CERTIFICATION OF FOREST ECOSYSTEM SERVICES:

CONCEPT, DEVELOPMENT, AND APPLICATION

by

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Abstract

Although forests provide various ecosystem services that support human welfare, forest ecosystems have undergone continuous degradation. To mitigate forest loss from illegal logging, forest certification was launched in the early-1990s, and the interest in certification has been expanding in scope from timber to a range of ecosystem services for a complete approach to sustainable forest management. This thesis defines such a certification scheme as the *certification of forest ecosystem services* (CFES).

In the first part, I propose a conceptual framework for CFES and argue that a key function of the certification system is to disclose information on the provision of ecosystem services to the market. This function distinguishes CFES from forest certification and may support improvements of market-based policy instruments for ecosystem services (Chapter 2).

The second part examines the possible development of CFES as an expansion of the Forest Stewardship Council (FSC) system, and analyzes the key FSC stakeholders, including certification bodies, enabling partners, and certificate holders. Their adaptability to ecosystem services was relatively high for biodiversity conservation, carbon storage, and non-timber forest products (Chapter 3). The adaptability also indicated that watershed and soil conservation services could be bundled to reduce the costs of certifying each service (Chapter 4). The FSC certificate holders preferred CFES that offers a price premium, technical training for forest owners, and/or access to global service markets, but their willingness to pay was low (Chapter 5).

The third part focuses on applying CFES to a payment for watershed services in West Lombok, Indonesia. Service buyers, sellers, and intermediaries perceived certification as a potential tool to improve watershed management (Chapter 6). Buyers demanded certified

services that disclose water quality, flood risk, and/or environmental and social forest safeguards (Chapter 7).

Preface

Six chapters (Chapter 2 - 7) of this thesis are published or being prepared for publication. All surveys conducted as part of this research were approved by the Behavioural Research Ethics Board (BREB) of the University of British Columbia (certificate no.: H13-02834).

Part one

Chapter 2: Wanggi Jaung designed the research, reviewed the literature, and wrote the manuscript. A version of Chapter 2 is under a journal's review.

Part two

Chapter 3: Wanggi Jaung designed the research, collected and analyzed data, and wrote the manuscript. Louis Putzel and Gary Q. Bull supervised the research. Robert Kozak and Chris Elliott provided critical comments. A version of Chapter 3 is published [Jaung, W., Putzel, L., Bull, G. Q., Kozak, R., & Elliott, C. (2016). Forest Stewardship Council certification for forest ecosystem services: An analysis of stakeholder adaptability. *Forest Policy and Economics, 70,* 91-98.].

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Part three

Chapter 6: Wanggi Jaung designed the research, collected and analyzed data, and wrote the manuscript. Louis Putzel and Gary Q. Bull supervised the research. Robert Kozak provided critical comments. Markum supported the field research. A version of Chapter 6 is published [Jaung, W., Putzel, L., Bull, G. Q., Kozak, R., & Markum. (2016). Certification of forest watershed services: A Q methodology analysis of opportunities and challenges in Lombok, Indonesia. *Ecosystem Services, 22, 51-59*.].

Chapter 7: Wanggi Jaung designed the research, collected and analyzed data, and wrote the manuscript. Gary Q. Bull and Louis Putzel supervised the research. Robert Kozak and Chris Elliott provided critical comments. Ussif Rashid Sumaila provided critical comments. Markum supported the field research. A version of Chapter 7 is under a journal's review.

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List of Abbreviations

ASC	Alternative specific constant
A/R CDM	Afforestation and Reforestation Clean Development Mechanism
AWS	Alliance for Watershed Stewardship
BBOP	Business and Biodiversity Offsets Programme
BMPs	Best management Practices
CFES	Certification of forest ecosystem services
CIFOR	Center for International Forestry Research
CoC	Chain of custody
EFA	Exploratory factor analysis
EPA	US Environmental Protection Agency
FSC	The Forest Stewardship Council
GEF	Global Environment Facility
GFTN	Global Forest & Trade Network
HCFV	High Conservation Value Forest
ICDPs	Integrated Conservation and Development Programs
ICRAF	World Agroforestry Centre
iid	independently and identically distributed
IMP	Institusi Multi Pihak (or multi-stakeholder institution in Lombok)
InVEST	Integrated Valuation of Environmental Services and Tradeoffs
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services

ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
MA	Millennium Ecosystem Assessment
MCA	Multiple correspondence analysis
MWTP	Marginal willingness to pay
NGO	Non-governmental organization
NTFPs	Non-timber forest products
PDAM	Perusahaan Daerah Air Minum (or a crown water company in Indonesia)
PEFC	Programme for the Endorsement of Forest Certification
PES	Payments for environmental services
PRESA	Pro-poor Rewards for Environmental Services in Africa
PWS	Payments for watershed services
REDD+	Reducing emissions from deforestation and forest degradation
SWM	Stadtwerke München (or Munich water utility)
TMDL	Total Maximum Daily Loads
UBC	University of British Columbia
UNEP	United Nations Environment Programme
VCS	Verified Carbon Standard
WWF	World Wide Fund for Nature

Glossary

Certification bodies

Third-party auditors of certification accredited or designated by a certification system

Certification of forest ecosystem services (CFES)

A certification system that discloses information on the provision of forest ecosystem services to a market

Certification of forest watershed services

CFES that discloses information on the provision of forest watershed services

Forest ecosystem services

Benefits that people obtain from forest ecosystems, such as services storing forest carbon, managing forest watersheds, and conserving forest biodiversity (MA, 2005)

Forest Stewardship Council (FSC)

Forest certification designed to promote sustainable forest management by certifying wood products from sustainably managed forests

FSC enabling partners

Agents who support or promote the FSC, including FSC national networks and WWF-GFTN networks

FSC FM certificate holders

Forest owners who hold FSC forest management (FM) certification

FSC stakeholders

Agents who supply, support, and demand the FSC system, including FSC certification bodies, enabling partners, and certificate holders

FSC stakeholder adaptability

FSC stakeholders' capacity to adapt to a new certification system, such as capacities of FSC certification bodies, enabling partners, and certificate holders to audit, support, and demand CFES, respectively

Market-based policy instruments for ecosystem services

Policy instruments designed to encourage management of ecosystem services via direct and indirect market signals, such as payments for environmental services, tradable permit programs, forest certification, and environmental subsidies

Payments for watershed services (PWS)

Payments for environmental services designed to encourage market-based management of watershed services, such as improving water quality, increasing water quantity, or managing flood risk

PWS buyers

Buyers (or users) of watershed services in PWS schemes, such as water buyers

PWS intermediaries

Agents who support PWS development and implementation, including a local government, NGO, water company, and university

PWS sellers

Sellers (or providers) of watershed services in PWS schemes, including local communities owning upstream forests

PWS stakeholders

Buyers, intermediaries, and sellers of PWS schemes

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To my parents

Chapter 1: Introduction

Over the last decades, notable loss has been observed in forest ecosystems that provide various services important for maintaining human welfare. Forests provide various ecosystem services,[1] namely provisioning services such as food and timber; regulating services such as water quality improvement and carbon sequestration; and cultural services such as recreational and aesthetic benefits (MA, 2005). Traditionally, forest laws and regulations have been used for the protection of forest ecosystems, but their enforcement is known to be ineffective in countries with weak forest governance. As a result, forest certification emerged to counter the growing trends in forest degradation and deforestation (Cashore et al., 2006; Hickey, 2004; Vogt et al., 2000).

Forest certification was initiated in the early-1990s by an alliance of environmental non-governmental organizations (NGOs) to mitigate illegal logging and biodiversity loss by certifying wood products coming from sustainably managed forests (Auld & Bull, 2003; Cashore et al., 2006; Elliott & Schlaepfer, 2001). The movement resulted in the establishment of the Forest Stewardship Council (FSC). Later, the Programme for the Endorsement of Forest Certification (PEFC) was established with support of the forest industries as an alternative to FSC forest certification (Cashore et al., 2006). Although these forest certification schemes still need to overcome challenges, like high costs and limited adoption in tropical forests (Durst et al.,

[1] For the rest of the thesis, ecosystem services indicate forest ecosystem services unless they are addressed as other kinds of ecosystem services, such as industry-based carbon emission reduction.

2006), their certified forests in the world have continuously increased from approximately 13.8 million ha in 2000 to 437.5 million ha in 2014 (MacDicken et al., 2015).

An increased interest has been shown in extending the notion of forest certification from timber to forest ecosystem services, including carbon storage, biodiversity conservation, and watershed protection (Bass & Simula, 1999; Griscom et al., 2014; Merger et al., 2011; Pettenella & Brotto, 2012; Rametsteiner & Simula, 2003; Vogt et al., 2000). The expansion of forest certification to these services may further support:

- development of certification for ecosystem services in a cost-efficient way;
- mitigation of incomplete information in ecosystem services markets;
- establishment of a more complete approach to sustainable forest management; and
- reduction of externalities related to ecosystem services.

These benefits are vital for achieving effective and cost-efficient management of forest ecosystems based on emerging market-based policy instruments, such as payments for watershed services (PWS) schemes. Although these policy instruments are expected to be more effective and cost-efficient than legal mechanisms such as command-and-control (Engel et al., 2008), the achievement of these advantages has been challenged due to limited information on ecosystem services, as in the amount of improved water quality by protecting upstream forests (Ferraro, 2008; Hanley & White, 2014; Muradian et al., 2010; Wunder et al., 2008). Certification is a tool used for disclosing incomplete or asymmetric information in the market (Bonroy & Constantatos, 2014; Dranove & Jin, 2010; Teisl & Roe, 2000). Its development, however, is often associated with the need for enormous financial resources and time, as demonstrated by the development of FSC certification (e.g., Tollefson et al., 2008). Thus, further investigation is

needed to assess the feasibility of developing certification for ecosystem services by expanding the existing system of forest certification to reduce development costs.

This thesis defines a certification scheme designed to certify forest ecosystem services as *certification of forests ecosystem services* (CFES) and it examines the concept, its development as a potential expansion of FSC forest certification, and its application to a PWS scheme in Lombok, Indonesia, as a case study. These analyses are required to examine the feasibility of developing CFES in a pragmatic way and to assess the potential for improving PWS schemes.

First, a concept of CFES must be understood before analyzing how the CFES system would differ from the FSC system that already requires some ecosystem services management (e.g., Stupak et al., 2011). Such information is vital for analyzing potential strategies for the FSC expansion to ecosystem services. A conceptualization of the CFES system and its function is also required before examining the system's expected benefits to target markets, such as a PWS scheme.

Second, the development of CFES as an expansion of the FSC system requires the adaptability of certification stakeholders to ecosystem services. These stakeholders include FSC certification bodies, FSC enabling partners, and FSC certificate holders, who would audit, support, and demand CFES, respectively. In addition, the expansion would require certifying bundling of ecosystem services to obtain enabling conditions for the certification scheme, as with increasing complementary relationships among services and helping forest owners to access diverse ecosystem services markets. The uptake of CFES also requires a demand from forest owners as they are the potential sellers of ecosystem services.

Third, to apply CFES to a PWS scheme, a demand is needed from stakeholders like service buyers, sellers, and intermediaries. Without their demand, the application would not be

feasible even if the certification scheme has expected benefits for a PWS scheme. The demand would be determined by various factors, such as stakeholder perspectives and the buyers' willingness to pay for certified watershed services.

This introductory chapter provides the background information to the thesis, including:

- forest certification, including the FSC;
- the FSC's links to ecosystem services;
- benefits and challenges of certifying bundling of ecosystem services;
- market demand for FSC forest certification;
- certification in PWS schemes; and
- the Lombok PWS scheme.

1.1 Literature review

1.1.1 Forest certification.

Among many forest certification schemes around the world, major global schemes include the FSC and the PEFC (Cashore et al., 2006; MacDicken et al., 2015; Purbawiyatna & Simula, 2008). As alternatives to each other, these schemes have different development histories and system structures. The FSC was initiated by a coalition of environmental NGOs, such as the World Wide Fund for Nature (WWF), to reduce illegal logging and forest biodiversity losses (Cashore et al., 2006; Elliott & Schlaepfer, 2001; Kozak et al., 2004). The FSC system has international Principles and Criteria (P&C)[2] and 46 regional and national standards. All of the regional and national standards are based on the P&C and specific local conditions. On the other

[2] FSC Principles and Criteria (2016, October 17). Retrieved from https://ic.fsc.org/en/certification

hand, the PEFC was initiated by forest-based industries as an alternative to the FSC. Its system endorses 43 national forest certification schemes,[3] including the Canadian Standards Association (CSA), Sustainable Forestry Initiative (SFI), Programa Brasileiro de Certificação Florestal (CERFLOR), and Malaysian Timber Certification Council (MTCC).

This thesis focuses on the FSC to analyze its potential expansion to ecosystem services since the FSC has a consistent certification system and represents one of the leading global forest certification schemes. The FSC is governed by a council of members belonging to one of three chambers – economic, environmental, or social – and established to implement multi-faceted safeguards related to the sustainability of forest management (Cashore et al., 2006; Hickey et al., 2006). The FSC requires third-party assessment, and its certification bodies are accredited by the Accreditation Services International.[4] As of 2016, a total of 37 FSC certification bodies were present around the world. The FSC is supported by enabling partners, such as the FSC national networks (e.g., FSC Canada) and environmental NGOs (e.g., the WWF's Global Forest & Trade Network) around the world. The partners train and support potential holders of FSC certification (e.g., forest owners) to promote FSC certification in their countries. To monitor processes from forests to products, the FSC has two major certification schemes: Forest Management (FM) and Chain of Custody (CoC). FM certification focuses on sustainable management of forests and it is obtained by the forest owners. The CoC certification focuses on supply chains from forests to wood product consumers and it is obtained by the manufacturers and retailers of wood products.

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[3] PEFC Council Members (2016, October 17). Retrieved from http://www.pefc.org/

[4] Accreditation Services International (2016, October 17). Retrieved from http://www.accreditation-services.com/archives/standards/fsc

As of March 2016, the FSC issued 1,375 FM certificates in 81 countries, covering 187,793,821 ha (FSC, 2016). About 83% of the certified forests exist in Europe and North America. The FSC also issued 30,077 CoC certificates in 117 countries, of which, 93% are in Asia, Europe, and North America. CoC certificates are issued more than FM certificates since wood products are traded through global supply chains. This thesis focuses on an expansion of FSC FM certification to ecosystem services since manufacturers and retailers of wood products (e.g., furniture companies) would be unlikely to expand their businesses to ecosystem services markets (e.g., a market for watershed services). For the rest of the thesis, FSC forest certification indicates FM certification unless it is addressed as CoC certification.

1.1.2 Ecosystem services.

A number of studies have identified the linkage of FSC forest certification to biodiversity conservation, non-timber forest products (NTFPs), water quality or quantity management, soil protection, and ecotourism. As described below, discrepancies exist among these studies due to the use or consideration of different criteria (e.g., the compliance with standards vs. on-the-ground impacts), different spatial scales (e.g., standards applicable internationally vs. at the national level), different economic contexts (developing vs. developed countries), and different expectations (e.g., those of biologists vs. sociologists). These discrepancies indicate the complexity of expanding the FSC system to ecosystem services, and the challenges in directly comparing results from one study to the next.

Biodiversity conservation is addressed in several studies. These studies are based on the analyses of FSC standards (Cauley et al., 2001; Gullison, 2003; Ioras et al., 2009; McDermott et al., 2008; Merger et al., 2011; Roberge et al., 2011), Corrective Action Requests (CARs) from

certification bodies (Newsom et al., 2006; Masters et al., 2010), stakeholder surveys (Moore et al., 2012), and mixed methods and reviews (Kuijk et al., 2009; Nasi et al., 2012; Putz & Romero, 2001; Sheil et al; 2010). Nevertheless, many studies are not completely consistent due to the limitations of the FSC's own requirements for addressing the complexity of measuring, managing, and monitoring biodiversity (Bennett, 2001; Ghazoul, 2001; Sheil et al; 2010), which usually follow tailor-made protocols that vary from ecosystem to ecosystem.

A number of studies address certified production of NTFPs, which are already covered by the FSC system. In 1999, the FSC board of directors approved development of case-by-case standards for NTFPs (Pierce et al., 2008). Consequently, various NTFPs have been certified under the FSC, including chicle latex, Brazil nuts, palm hearts, and maple syrup (Duchelle et al., 2014; Pierce et al., 2008; Shanley et al., 2008). While FSC NTFP standards may benefit producers and support biodiversity conservation, several studies highlight challenges affecting uptake. These include a lack of global markets for some products, and the fact that no corresponding CoC certification for NTFPs exists to ensure that products actually originate from certified forests. Competition with organic or Fairtrade certification schemes is also cited as a factor that reduces the demand for FSC certified NTFPs (Duchelle et al., 2014; Pierce et al., 2008; Schmitt et al, 2008).

Services related to *water quality or quantity* are evaluated through analyses of the FSC's certification standards (McDermott et al., 2008; Roberge et al., 2011; Stupak et al., 2011), CARs analyses (Newsom et al., 2006), an FSC stakeholder survey (Tikina et al., 2008), and an ecological study of FSC certified forests (Dias et al., 2015). Nevertheless, van Dam et al. (2010) consider the FSC standards too general to adequately assess water quality or quantity compared to agricultural certification schemes. Some of these studies also recognize the FSC system's

potential for contributing to *soil management* (Newsom et al., 2006; Stupak et al., 2011; van Dam et al., 2010) though no study measures the FSC's actual impacts on soil improvement, and they only draw conclusions based on compliance with the standards.

Carbon storage has not been assessed as an outcome of FSC international standards (Gan & Cashore, 2013; Merger et al., 2011) nor of FSC certification in the US (Foster et al., 2008). Medjibe et al. (2013), however, found a probable reduction in carbon emissions in FSC-certified forests in Indonesia based on ground measurements. Several studies discuss the potential use of FSC certification in the management of an REDD+ scheme (Medjibe et al., 2013; Pettenella & Brotto, 2012; Putz & Romero, 2012). In voluntary markets, carbon credits are also certified by the FSC (Goldstein et al., 2014). These credits can be extrapolated based on standards compliance to certify the credits, rather than certifying actually quantified forest carbon.

Ecotourism-related services have not yet been covered in studies of forest certification (Harshaw et al., 2007; Sheppard et al., 2004), though FSC international standards have been indicated to address the conservation of cultural values and some FSC national standards address the delivery of scenic beauty and opportunities for outdoor recreation. In any case, FSC standards do not address these ecosystem services explicitly, nor do they link the association of these values with tourism.

Despite these studies, the adaptability of FSC stakeholders to the particular requirements to certify ecosystem services is still unknown. Adaptability to shifting opportunities and innovations is an important quality of successful institutions and business models (McKee et al., 1989; Mori et al., 2016; Tuominen et al., 2004; Valentin et al., 2012). An expansion of the FSC system to ecosystem services requires stakeholder adaptability, such as the FSC certification bodies' capacity to audit service delivery, the FSC enabling partners' preferences to provide

training in the provision of services, and the FSC certificate holders' experiences and expectations to manage and sell services. Without this adaptability of the FSC stakeholders, the expansion would be challenged and costly.

1.1.3 Bundling of ecosystem services.

In the literature, bundling refers to selling multiple ecosystem services together or combined in a single credit (Deal et al., 2012; Robertson et al., 2014). In contrast, stacking refers to selling multiple services associated with the same management practice but accounted for and sold separately. Bundling of ecosystem services; for example, could entail selling a single credit that combines forest carbon and watershed protection derived from restoration activities in upstream watersheds. Stacking ecosystem services would involve selling the forest carbon and watershed protection as distinct credits. This thesis adopts the term bundling as a blanket term for various services managed jointly and considers bundling as a prerequisite of stacking.

A number of cases of bundling ecosystem services have occurred around the world. In Oregon (US), for example, the Counting on The Environment (COTE) standards have been established to trade services of providing wetland, salmonid, upland prairies, or improved water quality and to motivate landowners to restore multiple ecosystem services (Deal et al., 2012). In North Carolina (US), Neu-Con Bank sold wetland and nutrient offset credits based on the same conservation action (Fox et al., 2011). In Minnesota (US), the Conservation Marketplace of Minnesota and the American Farmland Trust initiated a project to trade carbon and water credits (Robertson et al., 2014). In Costa Rica, a national PES program bundles services of carbon storage, watershed protection, biodiversity conservation, and scenic beauty (Kemkes et al., 2010; Pagiola, 2008). In Bolivia, a PES program in the Los Negros Valley paid farmers for services of

protecting bird habitats and upstream watersheds (Asquith et al., 2008; Kemkes et al., 2010). Globally, the development of an REDD+ scheme is also discussed in the context of co-benefits, such as biodiversity conservation in addition to forest carbon sequestration (Kanowski et al., 2011). The discussion of REDD+ co-benefits signals the need for a better understanding of bundling of ecosystem services (Robertson et al., 2014).

Development of CFES is contingent on the benefits and challenges associated with the bundling of ecosystem services (Deal et al., 2012; Fox et al., 2011; Kemkes et al., 2010; Robertson et al., 2014). On the one hand, certifying the bundling of ecosystem services has a number of expected benefits to forest management and associated markets. It could increase the income of forest owners (Deal et al., 2012; Kemkes et al., 2010; Robertson et al., 2014), enable credit producers to hedge against risk (Robertson et al., 2014), reduce the transaction costs of providing multiple services (Wendland et al., 2010), allow forest owners to access diverse ecosystem services markets throughout each individual service in a bundle (Robertson et al., 2014; Wendland et al., 2010), and encourage forest owners to adopt more holistic approaches to management (Deal et al., 2012; Kemkes et al., 2010). These benefits are assumed to be enabling conditions of CFES, and without these benefits, the economic sustainability of the certification scheme would be compromised.

On the other hand, certifying the bundling of ecosystem services entails a number of challenges. Fundamentally, scientific knowledge and associated methodologies are insufficient for managing and measuring the delivery of ecosystem services in bundles (Robertson et al., 2014; Wendland et al., 2010). In addition, legal systems often lack a specific mechanism to support the governance of bundling (Robertson et al., 2014). With bundling, the requisite of additionality of service provision becomes more complex and difficult to establish, which

requires multiple baselines to be determined and the development of standardized assessment procedures (Robertson et al., 2014). The delineation of optimal offset caps would be complicated if bundles were to be taken into account (Woodward, 2011). These challenges are compounded with the more fundamental problems of CFES, including low market demand, lack of simple but scientific standards, and the expectation of high certification costs (Meijaard et al., 2011, 2014).

Despite the expected benefits and challenges associated with integration of bundled ecosystem services into CFES, bundling has not been examined from the perspective of certification. This knowledge gap challenges the testing of the benefits and challenges, and in turn, the analysis of feasibility of developing CFES and its application to ecosystem services markets.

1.1.4 Demand for certification.

In contrast to forest laws and regulations, FSC forest certification is an instrument of non-state market-driven governance, soft law, and market-based mechanism (Cashore et al., 2007; Hickey et al., 2006; Rametsteiner & Simula, 2003); market demand is a key requirement for applying CFES to the market-based management of ecosystem services. In wood product markets, FSC forest certification is demanded for various reasons. *Forest owners* certify wood products to access price premiums, to improve their capacity to manage forests, to signal their businesses' soundness to the market, to meet corporate social responsibility goals, and to responsibly manage their own forests (Bowers et al., 2012; Carlsen et al., 2012; Overdevest & Rickenbach, 2006). *Retailers* buy and sell certified wood products to improve company image, be an environmental leader in their industries, and increase market share (Chen et al., 2011b). *Consumers* purchase certified wood products to support biodiversity conservation and reduce

illegal deforestation, particularly in tropical countries (Aguilar & Vlosky, 2007; Aguilar & Cai, 2010; Thompson et al., 2010). Although these motivations provide insights into the reasons for the market demand for FSC forest certification, it is still uncertain whether or not these motivations would exist in ecosystem services markets for CFES, because wood product markets differ from these service markets from many perspectives: wood products are conventional products while ecosystem services are an emerging concept that defines the benefits of forest ecosystems, and these products and services are used by different consumers. Thus, knowledge is limited about the CFES market demand and certification's feasibility for benefiting ecosystem services markets.

1.1.5 PWS certification

PWS schemes are one of the target markets for CFES. A PWS scheme is a market-based mechanism designed to manage watershed services, and it has been increasingly implemented around the world (Ezzine-de-Blas et al., 2016; Porras et al., 2008; Wunder et al., 2008). In a PWS scheme, upstream forest owners are compensated for providing watershed protection services, such as improving water quality or controlling flood in the downstream (Landell-Mills & Porras, 2002; Wunder, 2005). Compensation to forest owners is financed by either water users in the downstream (or user-funded PWS) or local governments (or government-funded PWS) (Wunder et al., 2008). Although effective and cost-efficient management of forest watersheds is an expected advantage of a market-based mechanism, achieving this advantage from PWS schemes has been challenging due to the lack of information on watershed services (Ferraro, 2008; Hanley & White, 2014; Muradian et al., 2010; Wunder et al., 2008). CFES could mitigate

this problem of PWS schemes by disclosing information on watershed services. To achieve this possibility; however, market stakeholders need to perceive and value the benefits of CFES.

Although no case exists of CFES being applied to PWS schemes, some cases exist of other certification schemes (e.g., organic certification) (Table 1.1), which imply the potential benefits of CFES to PWS schemes. The applications can be described as either *implicit* or *explicit*. Implicit applications use certification as a medium to build enabling conditions for a PWS scheme, while explicit applications use certification as part of the implementation of a PWS scheme.

Table 1.1 PWS schemes with certification applications

PWS location	Kapingazi River, Kenya [a]	Munich, Germany [b]	New York, the US [c]
Leading institutions	The World Agroforestry Centre (ICRAF)	Stadtwerke München (SWM, or Munich water utility)	New York City
Certification application	Implicit	Explicit	Explicit
Certification type	Organic certification / eco-label	Organic certification	Origin certification
Certification scheme	- Rainforest Alliance (RA) - UTZ certified (UTZ)	- Bioland - Naturland - Demeter	- Pure Catskills
Certification benefit to PWS	Social, economic, and environmental safeguards of upstream farms	Providing a monitoring and verification system for the PWS scheme	Promoting farm products from the PWS regions
Certification costs	Financial supports from various institutions, including Rainforest Alliance (RA), Solidaridad (UTZ), and WorldBank (UTZ).	SWM subsidizes farmers to join organic certification. Farmers need to pay a join fee to organic associations.	Farmers pay an annual fee to the Watershed Agricultural Council who manages the certification system.

[a] Sources: Firmian et al. (2011), Mitei (2011), Schoonhoven-Speijer (2012), UTZ certified (2015).
[b] Sources: Alpine Convention (2011), Barataud et al. (2014), Escobar et al. (2013), Grolleau & McCann (2012), Vlahos & Schiller (2014).
[c] Sources: DEP (2014), Grolleau & McCann (2012), Pires (2004), Pure Catkills (2015).

A case of implicit application is the PWS scheme in Kapingazi River, Kenya, led by the World Agroforestry Centre (ICRAF). This PWS scheme aims to manage upstream watersheds of

Kapingazi River, where a number of tea and coffee farms exist (Firmian et al., 2011). Before the PWS scheme was launched, some of these farms had already obtained agricultural certification, such as UTZ certified and Rainforest Alliance (Firmian et al., 2011; Mitei, 2011; UTZ certified, 2015). These certification schemes are expected to benefit the PWS scheme by improving the farmers' capacity to implement organic practice and by incorporating social and economic safeguards (Firmian et al., 2011; Schoonhoven-Speijer, 2012).

Cases of explicit application include the PWS schemes in Munich, Germany, and New York City, USA. The PWS scheme in Munich explicitly uses organic certification (e.g., Bioland, Naturland, and Demeter) as a monitoring and verification system (Alpine Convention, 2011; Grolleau & McCann, 2012; Escobar et al., 2013). Upstream farmers in Mangfall Valley in Munich can become eligible to receive full payment from the PWS scheme when they join and maintain organic certification, because reduced agricultural inputs by organic practice contribute to improving water quality (Barataud et al., 2014; Vlahos & Schiller, 2014). This financial incentive rapidly increased the number of certified farms from 23 in 1993 to 150 in 2010 (Barataud et al., 2014). By applying organic certification, the Munich PWS scheme did not have to establish a new system of monitoring and verification with high costs.

The PWS scheme in New York City, USA, uses a certification of origin whereby local farm products from the Catskills region are labeled as "Pure Catskills" (Grolleau & McCann, 2012; Pure Catkills, 2015). The Catskills region is the major watershed for New York City, and local farmers are paid by the city for improved watershed management (Pires, 2004; Grolleau & McCann, 2012). The Pure Catskills label, launched in 2004, complements those direct payments through a buy-local campaign promoting Catskills farm products to city consumers based on claims of the region's contribution to the city's clean drinking water (DEP, 2014; Pure Catkills,

2015). Pure Catskills is managed by the Watershed Agricultural Program, which works as a PWS intermediary and provides technical support to farmers to improve their water management (Grolleau & McCann, 2012).

Although applied to PWS schemes, these certification schemes focus on impacts of agricultural practices on downstream water quality or promotion of agricultural products. In other words, the schemes are limited to certifying impacts of forest management on the provision of watershed services; they have limited potential to be expanded as certification for forest watershed services, compared to FSC forest certification.

Moreover, no case of CFES being applied to PWS schemes yet exists because CFES is still in its infancy. As a result, opportunities and challenges associated with such applications are still uncertain. It is also unknown how PWS stakeholders would perceive CFES and whether or not service buyers would demand certified watershed services. This knowledge gap is another challenge in the examining of the feasibility of CFES to improve PWS schemes.

1.1.6 Lombok PWS

This thesis analyzes the possible application of CFES to a PWS scheme in Lombok Island in Indonesia, as a case study (Figure 1.1). The PWS scheme is well-known in Indonesia and has been analyzed in many studies (e.g., Fauzi & Anna, 2013; Pirard, 2012b; Pirard et al., 2014; Prasetyo et al., 2009; WWF, 2014). The upstream forests in Mount Rinjani on the island have major water catchment areas (Magdalena et al., 2013; WWF, 2014). Springs in the watersheds are a major water source for the residents in Mataram City and West Lombok District. The water is distributed to them via pipelines managed by a local state water company, or PDAM (*Perusahaan Daerah Air Minum*). Historically, Lombok suffered from increased

deforestation in the upstream forests, which resulted in the reduction of water quality and the disappearance of upstream springs (Prasetyo et al., 2009; Fauzi & Anna, 2013). To improve forest management in the upstream and benefit community livelihoods, the PWS scheme was initiated in 2003 (WWF, 2014). The scheme is currently enforced by West Lombok government regulation (No. 4/2007) and managed by a multi-stakeholder institution called IMP (*Institusi Multi Pihak*).

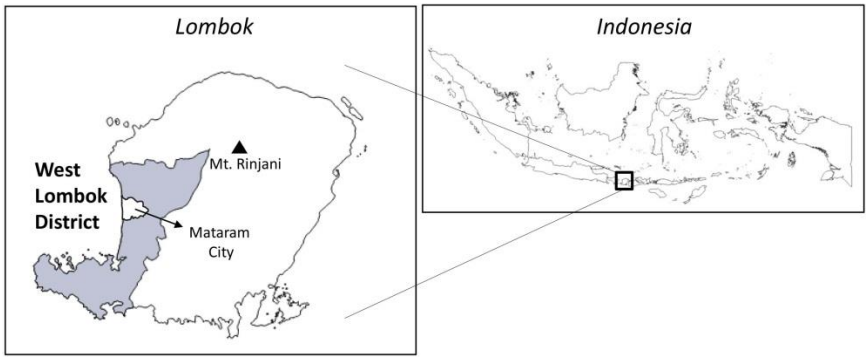

Figure 1.1 Lombok, Indonesia

Major stakeholders of the PWS scheme include sellers, buyers, and intermediaries (WWF, 2014). *The sellers* are upstream communities with forests. *The buyers* are households and private businesses using water of PDAM Giri Menang in West Lombok. The households and private businesses pay Rp. 1,000 (or USD 0.10) and Rp. 2,000 per month, respectively, for ecosystem service fees. These flat fees are added to their PDAM water bills. *The intermediaries* consist of multiple institutions, such as the West Lombok Forest Service, the IMP office, PDAM Giri Menang, and the WWF-Nusa Tenggara office.

1.2 Research objectives and structure

To support the feasibility analysis of CFES, this thesis analyzes its concept (part one), its development as an expansion of the FSC system (part two), and its application to a PWS scheme (part three) (Table 1.2). These analyses are conducted with six research objectives (or chapters), including the analyses of:

- a conceptual framework for the CFES system (Chapter 2);
- FSC stakeholder adaptability to ecosystem services (Chapter 3);
- FSC stakeholder adaptability to bundling of ecosystem services (Chapter 4);
- FSC certificate holders' demand for CFES (Chapter 5);
- PWS stakeholders' perspectives on CFES (Chapter 6); and
- PWS buyer demand for certified watershed services (Chapter 7).

Table 1.2 Research structure

Chapter	Focus	Methodology	Targeting group
Part one	Concept of CFES		
Ch. 2	Conceptual framework for CFES system	Literature review	
Part two	Development of CFES: Expansion of FSC forest certification		
Ch. 3	Stakeholder adaptability to ecosystem services	Survey	- FSC certification bodies - FSC enabling partners - FSC certificate holders
Ch. 4	Stakeholder adaptability to bundling of ecosystem services	Explanatory factor analysis, and multiple correspondence analysis	- FSC certification bodies - FSC enabling partners - FSC certificate holders - Ecosystem services projects
Ch. 5	Demand for CFES	Choice experiment	- FSC certificate holders
Part three	Application of CFES: Case studies in Lombok, Indonesia		
Ch. 6	Perspectives on CFES	Q methodology	- PWS buyers - PWS intermediaries - PWS sellers
Ch. 7	Demand for certified watershed services	Choice experiment	- PWS buyers

Part one analyzes a concept of CFES. As a working hypothesis, Chapter 2 proposes a conceptual framework for the components and function of the CFES system and compares the system with a forest certification system. It also analyzes the CFES system's expected benefits to target markets, such as a PWS scheme.

Part two focuses on the development of CFES as an expansion of the FSC system. Chapters 3 and 4 examine FSC stakeholder adaptability to the incorporation of ecosystem services and bundling of these services, respectively. Stakeholder adaptability is analyzed based on online surveys of FSC certification bodies' capacity to audit services, FSC enabling partners' preferences for training forest owners on services, and FSC certificate holders' experiences and expectations about managing and selling services. In addition to FSC stakeholders, Chapter 4 analyzes the bundling of services from a secondary database[5] on ecosystem services projects (e.g., forest carbon projects) since these projects may adopt CFES and demonstrate targeted service bundles on the ground. Chapter 5 estimates FSC certificate holders' demand for CFES as they represent forest owners with certification experience and the potential sellers of ecosystem services.

Part three analyzes an application of CFES to a PWS scheme in Lombok, Indonesia. By interviewing key informants, from buyers to sellers, and intermediaries, Chapter 6 analyzes PWS stakeholder perspectives on the opportunities and challenges associated with a CFES application. Based on face-to-face household surveys, Chapter 7 estimates the buyer demand for certified watershed services.

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[5] InVEST. (2016, October 20). Retrieved from http://www.naturalcapitalproject.org/InVEST.html

Chapter 2: A conceptual framework for certification of forest ecosystem services

2.1 Introduction

This chapter analyzes a conceptual framework for the certification of forest ecosystem services (CFES) since its conceptualization is a key requirement for expanding the FSC system to ecosystem services. Besides an academic interest in applying forest certification to ecosystem services management (Bass & Simula, 1999; Griscom et al., 2014; Merger et al., 2011; Pettenella & Brotto, 2012; Rametsteiner & Simula, 2003; Vogt et al., 2000), a certification system has been applied to the design and implementation of market-based policy instruments for ecosystem services. For example, voluntary and regulatory carbon markets have adopted certification systems such as the Verified Carbon Standard (VCS) and the Afforestation and Reforestation Clean Development Mechanism (A/R CDM) (Kollmus et al., 2010; Richards & Huebner, 2012a; 2012b). A certification system has been integrated into the design of tradable permit programs, such as water quality trading and biodiversity offset programs (Ellerman, 2005). Voluntary standards have emerged for watershed management and biodiversity offsets, such as the Alliance for Water Stewardship standard (AWS, 2013) and the Business and Biodiversity Offsets Programme (BBOP) standard (BBOP, 2012).

Despite these applications, a certification system applied to ecosystem services management has not been conceptualized in an integrated way. A certification system has been examined in the literature on tradable permit programs and forest carbon certification (e.g., Ellerman, 2005; Kollmus et al., 2010), but these studies only recognize the existence of a

certification system in tradable permit programs or focus only on a particular ecosystem service. In failing to establish well-functioning components of a certification system, many market-based policy instruments suffer from a lack of buyer-side conditionality, weak monitoring systems, slow verification procedures, and low market participation (Alvarado-Quesada et al., 2014; Bunn et al., 2013; Ellerman, 2005; Kollmuss et al., 2010). Thus, a conceptualization of the system components and function of CFES is necessary not only for the analysis of a potential expansion of the FSC system to ecosystem services, but also for the mitigation of malfunctioning applications of the CFES system for market-based policy instruments.

First, this chapter proposes a conceptual framework (Section 2.2) that compares main functions of CFES and forest certification (Section 2.3). Later, based on the identified function of CFES, it analyzes potential customers of CFES (Section 2.4) and market-based policy instruments that CFES would support (Section 2.5). Finally, it explores potential challenges of CFES (Section 2.6).

2.2 Conceptual framework

This study proposes a conceptual framework for components and the function of the CFES system, as a working hypothesis (Figure 2.1). First, the framework identifies the main components of a general certification system as *standards*, *an auditing system*, and *a disclosure system*. These components are key elements of various certification systems, such as forest certification, agricultural certification, and forest carbon certification (e.g., Bass et al., 2001; Hatanaka & Busch, 2008; Hickey et al., 2006; Kollmuss et al, 2010; Nussbaum & Simula, 2005; Richards & Huebner, 2012a; 2012b). Standards contain criteria to evaluate the quality of a product or service. An auditing system validates and verifies the compliance with standards. A

disclosure system discloses the compliance with the standards to markets through labels and certificates. These components allow a certification system to disclose information on the quality of a product or services in a market, which is a key function of a certification system (Bonroy & Constantatos, 2014; Dranove & Jin, 2010; Rametsteiner & Simula, 2003; Teisl & Roe, 2000). For example, forest certification intends to disclose information that certified wood products are from sustainably managed forests, so that product buyers can support sustainable wood products (Rametsteiner & Simula, 2003; Teisl & Roe, 2000).

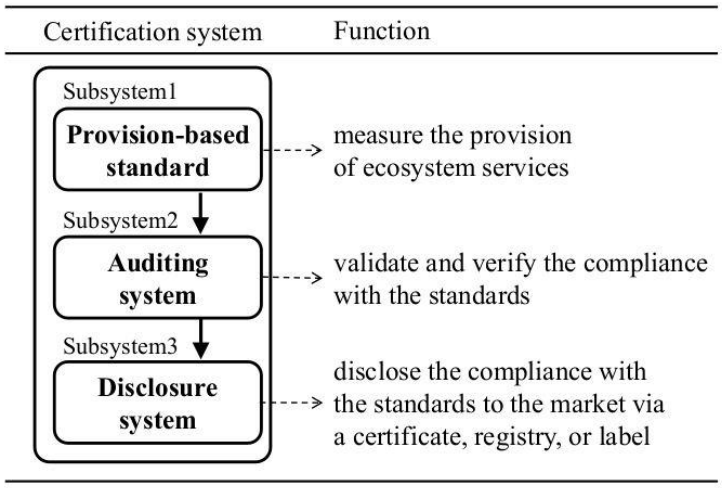


Figure 2.1 Components and function of CFES system

Second, the conceptual framework specifies particular components of a CFES system as *provision-based standards*, *an auditing system*, and *a disclosure system* (Figure 2.1 and Table 2.1). The following sections analyze each of these components in depth and demonstrate the differences between a CFES system and other certification systems, such as forest certification.

Table 2.1 Examples of CFES

System components	Certification of A/R CDM [a]	Verified Carbon Standard (VCS) [b]	Certification of the Tualatin trading program [c]	Certification of BushBroker program [d]
1. Provision-based standards				
Standard	A/R CDM standard	VCS standard	Water quality standard	Biodiversity offset standard
Ecosystem services	Carbon storage	Carbon storage	Watershed conservation	Vegetation conservation
Service unit	Ton	Ton	Temperature TDML	Hectare and species condition
Additionality	Required	Required	Required	Required
Uncertainty discounts	Adopted	Adopted	Adopted [1]	Adopted [4]
New method	Acceptable	Acceptable	Limited [2]	Limited [5]
2. Auditing system				
Auditor	Designated Operational Entities	Validation/ Verification Bodies	Govt agents	Developers/ Accredited organizations
Auditor type	3rd party	3rd party	2nd party	1st, 3rd party
3. Disclosure system				
Certificate	Exist	Exist	Exist	Exist
Registry	Exist	Exist	Not available [3]	Exist
Label	Not available	Not available	Not available	Not available
Certification markets	Carbon market	Carbon market	Water quality market	Biodiversity offset market
Market type	Regulatory	Voluntary	Regulatory	Regulatory

[a] Source: Kollmus et al. (2010)
[b] Source: Verified Carbon Standard (VCS) (www.v-c-s.org)
[c] Sources: Cochran & Logue (2011) and CWS (2013)
[d] Sources: Alvarado-Quesada et al., (2014) and DEPI (2013)
[1] Uncertainty discount is not applied to credit accounting but to a trade ratio (CWS, 2013).
[2] Only specified modelling can be used to calculate thermal credits (CWS, 2013).
[3] No credit registry is available but credit information is available on annual program reports (CWS, 2013).
[4] Threats are counted in a gain score calculation (DEPI, 2013).
[5] Only specified scoring method can be used to calculate vegetation credits (DEPI, 2013).

2.2.1 Provision-based standards.

Provision-based standards[6] are the key component of a CFES system. Allowing for the measurement of the provision of ecosystem services, these standards distinguish the CFES system from other certification systems, such as the FSC system. Although the features of all provision-based standards are broad and would evolve continuously, the following features are shared among emerging provision-based standards.

First, provision-based standards specify methodologies to measure *the provision of ecosystem services*. To measure the provision, these standards compare baselines to projections of provisioned services (Jones et al., 2006; McKenney & Kiesecker, 2010; Quétier & Lavorel, 2011; Richards & Huebner, 2012a; Wunder, 2005) (Figure 2.2). Baselines measure ecosystem services without (or before) forest ecosystem management, while projected lines measure services with (or after) the management. The provision of ecosystem services is measured as a difference between baselines and projected lines. The provision of services is measured in diverse units: forest carbon is measured by tons of carbon (Richards & Huebner, 2012a); water quality is measured by total daily maximum loads of sediments or water temperature (Cochran & Logue, 2011; Jones et al., 2006); and biodiversity is measured by habitat hectares or number of species (McKenney & Kiesecker, 2010). The provision of ecosystem services corresponds to a concept of "additionality" from voluntary carbon markets (Kollmus et al., 2010; Richards & Huebner, 2012a), PES (Wunder, 2005, 2015), biodiversity offset programs (McKenney & Kiesecker, 2010), and a concept of "performance-based payments" from reducing emissions

[6] "Provision-based standards" are also addressed as "accounting protocols/standards" (Kollmus et al., 2010) and "offset protocols/standards" (Richards & Huebner, 2012a).

from deforestation and forest degradation (REDD+) (Angelsen, 2009). In this manner, provision-based standards are connected to the primary requirements of the market-based policy instruments for ecosystem services.

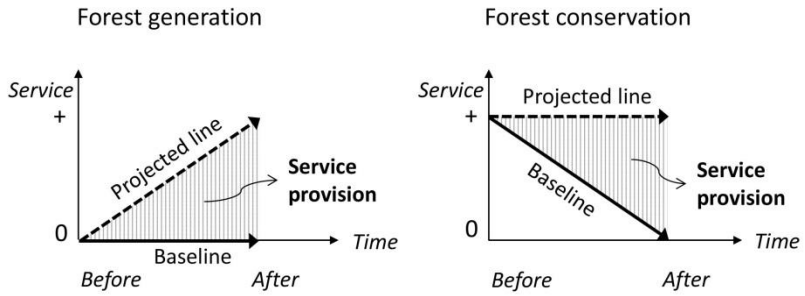


Figure 2.2 Conceptual measurements of ecosystem services

(Adopted from Wunder (2005))

Second, provision-based standards often adopt *uncertainty discounts* in accounting ecosystem services credits since ecosystem services management is associated with various uncertainties. For instance, the amount of carbon sequestrated by forests can be overestimated if the available data is insufficient for establishing baselines; the probability of species survival can be overestimated due to a lack of scientific information; and water quality improvement can be overestimated because of limited data on discharges of nonpoint source pollutants. To mitigate the uncertainties arising from inadequate measurements of ecosystem services, many provision-based standards adopt uncertainty discounts. Forest carbon standards require discounted carbon credits; e.g., discounting 10% of the estimated total carbons in a forest (Kollmuss et al., 2010). Water quality standards incorporate discount factors in counting water quality credits, such as counting total daily maximum loads (Jones et al., 2006). In addition, biodiversity offset standards

apply a discounting rate or time[7] for measuring the gains and losses from biodiversity offsets (Pouzols et al., 2012; Quétier & Lavorel, 2011). Uncertainty discounts can be applied to provision-based standards (e.g., discounted credits) and market rules (e.g., offset ratios) (Figure 2.3). This conceptual distinction, however, becomes unclear in regulatory market-based policy instruments where certification and instrument systems are integrated (i.e., regulations are both standards and trade rules). Uncertainty discounts also cannot mitigate the entirety of uncertainties associated with ecosystem services management (Quétier & Lavorel, 2011; Richards & Huebner, 2012a). Rather, these discounts can mitigate only some degree of uncertainty. Despite this limitation, uncertainty discounts are an emerging feature of provision-based standards that have not been applied to conventional certification schemes, such as forest certification and ecolabels.

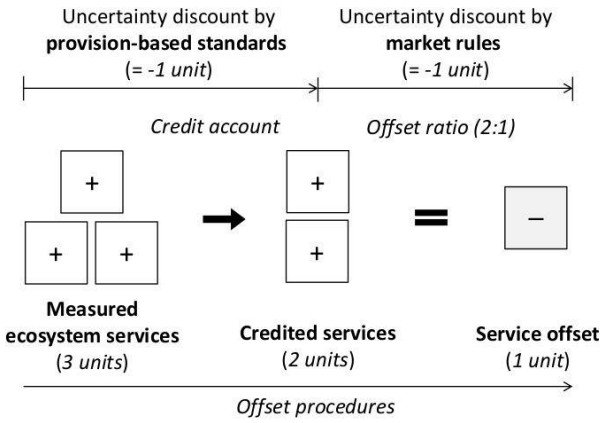


Figure 2.3 Examples of uncertainty discounts

Third, provision-based standards allow *bottom-up methodologies* proposed by forest owners to measure the provision of ecosystem services, in addition to top-down methodologies

[7] Pouzols et al. (2012) propose a biodiversity accounting framework that integrates time discounting into measurements of restoration impacts due to an uncertain time delay associated with restoration.

standardized by certification systems. For example, the Verified Carbon Standard accepts new methodologies to measure forest carbon throughout a methodology approval process (VCS, 2015). Carbon offset programs, such as the A/R CDM, allow project developers to apply site-specific methodologies with approval (Kollmuss et al., 2010). Biodiversity offset standards accept site-specific indicators (Quétier & Lavorel, 2011). The U.S. Environmental Protection Agency approves new methodologies for water quality trading programs in particular states, though many of the nonpoint source offset programs require developers to use Best Practice Managements (BPMs) with impacts that are identified and approved (Jones et al., 2006; Shortle & Horan, 2008). Supporting site-specific management of ecosystem services, these bottom-up approaches enable provision-based standards to integrate new technologies into ecosystem services measurement.

As a result, provision-based standards functionally differ from performance-based and system-based standards and distinguish CFES from other certification systems, such as forest certification and system management certification (Table 2.2). Provision-based standards focus on the *outcomes* of ecosystem management. These outcomes are measured services of forest ecosystems, such as amounts of carbon storage in forests and amounts of reduced sediments in forest watersheds. In contrast, performance-based standards[8] focus on management *activities* (e.g., planting trees) (Nussbaum & Simula, 2005). System-based standards focus on management systems and are neither based on activities nor outcomes of ecosystem management (Heras-

[8] In other disciplines, the term, "performance-based," is used to address industrial standards for outputs such as a clean environment (Coglianese and Lazer, 2003), or additionality of ecosystem services such as performance-based payments in a REDD+ scheme (Angelson, 2009). However, this study uses the term to address standards for forest management activities following the literature of forest certification (e.g., Nussbaum & Simula, 2005) to compare CFES and forest certification.

Saizarbitoria & Boiral, 2013). Because the provision of ecosystem services is often defined by stakeholders in practice, performance-based standards could be used to predict, or assume the provision when stakeholders accept this approach. To bypass methodological challenges of measurement, for instance, many PES schemes assume the provision of watershed services based on forest management activities (e.g., hectares of conserved forests) rather than on measured outcomes (e.g., reduced sediments in watersheds) (Engel et al., 2008; Hanley & White, 2014). Adopted by water quality trading programs for non-point source pollutants (Shortle & Horan, 2008), Best management Practices (BMPs) *per se* can be considered as performance-based standards. Nevertheless, measurement methodologies relying on BMPs are still considered as provision-based standards since they use BMPs having impacts on water quality that are statistically estimated (e.g., reduced water temperature from tree planting) (e.g., CWS, 2013). These methodologies measure outcomes of ecosystem services by comparing watersheds with and without BMPs adaptation. In this manner, provision-based standards are distinguished from performance-based and system-based standards in that provision-based standards become a unique feature of CFES.

Table 2.2 Certification standards applied for ecosystem services management

Standard type	Focus	Accuracy of service measurement	Function in ecosystem services markets	Example
Provision-based standards	Ecosystem services outcomes	High tier	Additionality	- Verified Carbon Standard - Water quality standard
Performance-based standards *	Forest management actions	Medium tier	Co-benefits	- FSC - PEFC
System-based standards *	System management	Low tier	Guidelines	- ISO 9001 - ISO 14001

*Adopted from Nussbaum and Simula (2005) and Heras-Saizarbitoria and Boiral (2013)

2.2.2 Auditing system.

CFES has an auditing system to establish the credibility of information generated by provision-based standards. The system specifies procedures for validating and verifying with compliance with standard requirements based on an established schedule (e.g., Kollmuss et al., 2010). Validation is a process of evaluating management plans, while verification is a process of evaluating the implementation of plans on site (Richards & Huebner, 2012b). The compliance can be validated and verified by a first-party (e.g., a forest owner), a second-party (e.g., a business partner of a forest owner), or a third-party (e.g., an independent auditor). In practice, the auditing system is not perfect, and in the case of forest certification (Auld et al., 2008; Rametsteiner & Simula, 2003), the auditing system may be subject to the reliability of auditors; even independent third-party auditors cannot always be objective. The reliability of auditing can also be affected by the complexities and site-specific conditions surrounding ecosystem services management. Despite these limitations, a third-party audit is still considered more credible than first- or second-party audits. Third-party auditors are certification bodies accredited by certification systems or governments. The cost efficiency and administrative effectiveness of an auditing system can also affect performance of a CFES system. For example, the performance can be negatively affected by limited availability of third-party auditors, high audit costs, and slow audit procedures. Unfortunately, these problems are common to the design of both voluntary and regulatory CFES systems (e.g., Bunn et al., 2013; Kollmuss et al., 2010).

An auditing system of CFES can also rely on additional systems and differentiated audit procedures. First, an auditing system can rely on separate approval systems. For example, some CFES systems in tradable permit programs have a separate approval system that approves audit results, such as the A/R CDM Executive Board (Kollmuss et al., 2010) and auditors alone cannot

approve permits. Second, an auditing system of CFES is not always associated with site visits. Some verification procedures only examine data and models used to measure the provision of ecosystem services, such as modeling of nonpoint source watersheds (Jones et al., 2006). In this case, no site visit is associated with the verification procedures.

2.2.3 Disclosure system.

CFES has a disclosure system to disclose information that services comply with provision-based standards for market-based policy instruments. The system is based on 1) certificates, 2) certificate registries, and/or 3) labels. Without a disclosure system, provision-based standards remain as guidelines of ecosystem services management (e.g., BBOP standard), instead of fully functioning as a certification system.

Certificates are a dominant way for the CFES system to disclose information since the system focuses on "services" instead of "products." Although CFES can be designed to certify the bundling of both ecosystem services and goods (e.g., forest carbon and clean drinking water), the current CFES systems mainly certify ecosystem services. Because ecosystem services are mainly intangible,[9] the proof of the services are certificate documents rather than labels on physical products. Ecosystem service credits and permits are specific types of certificates. These certificates are often registered and managed by certificate registries.

Certificate registries track the status of service credits, such as credit expiration or offset use. Certificate registries often share credit status publicly online and support information

[9] Outcomes of ecosystem services are often tangible (e.g., clean water). Nevertheless, these services are normally intangible in ecosystem services management (e.g., a reduced sediment rate in watersheds) unless services result in extreme outcomes (e.g., from highly polluted water to clean drinkable water).

disclosure of the CFES system. Certificate registries (e.g., VCS registries) administratively differ from trading registries of ecosystem services markets (e.g., Markit registries) though both types of registries have similar functions.

Labels are a less common feature of the CFES system, in contrast to certificates. Labels are a conventional way for certification systems (e.g., ecolabels) to disclose information on certified products to buyers. Ecolabels adopt a chain of custody (CoC) certification system to manage certified products throughout the supply chains, such as wood supply chains (Auld et al., 2008). Unlike ecolabels that certify products, CFES would be less subject to a CoC system since CFES mainly focuses on services. Labels are required only when CFES is designed to certify the bundling of ecosystem goods and services, but such certification schemes are still rather theoretical. Although some ecolabels, such as wood and coffee certification, claim to incorporate biodiversity safeguards in production (Auld et al., 2008; Perfecto et al., 2005), these ecolabels are limited in the degree to which they measure actual impacts. Consequently, ecolabels are not considered as CFES.

2.3 Comparison between CFES and forest certification

The conceptual framework highlights that CFES and forest certification systems are embedded in different functions in spite of their similarities. This functional difference demonstrates that development of a CFES system as an expansion of the FSC system would require establishment of additional certification systems to measure the provision of ecosystem services.

On the one hand, forest certification and CFES share similarities as certification systems. First, both certification systems are policy instruments to disclose information to markets. Forest

certification is a system designed to disclose information on forest safeguards in wood production (Bonroy & Constantatos, 2014; Rametsteiner & Simula, 2003). CFES is a system that discloses information on the provision of ecosystem services in market-based policy instruments. Second, both systems depend on certification markets for their implementation. Implementation of forest certification depends on demand for certified wood products. Implementation of a CFES system relies on demand for certified ecosystem services. Third, both certification systems obtain auditing and disclosure systems to establish the credibility of information disclosed by certification systems (Cashore et al., 2006; Nussbaum and Simula, 2005; Richards & Huebner, 2012b). Finally, both certification systems are subject to forest policies and regulations. Insecure property rights over timber concessions make it challenging for forest owners to obtain forest certification (Cashore et al., 2006; Nussbaum & Simula, 2005). Insecure property rights over ecosystem services also limit the ability of service sellers to adopt CFES.

On the other hand, CFES and forest certification are distinctive systems having different functions and target markets. First, CFES focuses on information on the provision of ecosystem services based on provision-based standards (or additionality), while forest certification concentrates on information on forest safeguards based on performance-based standards (or co-benefits) (e.g., Goldstein et al., 2014; Merger et al., 2011) (Table 2.2). These standards generate different funcations of these two certification systems in market-based policy instruments for ecosystem services. In a PWS scheme, for example, a main function of CFES is to disclose information about a service of improving watershed services, while a main function of forest certification is to disclose information about forest safeguards in the upstream (Figure 2.4). Thus, the development of the CFES system as an expansion of the FSC system would require establishment of provision-based standards. Otherwise, benefits of the FSC system to ecosystem

services markets would be limited to co-benefits of market implementation. Second, CFES and forest certification face different target markets. CFES is designed to target market-based policy instruments for ecosystem services (or intangible services), whereas forest certification is designed to target wood product markets (or tangible products). Due to this difference, a CoC certification scheme becomes essential for forest certification but not for CFES. CFES would need a CoC system only when it is used to certify bundling of ecosystem services (e.g., reduced carbon) and goods (e.g., spring water bottles produced from carbon-saving forests).

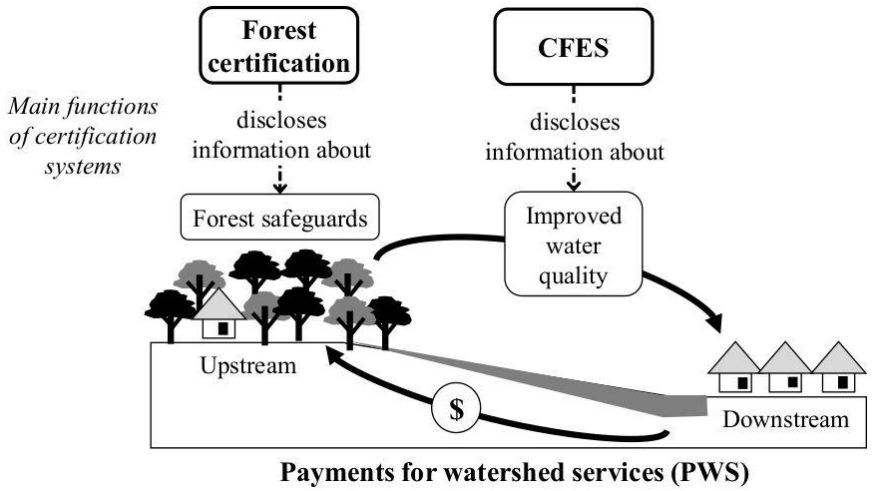


Figure 2.4 Main functions of CFES and forest certification in a PWS scheme

Joint-implementation of CFES and forest certification is a potential way for forest owners to disclose information on both additionality and co-benefits of ecosystem services management, but such implementation is likely restricted by high certification costs. In forest carbon markets, some forest owners obtain both VCS and FSC certificates (Goldstein et al., 2014; Merger et al., 2011) but they are mostly large firms who can afford high certification costs. Forest certification alone is known to be costly for many forest owners (Durst et al., 2006; Rametsteiner and Simula, 2003). Thus, costs of obtaining both CFES and forest certification schemes could be prohibitive to many forest owners (Merger et al., 2011). A potential way to reduce such costs is to make

both certification schemes recognize each other (e.g., common or overlapped criteria) so that both schemes can be validated and verified together which might reduce auditing costs (or direct costs of certification).

2.4 Market and demand structure

Implementation of a CFES system depends on market-based policy instruments for ecosystem services since these policy instruments provide trade infrastructure (e.g., registries of service credits), trade rules (e.g., contracts or offset rules), and support for property rights of ecosystem services (e.g., environmental laws and regulations). Without these market-based policy instruments, trading certified ecosystem services is normally not feasible and no demand for certified services would exist. Thus, market-based policy instruments for ecosystem services are considered as main markets for a CFES system.

CFES can be either an external or internal certification system to market-based policy instruments (Figure 2.5). On the one hand, CFES is *an external system* if the system was built independently from market-based policy instruments (e.g., PES schemes). An external CFES system has the potential to benefit market-based policy instruments when these instruments have no- or weak- capacity to disclose information on the provision of ecosystem services. This external feature also allows a CFES system to be an independent policy instrument.

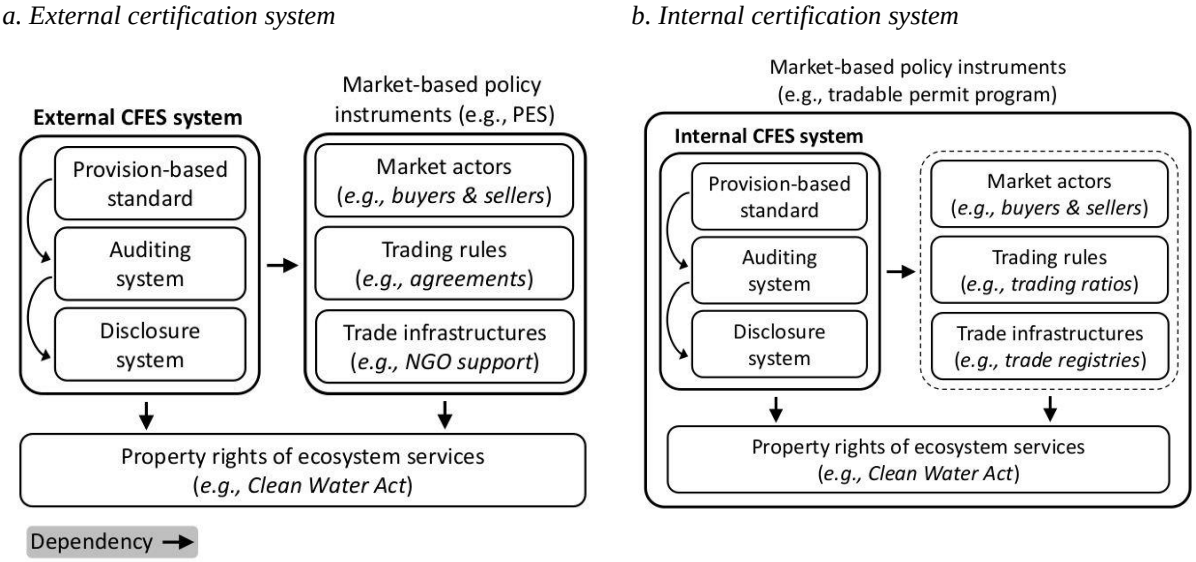


Figure 2.5 Market structure of CFES

On the other hand, CFES becomes *an internal system* when the system is built together with policy instruments (Ellerman, 2005). Examples are certification systems internally built in tradable permit programs, such as A/R CDM, biodiversity offsets programs, and water quality trading programs in the US and Australia (Table 2.1). In these policy instruments, CFES often does not exist in a clear form of a certification system. Rather components of certification systems are often combined with policy instrument systems. For instance, ecosystem services regulations can be both CFES standards as well as trade rules of policy instruments.

In order to be implemented in market-based policy instruments, a CFES system should be able to obtain demand from direct and indirect consumers (Figure 2.6). Direct consumers are ecosystem services sellers who are able to directly demand a certification system and adopt certificates. Indirect consumers are buyers and intermediaries who are able to demand certified services from sellers. To obtain demands from these consumers, a CFES system should be able to benefit them, and, in turn, these benefits would determine update of the system.

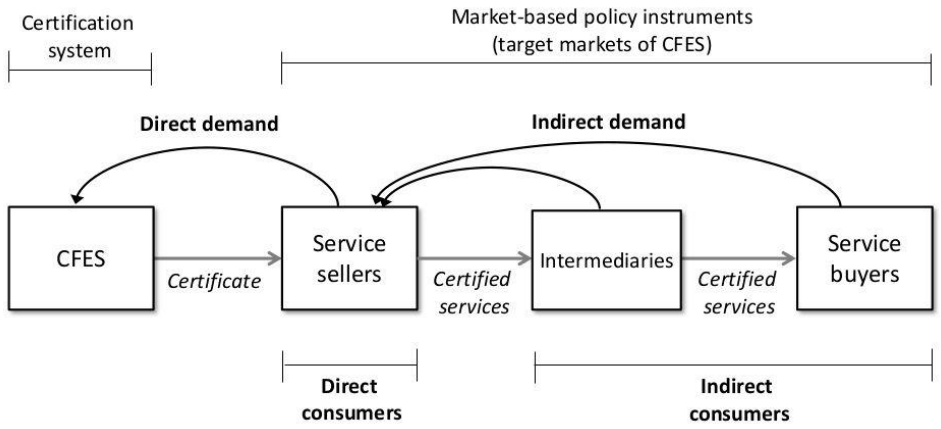


Figure 2.6 Demand structure of CFES

2.5 Target markets

Target markets for a CFES system include PES schemes and tradable permit programs as these policy instruments intend to trade ecosystem services. In addition, environmental subsidies have the potential to become target markets when intermediaries (e.g., government) of ecosystem services decide to use a certification system as a criterion to provide subsidies to forest owners. These market-based policy instruments are discussed below in terms of their connections and potential synergies with a CFES system.

2.5.1 Payments for environmental services.

A payment for environmental services (PES) scheme is a market-based policy instrument for ecosystem services, such as carbon storage, watershed conservation, and biodiversity conservation (Ezzine-de-Blas et al., 2016; Landell-Mills & Porras, 2002; Wunder, 2005). In PES schemes, these services are traded between service providers (or sellers) and users (or buyers). Wunder (2015) defines a PES scheme by "conditionality" on the provision of ecosystem services. This conditionality implies voluntary transactions of ecosystem services between sellers

and buyers based on their agreed rules (Wunder, 2015). Conditionality is applicable to seller and buyer sides. Seller-side conditionality occurs when sellers can decide whether or not to deliver ecosystem services regarding payment levels from buyers. Buyer-side conditionality takes places when buyers can decide whether or not to pay for services regarding provisioned services from sellers. Conditionality of PES schemes exists in diverse timelines, such as contract cycles, occasional public participation, or election cycles. Conditionality allows sellers and buyers to choose their best options given heterogeneous land use options and conservation costs. Conditionality makes PES schemes effective in conservation (e.g., no payment for no service provision) and cost efficient (e.g., no PES participation when opportunity costs are high) (Ezzine-de-Blas et al., 2016). In practice, however, many PES schemes lack conditionality (Brouwer et al., 2011; Wunder, 2005; Muradian et al., 2010). Many sellers have limited capacity to measure and monitor the provision of ecosystem services (Wunder, 2005; Muradiana et al., 2010). Buyers have limited access to information about management activities or the provision of ecosystem services from PES schemes (Hanley and White, 2014; Kosoy et al., 2007).

CFES has the potential to support 1) buyer-side conditionality and 2) monitoring systems of PES schemes. First, CFES can support buyer-side conditionality of PES schemes by disclosing information on the provision of ecosystem services to buyers. The availability of such information is a pre-condition to achieving conditional PES payments (Engel et al., 2008). Information on service provision would also empower buyers of regulatory PES schemes as it helps them understand and evaluate PES regulations and their outcomes. This capacity is vital for the public to influence environmental regulations (Beierle and Cayford, 2002). Second, CFES would be a monitoring tool for PES schemes as CFES validates and verifies the provision of ecosystem services over times (e.g., via annual auditing and reporting). By adopting an existing

system of CFES (e.g., available standards), PES schemes would avoid establishing a new monitoring system internally which normally requires considerable resources and times. In order to bring these benefits to PES schemes, of course, CFES must achieve several enabling conditions: the certification scheme must be demanded and supported by PES stakeholders; cost-effective and affordable; and applicable by local stakeholders with simple standards (e.g., Meijaard et al., 2011; 2014).

CFES has been applied to carbon-based PES schemes. In Uganda, for example, Trees for Global Benefits program has been certified by Plan Vivo[10]. In Bolivia, Noel Kempff Mercado Climate Action Project was verified against A/R CDM standard[11]. In Madagascar, the Makira REDD+ project has been certified by VCS[12]. Although there are cases that PES schemes based on watershed conservation have adopted organic certification or ecolabels (e.g., Barataud et al., 2014; Grolleau and McCann, 2012; Ottaviani and Scialabba, 2011), these certification schemes are not considered as CFES since they do not measure the provision of ecosystem services.

2.5.2 Tradable permit programs.

Tradable permit programs focus on establishment of regulatory markets for ecosystem services. Ellerman (2005) defines a tradable permit as "a transferable right to emit a substance that can create pollution." Programs featuring tradable permits mostly focus on industrial pollutants, such as air and wastewater pollutants (Freeman & Kolstad, 2006; Shortle et al., 2008).

[10] Trees for Global Benefits-Uganda. (2016, June 26). Retrieved from http://www.planvivo.org/project-network/trees-for-global-benefits-uganda/
[11] Noel Kempff Mercado Climate Action Project. (2016, June 26). Retrieved from http://www.forestcarbonportal.com/project/noel-kempff-mercado-climate-action-project
[12] Makira REDD+. (2016, June 26). Retrieved from http://www.carbonneutral.com/carbon-offsets/makira-redd-project-madagascar

These pollutants are typically point-source where a polluter can be readily identified. On the other hand, some programs focus on forest ecosystem services, such as forest carbon, water quality and temperature, and biodiversity (Alvarado-Quesada et al., 2014; Cochran & Logue, 2011). Such programs include non-point source watershed management as well where polluters cannot be readily identified (Shortle & Horan, 2008). Theoretically, tradable permit programs are more cost efficient than command-and-control regulations when markets are competitive and polluters face heterogeneous emission abatement costs (Shortle & Horan, 2008; Tietenberg, 2003). They are also politically more acceptable than taxes and regulations as tradable permit programs could allow existing firms to retain their market revenues (e.g., the scarcity rent) (Ellerman, 2005). However, more empirical evidence is required to confirm these theoretical advantages in practice (Freeman & Kolstad, 2006). Tradable permit programs also need to overcome challenges that are specific to each of ecosystem services in order to realize these advantages (Shortle & Horan, 2008).

CFES is an internal system of tradable permit programs (Ellerman, 2005). The internal certification system is designed to disclose information about tradable permits in the programs. Certification standards list acceptable methodologies to measure a quantity of permits, and often exist in forms of environmental regulations. For instance, standards of water quality trading programs in the US are based on the Clean Water Act (Jones et al., 2006). A/R CDM standards are based on the Kyoto Protocol (Kollmuss et al., 2010). Tradable permit programs are mostly verified by government agents although some programs designate private organizations as certification bodies (e.g., DEPI, 2013). Permit certificates and registries inform market actors of permit statuses, such as permit expiration and offset statuses.

Establishment of an internal system of CFES in tradable permit programs is not necessarily simpler than an external system of CFES designed as voluntary certification schemes since both internal and external certification systems require all the components of CFES to achieve its function (Figure 2.1). Any mal-functioning components of CFES would exacerbate performance of tradable permit programs. Unfortunately, this fact is often disregarded in design of tradable permit programs. For example, unclear standards and limited administrative capacity of auditors reduce the effectiveness of conservation banking in California (Bunn et al., 2013); a carbon offset program, the Regional Greenhouse Gas Initiative also suffers from administrative burden on environmental government agencies which are responsible for the program auditing (Kollmuss et al., 2010); and incomplete information on credits and monitoring systems hampers the proper functioning of biodiversity offset programs (Alvarado-Quesada et al., 2014). In order to mitigate these repercussions, therefore, each component of CFES would need to be integrated into design of tradable permit programs, and these components should be well-functioning. Moreover, tradable permit programs would benefit from adaptation of a well-functioning external system of CFES. For instance, a cap and trade program for greenhouse gas emissions in California adopted a credit registry (or Offset Project Registries) of the voluntary Verified Carbon Standard (VCS) instead of establishing its own registry[13].

2.5.3 Environmental subsidies.

Environmental subsidies are used for improvement of forest management by providing financial incentives to land owners. Environmental subsidies are applied for forest conservation

[13] VCS (2016, April 7). Retrieved from http://www.v-c-s.org/California

and restoration globally (Bull et al., 2006; Cubbage et al., 2007). Subsidies are also embedded in other policy instruments. For example, on behalf of users of ecosystem services, governments subsidize PES schemes and tradable permit programs (Engel et al., 2008; Shortle & Horan, 2008; Wunder et al., 2008). Despite these wide applications, environmental subsidies have been criticized as cost inefficient and environmentally ineffective as these subsidises do not take into account outcomes of forest management (Bull et al., 2006; Sterner & Coria, 2012).

CFES is a potential monitoring tool for environmental subsidies. An application of CFES could be used to measure and monitor the provision of subsidized ecosystem services. Based on this capacity, subsidies might evolve into market-based policy instruments when CFES is used as a subsidy criterion (e.g., subsidies for certified areas only). This conditionality makes environmental subsidies more conservation effective. Subsidies can be cost efficient when able to eliminate payments for ineligible areas which were initially subsidized. This possibility particularly increases in areas with strong moral hazard. A hybrid between subsidies and certification schemes are also observable from tradable permit programs and government-funded PES schemes. For example, subsidies are integrated into many of water quality trading programs in the US (Breetz et al., 2004; Shortle & Horan, 2008). Although not CFES, organic certification systems have been applied to a PES scheme in Munich, Germany, where Munich water utility (or SWM) subsidize farmers with organic certificates to improve water quality (Barataud et al., 2014; Grolleau & McCann, 2012). These cases indicate potential synergies between CFES and environmental subsidies. These synergies, however, would be feasible only when CFES is effectiveness and cost efficient in comparison to subside programs' internal monitoring system.

2.6 Challenges for CFES

Despite its theoretical benefits to market-based policy instruments, CFES faces various challenges in reality (Meijaard et al., 2011; 2014). These challenges can be analyzed in terms of 1) ecosystem services management and 2) development of the certification scheme.

The development of a CFES system is challenged by the complexity of ecosystem services management (Meijaard et al., 2011; 2014). First, *various uncertainties* exist in ecosystem services management, such as management of non-point source watershed pollutants and predicting future restorations (Jones et al., 2006; Kollmuss et al., 2010; Pouzols et al., 2012; Quétier and Lavorel, 2011). Although provision-based standards adopt uncertainty discounts, this approach cannot mitigate all the possible uncertainties associated with ecosystem services management. Second, there are *limited scientific knowledge and data* on ecosystem services (Meijaard et al., 2011). This limitation hampers the development of CFES methodologies that measure and predict the provision of services (Jones et al., 2006; Shortle and Horan, 2008). A lack of scientific rigor in standards can also generate biased information, which could jeopardize ecosystem management (Dietz et al., 2003). Third, *complex interactions* exist among different ecosystem services, featuring both trade-offs and complementarities (Bennett et al., 2009). These heterogeneous relationships complicate the development of provision-based standards and an audit system. Last but not least, *property rights* over ecosystem services are insecure in many regions of the world due to conflicts and weak governance over forest resources (Cubbage et al., 2007; Landell-Mills and Porras, 2002). Insecure property rights restrict adaptation and uptake of CFES, as stakeholders cannot secure legal rights to obtain certification.

CFES also faces certification-specific challenges. First, *contradictory requirements* exist for provision-based standards as they are required to be scientifically rigorous but simple for

application by a wide range of ecosystem services stakeholders from mitigation bankers to local communities (Meijaard et al., 2011; 2014). Second, *limited capacity* to adopt CFES is expected from ecosystem services stakeholders as their capacity to manage and monitor these services is considered to be low (Angelsen, 2009; Muradian et al., 2010). Thus, the certification scheme would be able to support these stakeholders: e.g., via guidelines, expert consultancy, and technical training. Third, *high certification costs* are expected due to high costs associated with ecosystem services management. High certification costs would restrict demand and uptake in both voluntary (Meijaard et al., 2011; 2014) and regulatory ecosystem services markets (Ellerman, 2005). Finally, *a few empirical studies* exist on CFES. For example, no studies are available on service sellers' demand for CFES certificates and service buyers' demand for certified services although these demands are expected to be low (e.g., Meijaard et al., 2011; 2014). The lack of the empirical knowledge limits potential advancement of the certification scheme and tests of its feasibility. Thus, more future studies are required on its enabling conditions and feasibility.

2.7 Conclusions

This study proposes a conceptual framework for CFES. As a working hypothesis, the framework articulates components and function of the certification system. Identified system components include provision-based standards, an auditing system, and a disclosure system. These components demonstrate that a function of the CFES system is to disclose information on the provision of ecosystem services to market-based policy instruments for ecosystem services. The function distinguishes the CFES system from the FSC forest certification system that is intended to disclose information on environmental, social, and economic forest safeguards.

Based on this function, the CFES system may strengthen buyer-side conditionality and monitoring systems of market-based policy instruments for ecosystem services, such as PES schemes. Therefore, these policy instruments are target markets of the CFES system.

Chapter 3: FSC forest certification for forest ecosystem services: An analysis of stakeholder adaptability[14]

3.1 Introduction

An expansion of the FSC system to forest ecosystem services could become a pragmatic way for developing certification of forest ecosystem services (CFES). To achieve this, however, various supporting conditions of the FSC system would be required, including stakeholder adaptability to ecosystem services. The adaptability to changing opportunities and innovations is a quality of many successful organizations and business models (McKee et al., 1989; Mori et al., 2016; Tuominen et al., 2004; Valentin et al., 2012). Consequently, an expansion of the FSC system to ecosystem services would require FSC stakeholder adaptability, such as the capacity of FSC certification bodies to audit service delivery, the preference of FSC enabling partners to train forest owners in service provisions, and the experiences and expectations of FSC certificate holders to manage and sell services. Although many studies have examined the linkages of the FSC to ecosystem services (Section 1.1.2), the adaptability of FSC stakeholders is still unknown. This knowledge gap is a challenge for analyzing the feasibility of FSC expansion since the expansion could be costly and malfunctioning without stakeholder adaptability. Thus, this study analyzes FSC stakeholder adaptability against various ecosystem services as a part of a feasibility analysis for CFES development as an expansion of the FSC system.

[14] A version of Chapter 3 is published [Jaung, W., Putzel, L., Bull, G. Q., Kozak, R., & Elliott, C. (2016). Forest Stewardship Council certification for forest ecosystem services: An analysis of stakeholder adaptability. *Forest Policy and Economics, 70*, 91-98].

3.2 Methods

3.2.1 FSC stakeholder adaptability.

The study analyzed key FSC stakeholders' self-assessed adaptability to requirements of certifying ecosystem services by conducting a series of online surveys. The surveys asked participants to rate eleven services defined by the Millennium Ecosystem assessment (MA, 2005) in terms of nine indicators reflecting adaptability.

Three key FSC stakeholder groups were identified and surveyed as potential stakeholders of an expanded FSC certification scheme for ecosystem services, including: *FSC certification bodies*, *FSC enabling partners*, and *FSC certificate holders* (Table 3.1). In order to analyze their adaptability, four online surveys were designed and administered following the Tailored Design Method (Dillman, 2011). Identified stakeholders were invited to the surveys via email. Contact emails were collected from stakeholder websites, survey participants, and FSC. The surveys were administrated with the online survey tool Survey Money. As a result, a total of 270 respondents joined the surveys (Table 3.2).

Table 3.1 Key FSC stakeholders and potential roles in CFES

Certification market	Key FSC stakeholders		Potential roles in CFES
Supply	*(a) FSC certification bodies:* Certification bodies accredited by the FSC	→	Potential auditors who audit ecosystem services
	(b) FSC enabling partners: FSC network partners, WWF-GFTN network, and Greenpeace	→	Potential supporting networks who promote certification and support forest owners' capacity to manage services
Demand	*(c) FSC certificate holders:* Forest owners holding FSC forest management certification	→	Potential service sellers

Table 3.2 Survey participants and origins

FSC stakeholders and origins	No. of participants	Response rates
(a) FSC certification bodies	39	32.23%
International	16	
Europe	14	
Latin America	4	
Asia	3	
US/Canada	2	
(b) FSC enabling partners	43	36.72%
Europe	15	
Asia	10	
Africa	6	
Latin America	5	
US/Canada	3	
International	3	
Oceania	1	
(c) FSC certificate holders	188	15.46%
Europe	58	
Latin America	48	
US/Canada	35	
Asia	32	
Africa	8	
Oceania	6	
Unknown*	2	
Total	270	

* Participants skipped socio-demographic questions.

FSC certification bodies were those accredited by the FSC scheme to grant and administer forest management certification. Their data were collected by the first survey from March 12 to 26, 2012 with a response rate of 32.23%. The response rate was estimated as the number of survey participants divided by the number of email invitations. The survey was conducted in English as the auditors were expected to have sufficient proficiency in English.

FSC enabling partners included representatives of FSC national networks, WWF's Global Forest & Trade Network (WWF-GFTN), and Greenpeace. The WWF-GFTN and Greenpeace were identified as FSC enabling partners because the survey of FSC national networks indicated that these organizations support FSC national networks. These enabling partners (e.g., WWF's GFTN) play significant roles in building forest owners' capacity to

achieve the FSC forest management certification (see also Nussbaum & Simula, 2013; Putzel et al., 2012) so that they were considered as potential capacity builders for CFES. Data of FSC enabling partners were collected through the second and third surveys. The second survey was conducted with the FSC network partners from April 16 to 30, 2012. The third survey was conducted with WWF's Global Forest & Trade Network (WWF-GFTN) and Greenpeace from July 10 to August 30, 2012. The response rate from the surveys of the enabling partners was 36.72% representing 33 countries. The surveys were conducted in English as the survey targets were international organizations. High survey participation was achieved from the FSC network partners and WWF-GFTN thanks to support from the FSC and WWF.

FSC certificate holders were forest owners holding FSC forest management certification. The FSC also has a chain of custody (CoC) certification scheme to ensure the integrity of certified wood product supply chains. However, the CoC scheme was excluded from the study because wood product supply chains are not directly involved with ecosystem services management or markets. In contrast, holders of the FSC forest management certification represent the current FSC certification market as well as potential sellers of ecosystem services since production forests contain various ecosystem services (Bauhus et al., 2010). Data of FSC certificate holders were collected by the fourth survey from July 9 to August 3, 2012 with a response rate of 15.46% representing 57 countries. Some of the forest owners were considered to have low proficiency in English so that multiple languages were used in the survey to encourage their participations, including: Chinese, English, French, Indonesian, Japanese, Korean, Portuguese, Spanish, and Vietnamese. When participants came from countries whose official languages are not any of these languages, the English version of the survey was used.

Eleven ecosystem services were taken from the Millennium Ecosystem Assessment (MA) for the study (Table 3.3) (MA, 2005). Commonly utilized in ecosystem services studies (Fisher et al., 2009), the MA list groups services into four categories: regulating services, cultural services, supporting services, and provisioning services. Watershed protection and ecotourism consist of three sub-services which were combined in the survey of FSC certificate holders to ensure a higher response rate. Agricultural goods were included in the survey because some of them (e.g., tea and coffee) also qualify as non-timber forest products (MA, 2005; Shanley et al., 2008).

Table 3.3 Ecosystem services framework

Service categories	Ecosystem services
Regulating services	1. Water quality (*watershed protection*)
	2. Water quantity (*watershed protection*)
	3. Water risk (*watershed protection*)
	4. Carbon storage
	5. Biodiversity conservation
Cultural services	6. Scenic beauty (*ecotourism*)
	7. Cultural experience (*ecotourism*)
	8. Biodiversity experience (*ecotourism*)
Supporting services	9. Soil conservation
Provisioning services	10. Agriculture goods
	11. NTFPs

(Adapted from the Millennium Ecosystem Assessment (MA, 2005))

A total of nine indicators were established by the study and evaluated by the key FSC stakeholders (Table 3.4). Different indicators were utilized to survey different stakeholder groups considering their own roles in the FSC system. Survey participants were asked to rate their preferences for each of the services in relation to given indicators. *FSC certification bodies* were asked to rate each of the eleven ecosystem services for which they had auditing capacity (Indicator 1). *FSC enabling partners* were asked to indicate their preferences for each service for which they were willing to offer technical training to forest owners. Technical training was

divided into training on legal aspects related to ecosystem services (Indicator 2), training in setting baselines for provision of the services (Indicator 3), training in quantification of the services (Indicator 4), and training in monitoring the services (Indicator 5). *FSC certificate holders* were asked to indicate their experiences in protecting services (Indicator 6), expectations of future sales potential of the services (Indicator 7), experiences in selling the services (Indicator 8), and experiences with ecosystem services certification (Indicator 9). These expectations and experiences of FSC certificate holders reflect the level of capacity in the FSC system to adapt to CFES.

Table 3.4 Framework to analyze FSC key stakeholder adaptive capacity

FSC stakeholders	Capacity indicators	Descriptions
Certification bodies	(1) Capacity to audit ecosystem services	Analyzing services that are currently auditable by certification bodies
Enabling partners	(2) Training in legal aspect of services (3) Training in setting service baseline (4) Training in service quantification (5) Training in monitoring service provision	Identifying services preferred by the networks based on partners' capacity to train forest owners
Certificate holders	(6) Experience in protecting services (7) Expected sale value of services (8) Experience in selling services (9) Experience with CFES	Analyzing services based on past experience and future expectations of FSC certificate holders

3.2.2 Data analysis.

The collected data were analyzed in terms of key FSC stakeholders' adaptability and individual indicators. First, the stakeholder adaptability was measured through indication of their preferences against Indicators 1 to 9. The adaptability was analyzed as supply-side, demand-side, and overall capacity. Supply-side adaptability was estimated by summing rated results from certification bodies and FSC enabling partners. The demand-side adaptability was examined by

summing results from FSC certificate holders. The overall FSC stakeholder adaptability was estimated based on counts of two of the highest and lowest normalized values of ecosystem services in each indicator. For the normalization, the rated values' norm vectors, or the Euclidean distances, were used since it allows obtaining positive values for all normalized values, unlike z-score based normalization (Abdi, 2010). With the normalization, ecosystem services with the highest normalization values (or support scores) were counted across the nine indicators to identify the corresponding services that are supportive of the FSC stakeholders' adaptability. The services with the lowest normalization values (or penalty scores) were also counted across the nine indicators to identify these services involved with some weak adaptability. Later, the overall adaptability was calculated by subtracting the penalty scores from support scores.

Second, the individual indicators were analyzed by drawing a radar chart per indicator based on the normalized value of the services. Each of the nine radar charts compared the degrees to which these indicators represent positive or negative levels of stakeholder adaptability.

The analysis relies on three assumptions. First, it assumes that each of the nine indicators equally contributes to FSC stakeholder adaptability to ecosystem services, since it was not feasible to calculate the weight of each indicator's contribution to the development of CFES. Second, the analysis assumes that the second highest and lowest values would still have impacts on the stakeholder adaptability in addition to the first values. As a result, it utilized two of the highest and lowest values from the normalization from each indicator when the support and penalty scores were estimated for each of services. Third, the study assumes that, because of the key roles these stakeholder groups play in the FSC system, the aggregated results reflect the adaptability of the whole FSC system to the incorporation of particular ecosystem services.

3.3 Results

3.3.1 FSC stakeholder adaptive capacity.

FSC stakeholder adaptability to the incorporation of ecosystem services is demonstrated as supply-side, demand-side, and overall adaptability. *The supply-side adaptability* represents the self-assessed capacity of FSC certification bodies and FSC enabling partners (Figure 3.1). On average, biodiversity conservation, non-timber forest products (NTFPs), and carbon storage scored high per this rating. FSC enabling partners' willingness to offer training in setting baselines for the provision of ecosystem services received the highest votes, while their willingness to offer training in legal aspects of services obtained the lowest votes among the five indicators. It implies that the FSC enabling partner's preferences to work on legal aspects of services is more challenging than the technical measurement of services, including setting baselines and quantification of services. The result of self-assessed auditing capacity also indicates that certification bodies rated their capacity lower than the FSC enabling partners.

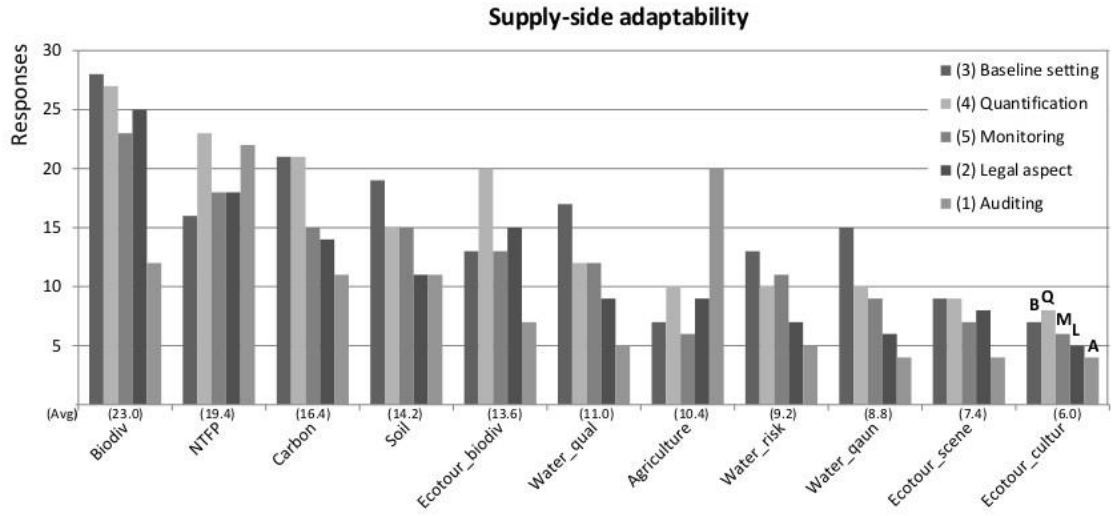


Figure 3.1 Supply-side capacity from FSC certification bodies and enabling partners

The demand-side adaptability shows the self-assessed adaptability of FSC certificate holders to the incorporation of ecosystem services (Figure 3.2). On the demand-side, the rated results against the four indicators were averaged. Biodiversity conservation, watershed protection, and carbon storage obtained the three highest values among services. Among the four indicators, FSC certificate holders' experience in protecting services obtained a distinctively higher vote than the other indicators. It signals a high likelihood that these services are already delivered in their FSC certified forests. However, relatively low values were associated with sales experience, expected sales, and certification experience. These low values signal that FSC certificate holders expect relatively weak demand for these services, even though the services are available in their forests.

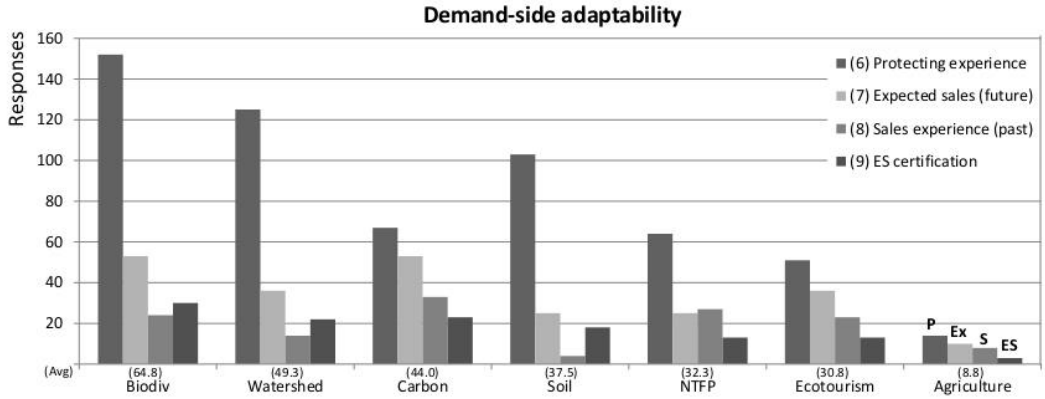


Figure 3.2 Demand-side capacity from FSC certificate holders

The overall adaptability shows the key FSC stakeholders' adaptability based on the overall, support, and penalty scores (Figure 3.3). The support and penalty scores were calculated by summing normalized values of the ecosystem services across the nine indicators (Table 3.5). Overall scores resulted from subtracting penalty scores from support scores. Overall scores indicated that the stakeholder adaptability was favorable to incorporate biodiversity conservation (score: 7), carbon storage (4), and NTFPs (3). On the other hand, the adaptability was weak for

cultural experience for ecotourism (-7), agriculture products (-5), and scenic beauty for ecotourism (-4). The sub-services under watershed protection fell in a neutral score range (1 to -1), suggesting that the adaptability was neither supportive nor disadvantageous to these services.

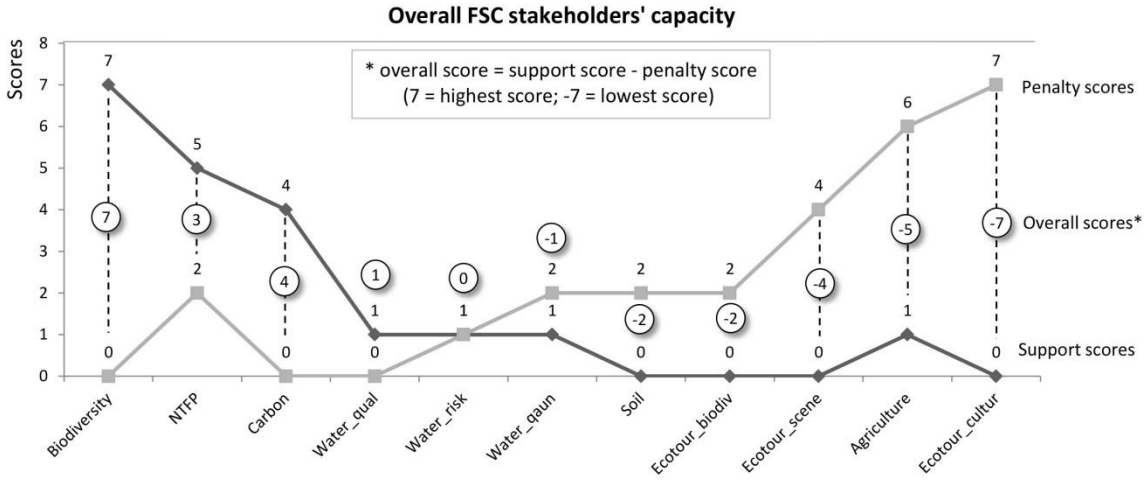


Figure 3.3 Overall capacity from FSC certification bodies, enabling partners, and certificate holders

Table 3.5 Normalized values of ecosystem services across nine adaptive capacity indicators

Forest ecosystem services	CBs	FSC enabling partners				FSC certificate holders			
	(1) Auditing capacity	(2) Legal training	(3) Baseline training	(4) Quantifi. training	(5) Monitoring training	(6) Protecting experience	(7) Expected sale	(8) Sale experience	(9) Certification experience
Water_qual	0.11	0.18	0.28	0.20	0.23	***0.51***	0.37	0.25	0.43
Water_quan	0.09	0.12	0.25	0.17	0.17	***0.51***	0.37	0.25	0.43
Water_risk	0.09	0.14	0.21	0.17	0.21	***0.51***	0.37	0.25	0.43
Carbon	0.23	0.28	***0.35***	0.36	0.29	0.27	***0.54***	***0.58***	***0.45***
Biodiversity	0.25	***0.50***	***0.46***	***0.46***	***0.45***	***0.62***	***0.54***	0.42	***0.59***
Ecotour_scene	0.09	0.16	0.15	0.15	0.14	0.21	0.37	0.41	0.26
Ecotour_cultur	0.09	0.10	0.12	0.14	0.12	0.21	0.37	0.41	0.26
Ecotour_biodiv	0.14	0.30	0.21	0.34	0.25	0.21	0.37	0.41	0.26
Soil	0.21	0.22	0.31	0.25	0.29	0.42	0.26	0.07	0.35
Agriculture	***0.41***	0.18	0.12	0.17	0.12	0.06	0.10	0.14	0.06
NTFPs	***0.46***	***0.36***	0.26	***0.39***	***0.35***	0.26	0.26	***0.48***	0.26

Notes:
• Two of the highest (***bold italic***) and lowest (underline) normalized values were counted for each service across the nine indicators in order to estimate "support scores" and "penalty scores" of services. When multiple services had equal values, all of them were marked.
• For the perceptions of FSC certificate holders (6-9), the values are identical for water_qual, water_quan, and water_risk and for ecotour_scence, ecotour_cultur, and ecotour_biodiv because watershed protection and ecotourism represented their sub-services in the survey.

3.3.2 Individual indicator radar charts.

Normalized values of the ecosystem services per each indicator are illustrated with radar charts. The radar charts are grouped based on the FSC stakeholder groups. Indicator 1 indicates the auditing capacity of FSC certification bodies. Indicators 2 to 5 illustrate the training preferences of FSC enabling partners. Indicators 6 to 9 show the demand capacity of FSC certificate holders.

First, *FSC certification bodies*' capacity to audit ecosystem services yielded high scores for NTFPs and agricultural products (Figure 3.4). NTFPs and agricultural products yielded the highest values. These values suggest that certification bodies' current audit capacity is relatively higher for provisioning services based on the MA list (Table 3.3). The high value attached to agricultural products was a distinctive result, reflecting the fact that certification bodies are closely working with agricultural certification schemes such as organic certification. On the other hand, the normalization values attached to watershed protection and ecotourism were low, indicating a relatively weak self-assessed capacity of certification bodies to audit those services.

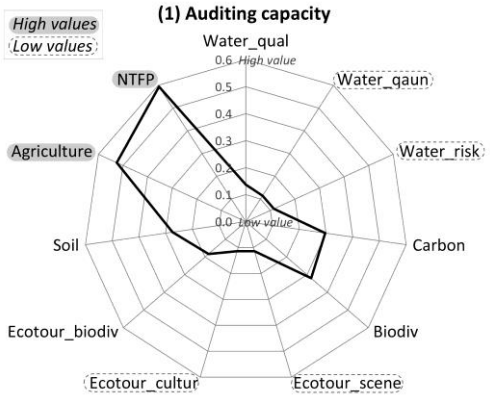


Figure 3.4 Adaptability self-assessed by FSC certification bodies

Second, *FSC enabling partners'* preferences related to Indicators 2 to 5 (Figure 3.5) yielded rather similar shapes in the radar charts, indicating relatively homogeneous capacity over the four indicators. The normalization values were generally high for biodiversity conservation, NTFPs, and carbon storage. On the other hand, the values were generally low for agricultural products, ecotourism with scenic beauty and cultural experience, and watershed protection for improving water quantity and reducing water-related risks.

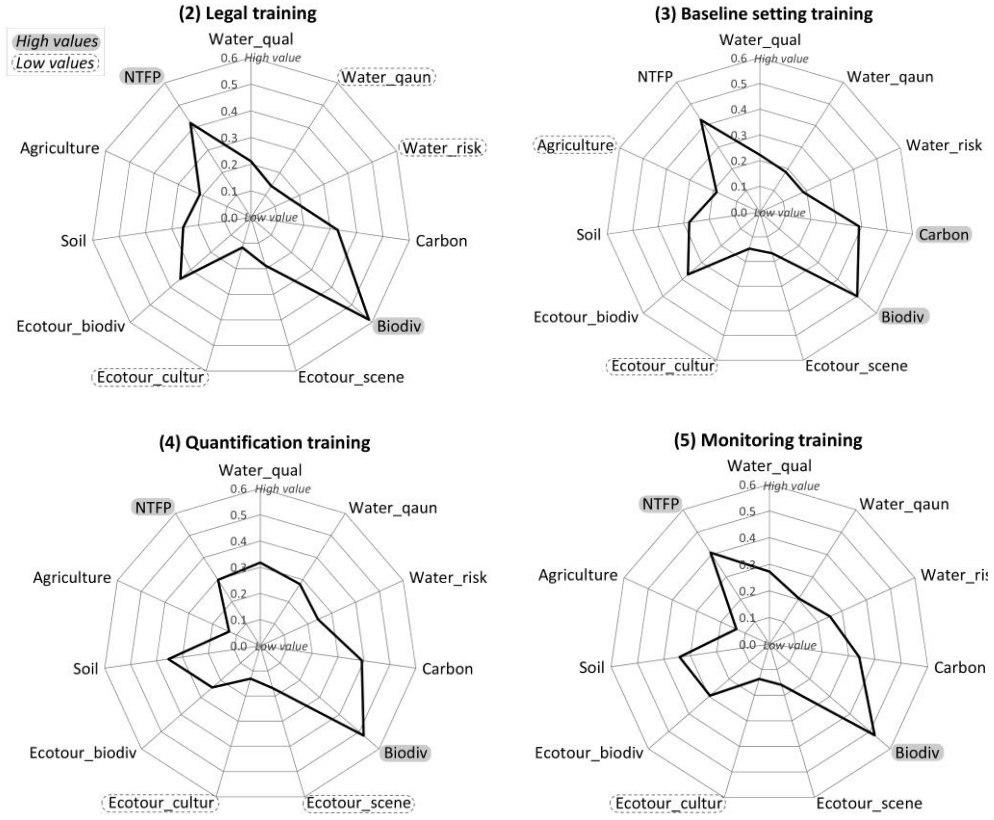


Figure 3.5 Adaptability self-assessed by FSC enabling partners

Third, *FSC certificate holders'* capacity against Indicators 6 to 9 yielded diverse shapes of radar charts (Figure 3.6). Biodiversity conservation and carbon storage generally had high values, while agricultural products received very low values. These results reflect the fact that

the most of the forest owners with the FSC certificate were likely not engaged with farm businesses.

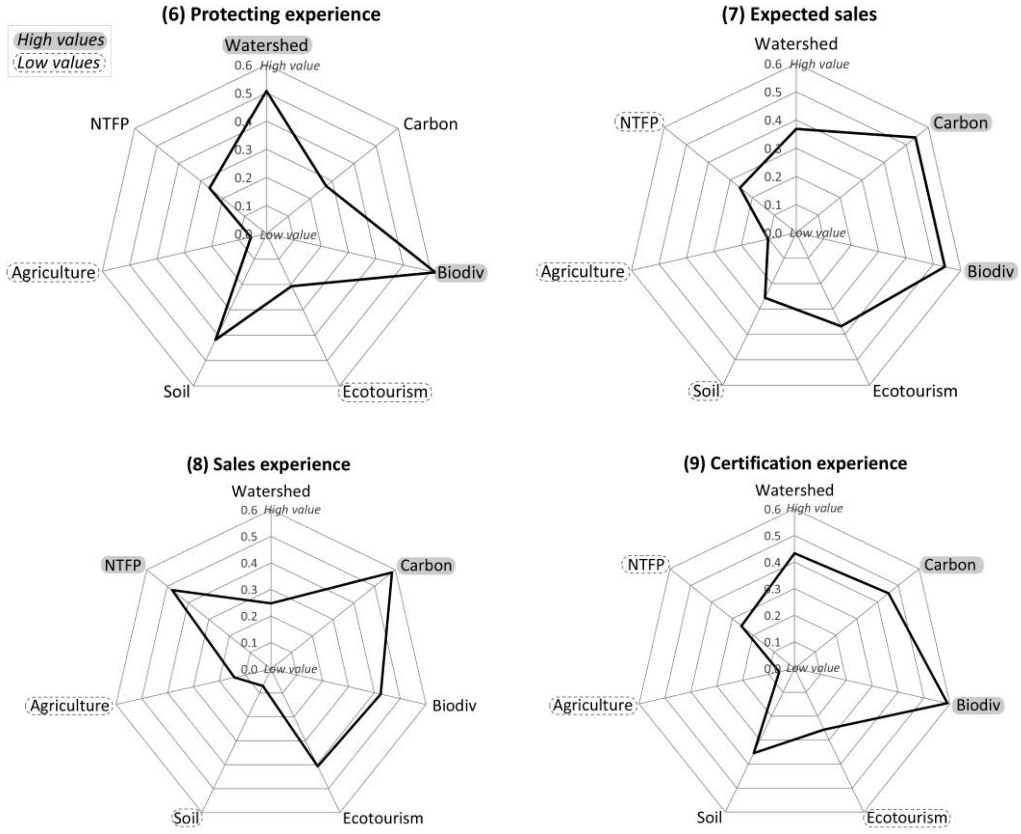


Figure 3.6 Adaptability self-assessed by FSC certificate holders

3.4 Discussion

Our results reveal that the key FSC stakeholders' adaptability was relatively high for biodiversity conservation, carbon storage, and NTFPs, medium for watershed protection services, and low for ecotourism and agricultural goods. Of course, the strong and low adaptability does not preclude the FSC's potential to adapt certification to these particular ecosystem services. Rather, to do so, they would first require various robust feasibility tests, such as market demand for FSC-certified ecosystem services. They would also need to overcome

challenges such as the need for developing simple but scientific standards to manage ecosystem services (Meijaard et al., 2011; 2014). Despite these limitations, the study results still support, by extension, a comparison of multiple services in terms of the adaptability within the FSC system. The comparison supports preparing feasibility tests for certification of a supported selection of ecosystem services.

The results of the study can be explained by the effects of two factors: 1) the FSC's internal system and 2) external forest carbon markets. *The FSC's internal system* influences the results in that ecosystem services already covered by the FSC's international principles and criteria are likely to score high because they are already to some degree outcome targets of the certification scheme. The principles and criteria directly address biodiversity conservation, watershed protection, soil conservation, and NTFPs (FSC, 2012). It is therefore not surprising that these services generally were associated with higher scores than those not directly addressed by the principles and criteria, with some exceptions (e.g., carbon) (Table 3.6). The high score attached to biodiversity conservation can be explained not only by the FSC principles and criteria (Cauley et al., 2001; Gullison, 2003; Ioras et al., 2009; McDermott et al., 2008; Merger et al., 2011; Roberge et al., 2011) but also by the fact that the FSC was initially developed specifically to address biodiversity loss (Cashore et al., 2006; Elliott & Schlaepfer, 2001; Rametsteiner & Simula, 2003). The high score of NTFPs can be explained by the fact that NTFPs are already integrated into the FSC system, such as the FSC Brazil nuts standards in Brazil and Peru (Duchelle et al., 2014; Shanley et al., 2008). Watershed and soil protections also achieved higher scores than ecotourism. The result is supported by studies that recognize the benefits of FSC's management in terms of watershed and soil protections (McDermott et al., 2008; Roberge et al.,

2011; Stupak et al., 2011) and by studies that address the FSC's lack of attention to scenic beauty, recreation, and tourism (Harshaw et al., 2007; Sheppard et al., 2004).

Table 3.6 Ecosystem services in FSC international principle and criteria (FSC, 2012)

Ecosystem services	Overall capacity scores	FSC criteria (C)
Biodiversity conservation	7	C6.4/ C6.6/ C6.8/ C9.1-1/ C9.1-2/ C9.1-3/ C10.10
Carbon storage	4	
NTFPs	3	C10.11
Water quality (watershed)	1	C6.7/ C9.1-4/ C9.1-5/ C10.10
Water risk (watershed)	0	C9.1-4
Water quantity (watershed)	-1	C6.7/ C9.1-4/ C9.1-5/ C10.10
Soil conservation	-2	C9.1/ C10.10
Biodiversity experience (ecotourism)	-2	
Scenic beauty (ecotourism)	-4	
Agricultural products	-5	
Cultural experience (ecotourism)	-7	C9.1

The study results would be affected by *external forest carbon markets* as well. Carbon storage is not explicitly covered by the FSC's international principles and criteria (Gan & Cashore, 2013; Merger et al. 2011; van Dam et al., 2010), but it obtained a high overall score. It is true that some FSC national standards implicitly address forest carbon (e.g., FSC Canada Maritime and FSC Australia standards) (Stupak et al., 2011). However, it is expected that the high score was mainly affected by the FSC stakeholders' business experience with carbon projects, particularly those of certification bodies and forest owners: some FSC-accredited certification bodies already audit forest carbon projects (e.g., Rainforest Alliance); some studies demonstrate the FSC's potential connections with forest carbon projects, such as a REDD+ schemes (Medjibe et al., 2013; Pettenella & Brotto, 2012; Putz & Romero, 2012); and some carbon credits in voluntary carbon markets are already certified by the FSC forest certification

(Goldstein et al., 2014). Additionally, the data required to estimate carbon storage are relatively more readily available than are the cases with many other service variables (Layke, 2009).

The results would provide indications of criteria to determine potential scope of the specific ecosystem services that would be supported by greater stakeholder adaptability when FSC expands to cover ecosystem services management. As ecosystem services encompass the range of benefits of sustainable forest management, FSC has made various efforts to examine its potential to incorporate these services, such as the ForCES project and analysis of FSC impacts on ecosystem services management[15]. Because many factors would affect successful expansion of the FSC to CFES, various criteria must be applied to analyze feasibility. One criterion is FSC stakeholders' adaptability to incorporating ecosystem services. FSC stakeholders are a key component of the FSC system, and building their capacity would entail considerable costs. Thus, a potential strategy to reduce the costs would be to focus first on ecosystem services for which the stakeholders already demonstrate a higher degree of adaptability.

The study has certain limitations. First, the self-assessed adaptability contains potential biases, such as over- or under- estimates of perceived capacities. The limitation is also embedded in the nature of self-administered online surveys. Thus, the measurement of more accurate adaptability would require standardized tests based on face-to-face interviews, field-based ecological studies, and verification of capacities via third-party data and reports. Second, stakeholder adaptability is subject to change in the future, for example, through any capacity building on ecosystem services or a change in stakeholders. Expanding carbon markets have

[15] "The FSC Ecosystem Services Programme," *Forest Stewardship Council*, accessed 23 April 2016 from https://ic.fsc.org/en/our-impact/program-areas/ecosystemservices

already changed stakeholder adaptability, as demonstrated by the high adaptability score associated with carbon. FSC supporters (e.g., Greenpeace) are also changeable. Third, stakeholders of ecosystem services projects (e.g., payments for environmental services) might have different adaptability compared to key FSC stakeholders. Last but not least, high-scoring adaptability would support certification development but do not guarantee successful expansions of the FSC system to relevant ecosystem services because the expansions should still overcome many challenges, such as expected low demand for certified ecosystem services, and limited scientific understanding of these services (Meijaard et al., 2011; 2014). These limitations also imply demand for further in-depth feasibility tests on this adaptation of the FSC system.

3.5 Conclusions

The study examined key FSC stakeholder adaptability to the incorporation of ecosystem services. A comparison of FSC stakeholders' self-assessed adaptability over various services showed that their adaptability was relatively high for biodiversity conservation, carbon storage, and NTFPs provision, medium for watershed protection services, and low for ecotourism values and provision of agricultural products. The results are expected to be supported by the FSC internal principles and criteria and influenced by forest carbon markets. These results contribute to our understanding of the potential scope to test the FSC system's expansion to ecosystem services.

Chapter 4: Bundling forest ecosystem services for FSC certification: An analysis of stakeholder adaptability[16]

4.1 Introduction

An expansion of the FSC system to certification of forest ecosystem services (CFES) would require certifying the bundling of ecosystem services due to several expected benefits from bundling. The integration of bundled services into CFES could increase the income of forest owners (Deal et al., 2012; Kemkes et al., 2010; Robertson et al., 2014), enable forest owners to hedge against risk (Robertson et al., 2014), reduce the transaction costs of providing multiple services (Wendland et al., 2010), allow forest owners to access diverse ecosystem service markets throughout each individual service in a bundle (Robertson et al., 2014; Wendland et al., 2010), and encourage forest owners to adopt more holistic approaches to management (Deal et al., 2012; Kemkes et al., 2010).

Despite these benefits, certifying the bundling of ecosystem services also faces expected challenges, such as insufficient scientific knowledge to measure the delivery of ecosystem services in bundles (Robertson et al., 2014; Wendland et al., 2010), the legal system's lack of a specific mechanism to support governance of bundled services (Robertson et al., 2014), difficulty in determining multiple baselines and developing standardized assessment procedures (Robertson et al., 2014), and a lack of optimal offset caps for bundled services (Woodward,

[16] A version of Chapter 4 is published [Jaung, W., Bull, G. Q, Putzel, L., Kozak, R., & Elliott, C. (2016). Bundling forest ecosystem services for FSC certification: A stakeholder analysis. *International Forestry Review, 18(4),* 1-14.].

2011). Therefore, integrating bundled ecosystem services into CFES requires various feasibility studies.

Although many studies have analyzed the bundling of ecosystem services (Section 1.1.3), bundling has not been examined from the perspective of certification. This knowledge gap is a challenge for the testing of these benefits and challenges, and in turn, for analyzing the feasibility of CFES. Thus, this chapter examines the existence of bundling from FSC stakeholder adaptability to ecosystem services. The evaluation of stakeholder preferences is critical in the management of bundling, because social expectations and priorities shape the identification, classification, and valuation of ecosystem services (Al-assaf et al., 2014; Deal et al., 2012; Endter-Wada et al., 1998; MA, 2005; Martín-López et al., 2011). The key stakeholders analyzed in this chapter include: FSC certification bodies, FSC enabling partners, FSC certificate holders, and ecosystem services projects (Figure 4.1). These stakeholders are expected to play critical roles in developing CFES as an expansion of the FSC system; therefore, a more complete understanding of the reviews of ecosystem services will improve our ability to examine the feasibility to certify bundling of ecosystem services.

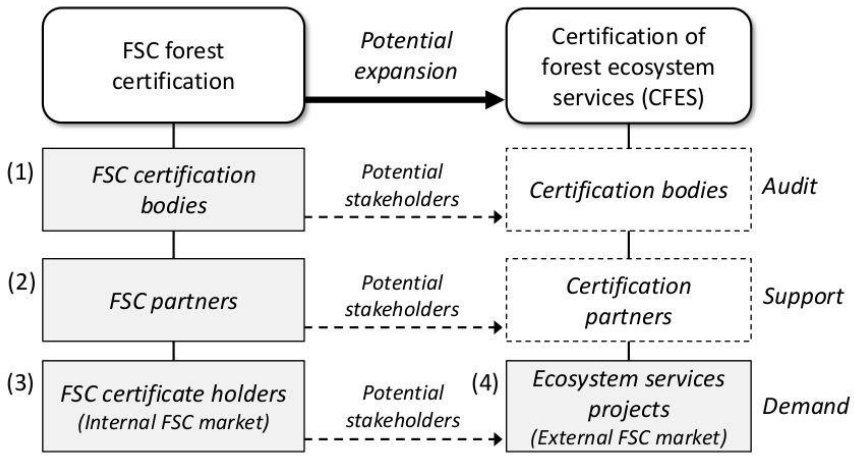


Figure 4.1 Analyzed stakeholders in this study

4.2 Methods

4.2.1 Analytic framework.

An analytic framework was developed to identify which combinations of ecosystem services would be most likely to be supported as bundles in the current FSC system. The framework assumes that supported bundles are those to which the existing system is most adaptable, as reflected in system stakeholders' capacities, preferences, and experience (Figure 4.2). Four stakeholder groups were taken as representative of the system, including: FSC certification bodies (Group 1), FSC enabling partners (Group 2), FSC certificate holders (Group 3), and ecosystem services projects (Group 4). These groups were identified based on their expected key roles in auditing, supporting, and demanding CFES. Data for Groups 1 to 3 were collected through online surveys. Data for Group 4 were collected from online data and websites of ecosystem services projects. An overview of the collected data is presented below in the data section.

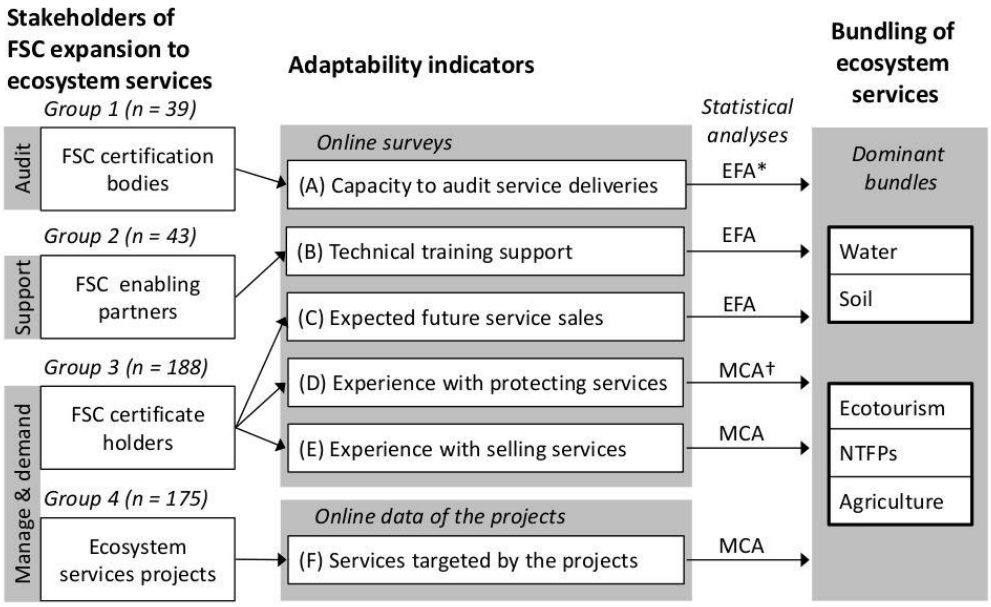


Figure 4.2 Key certification stakeholders analyzed in this study

The framework analyzed six indicators (A to F) of FSC stakeholder adaptability. *Indicator A* is a measure of FSC certification bodies' capacity to audit delivery of ecosystem services, which represents the potential supply of auditing services. *Indicator B* is a measure of FSC enabling partners' preferences to train forest owners on ecosystem services management. *Indicator C* is a measure of FSC certificate holders' expectations of future demand for ecosystem services, such as future sales. *Indicator D* is a measure of FSC certificate holders' experience in protecting services: i.e., their previous plans or efforts to manage ecosystem services. *Indicator E* is a measure of FSC certificate holders' experience in trading ecosystem services. *Indicator F* is an identification of the specific services that have previously been selected as targets of ecosystem services projects. Indicator A to E were estimated though self-assessment by surveyed stakeholders. Indicator F was estimated based on the researchers' analysis of online data identifying specific services targeted by ecosystem services projects.

The framework analyzed system adaptability against three sets of ecosystem services: simple, detailed, and mixed sets (Table 4.1). *The simple set*, consisting of seven service variables, was used to survey FSC certificate holders. The groups' response rate was expected to be lower than FSC certification holders and enabling partners who have strong institutional ties and greater interaction with the FSC. *The detailed set*, consisting of twelve service variables, was used to survey FSC certification bodies and FSC enabling partners. The detailed and simple sets were based on three separate surveys designed by the researchers to analyze adaptability of different certification stakeholders in the FSC system. These surveys focused on ecosystem services traded in markets, such as PES schemes, tradable permit programs, as well as ecotourism and NTFPs (Landell-Mills & Porras, 2002; MA, 2005; Sterner & Coria, 2012). *The mixed set*, consisting of eleven variables, was based on the secondary data on ecosystem services

projects. The framework did not consider a combination of sub-categories of the same or closely-related services as bundling of ecosystem services because these sub-categories were only available in the detailed set. For example, watershed conservation results in at least three services: water quality improvement, water provision, and water-associated risk reduction, but a bundle of two or more of these three services were not considered in this study. Moreover, agricultural goods were included in the surveys because some NTFPs (e.g., coffee and tea) overlap with agricultural production systems (MA, 2005).

Table 4.1 Analytic scope of ecosystem services

Categories	Ecosystem services	Detailed set[1]	Mixed set[2]	Simple set[3]
Regulating services	Watershed conservation		●	●
	- Water quality	●		
	- Water quantity	●		
	- Water risk	●	●	
	Carbon storage	●	●	●
	Biodiversity conservation	●	●	●
Cultural services	Ecotourism		●	●
	- Scenic ecotourism	●		
	- Cultural ecotourism	●	●	
	- Biodiversity ecotourism	●		
Supporting services	Soil conservation	●	●	●
	- Nutrient conservation		●	
Provisioning services	Agricultural goods	●	●	●
	Non-timber forest products	●	●	●
	Timber	●	●	
	Total	12	11	7

[1] For the analyses of FSC certification bodies and enabling partners
[2] For the analysis of ecosystem services projects
[3] For the analysis of FSC certificate holders

4.2.2 Data.

The data for the study were collected through online surveys and extraction of online data (Table 4.2). The online surveys were conducted to estimate system adaptability through self-

assessed indicators of capacities, preferences, and experience of FSC certification bodies (Group 1), FSC enabling partners (Group 2), and FSC certificate holders (Group 3) around the world. The surveys were conducted following the Tailored Design Method (Dillman, 2011). The online data on prior ecosystem services project experience (Group 4) were extracted from online.

Table 4.2 Stakeholder data and adaptability indicators

Key stakeholders	Sample sizes (*response rates*)	Data sources	Adaptability indicators
(1) FSC certification bodies	39 (32%)	Primary data	(A) Capacity to audit ES deliveries
(2) FSC enabling partners	43 (37%)	Primary data	(B) Technical training support
(3) FSC certificate holders	188 (16%)	Primary data	(C) Experience with protecting ES (D) Experience with selling ES (E) Expected future ES sales
(4) ES projects	175 (n/a)	Secondary data	(F) ES targeted by the projects

(ES: forest ecosystem services)

FSC certification bodies (Group 1) included those accredited to audit the FSC forest certification scheme. Certification bodies were surveyed from March 12 to 26, 2012. Survey contact information was collected from FSC websites. The survey was conducted in English, as high proficiency in English was expected of this group. Of the 121 contacts, 39 contacts participated in the survey, corresponding to a response rate of 32% (=39/121). Participants represented 64% of FSC certification bodies. The survey asked participants to evaluate their organizations' engagement with auditing ecosystem services against a five-point interval scale: no capacity (1), low capacity (2), medium capacity (3), high capacity (4), and already in business (5).

FSC enabling partners (Group 2) included FSC national network partners, the World Wildlife Fund's Global Forest & Trade Network (WWF-GFTN), and Greenpeace. FSC national network partners are FSC member organizations around the world (e.g., FSC Chile). They not only promote the current FSC certification but also train forest owners in forest certification.

WWF-GFTN and Greenpeace were identified as FSC supporters based on the survey of FSC national network partners. The FSC network partners were surveyed from April 16 to 30, 2012. The WWF-GFTN and Greenpeace were surveyed from July 10 to August 30, 2012. National offices of these organizations were invited to participate in the surveys via email. Survey contact information was collected through organization websites, the above-mentioned national network survey, and personal communications with organization representatives. Surveys were conducted in English as proficiency was expected to be high among the staff of international organizations. Of 117 contacts, 43 contacts responded (19 from the FSC national network partners and 24 from the WWF-GFTN and Greenpeace), resulting in a response rate of 37% (= 43/117). The surveys asked participants to vote for four types of technical training about ecosystem services that they would be willing to provide to forest owners. The options included training on legal aspects of ecosystem services, quantification of services, setting monitoring baselines for services, and monitoring the provision of services. The number of votes for training for each service was counted. The range of the counted values was from 0 (no training) to 4 (four sessions of training). The study assumed that the higher the counted value, the stronger the preference to provide the indicated types of training.

FSC forest management certificate holders (Group 3) represented FSC's current market for forest certification, as well as potential service sellers. Many of these certificate holders owned plantation forests which are also known to deliver various ecosystem services (Bauhus et al., 2010). Some of the certificate holders also came from national park systems where natural forests are dominant. FSC certificate holders were surveyed from July 9 to August 3, 2012. Contact information was obtained from the FSC. Since forest owners were expected to have a low response rate and low English proficiency, the survey was conducted in multiple languages,

including Chinese, English, French, Indonesian, Japanese, Korean, Portuguese, Spanish, and Vietnamese. The survey also provided examples to ensure a common understanding of ecosystem services. Of 1 216 contacts, 58 contacts were not valid. 188 of the remaining contacts participated in the survey, corresponding to a response rate of 16% (= 188/1158). The survey asked FSC certificate holders to rate their experience in management and sales of services in certified forests. Responses were coded as 0 (having no experience) and 1 (having experience). They were also asked to rate their expectations for future service sales from the forests, using a five-point interval scale: low (1), low-medium (2), medium (3), medium high (4), and high (5).

Ecosystem services projects (Group 4) included potential stakeholders of CFES developed as an expansion of the FSC. They included integrated conservation and development projects (ICDP) and PES schemes, whose objectives are to manage or trade ecosystem services. Ecosystem services projects were examined based on available online data. The data were mainly obtained from the database of the Integrated Valuation of Environmental Services and Tradeoffs (InVEST) project[17] which included information on 159 projects classified as ICDP and/or PES projects. Using the mixed set of ecosystem services (Table 4.1), this study coded services of these projects as 1 when the projects aimed to manage these services and as 0 when the services were not included in the project objectives. In addition to the InVEST database, an additional 16 PES projects were included into the secondary data identified by the literature, including Rewarding Upland Poor for the Environmental Services (RUPES)[18] and Pro-poor Rewards for Environmental Services in Africa (PRESA)[19].

[17] InVEST. (2016, June 23). Retrieved from http://www.naturalcapitalproject.org/InVEST.html
[18] RUPES. (2016, June 23). Retrieved from http://rupes.worldagroforestry.org/
[19] PRESA. (2016, June 23). Retrieved from http://presa.worldagroforestry.org/

4.2.3 Statistical methods.

The study analyzed the appearance of multiple ecosystem services (or bundling) against the six indicators (A to F) of system adaptability by employing exploratory factor analysis (EFA) and multiple correspondence analysis (MCA) (Table 4.3). Both EFA and MCA are statistical techniques used to identify relationships among variables or samples in reduced dimensions (Greenacre & Blasius, 2006; Husson et al., 2016; Thompson, 2004). EFA was applied to Indicators A, B, and C. MCA was applied to Indicators D, E, and F. Computations were performed using the statistical software R (3.2.5) and R packages psych (Revelle, 2015) and FactoMineR (Husson et al., 2016).

Table 4.3 Statistical methods and data structures

Adaptability indicators	Statistical method	Variable type	Sample and variable ratio *
(A) Auditing service deliveries	EFA	Interval	3:1 (= 39:12)
(B) Technical training support	EFA	Interval	4:1 (= 43:12)
(C) Expected future service sales	EFA	Interval	27:1 (= 188:7)
(D) Experience with protecting services	MCA	Dummy	27:1 (= 188:7)
(E) Experience with selling services	MCA	Dummy	27:1 (= 188:7)
(F) Services targeted by the projects	MCA	Dummy	16:1 (= 175:11)

* Ratios are rounded up as integers.

EFA was applied to the five-point interval data (e.g., low = 1 to high = 5). EFA is a descriptive multivariate technique used to discover coherent subsets (or factors) in observed variables by detecting correlation patterns (Thompson, 2004). EFA has been applied in studies of psychology and health, as well as forest certification (Araujo et al., 2009; Litwin et al., 1998; Thompson, 2004). Various guidelines exist on minimum sample sizes (100 to 1,000) and the minimum ratio of sample size to the number of variables (3:1 to 10:1) for factor analysis although such guidelines are also considered to lack empirical validity (MacCallum et al.,1999; Osborne & Costello, 2004; Thompson, 2004). Moreover, results of factor analysis are considered stable if they produce high degrees of communality (>0.6) (Thompson, 2004; MacCallum et al.,

1999). Therefore, although the sample sizes of FSC certification bodies (39) and enabling partners (43) were considered to be low for the purpose of conducting confirmatory factor analysis (CFA), EFA was applicable to these data because the data's sample to variable ratio met the ratio of at least 3:1; results reached high degrees of communality (>0.6); and the survey of certification bodies represented 64% of certification bodies accredited by FSC. In this study, EFA was based on either varimax or quatimax rotation. Factor extraction was based on eigenvalues higher than 1, following the Kaiser-Guttman criterion (Guttman, 1954; Kaiser, 1960). Extracted factors represent an amount of information in the data, or variance (Thompson, 2004). Factor loadings of service variables describe the relationships between factors and ecosystem services.

MCA was applied to datasets of binary values (e.g., 1 = experienced and 0 = not experienced). Like EFA, MCA is used in descriptive multivariate statistics to reduce the dimensions of data matrices (Greenacre & Blasius, 2006; Hoffman & De Leeuw, 1992; Le Roux & Rouanet, 2010). However, while EFA is used for analyzing quantitative variables, MCA is used for analyzing qualitative variables (Husson et al., 2011; Le Roux & Rouanet, 2010; Greenacre & Blasius, 2006). MCA has been applied in studies of medical, psychology, and marketing research (Greenacre & Blasius, 2006; Hoffman & De Leeuw, 1992; Tenenhaus & Young, 1985). In this study, MCA was calculated based on an indicative matrix. Dimension extraction was based on the average inertia of each active category, which is equivalent to Kaiser's rule in EFA (Di Franco, 2016). To interpret the MCA results, discrimination measures of the service variables were used. Interpreted as squared factor loadings, discrimination measures refer to correlation ratios between individual samples and the categorical variables (Hoffman & De Leeuw, 1992; Husson et al., 2011). The study also applied two-dimensional

maps to analyze their relationships following a dominant approach to interpreting MCA results (Greenacre & Blasius, 2006; Husson et al., 2011). On the map, for example, two variables close to each other indicate their close relationships (Husson et al., 2011).

4.3 Results

4.3.1 Group 1: FSC certification bodies.

EFA results from certification bodies' *capacity to audit delivery of ecosystem services* revealed no bundled services (Indicator A in Table 4.4). The EFA employed varimax rotation. Three factors were identified, explaining 80.4% of the data variance. Despite the high communality estimate, none of these factors were considered as bundled services since each group consisted of sub-categories of the same categories of ecosystem services. Factor 1 was comprised of a grouping of watershed conservation services. Factor 2 was comprised of provision of several ecosystem goods which included agricultural goods, NTFPs, and timber. Factor 3 loaded only the sub-categories of ecotourism.

Table 4.4 Results from FSC certification bodies and enabling partners (Indicators A and B)

	Indicator A: Auditing service deliveries (EFA)			*Indicator B:* Technical training support (EFA)		
Ecosystem services	Factor	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
Water quality	***0.95***	0.14	0.18	***0.85***	0.23	0.16
Water quantity	***0.84***	0.06	0.33	***0.82***	0.30	0.11
Water risk	***0.98***	0.11	0.11	***0.83***	0.26	0.22
Carbon	0.62	0.36	0.23	0.25	-0.02	***0.74***
Biodiversity	0.46	0.48	0.52	0.08	0.43	***0.71***
Ecotour.scenic	0.21	0.13	***0.95***	0.13	***0.88***	-0.06
Ecotour.culture	0.16	0.16	***0.97***	0.34	***0.82***	-0.08
Ecotour.biodiversity	0.36	0.40	0.63	0.19	***0.72***	0.30
Soil	0.48	0.65	0.25	***0.73***	0.12	0.46
Agriculture	0.29	***0.85***	0.26	0.44	***0.63***	-0.17
NTFPs	0.07	***0.91***	0.14	0.30	0.44	0.41
Timber	0.02	***0.71***	0.07	0.11	-0.27	***0.72***
Variance (%)	30.8	25.6	24.0	26.2	25.4	17.9
Cut value	*>0.8*	*>0.7*	*>0.9*	*>0.7*	*>0.6*	*>0.7*

The results demonstrate factor loadings.

4.3.2 Group 2: FSC enabling partners.

EFA results from FSC enabling partners' support for *ecosystem services management training* revealed three services bundles (Indicator B in Table 4.4). The EFA used varimax rotation. Three factors were identified, explaining 69.5% of the data variance. Factor 1 revealed a bundle of water quality, water quantity, water risk, and soil conservation. Factor 2 identified a bundle of scenic beauty experience for ecotourism, cultural experience for ecotourism, biodiversity experience for ecotourism, and agricultural goods. Factor 3 revealed a bundle of carbon storage, biodiversity conservation, and timber. This factor was only observed in data from FSC enabling partners, combining regulating services (carbon and biodiversity) and a provisioning service (timber).

4.3.3 Group 3: FSC certificate holders.

EFA results of FSC certificate holders' e*xpectations for future service sales* revealed one bundle (Indicator C in Table 4.5). The EFA employed quatimax rotation. Two factors were identified, explaining 61.1% of the data variance. Factor 1 revealed a bundle of watershed conservation, biodiversity conservation, ecotourism, and soil conservation, i.e., a bundle of regulating, cultural, and supporting services. Factor 2 loaded agricultural goods and NTFPs. However, these are sub-categories of the same category of services (provision of ecosystem goods) and, consequently, were not considered as a potential bundle.

Table 4.5 Results from FSC certificate holders (Indicators C, D, and E)

Ecosystem services	*Indicator C:* Expected future service sales (EFA)		*Indicator D*: Experience with protecting services (MCA)		*Indicator E*: Experience with selling services (MCA)		
	Factor 1	Factor 2	Dim 1	Dim 2	Dim 1	Dim 2	Dim 3
Water	***0.74***	-0.46	***0.45***	0.00	***0.67***	0.00	0.00
Carbon	0.51	-0.15	0.16	***0.47***	0.07	***0.36***	0.17
Biodiversity	***0.80***	-0.31	***0.32***	0.03	***0.64***	0.01	0.06
Ecotourism	***0.72***	0.01	0.23	0.12	0.06	***0.34***	0.20
Soil	***0.79***	0.00	***0.58***	0.00	***0.48***	0.01	0.09
Agriculture	0.47	***0.68***	0.10	***0.34***	0.01	0.16	***0.58***
NTFPs	0.52	***0.64***	0.29	0.07	0.00	***0.59***	0.04
Variance (%)	44.0	17.1	30.3	14.8	27.6	21.1	16.3
Cut value	>0.7	>0.6	>0.30	>0.30	>0.40	>0.30	>0.30

EFA results demonstrate factor loadings.
MCA results demonstrate discrimination measures.

MCA results from FSC certificate holders' *experience of protecting ecosystem services* revealed three bundles (Indicator D in Table 4.5). Two dimensions were identified, explaining 45.1% of the data variance (or of the total inertia). Dimension 1 revealed a bundle of soil, water, and biodiversity. Dimension 2 identified a bundle of carbon and agriculture. On the two-dimensional map (Figure 4.3), soil, water, and biodiversity appeared close to each other. Carbon and agriculture demonstrated their relationship. Although not meaningfully related to Dimension 1, ecotourism and NTFPs demonstrated their relationship based on their close positions on the plot; thus, they were also considered as a bundle in the analysis.

(a) Indicator D: Experience with protecting services **(b) Indicator E: Experience with selling services**

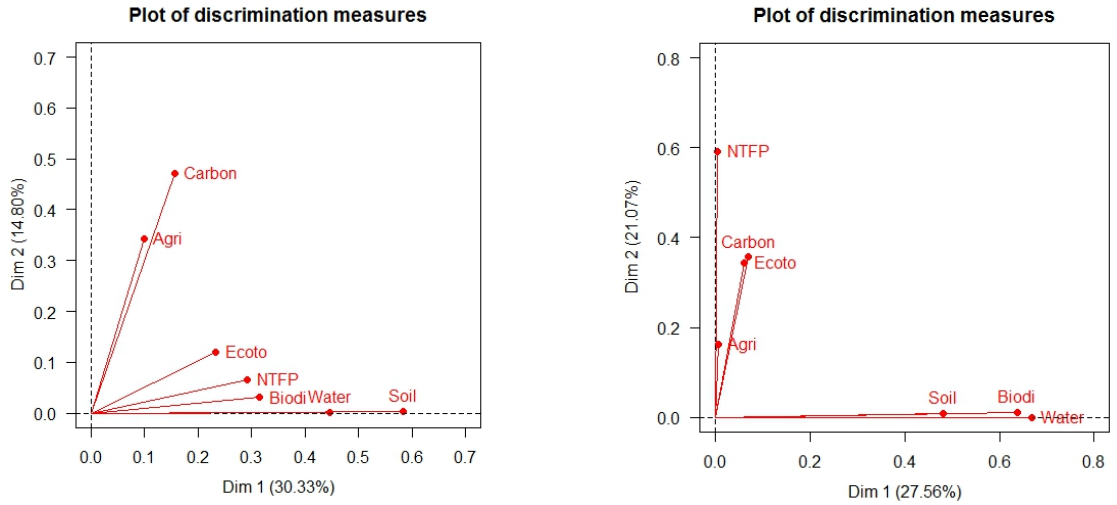


Figure 4.3 MCA result from FSC certificate holders (*Indicators D and E*)

MCA results from FSC certificate holders' e*xperience of selling ecosystem services* revealed two bundles (Indicator E in Table 4.5). Three dimensions were identified, explaining 64.9% of the total inertia. Dimension 1 revealed a bundle of soil, water, and biodiversity. Dimension 2 identified a bundle of NTFPs, carbon, and ecotourism. Dimension 3 was only related to agriculture, failing to demonstrate any bundle. In Figure 4.3, although agriculture was highly related to Dimension 3, the plot illustrates that agriculture is still connected to the bundle of Dimension 2.

4.3.4 Group 4: Ecosystem services projects.

MCA results of *ecosystem services targeted by projects* revealed two bundles (Indicator F in Table 4.6 and Figure 4.4). Three dimensions were identified explaining 52.7% of the total inertia. Dimension 1 revealed a bundle of agriculture, cultural ecotourism, timber, and NTFPs. These services represent cultural and provisioning services relevant to major economic activities in forestry. Dimension 2 identified a bundle of water, water risk, and soil services. These

services are relevant to environmental managements. Dimension 3 was related to carbon only and failed to produce any likely bundle.

Table 4.6 Results from ecosystem services projects (Indicator F)

Ecosystem services	*Type F*: Services targeted by the projects (MCA)		
	Dim 1	Dim 2	Dim 3
Water	0.00	***0.49***	0.01
Water risk	0.00	***0.41***	0.02
Carbon	0.02	0.02	***0.43***
Biodiversity	0.28	0.12	0.13
Ecotourism	0.19	0.00	0.02
Ecotour.culture	***0.61***	0.04	0.05
Soil	0.15	***0.39***	0.02
Nutrient	0.10	0.27	0.14
Agriculture	***0.62***	0.03	0.01
NTFPs	***0.39***	0.00	0.27
Timber	***0.41***	0.00	0.17
Variance (%)	25.2	16.1	11.5
Cut values	>0.30	>0.30	>0.40

The results demonstrate discrimination measures.

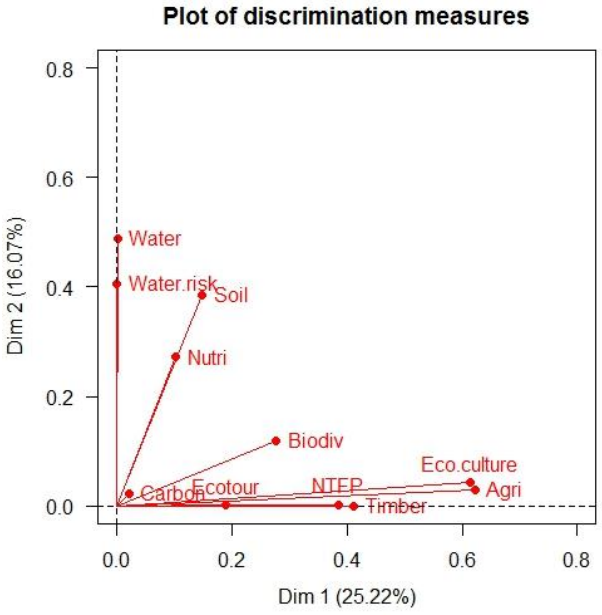


Figure 4.4 MCA result from projects (*Indicator F*)

4.3.5 Dominant service bundles.

Two bundles were supported across multiple indicators of FSC system adaptability, and this study therefore considered them dominant, i.e. likely to be most feasible under current conditions (Table 4.7). *Bundle 1* included watershed and soil conservation services and was supported by Indicators B, C, D, E, and F. *Bundle 2* included cultural ecotourism with NTFPs or agricultural goods and was supported by Indicators B, D, E, and F. Although NTFPs and agricultural goods were separated in the surveys, these services share many products particularly in the context of forests (e.g., coffee); thus, the study treated them as similar kinds of ecosystem services, as discussed in the methods and Group 1 results. In addition to Bundle 1 and 2, other bundles were identified from the analyses. However, they were either supported by a single indicator of the adaptability (e.g., carbon, biodiversity, and timber in Indicator B) or represented bundles of closely related services (e.g., scenic and biodiversity ecotourism in Indicator A). Therefore, these bundles were not considered dominant.

Table 4.7 Two dominant bundles of ecosystem services from EFA and MCA

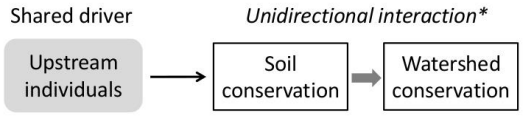
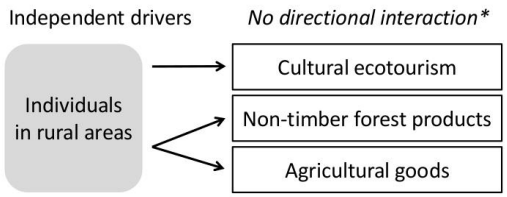
Adaptability indicators	Method	*Bundle 1* water / soil	*Bundles 2* ecotourism / NTFPs or agriculture
(A) Auditing service deliveries	EFA	Not observed	Not observed
(B) Technical training support	EFA	water / soil	ecotourism / agriculture
(C) Expected future service sales	EFA	water / soil	Not observed
(D) Experience with protecting services	MCA	water / soil	ecotourism / NTFPs
(E) Experience with selling services	MCA	water / soil	ecotourism / NTFPs
(F) Services targeted by the projects	MCA	water / soil	ecotourism / NTFPs & agriculture

4.4 Discussion

The study identified two dominant bundles of ecosystem services across multiple indicators of FSC system adaptability. Although there is no certification scheme for these service

bundles yet, the bundles exist in conventional ecosystem services management, such as watershed management (Bundle 1) and rural tourism (Bundle 2) (Table 4.8).

Table 4.8 Two dominant bundles from FSC stakeholder adaptability

Bundle	Selected ecosystem services	Description
Bundle 1		A strategy to manage water quality
Bundle 2		Rural tourism

*Relationship directions of ecosystem services was adapted from Bennett et al. (2009).

The services in Bundle 1 are associated with *strategies to manage water quality*. Many watershed management projects control soil erosion and sediment in order to improve water quality in watersheds and streams (Bennett et al., 2009; Kerr, 2002; Landell-Mills & Porras, 2002; Raudsepp-Hearne et al., 2010). According to Bennett et al. (2009), the two services in Bundle 1 have a "unidirectional interaction" since they are in a cause-and-effect relationship, where soil erosion decreases water quality. Watershed services are managed by some standards. For example, there have been efforts to develop and apply a standard of watershed management, notably the Alliance for Water Stewardship (AWS, 2013). In the US, water quality standards are designed to certify water quality credits even though they belong to mandatory markets for ecosystem services (or water quality trading programs) (EPA, 2004). The FSC's international principles and criteria also require water and soil management (FSC, 2012; Stupak et al., 2011), but these FSC requirements are too general to measure watershed services such as water quality

or quantity (van Dam et al., 2010). To certify Bundle 1, therefore, FSC would need to develop additional certification system such as a new standard for the bundle, verification procedure, and system to deliver information on certified bundle credits to ecosystem services markets (e.g., a public database for certified credits). Furthermore, the integration of Bundle 1 into certification requires overcoming challenges involved with watershed management ranging from the technical difficulties of measuring and monitoring watershed functions (IUCN & WBCSD, 2012; Meijaard et al., 2011) to complex socioeconomic issues affecting the engagement of watershed stakeholders (Hanemann, 2006).

The services in Bundle 2 are associated with the development of *rural tourism* and in particular, agritourism, which has long been popular in Europe and Canada (Dernoi, 1983; MacDonald & Jolliffe, 2003; Nickerson et al., 2001; Sharpley & Vass, 2006). Agritourism diversifies farmers' income sources by attracting tourists interested in experiencing the rural and farm lifestyle. The services in Bundle 2 have "no direction of interaction" according to Bennett et al. (2009). Each service is already certified by many certification schemes specialized in ecotourism, NTFPs, organic products, and fair trade certification schemes (Black & Crabtree, 2007; Cashore et al., 2006; Kozak et al., 2004; Shanley et al., 2008). To date, however, none of these certification schemes explicitly certify Bundle 2. To certify Bundle 2, therefore, the expansion of the FSC system would need to be equipped with a new certification system. This system would likely need to include a complementary chain of custody certification to ensure that supply chains of NTFPs and agricultural goods are maintained from source to market.

Some challenges emerge from our investigation into the feasibility of certification of particular service bundles. First, the auditing capacity of certification bodies would need to be improved to make both bundles functional because they appear to be overly specialized within

the same type of ecosystem services (Table 4.4). Certification bodies are a key component of certification system because third-party auditing is central to building the credibility upon which voluntary certification is grounded (Nussbaum & Simula, 2013). Second, successful certification of these bundles would be dependent on demand for the individual ecosystem services among forest owners and service buyers (e.g., buyers of water and soil service credits). Lack of market demand would be a challenge in implementing voluntary certification of these services (Meijaard et al., 2011; 2014). However, the level of demand for the individual services in Bundle 1 and 2 is, as yet, uncertain.

By identifying potential service bundles likely to be supported by the current FSC system, the findings of this study contribute to assessing the feasibility of a potentially new certification option and inform future studies on CFES. These bundles are derived from socio-economic aspects of bundling and certification-oriented management of ecosystem services. This socio-economic domain plays significant roles in valuing, managing, and trading ecosystem services (Al-assaf et al., 2014; Deal et al., 2012; Endter-Wada et al., 1998; MA, 2005; Martín-López et al., 2011) and, therefore, in the incorporation of bundling of ecosystem services into development of CFES. Although focusing on certification, moreover, the study findings are potentially applicable to general ecosystem services management, since Bundle 1 and 2 were supported by FSC certificate holders and ecosystem services projects (Table 4.7).

Last but not least, the study has its limitations signalling a need for further inquiry. First, the study is based on self-assessed adaptability of certification stakeholders measured by online surveys. In order to obtain more accurate measurements, a standardized test would be required based on face-to-face surveys. Second, although dominant, Bundle 1 and 2 were not supported by all entire stakeholder groups (e.g., certification bodies). The low adaptability of the non-

supported stakeholders should be considered in analyzing potential integration of Bundle 1 and 2 into certification. Third, some bundles were only reported by one stakeholder group and therefore they were excluded from further analysis; bundles of interest to particular certification stakeholders should be selected for specific study. Fourth, the study examines a limited number of stakeholder groups. The scope of CFES stakeholders is broad, including stakeholders of ecosystem services markets. FSC stakeholders are also changeable over time. Thus, further stakeholder groups need to be examined in order to analyze the feasibility of CFES and its potential to incorporate bundling of ecosystem services.

4.5 Conclusions

The study identified two potential bundles of ecosystem services through the analyses of adaptability of FSC certification bodies, FSC enabling partners, FSC certificate holders, and ecosystem services projects. Bundle 1 included services of watershed and soil conservation, which are commonly produced together by water projects as a watershed management strategy. Bundle 2 included services supporting agricultural goods, non-timber forest products, and cultural ecotourism. Traditional rural tourism in some areas constitutes a ready market for such a combination of services. These findings contribute to assessing the feasibility of expanding the FSC system to multiple ecosystem services (or bundling) by investigating which bundles would be most supported by the current system.

Chapter 5: Estimating demand for certification of forest ecosystem services: A choice experiment with FSC certificate holders[20]

5.1 Introduction

An expansion of the FSC system to certification of forest ecosystem services (CFES) would not be feasible without market demand. CFES would have little chance to disclose information on ecosystem services to target markets if only a few forest owners were motivated to certify their ecosystem services. In the literature on forest certification, forest owners are known to certify their wood products to access price premiums, improve their capacity to manage forests, signal the soundness of their business to the market, meet corporate social responsibility goals, and responsibly manage their own forests (Bowers et al., 2012; Carlsen et al., 2012; Overdevest & Rickenbach, 2006) (Section 1.1.4). Nevertheless, their motivations to certify ecosystem services and the demand for CFES have not been empirically analyzed, which presents a difficulty for analyzing the feasibility of the certification scheme. Thus, this chapter estimates the possible demand for CFES using a choice experiment with FSC forest management certificate holders around the world. As potential consumers of CFES, these certificate holders represent the FSC's internal market, the potential sellers of ecosystem services from plantation forests (Bauhus et al., 2010), and forest owners who have experienced realistic benefits and costs of forest certification.

[20] A version of Chapter 5 is published [Jaung, W., Putzel, L., Bull, G. Q., Guariguata, M. R., & Sumaila, U. R. (2016). Estimating demand for certification of forest ecosystem services: A choice experiment with Forest Stewardship Council certificate holders. *Ecosystem Services, 22, 193-201*].

5.2 Methods

5.2.1 Choice experiment.

This study employed a choice experiment to analyze market demand for CFES because this certification is a potential scheme (or non-market service) yet. A choice experiment is an effective way to elicit survey participants' preferences for non-market goods and services in terms of their expected attributes (Adamowicz et al., 1998; Bateman et al., 2002; Louviere et al., 2000). Following Train (2009), a random utility model of forest owners was defined in Equation 5.1:

$$U_{ni} = V_{ni} + \varepsilon_{ni} \; \forall j \tag{5.1}$$

U_{ni} is the random utility of a forest owner n with CFES scheme i. This utility is decomposed into two parts: V_{ni} and ε_{ni}. V_{ni} represents a forest owner's observable random utility and ε_{ni} represents the unobservable random utility. Assuming a rational decision maker, a forest owner would choose a certification scheme that maximizes her random utility. For example, let's assume there are J number of CFES schemes. A forest owner would choose the scheme i if this scheme provides the highest random utility among the J number of CFES schemes. Using maximum likelihood estimation, the probability for her to choose the scheme i over the scheme j is expressed as:

$$P_{ni} = \text{Prob}(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj} \quad \forall j \neq i) \tag{5.2}$$

$$= \int_{\varepsilon} I\left(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj} \;\; \forall j \neq i\right) f(\varepsilon_n) d\varepsilon_n$$

$I(\cdot)$ is a probability function. $f(\cdot)$ is a distribution function of ε_n. If $f(\varepsilon_n)$ is logistically distributed, this probability becomes:

$$P_{ni} = \frac{\exp^{Vni}}{\sum_{j} \exp^{Vnj}} \tag{5.3}$$

The integral of Equation 5.2 can be estimated under various assumptions. This study employed two assumptions resulting in multinomial and mixed logit models. First, ε_n was assumed independently and identically distributed (iid) as an extreme value type 1 distribution. This assumption led to a multinomial logit model. Second, ε_n was assumed to be randomly distributed and follows researcher-defined distributions including normal and triangular distributions. This assumption led to a mixed (or random parameter) logit model.

Marginal willingness to pay (MWTP) was estimated by:

$$MWTP = \frac{(\beta_k - \beta_{k0})}{-\beta_c} \tag{5.4}$$

where β_k is a coefficient of a certification attribute of interest, β_{k0} is a coefficient of an effect-coding baseline for β_k, and β_c is a coefficient of a certification cost. β_{k0} was subtracted to transform the effects-coded coefficients to dummy-coded coefficients. Therefore, β_k - β_{k0} is considered as a dummy-coded version of β_k [21]. The cost variable was also not randomized in the mixed logit model. In this way, β_c was assumed to be constant instead of random; MWTP estimates avoided singularities arising from dividing taste coefficients by a random cost variable (Train & Weeks, 2005). The confidence intervals of the MWTP were estimated by the Delta method (Bliemer & Rose, 2013; Hole, 2007). For the entire econometrics estimation, R 3.2.3 was used. The computation of choice experiment models was supported by R package mlogit (Croissant, 2013).

[21] Zweifel et al. (2009) explain the conversion of effects-coding to dummy coding for MWTP estimates.

Total welfare measures[22] (or compensating variations) were calculated based on scenario-based certification schemes and estimated MWTP for the attribute levels. Certification scheme scenarios were generated with all the possible combinations of statistically significant attribute levels. These scenarios described possible designs for CFES and allowed estimation of forest owner demand for these designs by summing their MWTP for the attribute levels included in the designs. All the total welfare measures included the MWTP estimate of an alternative-specific constant (*ASC*) since *ASC* represents impacts of certification attributes that were not included in this study. Estimated total welfare measures for the certification designs were compared with certification cost scenarios. Three cost scenarios were built in comparison to the median cost ($1.28) of forest certification: Scenario 1 was set at $1.28 per ha (or equal to the median); Scenario 2 at $1.60 per ha (or 25% higher); and Scenario 3 at $1.90 per ha (or 50% higher).

5.2.2 Hypothesis and choice experiment design.

This study tested two hypotheses: the first hypothesis (H1) was that forest owners would demand CFES associated a bundle of benefits and costs, and the second hypothesis (H2) was that forest owners would have sufficient WTP for this certification scheme in comparison to alternative certification cost scenarios.

The study established four potential attributes[23] of CFES by reviewing the contexts of forest certification, ecosystem services management, and ecosystem services markets. These four

[22] These total welfare measures were only based on the main effects of each attribute. It is due to the challenge to obtain both main and interaction effects in a robust way. Even the model with only two-attribute interactions became enormous and unstable.

[23] For the rest of this thesis, the term, "attributes," is used to indicate potential characteristics of CFES to be consistent with terminologies in the choice experiment literature (e.g., Louviere et al., 2000).

attributes consisted of potential benefits and costs of the certification scheme. As a market product, ecosystem services have abstract and complex features. Therefore, this study tried to reduce forest owners' difficulty to understand CFES by describing its explicit benefits and costs to them (Figure 5.1).

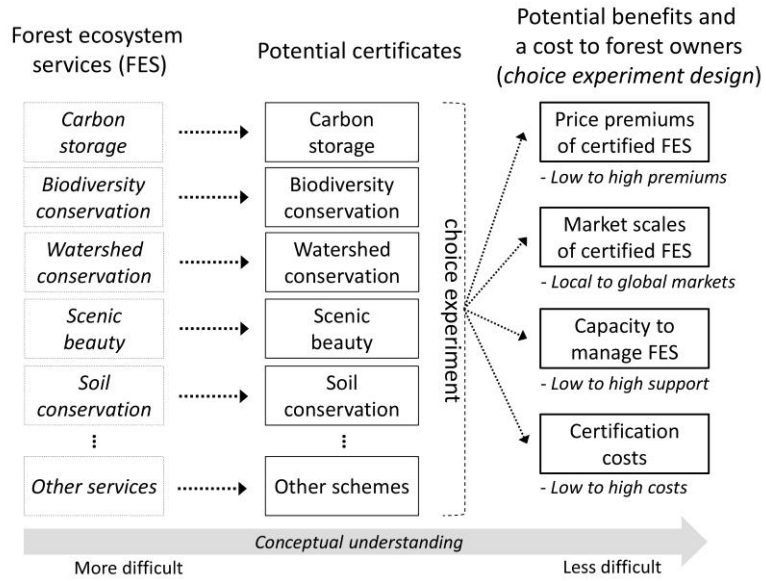


Figure 5.1 Choice experiment design in this study

Table 5.1 CFES attributes

	Attribute	Level	Coding name	Coding type
(1)	Price premium of certified services	- 0% - 25% - 50% - 75%	PREM00* PREM25 PREM50 PREM75	Effects coding
(2)	Market scale of certified services	- Might not be available - Only in your region - Only in your country - Globally	MARKET_none* MARKET_regional† MARKET_national MARKET_global	Effects coding
(3)	Training by FSC	- Not provided - Technical training - Administrative training	TRAIN_none* TRAIN_tech TRAIN_admini	Effects coding
(4)	Certification cost per ha in comparison to FSC FM forest certification	- 25% less - Same as FSC cost - 25% more - 50% more	COST	Dollar values by multiplying a median FSC cost/ha (USD $1.28) estimated by the survey

* Baselines for effects coding.

† Regional is used here in the sense of "sub-national" or "local."

The four certification attributes included 1) price premium on certified ecosystem services, 2) market scale of certified services, 3) training for forest owners by the FSC, and 4) certification cost per hectare in comparison to cost of FSC forest management certification (Table 5.1). The first attribute, the *price premium*, reflected forest owners' main motivation to obtain forest certification (Elliott 2000; Durst et al., 2006; Overdevest & Rickenbach, 2006). The attribute indicated incremental economic benefits of CFES to forest owners. The level of "a zero price premium" also demonstrated the reality of certification markets. For example, price premiums do not always exist for all the certified wood products (Durst et al., 2006), which may also be the case in regards to CFES. The second attribute, *market scale of certified services*, addressed a challenge that ecosystem services are delivered and captured at different spatial scales (Chan et al., 2006; Meijaard et al., 2011; Womble and Doyle, 2012): there is no existent market for certification of some ecosystem services; some service markets are highly localized (e.g., watershed-based PES schemes); only particular services have as yet been traded in any markets at all (e.g., forest carbon); and some service markets exist only in particular countries (e.g., biodiversity banks in the US and Australia). Thus, the second attribute incorporated the challenge associated with various scales of markets for certified services into the choice experiment design. The third attribute, *training associated with certification*, reflected the fact that many stakeholders often lack capacity to manage ecosystem services, such that training is likely required (Pagiola et al., 2005; Wunder et al., 2008). This attribute also corresponded to forest owners' motivation to "learn from forest certification" (Overdevest & Rickenbach, 2006); thus, this attribute represented a potential business value of CFES to forest owners. The fourth attribute, *certification cost*, reflected a major challenge to forest certification and PES schemes (Durst et al., 2006; Muradian et al., 2010; Muradian & Rival, 2012). High cost represented an

expected challenge of developing CFES as well (Meijaard et al., 2011; 2014). CFES, however, is still a potential scheme. Its scope and parameters have simply, as of yet, not been systematically defined. Therefore, this study did not completely reject the possibility that costs of CFES could be lower than FSC forest management certification.

All of the variables were estimated by effects coding, except for *ASC* and *COST*. *ASC* was dummy-coded, and *COST* was assigned numeric values in dollar terms. The dollar values of *COST* were obtained by multiplying the percentage-based costs by an estimated median cost of forest certification per hectare (or USD $1.28). This median cost was estimated from an analysis of survey participants' forest certification costs.

With these four attributes, a total of 16 choice sets were generated by a rotated experimental design. First, 16 certification schemes (or Scheme A) were generated by a fractional factorial design. Later 16 alternative certification schemes (or Scheme B) were generated by rotating attribute levels of Scheme A in different directions: the levels of the first and third attributes were rotated by +1 (e.g., 75% to 0% price premium) whereas the levels of the second and fourth attributes were rotated by -1 (e.g., regional market to no market). This design achieved orthogonality, balance, and minimal overlap between Scheme A and B (Reed Johnson et al., 2013). The design featured differentiated level changes as well. This design was chosen to focus the study at testing only the main effects, thereby reducing the number of choice sets. This was a strategy aimed at decreasing the complexity of administrating a global survey in multiple languages. Although software-generated experimental designs are increasingly applied nowadays due to their advanced features, a rotated (or fold-over) design has been also applied to choice experiments (DeShazo et al., 2015; Louviere et al., 2000; Reed Johnson et al., 2013). The study adopted two blocks. Eight choice sets (= 16/2) were administered per participant. Each choice set

had three options: Scheme A, Scheme B, and a *status quo* option (Figure 5.2). These certification schemes were described as a potential scheme of FSC and distinct from FSC FM certification. In this way, participants perceived the choice sets as credible scenarios. They were also allowed not to change their welfare status by selecting the *status quo* option.

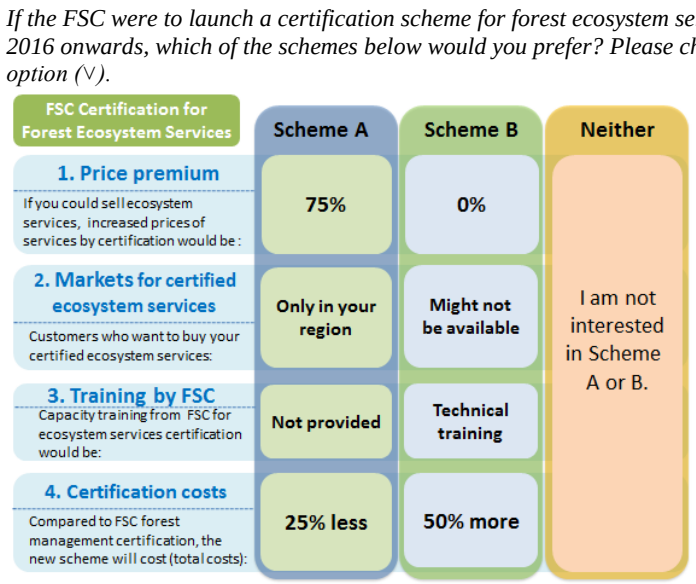


Figure 5.2 An example choice set

This study assumed that many participants were still new to the concept of ecosystem services, so initial survey questions presented several service examples from the Millennium Ecosystem Assessment (MA, 2005). These examples included forest carbon storage, watershed protection, biodiversity conservation, supporting ecotourism, soil conservation, and provision of non-timber forest products and agricultural goods. The survey asked participants questions related to various aspects of these services prior to starting the choice experiment questions. The established survey was pre-tested by two expert groups: researchers at the Center for International Forestry Research (CIFOR) and FSC staff. These two groups were selected for the pre-test not only because they were intellectually close to this research project but because they

are experts in forestry research with experience in both survey design and forest certification, respectively.

5.2.3 Survey administration.

Using an online survey, this study surveyed forest owners around the world who had obtained FSC forest management (FM) certification. The study excludes FSC chain of custody (CoC) certification because it was assumed that wood supply chains are not major supply chains of ecosystem services. Although some services, such as carbon, could be bundled with wood products in the future, the role of FSC CoC certificate holders (e.g., paper companies) in trading ecosystem services would be limited as compared to FSC FM certificate holders (e.g., forest owners). In the rest of this paper, FSC certificate holders represent FSC FM certificate holders. Contacts of forest owners were obtained from the FSC. These certificate holders mainly were associated with planted forests, though some were managers of national parks with natural forests. The survey was conducted in Chinese, English, French, Indonesian, Japanese, Korean, Portuguese, Spanish, and Vietnamese. The English version of the survey was used for participants from countries not using any of the above languages. The survey was conducted between July and August 2012. From 1,216 email invitations, the survey resulted in 188 respondents from 57 countries. The response rate was therefore 15.5%. Participants were distributed across the continents, but Africa and Oceania had limited survey participants reflecting the small numbers of FSC certificate holders in those regions (Table 5.2). A total of 178 surveys were used for the choice experiment after excluding surveys with no response in the choice experiment section. Five participants skipped some of choice experiment questions; a total of 1,389 panel responses were used for the analysis.

Table 5.2 Descriptions of survey participants

Variables †	Mean	SD
General		
Forest areas in ha	127,724	506,851
Emerging econ	0.42	0.49
Origin		
Europe	0.31	0.46
Latin America	0.26	0.44
US/Canada	0.18	0.39
Asia	0.17	0.37
Africa	0.04	0.20
Oceania	0.03	0.18
Unknown *	0.01	0.10
Service management experience		
Carbon	0.36	0.48
Watershed	0.67	0.47
Biodiversity	0.82	0.38
Ecotourism	0.28	0.45
Soil	0.56	0.50
NTFPs **	0.34	0.48
Agriculture	0.08	0.27

† All are dummy variables (1= yes, 0= no), except for forest areas.
* Two participates skipped this question.
** Non-timber forest products

5.3 Results

Both multinomial and mixed logit models were estimated (Table 5.3). The multinomial logit model had a rather low Pseudo-R^2 (0.07), even though eight variables were significant at the 10% level and its likelihood ratio test against a null model was significant at 1% level; thus, the interpretation of results is mainly based on the mixed logit model.

The mixed logit model had an improved Pseudo-R^2 (0.32). This fitness level is equivalent to around 0.6 of R^2 in linear regression models (Hensher et al., 2005). The model randomized seven variables: *ASC*, *PREM25*, *PREM50*, *PREM75*, *MARKET_regional*, *MARKET_national*, and *MARKET_global*. Except for *ASC*, all were randomized using a triangular distribution because it performed better than a normal and uniform distribution. *ASC* was randomized using a normal distribution for the same reason. All of the randomized variables were significantly

heterogeneous, supported by the significant standard deviations[24]. *TRAIN_tech*, *TRAIN_admini*, and *COST* were fixed (or not randomized) since their standard deviations were consistently not significant regardless of any distribution types. The mixed logit model was simulated by Halton draws. A draw of 100 times was selected because it provided the lowest *LL* (*log likelihood*) compared to draws of 50, 200, 1,000, and 2,000 times. This result is also consistent with the argument from Hensher and Green (2003) and Train (2000) that a higher number of Halton draws does not always guarantee the best model fit.

Table 5.3 Estimation results of multinomial and mixed logit models

	Multinomial logit		Mixed logit	
Variable	Coeff.	Std. error	Coeff.	Std. error
ASC	0.970 ***	0.209	1.816 ***	0.338
PREM25	-0.050	0.081	0.004	0.149
PREM50	0.155 *	0.082	0.451 ***	0.137
PREM75	0.204 **	0.080	0.460 ***	0.131
MARKET_regional	-0.044	0.079	-0.053	0.130
MARKET_national	-0.094	0.080	-0.331 **	0.136
MARKET_global	0.462 ***	0.080	0.528 ***	0.132
TRAIN_tech	0.228 ***	0.064	0.344 ***	0.101
TRAIN_admini	0.051	0.071	0.044 ***	0.106
COST	-1.263 ***	0.146	-2.292 ***	0.252
SocioDemographic variables				
Emerging_econ				
× TRAIN_tech	0.174 ***	0.061	0.292 ***	0.089
× TRAIN_admini	-0.112 *	0.065	-0.136	0.092
Standard deviations of random parameters				
ASC			3.971 ***	0.308
PREM25			0.436	0.379
PREM50			1.188 ***	0.306
PREM75			1.270 ***	0.280
MARKET_regional			0.340	0.352
MARKET_national			1.240 ***	0.296
MARKET_global			1.745 ***	0.288
McFadden pseudo-R^2	0.07		0.32	
Log-likelihood (LL)	-1314.60		-952.53	

*, **, and *** are significant at the 10%, 5%, and 1% significance level respectively.

[24] Although the standard deviations of *PREM25* and *MARKET_regional* were not significant (Table 5.3), these variables were randomized for the consistency with other variables in the same levels, including *PREM50*, *PREM75*, *MARKET_national*, and *MARKET_global*.

The mixed logit model obtained seven attributes significant at 1% level: *PREM50*, *PREM75*, *MARKET_national*, *MARKET_global*, *TRAIN_tech*, *COST*, and an interaction between *TRAIN_tech* and *Emerging_econ* (Table 5.3). First, *PREM50* and *PREM 75* produced almost identical[25] coefficients (or part-worth utilities) of 0.451 and 0.460, respectively. This indicates that once a price premium of certified services reaches 50%, a further increase in the price premium does not significantly increase forest owners' part-worth utilities. Second, *MARKET_national* yielded a negative part-worth utility, while *MARKET_global* yielded a positive one. It indicates that a national-scale market would reduce forest owners' utilities; the promise of global market reach is a key attribute for certification. Third, *TRAIN_tech* variable increased forest owners' utilities. This implicitly suggests that forest owners need capacity building to manage ecosystem services. The significant coefficient of the interaction between *TRAIN_tech* and *Emerging_econ* showed that this capacity building was demanded particularly by forest owners from emerging economies. Last but not least, *COST* yielded a significantly negative part-worth utility. This negative cost parameter reflects a decrease in the underlying utility function due to an increase in certification costs, or negative preferences for the cost attribute.

To analyze forest owners' preference distributions, the study estimated the random variables' negative and positive shares (Figure 5.3). These distributions follow a triangular distribution as defined by the mixed logit model. The negative share indicates a portion of a simulated population not preferring certification. The positive share indicates those preferring

[25] Since they were estimated in comparison to no price premium (*PREM00*), the degrees of their part-worth utilities are comparable. *PREM00* is not shown in Table 5.3 because it was the baseline of effects coding (or -1).

certification. *PREM50* and *PREM75* produced similar results. With a price premium of 50%, 81% of the population preferred certification. A 75% price premium produced a similar result. However, *MARKET_national* and *MARKET_global* had contrasting results. With market research limited to the national level, only 27% preferred certification. In contrast, 76% of the population preferred certification with global market reach.

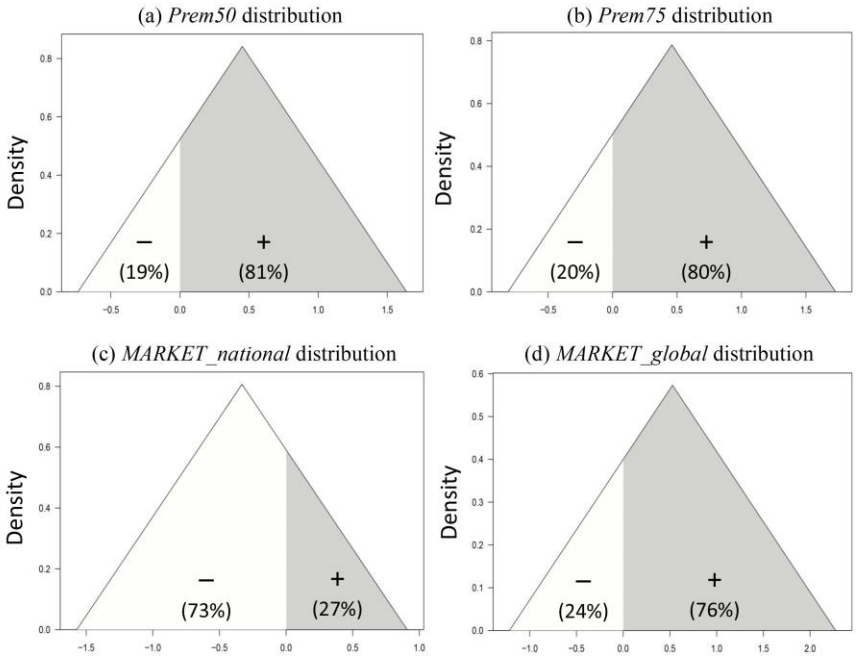


Figure 5.3 Distributions of the random variables

Marginal willingness to pay (MWTP) was estimated for four attributes: *PREM50*, *PREM75*, *MARKET_global*, and *TRAIN_tech* (Table 5.4). Confidence intervals were estimated using the Delta method (Bliemer & Rose, 2013; Hole, 2007). *PREM50* and *PREM75* had identical MWTP estimates (USD $0.60 per ha). It indicated that forest owners would be willing to pay $0.60 per ha for CFES if this certification scheme generates a price premium between 50% and 75%. These MWTP estimates assume that the other certification attributes remain the same. *TRAIN_tech* was associated with MWTP of $0.32 per ha. *MARKET_global* was associated

with MWTP of $0.29 per ha. *MARKET_national* was associated with MWTP of -$0.17. This negative MWTP suggested that forest owner preference for certification was negative if restricted to a national market scale.

Table 5.4 Welfare measures from the mixed logit model

Variables	MWTP per ha	(Lower 2.5% – Upper 97.5%)
PREM50	$0.60	($0.48 – $0.72)
PREM75	$0.60	($0.49 – $0.72)
MARKET_global	$0.29	($0.18 – $0.41)
TRAIN_tech	$0.32	($0.23 – $0.41)
MARKET_national	-$0.08	(-$0.19 – $0.03)

Total welfare measures were estimated through 11 scenario-based certification schemes (Table 5.5), and these measures were compared with three certification cost scenarios (Figure 5.4). In cost scenario 1, seven certification schemes (D1, D2, D3, D4, D5, D7, and D8) achieved measures higher than $1.28. In cost scenario 2, four certification schemes (D1, D2 D3, and D7) achieved measures higher than $1.60. In cost scenario 3, only one certification scheme (D1) obtained measures higher than $1.90.

Table 5.5 Total welfare measures for certification scheme scenarios (D1 - D11)

		Certification scheme scenarios										
Variables	MWTP	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11
ASC	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79
PREM50/75	$0.60	$0.60	$0.60	$0.60	$0.60			$0.60	$0.60			
M_global	$0.29	$0.29		$0.29		$0.29				$0.29		
M_national	-$0.08		-$0.08		-$0.08		-$0.08				-$0.08	
T_tech	$0.32	$0.32	$0.32			$0.32	$0.32	$0.32				$0.32
Total welfare measures		$2.00	$1.63	$1.68	$1.31	$1.41	$1.03	$1.71	$1.39	$1.09	$0.71	$1.11
		***	**	**	*	*		**	*			

*** indicates measures higher than $1.92 (cost 50% higher than $1.28).
** indicates measures higher than $1.60 (cost 25% higher than $1.28).
* indicates measures higher than $1.28 (cost equal to the forest certification cost).

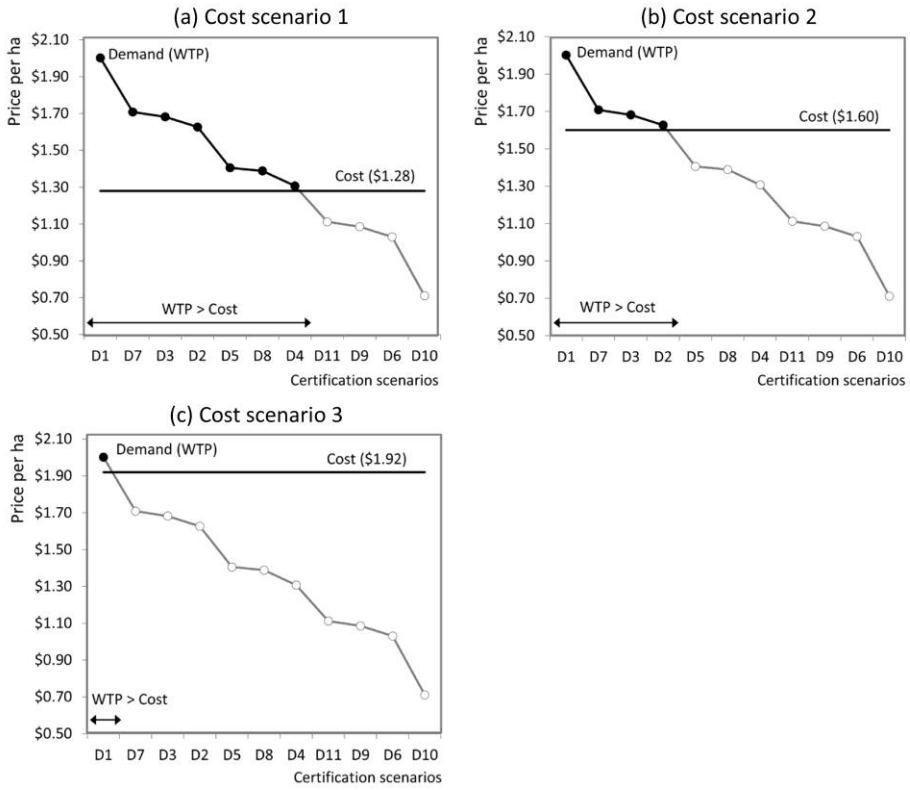


Figure 5.4 Comparison of the cost scenarios with the total welfare measures

5.4 Discussion

Our results failed to reject the hypothesis (H1) that forest owners would demand CFES associated with a bundle of benefits and costs. Each certification attribute obtained at least one statistically significant level (Table 5.3). On the other hand, the results partially rejected the hypothesis (H2) that forest owners would have sufficient WTP for this certification scheme in comparison to alternative certification cost scenarios (Figure 5.4). These results reveal not only potential motivations of forest owners to obtain CFES (Section 5.4.1), but also challenges to developing CFES (Section 5.4.2).

5.4.1 Motivations to obtain CFES.

Three types of certification benefits significantly increased part-worth utilities of FSC certificate holders (or forest owners): a price premium, technical training, and a global market for certified ecosystem services (Table 5.4).

First, the *price premium* for CFES was strongly preferred by forest owners. This preference is in line with previous observations related to FSC forest certification (Cai & Aguilar, 2013; Elliott 2000; Overdevest & Rickenbach 2006). This preference also confirmed that demand for CFES from ecosystem services sellers (e.g., forest owners) are affected by demand for certified services from buyers (e.g., buyers of watershed services). Price premiums for certified services would mainly derive from perceived additional benefits to service buyers, even though exceptionally some certification schemes set a minimum level of price premiums (e.g., FairTrade certification) (Raynolds et al., 2007). Thus, certified services should provide additional benefits to buyers compared to non-certified services in order to generate service sellers' certification demand. Among ecosystem services markets, price premiums for certified services have as yet only been observed in voluntary carbon markets (Bayon et al., 2009; Peters-Stanley et al., 2013) (Table 5.6). Price premiums in many other service markets, such as PES schemes, are still unknown because CFES is still in its infancy in those markets and no relevant demand studies are available. Although many ecotourism certification schemes focus on environmental and social safeguards (Black & Crabtree, 2007), to our knowledge no certification scheme certifies actual deliveries of ecosystem services related to scenic beauty, cultural experience, and biodiversity experience. No voluntary certification schemes are available to certify deliveries of watershed or biodiversity conservation services although some standards initiatives are under development, such as the Alliance for Water Stewardship (AWS) and the

Business and Biodiversity Offsets Program (BBOP). Price premiums associated with those certification schemes are as yet unknown. Therefore, more studies are needed on buyer-side demand to assess the potential for price premiums attached to CFES and the effect of those premiums on seller-side demand.

Table 5.6 Status of attributes affecting demand for CFES

		Attributes affecting CFES demand	
Forest ecosystem service	Market examples	Price premiums for certified services	Global market
Carbon storage	Voluntary carbon markets	●	●
Biodiversity conservation	Voluntary offsets		
Watershed protection	PES schemes		
Scenic beauty	Ecotourism		●
Cultural experience	Ecotourism		●
Biodiversity experience	Ecotourism		●
Soil conservation	PES schemes		

● indicates that a case is available.

Second, *technical training* was identified as a motivation for forest owners to obtain CFES. This finding indicates that forest owners had diverse motivations to demand CFES. This finding corresponds to forest owners' motivation to "learn from forest certification" (Overdevest & Rickenbach, 2006). Moreover, forest owners' MWTP ($0.32) for technical training of CFES was slightly higher than their MWTP ($0.29) to accessing to a global market for certified ecosystem services. Particularly, forest owners from emerging economies significantly preferred receiving technical training (Table 5.3). This preference also reflects forest owners' low technical capacity to manage ecosystem services.

Third, forest owners preferred access to g*lobal markets for certified ecosystem services*. Global market reach would provide access to a large number of potential consumers, thus potentially increased sales of ecosystem services. However, market scale is highly conditioned by legal frameworks and certain physical properties of ecosystem services (Chan et al., 2006;

Meijaard et al., 2011; Womble & Doyle, 2012). For instance, forest carbon is traded at the global level in voluntary carbon markets (Bayon et al., 2009) (Table 5.6). Atmospheric carbon dioxide is not physically contained and transcends national borders; the beneficiaries of climate change mitigation through forest carbon sequestration are global. On the other hand, forest watershed protection is regulated at regional, sub-national, or national scales (Pagiola et al., 2005; Porras et al., 2008; Wunder et al., 2008). Because water flows are contained in watersheds, the primary beneficiaries of improved water quality are those receiving water from managed watersheds. Consequently, those services traded only in regional markets would be challenged to generate sufficient demand for CFES, as forest owners dominantly preferred a global market to a national and regional market for certified services.

5.4.2 Challenges of CFES.

The results of the study elucidate three challenges to the generation and capture of market demand for CFES. First, the results indicate *low total welfare measures* for CFES in comparison with certification cost scenarios (Table 5.3 and Figure 5.4). The cost scenarios 2 ($1.60 per ha) and 3 ($1.92) are more likely than Scenario 1 ($1.28), considering the complexity of ecosystem services management (Bennett et al., 2009; MA, 2005; Meijaard et al., 2014). However, only a few certification scheme scenarios generated total welfare measures higher than the cost scenario 2 (D1, D2, D3, and D7) and scenario 3 (D1). The feasibility of these certification scenarios is currently uncertain due to the paucity of empirical studies on price premiums associated with certified services and service markets with limited global reach. Moreover, the challenge associated with the low welfare estimates is exacerbated by the fact that the current cost of forest certification is already not affordable to many forest owners, particularly in emerging economies

(Durst et al., 2006). Therefore, it is expected that high costs would inhibit market demand for CFES.

Second, forest owners would have *low technical capacity to manage ecosystem services*, implied by their stated preference for technical training (Table 5.3). This low capacity is also supported by lessons derived from PES and REDD+ schemes (Pagiola et al., 2005; Romijn et al., 2012; Wunder et al., 2008). For this reason, some PES schemes established their own technical training for forest stakeholders (Wunder et al., 2008; Gong et al., 2014). If CFES could take on this role, however, technical training would become a business opportunity, thereby potentially augmenting market demand.

Finally, despite efforts such as BBOP and VCS schemes, the lack of global market reach is unlikely to be overcome easily without the impetus of internationally binding mechanisms (e.g., the Kyoto Protocol) and/or a functional global voluntary market (e.g., voluntary forest carbon market).

5.4.3 Study limitations.

The study potentially entails a methodological risk of overestimating MWTP for the selected attributes. Our work may involve other potential biases due to the rather low response rate of the online survey (15.5%), one unbalanced attribute (or training for forest owners) in the choice experiment design, the introduction to forest owners of what is perceived by a new and complex concept, and the manually designed experimental design. Recognizing these risks, however, the researchers tried to reduce overestimates of MWTP by asking participants about their FSC forest certification costs in detail, as part of a payment vehicle. To help participants understand the concept of ecosystem services, the study asked their opinions over various

examples before the choice experiment questions. Despite the study's low response rate, the highly significant *p*-values of the mixed logit model strengthen the results (Table 5.3). The sample size of this study was still acceptable as each choice set had more than 20 participants (Louviere et al., 2000). The study also had one of the largest datasets of FSC forest management certificate holders used to date, surpassing previous FSC studies (e.g., Bowers et al., 2012; Carlsen et al., 2012; Kalonga et al., 2015; Overdevest & Rickenbach, 2006).

5.5 Conclusions

This chapter examined the FSC forest management certificate holders' demand for a possible expansion of the FSC system to certify ecosystem services management. FSC certificate holders represent the FSC's internal market, potential service sellers, and forest owners with certification experiences. The results indicated that financial benefit is their main motivation to participate in CFES: they preferred certification that provides a 50% price premium and global market research to sell certified ecosystem services. The findings also identified challenges in developing CFES: certificate holders had a low willingness to pay for certification; they were expected to have low technical capacity to manage services; and they had low demand for certification in regional and national markets. These findings reveal factors that may affect the marketability of CFES from the perspectives of FSC certificate holders.

Chapter 6: Certification of forest watershed services: A Q methodology analysis of opportunities and challenges in Lombok, Indonesia [26]

6.1 Introduction

A payment for watershed services (PWS) scheme is one of the target markets for certification of forest ecosystem services (CFES). In PWS, water users in the downstream or local government compensate upstream forest owners for providing forest watershed services to the downstream. These services include improved water quality, increased water quantity, and/or reduced flood risk (Landell-Mills & Porras, 2002; Wunder, 2005; Escobar et al., 2013). CFES may be able to improve PWS schemes by disclosing information on watershed services since, in practice, many of the schemes suffer from a lack of service information (Wunder, 2005; Wunder et al., 2008; Muradian et al., 2010; Hanley & White, 2014). To realize this potential benefit, however, the certification scheme needs to be perceived as beneficial by the PWS stakeholders, including sellers, buyers, and intermediaries, as these stakeholders determine certification adoption. Thus, the feasibility of CFES application to the PWS schemes is contingent on stakeholder perspectives. This chapter analyzes the PWS stakeholder perspectives on *certification of forest watershed services* (Figure 6.1) in West Lombok, Indonesia, as a case study using Q methodology.

[26] A version of Chapter 6 is published [Jaung, W., Putzel, L., Bull, G. Q., Kozak, R., & Markum. (2016). Certification of forest watershed services: A Q methodology analysis of opportunities and challenges in Lombok, Indonesia. *Ecosystem Services, 22, 51-59*.].

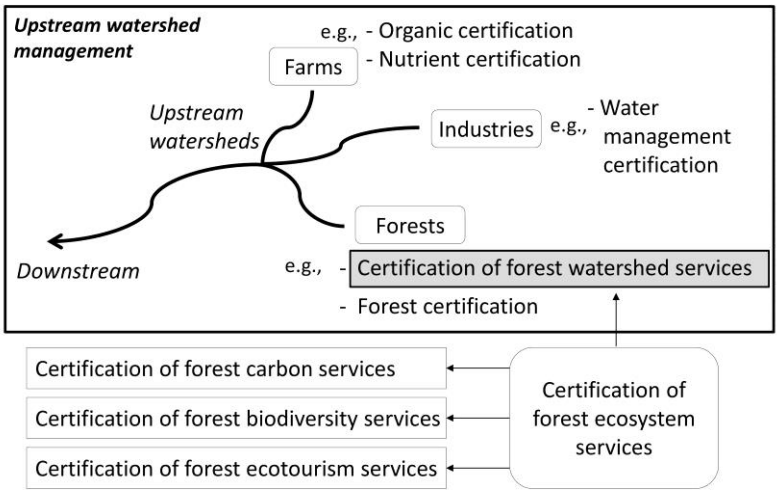


Figure 6.1 Certification of forest watershed services

6.2 Methods

6.2.1 Q methodology.

Q methodology is a qualitative-and-quantitative method designed to analyze subjective experience or key viewpoints of participants (Brown, 1986; Watts & Stenner, 2012; McKeown & Thomas, 2013). Developed by William Stephenson (1953), the method has been applied in diverse fields from environmental studies to psychology in order to examine stakeholder perceptions or discourses around specific topics (Barry & Proops, 1999; Watts & Stenner, 2005; Webler et al., 2009). Recently, Q methodology has been applied in many studies on ecosystem services and climate change (Lo, 2013; Armatas et al., 2014; Fisher & Brown, 2014; Schneider et al., 2015). A key strength of Q methodology is its systematic examination of holistic perspectives of participants by employing quantitative logic, which integrates hypothetico-deductive approach into Q methodology (Watts & Stenner, 2005; Webler et al., 2009).

The method involves the following steps: developing diverse statements on a subject (or Q statements); asking participants to sort these statements following a quasi-normal distribution (or Q sorts); examining correlations among Q sorts by using inverted factor analysis; extracting

dominant perspectives (or factors) from the correlations; and interpreting the extracted factors (Brown, 1986; Watts & Stenner, 2012; McKeown & Thomas, 2013). Our application of these steps for this study is detailed below.

6.2.2 Q statements.

A total of 48 Q statements were established, covering a wide range of challenges and opportunities of developing CFES (Table 6.2). The statements were based on online surveys of FSC experts and supporters, including FSC Network Partners, WWF-GFTN, Greenpeace, and on a literature review of enabling conditions of forest certification and eco-labels.

Following Dillman's tailored design (Dillman, 2011), two online surveys asked FSC experts and supporters about expected challenges and opportunities to developing the certification scheme based on their experience with FSC certification and knowledge of regional conditions. The first survey was conducted with the FSC Network Partners around the world from April 16 to 30, 2012. Contact emails were collected from the websites of the FSC and FSC Network Partners. 47 emails were sent out, two emails bounced back, and 18 responded from 18 different countries. The response rate was 40% (= 18/45). The second survey targeted the WWF-GFTN network, Greenpeace, and FSC supporters identified from the first analysis. The survey was conducted from July 10 to August 10, 2012. 72 email contacts were collected (WWF: 31, Greenpeace: 34, other agents: 7), and 25 responded. The response rate was 35% (= 25/72).

The literature on forest certification was reviewed in order to round out the range of previously mentioned challenges and opportunities into the Q statements (e.g., Auld & Bull, 2003; Rametsteiner & Simula, 2003; Kozak et al., 2004; Cashore et al., 2006; Durst et al., 2006; Chen et al., 2011a).

6.2.3 Study site and participants.

The study was conducted in West Lombok, Indonesia, where a well-known PWS scheme is being implemented (e.g., Prasetyo et al., 2009; Pirard, 2012b; Fauzi & Anna, 2013; Pirard et al., 2014; WWF, 2014) (Figure 6.2). On Lombok Island, the upstream forests in Mount Rinjani are major water catchment areas (Magdalena et al., 2013; WWF, 2014). These watersheds support the main water source of the island's piped water, managed by a local state water company, or PDAM (*Perusahaan Daerah Air Minum*). Piped water of PDAM Giri Menang is a major water source for the residents in Mataram City and West Lombok District. Historically, Lombok's upstream forests suffered from various deforestation activities resulting in a reduction of water quality and the disappearance of upstream springs (Prasetyo et al., 2009; Fauzi & Anna, 2013). Initiated in 2003, the PWS scheme aims to improve forest management and community livelihoods (WWF, 2014). The scheme is enforced by West Lombok government regulation (No. 4/2007) and managed by a multi-stakeholder institution called IMP (*Institusi Multi Pihak*). The IMP was established in 2007 for independent management of the PWS scheme and collected funding from the PWS buyers.

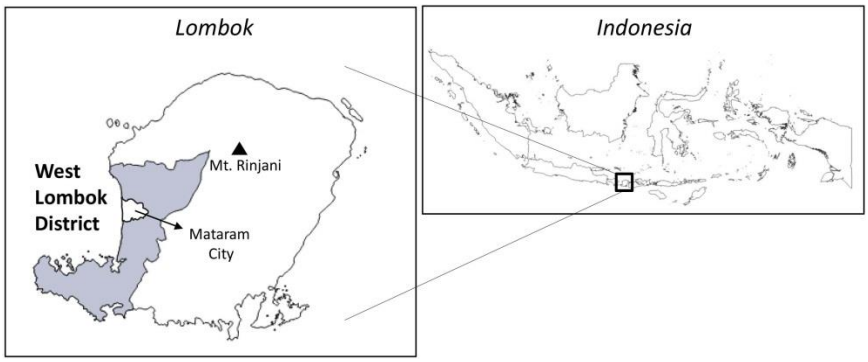


Figure 6.2 Study site, West Lombok in Indonesia

There are three major stakeholder groups in the PWS scheme: sellers, buyers, and intermediaries (Table 6.1). Key informants from these groups were interviewed for the Q methodology analysis. *The sellers* are upstream communities with forests (WWF, 2014). The study interviewed four village heads from upstream communities with PWS experience. *The buyers* are households and private businesses using water of PDAM Giri Menang in West Lombok[27]. The households and private businesses pay Rp. 1,000 (or USD 0.10) and Rp. 2,000 per month, respectively, for PWS ecosystem service fees (WWF, 2014). The fees are added to their PDAM water bills. The study interviewed six members of a water user association in West Lombok as key informants. The association was established in the early development stage of the PWS scheme whose objective was to represent the buyer group to the PWS scheme. Although its activities have been rather limited, the association obtained legal status in 2015 attempting to resume its activities. *The intermediaries* are members of the IMP. The IMP members consist of multiple institutions, such as the West Lombok Forest Service, the IMP office, PDAM Giri Menang, and the WWF-Nusa Tenggara office (WWF, 2014). The study interviewed seven members of the IMP. In addition to the IMP members, two participants from a local NGO, TRANSFORM, were also included in the study due to their expertise in the development history of PWS scheme and upstream forest watershed management in West Lombok.

[27] PDAM water users in Mataram City do not pay for the ecosystem service fees since they are not PWS buyers although their perceptions were studied in the initial development of the PWS scheme. Mataram City government allocated annual funds for the PWS scheme (e.g., 1 billion rupiahs, or USD 10,000, in 2013) (WWF, 2014). However, continuation of this govt funding is uncertain at the time of writing.

Table 6.1 Participants of the Q methodology analysis

PWS stakeholders (no.)	Descriptions
Sellers (4)	Village heads of the upstream communities
Buyers (6)	Members of the water user association
Intermediaries (9)	Officers from the IMP office Officers from PDAM Giri Menang Officers from the West Lombok Forest Service Officers from WWF-Nusa Tenggara Officers from TRANSFORM

A total of 25 participants joined the interviews, resulting in 25 corresponding Q sorts. However, only 19 of them were used for the study's data analysis since the researchers concluded that six of the participants (= 25 - 19) were ineligible as key informants because they lacked relevant information on PWS (five participants), or did not produce a Q sort of sufficient quality based on the researchers' judgment (one participant). In spite of this data reduction, 19 participants are not only acceptable for Q methodology but also fit the recommended ratio of participants to Q statements. Q methodology is not restrictive in terms of the size of the participants; highly effective Q studies can be conducted with small numbers of participants (Watts & Stenner, 2005). For Q methodology, Webler et al. (2009) recommend a ratio of 15 participants to 45 Q statements, which is close to our ration of 19 to 48.

6.2.4 Q sorts.

Before the interviews, participants received a brief presentation by a local facilitator about the PWS in West Lombok and about certification of forest watershed services. Later, participants were asked to sort the 48 Q statements on a quasi-normal distribution built for this study (Figure 6.3). The distribution featured a 13-point scale from +6 to -6. When sorting the 48 Q statements, participants were asked to use twelve labeled cups designed to reduce their

cognitive burden. First, they were asked to sort the Q statements into three cups labeled as "agree," "neutral," and "disagree." Later, these results were sorted into nine sub-categories by the participants. The sub-categories were "highly agree," "agree," and "less agree" for the results in the *agree* category; "positively neutral," "neutral," "negatively neutral" for the results in the *neutral* category; and "less disagree," "disagree," "highly disagree" for the results in the *disagree* category. After all the Q statements were sorted these sub-categories, the participants were asked to place the sort results on the distribution board following the researchers' guidance.

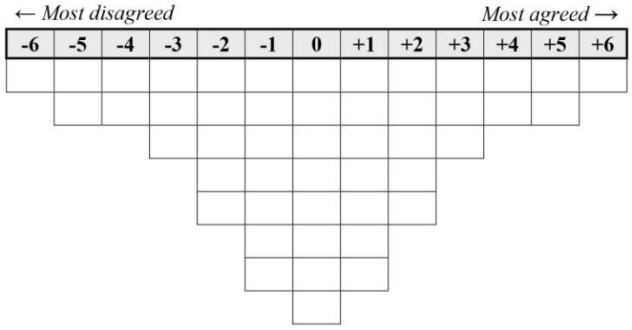


Figure 6.3 Quasi-normal distribution used for the Q sorts

6.2.5 Analytic procedures.

Collected Q sorts were analyzed with a Q methodology software, PQMethod 2.35 (Schmolck, 2014). Using the software, principal component analysis was conducted and its results were rotated using a varimax rotation. A number of factors (i.e., the perspectives) were chosen based on two criteria: 1) factors whose eigenvalues are higher than 1, following the Kaiser-Guttman criterion (Guttman, 1954; Kaiser, 1960) and 2) factors that load at least two Q sorts (Brown, 1980). The criteria resulted in three factors: *Factor A*, *B*, and *C*. The study selected Q sorts of those factors when factor loadings of Q sorts were significant at $p < 0.01$. In this study, factor loadings higher than 0.59 were significant at $p < 0.01$ based on an equation,

$2.58 \times \left(1/\sqrt{n}\right)$ (Brown, 1980; Watts & Stenner, 2012), where *n* is the number of Q sorts. After Q sorts of the three factor were chosen, z-scores of the 48 Q statements were calculated for *Factor A*, *B*, and *C*. These z-scores determined the Q statements' rankings (+6 to -6) with *Factor A*, *B*, and *C* on the quasi-normal distribution (Figure 6.3). These rankings of the Q statements were used to label and interpret *Factor A*, *B*, and *C* (Table 6.2).

Table 6.2 Statement rankings of *Factor A, B,* and *C*

		Factors		
Q statements		A	B	C
	Bundling of ecosystem services for certification			
1	I think watershed certification needs to manage forest carbon as well.	**1**	-4	-1
2	I think watershed certification needs to manage forest biodiversity as well.	**3**	**4**	0
3	I think watershed certification needs to manage forest ecotourism as well.	0	0	-1
4	I think watershed certification needs to manage timber as well.	-2	-6	-2
	Market demand for ecosystem services			
5	I think there would be buyers for forest carbon in Sesaot forests.	-3	0	-1
6	I think there would be buyers who pay for watershed protection in Sesaot forests.	-1	**2**	-4
7	I think there would be buyers who pay for biodiversity conservation in Sesaot forests.	-1	0	-6
8	I think there would be many ecotourists who want to experience Sesaot forests' biodiversity and culture.	**1**	0	0
	Types of information disclosure from certification			
9	I think watershed certification should improve the water quantity in the downstream.	**2**	0	0
10	I think watershed certification should tell buyers about the quality of certified water (e.g., pH level and temperature).	**2**	**2**	0
11	I think water buyers need to know the quality of water that they buy.	**3**	**2**	**6**
12	If our water comes from protected watersheds, people protecting these watershed should get economic benefits.	**1**	**3**	**2**
13	If our water comes from protected watersheds, biodiversity of these watersheds should be protected.	**4**	**3**	**2**
14	If our water comes from protected watersheds, people protecting these watersheds should get social benefits, such as reducing social conflicts over the watersheds.	**5**	**1**	**1**
	Buyers & certification			
15	I am often confused with many certification labels in the market.	-4	-2	**3**
16	I am usually not interested in knowing the meanings of certification labels on the water bottles that I am buying them.	-5	-4	-5
17	Meaning of a certificate label should be explained on the Internet to help buyers of certified products.	0	-5	**5**
18	I often feel hard to understand certification labels on water bottles but these labels must be still important.	-2	-2	**3**
19	A procedure to issue watershed certification in Lombok should be transparent to the public.	**6**	**3**	**2**
	Economic benefits from certification			
20	Certified water should not be more expensive than non-certified water.	-6	-1	**4**
21	Certified water should receive a price premium from water buyers.	-2	**1**	-5
22	Watershed certification should have a global market to sell certified water.	-1	-1	-3
23	Watershed certification should have a national market to sell certified water.	0	-3	-1
24	Watershed certification should have a regional market to sell certified water.	0	**1**	-2
	Non-economic benefits from certification			
25	Watershed certification should improve watershed management in the upstream.	**2**	**5**	**4**
26	Watershed certification should improve local communities' capacity to manage watersheds.	**3**	**6**	**2**
27	Watershed certification should support improving watershed regulations in Lombok.	0	-3	-3
28	Watershed certification should support improving water users' environmental perceptions on the upstream watersheds.	**4**	**1**	**1**

Table 6.2 Statement rankings of *Factor A, B,* and *C - continued*

Q statements		Factors A	B	C
	Certification cost			
29	Cost of watershed certification should be low.	-5	**1**	**1**
30	Certification's auditing cost should be low.	-3	**2**	**2**
31	If certification requires improving watershed management, the cost of this improvement should not be too high to forest owners.	-4	-2	-2
32	Certification initiatives should subsidize certification cost to keep the certification cost low.	-1	**1**	-1
33	NGOs should subsidize certification cost to reduce its cost.	-2	-1	-5
34	Governments should subsidize certification cost to reduce its cost.	0	0	5
	Certification system			
35	Watershed certification should be audited by an independent agent rather than by the upstream communities.	-1	-1	**1**
36	Watershed certification should provide special support for small forest holders.	**1**	-1	-3
37	Certification standards should provide well-established methods to forest owners if certification requires measuring water quality.	0	**1**	-1
38	Certification standards should allow forest owners to use their own methods to measure water quality if these methods are scientific enough.	-2	0	-4
39	Certification standards should be simple even if they are less scientific.	-3	**2**	0
40	Certification standards should be scientific although they might become a bit complicated.	0	-3	**1**
41	I think developing standards would be the main challenge of implementing watershed certification in Lombok.	-1	**1**	**2**
	Stakeholder capacity			
42	Watershed regulations are critical to implementing watershed certification.	**2**	**4**	0
43	Lombok has a secured watershed regulation.	**3**	-2	-2
44	Local governments need capacity building to support watershed certification technically and administratively.	**5**	-1	**1**
45	Local NGOs need capacity building to support watershed certification technically and administratively.	**1**	-1	0
46	Upstream forest holders need capacity building to implement watershed certification.	**1**	**5**	-1
47	Water users need more education to understand watershed certification.	-1	-2	-2
48	International organizations, such as UN and NGOs, should support watershed certification in Lombok technically and administratively.	**2**	0	-1

6.3 Results

Three factors were identified from the stakeholders of the PWS scheme in West Lombok, Indonesia (Table 6.2). These factors were: cautious anticipation of improvement in the PWS scheme associated with adoption of certification (*Factor A*); anticipation of benefits to upstream communities accrued through adoption of certification (*Factor B*); and skepticism about

certification in general (*Factor C*). These factors explained 51% of the total variance and loaded 14 participants out of the 19 participants. The remaining five participants yielded neither significant nor compounded loadings.

6.3.1 Factor A: Cautious anticipation of improvement in the PWS scheme associated with adoption of certification.

Factor A explained 28% of the total variance whose eigenvalue was 6.56, representing PWS stakeholders' major perceptions on certification of forest ecosystem services. Eight participants were loaded to the factor at a 1% significance level (0.59). Four participants were from the state intermediaries of the PWS scheme. The four other participants came from the association of water users.

Factor A represents cautious anticipation of improvement in the PWS scheme associated with adoption of certification. On the one hand, caution is required in the certification application process. Procedures of certification implementation should be transparent to the public (19: +6)[28]. The local government does not yet have sufficient administrative and technical capacity to support certification (44: +5). On the other hand, certification is expected to benefit to the PWS scheme, particularly through stakeholder capacity building. The certification scheme should improve PWS buyers' environmental knowledge, such as their understandings of forest watershed services, (28: +4) and PWS sellers' administrative and technical capacity to manage forest watersheds (26: +3). The certification scheme would be more beneficial by incorporating

[28] Here, 19 is a Q statement number (Table 6.2) and +6 is the Q statement's ranking in *Factor A*. This format is consistently applied in this paper.

disclosure of information on social safeguards (14: +5), environmental safeguards such as biodiversity (13: +4/ 2: +3), and water quality (11: +3) of upstream watersheds. Due to these expected benefits, the costs of certification should be bearable (20: -6/ 29: -5/ 30: -3) as long as certification delivers these values in a transparent way (19: +6).

6.3.2 Factor B: Anticipation of benefits to upstream communities accrued through adoption of certification.

Factor B explained 14% of the total variance with an eigenvalue of 1.87. Four participants were loaded at a 1% significant level. Three of them belonged to non-state intermediaries of the PWS scheme. One participant was from a village head of an upstream community.

Factor B represents anticipation of benefits to upstream communities accrued through adoption of certification. Certification needs to improve the upstream communities' capacity to manage forest watersheds (26: +6), which would consequently improve the upstream watershed management (25: +5). Disclosure of information on forest biodiversity is vital for certification (2: +4) because protection of forest biodiversity plays a significant role in forest watershed management (13: +3). However, it is important to notice that as yet the upstream communities do not have sufficient capacity to implement this certification scheme (46: +5). Therefore, certification standards should be simple and applicable by the upstream communities due to the communities' low capacity, even if scientific rigor of the standards might be compromised to some degree (39: +2 / 40: -3). It is recommended that certification incorporate economic safeguards of the upstream communities (12: +3). Certification costs, such as auditing cost,

should be affordable to the upstream communities (30: +2 / 29: +1), and a price premium for certified watershed services would benefit the upstream communities as well (21: +1/ 20: -1).

6.3.3 Factor C: Skepticism about certification in general.

Factor C accounted for 9 % of the total variance. Its eigenvalue was 1.46. Two participants were loaded at a 1% significance level: one was a member of the association of water users (or PWS buyers), while the other was a village head of an upstream community (or PWS sellers).

Factor C represents general skepticism about certification. It is critical for PWS buyers to know what improvement in water quality they are paying for (11: +6). Consequently, certification would be worthwhile only if certification successfully improves upstream watershed management (25: +4). Despite this benefit, the certification scheme should not increase the current ecosystem services fee of the PWS scheme (20: +4); thus, the government should subsidize adoption of certification and internalize its costs into the PWS scheme (34: +5). It is also important to stress that many buyers are often confused by many certification labels in the market (15: +3). It is also challenging for buyers to understand the meaning of these labels (18: +3). Thus, certification information should be publicly available through posted information on the Internet (17: +5).

6.4 Discussion

Our results support the existence of three predominant views (or factors) among stakeholders on the PWS scheme in West Lombok, Indonesia (Table 6.3). These factors and their

comparisons shed light on the holistic perspectives of stakeholders as to the opportunities and challenges in applying the certification scheme to the PWS scheme.

Table 6.3 PWS stakeholder perspectives on certification for forest watershed services

Perspectives	Challenges	Opportunities
Factor A: Cautious expectations to improve the PWS scheme	• Building transparent certification • Low stakeholder capacity • Securing international community support	• Improving stakeholder capacity • Disclosing information on watershed safeguards • Acceptance of certification costs • Disclosing information on service quality • Improving watershed management
Factor B: Expectations to benefit upstream	• Low upstream capacity • Building simple standards • Maintaining low certification costs	• Improving capacity of upstream communities • Improving watershed management • Disclosing information on biodiversity and economic watershed safeguards • Disclosing information on watershed services
Factor C: Skepticism on certification	• Internalizing certification costs • Buyer confusions about certification • Building scientific standards	• Disclosing information on watershed services • Improving watershed management

First, PWS stakeholders considered certification of forest watershed services as a capacity-building tool. It indicated that a price premium for certified watershed services would seldom be a criterion for PWS stakeholders to adopt the certification scheme. This motivation was supported by all the three factors. The only discrepancies among these factors were in the intended targets of capacity building and relative importance of their preferences. This motivation to "learn from certification" is also observable from other PWS schemes utilizing certification and forest owners obtaining forest certification. The PWS schemes in Kenya and Munich, for instance, indicate that organic certification can benefit their PWS implementation by building the capacity of upstream farmers (Alpine Convention, 2011; Firmian et al., 2011). It corresponds with previous work by Overdevest and Rickenbach (2006) asserting that one of the main motivations of forest owners to obtain forest certification was to benefit from its potential as a "learning mechanism."

However, the value attached to the potential to learn from certification does not mean that the incentive of a price premium for certified watershed services is insignificant. Rather it highlights that there are various motivations for PWS stakeholders to adopt certification of forest watershed services. A price premium is an important enabling condition for successful uptake of voluntary certification (Rametsteiner & Simula, 2003; Overdevest & Rickenbach, 2006; Chen et al., 2011a), and this was apparent in the results linked to *Factor B.* As a result, it is very likely that the absence of a price premium would inhibit implementation and uptake of this certification scheme, which confirms the view of Meijaard et al. (2011; 2014).

Second, certification of forest watershed services would depend on financial inputs of intermediaries of PWS schemes other than sellers and buyers. Theoretically, market-based certification depends on demand from both sellers and buyers. As direct customers, sellers pay for achieving certificates to capture a price premium for certified products. As indirect customers, buyers pay for a certified product so as to benefit from credible disclosure of information on product quality. However, our study identifies that PWS intermediaries are another source of demand for certification of forest watershed services, a finding supported by stakeholder perspectives on certification costs (Table 6.2 and Table 6.3). On the one hand, *Factor A* showed acceptance of certification costs. This rather unusual viewpoint would be partially explained by a strong motivation of stakeholders to learn from the certification scheme: they would be willing to cover certification costs if the certification scheme were to improve the PWS scheme. On the other hand, *Factor B* and *C* were against high certification costs. *Factor B* preferred low certification costs although it was somewhat tolerable to costs of improving watershed management for certification adoption (or indirect costs of certification). *Factor C* strongly preferred government subsidies on certification costs. As a result, these perspectives

suggest that one way to satisfy all three factors is adoption of certification with a financial support of PWS intermediaries. Of course, this would be the case only if intermediaries consider that certification values outweigh certification costs. The Munich water utility (or Stadtwerke München), for instance, supports all costs to farmers of adopting organic certification in order to benefit from the PWS scheme (Alpine Convention, 2011). The decision to provide this financial support was based on the facts that organic certification can help upstream farmers improve soil management and water quality (Grolleau & McCann, 2012) and that certification costs (0.01 euros per cubic meter of consumed tap water) are in fact lower than the expected costs of water purification (0.30 euros per cubic meter) (Alpine Convention, 2011).

Third, the need of PWS stakeholders for simple but scientific standards is a challenge for certification. Stakeholders had contradictory requests for certification standards. On the one hand, *Factor A* disagreed with sacrificing scientific rigor of standards for the sake of their simplicity. *Factor A* was also neutral in regards to increasing the complexity of standards in order to make them more scientific. In contrast, *Factor B* showed a preference for simple standards and opposed the introduction of complex standards. This challenge is addressed by Meijaard et al. (2011): scientific standards are vital for a certification scheme to effectively manage site-specific complexities of forest watersheds. But complex standards may discourage the participation of small forest holders who may not have the resources to decipher and implement them.

Fourth, forest biodiversity was considered an important component of certification of forest watershed services. PWS stakeholders were interested in the protection of forest biodiversity to improve watershed management despite their pessimistic views on a market for biodiversity. This indicates that they consider forest biodiversity as a strategy to improve forest

watersheds rather than as the foundation for tradable biodiversity credits in the market. The early history of the PWS scheme in West Lombok sheds some light on this perspective. The PWS scheme was initially launched to reduce upstream deforestation in Lombok when deforestation was found to be the main cause of the rapid disappearance of upstream springs (Prasetyo et al., 2009; Fauzi & Anna, 2013). The interest in biodiversity also suggests potential synergies between forest certification and certification of forest watershed services; FSC forest certification, for example, has a special emphasis on forest management that conserves biodiversity such as High Conservation Value Forest (HCFV) (Cashore et al., 2006).

Indeed, these opportunities and challenges of certification of forest watershed services are not conclusive. Because the characteristics of forest watersheds are diverse and site-specific (Meijaard et al., 2011), it is hard to reject the possibility that stakeholders in PWS schemes elsewhere exposed to different socio-ecological conditions and they would see the questions differently. In spite of these limitations, the study successfully shows that there is a diversity of viewpoints among PWS stakeholders with regard to the certification scheme. Some of our findings are also unexpected considering the literature (Meijaard et al., 2011; 2014) (e.g., the role of certification in capacity building as a motivating feature for stakeholders). These new findings advance the state of our knowledge as to the factors affecting feasibility in implementation of certification of forest watershed services.

6.5 Conclusions

This study explored the challenges and opportunities of applying certification of forest watershed services by investigating a PWS scheme in West Lombok, Indonesia. A Q methodology analysis revealed three dominant perspectives (or factors) of the PWS stakeholders:

cautious anticipation of improvement in the PWS scheme was associated with adoption of certification; anticipation of benefits to the upstream communities was accrued through adoption of certification; and skepticism existed about certification in general. These factors revealed several opportunities and challenges for the potential certification. The opportunities include the view that stakeholders were interested in the certification scheme as a capacity-building tool. The challenges include the need for simple but scientific certification standards, the existing confusion about the meaning of certification labels in the market, and the concerns about transparency. These opportunities and challenges contribute to the analysis of the feasibility of applying CFES to a PWS scheme.

Chapter 7: Estimating demand for certified watershed services: A choice experiment with water buyers in Lombok, Indonesia

7.1 Introduction

Applying certification of forest watershed services to a payment for watershed services (PWS) scheme requires the service buyers' demand for certified services. The demand of PWS buyers is a major influence of the level of price premiums for certified watershed services, and in turn, affects the PWS sellers' adoption of certification. Nevertheless, prior studies that inform the FSC's deliberations predict a low demand for CFES due to the mandatory participation of buyers in many PWS schemes and the limited market scope (Meijaard et al., 2011, 2014). Despite this expectation, PWS buyer demand for certified watershed services has never been empirically tested. Thus, this chapter tests the existence of this demand by means of a choice experiment conducted among PWS buyers in West Lombok, Indonesia.

7.2 Attributes of certification of forest watershed services

Since certification of forest watershed services is a potential scheme, one possible way to evaluate its market demand is to elicit stated-preferences of PWS buyers over expected features (or attributes) of the certification scheme. From the buyers' perspectives, certification attributes would consist of benefits, credibility, and prices of the certification scheme. Thus, the study focuses on attributes related to 1) types of disclosed information on provisions of watershed services; 2) types of disclosed information on forest safeguards; 3) types of standard developers; and 4) prices of certified watershed services (Figure 7.1).

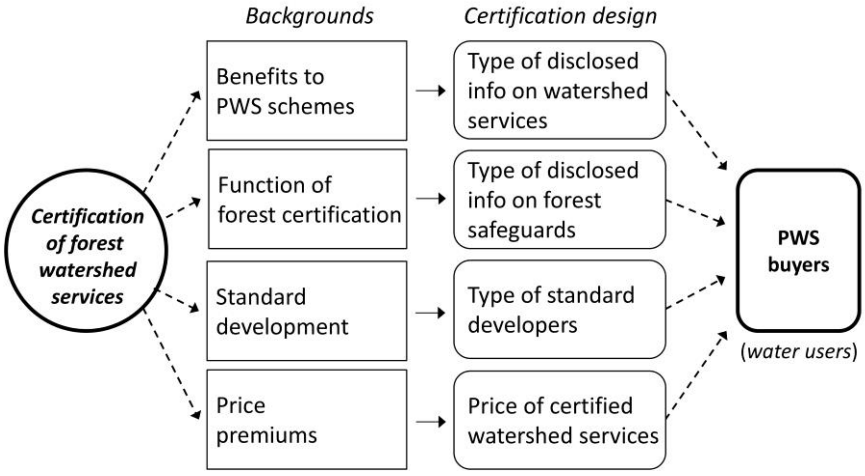


Figure 7.1 Potential design of certification of forest watershed services

First, disclosure of information on the provision of watershed services is an expected benefit of the certification scheme as it intends to target PWS schemes. The types of information entail improved water quality, increased water quantity, or reduced a flood risk by PWS schemes since the provision of these services is main objectives of PWS schemes (Landell-Mills & Porras, 2002; Wunder, 2005; Escobar et al., 2013). In practice, many PWS schemes fail to deliver such information to buyers (Ferraro, 2008; Muradian et al., 2010; Wunder et al., 2008). The failure of information delivery causes incomplete- or asymmetric- information exchange between PWS buyers and sellers (Ferraro, 2008; Hanley & White, 2014), and weakens buyers' capacity to influence PWS schemes (or buyer-side conditionality) and their demand for PWS schemes. The problem increases transaction costs and undermines the cost efficiency of PWS schemes (Ferraro, 2008; Hanley & White, 2014; Wunder, 2015). Certification has been a conventional approach to disclosing incomplete information in markets (Busch, 2011; Dranove & Jin, 2010). Thus, the disclosure of service information is an expected benefit of certification of forest watershed services to PWS schemes.

Second, disclosure of information on forest safeguards is another expected benefit of the certification scheme since the study assumes that the scheme relies on the FSC system. The FSC forest management certification concentrates on social, economic, and environmental perspectives of sustainable forest management (Auld & Bull, 2003; Cashore et al., 2006). The disclosure of information on these forest safeguards is the FSC's main business values (or benefits to the market). FSC labels intend to benefit buyers of certified wood product who concern about wood products' environmental impacts on forests by allowing them to distinguish certified and non-certified wood products (Aguilar & Vlosky, 2007; Aguilar & Cai, 2010; Thompson et al., 2010). Moreover, the disclosure of information on forest safeguards represents collective benefits to a society whereas the disclosure of information on watershed services represents buyer-specific benefits.

Third, a type of a standard developer (e.g., NGO vs govt) is a potential attribute of the certification scheme as the developer could affect the credibility of certification. An expansion of FSC to forest watershed services is expected to be based on case-by-case regional watershed standards, according to the case of the FSC expansion to non-timber forest products (NTFPs) (Pierce et al., 2008). Since various stakeholder groups exist with PWS schemes (Landell-Mills & Porras, 2002; Wunder et al., 2008), the standard development would be led by- or collaborated with- various stakeholders. For example, standards would rely on watershed standards from an international organization (e.g., AWS, 2013), watershed regulations of a local government (e.g., water quality trading programs in the US), watershed management tools (e.g., modelling) used by a local NGOs, or traditional watershed management of upstream communities. Therefore, it is necessary to understand which stakeholders would be credible to PWS buyers as standard

developers since buyer participation and their demand are a vital enabling condition for uptakes of voluntary certification (Carlsen et al., 2012; Durst et al., 2006).

Fourth, a price of certified watershed services must be a major attribute of the certification scheme from the PWS buyers' perspectives. The price can be either an opportunity or challenge to certification uptake, depending on how much buyers value the certified services. One the one hand, if buyers are willing to pay more for certified watershed services than non-certified services, there would be a high chance for certified services to generate price premiums. Price premiums are known to be the main motivation for forest owners to certify their wood products (Carlsen et al., 2012; Overdevest & Rickenbach, 2006); thus, high price premiums are expected to motivate PWS sellers (or forest owners) to certify their watershed services. On the other hand, if certified services do not benefit PWS buyers compared to non-certified services, no price premium would exist for certified services. A lack of price premiums could certainly limit certification uptake, as demonstrated by research on forest certification (Durst et al., 2006). Therefore, it is critical to examine the degrees of PWS buyers' willingness to pay for certified forest watershed services.

7.3 Methods

7.3.1 Choice experiment.

This study employed a choice experiment to examine the potential demand for certification of forest watershed services from PWS buyers in West Lombok, Indonesia. A choice experiment is a stated preferences technique designed to elicit individuals' preferences (Adamowicz et al., 1998; Bateman et al., 2002; Kanninen, 2007; Louviere et al., 2000). The technique is increasingly applied to a wide-range of disciplines, including environmental science,

agricultural economics, health economics, tourism, and transport science (Hensher, 2014). A choice experiment was used with the following steps: development of a random utility model for certification of forest watershed services; identification of certification attributes; development of an experimental design based on the attributes; choice experiment surveys in West Lombok; and establishment of multinomial logit models based on the collected data.

Following Train (2009), a random utility model of PWS buyers was established and expressed as Equation 7.1:

$$U_{ni} = V_{ni} + \varepsilon_{ni} \; \forall j \tag{7.1}$$

U_{ni} is the random utility of a buyer n with certification scheme i. This utility is the sum of V_{ni} and ε_{ni}, where V_{ni} indicates a buyer's observable random utility and ε_{ni} denotes her unobservable random utility. Assuming this buyer is a rational decision maker, she will select a certification scheme that maximizes her random utility. If there are J certification schemes for forest watershed services, a buyer would choose the scheme i which provides the highest random utility among the J number of certification schemes. Using maximum likelihood estimation, the probability for this PWS buyer to prefer the scheme i to the scheme j can be demonstrated as:

$$P_{ni} = \text{Prob}(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj} \quad \forall j \neq i) \tag{7.2}$$

$$= \int_{\varepsilon} I\left(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj} \; \forall j \neq i\right) f(\varepsilon_n) d\varepsilon_n$$

$I(\cdot)$ is a probability function. $f(\cdot)$ which demonstrates a distribution function of ε_n. Once $f(\varepsilon_n)$ is logistically distributed, this probability can be expressed as:

$$P_{ni} = \frac{\exp^{Vni}}{\sum_j \exp^{Vnj}} \tag{7.3}$$

With a multinomial logit model, ε_n is assumed to be independently and identically distributed (iid) as an extreme value type 1 distribution. In the literature, the iid assumption is tested by the Hausman-McFadden test (Hausman & McFadden, 1984).

In this study, variables of multinomial logit models were based on effects-coding[29], except for the alternative specific constant (*ASC*) and *PWS price* variable. Consequently, marginal willingness to pay (MWTP) for the effects-coded variables was estimated by:

$$MWTP = \frac{(\beta_k - \beta_{k0})}{-\beta_c} \tag{7.4}$$

where β_k is a coefficient of an attribute for the welfare measure (e.g., *Water_qual*), β_{k0} is a coefficient of a baseline level for β_k, and β_c is the coefficient of *PWS price* (Table 7.1). β_c was assumed as a constant rather than a mean of a random variable in order to avoid a singularity from dividing taste variables (β_k) by a random variable (Train & Weeks, 2005). β_k was subtracted by β_{k0} to transform effects-coded coefficients to dummy-coded coefficients. The confidence intervals of the MWTP estimates were derived using the Delta method (Hole, 2007).

Two statistical software programs were utilized. SAS 9.3 was used to generate the fractional factorial experimental design. Econometric estimations were computed by R 3.0.2. The multinomial logit model was estimated with support of R package mlogit (Croissant, 2013).

[29] Effects-coding allows coding non-linear effects of attribute levels that are not confounded with the grand mean (Hensher et al, 2005). With dummy coding, for example, a discrete variable having values of "high" and "low" would be coded with a dummy variable whose values are either 1 (e.g., high) or 0 (e.g., low). In this case, the grand mean of these two values are confounded with 1 (or high). Meanwhile, with effects-coding, the variable has 1 for high and -1 for low so that the grand mean can be zero.

7.3.2 Survey site.

Lombok Island in Indonesia was selected for the study (Figure 7.2). The study particularly focused on West Lombok Regency, where a well-known PWS scheme has been implemented since 2003 (WWF, 2014). Many studies are available on the scheme (e.g., Fauzi & Anna, 2013; Pirard, 2012b; Pirard et al., 2014; Prasetyo et al., 2009; WWF, 2014). Major stakeholder groups of the PWS scheme are divided into intermediaries, buyers, and sellers.

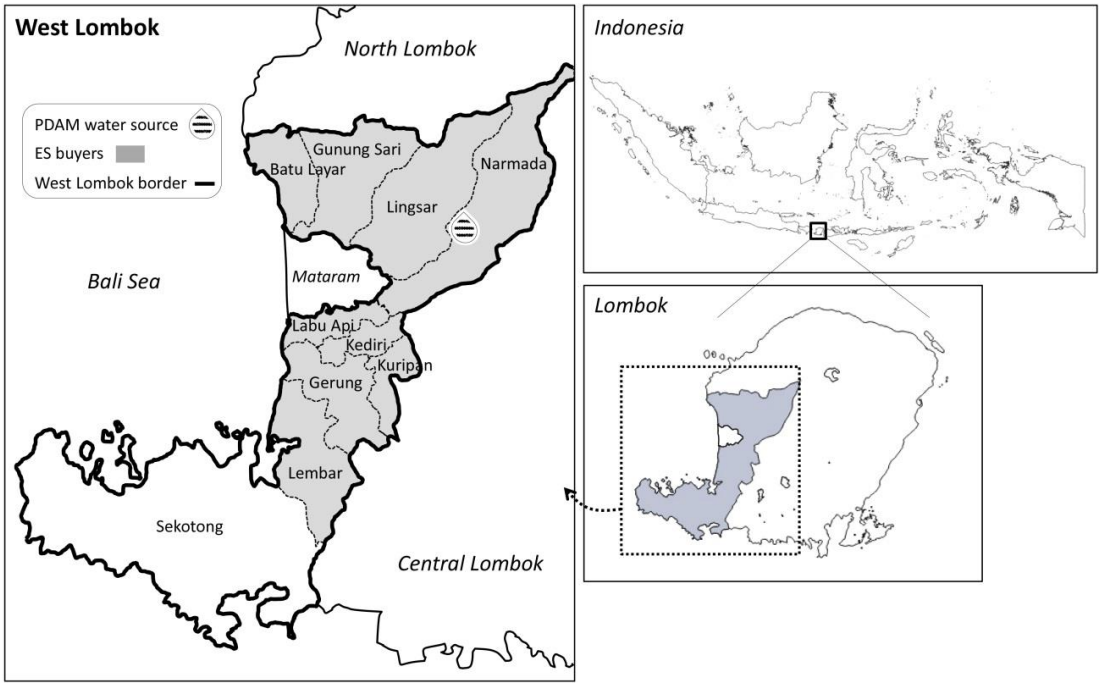


Figure 7.2 West Lombok, Indonesia

The PWS intermediaries are a multi-stakeholder institute (or IMP) (WWF, 2014). The IMP was established in 2007 by West Lombok government's ecosystem services regulation (No. 4/2007) for independent PWS scheme management, including PWS funding. As an independent agent, the IMP has members from government agencies, NGOs, and a local state water company (or PDAM Menang Giri). The regulation (No. 4/2007) requires the IMP to use 75% of the PWS funding for ecosystem services management and economic benefits for upstream communities

and 25% as an overhead of the PWS management. Other roles of the IMP include receiving and approving forest management proposals from upstream communities (or PWS sellers), and monitoring proposed activities. Thus, the IMP directly interacts with PWS sellers on behalf of PWS buyers.

The PWS buyers consist of three groups: (a) household-level water users in West Lombok, (b) business-level water users in West Lombok, and (c) the government of Mataram City (WWF, 2014). In West Lombok, households using piped water pay Rp.1,000 (or US$0.07)[30] each month to the water company as an ecosystem services fee. Business-level water users (e.g., hotels) pay Rp.2,000 each month. These ecosystem services fees[31] have been charged on water bills since 2009. These fees are enforced by the ecosystem services regulation (No. 4/2007). Participation in the PWS scheme is therefore mandatory (Pirard, 2012b; Fauzi & Anna, 2013) to household-level and business-level buyers in West Lombok. The government of Mataram City is acting as a PWS buyer on the behalf of the city's piped water users (WWF, 2014). Unlike the buyers in West Lombok, the city's ecosystem services fees are on a voluntary and annual basis. In 2013, for example, the city provided 1 billion rupiahs (or US$ 73,354) for the PWS scheme.

The PWS sellers are upstream communities (WWF, 2014). To join the PWS scheme, they can submit forest management proposals to the IMP. The PWS scheme is considered voluntary to the PWS sellers (Pirard, 2012b). Once their proposals are accepted, the IMP disburses the PWS funding for proposed activities (WWF, 2014). So far 24 communities from 12 upstream

[30] The currency is based on the moment of the field survey in Lombok. As of March 2015, a parking fee for a motorbike was Rp. 1,000. A water bottle of 600 *ml* cost between Rp. 2,000 to Rp. 3,000.
[31] Between 2010 and 2013, a total of the collected fund was about Rp. 1,915,057,016 (or US$ 134,053,991) (WWF, 2014).

villages have participated in the PWS scheme. Those communities are located in the districts of Batu Layar, Gunug Sari, Lingsar, and Narmada (Figure 7.2). It is reported that each community received between 30 to 80 million rupiah. As of November 2013, a total of 650 ha of upstream lands were targeted for forest restoration activities using the PWS fund which also provided business management training to upstream communities.

7.3.3 Choice experiment design.

Certification attributes were identified through a literature review of PWS and forest certification and three focus group discussions (FDGs) with PWS stakeholders in West Lombok. The details of the literature are discussed in Section 2. The FDGs were conducted with buyers, sellers, and intermediaries of the PWS scheme. These FDGs were separated to reduce the effect of power imbalance among the PWS stakeholders. *The buyer group* consisted of members of a water consumer association in Lombok. The association was established in the early stage of the PWS scheme to represent the downstream water users. *The seller group* was upstream communities who provide forest watershed services. *The intermediary group* included members of a multi-stakeholder institution (or IMP) which was established for independent management of PWS funds (WWF, 2014). At the beginning of each FGD, a facilitator presented background information about certification of forest watershed services. The participants were asked to discuss about expected benefits and challenges of the certification scheme based on their PWS experiences.

As a result, four certification attributes were defined (Table 7.1). Since PWS buyers were the target of the choice experiment, the attributes mainly reflected their perspectives although the attributes were addressed by the PWS intermediaries and sellers as well. *The first attribute*

relates to information disclosure on the provision of watershed services. The attribute provides information on water quality, water quantity, or a flood risk of forest watersheds. *The second attribute* relates to information disclosure on forest safeguards. The attribute captures social safeguards (e.g., mitigation of water-related conflicts), economic safeguards (e.g., support of local communities), and environmental safeguards (e.g., forest restoration) of forest cover in watersheds. *The third attribute* relates to suitability of institutions as standard developers. The attribute consists of an international organization, the Indonesian government, a non-governmental organization (NGO) in Indonesia, or upstream communities in Lombok. *The fourth attribute* relates to prices for certified watershed services. The attribute was a payment vehicle of the choice experiment. The fees were in Indonesia Rupiah (Rp.). Resulted from the FGDs of PWS stakeholders, the range of the fees was defined as Rp.1,000, Rp.6,000, Rp.11,000, and Rp.16,000. For the sake of simplicity[32] of the survey questions, these prices were presented as ecosystem services fees instead of price premiums of certified services. The current ecosystem services fee is Rp.1,000 (or US$0.07) per month in West Lombok (WWF, 2014) which made price premiums in a range of Rp.0, Rp.5,000, Rp.10,000, and Rp.15,000 (= Rp.16,000 – Rp.1,000). The zero price premium (or Rp.0) was a realistic and important scenario of the certification scheme as many voluntary certification schemes do not always generate price premiums including FSC forest certification itself (Cashore et al., 2006; Durst et al., 2006). Depending on market conditions, therefore, buyers could encounter certified products with no price premiums.

[32] Because the ecosystem services (ES) fee (Rp. 1,000) existed on buyers' water bills, survey questions became much simpler by presenting total ES fees increased by certification compared to presenting price premiums for certified ES. With price premiums, participants would have calculated their total ES fees since the total fee is a sum of the current ES fee and a price premium for certified ES.

Table 7.1 Attributes of certification of forest watershed services

	Attribute [a]	Level	Coded name
(1)	Information disclosure on watershed services	- Not provided - Water quality - Water quantity - Flood risk	Water_none [b] Water_qual Water_quan Water_flood
(2)	Information disclosure on forest safeguards	- Not provided - Economic safeguards - Social safeguards - Environmental safeguards	Safegu_none [b] Safegu_econ Safegu_socio Safegu_enviro
(3)	Suitability of institutions as standard developers	- International organization - Indonesian government - NGO in Indonesia - Upstream communities	Devel_int [b] Devel_govt Devel_NGO Devel_commu
(4)	Ecosystem services fees increased by certification	- Rp. 1,000 [c] - Rp. 6,000 - Rp. 11,000 - Rp. 16,000	PWS price

[a] All the attributes had effects coding except for the fourth attribute (ES fee).
[b] Baselines of effects coding.
[c] Indonesian Rupiah (Rp.) 1,000 is US$0.07 as of November 2015.

An experimental design was used to establish choice experiment questions featuring the four attributes. A total of 32 choice experiment questions (or choice sets) were generated by using a fractional factorial design (Louviere et al., 2000; Kuhfeld, 2010). The experimental design's *D*-deficiency was 100%. Each set had three choices: Certificate 1, Certificate 2, and none of them (or *status quo*) (Figure 7.3). The 32 sets were divided into four blocks, each containing 8 sets (32 sets = 4 blocks × 8 sets). Each participant was asked to complete one block, or 8 sets. The orders of 8 sets in each block were shuffled once in two or three days during the surveys to minimize any set-order effects on participants' responses. The established choice experiment survey was pre-tested and revised in West Lombok.

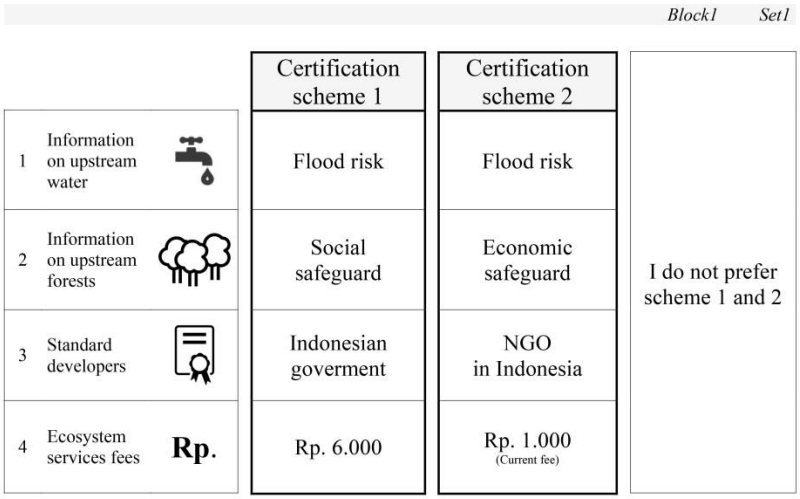


Figure 7.3 Example of choice experiment questions

Although a widely applied research methodology, a choice experiment requires many efforts in its survey design and conduct to minimize any potential biases (Bateman et al., 2002; Kanninen, 2007). Consequently, several of these efforts were made in the study. First, the payment vehicle in the choice experiment was designed with participants' real ecosystem services (ES) fee (or Rp.1,000) rather than using hypothetical price premiums of certification. Second, participants' water bills were used to explain the ES fee and certification so that participants could visualize ES fees and potential impacts of certification on their ES fees. Third, the survey enumerators provided presentations (Figure 7.4) to each participant about the PWS scheme and certification before the choice experiment was conducted as the topics were considered new to many participants. Fourth, emphases were made to participants that their choices of high-ES-fee certification schemes could actually increase their ES fees because study results would be shared with decision makers of the PWS scheme (e.g., intermediaries) as the study was collaborated with them. Fifth, the enumerators reminded participants of ES fees in the choice experiment questions whenever participants select designs with ES fees higher than the

current ES fee (or Rp. 1,000). Sixth, participants were asked to explain the reasons behind their choices to prevent random responses.

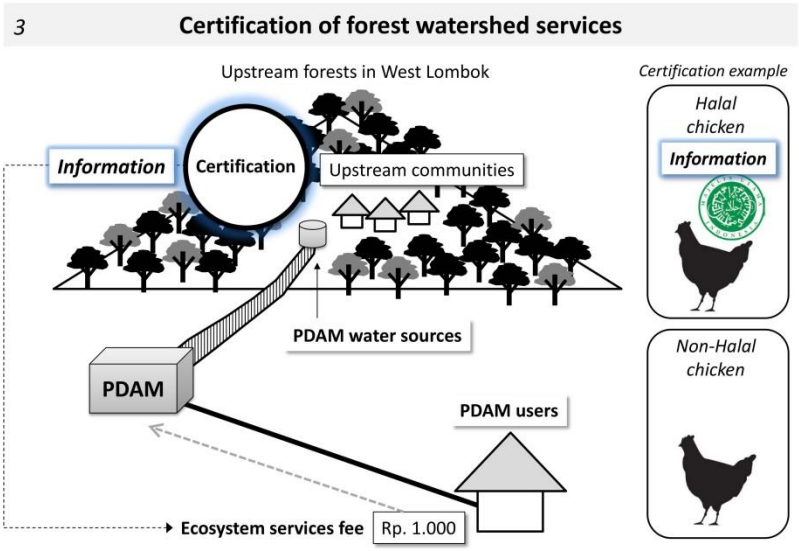


Figure 7.4 An example side presented to survey participants

7.3.4 Survey administration.

Household-level PWS buyers were surveyed in West Lombok. A total of 606 households participated in face-to-face household surveys from March to May 2015. Only households using PDAM pay the extra PWS fee. Their contact information was collected through PDAM Menang Giri and its district offices in West Lombok. There were about 35,000 households who participate in the PWS scheme. Two-stage cluster sampling was employed as a random sampling method. The first stage random sampling was based on sub-villages (or *dusun* in Indonesian). The second stage random sampling was based on household-level PWS buyers (or *rumah tangga*). Sub-villages with more than 100 PWS buyers were divided into smaller groups. If a sub-village *X* had 200 buyers, for example, the buyers were divided into two groups labeled as a

sub-village *X1* (with 100 buyers) and a sub-village *X2* (with 100 buyers). In this way, sub-village *X* with 200 buyers was twice as likely to be randomly selected compared to a sub-village *Y* with 100 buyers. Thus, the random selection process reflected the relative proportions of buyer populations in the sub-villages. A total of six local enumerators conducted the household surveys. All of them received sufficient training before the surveys. All were capable of speaking both Indonesian and a local language in Lombok (or Sasak language). The surveys were mainly conducted in Indonesian, but Sasak language was used if participants preferred. Locations and descriptions of surveyed participants are illustrated in Table 7.2 and Table 7.3.

Table 7.2 Sample distribution in West Lombok

	Districts	Villages (no.)	Sub-villages (no.)	Households (no.)
1	Narmada	9	11	126
2	Labu Api	7	12	112
3	Gerung	6	11	111
4	Kediri	6	6	57
5	Gunung Sari	5	7	55
6	Batu Layar	3	5	45
7	Lembar	3	4	41
8	Kuripan	2	4	32
9	Lingsar	2	2	18
10	Mataram *	1	1	9
	Total	44	63	606

* Mataram City is not in West Lombok (Figure 7.2). However, some PWS buyers existed in Mataram City near the border of West Lombok due to boundary changes between Mataram City and West Lombok. The study found that unfortunately these changes have not been reflected into the PWS scheme yet.

Table 7.3 Descriptions of survey participants

Variable	Mean	Std.
Age (yr.)	37.41	11.57
Female (1: yes, 0: no)	0.65	0.51
Education (yr.)	9.58	4.43
University degree (1: yes, 0: no)	0.14	0.34
Household members (no.)	4.42	1.50
Urban resident (1: yes, 0: no)	0.25	0.43
Aware of a PWS fee (1: yes, 0: no)	0.30	0.46
PWS knowledge (1: low - 5: high)	2.08	1.89
Monthly income (Rp.)	1,936,000	2,586,308
Monthly water bill (Rp.)	52,883	38,997

7.4 Results

Two multinomial logit models were established (Table 7.4). Model 1 was based on certification attributes only. Model 2 included socio-demographic variables of the participants. In both models, all of the variables were significant at 1% level, except for *Water_quan* and *Safegu_econ*. Model 1 and 2 obtained 0.43 and 0.4 of McFadden Pseudo-R^2 values which had values equivalent to 0.70 to 0.80 of R^2; both models achieved high goodness of fit (Hensher et al., 2005). Both models also met an assumption that unobserved utilities (ε_n) were independently and identically distributed (iid), supported by the Hausman-McFadden test (Hausman & McFadden, 1984). The test's *p*-values were significant at 1% level. Consequently, the models did not fit into any random distributions significantly in the data analysis. Thus, the study does not adopt mixed logit models (or random parameter models). Study results were interpreted based on Model 2 since the model integrated covariates and achieved better statistical results.

Table 7.4 Results of multinomial logit models

	Model 1		Model 2	
Variables	Coeff.	Std. error	Coeff.	Std. error
ASC	1.776 ***	0.059	1.449 ***	0.125
Water_qual	0.477 ***	0.059	0.482 ***	0.059
Water_quan	0.052	0.068	0.046	0.069
Water_flood	0.314 ***	0.064	0.322 ***	0.065
Safegu_econ	-0.029	0.053	-0.029	0.053
Safegu_socio	0.164 ***	0.061	0.168 ***	0.062
Safegu_enviro	0.326 ***	0.057	0.328 ***	0.057
Devel_govt	0.363 ***	0.057	0.366 ***	0.058
Devel_NGO	-0.420 ***	0.064	-0.430 ***	0.064
Devel_commu	-0.151 ***	0.059	-0.152 ***	0.059
PWS price	0.000 *** †	0.000	0.000 *** ††	0.000
SocioDemographic variables				
Income			0.043 ***	0.009
University			0.156 ***	0.059
PWS_knowledg			0.081 ***	0.028
McFadden Pseudo-R^2	0.43		0.44	
LL	-2858.60		-2825.30	

*** Significant at 1% significance level
† Rounded from -4.1790e-04
†† Rounded from -4.2296e-04

Model 2 illustrated how certification attributes and socio-demographic variable affected part-worth utilities of buyers in the PWS scheme in West Lombok. The part-worth utilities (or coefficients) cannot be directly compared unless they are under the same groups of effects-coding (Table 7.1). For instance, a comparison of the part-worth utilities of *Water_qual*, *Water_quan*, and *Water_flood* is feasible because their utilities were estimated in comparison with the same baseline (or *Water_none*). However, a comparison of the part-worth utilities between *Water_qual* and *Safegu_enviro* is not feasible since their utilities rely on different baselines (or *Water_none* and *Safegu_none*). For the same reason, the part-worth utilizes under standard developers should be interpreted in comparison with an international organization (or *Devel_int*).

Despite these limitations, positive and negative signs of part-worth utilities can illustrate whether variables increased (+) or decreased (–) buyers' utilities. For example, the buyers' utilities increased as the certification scheme discloses information on water quality (*Water_qual*), a flood risk (*Water_flood*), environmental safeguards (*Safegu_enviro*), and social safeguards (*Safegu_socio*) of forest watersheds (Table 7.4). Certification standards developed by the Indonesian government (*Devel_govt*) were more preferred than those developed by an international organization (*Devel_int*). However, standards from an NGO in Indonesia (*Devel_NGO*) and upstream communities (*Devel_commu*) were less preferred than those from an international organization. An increase in *PWS price* reduced the buyers' utilities but at a considerably low degree (-4.2296e-04). The certification scheme also increased buyers' utilities when they had higher incomes (*Income*), a university degree (*University*), and a better understanding of PWS (*PWS_knowledg*).

Part-worth utilities were also compared in each certification attribute (Figure 7.5). Buyers preferred water quality information (*Water_qual*) to flood risk information (*Water_flood*). They preferred environmental safeguard information (*Safegu_enviro*) to social safeguard information (*Safegu_socio*). Although not statistically significant, the part-worth utility of economic safeguards (*Safegu_econ*) was negative. This indicates that economic safeguard information was not a strong interest of PWS buyers.

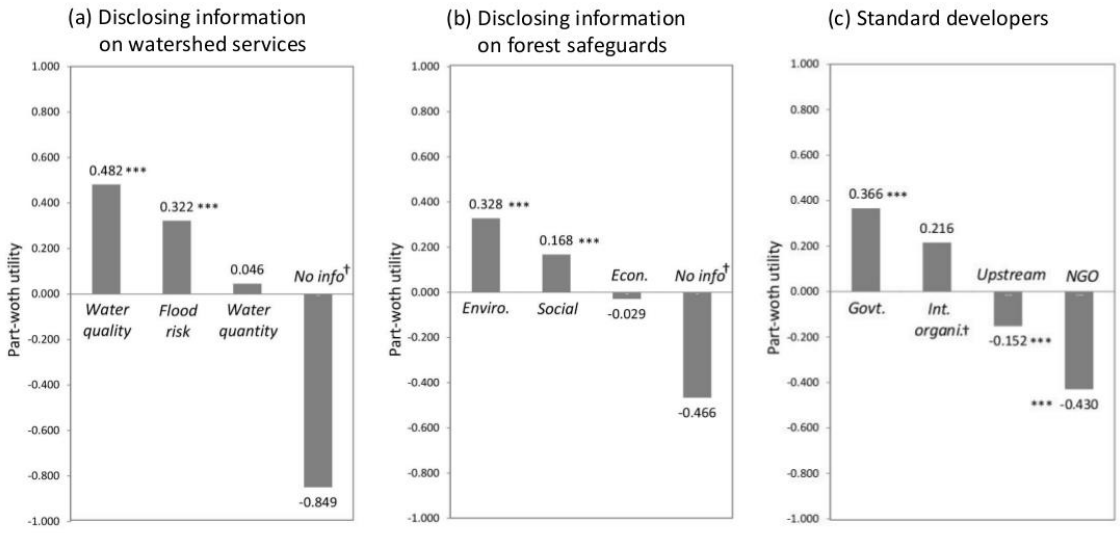


Figure 7.5 Comparisons of buyers' part-worth utilities for certification

*** Significant at 1% significance level
† Effects code baseline

PWS buyers' marginal willingness to pay (MWTP) estimates[33] were compared over the disclosed information on watershed services (or Attribute 1) and information on forest safeguards (or Attribute 2) (Figure 7.6). These attributes represent both different benefits of certification to a PWS scheme, interpreted as business values of certification to the market. The MWTP estimates showed that the buyer preferences for information on watershed services outweighed information on safeguard information. Furthermore, their MWTP estimates for both types of information were higher than the current ES fee. These welfare estimates empirically supported the existence of potential demand for certification of forest watershed services from PWS buyers.

[33] MWTP estimates for standard developers (or Attribute 3) were Rp. 356 for Indonesian govt (*Devel_govt*), -Rp. 1,526 for NGOs in Indonesia (*Devel_NGO*), and -Rp. 869 for upstream communities (*Devel_commu*). However, interpretations of these MWTP estimates are not straightforward since they were measured in comparison with international organizations (*Devel_int*). Thus, these MWTP estimates are not discussed in Figure 7.6.

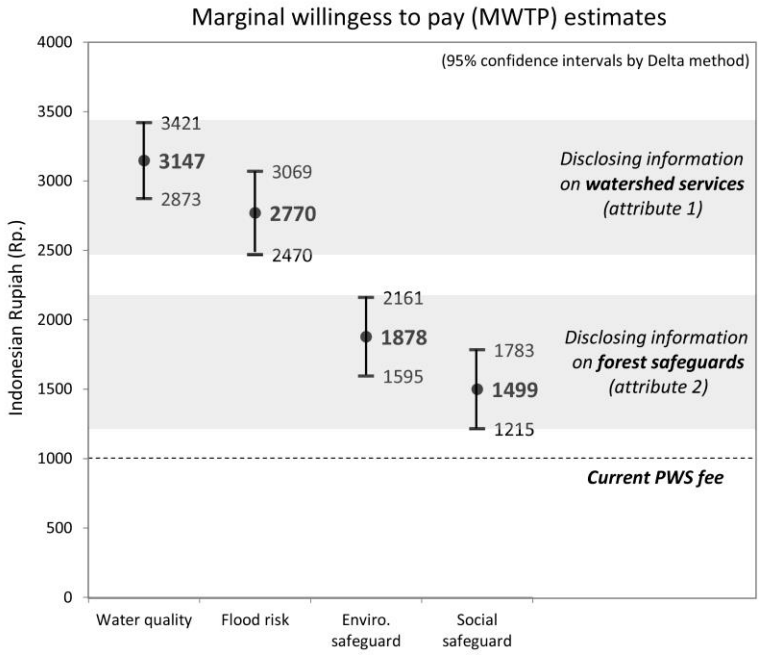


Figure 7.6 Comparison of MWTP estimates for certification attributes

7.5 Discussion

Our results supported the existence of potential demand for certification of forest watershed services from PWS buyers in West Lombok, Indonesia. The findings were not expected per previous studies predicting low certification demand from PWS schemes, particularly government-funded ones (Meijaard et al., 2011; 2014). However, though our results detected some level of demand for specific benefits the hypothetical certification might provide, market demand alone is not sufficient to confirm feasibility of such a scheme. As Meijaard et al. (2011; 2014) argue, such a certification scheme would face many challenges: watershed management is site-specific and complex; scientific knowledge of forest watershed services is limited; and certification standards would need to be both simple and scientific, presenting challenges to standard developers. In spite of these challenges, this study discovered demand for the certification scheme among PWS buyers even through their participation is mandatory. The

demand for certification arose from buyer preferences to have access to information on water quality, flood risk, and environmental and social safeguards of forested watersheds.

Buyer demand for certification must have arisen from their lack of access to information on the provision of watershed services, especially water quality. The PWS scheme in West Lombok has made progress since it was launched in 2003, such as the establishment of the multi-stakeholder institution (or IMP), and voluntary participation of service sellers (or upstream communities) (Pirard, 2012b; WWF, 2014). However, the PWS scheme still lacks a system to deliver service information to buyers like many other PWS schemes (Ferraro, 2008; Muradian et al., 2010; Wunder et al., 2008). A lack of the information delivery system undermines the effectiveness of PWS schemes since the system is a pre-requisite for buyer-side conditionality in PWS schemes. Wunder (2015) defines conditionality as a key component of PWS schemes. Buyer-side conditionality occurs when buyers are able to make proper market decisions with regard to delivered services. Thus, the buyers' demand for certification signals that the PWS scheme has not achieved buyer-side conditionality and needs to improve its capacity to disclose service information to buyers. The fact that buyers have no choice about whether to participate in the PWS scheme and are required to pay a supplemental fee may actually further support the demand for certification detected through this study.

The availability of service information would support the advancement of PWS schemes, even if buyer participation is mandatory since mandatory PWS schemes are capable to reflect buyer preferences at certain degrees. In West Lombok, for example, the amount of the ecosystem services fee (Rp.1,000) was determined by market studies with buyers conducted in the early development stage of the PWS scheme (Fauzi & Anna, 2013; Prasetyo et al., 2009; WWF, 2014). The study results were eventually reflected on the amendment of the local PWS

regulation (No. 4/2007) in setting the level of the PWS fee (WWF, 2014). Many other PWS schemes have also designed a degree of payments by examining buyer preferences (Whittington & Pagiola, 2012). Indeed, buyers cannot immediately affect implementations of mandatory PWS schemes as they do in conventional markets, such as not buying low-quality coffee. It would take considerable times for mandatory PWS schemes to reflect changes in buyer preferences (e.g., amendment of PWS regulations). Similar restrictions are also observable in voluntary PWS schemes, however. If buyers voluntarily join 2-year PWS contracts, for instance, they would need to wait for 2 years to terminate the contracts even if dissatisfied with the services. Thus, discrepancies of conditionality in between voluntary and mandatory PWS schemes could mainly remain at different time scales although some mandatory PWS schemes would never achieve buyers' conditionality, especially where buyers have limited voices and governments do not communicate with the public.

Implications of the study include identification of important business values of certification of forest watershed services for a PWS scheme. The buyers' preferences identify that these business values entail disclosure of information on watershed services and forest safeguards. Moreover, the buyers' high MWTP for the information on watershed services indicates that FSC forest certification would need to be equipped with an additional system that discloses information on watershed services when applied to a PWS scheme. FSC forest certification mainly focuses on disclosure of information on environmental, social, and economic safeguards of forests (Auld & Bull, 2003; Cashore et al., 2006; Hickey et al., 2006). Certainly, environmental safeguards have potential to support deliveries of watershed services (e.g., Dias et al., 2015; Hickey et al., 2006). However, the Principles and Criteria of FSC are yet not equipped to quantify delivery of watershed services, such as water quality or quantity (van Dam et al.,

2010). Achievement of environmental safeguards does not explicitly address an amount of delivered watershed services (e.g., an amount of reduced sediments).

Another implication of the study is an analysis of information disclosure in PWS schemes. Several studies analyze the problem of incomplete information in PWS schemes which has negative impacts on transaction costs and efficiency (Ferraro, 2008; Muradian et al., 2010; Wunder et al., 2008). However, the problem has not yet been addressed from the perspective of PWS buyer demand and certification. The study addresses these new perspectives on the problem by highlighting PWS buyers' demand for information disclosure and, in turn, for achieving their conditionality. The demand emphases the importance of an information delivery system in PWS design and a need to analyze the system, which might be accomplished through certification.

Finally, the authors recognize that this study has limitations. First, buyer demand for certified forest watershed services could change over time and vary with geographical area and culture. In this study, for example, buyer trust in the national government and, to a lesser degree, international organizations reflect site-specific stakeholder relationships in West Lombok. Second, the demand estimates for different certification attributes are based on assumptions that certification would be able to deliver information on watershed services and forest safeguards to buyers, and the surveys reflect as much. Thus if future certification schemes for forest watershed services fail to meet this assumption in practice, the associated estimates of demand would not be valid. Last but not least, the study only focuses on certification which is one type of an information delivery system. In other words, buyers might well prefer other alternatives (e.g., development of internal monitoring systems) to certification if these alternatives are capable of

disclosing the same information at less cost than certification. However, these alternatives were beyond the scope of this study.

7.6 Conclusions

This chapter estimated the potential demand for certification of forest watershed services from buyers of a PWS scheme in West Lombok, Indonesia. The demand reflected the buyers' desire to improve the PWS scheme's transparency through certification. Buyers wanted access to information on water quality, flood risk, environmental safeguards, and social safeguards of forest watersheds via certification. Their MWTP for the information was even higher than the current PWS fees despite the fact that their participation in the PWS scheme is mandated by a local regulation. Certainly, challenges remain in developing certification of forest watershed services, such as the limited scientific knowledge about the provisions of forest watershed services and the difficulty in developing simple yet science-based certification standards. Despite these challenges, the study demonstrated the existence of buyer demand for certification from the PWS schemes, especially where service information was lacking. PWS buyers whose participation is mandatory may also desire to improve a PWS scheme (e.g., through certification) as much as would the voluntary PWS buyers. The demand also identifies required business values of the certification scheme and highlights the importance of information disclosure in a PWS scheme.

Chapter 8: Conclusion

8.1 Overview

This thesis examined the feasibility of certification of forest ecosystem services (CFES) in terms of its concept (part one), its development as an expansion of the FSC system (part two), and its application to a payment for watershed services (PWS) scheme (part three). These analyses were conducted with six research objectives, including the analyses of:

- a conceptual framework for the CFES system (Chapter 2);
- FSC stakeholder adaptability to ecosystem services (Chapter 3);
- FSC stakeholder adaptability to the bundling of ecosystem services (Chapter 4);
- FSC certificate holders' demand for CFES (Chapter 5);
- PWS stakeholders' perspectives on CFES (Chapter 6); and
- PWS buyer demand for certified watershed services (Chapter 7).

Chapter 2 constructed a conceptual framework that identifies the key components of a CFES system as provision-based standards, an auditing system, and a disclosure system. These components allow the certification system to disclose information about the provision of ecosystem services. This function distinguishes a CFES system from the FSC system. The function could benefit market-based policy instruments by mitigating incomplete information about ecosystem services when the instruments suffer from a weak or lack of system to disclose the information. To achieve this theoretical benefit, however, the development of a CFES system should overcome various challenges, such as limited scientific knowledge on ecosystem services management and the need to develop provision-based standards that are simple to use by forest

owners but scientifically rigorous to measure the provision of ecosystem services (Meijaard et al., 2011).

Chapter 3 analyzed FSC stakeholder adaptability to different ecosystem services. Their adaptability was relatively high for biodiversity conservation, carbon storage, and the provision of non-timber forest products (NTFPs), compared to other services. The adaptability would be influenced by the FSC requirement to manage biodiversity in High Conservation Value Forests, the FSC's experience to certify NTFPs (e.g., Brazil nuts), and the stakeholders' experience with emerging voluntary carbon markets.

Chapter 4 examined FSC stakeholder adaptability to the bundling of ecosystem services. Two specific bundles were dominant in their adaptability. The first bundle included watershed and soil conservation services, which are commonly adopted by water management projects to improve water quality in the downstream by protecting soils in the upstream. The second bundle involved cultural ecotourism with NTFPs or agricultural goods, which exist in rural tourism, where farmers produce NTFPs or agricultural goods and operate tourism to experience a rural lifestyle.

Chapter 5 estimated FSC certificate holders' demand for CFES. Certificate holders preferred CFES that provides a 50% price premium, technical training for forest owners, and/or access to global markets for certified ecosystem services. Meanwhile, their willingness to pay for CFES and the technical capacity to manage ecosystem services were low, and to date, the only service traded at the global scale is forest carbon. These results indicate benefits of CFES that forest owners require and point to the expected challenges in developing the certification scheme.

Chapter 6 analyzed the perspective of PWS stakeholders on CFES in Lombok, Indonesia, as a case study. On the one hand, stakeholders perceived the certification scheme to be a potential tool for building their capacity to manage watershed services. On the other hand, they required simple, yet scientific standards that are not yet available and had concerns about the transparency of the certification scheme. These results indicate the opportunities and challenges in applying the certification scheme to a PWS scheme.

Chapter 7 estimated the PWS buyer demand for certified watershed services. Service buyers demanded certified services that disclose information on water quality, flood risk, and/or environmental and social forest safeguards related to the PWS scheme. This demand indicates a potential opportunity for applying CFES to watershed service markets and suggest the buyers' preferences for improving the PWS scheme.

8.2 Common themes emerging from the research

In addition to the findings presented in the individual chapters, a comparison of the chapters also provides information for the feasibility analysis of CFES; in particular: 1) provision-based standards are a key component of the certification scheme; 2) the demand structure of the certification scheme is demonstrated by the preferences of PWS buyers and FSC certificate holders; and 3) challenges still exist for developing and applying the certification scheme.

8.2.1 Provision-based standards.

The importance of provision-based standards to CFES is corroborated by the analyses of the central concept (Chapter 2) and the PWS buyer demand (Chapter 7). Chapter 2 argues that

provision-based standards are a key component of CFES, as the measurement of ecosystem services plays a critical role in the implementation of market-based policy instruments for ecosystem services. In voluntary forest carbon markets, for example, the provision of a carbon storage service is a key indicator for additionality of forest carbon projects, and in turn, is a key requirement for generating forest carbon credits (Richards & Huebner, 2012a). Moreover, the PWS buyers' willingness to pay for information on watershed services was significantly higher than their willingness to pay for information on forest safeguards in the upstream (Figure 7.6). In other words, buyers perceived that information disclosed by provision-based standards would be more valuable to them, compared to information disclosed by the current FSC system. This implies that a potential expansion of the FSC system to ecosystem services would require an additional system that measures the provision of services to capture the market demand.

8.2.2 Demand structure.

Buyers and sellers in ecosystem service markets would demand different business values of CFES, and the buyer demand for certified services would affect the seller demand for CFES certificates. Different attributes of CFES were demanded by the PWS buyers (or buyers of ecosystem services) (Chapter 7) and FSC certificate holders (or potential sellers of ecosystem services) (Chapter 5) (Table 8.1). On the one hand, *PWS buyers* preferred CFES that disclosed information on the provision of watershed services and/or forest safeguards. This indicates that the buyer demand for certified ecosystem services would be mainly affected by certification design, such as the measuring of delivered services, or ensuring of forest safeguards. On the other hand, *FSC certificate holders* preferred CFES that provides a 50% price premium, technical training for forest owners, and access to global markets for certified services. This

indicates that the seller demand for CFES certificates would be influenced by both the buyer demand for certified services, which influences a price premium for certified services, and certification design, such as decisions to provide technical training for forest owners and to certify ecosystem services that traded in global markets. Thus, CFES should be able to satisfy both buyers and sellers in the ecosystem service markets since their demands are connected, and voluntary adoption of certification is determined by their demands.

Table 8.1 Business values of CFES preferred by PWS buyers and FSC certificate holders

Roles and preferences	PWS buyers (Ch.7)	FSC certificate holders (Ch.5)
Roles in ecosystem services markets	Service buyers	Potential service sellers
Roles in CFES markets	Indirect consumers who demand certified services	Direct consumers who demand CFES certificates
Preferred business values of CFES	Disclosure of information on: 1) the provision of services 2) forest safeguards	1) Price premium for certified services 2) Technical training for forest owners 3) Access to global service markets

8.2.3 Challenges.

Several chapters revealed challenges for CFES. First, the development of CFES as FSC expansion would require an improved FSC stakeholder adaptability to ecosystem services and/or bundling of these services due to differentiated stakeholder adaptability (Chapters 3 and 4). Both types of adaptability could indicate the preliminary scope of FSC expansion. Consequently, if one type of adaptability (e.g., adaptability to bundled services) is prioritized in the analysis of the potential expansion of the FSC system, the other type (e.g., adaptability to individual services in the bundle) would need to be improved for the expansion, which would be costly.

Second, forest owners revealed a low willingness to pay for CFES (Chapter 5). Indeed, the low demand would have been affected by the fact that timber production was the major

business of FSC certificate holders, and only a few of the forest owners experienced the ecosystem services markets, such as forest carbon projects. Nevertheless, they still represented an internal market of FSC and were potential sellers of ecosystem services. Thus, their low demand indicates a potential challenge for CFES to capture a sufficient demand from an internal market of FSC and service sellers.

Third, the development of CFES standards (or provision-based standards) would be challenging and complicated. For instance, the existing provision-based standards, such as forest carbon standards, still faced criticisms in that the measurement of ecosystem services involves high uncertainties (Chapter 2). The challenge becomes further complicated by the fact that PWS stakeholders preferred simple standards for easy adaptation to local communities (Chapter 6), which was contradictory to the development of scientifically rigorous standards. These challenges also supported the argument of Meijaard et al. (2011).

Fourth, CFES should be able to inform market stakeholders of certification objectives in a transparent way. PWS stakeholders expressed their concern about certification transparency (Chapter 6) and they were also often confused by the explanation of various certification schemes in the market. Although these challenges are also prevalent among many other certification schemes, overcoming the challenges is not straightforward. In the long-run, enormous scientific and political efforts would be required (e.g., development of trust by the local communities in the certification scheme).

8.3 Research limitations

This thesis faces certain limitations that need to be considered when interpreting the research. The first part does not test the proposed working hypothesis with a conceptual

framework for CFES. Although hypothesis development is a critical step for conceptualizing the certification scheme, evidence-based tests are still required to confirm the hypothesis.

The second part only focuses on a potential expansion of the FSC system. Although the FSC is one of the two major global forest certification schemes, the FSC studies are still limited to representing other forest certification schemes around the world, such as the PEFC. Chapters 3 and 4 examined FSC stakeholders based on their self-assessed adaptability, given in online surveys. To confirm the study results, in-depth analyses will be required, such as standardized tests for the stakeholders via face-to-face interviews. Chapter 5 indicated a rather low response rate to the online survey, and the certification attribute of training was unbalanced compared to the other three attributes. The chapter also examined only those FSC certificate holders who were from a particular group of potential sellers of ecosystem services. Their demand for CFES was also estimated with an assumption that the certification scheme considered only four attributes.

The third part analyzed a single PWS scheme in Lombok, Indonesia, as a case study. Consequently, the findings would not be representative of all PWS schemes. PWS schemes also present market-based policy instruments for watershed services within the policy instruments for various ecosystem services; thus, the buyers of other services could have different perspectives and preferences. The PWS buyer demand was also elicited with the assumption that CFES can disclose information on watershed services and forest safeguards. Therefore, the estimated demand would not be valid if CFES failed to disclose such types of information in the future.

8.4 Future research

Research limitations imply the need for future studies on the feasibility of developing CFES and its application to market-based policy instruments for ecosystem services to disclose incomplete, or asymmetric, information on services.

Studies on methodologies to measure ecosystem services are required to analyze the feasibility of developing CFES standards. To establish successful provision-based standards for CFES, the methodologies need to be scientific, capable of integrating uncertainties in ecosystem services management, standardizable in various regions, applicable and affordable for local communities, and supported by various service stakeholders. Since some of these requirements are contradictory, trade-offs might be inevitable. Furthermore, more studies are needed to analyze the feasibility of improving the provision-based standards that have already been adopted for forest carbon certification, water quality trading programs, and biodiversity offset programs. The feasibility analysis should also advance our scientific knowledge of ecosystem services management.

Studies on the impact of the current FSC system on the provision of ecosystem services are also required. The evaluation of these impacts would reveal the current FSC system's benefits to market-based policy instruments for ecosystem services. These benefits should be integrated into strategies for developing CFES as an expansion of the FSC system. Indeed, evaluation of the FSC impacts on the ground faces various methodological challenges, such as controlling for non-FSC impacts on certified forests (Romero et al., 2013). In any case, the evaluation is still vital for identifying business values that must be developed by the current FSC system for target markets of CFES.

Studies on the potential of other certification schemes to support the development of CFES are required. Although forest certification is highly relevant to the management of forest ecosystem services, other certification schemes are connected to some extent with the management of these services. For example, organic certification schemes have been applied to the implementation of payments for environmental services (Section 1.1.5). Ecotourism certification schemes may also support the management of cultural ecosystem services.

More market studies are required for CFES. The uptake of a certification scheme depends on the demand from market-based policy instruments for ecosystem services, involving a variety of services and stakeholders. These policy instruments vary from voluntary carbon markets to biodiversity banking, and the instruments face different implementation conditions around the world, such as the legality of property rights of ecosystem services. These instruments also consist of service buyers and sellers, and their expectations (or business values) about the certification scheme could differ.

Studies on the expected costs of CFES are required for the cost-benefit analysis. The scope of these studies should include direct and indirect costs for obtaining the certification scheme to forest owners, prices of certified ecosystem services to buyers, costs of maintaining the certification system and registries to share ecosystem service data among certification stakeholders, and the cost-effectiveness of CFES in comparison with other policy instruments.

Studies on the impacts of CFES on market-based policy instruments for ecosystem services should be evaluated to test the proposed function of the certification scheme and its potential synergies with target markets. Such tests would require data on the implementation of CFES.

Bibliography

Abdi, H. e. (2010). Normalizing Data. In N. Salkind (Ed.), *Encyclopedia of Research Design*. Thousand Oaks, CA: Sage.

Adamowicz, W., Boxall, P., Williams, M., & Louviere, J. (1998). Stated preference approaches for measuring passive use values: choice experiments and contingent valuation. *American Agricultural Economics, 80*, 64-75.

Aguilar, F. X., & Vlosky, R. P. (2007). Consumer willingness to pay price premiums for environmentally certified wood products in the U.S. *Forest Policy and Economics, 9*(8), 1100-1112.

Aguilar, F. X., & Cai, Z. (2010). Conjoint effect of environmental labeling, disclosure of forest of origin and price on consumer preferences for wood products in the US and UK. *Ecological Economics, 70*(2), 308-316.

Al-assaf, A., Nawash, O., & Omari, M. (2014). Identifying forest ecosystem services through socio-ecological bundles: a case study from northern Jordan. *International Journal of Sustainable Development & World Ecology, 21*(4), 314-321.

Alpine Convention. (2011). *Sustainable Rural Development and Innovation: Report on the State of the Alps.* Paper presented at the XI Alpine Conference, Brdo pri Kranju, Slovenia.

Alvarado-Quesada, I., Hein, L., & Weikard, H.-P. (2014). Market-based mechanisms for biodiversity conservation: a review of existing schemes and an outline for a global mechanism. *Biodiversity and Conservation, 23*(1), 1-21.

Anderson, R., & Hansen, E. (2004). Determining consumer preferences for ecolabeled forest products: an experimental approach. *Journal of Forestry, 4*, 28-32.

Angelsen, A. (2009). *Realising REDD+: National strategy and policy options*. Bogor: Center for International Forestry Research (CIFOR).

Araujo, M., Kant, S., & Couto, L. (2009). Why Brazilian companies are certifying their forests? *Forest Policy and Economics, 11*, 579-585.

Armatas, C. A., Venn, T. J., & Watson, A. E. (2014). Applying Q-methodology to select and define attributes for non-market valuation: A case study from Northwest Wyoming, United States. *Ecological Economics, 107*, 447-456.

Asquith, N. M., Vargas, M. T., & Wunder, S. (2008). Selling two environmental services: In-kind payments for bird habitat and watershed protection in Los Negros, Bolivia. *Ecological Economics, 65*(4), 675-684.

Auld, G., & Bull, G. Q. (2003). The institutional design of forest certification standards initiatives and its influence on the role of science: the case of forest genetic resources. *Journal of Environmental Management, 69*(1), 47-62.

Auld, G., Gulbrandsen, L. H., & McDermott, C. L. (2008). Certification schemes and the impacts on forests and forestry. *Annual Review of Environment and Resources, 33*, 187-211.

AWS (Alliance for Water Stewardship). (2013). The AWS International Water Stewardship Standard: Beta version for stakeholder input and field testing, Version 04.03.2013.

Balzarova, M., & Castka, P. (2012). Stakeholders' influence and contribution to social standards development: The case of multiple stakeholder approach to ISO 26000 development. *Journal of Business Ethics, 111*(2), 265-279.

Barataud, F., Aubry, C., Wezel, A., & Mundler, P. (2014). Management of drinking water catchment areas in cooperation with agriculture and the specific role of organic farming. Experiences from Germany and France. *Land Use Policy, 36*, 585-594.

Barry, J., & Proops, J. (1999). Seeking sustainability discourses with Q methodology. *Ecological Economics, 28*(3), 337-345.

Barry, M., Cashore, B., Clay, J., Fernandez, M., Lebel, L., Lyon, T., et al. (2012). *Toward sustainability: The roles and limitations of certification*. Washington, DC: RESOLVE, Inc.

Bass, S., & Simula, M., (1999). Independent Certification/Verification of Forest Management. Background Paper. World Bank and WWF Alliance Workshop. November. Washington, DC.

Bateman, I. J., Carson, R. T., Day, B., Hanemann, M., Hanley, N., Hett, T., et al. (2002). *Economic Valuation with Stated Preference Techniques: A Manual*. Cheltenham: Edward Elgar Publishing Limited.

Bauhus, J., Van der Meer, P., & Kanninen, M. (2010). *Ecosystem Goods and Services from Plantation Forests*. London, UK: Earthscan.

Bayon, R., Hawn, A., & Hamilton, K. (2009). *Voluntary Carbon Markets: An International Business Guide to What They Are and How They Work*. London: Earthscan.

BBOP (Business and Biodiversity Offsets Programme). (2012). *Standard on Biodiversity Offsets*. BBOP: Washington, D.C.

Beierle, T. C., & Cayford, J. (2002). *Democracy in practice: Public participation in environmental decisions*: Resources for the Future.

Bennett, E. L. (2001). Timber Certification: Where Is the Voice of the Biologist? *Conservation Biology, 15*(2), 308-310.

Bennett, E. M., Peterson, G. D., & Gordon, L. J. (2009). Understanding relationships among multiple ecosystem services. *Ecology Letters, 12*(12), 1394-1404.

Black, R., & Crabtree, A. (2007). *Quality Assurance and Certification in Ecotourism*. Cambridge: CABI Pub.

Bliemer, M. C. J., & Rose, J. M. (2013). Confidence intervals of willingness-to-pay for random coefficient logit models. *Transportation Research Part B: Methodological, 58*(0), 199-214.

Bonroy, O., & Constantatos, C. (2014). On the Economics of Labels: How Their Introduction Affects the Functioning of Markets and the Welfare of All Participants. *American Journal of Agricultural Economics*.

Bowers, T., Eastin, I., Ganguly, I., Cao, J., & Seol, M. (2012). Forest certification in Asia: The changing marketplace for value-added wood product manufacturers in China and Vietnam. *The Forestry Chronicle, 88*(5), 578-584.

Breetz, H. L., Fisher-Vanden, K., Garzon, L., Jacobs, H., Kroetz, K., & Terry, R. (2004). Water quality trading and offset initiatives in the US: A comprehensive survey. *Dartmouth College and the Rockefeller Center for the US Environmental Protection Agency*.

Brown, S. R. (1980). *Political subjectivity: Applications of Q methodology in political science*: Yale University Press.

Brouwer, R., Tesfaye, A., & Pauw, P. (2011). Meta-analysis of institutional-economic factors explaining the environmental performance of payments for watershed services. *Environmental Conservation, 38*(04), 380-392.

Bull, G. Q., Bazett, M., Schwab, O., Nilsson, S., White, A., & Maginnis, S. (2006). Industrial forest plantation subsidies: Impacts and implications. *Forest Policy and Economics, 9*(1), 13-31.

Bunn, D., Lubell, M., & Johnson, C. K. (2013). Reforms could boost conservation banking by landowners. *California Agriculture, 67*(2), 86-95.

Busch, L. (2011). *Standards: Recipes for Reality*. Cambridge: The MIT Press.

Cai, Z., & Aguilar, F. X. (2013). Meta-analysis of consumer's willingness-to-pay premiums for certified wood products. *Journal of Forest Economics, 19*, 15-31.

Carlsen, K., Hansen, C. P., & Lund, J. F. (2012). Factors affecting certification uptake - Perspectives from the timber industry in Ghana. *Forest Policy and Economics, 25*(0), 83-92.

Cashore, B., van Kooten, G. C., Vertinsky, I., Auld, G., & Affolderbach, J. (2005). Private or self-regulation? A comparative study of forest certification choices in Canada, the United States and Germany. *Forest Policy and Economics, 7*(1), 53-69.

Cashore, B., Gale, F., Meidinger, E., & Newsom, D. (2006). Confronting Sustainability: Forest Certification in Developing and Transitioning Countries. New Haven: Yale School of Forestry & Environmental Studies.

Cashore, B., Egan, E., Auld, G., & Newsom, D. (2007). Revising Theories of Nonstate Market-Driven (NSMD) Governance: Lessons from the Finnish Forest Certification Experience. *Global Environmental Politics, 7*(1), 1-44.

Cauley, H. A., Peters, C. M., Donovan, R. Z., & O'Connor, J. M. (2001). Forest Stewardship Council Forest Certification. *Conservation Biology, 15*(2), 311-312.

Chen, J., Innes, J. L., & Kozak, R. A. (2011a). An exploratory assessment of the attitudes of Chinese wood products manufacturers towards forest certification. *Journal of Environmental Management, 92*(11), 2984-2992.

Chen, J., Tikina, A., Kozak, R., Innes, J. L., Duinker, P., & Larson, B. (2011b). The efficacy of forest certification: Perceptions of Canadian forest products retailers. *Forestry Chronicle, 87*(5), 636-643.

Christiansen, K., Wesnæs, M., & Weidema, B. P. (2006). Consumer demands on Type III environmental declarations *ANEC and AISBL*. Brussels.

Cochran, B., & Logue, C. (2011). A Watershed Approach to Improve Water Quality: Case Study of Clean Water Services' Tualatin River Program1. *JAWRA Journal of the American Water Resources Association, 47*(1), 29-38.

Coglianese, C., & Lazer, D. (2003). Management-based regulation: Prescribing private management to achieve public goals. *Law & Society Review, 37*(4), 691-730.

Croissant, Y. (2013). mlogit: multinomial logit model. R package version 0.2-4. https://CRAN.R-project.org/package=mlogit

Cubbage, F., Harou, P., & Sills, E. (2007). Policy instruments to enhance multi-functional forest management. *Forest Policy and Economics, 9*(7), 833-851.

CWS (Clean Water Services). (2013). Temperature Management Plan & Credit Trading Activities, Annual Report. Hillsboro: Clean Water Services.

Deal, R. L., Cochran, B., & LaRocco, G. (2012). Bundling of ecosystem services to increase forestland value and enhance sustainable forest management. *Forest Policy and Economics, 17*(0), 69-76.

DEP (The New York City Department of Environmental Protection). (2014). New York City 2014 drinking water supply and quality report. New York.

DEPI (Department of Environment and Primary Industries). (2013). Native Vegetation Gain Scoring Manual: Version 1. Melbourne: Victorian Government Department of Environment and Primary Industries.

Dernoi, L. A. (1983). Farm tourism in Europe. *Tourism Management, 4*(3), 155-166.

DeShazo, J., Carson, R. T., Schwabe, K. A., Vincent, J. R., Ismariah, A., Chong, S., et al. (2015). Designing and implementing surveys to value tropical forests. *Journal of Tropical Forest Science*, 92-114.

Di Franco, G. (2016). Multiple correspondence analysis: one only or several techniques? *Quality & Quantity, 50*(3), 1299-1315.

Dias, F. S., Bugalho, M. N., Rodríguez-González, P. M., Albuquerque, A., & Cerdeira, J. O. (2015). Effects of forest certification on the ecological condition of Mediterranean streams. *Journal of Applied Ecology, 52*(1), 190-198.

Dietz, T., Ostrom, E., & Stern, P. C. (2003). The struggle to govern the commons. *Science, 302*(5652), 1907-1912.

Dillman, D. A. (2011). *Mail and Internet surveys: The tailored design method--2007 Update with new Internet, visual, and mixed-mode guide*: Wiley.

Dranove, D., & Jin, G. Z. (2010). Quality Disclosure and Certification: Theory and Practice *Journal of Economic Literature, 48*(4), 935–963.

Duchelle, A. E., Kainer, K. A., & Wadt, L. H. O. (2014). Is Certification Associated with Better Forest Management and Socioeconomic Benefits? A Comparative Analysis of Three Certification Schemes Applied to Brazil Nuts in Western Amazonia. *Society & Natural Resources, 27*(2), 121-139.

Durst, P., McKenzie, P. J., Brown, C. L., & Appanah, S. (2006). Challenges facing certification and eco-labelling of forest products in developing countries. *International Forestry Review, 8*(2), 193-200.

Ellerman, A. D. (2005). A Note on Tradeable Permits. *Environmental and Resource Economics, 31*(2), 123-131.

Elliott, C. (2000). *Forest Certification: A Policy Perspective*. Bogor: CIFOR.

Elliott, C., & Schlaepfer, R. (2001). Understanding forest certification using the Advocacy Coalition Framework. *Forest Policy and Economics, 2*(3-4), 257-266.

Endter-Wada, J., Blahna, D., Krannich, R., & Brunson, M. (1998). A framework for understanding social science contributions to ecosystem management. *Ecological Applications, 8*(3), 891-904.

Engel, S., Pagiola, S., & Wunder, S. (2008). Designing payments for environmental services in theory and practice: An overview of the issues. *Ecological Economics, 65*(4), 663-674.

EPA (Environmental Protection Agency). (2004). *Water Quality Trading Assessment Handbook: Can Water Quality Trading Advance Your Watershed's Goals?* Washington, DC.

Escobar, M. M., Hollaender, R., & Weffer, C. P. (2013). Institutional durability of payments for watershed ecosystem services: Lessons from two case studies from Colombia and Germany. *Ecosystem Services*, 6(0), 46-53.

Ezzine-de-Blas, D., Wunder, S., Ruiz-Pérez, M., & Moreno-Sanchez, R. d. P. (2016). Global Patterns in the Implementation of Payments for Environmental Services. *PLoS ONE, 11*(3), e0149847.

Fauzi, A., & Anna, Z. (2013). The complexity of the institution of payment for environmental services: A case study of two Indonesian PES schemes. *Ecosystem Services, 6*(0), 54-63.

Ferraro, P. J. (2008). Asymmetric information and contract design for payments for environmental services. *Ecological Economics, 65*(4), 810-821.

Firmian, I., Catacutan, D., Gatenya, J., & Namirembe, S. (2011). PES and Eco-Certification in the Kapingazi Watershed, Kenya. In D. Ottaviani & N. E.-H. Scialabba (Eds.), *Payment for Ecosystem Services and Food Security*. Rome: Food and Agriculture Organization of the United Nations (FAO).

Fisher, B., Turner, R. K., & Morling, P. (2009). Defining and classifying ecosystem services for decision making. *Ecological Economics, 68*(3), 643-653.

Fisher, J. A., & Brown, K. (2014). Ecosystem services concepts and approaches in conservation: Just a rhetorical tool? *Ecological Economics, 108*, 257-265.

Foster, B. C., Wang, D., & Keeton, W. S. (2008). An Exploratory, Post-Harvest Comparison of Ecological and Economic Characteristics of Forest Stewardship Council Certified and Uncertified Northern Hardwood Stands∗. *Journal of Sustainable Forestry, 26*(3), 171-191.

Fox, J., Gardner, R. C., & Maki, T. (2011). Stacking Opportunities and Risks in Environmental Credit Markets. *Environmental Law Reporter, News & Analysis, 41*(2), 10121-10125.

Freeman, J., & Kolstad, C. D. (2006). *Moving to Markets in Environmental Regulation: Lessons from Twenty Years of Experience: Lessons from Twenty Years of Experience*: Oxford University Press.

FSC (The Forest Stewardship Council). (2012). FSC Principles and Criteria for Forest Stewardship (FSC-STD-01-001 V5-0 D5-0 EN). Bonn.

FSC (The Forest Stewardship Council). (2016). FSC Facts & Figures: March 1, 2016. Bonn

Gan, J., & Cashore, B. (2013). Opportunities and Challenges for Integrating Bioenergy into Sustainable Forest Management Certification Programs. *Journal of Forestry, 111*(1), 11-16.

Ghazoul, J. (2001). Barriers to Biodiversity Conservation in Forest Certification. *Conservation Biology, 15*(2), 315-317.

Goldstein, A., Gonzalez, G., & Peters-Stanley, M. (2014). Turning over a New Leaf: State of the Forest Carbon Markets 2014. *Ecosystem Market Place*.

Gong, Y., Hegde, R., & Bull, G. Q. (2014). Payment for Ecosystem Services: Lessons from Developing Countries. In S. Kant & J. Alavalapati (Eds.), *Handbook of Forest Resource Economics*: Routledge.

Greenacre, M., & Blasius, J. (2006). *Multiple correspondence analysis and related methods*: CRC Press.

Griscom, B., Ellis, P., & Putz, F. E. (2014). Carbon emissions performance of commercial logging in East Kalimantan, Indonesia. *Global Change Biology, 20*(3), 923-937.

Grolleau, G., & McCann, L. M. J. (2012). Designing watershed programs to pay farmers for water quality services: Case studies of Munich and New York City. *Ecological Economics, 76*(0), 87-94.

Gullison, R. E. (2003). Does forest certification conserve biodiversity? *Oryx, 37*(02), 153-165.

Guttman, L. (1954). Some necessary conditions for common-factor analysis. *Psychometrika, 19*(2), 149-161.

Hanley, N., & White, B. (2014). Incentivizing the provision of ecosystem services. *International Review of Environmental and Resource Economics, 7*(3-4), 299-331.

Hanemann, M. W. (2006). The Economic Conception of Water. In P. P. Rogers, M. R. Llamas & L. Martinez-Cortina (Eds.), *Water Crisis: Myth or Reality?* (pp. 61-91). London; New York: Taylor & Francis.

Harshaw, H. W., Sheppard, S., & Lewis, J. L. (2007). A review and synthesis of social indicators for sustainable forest management. *Journal of Ecosystems and Management, 8*(2).

Hatanaka, M., & Busch, L. (2008). Third-Party Certification in the Global Agrifood System: An Objective or Socially Mediated Governance Mechanism? *Sociologia Ruralis*, 48(1), 73-91.

Hausman, J., & McFadden, D. (1984). Specification tests for the multinomial logit model. *Econometrica: Journal of the Econometric Society*, 1219-1240.

Hensher, D., & Greene, W. (2003). The Mixed Logit model: The state of practice. *Transportation, 30*(2), 133-176.

Hensher, D. A., Rose, J. M., & Greene, W. H. (2005). *Applied Choice Analysis: A Primer*. Cambridge: Cambridge University Press.

Hensher, D. A. (2014). Process heuristics in choice analysis: An editorial. *Journal of Choice Modelling, 11*, 1-3.

Heras-Saizarbitoria, I., & Boiral, O. (2013). ISO 9001 and ISO 14001: towards a research agenda on management system standards. *International Journal of Management Reviews*, 15(1), 47-65.

Hickey, G. M. (2004). Regulatory approaches to monitoring sustainable forest management. *International Forestry Review, 6*(2), 89-98.

Hickey, G. M., Innes, J. L., Kozak, R. A., Bull, G. Q., & Vertinsky, I. (2006). Monitoring and information reporting for sustainable forest management: An inter-jurisdictional comparison of soft law standards. *Forest Policy and Economics, 9*(4), 297-315.

Hoffman, D. L., & De Leeuw, J. (1992). Interpreting multiple correspondence analysis as a multidimensional scaling method. *Marketing Letters, 3*(3), 259-272.

Hole, A. R. (2007). A comparison of approaches to estimating confidence intervals for willingness to pay measures. *Health Economics, 16*(8), 827-840.

Husson, F., Lê, S., & Pagès, J. (2011). *Exploratory multivariate analysis by example using R*. Boca Raton: CRC Press.

Husson, F., Josse, J., Le, S., & Mazet, J. (2016). *FactoMineR: Multivariate Exploratory Data Analysis and Data Mining. R package version 1.32.*

Ioras, F., Abrudan, I. V., Dautbasic, M., Avdibegovic, M., Gurean, D., & Ratnasingam, J. (2009). Conservation gains through HCVF assessments in Bosnia-Herzegovina and Romania. *Biodiversity and Conservation, 18*(13), 3395-3406.

IUCN, & WBCSD. (2012). *Water for Business: Initiatives Guiding Sustainable Water Management in the Private Sector (3rd edition)*. Gland and Geneva.

Jensen, K. L., Jakus, P. M., English, B. C., & Menard, J. (2004). Consumers' willingness to pay for eco-certified wood products. *Journal of Agricultural and Applied Economics, 36*(03), 617-626.

Jones, C., Bacon, L., Kieser, M. S., & Sheridan, D. (2006). *Water-Quality Trading: A Guide for the Wastewater Community*. New York: McGraw-Hill.

Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and Psychological measurement*.

Kalonga, S. K., Midtgaard, F., & Eid, T. (2015). Does Forest Certification Enhance Forest Structure? Empirical Evidence from Certified Community-Based Forest Management in Kilwa District, Tanzania. *International Forestry Review, 17*(2), 182-194.

Kanninen, B. J. (2007). *Valuing environmental amenities using stated choice studies*: Springer.

Kanowski, P. J., McDermott, C. L., & Cashore, B. W. (2011). Implementing REDD+: lessons from analysis of forest governance. *Environmental Science & Policy, 14*(2), 111-117.

Kemkes, R. J., Farley, J., & Koliba, C. J. (2010). Determining when payments are an effective policy approach to ecosystem service provision. *Ecological Economics, 69*(11), 2069-2074.

Keohane, N. O., & Olmstead, S. M. (2007). *Markets and the Environment*. Washington: Island Press.

Kerr, J. (2002). Watershed Development, Environmental Services, and Poverty Alleviation in India. *World Development, 30*(8), 1387-1400.

Kollmuss, A., Lazarus, M., Lee, C., LeFranc, M., & Polycarp, C. (2010). *Handbook of Carbon Offset Programs: Trading Systems, Funds, Protocols and Standards*. London: Earthscan.

Kosoy, N., Martinez-Tuna, M., Muradian, R., & Martinez-Alier, J. (2007). Payments for environmental services in watersheds: Insights from a comparative study of three cases in Central America. *Ecological Economics, 61*(2–3), 446-455.

Kozak, R. A., Cohen, D. H., Lerner, J., & Bull, G. Q. (2004). Western Canadian consumer attitudes towards certified value-added wood products: An exploratory assessment. *Forest Products Journal, 54*(9), 21-24.

Kuhfeld, W. F. (2010). Marketing research methods in SAS. *Experimental Design, Choice, Conjoint, and Graphical Techniques. Cary, NC, SAS-Institute TS-722*.

Kuijk, M. v., Putz, F. E., & Zagt, R. (2009). Effects of Forest Certification on Biodiversity. Wageningen: Tropenbos International.

Landell-Mills, N., & Porras, I. T. (2002). Silver bullet or fools' gold? A global review of markets for forest environmental services and their impact on the poor. London: International Institute for Environment and Development.

Layke, C. (2009). Measuring nature's benefits: a preliminary roadmap for improving ecosystem service indicators. *World Resources Institute: Washington*.

Le Roux, B., & Rouanet, H. (2010). *Multiple correspondence analysis* (Vol. 163): Sage.

Litwin, M. S., Hays, R. D., Fink, A., Ganz, P. A., Leake, B., & Brook, R. H. (1998). The UCLA Prostate Cancer Index - Development, reliability, and validity of a health-related quality of life measure. *Medical Care, 36*(7), 1002-1012.

Lo, A. Y. (2013). Agreeing to pay under value disagreement: Reconceptualizing preference transformation in terms of pluralism with evidence from small-group deliberations on climate change. *Ecological Economics, 87*, 84-94.

Louviere, J. J., Hensher, D. A., & Swait, J. D. (2000). *Stated Choice Methods: Analysis and Applications*. Cambridge: Cambridge University Press.

MA (Millennium Ecosystem Assessment). (2005). Ecosystems and Human Well-being: Current State and Trends. Washington, DC: Island Press.

MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological methods, 4*(1), 84.

Magdalena, Lawrence, D., Filer, C., Potter, L., & Resosudarmo, B. (2013). Local management arrangements in Sesaot forest, Lombok Indonesia. *Journal of Environmental Technology and Management, 4*(1), 1-21.

Martín-López, B., García-Llorente, M., Palomo, I., & Montes, C. (2011). The conservation against development paradigm in protected areas: Valuation of ecosystem services in the Doñana social–ecological system (southwestern Spain). *Ecological Economics, 70*(8), 1481-1491.

Masters, M., Tikina, A., & Larson, B. (2010). Forest certification audit results as potential changes in forest management in Canada. *The Forestry Chronicle, 86*(4), 455-460.

MacDicken, K. G., Sola, P., Hall, J. E., Sabogal, C., Tadoum, M., & de Wasseige, C. (2015). Global progress toward sustainable forest management. *Forest Ecology and Management, 352*, 47-56.

MacDonald, R., & Jolliffe, L. (2003). Cultural rural tourism: Evidence from Canada. *Annals of Tourism Research, 30*(2), 307-322.

McDermott, C. L., Noah, E., & Cashore, B. (2008). Differences That 'Matter'? A Framework for Comparing Environmental Certification Standards and Government Policies. *Journal of Environmental Policy & Planning, 10*(1), 47-70.

McKee, D. O., Varadarajan, P. R., & Pride, W. M. (1989). Strategic adaptability and firm performance: a market-contingent perspective. *The Journal of Marketing*, 21-35.

McKenney, B. A., & Kiesecker, J. M. (2010). Policy development for biodiversity offsets: a review of offset frameworks. *Environmental Management, 45*(1), 165-176.

McKeown & Thomas (2013) Q methodology (Quantitative Applications in the Social Sciences series, Vol. 66). London: Sage.

Medjibe, V. P., Putz, F., & Romero, C. (2013). Certified and Uncertified Logging Concessions Compared in Gabon: Changes in Stand Structure, Tree Species, and Biomass. *Environmental Management, 51*(3), 524-540.

Meijaard, E., Sheil, D., Guariguata, M. R., Nasi, R., Sunderland, T. C. H., & Putzel, L. (2011). Ecosystem services certification: Opportunities and constraints (pp. 57p.). Bogor, Indonesia: Center for International Forestry Research (CIFOR).

Meijaard, E., Wunder, S., Guariguata, M. R., & Sheil, D. (2014). What scope for certifying forest ecosystem services? *Ecosystem Services, 7*, 160-166.

Merger, E., Dutschke, M., & Verchot, L. (2011). Options for REDD+ Voluntary Certification to Ensure Net GHG Benefits, Poverty Alleviation, Sustainable Management of Forests and Biodiversity Conservation. *Forests, 2*, 550-577.

Mitei, Z. (2011). Growing sustainable tea on Kenyan smallholder farms. *International Journal of Agricultural Sustainability, 9*(1), 59-66.

Moore, S. E., Cubbage, F., & Eicheldinger, C. (2012). Impacts of Forest Stewardship Council (FSC) and Sustainable Forestry Initiative (SFI) Forest Certification in North America. *Journal of Forestry, 110*(2), 79-88.

Mori Junior, R., M. Franks, D., Ali, S. H., Eweje, G., & Eweje, G. (2016). Sustainability certification schemes: evaluating their effectiveness and adaptability. *Corporate Governance: The International Journal of Business in Society, 16*(3), 1-27.

Muradian, R., Corbera, E., Pascual, U., Kosoy, N., & May, P. H. (2010). Reconciling theory and practice: An alternative conceptual framework for understanding payments for environmental services. *Ecological Economics, 69*(6), 1202-1208.

Muradian, R., & Rival, L. (2012). Between markets and hierarchies: The challenge of governing ecosystem services. *Ecosystem Services, 1*(1), 93-100.

Nasi, R., Billand, A., & van Vliet, N. (2012). Managing for timber and biodiversity in the Congo Basin. *Forest Ecology and Management, 268*(0), 103-111.

Newsom, D., Bahn, V., & Cashore, B. (2006). Does forest certification matter? An analysis of operation-level changes required during the SmartWood certification process in the United States. *Forest Policy and Economics, 9*(3), 197-208.

Nickerson, N. P., Black, R. J., & McCool, S. F. (2001). Agritourism: Motivations behind Farm/Ranch Business Diversification. *Journal of Travel Research, 40*(1), 19-26.

Nussbaum, R., & Simula, M. (2005). *The Forest Certification Handbook* (2nd ed.). London: Earthscan.

Osborne, J. W., & Costello, A. B. (2004). Sample size and subject to item ratio in principal components analysis. *Practical Assessment, Research & Evaluation*, *9*(11), 8.

Ottaviani, D., & Scialabba, N. E.-H. (2011). *Payment for Ecosystem Services and Food Security*. Rome: Food and Agriculture Organization of the United Nations (FAO).

Overdevest, C., & Rickenbach, M. G. (2006). Forest certification and institutional governance: An empirical study of forest stewardship council certificate holders in the United States *Forest Policy and Economics, 9*(2), 93-102.

Pagiola, S., Arcenas, A., & Platais, G. (2005). Can Payments for Environmental Services Help Reduce Poverty? An Exploration of the Issues and the Evidence to Date from Latin America. *World Development, 33*(2), 237-253.

Pagiola, S. (2008). Payments for environmental services in Costa Rica. *Ecological Economics, 65*(4), 712-724.

Perfecto, I., Vandermeer, J., Mas, A., & Pinto, L. S. (2005). Biodiversity, yield, and shade coffee certification. *Ecological Economics, 54*(4), 435-446.

Peters-Stanley, M., Gonzalez, G., & Yin, D. (2013). Covering New Ground: State of the Forest Carbon Markets 2013. Washington, D.C.: Ecosystem Marketplace

Pettenella, D., & Brotto, L. (2012). Governance features for successful REDD+ projects organization. *Forest Policy and Economics, 18*, 46-52.

Pierce, A., Shanley, P., & Laird, S. (2008). Non-timber forest products and certification: strange bedfellows. *Forests, Trees and Livelihoods, 18*(1), 23-35.

Pirard, R. (2012a). Market-based instruments for biodiversity and ecosystem services: A lexicon. *Environmental Science & Policy, 19-20*, 59-68.

Pirard, R. (2012b). Payments for Environmental Services (PES) in the public policy landscape: "Mandatory" spices in the Indonesian recipe. *Forest Policy and Economics, 18*, 23-29.

Pirard, R., de Buren, G., & Lapeyre, R. (2014). Do PES Improve the Governance of Forest Restoration? *Forests, 5*(3), 404-424.

Pires, M. (2004). Watershed protection for a world city: the case of New York. *Land Use Policy, 21*(2), 161-175.

Porras, I., Grieg-Gran, M., & Neves, N. (2008). All that glitters: A review of payments for watershed services in developing countries. London: International Institute for Environment and Development.

Pouzols, F. M., Burgman, M. A., & Moilanen, A. (2012). Methods for allocation of habitat management, maintenance, restoration and offsetting, when conservation actions have uncertain consequences. *Biological Conservation, 153*, 41-50.

Prasetyo, F. A., Suwarno, A., Purwanto, & Hakim, R. (2009). Making policies work for Payment for Environmental Services (PES): an evaluation of the experience of formulating conservation policies in districts of Indonesia. *Journal of Sustainable Forestry, 28*(3-5), 415-433.

Purbawiyatna, A., & Simula, M. (2008). *Developing Forest Certification: Towards Increasing the Comparability and Acceptance of Forest Certification Systems Worldwide*. Yokohama: International Tropical Timber Organization.

Putz, F. E., & Romero, C. (2001). Biologists and Timber Certification. *Conservation Biology, 15*(2), 313-314.

Putzel, L., Dermawan, A., Moeliono, M., & Trung, L. Q. (2012). Improving opportunities for smallholder timber planters in Vietnam to benefit from domestic wood processing. *International Forestry Review, 14*(2), 227-237.

Pure Catkills. (2015). Supporting Working Landscapes in the Catskills. Retrieved on 18 August 2015 from http://purecatskills.com/supporting-working-landscapes-catskills

Quétier, F., & Lavorel, S. (2011). Assessing ecological equivalence in biodiversity offset schemes: key issues and solutions. *Biological Conservation, 144*(12), 2991-2999.

Rametsteiner, E., & Simula, M. (2003). Forest certification-an instrument to promote sustainable forest management? *Journal of Environmental Management, 67*(1), 87-98.

Raudsepp-Hearne, C., Peterson, G. D., & Bennett, E. M. (2010). Ecosystem service bundles for analyzing tradeoffs in diverse landscapes. *Proceedings of the National Academy of Sciences of the United States of America, 107*(11), 5242-5247.

Raynolds, L., Murray, D., & Heller, A. (2007). Regulating sustainability in the coffee sector: A comparative analysis of third-party environmental and social certification initiatives. *Agriculture and Human Values, 24*(2), 147-163.

Reed Johnson, F., Lancsar, E., Marshall, D., Kilambi, V., Mühlbacher, A., Regier, D. A., et al. (2013). Constructing Experimental Designs for Discrete-Choice Experiments: Report of the ISPOR Conjoint Analysis Experimental Design Good Research Practices Task Force. *Value in Health, 16*(1), 3-13.

Revelle, W. (2015). *psych: Procedures for Psychological, Psychometric, and Personality Research*. Evanston, Illinois: Northwestern University.

Richards, K. R., & Huebner, G. E. (2012a). Evaluating protocols and standards for forest carbon-offset programs, Part A: additionality, baselines and permanence. *Carbon Management, 3*(4), 393-410.

Richards, K. R., & Huebner, G. E. (2012b). Evaluating protocols and standards for forest carbon-offset programs, Part B: leakage assessment, wood products, validation and verification. *Carbon Management, 3*(4), 411-425.

Roberge, A., Bouthillier, L., & Boiral, O. (2011). The influence of forest certification on environmental performance: an analysis of certified companies in the province of Quebec (Canada). *Canadian Journal of Forest Research, 41*(4), 661-668.

Robertson, M., BenDor, T. K., Lave, R., Riggsbee, A., Ruhl, J. B., & Doyle, M. (2014). Stacking ecosystem services. *Frontiers in Ecology and the Environment, 12*(3), 186-193. doi: 10.1890/110292

Romero, C., Putz, F. E., Guariguata, M. R., Sills, E. O., Cerutti, P. O., & Lescuyer, G. (2013). *An Overview of Current Knowledge about the Impacts of Forest Management Certification: A Proposed Framework for Its Evaluation* Bogor: CIFOR.

Romijn, E., Herold, M., Kooistra, L., Murdiyarso, D., & Verchot, L. (2012). Assessing capacities of non-Annex I countries for national forest monitoring in the context of REDD+. *Environmental Science & Policy, 19–20*, 33-48.

Schmitt, J., Pokorny, B., & Ying, L. (2008). Certification of non-timber forest products in China: effects on food quality, forest conservation and rural development. *Forests, Trees and Livelihoods, 18*(1), 81-89.

Schmolck, P., 2014. PQMethod. http://schmolck.userweb.mwn.de/qmethod/downpqwin.htm

Schneider, C., Coudel, E., Cammelli, F., & Sablayrolles, P. (2015). Small-Scale Farmers' Needs to End Deforestation: Insights for REDD+ in São Felix do Xingu (Pará, Brazil). *International Forestry Review, 17*(s1), 124-142.

Schoonhoven-Speijer, M. (2012). *Maintaining a Sustainable Livelihood: An Analysis of the Effects of UTZ Certification on Market Access, Risk Reduction and Livelihood Strategies of Kenyan Coffee Farmers.* (Master's thesis), Radboud University Nijmegen, Nijmegen, Netherlands.

Shanley, P., Pierce, A. R., Laird, S. A., & Robinson, D. (2008). *Beyond timber: certification and management of non-timber forest products*. Bogor, Indonesia: Center for International Forestry Research (CIFOR).

Sharpley, R., & Vass, A. (2006). Tourism, farming and diversification: An attitudinal study. *Tourism Management, 27*(5), 1040-1052.

Sheil, D., Putz, F. E., & Zagt, R. J. (2010). *Biodiversity conservation in certified forests*. Wageningen: Tropenbos International.

Sheppard, S. R., Achiam, C., & D'Eon, R. G. (2004). Aesthetics: are we neglecting a critical issue in certification for sustainable forest management? *Journal of Forestry, 102*(5), 6-11.

Shortle, J. S., & Horan, R. D. (2008). The economics of water quality trading. *International Review of Environmental and Resource Economics, 2*(2), 101-133.

Stephenson, W. (1953). The study of behaviour: Q technique and its methodology. Chicago: University of Chicago Press.

Sterner, T., & Coria, J. (2012). *Policy Instruments for Environmental and Natural Resource Management* (2nd ed.). Washington, DC: RFF Press.

Stupak, I., Lattimore, B., Titus, B. D., & Tattersall Smith, C. (2011). Criteria and indicators for sustainable forest fuel production and harvesting: A review of current standards for sustainable forest management. *Biomass and Bioenergy, 35*(8), 3287-3308.

Teisl, M. F., & Roe, B. (2000). Environmental certification: Informing consumers about forest products. *Journal of Forestry, 98*(2), 36-42.

Tenenhaus, M., & Young, F. (1985). An analysis and synthesis of multiple correspondence analysis, optimal scaling, dual scaling, homogeneity analysis and other methods for quantifying categorical multivariate data. *Psychometrika, 50*(1), 91-119.

Thompson, B. (2004). *Exploratory and confirmatory factor analysis: Understanding concepts and applications*. Washington, DC: American Psychological Association.

Thompson, D. W., Anderson, R. C., Hansen, E. N., & Kahle, L. R. (2010). Green segmentation and environmental certification: insights from forest products. *Business Strategy and the Environment, 19*(5), 319-334.

Tietenberg, T. (2003). The Tradable-Permits Approach to Protecting the Commons: Lessons for Climate Change. *Oxford Review of Economic Policy, 19*(3), 400-419.

Tikina, A., Kozak, R., & Larson, B. (2008). What factors influence obtaining forest certification in the U.S. Pacific Northwest? *Forest Policy and Economics, 10*(4), 240-247.

Tollefson, C., Gale, F., & Haley, D. (2008). *Setting the Standard: Certification, Governance, and the Forest Stewardship Council*. Vancouver: UBC Press.

Train, K. (2000). *Halton sequences for mixed logit*. Economics Working Papers E00-278. University of California at Berkeley.

Train, K. (2009). *Discrete Choice Methods with Simulation*. Cambridge: Cambridge University Press.

Train, K., & Weeks, M. (2005). Discrete Choice Models in Preference Space and Willingness-to-pay Space. In R. Scarpa & A. Alberini (Eds.), *Applications of Simulation Methods in Environmental and Resource Economics* (pp. 1-16). Dordrecht: Springer.

Tuominen, M., Rajala, A., & Moller, K. (2004). How does adaptability drive firm innovativeness? *Journal of Business Research, 57*(5), 495-506.

UTZ certified. (2015). Rianjagi Farmers Cooperative Society celebrates! Retrieved on 18 August 2015 from https://www.utzcertified.org/newsroom/utz-in-the-news/116-rianjagi-farmers-cooperative-society-celebrates?offset=280&lang=en

Valentin, C. D., Emrich, A., Werth, D., & Loos, P. (2012). *Conceiving Adaptability for Business Models: A Literature-based Approach.* Paper presented at the CONF-IRM 2012 Proceedings.

van Dam, J., Junginger, M., & Faaij, A. P. C. (2010). From the global efforts on certification of bioenergy towards an integrated approach based on sustainable land use planning. *Renewable and Sustainable Energy Reviews, 14*(9), 2445-2472.

van Kooten, G. C., Nelson, H. W., & Vertinsky, I. (2005). Certification of sustainable forest management practices: a global perspective on why countries certify. *Forest Policy and Economics, 7*(6), 857-867.

VCS (Verified Carbon Standard). (2015). Methodology Approval Process: VCS Version 3.

Vlahos, G., & Schiller, S. (2014). Transition Processes and Natural Resource Management. In L.-A. Sutherland, I. Darnhofer, G. Wilson & L. Zagata (Eds.), *Transition Pathways Towards Sustainability in Agriculture: Case Studies from Europe* (pp. 113-126): CABI International.

Vogt, K. A., Larson, B. C., Gordon, J. C., Vogt, D. J., & Fanzers, A. (2000). *Forest Certification: Roots, Issues, Challenges, and Benefits*. New Haven: School of Forestry and Environmental Studies, Yale University.

Watts, S., & Stenner, P. (2005). Doing Q methodology: theory, method and interpretation. *Qualitative Research in Psychology, 2*(1), 67-91.

Watts, S., & Stenner, P. (2012). *Doing Q methodological research: Theory, method & interpretation*: Sage.

Webler, T., Danielson, S., & Tuler, S. (2009). Using Q method to reveal social perspectives in environmental research. *Greenfield, MA: Social and Environmental Research Institute*.

Wendland, K. J., Honzák, M., Portela, R., Vitale, B., Rubinoff, S., & Randrianarisoa, J. (2010). Targeting and implementing payments for ecosystem services: Opportunities for bundling biodiversity conservation with carbon and water services in Madagascar. *Ecological Economics, 69*(11), 2093-2107.

Whittington, D., & Pagiola, S. (2012). Using contingent valuation in the design of payments for environmental services mechanisms: a review and assessment. *The World Bank Research Observer, 27*(2), 261-287.

Womble, P., & Doyle, M. (2012). Geography of trading ecosystem services: a case study of wetland and stream compensatory mitigation markets. *Harvard Environmental Law Review, 36*, 229.

Woodward, R. T. (2011). Double Dipping in Environmental Markets. *Journal of Environmental Economics and Management, 61*, 153-169.

Wunder, S. (2005). Payments for Environmental Services; Some Nuts and Bolts (pp. 1-24). Bogor: CIFOR.

Wunder, S., Engel, S., & Pagiola, S. (2008). Taking stock: A comparative analysis of payments for environmental services programs in developed and developing countries. *Ecological Economics, 65*(4), 834-852.

Wunder, S. (2015). Revisiting the concept of payments for environmental services. *Ecological Economics, 117,* 234–243.

WWF (The World Wide Fund for Nature). (2014). Jasa Lingkungan: Inisiatif Pendanaan Berkelanjutan Untuk Kawasan Rinjani. Lombok.

Zweifel, P., Rischatsch, M., & Brändle, A. (2009). *GPs' preferences: What price fee-for-service?* (Working Paper No. 0910). Zurich: Socioeconomic Institute, University of Zurich.

Appendices: Survey instruments

Appdenix A. Survey questionnaires for FSC certification bodies

Survey instruction

Thank you for your participation in this survey.

The survey has four sections:
- Section 1: Organization backgrounds
- Section 2: Capacity for ecosystem services certification
- Section 3: Direct costs of ecosystem services certification

The survey has a total of 15 questions, and it should take 15 - 20 minutes to complete.

Section 1: Organization backgrounds

1. Respondent information

Respondent name:	
Email (to share the survey result):	
Company name:	

2. How many years has your organization been in a certifying business?

Years:	

3. How many people are working in your organization?

Years:	

4. How many certified operations do you audit per year?

The number of audits per year:	

5. In which countries do you certify?

Section 2: Capacity for ecosystem services certification

6. To what degree does your organization have the capacity at this moment to audit certification of the following ecosystem services and goods?
Please check (∨) one option in each ecosystem services.

Options:
- (Not at all): not feasible to certify
- (Low capacity): challenging to certify
- (Medium capacity): might be possible
- (High capacity): highly feasible
- (Already in business): services are already in business
- (Don't know): I don't know

	Not at all	Low capacity	Medium capacity	High capacity	Already in business	Don't know
1. Watershed protection for "water quality improvement"	○	○	○	○	○	○
2. Watershed protection for "water quantity improvement"	○	○	○	○	○	○
3. Watershed protection for "flood risk reduction"	○	○	○	○	○	○
4. Carbon sequestration	○	○	○	○	○	○
5. Biodiversity conservation	○	○	○	○	○	○
6. Eco - tourism providing "scenic beauty"	○	○	○	○	○	○
7. Eco - tourism providing "cultural experiences"	○	○	○	○	○	○
8. Eco - tourism providing "biodiversity experiences"	○	○	○	○	○	○
9. Soil protection	○	○	○	○	○	○
10. Sustainable "agricultural products"	○	○	○	○	○	○
11. Sustainable "non - forest timber products"	○	○	○	○	○	○
12. Sustainable "Timber"	○	○	○	○	○	○

Any comments

Section 3: Direct costs of ecosystem services certification

7. Please estimate the direct costs of certifying ecosystem services by comparing to the direct cost* of "forest management certification," as per the current experience of your organization. Please check (∨) your estimated cost.

(*The direct costs are costs to certification applicants to follow certification procedures, including costs of document preparation, internal auditing, consulting, training, communication, and application.)

	25% cheaper (or less)	Same as "forest certification"	25% more expensive	50% more expensive	75% more expensive (or more)	Don't know
1. Watershed protection for "water quality improvement"	○	○	○	○	○	○
2. Watershed protection for "water quantity improvement"	○	○	○	○	○	○
3. Watershed protection for "flood risk reduction"	○	○	○	○	○	○
4. Carbon sequestration	○	○	○	○	○	○
5. Biodiversity conservation	○	○	○	○	○	○
6. Eco - tourism providing "scenic beauty"	○	○	○	○	○	○
7. Eco - tourism providing "cultural experiences"	○	○	○	○	○	○
8. Eco - tourism providing "biodiversity experiences"	○	○	○	○	○	○
9. Soil protection	○	○	○	○	○	○
10. Sustainable "agricultural products"	○	○	○	○	○	○
11. Sustainable "non - forest timber products"	○	○	○	○	○	○

Appdenix B. Survey questionnaires for FSC enabling partners

Survey instruction

Thank you for your participation in the survey!
This survey has a total of 8 questions, and it should take 15 - 20 minutes to complete.

Section 1: Organizational background

1. Survey participant name and email

Organization name:	
First name:	
Last name:	
Email (to share the result):	

Section 2: Technical training for ecosystem services certification

2. What types of capacity training are your organization willing to support related to the provision of the following ecosystem services (1 - 12)?
Please check (∨) options in each ecosystem service.

*ESG (Ecosystem Services and Goods)

	Not preferred	Training in legal aspects of ESG *	Quantifying ESG	Setting a baseline to monitor provision of ESG	Monitoring provision of ESG
1. Sustainable Timber (the current FSC scheme)	○	○	○	○	○
2. Watershed protection to improve "water quality"	○	○	○	○	○
3. Watershed protection to improve "water quantity"	○	○	○	○	○
4. Watershed protection to reduce "flood risk"	○	○	○	○	○
5. "Carbon" sequestration	○	○	○	○	○
6. "Biodiversity" conservation	○	○	○	○	○
7. Ecotourism providing "scenic beauty"	○	○	○	○	○
8. Ecotourism providing "cultural experiences"	○	○	○	○	○
9. Ecotourism providing "biodiversity" experiences	○	○	○	○	○
10. "Soil protection"	○	○	○	○	○
11. Sustainable "agricultural products"	○	○	○	○	○
12. Sustainable "non-timber forest products"	○	○	○	○	○

Any comments

Section 3: Funding support

3. Does (or will) your organization provide financial support to FSC certification applicants or holders (e.g., forest owners)?

- ○ Yes
- ○ No

If yes, would you provide an average (or estimated) amount per year?

4. If FSC were to launch a new certification scheme for ecosystem services in August 2015, how many percent of your funding for FSC forest certification could be available for the following schemes of FSC certification (1 -7)?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1. Watershed protection:	○	○	○	○	○	○	○	○	○	○	○
2. Carbon sequestration:	○	○	○	○	○	○	○	○	○	○	○
3. Biodiversity conservation:	○	○	○	○	○	○	○	○	○	○	○
4. Ecotourism:	○	○	○	○	○	○	○	○	○	○	○
5. Soil protection:	○	○	○	○	○	○	○	○	○	○	○
6. Sustainable agricultural products:	○	○	○	○	○	○	○	○	○	○	○
7. Sustainable non-timber forest products:	○	○	○	○	○	○	○	○	○	○	○

Any comments (optional)

Section 4: Lessons for developing FSC standards for ecosystem services

What would be expected "challenges" or "opportunities" of developing FSC standards for ecosystem services in the country where you support FSC? (e.g. watershed protection, carbon sequestration, biodiversity conservation, ecotourism, and soil preservation.)
Please tell us them based on your experiences with the current FSC certification.

5. Expected "challenges" in the country:

6. Expected "opportunities" in the country:

Section 5: Identifying other certification stakeholders

7. Please identify associations (or unions) of forest owners in your country, if any exists (e.g., names, descriptions, and available websites or emails).

8. Please identify certification promoters in your country who are not certification bodies, but support FSC certification in terms of capacity building and funding (e.g., names, roles, and available websites/emails).

Appdenix C. Survey questionnaires for FSC forest management certificate holders

Market Survey for Forest Certification for Ecosystem Services (ForCES)

Thank you for your participation in this survey! The survey has 14 questions in 4 sections:
- Section 1: Background and certification costs
- Section 2: Projects of forest ecosystem services
- Section 3: Market preferences for ecosystem services
- Section 4: Preferences for FSC certification for ecosystem services

The survey should take 15 - 20 minutes to complete.

Section 1: Background and certification costs

1. Participant information

Participant name:

FSC code (e.g. FSC - C******):

2. How much did (or does) it cost* for you to get FSC forest management certification (approximate)?

	Amounts ($USD)
a. Initial assessment costs invoiced by a certification body (the total):	
b. Average annual audit costs invoiced by a certification body (per year):	
c. Costs to meet the requirements of the "FSC Principles & Criteria" as well as "Corrective Action Requests" from a certification body (the total):	

Comments (optional)

* Individuals' cost information will remain anonymous and will not be shared with other parties.

----------[More information on Question 2]----------
- Total certification costs for 4 years = "a" (first year) + ("b" x 3 years) + "c"
- "a" and "b" are your certification costs to a certification body (direct costs).
- "c" is indirect costs. Examples include costs of training your staffs, or costs of adopting low-impact logging.

(Cost examples)
- $2,245 => $2,000
- $2,872 => $3,000

Section 2: Projects of forest ecosystem services

3. In your forests, if you have a conservation project that "protects" ecosystem services, which ecosystem services are protected? Please mark all the ecosystem services protected.

- ☐ a) no conservation project exists
- ☐ b) carbon storage
- ☐ c) watershed protection
- ☐ d) biodiversity conservation
- ☐ e) ecotourism
- ☐ f) soil conservation
- ☐ g) non - timber forest products
- ☐ h) agricultural products
- ☐ i) don't know

Other ecosystem services (please specify)

4. In your forests, if you have an ecosystem services project that "sells" ecosystem services, which ecosystem services are being sold? Please mark all the ecosystem services in sale.

- ☐ a) no conservation project exists
- ☐ b) carbon storage
- ☐ c) watershed protection
- ☐ d) biodiversity conservation
- ☐ e) ecotourism
- ☐ f) soil conservation
- ☐ g) non - timber forest products
- ☐ h) agricultural products
- ☐ i) don't know

Other ecosystem services (please specify)

5. Do you hold any certificate (other than FSC) for the provision of ecosystem services? Please mark all the ecosystem services under certification.

- ☐ a) no conservation project exists
- ☐ b) carbon storage
- ☐ c) watershed protection
- ☐ d) biodiversity conservation
- ☐ e) ecotourism
- ☐ f) soil conservation
- ☐ g) non - timber forest products
- ☐ h) agricultural products
- ☐ i) don't know

Other ecosystem services (please specify)

---------- [More information on Question 3 - 5] ----------
(Examples of ecosystem services):
b) Carbon storage services are protecting trees to store carbon which alleviates global warming.
c) Watershed protection services include providing clean water to downstream from forests.
d) Biodiversity conservation services are to conserve plants and animals or their habitats in forests.
e) Ecotourism services include providing cultural experience, scenic beauty, or wildlife experience for tourists.
f) Soil conservation services include conserving soil nutrients and preventing soil sediment runoffs.
g) Non-timber forest products include mushrooms, banana, nuts, and etc.
h) Forests support agricultural activities by providing irrigation sources or fertile soils.

Section 3: Market preferences for ecosystem services

6. According to your opinion, which ecosystem services from your forests have the potential for sale? Please rate them below in terms of their potential market demand.

	Low	Low medium	Medium	Medium high	High	Don't know
1. carbon storage	○	○	○	○	○	○
2. watershed protection	○	○	○	○	○	○
3. biodiversity conservation	○	○	○	○	○	○
4. ecotourism	○	○	○	○	○	○
5. soil conservation	○	○	○	○	○	○
6. non-timber forest products	○	○	○	○	○	○
7. agricultural products	○	○	○	○	○	○

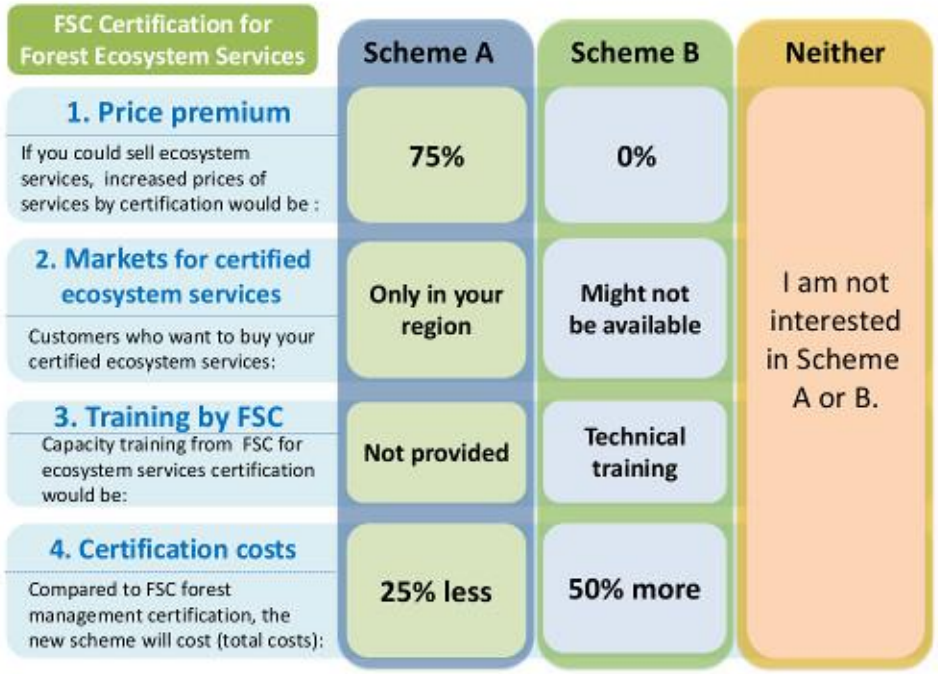
Section 4: Preferences for FSC certification for ecosystem services

* Questions 7 to14 are repeated because they are designed to estimate your preferences for "different characteristics" of certification by asking 8 questions. They seem similar but are different in terms of their characteristics.

7. * If the FSC were to launch a certification scheme for forest ecosystem services from 2016 onwards, which of the schemes below would you prefer? Please check one option (∨).

○ Scheme A ○ Scheme B ○ Neither

Any comments (optional)



(Appendix note: block 1 and set 1)

---------- [More information on Question 7 - 14] ----------

1. Price premium
   - Examples of price premium are an increased price of carbon credits or increased compensation of watershed protection by FSC certification which would have been lower without certification.
2. Markets for certified ecosystem services
   - An example case of "might not be available" includes certifying ecosystem services not for their sales but for non-economic purposes such as improving management by certification, or following government regulations.
3. Training by FSC
   - Examples of "technical trainings" include measuring and monitoring ecosystem services.
   - Examples of "administrative trainings" include registering carbon or biodiversity credits in markets
4. Certification costs
   - Costs of FSC certification for ecosystem services are shown in a comparison with the cost of your FSC forest management certification.

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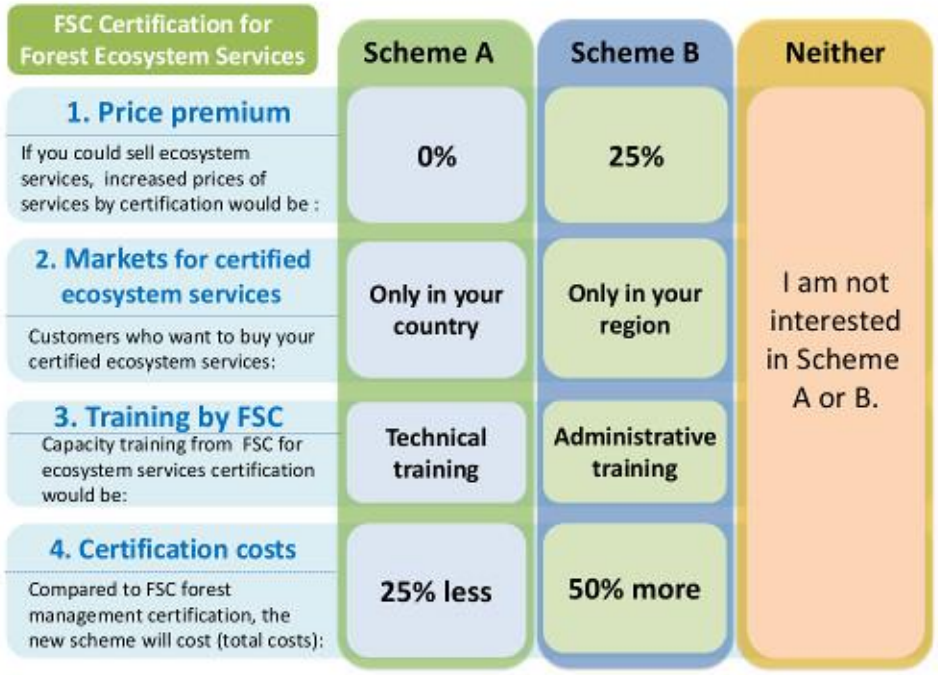
* Questions 7 to14 are repeated because they are designed to estimate your preferences for "different characteristics" of certification by asking 8 questions. They seem similar but are different in terms of their characteristics.

8. * If the FSC were to launch a certification scheme for forest ecosystem services from 2016 onwards, which of the schemes below would you prefer? Please check one option (∨).

○ Scheme A ○ Scheme B ○ Neither

Any comments (optional)



(Appendix note: block 1 and set 2)

---------- [More information on Question 7 - 14] ----------

1. Price premium
 - Examples of price premium are an increased price of carbon credits or increased compensation of watershed protection by FSC certification which would have been lower without certification.
2. Markets for certified ecosystem services
 - An example case of "might not be available" includes certifying ecosystem services not for their sales but for non-economic purposes such as improving management by certification, or following government regulations.
3. Training by FSC
 - Examples of "technical trainings" include measuring and monitoring ecosystem services.
 - Examples of "administrative trainings" include registering carbon or biodiversity credits in markets
4. Certification costs
 - Costs of FSC certification for ecosystem services are shown in a comparison with the cost of your FSC forest management certification.

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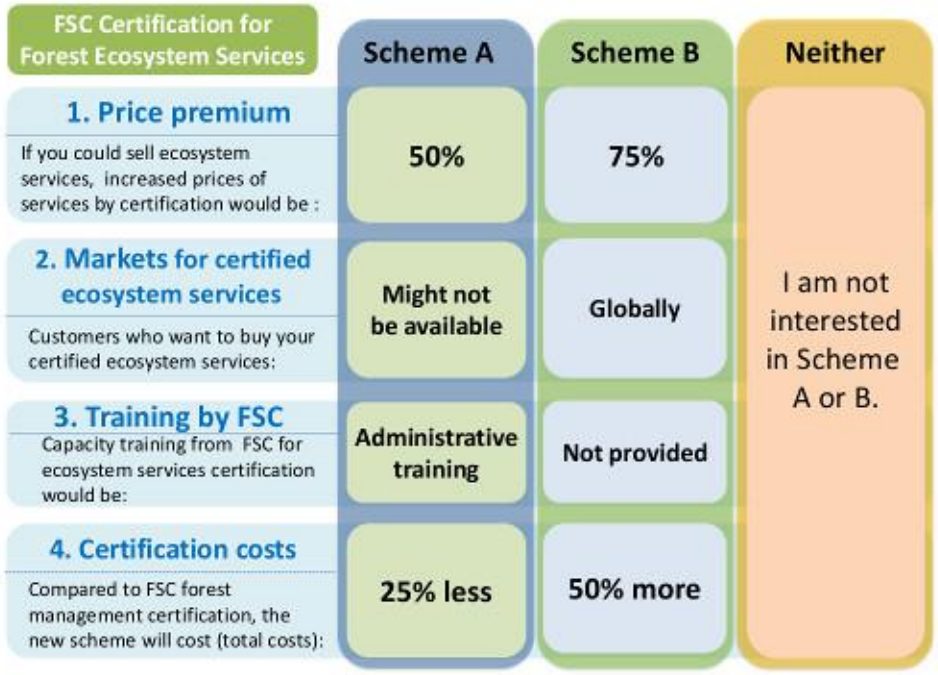
* Questions 7 to14 are repeated because they are designed to estimate your preferences for "different characteristics" of certification by asking 8 questions. They seem similar but are different in terms of their characteristics.

9. * If the FSC were to launch a certification scheme for forest ecosystem services from 2016 onwards, which of the schemes below would you prefer? Please check one option (∨).

○ Scheme A ○ Scheme B ○ Neither

Any comments (optional)



(Appendix note: block 1 and set 3)

---------- [More information on Question 7 - 14] ----------

1. Price premium
 - Examples of price premium are an increased price of carbon credits or increased compensation of watershed protection by FSC certification which would have been lower without certification.
2. Markets for certified ecosystem services
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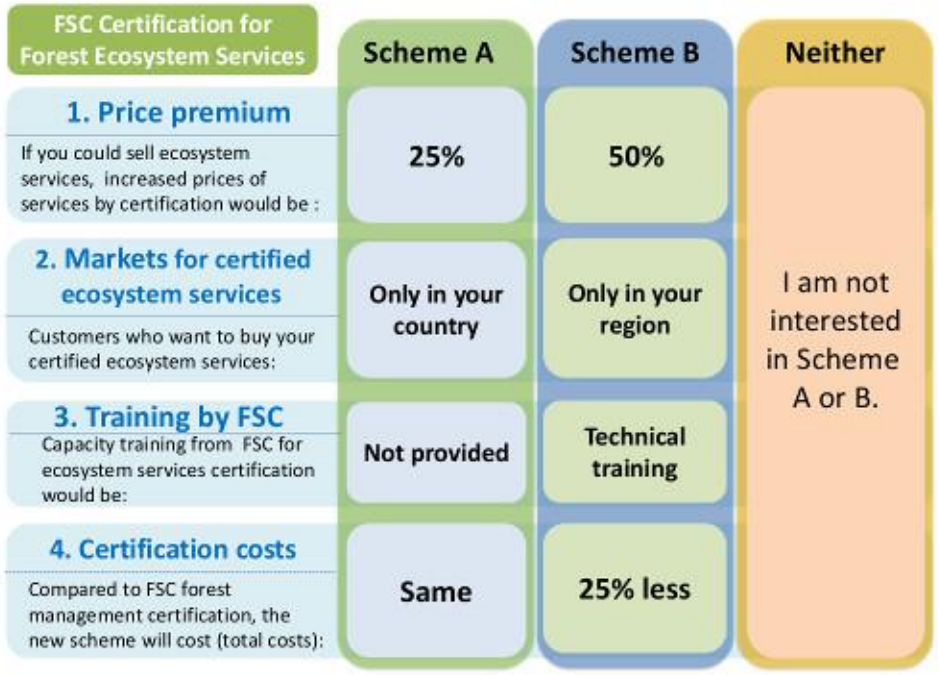
* Questions 7 to14 are repeated because they are designed to estimate your preferences for "different characteristics" of certification by asking 8 questions. They seem similar but are different in terms of their characteristics.

10. * If the FSC were to launch a certification scheme for forest ecosystem services from 2016 onwards, which of the schemes below would you prefer? Please check one option (∨).

○ Scheme A ○ Scheme B ○ Neither

Any comments (optional)



(Appendix note: block 1 and set 4)

---------- [More information on Question 7 - 14] ----------

1. Price premium
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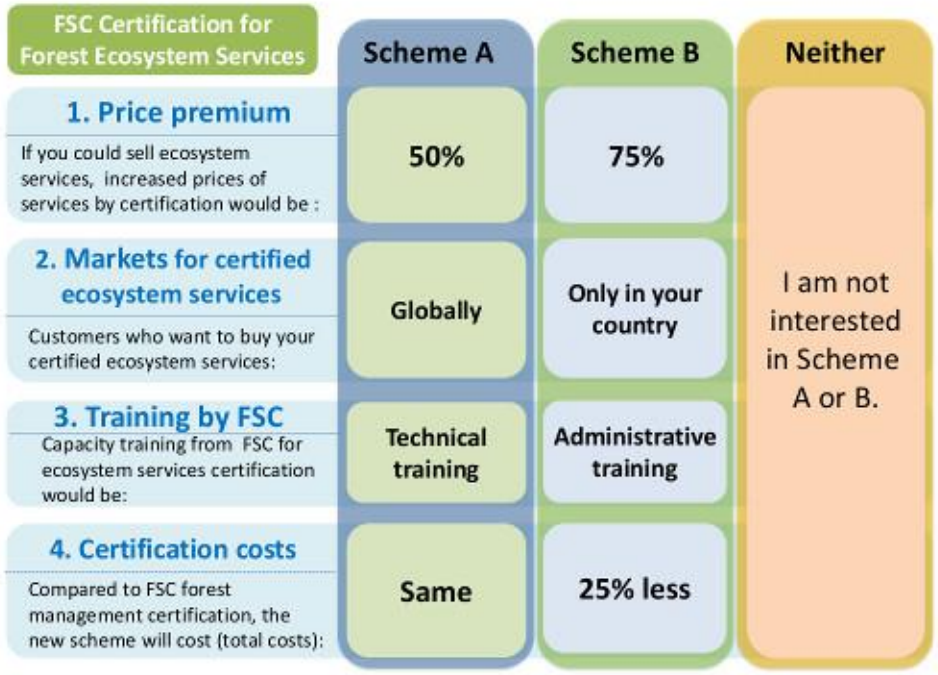
Any comments (optional)



(Appendix note: block 1 and set 5)

---------- [More information on Question 7 - 14] ----------

1. Price premium
 - Examples of price premium are an increased price of carbon credits or increased compensation of watershed protection by FSC certification which would have been lower without certification.
2. Markets for certified ecosystem services
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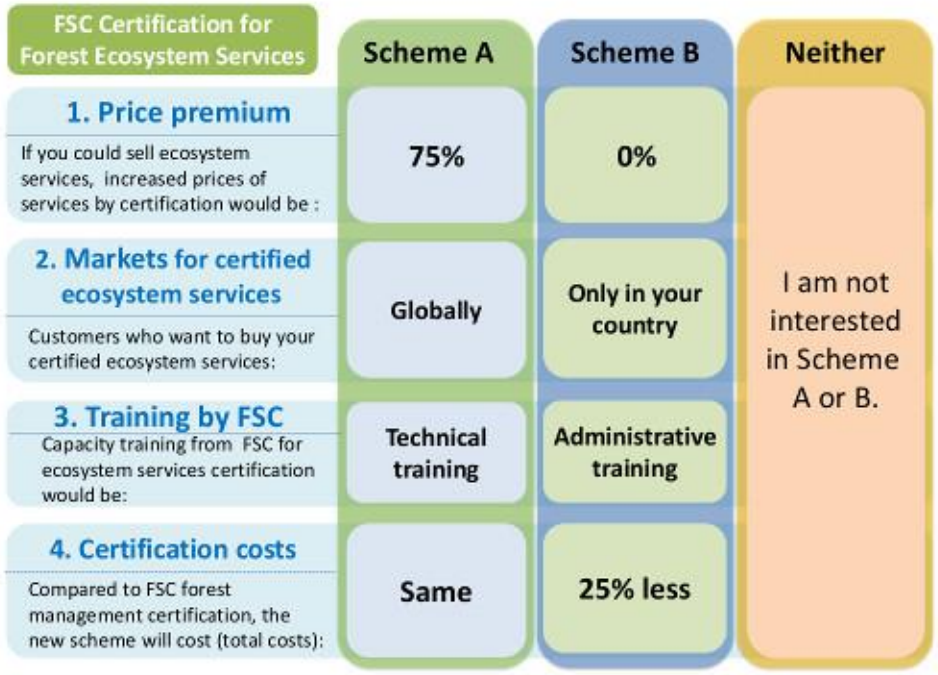
Any comments (optional)



(Appendix note: block 1 and set 6)

---------- [More information on Question 7 - 14] ----------

1. Price premium
 - Examples of price premium are an increased price of carbon credits or increased compensation of watershed protection by FSC certification which would have been lower without certification.
2. Markets for certified ecosystem services
 - An example case of "might not be available" includes certifying ecosystem services not for their sales but for non-economic purposes such as improving management by certification, or following government regulations.
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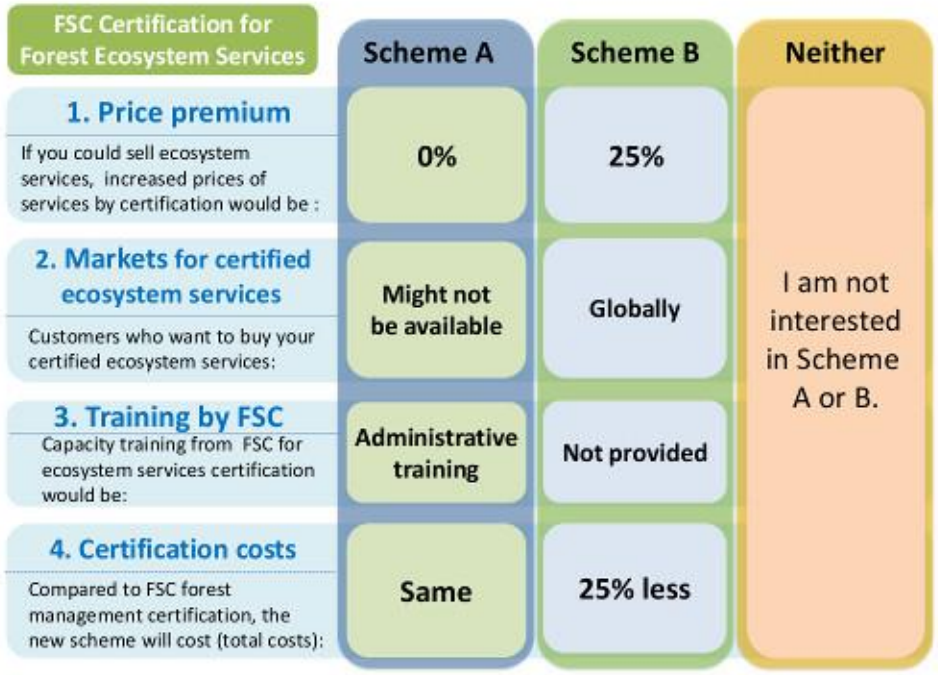
Any comments (optional)



(Appendix note: block 1 and set 7)

---------- [More information on Question 7 - 14] ----------

1. Price premium
 - Examples of price premium are an increased price of carbon credits or increased compensation of watershed protection by FSC certification which would have been lower without certification.
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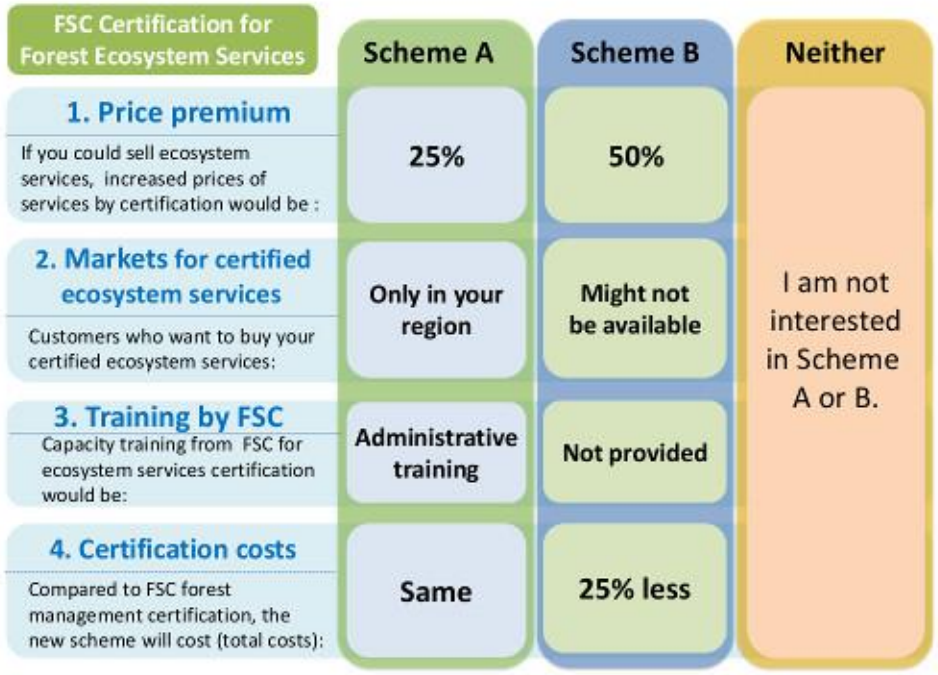
14. * If the FSC were to launch a certification scheme for forest ecosystem services from 2016 onwards, which of the schemes below would you prefer? Please check one option (∨).

○ Scheme A ○ Scheme B ○ Neither

Any comments (optional)



(Appendix note: block 1 and set 8)

---------- [More information on Question 7 - 14] ----------

1. Price premium
 - Examples of price premium are an increased price of carbon credits or increased compensation of watershed protection by FSC certification which would have been lower without certification.
2. Markets for certified ecosystem services
 - An example case of "might not be available" includes certifying ecosystem services not for their sales but for non-economic purposes such as improving management by certification, or following government regulations.
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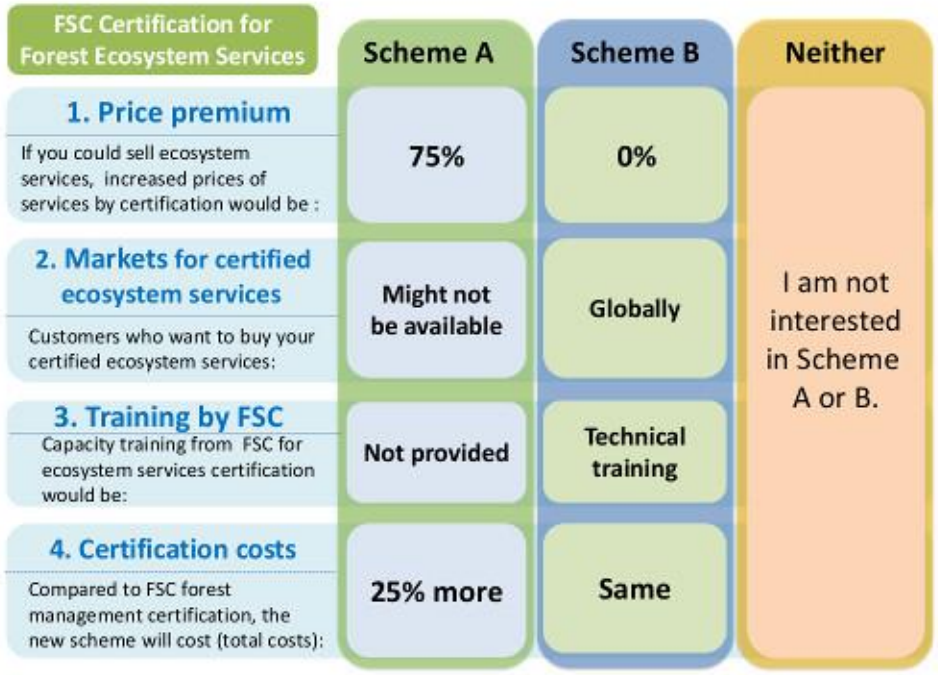
7. * If the FSC were to launch a certification scheme for forest ecosystem services from 2016 onwards, which of the schemes below would you prefer? Please check one option (∨).

○ Scheme A ○ Scheme B ○ Neither

Any comments (optional)



(Appendix note: block 2 and set 9)

---------- [More information on Question 7 - 14] ----------

1. Price premium
 - Examples of price premium are an increased price of carbon credits or increased compensation of watershed protection by FSC certification which would have been lower without certification.
2. Markets for certified ecosystem services
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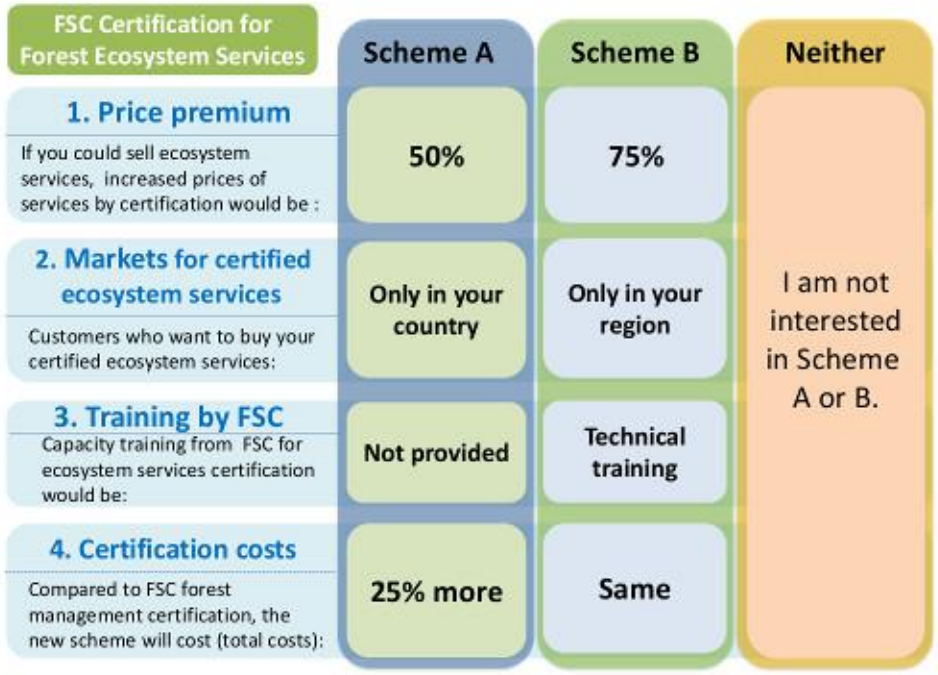
* Questions 7 to14 are repeated because they are designed to estimate your preferences for "different characteristics" of certification by asking 8 questions. They seem similar but are different in terms of their characteristics.

8. * If the FSC were to launch a certification scheme for forest ecosystem services from 2016 onwards, which of the schemes below would you prefer? Please check one option (∨).

○ Scheme A ○ Scheme B ○ Neither

Any comments (optional)



(Appendix note: block 2 and set 10)

---------- [More information on Question 7 - 14] ----------

1. Price premium
 - Examples of price premium are an increased price of carbon credits or increased compensation of watershed protection by FSC certification which would have been lower without certification.
2. Markets for certified ecosystem services
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9. * If the FSC were to launch a certification scheme for forest ecosystem services from 2016 onwards, which of the schemes below would you prefer? Please check one option (∨).

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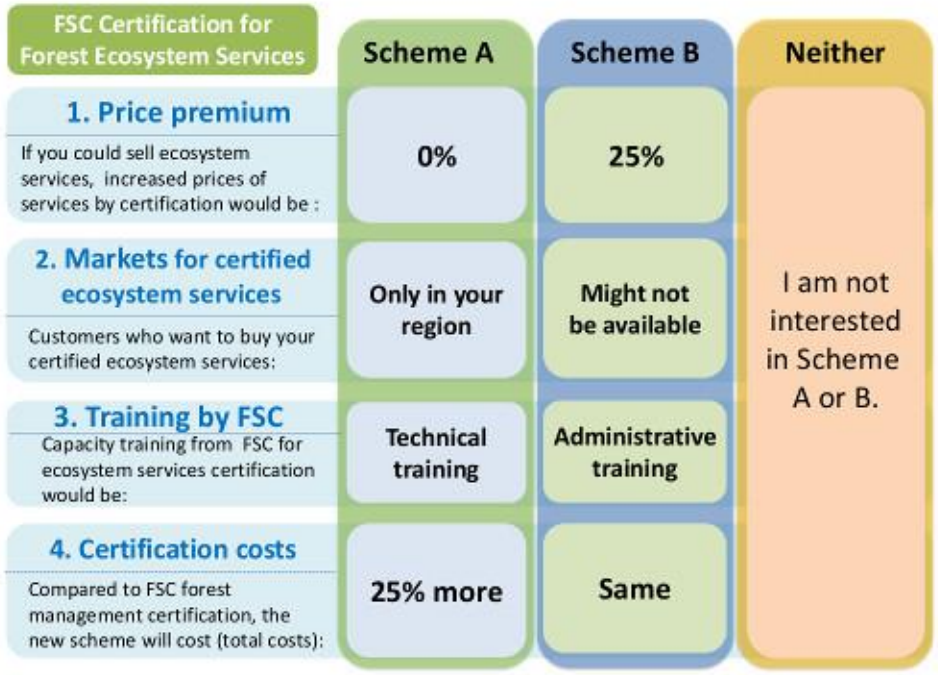
Any comments (optional)



(Appendix note: block 2 and set 11)

---------- [More information on Question 7 - 14] ----------

1. Price premium
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10. * If the FSC were to launch a certification scheme for forest ecosystem services from 2016 onwards, which of the schemes below would you prefer? Please check one option (∨).

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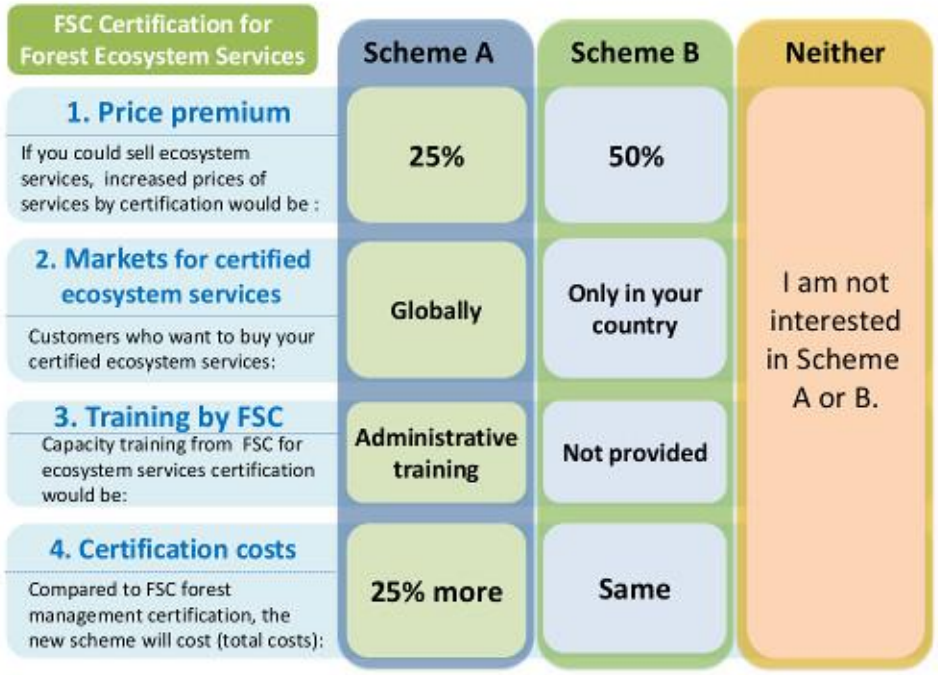
Any comments (optional)



(Appendix note: block 2 and set 12)

---------- [More information on Question 7 - 14] ----------

1. Price premium
 - Examples of price premium are an increased price of carbon credits or increased compensation of watershed protection by FSC certification which would have been lower without certification.
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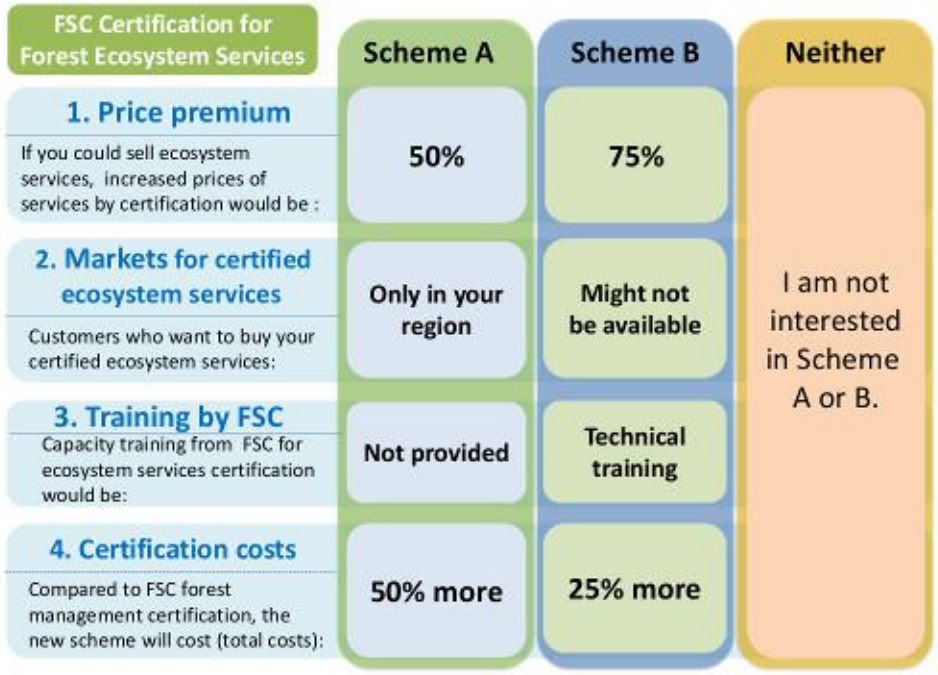
Any comments (optional)



(Appendix note: block 2 and set 13)

---------- [More information on Question 7 - 14] ----------

1. Price premium
 - Examples of price premium are an increased price of carbon credits or increased compensation of watershed protection by FSC certification which would have been lower without certification.
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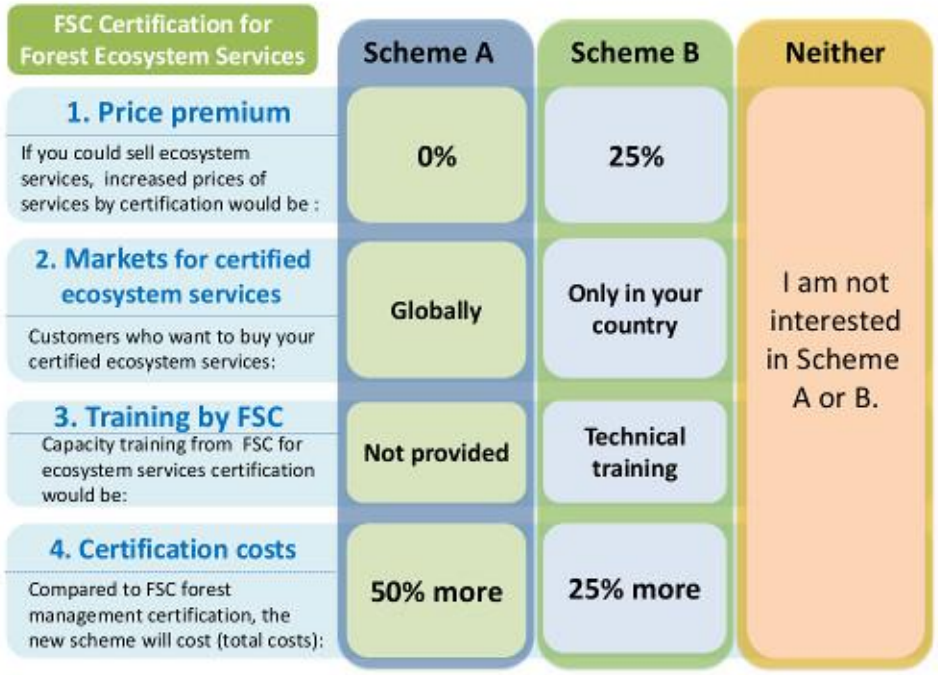

(Appendix note: block 2 and set 14)

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1. Price premium
   - Examples of price premium are an increased price of carbon credits or increased compensation of watershed protection by FSC certification which would have been lower without certification.
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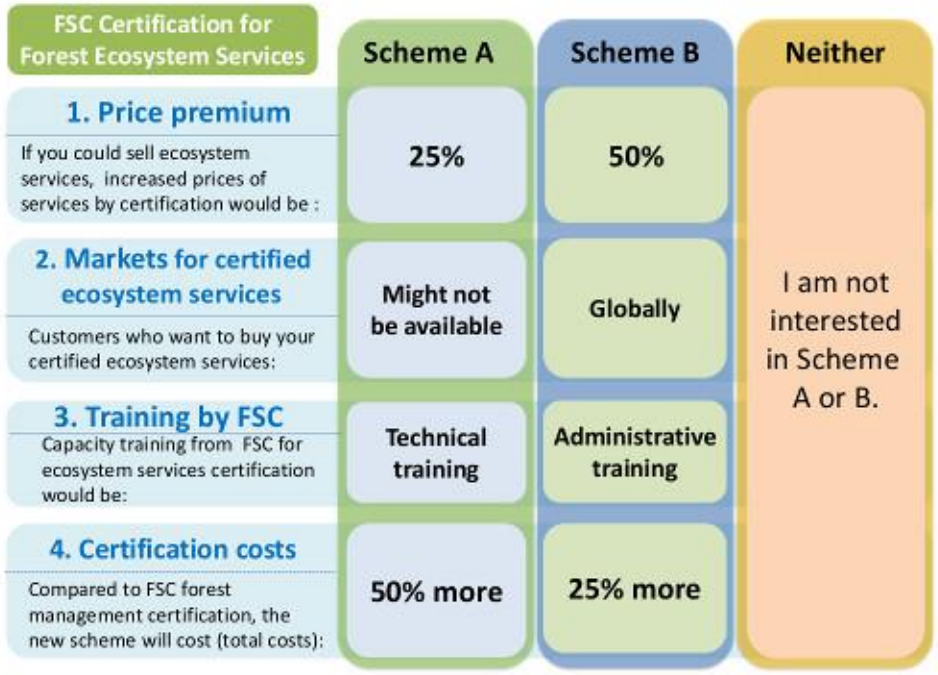

(Appendix note: block 2 and set 15)

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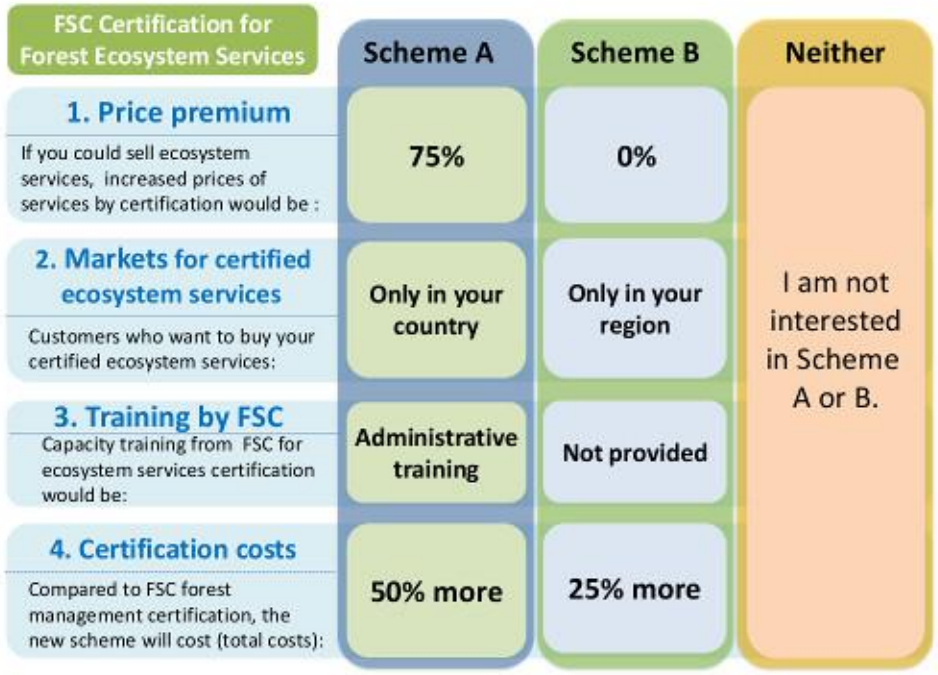

(Appendix note: block 2 and set 16)

---------- [More information on Question 7 - 14] ----------

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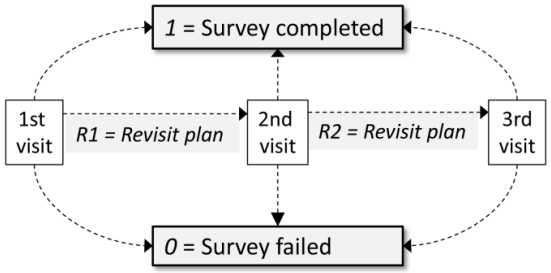
Appendix D. Survey questionnaires for PWS buyers in West Lombok, Indonesia

Riset Pasar untuk Sertifikasi Daerah Aliran Sungai di Lombok: Survei Konsumen Air	v5.4 | May 2015 | BI |	Rumah Tangga

Bagian 1: Informasi Survei

Informasi kontak: Selamat pagi bapak/Ibu. Kami mahasiswa dari Universitas British Columbia dari Canada, akan mengadakan wawancara tentang Sertifikasi untuk jasa lingkungan (air), dalam rangka mengetahui apakah pelanggan ingin Sertifikasi atau tidak. Apakah Bapak atau Ibu punya waktu untuk diwawancara? Mungkin Kurang lebih 30 menit. (**d1** => **d2** => **d3** => **d4a** => **Part 3**)

Part 1: sebelum survei	
(a) Nama pewawancara:	
(b1) Kecamatan:	
(b2) Desa:	(b3) Letak: *1* = Kampung *2* = Kota
(b4) Dusun:	
(c1) **Choice experiment SET**: 1 2 3 4	
(c2) **Harga random jasa lingkungan**: Rp. ribu	
Part 3: tangaal dan waktu survei	
Kunjungan pertama *(1st)*	
(e1a) Tanggal: - - 2015 (*hari – bulan – tahun*)	
(e1b) Waktu mulai: **:** (*jam*: *min*) pagi / siang / sore / malam	
(e1c) Waktu berhenti: **:** (*jam*: *min*) pagi / siang / sore / malam	
Kunjungan kedua (2nd)	
(e2a) Tanggal: - - 2015 (*hari – bulan – tahun*)	
(e2b) Waktu mulai: **:** (*jam*: *min*) pagi / siang / sore / malam	
(e2c) Waktu berhenti: (*jam*: *min*) pagi / siang / sore / malam	

Part 2: verifikasi responden	
(d1) PDAM samb: 2A 2B – 2C 2D 2E – 2F 2G	
(d2) PDAM Gol:	
(d3) Berumur lebih 18 tahun:	*1* = Ya *2* = Tidak (not eligible)
(d4) Posisi di keluarga:	*1* = Kepala Rumah tangga *2* = Orang dewasa yang paham
(d5a) **Persetujuan survei**:	*1* = Ya, dengan kertas persetujuan *2* = Ya, dengan persetujuan lisan *-8* = lainnya (d5b):
Part 4: setelah survey	
(f) Status survei:	

Bagian 2: Demografi rumah tangga

(2.1). **Anggota 1-5**

1 = Istri /Suami *2* = Anak /Anak saudara *3* = Orang tua *4* = Mertua *5* = Menantu *6* = Bukan anggota keluarga *-8* = Lainnya (a2)					-9 = Tidak tahu (TT) 0 = Tidak sekolah (TS) -8 = Lainnya (e2)	-9 = Tidak tahu (TT)		-9 = Tidak tahu 0 = Pengangguran 1 = Ibu rumah tangga 2 = Pelajar 3 = Pensiunan 4 = Swasta -8 = Lainnya (f2)
(a1) Posisi dalam Keluarga		**(b) Usia**	**Tinggal bersama (c)**	**Jenis Kelamin (d)**	**(e1) Tingkat Pendidikan**	**Bisa membaca (f)**	**Tempat kelahiran (g)**	**(f1) Pekerjaan**
A1	1 2 3 4 5 6 Nama koresponden:		*1* = Ya	*0* = L *1* = P	*-9* = TT *0* = TS *1* = SD *2* = SMP *3* = SMA *4* = S1 *5* = S2 *6* = S3 *7* = Diploma *-8*	*-9* = TT *0* = Tidak *1* = Ya	*-9* = TT *1* = Lombok *-8* = Lainnya	-9 0 1 2 3 4 -8:
A2	1 2 3 4 5 6 -8:		*0* = Tidak *1* = Ya	*0* = L *1* = P	*-9* = TT *0* = TS *1* = SD *2* = SMP *3* = SMA *4* = S1 *5* = S2 *6* = S3 *7* = Diploma *-8*	*-9* = TT *0* = Tidak *1* = Ya	*-9* = TT *1* = Lombok *-8* = Lainnya	-9 0 1 2 3 4 -8:
A3	1 2 3 4 5 6 -8:		*0* = Tidak *1* = Ya	*0* = L *1* = P	*-9* = TT *0* = TS *1* = SD *2* = SMP *3* = SMA *4* = S1 *5* = S2 *6* = S3 *7* = Diploma *-8*	*-9* = TT *0* = Tidak *1* = Ya	*-9* = TT *1* = Lombok *-8* = Lainnya	-9 0 1 2 3 4 -8:
A4	1 2 3 4 5 6 -8:		*0* = Tidak *1* = Ya	*0* = L *1* = P	*-9* = TT *0* = TS *1* = SD *2* = SMP *3* = SMA *4* = S1 *5* = S2 *6* = S3 *7* = Diploma *-8*	*-9* = TT *0* = Tidak *1* = Ya	*-9* = TT *1* = Lombok *-8* = Lainnya	-9 0 1 2 3 4 -8:
A5	1 2 3 4 5 6 -8:		*0* = Tidak *1* = Ya	*0* = L *1* = P	*-9* = TT *0* = TS *1* = SD *2* = SMP *3* = SMA *4* = S1 *5* = S2 *6* = S3 *7* = Diploma *-8*	*-9* = TT *0* = Tidak *1* = Ya	*-9* = TT *1* = Lombok *-8* = Lainnya	-9 0 1 2 3 4 -8:

(2.2). **Anggota 6-10**

1 = Istri /Suami *2* = Anak /Anak saudara *3* = Orang tua *4* = Mertua *5* = Menantu *6* = Bukan anggota keluarga *-8* = Lainnya (a2) **(a1) Posisi dalam Keluarga**		**(b) Usia**	**Tinggal bersama (c)**	**Jenis Kelamin (d)**	*-9* = Tidak tahu (TT) *0* = Tidak sekolah (TS) *-8* = Lainnya (e2) **(e1) Tingkat Pendidikan**	*-9* = Tidak tahu (TT) **Bisa membaca (f)**	*-9* = Tidak tahu (TT) **Tempat kelahiran (g)**	*-9* = Tidak tahu *0* = Pengangguran *1* = Ibu rumah tangga *2* = Pelajar *3* = Pensiunan *4* = Swasta *-8* = Lainnya (f2) **(f1) Pekerjaan**
A6	1 2 3 4 5 6 -8:		*0* = Tidak *1* = Ya	*0* = L *1* = P	*-9* = TT *4* = S1 *0* = TS *5* = S2 *1* = SD *6* = S3 *2* = SMP *7* = Diploma *3* = SMA *-8*	*-9* = TT *0* = Tidak *1* = Ya	*-9* = TT *1* = Lombok *-8* = Lainnya	-9 0 1 2 3 4 -8:
A7	1 2 3 4 5 6 -8:		*0* = Tidak *1* = Ya	*0* = L *1* = P	*-9* = TT *4* = S1 *0* = TS *5* = S2 *1* = SD *6* = S3 *2* = SMP *7* = Diploma *3* = SMA *-8*	*-9* = TT *0* = Tidak *1* = Ya	*-9* = TT *1* = Lombok *-8* = Lainnya	-9 0 1 2 3 4 -8:
A8	1 2 3 4 5 6 -8:		*0* = Tidak *1* = Ya	*0* = L *1* = P	*-9* = TT *4* = S1 *0* = TS *5* = S2 *1* = SD *6* = S3 *2* = SMP *7* = Diploma *3* = SMA *-8*	*-9* = TT *0* = Tidak *1* = Ya	*-9* = TT *1* = Lombok *-8* = Lainnya	-9 0 1 2 3 4 -8:
A9	1 2 3 4 5 6 -8:		*0* = Tidak *1* = Ya	*0* = L *1* = P	*-9* = TT *4* = S1 *0* = TS *5* = S2 *1* = SD *6* = S3 *2* = SMP *7* = Diploma *3* = SMA *-8*	*-9* = TT *0* = Tidak *1* = Ya	*-9* = TT *1* = Lombok *-8* = Lainnya	-9 0 1 2 3 4 -8:
A10	1 2 3 4 5 6 -8:		*0* = Tidak *1* = Ya	*0* = L *1* = P	*-9* = TT *4* = S1 *0* = TS *5* = S2 *1* = SD *6* = S3 *2* = SMP *7* = Diploma *3* = SMA *-8*	*-9* = TT *0* = Tidak *1* = Ya	*-9* = TT *1* = Lombok *-8* = Lainnya	-9 0 1 2 3 4 -8:

(2.3) Pembayaran PDAM

(a) Siapakah yang biasa membayar tagihan PDAM? A1 A2 A3 A4 A5 A6 A7 A8 A9 A10

Bagian 3: Penggunaan air

(3.1). Penggunaan PDAM | (**h**) Kenapa rumah tangga ini memakai PDAM?:

(a1) Bagaimana penggunaan air PDAM?

-9 = Tidak tahu
1 = Untuk mandi
2 = Untuk mencuci/membilas
3 = Untuk minum
4 = Untuk masak
-8 = Untuk lainnya (a3):

(a2) Jika 3 atau 4 dicek, apakah ada pengalaman **diare** dari minum air?
-9= Tidak tahu *0* = Tidak *1* = Ya karena mentah *2* = Ya dengan proses

(b) Berapakah keluarga ini membayar tagihan PDAM rata-rata per bulan?

-9 = Tidak tahu

Juta			*Ribu*			
				0	0	Rp. per bulan

(c) Apakah rumah tangga ini membayar biaya jasa lingkungan (biaya konservasi)?

-9 = Tidak tahu *0* = Tidak bayar

Juta			*Ribu*			
				0	0	Rp. per bulan

(e) Pengalaman rumah tangga ini dengan PDAM:

Rasa dari PDAM:	(e1h) Musim hujan:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
	(e1p) Musim panas:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
Bau air dari PDAM:	(**e5h**) Musim hujan:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
	(**e5p**) Musim panas:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
Tekanan pipa PDAM:	(e2h) Musim hujan:	*1* = Sangat kurang	*2* = Kurang	*3* = Sedang	*4* = Bagus	*5* = Sangat bagus
	(e2p) Musim panas:	*1* = Sangat kurang	*2* = Kurang	*3* = Sedang	*4* = Bagus	*5* = Sangat bagus
Harga PDAM:	(e3)	*1* = Sangat murah	*2* = Murah	*3* = Sedang	*4* = Mahal	*5* = Sangat mahal
Kekurangan air dari PDAM:	(e4h) Musim hujan:	*1*= Tidak pernah	*2* = Jarang	*3* = Kadang-kadang	*4* = Sering	*5* = Sangat sering
	(e4p) Musim panas:	*1*= Tidak pernah	*2* = Jarang	*3* = Kadang-kadang	*4* = Sering	*5* = Sangat sering

(f1) Sumber air apa yang digunakan untuk pengganti PDAM, ketika PDAM sedang tidak tersedia?

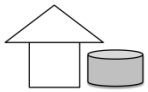
0 = Tidak ada alternatif
-9 = Tidak tahu
1 = Sumur rumah tangga
2 = Sumur keran bersama
3 = Sumur bersama
4 = Air dalam kemasan (air botol)
5 = Air galon isi ulang
6 = Anak sungai, sungai kecil, dan sungai
7 = Mengumpulkan air hujan
8 = Sumur milik tetangga
-8 = Lainnya (f2):

(g1) Biasanya membayar tagihan PDAM dimana?

1 = PDAM loket office *2* = PDAM office *3* = Internet banking *4* = Post office *5* = Toko pulsa dan listrik *-8* = Lain (g2):

(i1) Sumber air apa yang digunakan oleh rumah tangga?

-9 = Tidak tahu	*2* = Sumur keran bersama (3.3)	*5* = Air galon isi ulang (3.6)	*8* = Sumur milik tetangga
1 = Sumur rumah tangga (3.2)	*3* = Sumur bersama (3.4)	*6* = Anak sungai, sungai kecil, dan sungai (3.7)	*-8* = Lainnya (i2):
	4 = Air dalam kemasan (air botol) (3.5)	*7* = Mengumpulkan air hujan	



(3.2). Sumur rumah tangga

(a1) Apakah rumah tangga ini memiliki sumur di dalam rumahnya? *-9* = Tidak tahu; *1* = Ya; *0* = Tidak. Lalu ***kenapa*** (a2)?? =>

Jika (a1) adalah iya:

(b1) Bagiamana air sumur tersebut digunakan? *-9* = Tidak tahu; *1* = Untuk mandi; *2* = Untuk mencuci/membilas; *3* = Untuk minum; *4* = Untuk masak; *-8* = Untuk lainnya (b3): _____

(b2) Jika 3 atau 4 dicek, apakah ada pengalaman diare dari minum air? *-9* = Tidak tahu; *0* = Tidak; *1* = Ya karena mentah; *2* = Ya dengan proses

(c) Pengalaman rumah tangga ini dengan sumur:

Rasa air:	(c1h) Musim hujan:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
	(c1p) Musim panas:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
Bau air:	(**c5h**) Musim hujan:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
	(**c5p**) Musim panas:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
Kekurangan air:	(c2h) Musim hujan:	*1*= Tidak pernah	*2* = Jarang	*3* = Kadang-kadang	*4* = Sering	*5* = Sangat sering
	(c2p) Musim panas:	*1*= Tidak pernah	*2* = Jarang	*3* = Kadang-kadang	*4* = Sering	*5* = Sangat sering

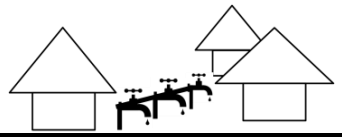
Perkiraan biaya pengembangan (c3): *-9* = Tidak tahu; *-7* = Tidak berlaku

	Juta			*Ribu*			
					0	0	Rp. per SUMUR

Perkiraan biaya pemeliharaan (c4): *-9* = Tidak tahu; *-7* = Tidak berlaku

	Juta			*Ribu*			
					0	0	Rp. per BULAN

(3.3). Air keran bersama



(a1) Apakah rumah tangga ini menggunakan air keran bersama yang digunakan bersama dengan masyarakat?	*-9* = Tidak tahu *1* = Ya	*0* = Tidak. Lalu ***kenapa*** (a2)?? =>

Jika (a1) adalah Ya:

			(b2) Jika 3 atau 4 dicek, apakah ada pengalaman diare dari minum air?	
(b1) Bagiamana air sumur tersebut digunakan?	*-9* = Tidak tahu *1* = Untuk mandi *2* = Untuk mencuci/membilas	*3* = Untuk minum *4* = Untuk masak *-8* = Untuk lainnya (b3):	*-9* = Tidak tahu *0* = Tidak	*1* = Ya karena mentah *2* = Ya dengan proses

(c) Pengalaman rumah tangga ini dengan sumur:

Rasa air:	(c1h) Musim hujan:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
	(c1p) Musim panas:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
Bau air:	(**c5h**) Musim hujan:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
	(**c5p**) Musim panas:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
Kekurangan air:	(c2h) Musim hujan:	*1*= Tidak pernah	*2* = Jarang	*3* = Kadang-kadang	*4* = Sering	*5* = Sangat sering
	(c2p) Musim panas:	*1*= Tidak pernah	*2* = Jarang	*3* = Kadang-kadang	*4* = Sering	*5* = Sangat sering

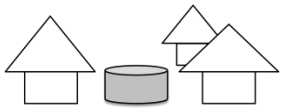
-9 = Tidak tahu *-7* = Tidak berlaku *-8* = Biaya sosial lainnya (c3b):

	Juta			*Ribu*			
Perkiraan biaya pengembangan (c3a):							Rp. per air keran
					0	0	

-9 = Tidak tahu *-7* = Tidak berlaku *-8* = Biaya sosial lainnya (c4b):

	Juta			*Ribu*			
Perkiraan biaya pemeliharaan (c4a):							Rp. per BULAN
					0	0	

(3.4). Sumur bersama



(a1) Apakah rumah tangga ini menggunakan sumur yang digunakan bersama dengan masyarakat?	*-9* = Tidak tahu *1* = Ya *0* = Tidak. Lalu ***kenapa*** (a2)?? =>

Jika (a1) adalah Ya:

(b1) Bagiamana air sumur tersebut digunakan?	*-9* = Tidak tahu *1* = Untuk mandi *2* = Untuk mencuci/membilas	*3* = Untuk minum *4* = Untuk masak *-8* = Untuk lainnya (b3):	(b2) Jika 3 atau 4 dicek, apakah ada pengalaman diare dari minum air? *-9* = Tidak tahu *1* = Ya karena mentah *0* = Tidak *2* = Ya dengan proses

(c) Pengalaman rumah tangga ini dengan sumur:

Rasa air:	(c1h) Musim hujan:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
	(c1p) Musim panas:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
Bau air:	(**c5h**) Musim hujan:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
	(**c5p**) Musim panas:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
Kekurangan air:	(c2h) Musim hujan:	*1*= Tidak pernah	*2* = Jarang	*3* = Kadang-kadang	*4* = Sering	*5* = Sangat sering
	(c2p) Musim panas:	*1*= Tidak pernah	*2* = Jarang	*3* = Kadang-kadang	*4* = Sering	*5* = Sangat sering

-9 = Tidak tahu *-7* = Tidak berlaku *-8* = Biaya sosial lainnya (c3b):

Perkiraan biaya pengembangan (c3a):

			Juta			*Ribu*			
							0	0	Rp. per air keran

-9 = Tidak tahu *-7* = Tidak berlaku *-8* = Biaya sosial lainnya (c4b):

Perkiraan biaya pemeliharaan (c4a):

			Juta			*Ribu*			
							0	0	Rp. per BULAN

(3.5). Penggunaan air dalam kemasan (**baru**)

(a1) Apakah rumah tangga ini membeli air dalam kemasan? -*9* = Tidak tahu *0* = Tidak. Lalu ***kenapa*** (a2)? =>
1 = Ya

Jika (a1) adalah Ya:

(b) Konsumsi air dalam kemasan dalam rumah tangga ini:

	-*9* = Tidak tahu *1* = Aqua *3* = Netral *2* = Narmada *4* = Cleo -*8* = Lainnya (b1b) (b1a) **Nama merk**	*1* = Ukuran besar (**Galon**) *2* = Ukuran sedang (2 liter) *3* = Ukuran kecil (< 1,500 ml) (b2) **Ukuran botol**	(b3) **Harga per botol** *Juta* / *Ribu*	Rata-rata oleh rumah tangga (b4) **Jumlah**
Merk 1	-9 1 2 3 4	1 2 3	Rp. 0 0	perminggu
	-8:	1 2 3	Rp. 0 0	perminggu
Merk 2	-9 1 2 3 4	1 2 3	Rp. 0 0	perminggu
	-8:	1 2 3	Rp. 0 0	perminggu

(c) Bagaimana anggapan anda dengan *rasa* air? *1* = Sangat tidak puas *2* = Tidak puas *3* = Sedang *4* = Puas *5* = Sangat Puas

(e) Bagaimana anggapan anda dengan *bau* air? *1* = Sangat tidak puas *2* = Tidak puas *3* = Sedang *4* = Puas *5* = Sangat Puas

(d) Bagaimana anggapan anda dengan *harga* air? *1* = Sangat murah *2* = Murah *3* = Sedang *4* = Mahal *5* = Sangat mahal

(3.6). Penggunaan air galon **isi ulang**

(1) 

(2) 

(a1) Apakah rumah tangga ini membeli air galon isi ulang? -*9* = Tidak tahu *0* = Tidak. Lalu ***kenapa*** (a2)? =>
1 = Ya, oleh ganti galon 2 = Ya, oleh tangki air ke rumah

Jika (a1) adalah Ya:

(b) Konsumsi air galon isi ulang

-*9* = Tidak tahu merk (b1) **Nama merk**	*1* = Ukuran besar (Galon) *2* = Ukuran sedang (2 liter) (b2) **Ukuran galon**	(b3) **Harga per isi ulang** *Juta* / *Ribu*	Rata-rata oleh rumah tangga (b4) **Jumlah**
-9	1 2	Rp. 0 0	per minggu
	1 2	Rp. 0 0	per minggu

(c) Bagaimana anggapan anda dengan *rasa* air galon? *1* = Sangat tidak puas *2* = Tidak puas *3* = Sedang *4* = Puas *5* = Sangat Puas

(e) Bagaimana anggapan anda dengan *bau* air galon? *1* = Sangat tidak puas *2* = Tidak puas *3* = Sedang *4* = Puas *5* = Sangat Puas

(d) Bagaimana anggapan anda dengan *harga* air galon? *1* = Sangat murah *2* = Murah *3* = Sedang *4* = Mahal *5* = Sangat mahal

(3.7). Penggunaan sungai atau anak sungai

(a1) Apakah rumah tangga ini menggunakan air sungai atau air anak sungai? *-9* = Tidak tahu *0* = Tidak. Lalu ***kenapa*** (a2)? => *1* = Ya

Jika (a1) adalah Ya:

(b1) Bagiamana air sungai atau anak sungai tersebut digunakan?
-9 = Tidak tahu
1 = Untuk mandi
2 = Untuk mencuci/membilas
3 = Untuk minum
4 = Untuk masak
-8 = Untuk lainnya (b3): _____

(b2) Jika 3 atau 4 dicek, apakah ada pengalaman diare dari minum air?
-9 = Tidak tahu *0* = Tidak *1* = Ya karena mentah *2* = Ya dengan proses

(c) Pengalaman rumah tangga ini dengan sungai atau anak sungai:

Rasa air:	(c1h) Musim hujan:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
	(c1p) Musim panas:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
Bau air:	(**c5h**) Musim hujan:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
	(**c5p**) Musim panas:	*1* = Sangat tidak puas	*2* = Tidak puas	*3* = Sedang	*4* = Puas	*5* = Sangat Puas
Kekurangan air:	(c2h) Musim hujan:	*1* = Hampir tidak pernah	*2* = Sekali-sekali	*3* = Kadang-kadang	*4* = Sering	*5* = Hampir selalu
	(c2p) Musim panas:	*1* = Hampir tidak pernah	*2* = Sekali-sekali	*3* = Kadang-kadang	*4* = Sering	*5* = Hampir selalu

-9 = Tidak tahu *-7* = Tidak berlaku *-8* = Biaya sosial lainnya(c3b):

Perkiraan biaya pengembangan (c3a): (Access cost: e.g., transportation cost)

	Juta		*Ribu*			
				0	0	Rp. per kali

(c4a) Berapa jam sampai sungai? _____ (c4b) *1*= Min *2*= Jam

(3.8). **Pengalaman proyek air**

(a) Apakah anda pernah mempunyai pengalaman mendapat pekerjaan dari pemerintah atus organisasi international untuk membantu anda meningkatkan sumber air, sperti instalasi PDAM misalnya, instalasi air keran bersama atau instalasi sumur bersama?
0 = Tidak *-9* = Tidak tahu (TT) *1* = Ya

Jika (a1) adalah Ya:

(b) Dari institusi manakah (contohnay PDAM dan LSM)? _____

(c) Kapan (e.g., tahun berapa)? _____

(d) Berapa lama? _____

(e) Apa kegiatan utama dari proyek tersebut?

Bagian 4: Persepsi peserta

(4.1) Bagaimana masalah-masalah yang berhubungan dengan masalah air di wilayah Lombok, menurut koresponden?

Masalah air di Lombok	Tingkatan masalah					
(a) Konflik berbasis air	*-9* = Tidak tahu	*1* = Sangat rendah	*2* = Rendah	*3* = Sedang	*4* = Tinggi	*5* = Sangat tinggi
(b) Kekurangan air	*-9* = Tidak tahu	*1* = Sangat rendah	*2* = Rendah	*3* = Sedang	*4* = Tinggi	*5* = Sangat tinggi
(c) Banjir	*-9* = Tidak tahu	*1* = Sangat rendah	*2* = Rendah	*3* = Sedang	*4* = Tinggi	*5* = Sangat tinggi

(4.2) Apakah koresponden sering mendengar istilah di bawah ini?

Istilah	Tingkatan familiar				
(a) Ekowisata	*1* = Hampir tidak pernah	*2* = Sekali-sekali	*3* = Kadang-kadang	*4* = Sering	*5* = Hampir selalu
(b) Daur ulang	*1* = Hampir tidak pernah	*2* = Sekali-sekali	*3* = Kadang-kadang	*4* = Sering	*5* = Hampir selalu
(c) Tanggung jawab Sosial Perusahaan (CSR)	*1* = Hampir tidak pernah	*2* = Sekali-sekali	*3* = Kadang-kadang	*4* = Sering	*5* = Hampir selalu
(d) Kawasan konservasi	*1* = Hampir tidak pernah	*2* = Sekali-sekali	*3* = Kadang-kadang	*4* = Sering	*5* = Hampir selalu
(e) Bioenergi	*1* = Hampir tidak pernah	*2* = Sekali-sekali	*3* = Kadang-kadang	*4* = Sering	*5* = Hampir selalu
(f) Perubahan iklim	*1* = Hampir tidak pernah	*2* = Sekali-sekali	*3* = Kadang-kadang	*4* = Sering	*5* = Hampir selalu
(g) Pembayaran jasa lingkungan	*1* = Hampir tidak pernah	*2* = Sekali-sekali	*3* = Kadang-kadang	*4* = Sering	*5* = Hampir selalu
(h) REDD (atau pasar karbon hutan)	*1* = Hampir tidak pernah	*2* = Sekali-sekali	*3* = Kadang-kadang	*4* = Sering	*5* = Hampir selalu

(4.4) Label yang manakah yang dikenali oleh koresponden?

Label		Tingkatan familiar					
(a)		*-9* = Tidak tahu	*1* = Tidak pernah	*2* = Jarang	*3* = Kadang-kadang	*4* = Sering	*5* = Sangat sering
(b)		*-9* = Tidak tahu	*1* = Tidak pernah	*2* = Jarang	*3* = Kadang-kadang	*4* = Sering	*5* = Sangat sering
(c)		*-9* = Tidak tahu	*1* = Tidak pernah	*2* = Jarang	*3* = Kadang-kadang	*4* = Sering	*5* = Sangat sering
(d)		*-9* = Tidak tahu	*1* = Tidak pernah	*2* = Jarang	*3* = Kadang-kadang	*4* = Sering	*5* = Sangat sering
(e)		*-9* = Tidak tahu	*1* = Tidak pernah	*2* = Jarang	*3* = Kadang-kadang	*4* = Sering	*5* = Sangat sering

(4.3) Seberapa penting masalah ini untuk Anda?

Istilah	Tingkatan kepentingan					
(a) Perlindungan ekonomi di hutan hulu in Lombok - *Kesempatan bekerja untuk masyarakat di hutan hulu* - *Pembangunan infrastruktur untuk maysarakat hulu*	*-9* = Tidak tahu	*1* = Sangat rendah	*2* = Rendah	*3* = Sedang	*4* = Tinggi	*5* = Sangat tinggi
(b) Perlindungan sosial di hutan hulu di Lombok - *Menghargai budaya masyarakat di hutan hulu* - *Menghargai hak masyarakat (awing-awing)*	*-9* = Tidak tahu	*1* = Sangat rendah	*2* = Rendah	*3* = Sedang	*4* = Tinggi	*5* = Sangat tinggi
(c) Perlindungan lingkungan di hutan hulu di Lombok *-Melindungi hewan dan tumbuhan langka di hutan hulu* - *Melindungi hutan lindung*	*-9* = Tidak tahu	*1* = Sangat rendah	*2* = Rendah	*3* = Sedang	*4* = Tinggi	*5* = Sangat tinggi

Bagian 5: Permintaan pasar

Informasi pembayaran jasa lingkungan:

1. Ibu/ bapak, sejak tahun 2010, PDAM mengharuskan Anda membayar 1.000 rupiah setiap bulan (contoh bill).
2. Pemerintah Lombok Barat memutuskan harga ini berdasarkan survey pada tahun 2003.
3. Uang yang dikumpulkan telah digunakan untuk menanam pohon, perlindungan hutan dan membantu masyarakat yang tinggal di hulu Lombok (hutan Sesaot).
4. Pemerintah dan LSM di Lombok yakin bahwa hutan yang berada di hulu penting untuk melindungi kualitas sumber air yang digunakan PDAM

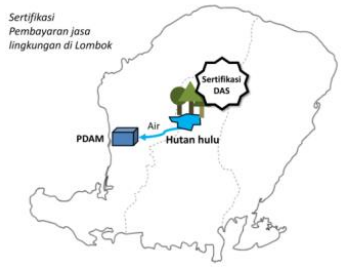
(5.1) Pembayaran **jasa lingkungan**

(a) Jika pemerintah Lombok Barat ingin mengadakan pemungutan suara untuk menentukan biaya jasa lingkungan sebesar **Rp. ribu** setiap bulan, dan dimulai pada bulan depan, apakah Anda akan memilih "**Ya**" atau "**Tidak**"?

0 = No Why (bN)?: _____

1 = Yes Why (bY)?: _____

(5.2) Pembayaran untuk sertifikasi DAS di hutan



Sertifikasi DAS di hutan:

Jika pemerintah Lombok Barat berencana memiliki sertifikasi baru untuk daerah hutan hulu Sesaot dalam waktu dekat, skema sertifikasi mana yang anda akan pilih?

Sertifikasi yang baru akan berdampak pada pembayaran jasa lingkungan anda.

Penelitian ini juga akan memberikan pengaruh kepada keputusan pemerintah daerah.

(a) CE blok: 1 2 3 4

	Set	(b1) Pilihan	(b2) Alasan pemilihan	Set	(b1) Pilihan	(b2) Alasan pemilihan
Jasa lingkungan	Set **1**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal	Set **5**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal
	Set **2**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal	Set **6**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal
	Set **3**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal	Set **7**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal
	Set **4**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal	Set **8**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal

(c) Bagaimana pertimbangan terhadap pentingnya sertifikasi DAS di hutan Sesaot?

1 = Sangat rendah *2* = Rendah *3* = Sedang *4* = Tinggi *5* = Sangat tinggi

(5.3) Air botol ★★★★★

	Set	(b1) Pilihan	(b2) Alasan pemilihan	Set	(b1) Pilihan	(b2) Alasan pemilihan
	Set **1**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal	Set **5**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal
	Set **2**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal	Set **6**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal
	Set **3**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal	Set **7**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal
	Set **4**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal	Set **8**	***1*** = Sertifikasi 1 ***2*** = Sertifikasi 2 ***0*** = Tidak ada pilihan	*1* = Mahal

Bagian 6: Asset rumah tangga

Proteksi informasi:
Informasi survei ini tidak akan disebarkan dengan pihak lain, identitas Anda akan dilindungi. Hasil survei ini hanya akan menampilkan angka stastik saja

(6.2). Aset rumah

(a) Apakah keluarga ini memiliki rumahnya sendiri? *0* = Tidak *1* = Ya						
Jika (a) adalah ya	*0* = Tidak digunakan *1* = Disewakan ke orang lain *2* = Dihuni sendiri	Daerah perkotaan (kota) = *1* Daerah pedesaan (kampung) = *2*		Banyaknya bilik rumah		
	(b) Tipe rumah	(c1) Lokasi	(c2)	(d1) Banyak dapur	(d2) Banyak kamar mandi	(d3) Banyak kamar tidur
Rumah 1	0 1 2		1 2			
Rumah 2	0 1 2		1 2			

(6.3). Aset tanah

(a) Apakah keluarga ini memiliki tanah sendiri? *0* = Tidak *1* = Ya				
Jika (a) adalahya	*0* = Tidak digunakan *3* = Ladang *1* = Residensial *-9* = Tidak tahu *2* = Komersil (b) Tanah digunakan	Daerah perkotaan (kota) = *1* Daerah pedesaan (kampung) = *2* (c1) Lokasi	(c2)	(d) Luas
Lahan 1	0 1 2 3 -9		1 2	ha
Lahan 2	0 1 2 3 -9		1 2	ha

(6.4). Aset pribadi

Aset (*jumlah di rumah*)	*0* = Tidak ada (TA) *-9* = Tidak tahu (TT)			Aset (*jumlah di rumah*)	*0* = Tidak ada (TA) *-9* = Tidak tahu (TT)		
	(a) Jumlah	(b) Model	(c) Ukuran		(a) Jumlah	(b) Model	(c) Ukuran
1.Kulkas	0 -9	-9	-9	10. Tablet	0 -9	-9	-9
2.Kompor gas	0 -9	-9	-9	11. Komputer	0 -9	-9	-9
3.Kompor minyak tanah	0 -9	-9	-9	12. Laptop	0 -9	-9	-9
4. Kompor kayu	0 -9	-9	-9	13. Mobil	0 -9	-9	-9
5. TV	0 -9	-9	-9	14. Sepeda motor	0 -9	-9	-9
6. TV (LCD)	0 -9	-9	-9	15. Mesin cuci pakaian	0 -9	-9	-9
7. Kipas angin	0 -9	-9	-9	16. HP (*jumlah*)	0 -9	-9	-9
8. AC	0 -9	-9	-9	17. Smart phone (*jumlah*)	0 -9	-9	-9

(6.5). Kondisi rumah (**oleh enumerator sendiri**)

(a1) Apa **materi lantai** utama?	(b1) Apa **materi atap** utama?
1 = Keramik / marmer / granit *2* = Lantai ubin / teraso *3* = Cement / bricks *4* = Kayu / Board *5* = Bambu *6* = Tanah *-8* = Lainnya (a2):	*1* = Alang Alang *2* = Sirap Kayu Ulin / Besi *3* = Ubin Atap Tanah Liat *4* = Judul logam *5* = Atap beton *-8* = Lainnya (b2):

(6.6) Pilihan untuk menerima hasil survei lewat email: *0* = Tidak tertarik *1*= Tertarik (email): _____ @ _____

(6.1) Berapakah rata-rata pendapatan Anda per bulan: *0* = Tidak ada

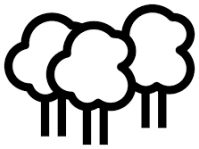
0 - 1 juta ☐	1 - 2 juta ☐	2 - 3 juta ☐	3 - 4 juta ☐	4 - 5 juta ☐	5 - 6 juta ☐	6 - 7 juta ☐	7 - 8 juta ☐	8 - 9 juga ☐	9 - 10 juga ☐
10 - 11 juta ☐	11 - 12 juta ☐	12 - 13 juta ☐	13 - 14 juta ☐	14 - 15 juta ☐	15 - 16 juta ☐	16 - 17 juta ☐	17 - 18 juta ☐	18 - 19 juta ☐	19 - 20 juta ☐

21 = Lebih 20 juta

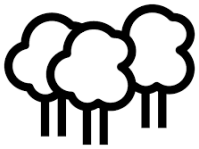
Berapakah rata-rata pendapatan Anda per bulan?

- ☐ Rp. **0 – 1** juta
- ☐ Rp. **1 – 2** juta
- ☐ Rp. **2 – 3** juta
- ☐ Rp. **3 – 4** juta
- ☐ Rp. **4 – 5** juta
- ☐ Rp. **5 – 6** juta
- ☐ Rp. **6 – 7** juta
- ☐ Rp. **7 – 8** juta
- ☐ Rp. **8 – 9** juta
- ☐ Rp. **9 – 10** juta
- ☐ Rp. **10 – 11** juta
- ☐ Rp. **11 – 12** juta
- ☐ Rp. **12 – 13** juta
- ☐ Rp. **13 – 14** juta
- ☐ Rp. **14 – 15** juta
- ☐ Rp. **15 – 16** juta
- ☐ Rp. **16 – 17** juta
- ☐ Rp. **17 – 18** juta
- ☐ Rp. **18 – 19** juta
- ☐ Rp. **19 – 20** juta
- ☐ *Lebih* Rp. **20** juta

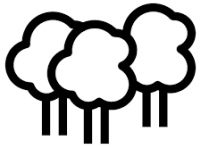
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1z**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Bahaya banjir	Bahaya banjir	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan sosial	Perlindungan ekonomi	
3	Sertifikasi dari 	Pemerintah Indonesia	LSM di Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 6.000	Rp. 1.000 (Harga saat ini)	

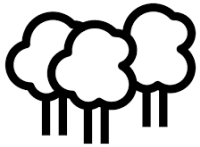
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kuantitas air	Kualitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	*Tidak ada*	Perlindungan lingkungan	
3	Sertifikasi dari 	Organisasi sertifikasi internasional	Pemerintah Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 16.000	Rp. 16.000	

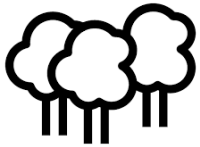
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	*Tidak ada*	Kuantitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan lingkungan	Perlindungan sosial	
3	Sertifikasi dari 	Pemerintah Indonesia	LSM di Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 16.000	Rp. 16.000	

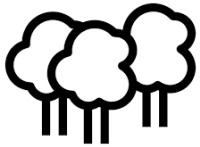
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kuantitas air	Kualitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan sosial	Perlindungan ekonomi	
3	Sertifikasi dari 	LSM di Indonesia	Organisasi sertifikasi internasional	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 11.000	Rp. 11.000	

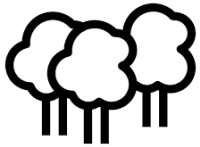
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	*Tidak ada*	Kuantitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan ekonomi	*Tidak ada*	
3	Sertifikasi dari 	Masyarakat hulu di Lombok	Masyarakat hulu di Lombok	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 11.000	Rp. 11.000	

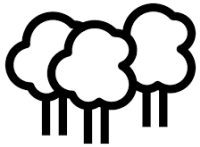
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kualitas air	*Tidak ada*	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan ekonomi	*Tidak ada*	
3	Sertifikasi dari 	Organisasi sertifikasi internasional	Pemerintah Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 6.000	Rp. 1.000 (Harga saat ini)	

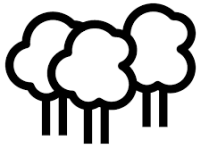
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Bahaya banjir	Bahaya banjir	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	*Tidak ada*	Perlindungan lingkungan	
3	Sertifikasi dari 	Masyarakat hulu di Lombok	Masyarakat hulu di Lombok	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 1.000 (Harga saat ini)	Rp. 6.000	

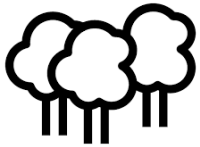
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kualitas air	*Tidak ada*	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan lingkungan	Perlindungan sosial	
3	Sertifikasi dari 	LSM di Indonesia	Organisasi sertifikasi internasional	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 1.000 (Harga saat ini)	Rp. 6.000	

Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kualitas air	Kualitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	*Tidak ada*	Perlindungan sosial	
3	Sertifikasi dari 	Pemerintah Indonesia	Masyarakat hulu di Lombok	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 11.000	Rp. 1.000 (Harga saat ini)	

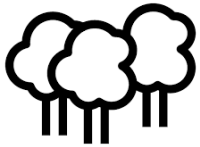
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Bahaya banjir	Kuantitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan ekonomi	Perlindungan ekonomi	
3	Sertifikasi dari 	LSM di Indonesia	Pemerintah Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 16.000	Rp. 6.000	

Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	*Tidak ada*	Bahaya banjir	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	*Tidak ada*	Perlindungan sosial	
3	Sertifikasi dari 	LSM di Indonesia	Pemerintah Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 6.000	Rp. 11.000	

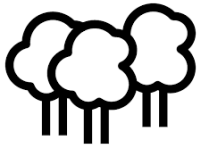
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kuantitas air	*Tidak ada*	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan lingkungan	Perlindungan lingkungan	
3	Sertifikasi dari 	Masyarakat hulu di Lombok	LSM di Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 6.000	Rp. 11.000	

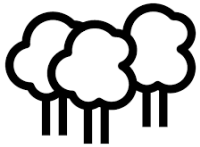
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kualitas air	Kualitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan sosial	*Tidak ada*	
3	Sertifikasi dari 	Masyarakat hulu di Lombok	LSM di Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 16.000	Rp. 6.000	

Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kuantitas air	*Tidak ada*	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan ekonomi	Perlindungan ekonomi	
3	Sertifikasi dari 	Pemerintah Indonesia	Masyarakat hulu di Lombok	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 1.000 (Harga saat ini)	Rp. 16.000	

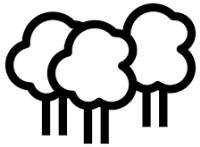
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Bahaya banjir	Kuantitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan lingkungan	Perlindungan lingkungan	
3	Sertifikasi dari 	Organisasi sertifikasi internasional	Organisasi sertifikasi internasional	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 11.000	Rp. 1.000 (Harga saat ini)	

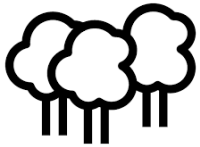
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	*Tidak ada*	Bahaya banjir	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan sosial	*Tidak ada*	
3	Sertifikasi dari 	Organisasi sertifikasi internasional	Organisasi sertifikasi internasional	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 1.000 (Harga saat ini)	Rp. 16.000	

Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Bahaya banjir	*Tidak ada*	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan sosial	Perlindungan sosial	
3	Sertifikasi dari 	Organisasi sertifikasi internasional	Masyarakat hulu di Lombok	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 16.000	Rp. 11.000	

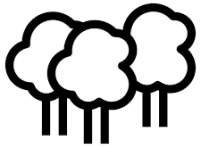
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kualitas air	Bahaya banjir	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan lingkungan	Perlindungan ekonomi	
3	Sertifikasi dari 	Masyarakat hulu di Lombok	Pemerintah Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 11.000	Rp. 16.000	

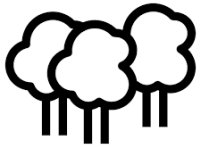
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Bahaya banjir	*Tidak ada*	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	*Tidak ada*	*Tidak ada*	
3	Sertifikasi dari 	LSM di Indonesia	LSM di Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 11.000	Rp. 16.000	

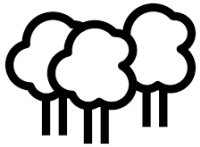
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kualitas air	Bahaya banjir	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan ekonomi	Perlindungan lingkungan	
3	Sertifikasi dari 	Pemerintah Indonesia	Organisasi sertifikasi internasional	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 16.000	Rp. 11.000	

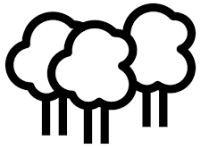
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	*Tidak ada*	Kualitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan lingkungan	Perlindungan ekonomi	
3	Sertifikasi dari 	Organisasi sertifikasi internasional	Masyarakat hulu di Lombok	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 6.000	Rp. 6.000	

Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	*Tidak ada*	Kualitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan ekonomi	Perlindungan lingkungan	
3	Sertifikasi dari 	LSM di Indonesia	LSM di Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 1.000 (Harga saat ini)	Rp. 1.000 (Harga saat ini)	

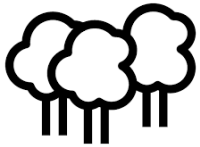
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kuantitas air	Kuantitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan sosial	Perlindungan sosial	
3	Sertifikasi dari 	Masyarakat hulu di Lombok	Pemerintah Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 1.000 (Harga saat ini)	Rp. 1.000 (Harga saat ini)	

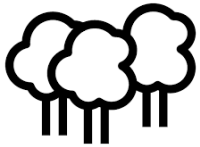
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kuantitas air	Kuantitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	*Tidak ada*	*Tidak ada*	
3	Sertifikasi dari 	Pemerintah Indonesia	Organisasi sertifikasi internasional	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 6.000	Rp. 6.000	

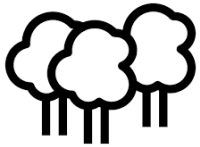
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Bahaya banjir	Kualitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan lingkungan	*Tidak ada*	
3	Sertifikasi dari 	Pemerintah Indonesia	Pemerintah Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 1.000 (Harga saat ini)	Rp. 11.000	

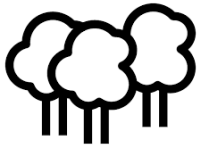
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Bahaya banjir	Kualitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan ekonomi	Perlindungan sosial	
3	Sertifikasi dari 	Masyarakat hulu di Lombok	Organisasi sertifikasi internasional	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 6.000	Rp. 16.000	

Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kualitas air	Kuantitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan sosial	Perlindungan lingkungan	
3	Sertifikasi dari 	LSM di Indonesia	Masyarakat hulu di Lombok	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 6.000	Rp. 16.000	

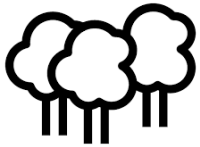
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kuantitas air	Bahaya banjir	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan lingkungan	*Tidak ada*	
3	Sertifikasi dari 	LSM di Indonesia	Masyarakat hulu di Lombok	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 16.000	Rp. 1.000 (Harga saat ini)	

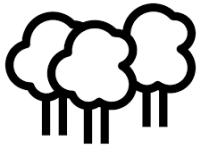
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kualitas air	Kuantitas air	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	*Tidak ada*	Perlindungan ekonomi	
3	Sertifikasi dari 	Organisasi sertifikasi internasional	LSM di Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 1.000 (Harga saat ini)	Rp. 11.000	

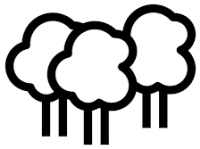
Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	Kuantitas air	Bahaya banjir	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan ekonomi	Perlindungan sosial	
3	Sertifikasi dari 	Organisasi sertifikasi internasional	LSM di Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 11.000	Rp. 6.000	

Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	*Tidak ada*	*Tidak ada*	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	Perlindungan sosial	Perlindungan lingkungan	
3	Sertifikasi dari 	Pemerintah Indonesia	Pemerintah Indonesia	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 11.000	Rp. 6.000	

Jika daerah hulu hutan Sesaot diberikan sertifikasi dari tahun 2016 dan seterusnya, skema sertifikasi mana yang mungkin anda lebih suka?

		Sertifikasi DAS **1**	Sertifikasi DAS **2**	
1	Informasi air dari hutan hulu 	*Tidak ada*	*Tidak ada*	Saya TIDAK mau sertifikasi 1 dan 2
2	Informasi hutan hulu 	*Tidak ada*	Perlindungan ekonomi	
3	Sertifikasi dari 	Masyarakat hulu di Lombok	Organisasi sertifikasi internasional	
4	Harga jasa lingkungan dari PDAM **Rp.**	Rp. 16.000	Rp. 1.000 (Harga saat ini)	