs

Given the number of ESVs being conducted, there is little research regarding how decision-makers actually use the data and how its use can be increased (Posner et al., 2016; Liang et al., 2017). A few strategies and methods have been suggested to facilitate the use of ESVs, including deliberative models, participatory valuations and creating more legitimate and credible data, however, following an in-depth review of literature, there is no single framework taking into consideration how to apply these different ideas for optimal results to increase the likelihood of the practical use of ESV knowledge.

According to Posner et al. (2016) the most important factors for facilitating the use of ESVs are salience, credibility and legitimacy. Salience is a challenging attribute, as decision-makers all have an opinion about what they think should be done with a given piece of land, and they will look for data to back-up those desires. A palm oil company looking to clear a forest for production may attempt to reject data illustrating that the forests ecosystem services are worth more than the palm oil. The following two attributes credibility and legitimacy, can be achieved through the participation and co-production of valuation results between experts and local stakeholders.

Coinciding with credibility and legitimacy, Kuchelmeister (2003) suggests that many decision-makers from rural regions of developing countries do not trust ESV results and data because the knowledge it conveys is not presented in a manner for them to understand it well enough, and therefore, they cannot trust the data. In response to this challenge, it is suggested to perform participatory economic valuations. By having local stakeholders participate in the process, two problems associated with academics performing valuations on their own are ressolved. First of

all, if they participate in the collection of data they will better understand the results to make more effective decisions. Secondly, locals have the most knowledge about what the ecosystem service benefits are, and the potential costs associated with losing them, therefore involving them in the deliberation process can make the valuations more accurate.

The deliberative model is a more elaborated method of conducting valuations related to the inclusive framework mentioned by Kuchelmeister (2003). They essentially involve stakeholders of various backgrounds through a discussion of the value of non-marketable goods (Kenter et al., 2016). The deliberation process exposes the different groups stakeholders to other values, beliefs and norms regarding the same ecosystem services. This process can consequently increase systematic understanding, trust between stakeholders, trigger dormant values, shift orientation of decision towards a common good etc. The main aim is not to get values of numerous different services but to find common services that all or many groups value which can then be decided to prioritise. If, through the deliberative process, there is agreement between the stakeholders about the ESV data, it is more likely that the information it provides will be used by the decision-makers.

Ruckelshaus et al. (2015) argues that there are four pathways which can be taken when attempting to apply the ecosystem services concept to decision-making processes. In order from least impactful to most impactful for decision-making are the following pathways: 1) The least effective pathway is the simple performance of an ESV, where results are produced, published and then disseminated in a purely academic setting. This pathway may spread knowledge amongst academics, but likely will have little to no impact on decision-makers around the area of study due to the little interaction between the research and stakeholders. The stakeholders may not even know the data exists. 2) The second pathway which can marginally increase the possibility of data use is called the changing perspectives pathway. Interaction occurs with stakeholders to help understanding of data and different positions about values and data interpretations are discussed. 3) The next pathway attempts to generate action, by creating alternative choices and scenarios in the research for the stakeholders to analyse. Plans and policies already in place are considered, and the results show how new policies could alter the social-ecological system and current state of the economy. 4) The final, and most favourable pathway integrates stakeholders into the study where ESVs develop new policies directly through the process. This leads to greater access and provision of ecosystem services to the general public and thus improved human well-being.

To achieve the most effective pathway Ruckelshaus et al. (2015) outline the following measures to be taken:

1. Communication and interaction between scientists and policy-makers is key to getting decision-making results. An interactive process enhances understanding, credibility and trust in the numbers being used to make decisions.
2. Keeping data simple and easy to understand is imperative in all cases but especially in underdeveloped countries where lack of background scientific knowledge amongst decision-making stakeholders is more likely.
3. Using local experts to help conduct the assessments and analyse data helps to continue monitoring and yields trust in the process as locals provide data rather than outsiders who may have alternative motives. It provides the possibility of continuous learning and the maximisation of benefits to be taken from valuation results.
4. ESV data should be clearly related to how it can improve livelihoods. Simple numerical results are meaningless without an explanation to how it can potentially increase the health, and well-being of the local and even global human population.

5. The degree of uncertainty and the assumptions made should be clearly reported to the stakeholders making decisions, so they can judge for themselves how much they are willing to trust or count on the information being provided to them.

Knight et al. (2008) address the "knowledge-doing" gap in relation to conservation research, however many of the recommendations can be applied to the ESV knowledge-practice gap discussed in this thesis. First, the ESV practitioners must be aware that the gap is real. The awareness can lead to various pathways of action. Second, what is being valued, in terms of area of study and ecosystem services should be defined with stakeholders to ensure knowledge being created is applicable to a decision-making issue. Third, using institutions to create a link between scientists and practitioners can create transdisciplinary collaboration and more effective use of results. Multi-jurisdictional meetings and the creation of committees or organisations focusing on fostering these relationships between stakeholders and academia can help facilitate understanding and use of ESV knowledge across many projects if they become established. Fourth, research funding bodies can also play a role in narrowing the gap. In general, funding bodies put little to no emphasis on implementation, rather only focusing on the knowledge itself. If criteria to receive funding includes the requirement to create a plan to apply the knowledge to policy or practice exists, then researchers will be more inclined to make an effort to create useful information for stakeholders making land-use decisions.

3.7 The Importance of Ecosystem Service Valuations in Indonesia

The expansion of the timber, palm and rubber industries, coinciding with poor institutional structures (Indigenous Dayak interview, 2018) have resulted in highly degraded and fragmented forests (Curran et al. 2004), holds true for Kalimantan today as the region currently experiences some of the highest deforestation rates in the world (Lewis et al., 2015; Miettinen et al., 2016). For example, peatland forests, which are of significant importance to biodiversity, the hydrological cycle and carbon storage (Van Straaten et al., 2015), have essentially disappeared in Malaysia, Sumatra and Kalimantan. Since 1990 only 6% of peatland has not been influenced by human activity, with only 29% of peatland being covered by forest in 2015 compared to 76% in the year 1990 (Miettinen et al., 2016). Clearly, these disturbances to the ecosystems are changing the balance of the majority of social-ecological systems. Through the establishment of a structure for the expansion of the use of ESVs in decision-making arenas, the value of intact and healthy peatland forests can hopefully be illustrated to the relevant stakeholders, resulting in better management of the land and the invaluable services tropical peat forests provide. This idea is backed up by a recent study (Shahputra and Zen, 2018), which found that palm oil could double its current land cover in Indonesia, thus contributing to the economy, without needing to disturb any forests, as a plethora of degraded lands already exist. This fact coinciding with ESV use should result in more efficient use of land and the conservation of healthy tropical forests in the country, if the degraded lands are prioritised for palm plantations, backed up by ESV knowledge.

The effective use of ESV knowledge reinforces the new sustainability paradigm (see figure 3-2), which is described by Cato (2009) as the economy operating within the sphere of society and environment. The economy is dependent on the social relationships, which are also embedded within the natural world. As the value of natural capital becomes evident through ESV data, sustainable use of resources for society as a whole creates resilience of the social-ecological systems, as the economy is not strained in the long-term and nature is available for diverse uses and services by humans (Goldstein et al., 2012). If the model is understood by decision-makers, decisions will be made that do not compromise the environment's health.

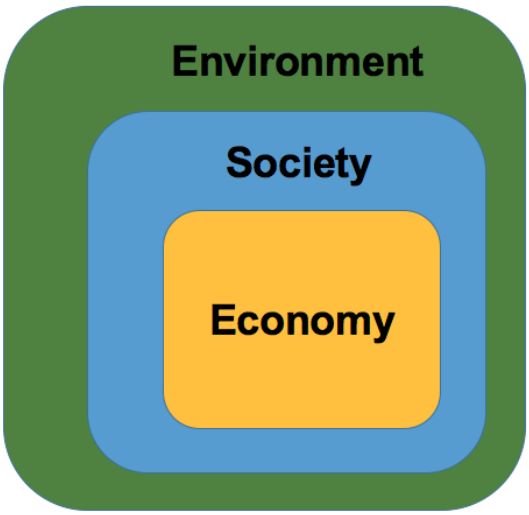

Figure 3-2 The sustainability paradigm which leads to resilient social-ecological systems with a diverse economy. Diagram based on Cato (2009).

According to Meijaard et al. (2017), the estimated annual value of Borneo's non-timber forest ecosystem services is valued at approximately $205 billion. Other economists believe the benefit to cost ratio of conserving versus converting forests to be near the order of 100:1 (Balmford et al., 2002). With these two claims in mind, conserving the remaining forests of Kalimantan should be an obvious choice, as the average annual GDP generated by the entire island, is estimated to be only $135 billion, meaning the further destruction of forest habitats for alternative uses does not make economic sense. More ESVs being conducted in Kalimantan can help make the claims of Meijaard and Balmford more legitimate and credible resulting in more awareness of the need to conserve the forests.

The destruction of high quality forests has multiple impacts, but most importantly, as the environment degrades, so does social welfare (Leong et al., 2005), as human populations become more vulnerable to shocks, and thus less resilient. Therefore, it can be concluded that the average resident of Kalimantan does not benefit from the further destruction of its tropical forests. In fact, larges-scale private companies seem to be the only stakeholders to benefit from forest conversion to palm oil (Suwarno et al., 2015). Public entities and local Dayak communities are the losers in the business as usual scenario of deforestation. The income of the average resident working in the palm oil industry is cancelled out by the potential gains from ecosystem services, such as the disappearance of tourists from environmental degradation, and the replacement of provisioning and regulating ecosystem services with purchased services, such as clean water or flood mitigation, and the reduction in productivity of forests, as many NTFPs rely on healthy forest ecosystems. Furthermore, it is often the groups of people who are not employed in the oil palm industry who suffer as they are the ones dependent on NTFPs for survival.

In a study conducted by Van Beukering et al. (2009), all of the forest ecosystem services were valued with a forecast of their values to 2038, with a base year of 2008. Two scenarios were considered: deforestation and conservation. For all of the services, including water supply, fisheries, flood and drought prevention, agriculture and plantations, hydro-electricity, tourism, biodiversity, carbon sequestration, fire prevention, NTFPs and timber, the conservation scenario yielded higher annual benefits in monetary terms of marketable and non-marketable services than in the deforestation scenario, except for timber and the first few years of agriculture (following 10 years the conservation scenario became more valuable). When considering all of the values together in a TEV, the conservation scenario became more valuable

after 13 years, demonstrating the long-term benefits of tropical forest conservation. ESVs are therefore beneficial, as they can put a monetary value on things like NTFPs, flood mitigation and tourism potential, as they are frequently overlooked by traditional economic markets and decision-makers who typically base decisions on economic data (Saragih, 2011).

Furthermore, conservation and selective use scenarios demonstrate how the benefits from ecosystem services are spread more evenly from a spatial point of view, resulting in less conflict between regions. Additionally, the income gap can be narrowed through conservation because the poor, who are the majority in Kalimantan, reap the benefits from greater access to ecosystem services (Van Beukering et al., 2003). Turner et al. (2003) found forest commercialisation of goods to be a great disadvantage to the poorest groups of people, as they do not see the profits. Furthermore, conservation can actually increase income of the most marginalised people by up to 38%. Therefore, ESVs can illustrate who benefits from the ecosystem service to ensure the elite are not the only benefactors, in which deforestation scenarios illustrate that the income gap between the wealthy and poor increases.

Unfortunately, attempts to conserve forest ecosystems in Indonesia have been unsuccessful. For example, despite the designation of protected areas by the Indonesian government, the country still saw a large decline in forest cover within these protected areas, largely due to both man-made and naturally occurring forest fires. Conversely, Costa Rica's and Brazil's protected areas have managed to remain healthy (Curran et al., 2004). Therefore, it is even more important for Indonesia to recognize the value of forests and for public, private and local sector stakeholders to work together to protect them. Locals are not always the innocent losers in the situations, as they are often unaware of the value of forests and therefore do not respect the protected area laws, which contribute to the deforestation problem. If participatory ESVs take place the awareness of the value of tropical forests in the region could rise (Laurans et al., 2013).

According to literature, if conducted properly, ESVs can undoubtedly be used as a tool to help make informed and responsible land-use decisions, which more often than not favour conservation over landscape conversion. Some limitations exist, and methods can be complicated, but with collaboration between scientists, governments and other relevant stakeholders, it seems possible for positive results to occur in the context of Kalimantan.

4 Findings

4.1 General Information

Through the analysis of 24 case studies, certain keywords and concepts were searched to gauge how much attention was given to decision-making and particularly the knowledge-practice gap between ESVs and their use in land-use decision-making. Figure 4-1 illustrates the number of papers that mentioned the direct application and implementation of ESV data and results for decision-making. Four of the 24 case studies (16.67%) mention how the knowledge they produce could be applied in a real-life scenario.

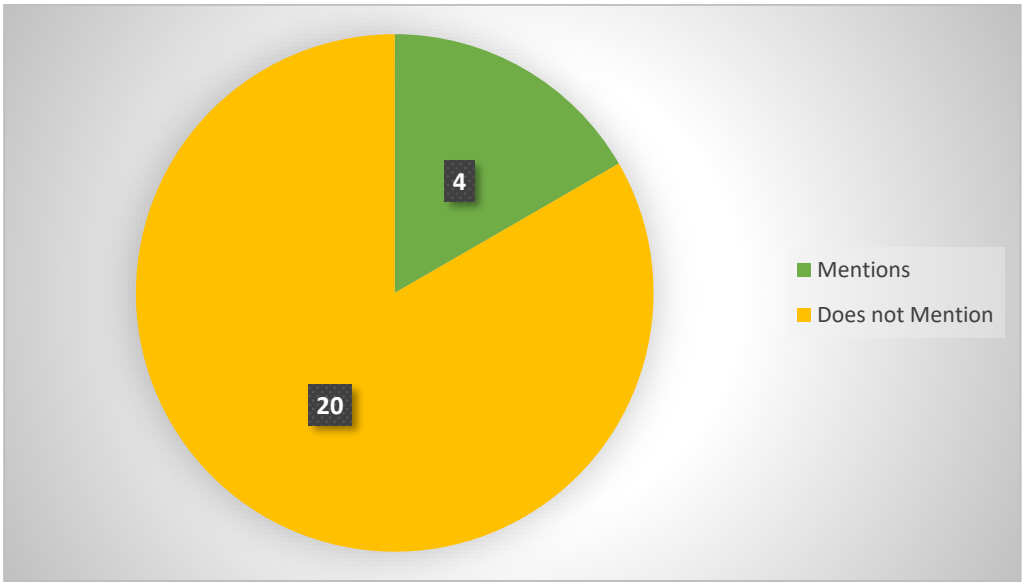

Figure 4-1 Case studies mentioning the knowledge-practice gap.

Figure 4-2 shows how often decision-making was mentioned in the case studies. Decision-making was only counted once for each time it was mentioned regarding a new point or in a new paragraph. Only 2 studies did not mention decision-making at all, with 4 having decision-making as the main focus with 10 or more mentions. Although it seems as though the majority of the case studies had between 1 and 3 mentions. These studies predominantly mention decision-making as something the results of the observed variables can help with, without any real emphasis on how ESV use in decision-making can be achieved. When observing figure 4-1 and 4-2 together, it can be seen that there is an absence of critical utilisation of results or planning of how the findings of the case studies can be actively used to make a positive impact in the area of study.

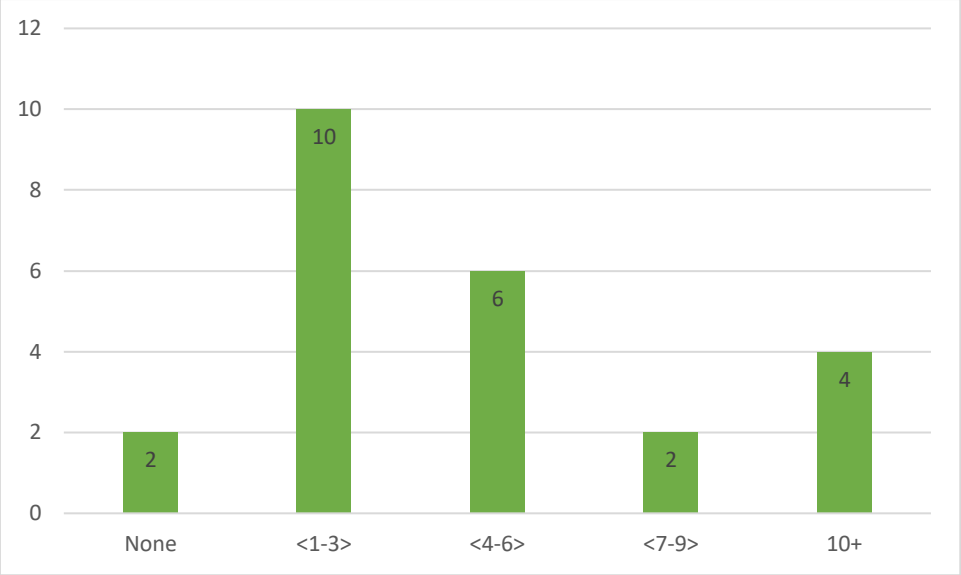

Figure 4-2 Number of mentions of decision-making in relation to results from case studies.

Of the 24 valuation case studies, 10 could be used to provide a TEV with enough background information to calculate a per square kilometre value of the forest ecosystem services. Every forest will of course have different values however the results varied by several orders of magnitude. The TEVs from the review of case studies had a minimum value of 16 546 Euros per square kilometre, and a maximum value of 46 026 557 Euros, however the median value of this data set is in the range of 500 000 Euros. This corresponds well with the findings of De Groot et al. (2012) who estimated the average value of tropical forests to be roughly 500 000 Euros per square kilometre All of the TEV values from the systematic review of case studies can be viewed in Table 4-1.

Table 4-1 TEV per square kilometre of case studies and their locations.

Location	**Value in 2015 Euros/km^2**
Kangenchugan, Nepal	16 546
Koshi Tappu, Nepal	91 590
Nagarhole, India	114 750
Sekong, Laos	275 320
Leuser, Indonesia	430 398
Sanjiang, China	587 600
Liang, China	608 873
Oku Aizu, Japan	1 527 645

Aceh, Indonesia	31 528 978
Ayer Hitam, Malaysia	46 026 557

Despite the wide range of values in the TEVs and methods used in all of the case studies valuing only a select number of ecosystem services, the conclusions the authors made were very similar. Figure 4-3 illustrates that all but three of the studies claimed conservation was the best pathway forward in economic terms. Only one of the results supported a conclusion stating that land should be cleared in favour of plantations, one had a mixed message, claiming conservation and clearing could both yield benefits and one had no recommendation regarding a best possible land-use pathway. Based on this information, it can be concluded that the absolute values produced by the ESVs are not necessarily important as long as the methods used are consistent with the ability to provide comparable values to be used in the aforementioned CBA.

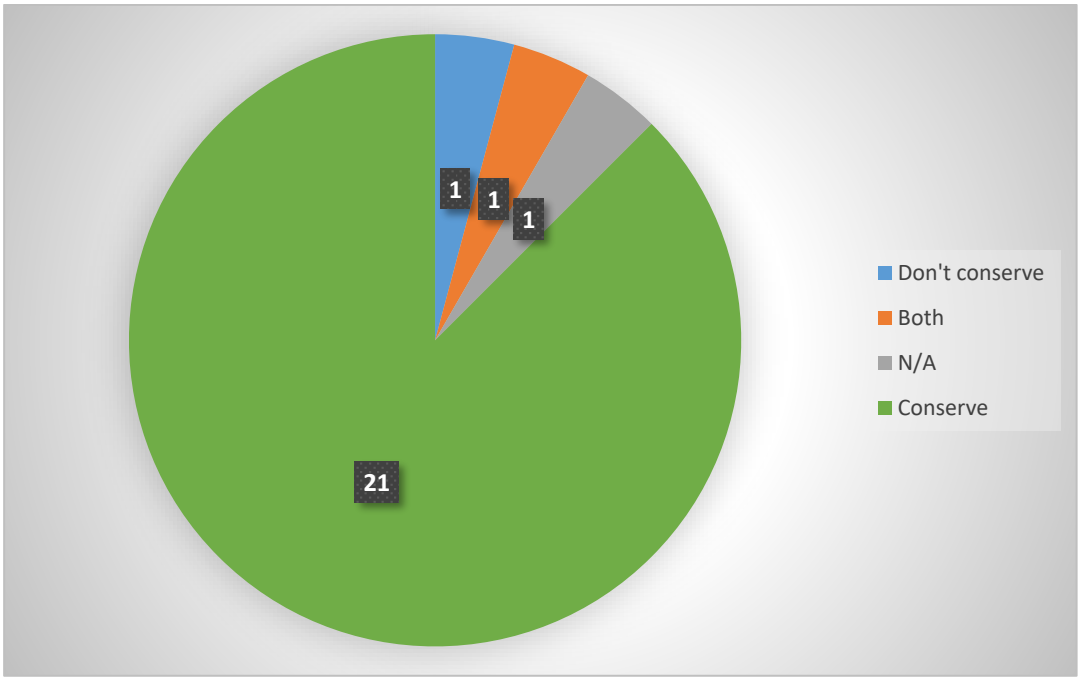

Figure 4-3 Recommendations of conservation or conversion made by the researchers conducting the ESVs.

4.2 The lack of ESV Data Use in Decision-Making

Based on information acquired from 4 authors who participated in conducting ESVs, some further information regarding the use of ESV data in decision-making could be obtained. From four questionnaire responses only one of four said their research was used in some form, namely policy documents. When asked why they thought data and results are under-used, a wide range of reason were brought to light. The ideas and thoughts of the experts are summarised in the following two sections.

First, it is believed that people, from high-ranking decision-making officials to rural village-dwellers in developing countries, who did not have access to higher levels of education, lack the basis of understanding the importance of ecosystem services (Questionnaire A, 2018; Torres and Hanley, 2017; Perez-Verdin et al., 2016) and how to effectively use ESV data and results (Saarikoski et al., 2017). Second, in developing country contexts the thought that development can only be achieved by earning a short-term profit is prevalent, which always seems to outweigh

some of the resulting societal or environmental pitfalls (Questionnaire B, 2018). Third, the argument of ESVs being purely hypothetical means stakeholders do not trust the value assigned to the ecosystem services (Questionnaire B, 2018). Without credibility and legitimacy, decisions will not be based on these economic numbers (Questionnaire A, 2018). Fourth, one expert believes that the use of ESVs is not embedded in the process of decision-making and will continue to be underused unless institutions mainstream it as a requirement for land-use decision-making (Questionnaire C, 2018), especially when converting from one landscape to another. Fifth, ESVs are still a relatively new concept, especially in the developing world, therefore it is not yet accepted as viable knowledge to aid in making decisions (Questionnaire B, 2018). Sixth, projects and developments are short sighted, meaning that the long-term benefits of ecosystem services are often overlooked (Questionnaire B, 2018). Finally, the most problematic factor holding back the use of ESVs in decision-making is corruption. Decisions are made by people in a place of power and data is easily overruled to make a decision which is best for the person in power and the circle of people around the decision-maker. Typically, the decision-makers aim to make decisions that will yield them the most benefit personally (Questionnaire D, 2018).

4.3 Bridging the Knowledge-Practice Gap

The authors were also asked what steps or measures they believe could be taken to narrow the knowledge-practice gap. One expert said he believed decision-makers should be approached prior to the valuation to see what is important to them so that the results can be catered to the context in which they need data to make more effective decisions. These results should be made readily available for decision-makers and society alike in an open-access manner to ensure values are not misinterpreted and misused (Questionnaire B, 2018). Stakeholder involvement in the scoping and data collection portion of an ESV gives a sense of ownership to the results and can create more useful values as the stakeholders can also decide what aspects of an ecosystem should be valued and analysed in a cost-benefit approach.

Informants reported that results of studies need to be presented in a form which clearly illustrates a real impact for those people involved. In other words, the results should give clear scenarios of what would occur to the value of the land and the ecosystem services it provides given the potential economic activities. Related to this, the methods and findings should be inclusive or at the very least be transparent for stakeholders to view (Questionnaire D, 2018). As discussed in the literature review and supported by an interviewee, this will enhance the acceptability and credibility of the valuations (Questionnaire C, 2018).

One expert took a more regulatory approach to the problem of the under-use of ESV results. To increase ESV data use in decision-making the expert thought it should be made obligatory by law to conduct an ESV (Questionnaire A, 2018), similar to environmental impact assessments, before conversion of landscapes for development occurs. This would ensure the best possible use of the land.

Finally, environmental and economic experts should be incorporated in the land conversion decision-making process (Questionnaire A, 2018), so ESV data and results can be properly analysed and presented in an understandable manner for the relevant stakeholders to make informed decisions.

Additional useful information from the questionnaires included if local stakeholders were involved in the study and what, beyond decision-making, the ESVs were used for. Three of the four respondents said local stakeholders participated in the valuation in some form, yet only

one of the studies was used to help in a policy document. Unfortunately, there were not enough respondents to evaluate if there was a real correlation between the actual use of the data in decision-making and the magnitude of local participation. In terms of other uses of the study, the authors said there was either no additional use for the study; the study was to serve as a reference to advance the quality of future valuations; and to illustrate that forests have value beyond timber in a region pressured by deforestation.

4.4 Results Related to the Context of Kalimantan

4.4.1 Point of view from local stakeholder

According to an indigenous Dayak person from East Kalimantan, who participates in a community-based forest conservation effort and helps his family with a small-holder palm plantation, ESVs can be a helpful tool to promote conservation. He indicated that valuation data could be used to help convince the multiple levels of government involved in land-use decision-making of the value of protecting the local forest from the encroachment of timber companies and eventual conversion to palm oil. He is part of the local governing body from the village that is attempting to protect a 38 000-hectare plot of mostly primary forest. Parts of this forest were selectively logged, but the activity was stopped due to unprofitability approximately 15 years ago, which is when the community used customary law in an attempt to protect the forest. With the expansion of road networks and increased accessibility to the forest, the locals fear the companies will soon see logging the area as profitable again. Although the surrounding forestry companies practice both selective and clear-cut logging, the locals hope the protected area to remain pristine and free of impactful disturbances. The villagers are afraid they will lose this forest and the benefits they incur from it because of the illegal encroachment of the surrounding timber companies and future decisions to allocate the forest as a timber concession and eventually to a palm plantation. He stated that the regency and provincial levels of government do not recognise the entirety of the forest as protected, therefore they do little to help the local indigenous' peoples claim to the land. As the government does not enforce the protection of the forest, they can easily decide to take it away from the villagers and give control to a nearby timber company and then palm oil company. Although the locals own the land, they do not have the power to enforce protection if the government decides to make it a logging concession, because their customary law and institutions are still too weak.

According to the local resident, the villagers are the only legal users of the forests goods and use them in multiple ways, although there is evidence from camera traps in the protected area that some illegal hunting and cutting of trees is occurring. The locals collect seedlings from the forest and sell them to reforestation projects, there are some tourists who visit the forests who with permission are allowed to enter the forest edge and hike in an attempt to see some wildlife. Researchers pay to conduct primarily wildlife research in the protected area. Children from the village are brought to the forest to learn about the traditional methods of living of their elders and ancestors and locals are allowed to hunt the bearded pig but only certain times of the year. Beyond using the forest for its ecosystem services some land-owning locals also have agriculture, including rice fields and small-holder palm plantations. From these plantations they earn additional income. For example, one family owns 2 hectares of palm oil and earns approximately 30 euros per month from the harvest.

4.4.2 Point of view from palm oil company employee

A palm plantation employee who has previously worked in Kalimantan and currently continues to work in the palm industry in Papua, was interviewed to get insight from the perspective of large scale palm companies. His title is senior conservation staff dealing with high conservation value forests within palm oil concessions. In terms of expanding palm oil plantations, he claims

it has become increasingly difficult to clear land in Kalimantan in favour of palm oil as rules have become tighter. He states that palm companies typically have a designated team that looks for land to purchase to develop plantations on. They survey the land for soil content, slope, forest status, and social conditions of the surrounding population. They try to take all things into consideration that will impact the cost and harvest of the palm oil. Prior to the purchase, it is ensured that the land is not protected by the national government. Some companies do not have an allocated team and in that case hire consultants to find suitable land. Due to the high investment cost and lag of seeing a return on the investments, companies are careful to ensure land is suitable. Once land is purchased, the company must get all of permits and licenses, including location permit, plantation business permit, decree of disposal, business license, permit principle of investment approval etc. Typically, surrounding communities are informed about plans to open the new plantations and the residents are said to be compensated accordingly. The employee believes palm oil to be profitable wherever it is grown, and if land is suitable and not protected by the national government, it will eventually be cleared and converted to palm oil.

Before palm plantations are planted and grown there is discussion between the private and public sector. He believes involvement with NGOs is avoided as NGOs are typically opposed to the palm oil industry. Some interaction with NGOs does occur when there is enough pressure to do so. He goes on to state that companies aim to open as much land as possible to increase potential profits and NGOs will attempt to restrict this. Local community engagement is essential and occurs frequently. Companies conduct free, prior and informed consent with communities along with high conservation value and high carbon stock assessments.

In terms of valuating nature, the employee believes a land owner will mostly choose to have the land developed to a plantation even if it is worked on by a company, because they get capital deposited into their accounts directly without needing to do work. He claims they can earn up to 37.50 Euros per month for one hectare of land, which is a high estimate compared to the 15 Euros per month for one hectare earned by the local who was interviewed. Investors, entrepreneurs and governments see palm oil as more profitable and better for society than standing forest, therefore they will always choose to convert land if possible, even if ESV data shows otherwise. He claims that palm development creates jobs, builds roads, open other economic activities in the marketplace, schools are built and provides income through taxes for locals and governments. He believes land clearing will persist even though he is convinced that policy-makers are aware of the dangers deforestation causes, say in the form of flooding, but he does not think these cases are strong enough to change the business as usual pathway of deforestation. He states that until a real income can be earned as fast or as easy as with palm oil the destruction of Kalimantan's forest will continue.

Areas under a palm oil permit area with some saved high conservation value forests may increase the viability of the company as a sustainable company in line with the RSPO (Roundtable for Sustainble Palm Oil), but the problem is that it is usually still more profitable to clear all the land for more palm oil, rather than be seen as a responsible company. Although some additional value to communities can be yielded from the high conservation value forests in the form of NTFP collection for goods such as honey, bamboo, rattan, medicinal plants, etc. Furthermore, he claims that the conservation of forested areas can reduce conflicts with communities who still use forests for goods and for spiritual purposes related to their indigenous identity. Therefore, giving a value to these non-marketable aspects of forests and showing the leaders of the company that there are values and benefits beyond being called a sustainable company, can sway opinions about conserving at least some healthy forests. As a result, handing over

management of high conservation value forests to communities could help conservation be seen as profit paradigm, rather than one associated with costs and losses.

4.4.3 Point of view from founder and former CEO of conservation NGO

The operator of the NGO with the aim of supporting a local conservation effort was interviewed. He led discussions with local and regional governing bodies along with the private sector, especially timber companies. He believes the land-use decision-making process to be unsuccessful in slowing deforestation because of the Indonesian policy of decentralisation which occurred after the fall of Suharto in 1998. The extremely authoritarian and centralised government rapidly became one of the most decentralised political structures on the planet. Decision-making power was rapidly re-allocated to provincial, regency and district and village levels, without much afterthought about the consequences. As a result, it is extremely challenging to have the multiple decision-making stakeholders come to agreements due to conflicting interests and priorities. The current landscape has the national government making decisions about protected areas, however unless the area is at the highest level of protection, it is at risk to being lost to other economic activities. Furthermore, he believes the national government does not have the resources to keep the private sector and lower levels of government in line. Therefore, provincial governments, who are in charge of forestry, and the regency governments which are responsible for agriculture and mining often make decisions about the same area but based on different types of land-use. The problem then with forest areas protected by customary indigenous law, which is weakly recognized by the national government, is that the provincial governments do not make money from the ecosystem services they provide, which is why the local indigenous are afraid they will lose their forests to logging companies with the provincial governments backing those companies to earn more income. Over the last few years, the national government has granted absolute rights to some community protected forests to govern those parcels of land to the highest degree of the law, but this type of protected area remains rare.

He goes on to argue that the decision-making landscape in Indonesia is evidently, complex and difficult to navigate, therefore he believes applying the ESV concept in this region to be challenging for structural reasons. He argues that the idea of ecosystem services is too difficult to sell to policy-makers, and since there is a lack of a market for ecosystem services to be transformed into real income, it will not be taken seriously. Even by engaging stakeholders in the valuation process, he believes putting a monetary value on something that locals can get for free in the forest will not be understood, despite them not having access to the goods once the forest disappears. The ESV concept in general, he believes is too academic and abstract to be seen as legitimate and thus, successfully implemented on a wide scale.

The only way this experienced individual sees some sort of valuation of ecosystem services to work in the area, is if it translated back to health. Stakeholders do not listen when the only cost is the loss of natural capital, however if the loss of natural capital is translated to the health of the people, it becomes something people and decision-makers care more about. For example, the trade-off of growing vegetables instead of palm oil can earn just as much or more money on the market and for their own consumption, rather than earning 15 euros per month from an acre of a smallholder plantation. From the extra 15 euros the income earners do not have access to fresh and healthy produce, but rather go to the market and buy cheap and unhealthy instant ramen noodles. By making these connections between environment and health the value in conserving forests, health related valuations could yield better results.

4.5 Conservation vs. Conversion of Forested Land

Results from the case studies undoubtedly illustrate that conservation has more value than land conversion to palm oil. Figure 4-4 illustrates the values derived from converting a tropical forest landscape to palm oil vs. the conservation of the forest over a 40-year period. The curves represent a cumulative total value over that time period. A 40-year period was chosen because after that period of time has elapsed, a new land-use decision needs to be made to either re-plant new palm trees on the degraded land or choose an alternative land-use. Re-planting would incur additional investment costs including pulling up old trees, re-planting new ones, and using fertilizer on the nutrient poor soil. At this point the conversion curve would also refresh its discount rate as it should be at a maximum at the time of the decision.

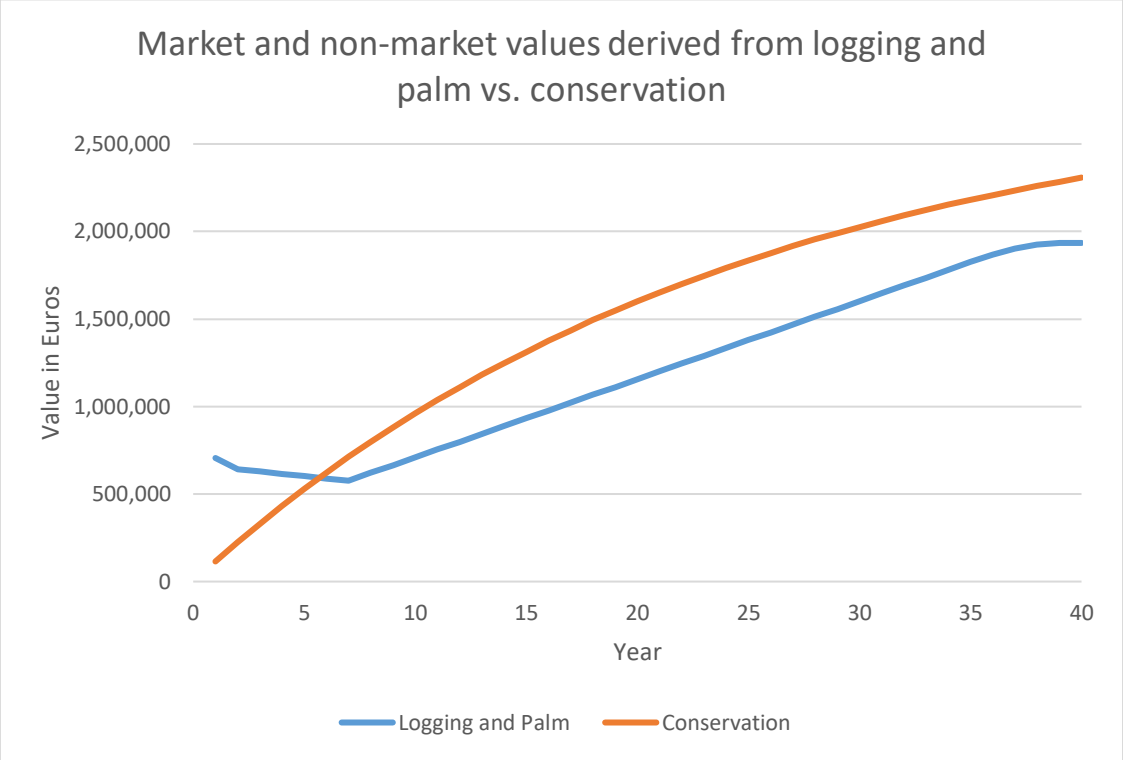

Figure 4-4 Cumulative value of logging tropical forest and setting up palm oil vs. cumulative value of conservation per square kilometre over a 40-year span. Logging creates one-time income flux followed by a few years of losses from investing in planting palm oil without return, followed by steady returns over ~30 years before production tapers off. The conservation line is a steady increase the value of the forest. This curve is shown with a 4% annual discount rate. Conservation becomes the favourable option between years 5 and 6. Data sources: Ninan and Kontoleon (2016); Abdullah et al. (2016); Interview Palm Oil Employee (2018); World Agroforestry Centre (n.d.).

A reasonable estimate of the initial value of clearing one square kilometre of tropical forest similar to one found in Kalimantan would be about 707 000 euros (Abdullah et al., 2016) for the timber. This number was chosen as it represents the value of trees in a tropical forest similar to one that can be found in Kalimantan. It can be assumed that it takes approximately 1 year to clear the trees and area. Following the year of clearing, some investment must occur to make the land suitable to plant palm seeds and care for the young trees until they are ready to bear

fruit for harvest (World Agroforestry Centre, n.d.), therefore, the blue curve representing logging and palm oil value curve quickly rises than declines slowly until about year 7 when significant kernels can be sold to start yielding an annual income of about 44 600 euros per square kilometre of planted palm oil trees (Palm Oil Employee Interview, 2018). The higher estimate between the two values received from the interviews concerning of how much can be earned from palm oil was used for this example as it represents how much a more efficient large-scale palm oil company can earn. Production of oil palm begins to taper off following 30 years of production. The orange curve represents conservation and is based on the third lowest TEV value from the systematic review of case studies (Ninan and Kontoleon, 2016). This value was used to illustrate that even conservative valuations can quickly outperform generous palm oil production estimates in purely economic terms. A 4% discount rate was applied to the TEV.

The diagram demonstrates that even over time it is impossible for the value of logging and palm plantations to be more profitable than conservation of forests, as the conservation value exceeds the development value between years 5 and 6 and never catches up despite the consideration of the discount rate. The 4% rate was chosen as this was one of the most common rates used in the case studies that did use discount rates at all. The curve stops following the 40-year period as a transformed ecosystem would have degraded soil and not yield much more value, whereas an intact tropical forest would continue to yield services and goods to the surrounding population. In addition to conservation being the more valuable option, the benefits are spread more equally across the stakeholders (Suwarno et al., 2015). Palm oil almost exclusively benefits palm companies with little to no benefits going to locals, especially the indigenous Dayak.

5 Discussion

The analysis of the results from each of the methods creates many interesting discussion points that can be elaborated to help answer the given research questions. Combining results gives from the various methods gives a more holistic view of what valuations tell decision-making stakeholders, why valuations are being neglected and how the use of ESVs in decision-making can be increased and finally, how the valuations can help achieve the resilience of social-ecological systems in the context of Kalimantan.

5.1 Why the Under-Use of ESVs in Land-Use Decision-Making?

Based on the results of the number of mentions of decision-making in the case studies and the mentions of how the knowledge can be applied to decision-making some curiosities arise. The fact that only two case studies do not mention decision-making at all means the academics conducting the research are aware that their research outputs are potentially useful for decision-makers. At the same time only four case studies mention ways in which the knowledge can actually be applied. It is evident that there is use for ESV data but little understanding about the importance of thinking about how the knowledge can be applied. Considering that literature found that only one third of conservation studies result in direct action (Knight et al., 2008) and that only 17% of Caribbean case studies were applied to decision-making processes (Waite et al., 2015) these numbers match. Perhaps, if more attention is paid to applying knowledge more use will come out of the data and results produced, which should generally be the main aim of research.

Beyond academics not focusing on the application of their research, ESVs are being ignored for multiple more reasons, some of which can be resolved quite easily and others which are more challenging to resolve. Table 5-1 summarises the reasons for the low usage of ESVs in land-use decision-making and what can be done resolve each problem which was presented in section 4. The discussion points regarding the table are elaborated on below.

Table 5-1 Reasons for the under-use of ESVs in decision-making, what can be done to solve the problem and how difficult the problem would be resolve in the context of Kalimantan.

Reason	Solution and Level of Difficulty to Resolve
1. Knowledge and skills do not align with required skills for ESV data understanding	Medium - Engage local stakeholders in the valuation process - Provide training programs - Involve stakeholders in scoping of valuation
2. Figures lack credibility and legitimacy	Easy - Engage local stakeholders in the valuation process to increase trust and ownership of values
3. Decision-makers favour market over non-market values	Difficult - Clearly illustrate economic costs of ecosystem service losses

4. Not embedded in decision-making institutions	Difficult - NGOs can promote the use of ESVs to the communities they work with - Governments can take measures to mainstream ESV use
5. New concept in developing world, therefore not accepted	Difficult - Continue ESV studies while engaging local stakeholders in the process
6. Projects and developments are short sighted	Difficult - Attempts can be made to emphasize the short-term gains of conserving forests through ESVs - Apply low discount rates that show the benefits of long-term thinking
7. Corruption	Difficult - Involve local stakeholders beyond decision-makers to increase accountability of decision-makers to make decision for the good of the whole population

The lack of access to education in the developing world is a real challenge. Having the skills to understand and the ability to analyse information from ESVs requires a certain degree of formal education or at the very least specific training. The lack of confidence and ability to use ESV results and data is major limiting factor if stakeholders are expected to use the knowledge to make more informed decisions. To combat this issue local stakeholders can be involved in the scoping, data collection, deliberative process of finding values etc. Furthermore, willing stakeholders can be offered short workshops or training programs by conductors of case studies or NGOs to help create informed decision-making platforms. This could be seen as challenging as NGOs and academics need to work together with their aligned goals of curbing deforestation and increasing human well-being. People working in NGOs are often academics themselves. If they are the ones performing valuation studies this issue may be easier to resolve. This is given a medium level to achieve as academics conducting research can easily involve local stakeholders, however a willing NGO must be found to provide additional support.

Figures based on ESV knowledge lack legitimacy and credibility. Foreign people coming to regions to conduct valuations, essentially put a monetary value on things that locals can access for free would seem like a strange concept to someone not exposed to academia or economic theory. If it is uncertain where the values were derived from and what they were based on, then it would be challenging to trust those numbers and base decisions on them. Related to the first point of resolving the problem, if local decision and non-decision-making stakeholders are involved in the same ways as was described, ownership and confidence in the values can be created. The controversy lies in the fact that stakeholders must understand the numbers can be helpful to make decisions but are not absolute values representing the actual worth of the ecosystem services as there is a distinction between market and non-market values that they must understand. The lack of credibility and legitimacy can also be attributed to the wide range of values that researchers attain from their studies, as was brought to light in Table 5-1. The wide range is not explained by the authors. However, through observations of the studies, many

did not specify exactly which ecosystems services were being valued or elaborate on the methods used to get their values. This could explain the variance in values. As shown in the results (see Figure 4-4), in spite of the wide range in values, all but three of the authors vouched for conservation over land conversion. Based on this information, it can be concluded that the absolute values produced by the ESVs are not necessarily important, as long as the methods used are consistent with the ability to provide comparable values to be used in the aforementioned CBA. This is given an easy level to achieve as engagement of local stakeholders is a relatively simple task for conductors of ESVs to perform, which would not only increase potential use but likely increase the quality of data as well.

The fact that decision-makers in the private sector favour market values over non-market values is obvious, as companies are based on gaining a hard profit in the form of income. However, as the conservation officer of the palm oil company pointed out, conservation of some plots of forests within palm concessions can reduce conflict between communities and palm oil companies, thus reducing potential costs and resources on conflict resolution. Furthermore, conserving forests can also help the image of the company as the palm oil can be labelled as a sustainably sourced product, in turn increasing sales. The challenge is to convey this information decision-makers of the company. They may be reluctant to accept the information, because they prefer to earn income with minimal risk, and the obvious decision would be to produce as much palm oil as possible. The thought of conserving some forest to earn more income is counter intuitive and must come from within the company to gain traction. People working in the palm oil industry assumingly never were or no longer are researching academics, therefore, it could be up to the academics performing ESVs to involve palm oil employees in the process to help them gain understanding, but as the interviewed palm oil employee pointed out, collaboration with stakeholders vouching for conservation could cause more barriers than opportunities for the companies. In the public sector, and on more local levels, valuations which clearly illustrate the costs associated with ecosystem service losses may sway opinions to reconsider land conversion as the people will be directly impacted. Combine this with the first point of involving the stakeholders to create trust in the data and would the likelihood of data being used in decision-making could increase. This is challenging to resolve as there will always be a preference to earn income in the most straight forward and fastest way possible.

In the context of Kalimantan, ESVs do not seem to be embedded in decision-making structures or institutions on any level. If ESVs are to be used, it must be brought to the attention of the decision-making bodies as stakeholders have no requirements or incentive to use knowledge from ESVs in their deliberation process. On a local and regional governmental level, NGOs could promote ESVs and their use in decision-making to occur, with the academics and communities they work with. The governments themselves, once exposed to ESVs can take steps to mainstream their use in prospective land conversion situations. NGOs and academics can try to convince stakeholders, but ultimately as with the private sector, willingness to change would need to come from members within the political system. Finding governments willing to apply the concept could be challenging as the issue does not seem to currently be on the agenda for governments as they are unaware of the potential benefits of cost reducing ecosystem services, rather they prefer market values.

The ESV concept has been around for over 20 years, but due to its sparse usage in land-use decision-making, there has been little traction for it to be used more widely, especially in the developing world. Therefore, its sparse usage overall, and the idea stemming from the global North, has created a lack of acceptance amongst stakeholders in the developing world. If ESVs are to be mainstreamed, valuations need to continue to be performed with community

engagement kept in mind. According to the founder of the NGO (interview, 2018), who is critical of the effectiveness of the ESVs in land-use decision-making, relating the loss of ecosystem services to health rather than other environmental costs seems to be a plausible alternative. He argues that when people's health is at stake they take problems more seriously. Alternatively, a focus on the purchasers of palm oil products can be taken. If only sustainable palm oil products are demanded by the public or larger companies using palm oil in their products, then the industry would need to change at the source of the supply chain. It is challenging to implement something that has few success stories. If more examples of success are created using ESV knowledge in decision-making, a snowball effect can occur.

Projects and developments are typically short-sighted with quick profits in mind. Private entities reward market value profits and the public sector, which runs on short election cycles, except at the village level where chiefs are elected for life, typically make decisions that will have the probability of their re-election increase. From the data gathering in this project it appears that there is no real way around this problem, but ESVs can attempt to illustrate to the relevant stakeholders that there is value in conservation, by clearly illustrating the economic profits they yield. Moreover, similar to the diagram shown in figure 4-4, the long-term trade-offs, between economic activities can be illustrated, showing how much value standing, healthy forests have in not only the long, but also the short run. Again, this will only be effective if the figures are credible and trusted by the stakeholders. This is difficult to resolve given the human-nature of short-term preferences, short political cycles and desire for short-term income, long-term benefits will always take a back seat.

Corruption is a significant problem in Indonesian and global politics alike. Local land-owning elites and decision-makers often cater to each other to share the profits that ecosystems provide while marginalizing the poor and indigenous. By performing these ESVs and engaging non-power wielding stakeholders, transparency and accountability for making responsible land-use decisions can be created. If villagers are made aware of the value of the surrounding ecosystem services, they will not accept the elite of the village to sell the right to the land to private companies for less value than the land is worth when the villagers who use the land are the clear losers who are not compensated for. It gives them the power to come together and stand-up against the destruction of their traditional methods of living in the tropical forests of Kalimantan. This will still be extremely challenging to resolve as corruption persists all over the world despite efforts to combat the problem.

5.2 Framework for Bridging the Knowledge-Practice Gap

This work provides evidence that to increase the probability of ESV results and data use in decision-making certain measures can be taken. These actions can be taken before, during and after the actual performance of the valuation by various participants in the ESV process including, NGOs, governments, donor institutions and academics. Figure 5-1 illustrates what each stakeholder in the ESV process can do to help create useful information for decision-making stakeholders. The framework is built on the application of the resolutions from the previous sections of the paper and is elaborated on below.

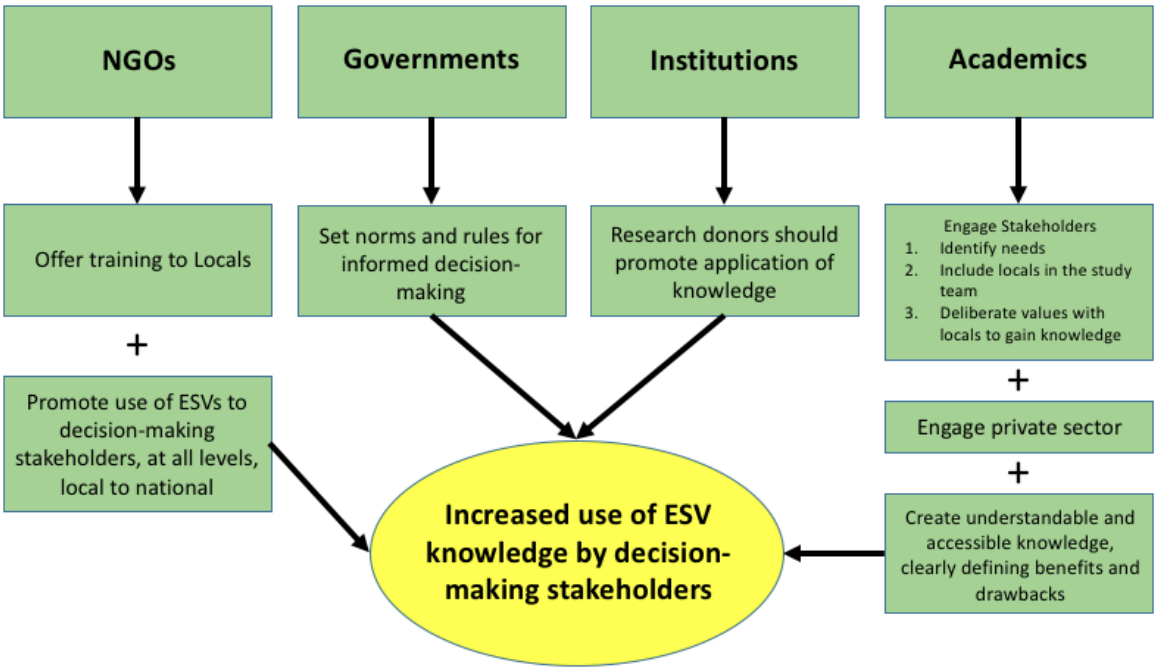

Figure 5-1 Framework of strategies entities can take for increasing the use of ESV knowledge in land-use decision-making.

To summarise figure 5-1, each player in the process of ESVs can contribute to increasing the use of knowledge gained from a given valuation. Each step individually could increase the probability of use and together could yield more optimal results and effective use of the knowledge in practice. Despite these strategies enabling more potential use of ESV knowledge, the decision to use the data is ultimately up to the decision-makers, and they typically have the power to make a decision with or without any information they wish to use.

The role of NGOs should be to provide assistance in the form of training to decision-makers who are not familiar with valuation knowledge, and how they can apply the information to a CBA to make effective land-use decisions. Prior to providing the training, they should help academics, as many people working for NGOs are also academics, to promote the use of ESVs as an important tool in making decisions that can help benefit the most possible people. In turn, NGOs working in conservation, sustainability and resilience can potentially increase the chance of achieving their goals.

If governments are serious about making the most informed decisions possible regarding land-use, they can apply some norms or rules integrating ESV knowledge into the process. This could take time and may be a challenge to implement but if achieved, sustainable land-use decisions could become more common, which could result in more resilient social-ecological systems. This does not yet seem to have been applied in practice, but similar to environmental impact assessments, it could become the norm. It could be beneficial to apply some rules and laws at lower levels of government to see if they can be effective, before applying them to more regional and national governance levels (Questionnaire A, 2018).

Funders of research can also play a role to increase use. They could put emphasis on the application of the knowledge being gained through research, should they wish to contribute to useful knowledge creation. By demanding plans and inclusion of knowledge contributions to

practice within application criteria, academics will begin to plan for and take steps to increase the probability of the creation and application of useful information to come from their research, as they will be financially rewarded by the donor institutions (Knight et al., 2008).

Academics are the most important players as the actual performers of ESV case studies. First of all, if there is a desire for the application of the knowledge they create to be used in decision-making, they should take the following measures. Before conducting a valuation, they should engage with decision-makers to help scope the study (Posner et al., 2016; Kuchelmeister, 2003; Questionnaire B, 2018). They should identify what and where the current land-use issues are to help make impactful knowledge. To increase understanding and credibility of the values created by the research, local academics should be included in the research team. Local stakeholders will trust people from their region more than someone coming from another country stating abstract monetary values for a non-marketable good, that should be accepted without much afterthought. Furthermore, locals should also be surveyed to gain an understanding of how much they value certain ecosystem services. Going through a deliberative process can also create transparency of what the values of the ecosystem services are and have the local population demand for the use of the knowledge in decision-making by those in power (Bunse et al., 2015; Kenter et al., 2016). If academics wish to make an impact in the private sector they should also engage local companies with their studies illustrating the value in conservation. As described by the palm oil employee in the interview, conservation can decrease the operating costs and increase the profits of the company, making ESVs a tool even for those wanting to convert landscapes. Moreover, this work has shown a number of areas where it is very important for academics to make the knowledge they create more understandable and accessible for the masses. Making information open-access and providing stakeholders with results directly, can greatly increase the chance of its use as the information is able to be used as the stakeholders please, otherwise they may not even know that the information exists (Questionnaire B, 2018). In areas where education is not relatively high, data should be easily understood with clear benefits and drawbacks of alternative scenarios of economic activities to make it as easy as possible for the data and results to be applied. Lastly, the assumptions and the degree of uncertainty must be clearly reported to the decision-making stakeholders. This allows them to decide for themselves how they use the information in the process of decision-making and helps them understand where the values are coming from to give them greater credibility, even if some illustration of uncertainty is shown (Ruckelshaus et al., 2015).

5.3 Can ESVs Create Resilient Social-Ecological Systems?

Taking all of the results into consideration and reflecting on the different points of view, it can be determined that ESVs can be a helpful tool to curb deforestation, resulting in more social-ecological systems, despite considering some of the challenges brought to light by the literature review and one of the interviewees who adamantly rejected the idea of ESVs having the potential to being successful in helping make informed land-used decision to curb deforestation.

It is clear that ESVs can only be successful it if is accepted and embraced by the relevant decision-making stakeholders. This is the main challenge, as there is a lack of trust in data in which stakeholders were not involved in collecting. Furthermore, there is evidence of ESV data being ignored or neglected because of corruption (NGO Founder interview, 2018), as valuations tend to favour conservation, predominantly because benefits reach more of the community in indirect ways with non-market values. Consistent with the findings from the literature review, people poorly understand the consequences of biodiversity loss resulting from deforestation, which is an additional reason why the results are disregarded (Torres and Hanley, 2015).

If ESVs are embraced, they can create sustainable use of forests and lead to the creation of social-ecological resilience. Figure 5-2 is a theoretical framework based on the research, which

illustrates how the use of ESVs could help create these resilient social-ecological systems. The framework was deduced from the literature and systematic review.

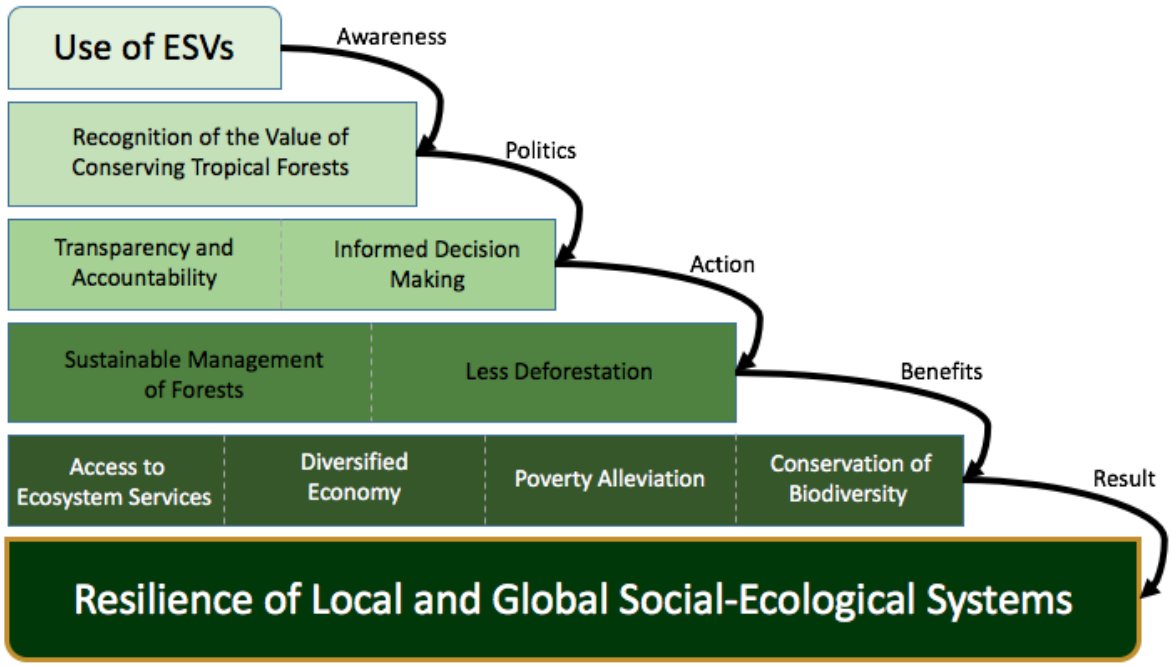

Figure 5-2 The process through which ESVs can build the resilience of social-ecological systems.

First, the use of ESVs, creates awareness about the benefits of ecosystem services and the economic impacts of losing them to forest conversion. Once the value of conserving tropical forests is recognised, political action can be taken as the data and results make the value of tropical forests to local inhabitants transparent, which can force leaders to take this into consideration, lowering the chance of corruption. The result could be greater benefits to the community as a whole rather than land-owning elite. Furthermore, it can be used as knowledge to make the most informed decisions about how to most effectively use land to equally benefit the largest portion of the population. Following the political process, action can be taken to create sustainable management of forests through less destructive economic activities. This, along with conservation, leads to less deforestation. Following action, stakeholders can reap the benefits of a healthy forest ecosystem through access to various ecosystem services, a diversified economy, poverty alleviation, and conservation of biodiversity. The existence of forests ensures better access to the general population to its goods and services. The forest also increases the chance of operating a diversified economy, more resilient to shocks as it is not depending on a single good or service for income. Conserved forests can also alleviate poverty as data has shown that a healthy environment creates opportunities for a wider group of residents in Kalimantan, in contrast to fewer individuals benefiting from the conversion of forests to palm oil (Turner et al., 2003), in addition to reducing the costs of needing to potentially pay for flood mitigation, clean water and food from the market. Finally, the conservation of biodiversity gives assurance that future ecosystem services will exist as biodiversity ensures natural systems continue to function. The results of these benefits spread across the general population, leads to the resilience of both local and global social-ecological systems as the responsible and sustainable use of forests and their ecosystem services ensures the long-term prosperity of humankind, spread across the maximum number of individuals, rather than a select few.

For this framework to occur in practice, some enabling conditions must exist. First and foremost, decision-making stakeholders need to be willing to engage, use, accept and trust ESV knowledge and the conductors of the study. Related to this, corruption cannot be too ingrained in the system, or else valuations will be completely ignored. As mentioned ESVs can help combat corruption, but only to a certain extent. Monetary gain will always drive some individuals to make selfish decisions at the cost of the general public. Second, data needs to be available, for this to occur, local or international scientists must have the time and the funding to perform the studies.

Obstacles involving the effective creation of resilience exist. The main barrier to achieving this resilience lies in the authoritarian, rapidly decentralised political structure of Indonesia. As decision-making power was rapidly re-allocated to provincial, regency, district and village levels, without much afterthought about the consequences, a fragmented system was created. Having each of the levels of government buy-in to the ESV system is unlikely, and the contradictory decision-making concerning the same parcel of land will likely persist, unless there is a foundational change in the system. Furthermore, more diverse economic opportunities outside oil palm must be shown to the people of Kalimantan, otherwise the destruction of the forests will continue as it is the only way people see the potential to make an easy income. As governments and companies see oil palm as the most profitable activity and continue to see it as beneficial to society despite, academics publishing information illustrating otherwise, land will continue to be converted. The private companies and governments hold most of the power and will continue to make decisions that show a fast profit unless they experience otherwise. The rapid benefits accrued of oil palm by companies and landowners currently outweigh the long-term benefits of conservation.

6 Conclusions and Recommendations

ESVs are being increasingly conducted around the world, with tropical forests being one of the ecosystems being valued the most. Despite numerous studies existing in the tropical forest context of Southeast Asia, results are not being used to help make informed land-use decisions as much as they could be. Reasons for the lack of the application of ESV data and results in decision-making can be attributed to a mismatching of skills and education between available ESV knowledge and decision-making stakeholders; a lack of credibility, legitimacy and trust in the data; favouritism toward market versus non-market land-use values; lack of a platform to apply ESV knowledge in the decision-making process; the short-sightedness of land-use development projects; corruption between the elites of the private and public sectors; and the lack of experience and proof of successful projects of ESV application in decision-making in the developing world.

Although scepticism around the effectiveness of ESVs in land-use decision-making exists to go along with the evident limitations, as was outlined in the literature review and discussion, the application of the laid-out strategic framework can hopefully increase the use of ESV knowledge and result in in the curbing of deforestation and increased social-ecological resilience. Among the multiple actions that various stakeholders can take to increase the use of ESVs are the following:

1) Academics who conduct ESVs are the most important players as they can take the most impactful actions. By engaging decision-making stakeholders in the public and private stakeholders the ESV process, they can get more accurate data, while increasing the legitimacy and trust of the results created. By identifying the land-use needs and problems with stakeholders, the project can be scoped to help understand the situation more clearly. Furthermore, it helps local stakeholders understand how to use the knowledge gained from the ESV. Academics should create clear and concise knowledge that illustrates impacts of certain land-use actions which is easily understood.

2) NGOs can play the role of facilitator as they promote the use of ESVs to decision-makers with whom they interact with, at multiple levels of government, from local communities to national governments. In addition to promoting the use of ESVs as a tool to help make informed decisions leading to resilient social-ecological systems, they can offer training to align the stakeholders' skills with those necessary to understand and use valuation data and results.

3) Governments can set norms and rules around making informed decisions regarding land-use. This can encourage precautionary actions when making decisions regarding the conversion of landscapes, which exposes local communities to potential profits but also greater risks.

4) Donor institutes who provide research funding for academics performing ESVs can also influence the chance of practical knowledge creation. In grant application criteria, institutes should encourage researchers to think about the application of the knowledge they create. If academics are more likely to receive funding by incorporating knowledge they will be more likely to create meaningful and applicable knowledge.

A prominent indigenous resident believes giving a monetary value to nature can be helpful to raise awareness of the value of conservation. Currently, the community in which he lives is afraid that the last parcels of forest which the community has access to, are at risk to being lost to logging companies. The profit-oriented companies with the support of the government do not give the community much hope, however they seem willing to try new avenues to illustrate the

value of the forest to higher ranking officials and ESVs could be an avenue to achieve this. A sustainability officer in the palm oil industry believes there is value in conserving some forest while still advocating for the benefits of palm oil. He believes applying ESVs could illustrate to the primary decision-makers that conservation of some forest can actually be profitable for the business through sustainable labelling of the product, and conflict avoidance with local communities, in turn reducing costs. Given the complex geopolitical problems associated with the decentralised governance structure of Indonesia, the ESV concept may be challenging to apply to the Kalimantan, however the continued performance of ESVs could create accountability if locals are engaged in the process of evaluating ecosystems services as they become aware of the values of the forests ecosystem services.

Literature and results from the systematic review support the fact that conservation can create resilience and ESVs can create economic arguments favouring conservation over land conversion. However future research is required to confirm if the recommendations made in the framework to increase the use of ESV knowledge in land-use decision-making actually increase the probability of use. The outcome is a synthesis of information from various sources and it is unknown which aspects could be most important. Moreover, each case the framework may be applied to is different, with various geopolitical circumstances. The enabling conditions for ESV knowledge to be successfully applied to decision-making need to be understood to see if there is potential for success. Successful cases should be evaluated to find similarities and correlations of successful cases of implementation. Community engagement is highly recommended in numerous sources however, actual research regarding how to engage communities in resource use decision-making is sparse. Finally, as mentioned, the link between ESVs and resilience seems to be evident, however a gap concretely relating the concepts to one another is present. Furthermore, situations that successfully integrate ESV knowledge into land-use decision-making practice should monitor the impacts to see if the resilience of social-ecological systems is actually strengthened as a result. It does however seem evident that the slowing of deforestation and promotion of conservation would increase resilience against shocks to a system based primarily on oil palm, as is the case in Kalimantan.

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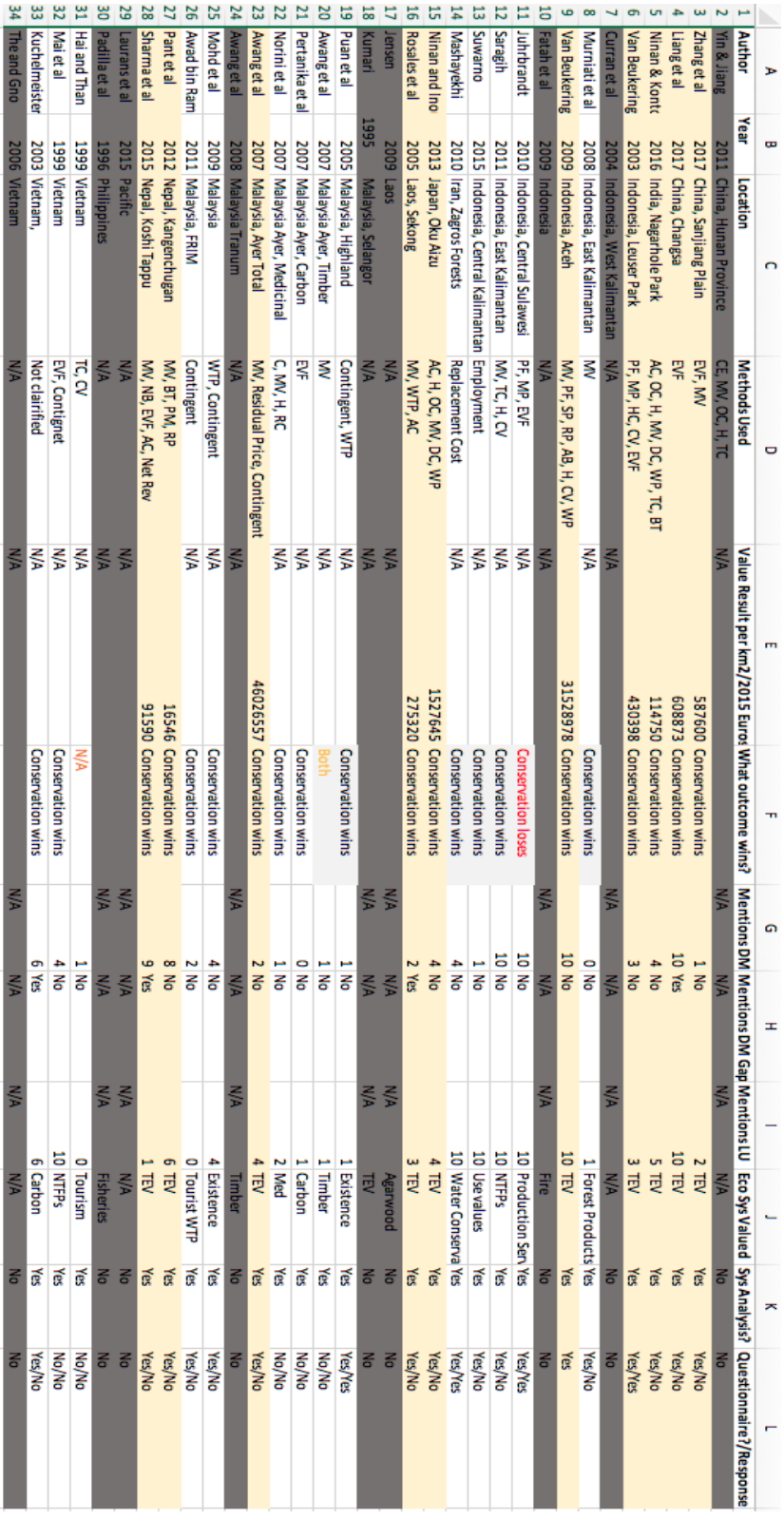
Appendix

Appendix A



	A	B	C	D	E	F	G	H	I	J	K	L
1	Author	Year	Location	Methods Used	Value Result per km2/2015 Euros	What outcome wins?	Mentions DM	Mentions DM Gap	Mentions LU	Eco Sys Valued	Sys Analysis?	Questionnaire?/Response
2	Yin & Jiang	2011	China, Hunan Province	CE, MV, OC, H, TC	N/A	N/A	N/A	N/A	N/A	N/A	No	No
3	Zhang et al	2017	China, Sanjiang Plain	EVF, MV	587600	Conservation wins	1 No		2 TEV	Yes	Yes	Yes/No
4	Liang et al	2017	China, Changsa	EVF	608873	Conservation wins	10 Yes		10 TEV	Yes	Yes	Yes/No
5	Ninan & Kontc	2016	India, Nagarhole Park	AC, OC, H, MV, DC, WP, TC, BT	114750	Conservation wins	4 No		5 TEV	Yes	Yes	Yes/No
6	Van Beukering	2003	Indonesia, Leuser Park	PF, MP, HC, CV, EVF	430398	Conservation wins	3 No		3 TEV	Yes	Yes	Yes/Yes
7	Curran et al	2004	Indonesia, West Kalimantan	N/A	N/A		N/A	N/A	N/A	N/A	No	No
8	Murniati et al	2008	Indonesia, East Kalimantan	MV	N/A	Conservation wins	0 No		1 Forest Products	Yes	Yes	Yes/No
9	Van Beukering	2009	Indonesia, Aceh	MV, PF, SP, RP, AB, H, CV, WP	31528978	Conservation wins	10 No		10 TEV	Yes	Yes	Yes
10	Fatah et al	2009	Indonesia	N/A	N/A		N/A	N/A	Fire	No	No	
11	Juhrbrandt	2010	Indonesia, Central Sulawesi	PF, MP, EVF	N/A	Conservation loses	10 No		10 Production Sen	Yes	Yes/Yes	
12	Saregih	2011	Indonesia, East Kalimantan	MV, TC, H, CV	N/A	Conservation wins	10 No		10 NTFPs	Yes	Yes/No	
13	Suwarno	2015	Indonesia, Central Kalimantan	Employment	N/A	Conservation wins	1 No		10 Use values	Yes	Yes/No	
14	Mashayekhi	2010	Iran, Zagros Forests	Replacement Cost	N/A	Conservation wins	4 No		10 Water Conserva	Yes	Yes/Yes	
15	Ninan and Ino	2013	Japan, Oku Aizu	AC, H, OC, MV, DC, WP	1527645	Conservation wins	4 No		4 TEV	Yes	Yes/No	
16	Rosales et al	2005	Laos, Sekong	MV, WTP, AC	275320	Conservation wins	2 Yes		3 TEV	Yes	Yes/No	
17	Jensen	2009	Laos	N/A	N/A		N/A	N/A	Agarwood	No	No	
18	Kumari	1995	Malaysia, Selangor	N/A	N/A		N/A	N/A	TEV	No	No	
19	Puan et al	2005	Malaysia, Highland	Contingent, WTP	N/A	Conservation wins	1 No		1 Existence	Yes	Yes/Yes	
20	Awang et al	2007	Malaysia Ayer, Timber	MV	N/A	Both	1 No		1 Timber	Yes	No/No	
21	Pertanika et al	2007	Malaysia Ayer, Carbon	EVF	N/A	Conservation wins	0 No		1 Carbon	Yes	No/No	
22	Norini et al	2007	Malaysia Ayer, Medicinal	C, MV, H, RC	N/A	Conservation wins	1 No		2 Med	Yes	No/No	
23	Awang et al	2007	Malaysia, Ayer Total	MV, Residual Price, Contingent	46026557	Conservation wins	2 No		4 TEV	Yes	Yes/No	
24	Awang et al	2008	Malaysia Tranum	N/A	N/A		N/A	N/A	Timber	No	No	
25	Mohd et al	2009	Malaysia	WTP, Contingent	N/A	Conservation wins	4 No		4 Existence	Yes	Yes/No	
26	Awad bin Ram	2011	Malaysia, FRIM	Contingent	N/A	Conservation wins	2 No		0 Tourist WTP	Yes	Yes/No	
27	Pant et al	2012	Nepal, Kangenchugan	MV, BT, PM, RP		16546 Conservation wins	8 No		6 TEV	Yes	Yes/No	
28	Sharma et al	2015	Nepal, Koshi Tappu	MV, NB, EVF, AC, Net Rev		91590 Conservation wins	9 Yes		1 TEV	Yes	Yes/No	
29	Laurans et al	2015	Pacific	N/A	N/A		N/A	N/A	N/A	No	No	
30	Padilla et al	1996	Philippines	N/A	N/A		N/A	N/A	Fisheries	No	No	
31	Hai and Than	1999	Vietnam	TC, CV	N/A	N/A	1 No		0 Tourism	Yes	No/No	
32	Mai et al	1999	Vietnam	EVF, Contlignet	N/A	Conservation wins	4 No		10 NTFPs	Yes	No/No	
33	Kuchelmeister	2003	Vietnam,	Not clairified	N/A	Conservation wins	6 Yes		6 Carbon	Yes	Yes/No	
34	The and Gno	2006	Vietnam	N/A	N/A		N/A	N/A	N/A	No	No	

Grey rows = Eliminated; White rows = Analysed; Yellow Rows = Analysed + TEV study.

Appendix B

Questionnaire questions posed to conductors of ESVs
1. Where is the specific area of your study?
2. To your knowledge, was the data from the valuation you conducted used by stakeholders to make land-use decisions about the area of study?
3. If yes, can you briefly elaborate on how it was used, and what the outcome was?
4. Do you have any thoughts on why valuation results are being under-used in decision-making?
5. How do you think the use of valuation results can be increased in decision-making processes?
6. Beyond land-use decision-making, were the valuation results used for anything else? If yes, what for?
7. Did any local persons, with a stake in the area of study, participate in conducting or analysing the valuation?

Appendix C

Questions asked to local indigenous person from East Kalimantan
1. If the province or district governments decide to, can they make the protected forest a timber or palm oil concession?
2. Are the people of the community afraid that this might happen?
3. Do you think that giving a monetary value to the forest and the services it provides to the people of your community can help the governments understand the importance of protecting the forest?
4. Do people from the community own palm oil?
5. How much does your family earn from the 2 hectares they own?
6. Does your family harvest the kernels or is the work contracted out to another palm company?
7. Is there anything else you want to tell me about the topic?

Appendix D

Questions asked to conservation officer of a palm oil company
1. What is your current job position?
2. How do palm oil companies decide where to make new plantations? Please elaborate about the process.
3. Are there any discussions with the government NGOs and/or local people about where plantations will be planted?
4. Do you think assigning an economic value to nature, like standing forests, can help decision-makers understand the value of conservation and help slow deforestation rates in Kalimantan?
5. Do you have any other thoughts on the use of valuation data for land-use decision-making in the context of Kalimantan?

Appendix E

Questions asked to founder and CEO of conservation NGO in Kalimantan
1. How many levels of government are making land-use decisions in Indonesia?
2. Do you think ESVs can help the governments understand the value of protecting of forests and slowing deforestation?
3. Do you think valuations conducted with the help of locals can help build transparency around land-use decision-making, and increase accountability?
4. What other thoughts do you have regarding combating the deforestation problem in Kalimantan?