

Economic Incentives to Strengthen Ecosystem Connectivity in a Central Sumatran Agricultural Landscape

By

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Abstract

In Riau, Sumatra, Indonesia, a GEF project is considering a number of interventions to restore the Batabo Hill Protection Forest as a viable and sustainable wildlife corridor. The project site is an 11 km highway bisecting the Batabo Hill Protection Forest, which over the past two decades, has been largely converted to smallholder rubber production and scrub.

One proposed intervention includes building eco-infrastructure - a series of bridges to allow tigers safer pathways across the 11 km road. Several hundred smallholders are farming rubber along the highway. Therefore, securing project buy-in and land access rights from key smallholders operating in Batabo Hill is central to any wildlife connectivity effort.

For this reason, the overarching objective of this thesis is to explore the opportunity for a Payments for Ecosystem Services (PES) program to complement the proposed GEF eco-infrastructure option, as a way to improve wildlife connectivity, while not leaving smallholder households worse off. The PES program would 'buy out' the land from the smallholders for a period of five years, allowing time for the understory cover to regenerate, and for the wildlife to return.

In order to achieve the study objective, four phases of analysis were conducted using data obtained through key informant interviews, focus group discussions and a household survey of 300 farm households across four villages in Kuantan Mudik Sub District in Riau.

The first analytical chapter drew on the qualitative data and confirmed that households from villages in Kuantan Mudik Sub District are operating land in the Protection Forest and that these households view the Protection Forest as a resource available to support their livelihood needs. The reliance of these households on the Protection Forest for their livelihoods and the absence of alternative sources of income has prevented the effective management of the Protection Forest. However, the clearing of land in the forest for agriculture

has had devastating effects on the community, particularly with respect to water quality and availability.

The second analytical chapter examined the willingness of rubber producers operating within Batabo Hill to participate in a wildlife connectivity project by eliciting willingness to accept (WTA) compensation to forgo access to their land in Batabo Hill. Applying the novel inferred valuation technique to an open-ended WTA elicitation format, respondents were asked directly what they would be WTA as well as what their neighbour would be WTA a) when surveyed, and b) in real life. Initially, only male head of household survey data was examined. The regression results highlighted that on average, male heads of household were willing to accept compensation to forgo access to their land and found evidence of hypothetical bias in WTA.

The third analytical chapter extended the analysis to include female heads of household and investigated gender differences in the head of household WTA. The regression results found that on average, female heads of household were willing to accept lower payments and highlighted that different factors influence male and female head of household WTA.

The fourth analytical chapter took a new approach, pooling the male and female data to examine gender differences in WTA more explicitly, using gender interaction variables. While the results found that the gender dummy itself was not significant, gendered household labour effects were present in the WTA decision in addition to gendered enumerator bias, which was equal to approximately one third of the value of mean WTA.

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Chapter 1 Introduction

1.1 Background and Motivations

Agricultural expansion is one of the leading causes of deforestation in the developing world (Geist & Lambin 2002; Hosonuma et al. 2012). Deforestation is especially prevalent in Sumatra, Indonesia, where the rapid conversion of high-conservation value forests to agriculture, typically oil palm or rubber, is leading to widespread biodiversity and habitat losses (Bhagabati et al. 2012). Fire is the lowest cost method to clear forest for agriculture and is frequently employed, generating a smoky haze originating in Sumatra which then spreads to Malaysia and Singapore (Lee et al. 2016) causing serious costs. The World Bank (2015a) estimates the total economic costs related to Sumatra forest fires exceeded USD \$16¹ billion in 2015.

Regulations to protect biodiversity loss in critical ecosystems often fail because they do not consider the livelihood needs of local populations. This study focuses on a landscape within the Bukit Batabuh Protection Forest (Batabo Hill), in Sumatra, Indonesia. The Bukit Batabuh Protection Forest provides a key wildlife corridor connecting two Priority Tiger Conservation Landscapes, the Bukit Rimbang Baling Wildlife Reserve and the Bukit Tigapuluh National Park (Sanderson et al. 2006). The 135,267 ha wildlife reserve and the 138,185 ha national park are critical for the conservation of endemic mammals including the Sumatran tiger (*Panthera tigris sumatrae*) and the Sumatran elephant (*Elephas maximus sumatranus*).

To help safeguard remaining unique ecosystems, Sumatra Island's spatial planning regulations recognise corridor ecosystems as critical for connecting protection areas and home ranges for large mammals (such as tigers and elephants). By connecting key habitats,

¹ All currency throughout this thesis is in USD \$.

corridors provide an opportunity for wildlife migration and enhanced genetic flow, supporting the survival of the critically endangered Sumatran tiger and elephant.

A 2012 Presidential Decree designates the RIMBA Corridor as one of five ecosystem corridors within Sumatra (Sulistiyawan et al. 2017)². In addition, national and provincial governments together with the World Wildlife Fund (WWF) Indonesia have begun implementing the RIMBA Project—a Global Environmental Facility (GEF) project to strengthen forest and ecosystem connectivity³. The Batabo Hill Protection Forest is a key landscape within the RIMBA Corridor.

The RIMBA GEF project is considering a number of interventions to restore the Batabo Hill Protection Forest as a viable and sustainable wildlife corridor to link the two Tiger Priority Conservation Landscapes. The site of the RIMBA GEF project is an 11 km highway bisecting the Batabo Hill landscape. Over the past two decades, around half the original forests on five km either side of the highway has been converted to other uses, mostly smallholder rubber production and scrub.

One proposed intervention includes eco-infrastructure, building a series of bridges at key wildlife corridors to allow tigers safer pathways across the 11 km road (see Figure 1.1 for the location of the proposed intervention). In all six bridges, known as ‘fly-overs,’ would facilitate the migration and dispersal of the Sumatran tiger and other animals. The proposed eco-infrastructure is estimated to cost around \$6 million to build. In addition, rights to land near the six ‘fly-overs’ need to be acquired. Several hundred smallholders operate under

² Presidential Decree No 13/2012 (article 48).

³ The full title of the RIMBA GEF Project is ‘Strengthening Forest and Ecosystem Connectivity in RIMBA Landscape of Central Sumatra through Investing in Natural Capital, Biodiversity Conservation, and Land-based Emission Reductions.’

<https://www.thegef.org/project/strengthening-forest-and-ecosystem-connectivity-rimba-landscape-central-sumatra-through>

tenuous tenure circumstances, farming rubber along the highway in Batabo Hill.⁴ Therefore, securing project buy-in and land access rights from key smallholders operating in Batabo Hill is central to any wildlife connectivity effort.

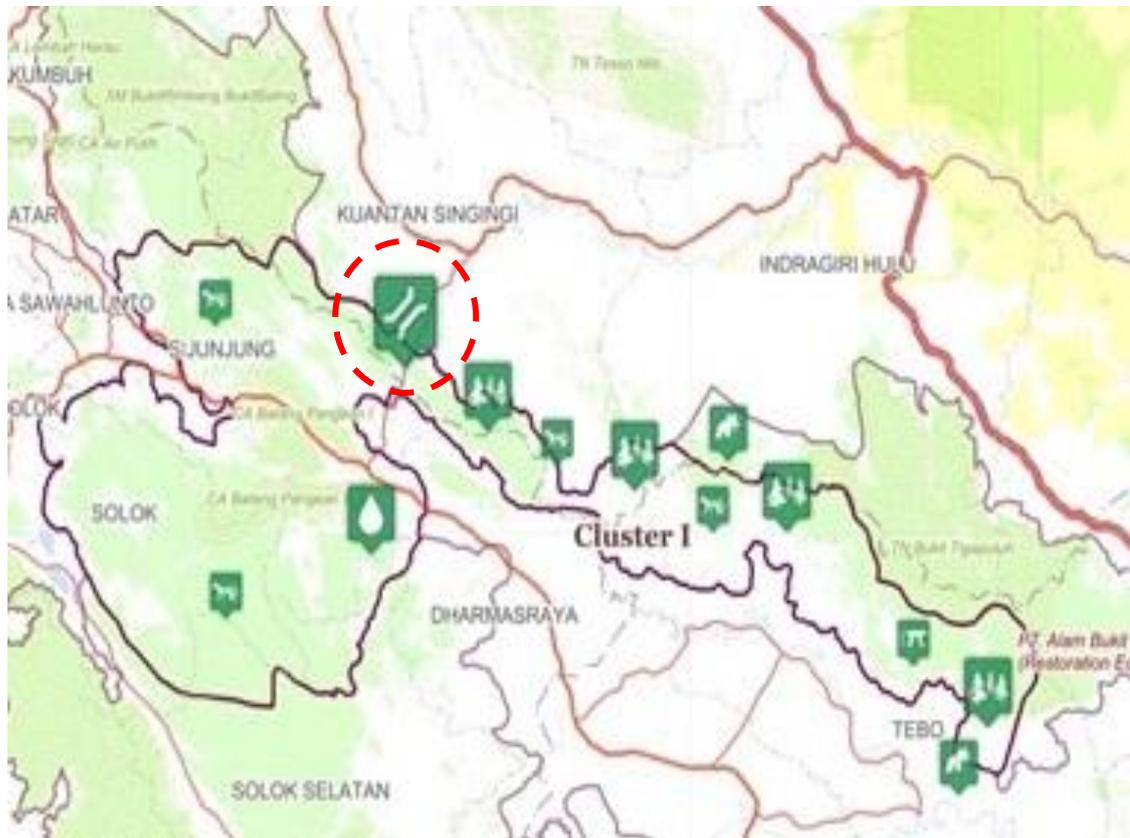


Figure 1.1: Location of the Proposed Eco-infrastructure, Riau, Sumatra (circled in red).

Source: World Wildlife Fund Indonesia, 2015

This thesis examines the willingness of the rubber producers operating within Batabo Hill to participate in a wildlife connectivity project and estimates the costs associated with farmers giving up their rubber trees and abandoning their use-rights to their land in Batabo Hill. Much of this land is needed to support the wildlife connectivity objectives of the eco-infrastructure activities.

⁴ The farm households do not have formal legal status to the land. They do have locally recognised access rights. Large plantation companies are also known to have directly or indirectly (via renting from smallholders) cleared land in the Protection Forest.

This research follows the approach of Southgate et al. (2010) to investigate the cost of a PES program that directly pays land-users to give up access to their land for a period of five years. Based on advice from the WWF Indonesia RIMBA project team, the PES program would seek as much land as possible for five km on either side of the 11 km road. The aim is to reduce human activity and allow the understory cover to regenerate to attract prey animals. The proposed PES program would directly target the agents of agricultural expansion (Delacote & Angelsen 2015), who are in the best position to protect the wildlife corridor (Ferraro 2001).

The purpose of this study is to investigate the willingness of smallholder farmers to forgo access to their land to support the wildlife connectivity objectives of the proposed eco-infrastructure. This study builds on recent work by Cacho et al. (2014) in Sumatra to examine the openness of farm households to accept compensation to give up access to their land as part of a hypothetical conservation intervention. Using an open-ended willingness to accept (WTA) approach, this thesis estimates the payments that households in four villages surrounding Batabo Hill would require to participate in the conservation program. In addition to directly asking the household what amount of compensation they would be willing to accept, this study employs an innovative ‘inferred valuation’ approach developed by Lusk and Norwood (2009a, 2009b), which asks respondents to infer the preferences of others.

Typically, contingent valuation studies only interview a single respondent in the household and assume the husband and wife have the same preferences. Yet households do not always make decisions ‘as one’; women and men within the same households do not always have the same preferences, nor do they always share resources. An emerging literature examining intra-household resource allocation using contingent valuation methods finds that husbands and wives within the same household have different preferences (Lampietti 1999; Prabhu 2010; Whittington et al. 2008); recommending that future studies

interview both the male and female head of household to account for each respondent's individual preferences.

Accordingly, this research separately interviews the male and female head of household to examine their willingness to accept compensation to forgo access to their land in Batabo Hill as part of a hypothetical PES program, ensuring that the valuations which inform any future PES program more accurately reflect the preferences of the target population. By capturing the value placed on the land by both the male and female heads of household, advice can be provided to policymakers and program specialists on how gender influences willingness to participate in a future PES program. This has implications for program uptake, compliance and targeting.

This thesis contributes to the emerging inferred valuation literature in three ways. First, by testing the inferred valuation method in a developing-country context. Second, this research extends the empirical evidence base via the third known application of the inferred valuation method to a WTA approach (following on from Kaczan & Swallow 2013 and Drichoutis, Lusk & Pappa 2016) and the first application using an open-ended elicitation format. Third, by contributing to the small inferred valuation literature reporting on gender differences (i.e. Carlsson, Daruvala & Jadell 2010).

In addition, this study analyses the effects of social desirability bias and hypothetical bias on WTA estimates and calculates simple mean WTA values. The simple WTA mean values are compared to local land values and opportunity costs of farming rubber as a test of the external validity of the WTA results (Kaczan & Swallow 2013)

1.2 The Ecological Issue

Sumatra's forests produce vital ecosystem services and provide habitats to species of global consequence, including Orang-utans, the Sumatran tiger, Sumatran elephant and Sumatran Rhinoceros. Historically, Riau Province was a stronghold for the Sumatran tiger; and was estimated to harbour around 30 per cent of the Sumatran tiger population (Borner

1978). However, based on historical rates of deforestation, Sumatra is at risk of losing the last important forest habitats for tigers, with much of the remaining forest area under pressure from agricultural expansion. In 2012, Indonesia surpassed Brazil⁵, recording the highest annual deforestation rate in the world. Between 2000 and 2012 Sumatra lost nearly 18 per cent or 2.8 million hectares of its primary forests, directly resulting in habitat loss and animal extinctions (Margono et al. 2014).

Indonesia designates several legal categories for forest areas, including Production Forests, Protection Forests, Conservation Forests, Nature Reserves and Nature Conservation Forests (Ardiansyah et al 2015). The government's spatial planning regulations are designed to protect home ranges for large mammals with corridor ecosystems. Protecting forest areas is recognised as a leading approach to conservation, particularly for large mammals (Adams et al. 2004; Margules & Pressey 2000).

While Conservation Forests, National Parks and Nature Reserves receive the highest levels of protection, Indonesia's Protection Forests allow roads and underground mining permits⁶. Recent studies conclude that biodiversity, wildlife habitat and agricultural productivity are all at risk in Indonesia (Leimona et al. 2015b; OECD 2012; World Bank 2015b). This is partly driven by District governments seeking operating revenues through selling off land concessions for agriculture, and partly by economic policies that provide incentives to expand agriculture into important watersheds. The consequence is that the command and control system to protect and conserve forests in Sumatra remains ineffective at preventing deforestation and the loss of key wildlife habitats (Brun et al. 2015).

⁵ In part, due to improving conditions in Brazil.

⁶ A Protection Forest is a legal status for forest areas whose main function is protecting life-supporting systems for hydrology, preventing floods, controlling erosion, preventing sea-water intrusion and maintaining soil fertility.

Interventions to help limit human activity in agro-ecosystems bordering high-biodiversity forests can facilitate movement of wildlife between fragmented habitats by enhancing connectivity. Tigers are likely to use areas with adequate understory cover and low levels of human activity radiating out from their main forest habitat; this includes plantation areas (Sunarto et al. 2012). If human disturbance can be removed or reduced sufficiently, and understory cover regenerated, the lands along the highway in Batabo Hill can provide a more suitable habitat for wildlife, including tigers.

Figure 1.2 below depicts habitat quality modelling of the RIMBA landscape, with the Bukit Batabuh (Batabo Hill) landscape identified as having the highest quality habitat (indicated by the dark colour which corresponds to a value of 1) for the Sumatran tiger and elephant (Sulistyawan et al. 2017).

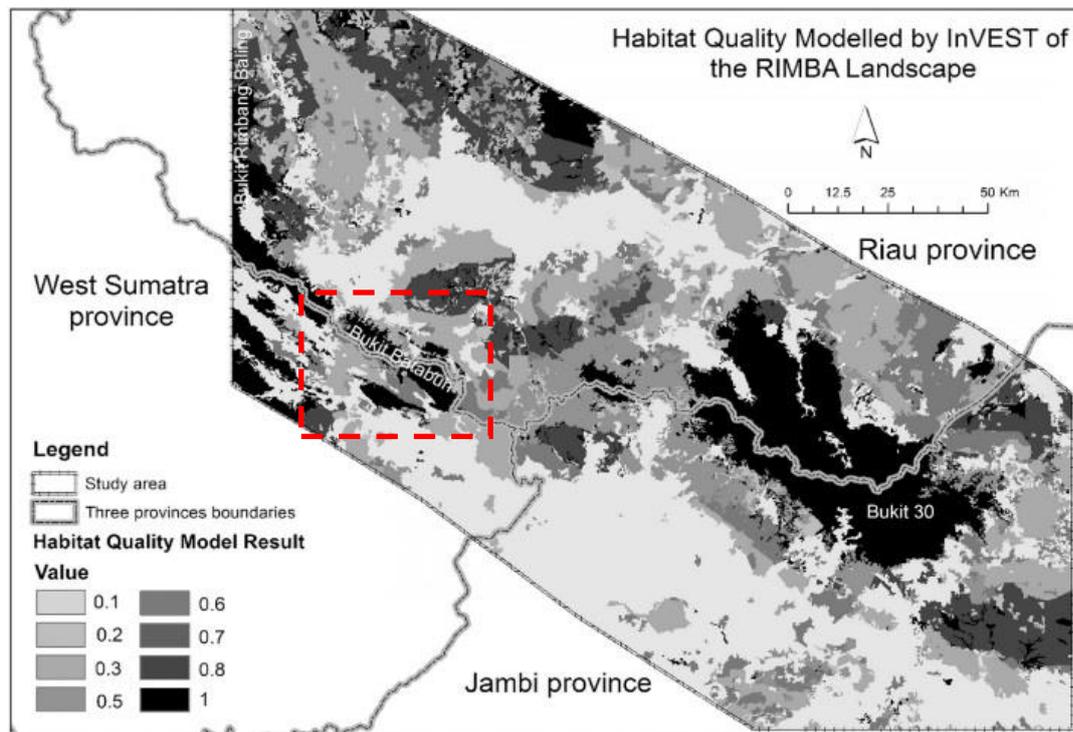


Figure 1.2: Habitat Quality Modelling of the RIMBA Landscape⁷

Source: Sulistyawan et al. 2017

⁷ The results of the habitat quality model are such that dark colour means high quality (indicated by the value 1) and the light grey means lower quality (indicated with value 0.1) (Sulistyawan et al.2017).

1.3 Research Objectives

This study investigates the potential for a PES program in a key wildlife corridor in Riau, Sumatra. Specific research objectives of this study are:

1. To understand the extent of, and drivers of agricultural expansion in Batabo Hill, and identify the population with use rights to this land.
2. To explore local perceptions of the changing environment, and the factors driving these changes.
3. To investigate the willingness of households in Kuantan Mudik Sub District to accept payments to give up use-rights to their land in Batabo Hill.
4. To examine the sources of bias affecting the willingness to accept decision, and the potential for inferred valuation methods to control for this.
5. To investigate gender differences in willingness to accept, and explore the implications for study design and program targeting.

1.4 Structure of the Thesis

Along with this chapter, this thesis is organised into eight additional chapters. Chapter 2 provides an overview of current literature regarding the drivers of agricultural expansion and payments for ecosystem services programs to help understand the factors influencing smallholder agricultural expansion in Batabo Hill and to explore the different approaches to achieving conservation goals in a range of developing country contexts.

Contingent valuation studies are reviewed in order to explore the application of contingent valuation approaches to inform the design of PES programs and to examine new methods to mitigate against hypothetical and social desirability bias. The last section of this chapter provides an overview of gender differences in empirical research and explores the small literature examining gender differences in contingent valuation studies.

Chapter 3 presents the methods used in this study. It details the field work activities completed to obtain data, including focus group discussions and key informant interviews, the development of the questionnaire, sample selection and data analysis.

Chapter 4 describes the characteristics of the households sampled and the dependence of these households on agriculture for their livelihoods. It discusses the land use and labour allocation activities of these households and the transformation of the agricultural and inheritance systems in Riau.

Chapter 5 addresses the first two research objectives and, using data from key informant interviews and focus group discussions, investigates the drivers of smallholder agricultural expansion in Batabo Hill and the extent to which smallholders understand the links between agricultural expansion and the decline in the natural resource base.

Chapters 6 and 7 addresses the third research objective: to investigate the willingness of households in Kuantan Mudik Sub District to accept payments to give up use-rights to their land in Batabo Hill and the fourth research objective: to examine the sources of bias influencing the willingness to accept decision, and how the inferred valuation method can mitigate against this.

Chapter 6 begins by taking a traditional contingent valuation approach and focusses on the valuations provided by the male heads of household. Chapter 7 extends the analysis to include the female heads of household, allowing for direct comparison between both male and female heads of households to explore if there are gender differences in a) willingness to accept compensation to participate in a hypothetical PES program and b) in the sources of bias influencing WTA values. In doing so, Chapter 7 begins preliminary investigations into the fifth research objective.

Chapter 8 takes a new methodological approach, pooling the male and female head of household data to more explicitly explore the fifth research objective: whether there are

gender differences in male and female head of household WTA, and examines intra-household differences in payment preferences.

In Chapter 9, a summary discussion of study findings and contributions are presented. Finally, policy and program design implications and suggestions for future research are detailed.

Chapter 2 Literature Review

2.1 Introduction

Chapter 1 outlines the importance of the Batabo Hill Protection Forest as a wildlife corridor linking two Tiger Priority Conservation Landscapes. This chapter reviews the literature on agricultural expansion to help understand the drivers of smallholder agricultural expansion in Batabo Hill and inform decision-making surrounding any proposed intervention.

Securing the buy-in and land access rights from key smallholders operating in Batabo Hill will be central to any wildlife connectivity effort. PES programs represent a popular approach to engage with smallholders to achieve conservation outcomes. This chapter provides an overview of the PES literature and discusses the different approaches to achieving conservation goals in a range of developing country contexts.

This thesis investigates the willingness of rural farm households to accept compensation to participate in a hypothetical PES program which requires them to give up access to their land in Batabo Hill. This chapter provides a summary of the contingent valuation literature and explores the application of contingent valuation approaches to inform the design of a PES program which asks farmers to give up access to land.

This thesis employs a novel approach to mitigating against hypothetical and social desirability bias, and the application of this new inferred valuation method is discussed. This chapter outlines the empirical evidence of gender differences in economic studies and discusses the literature examining gender differences in contingent valuation. The goal of this literature

review, therefore, is to provide a synthesis of relevant literature and identify gaps in research to date.

2.2 The Drivers of Agricultural Expansion

A more complete understanding of the drivers of agricultural expansion in Riau, Sumatra is needed to shape decision making about how deforestation can be curbed. Recent literature examining deforestation and land use change in Indonesia predominantly feature spatial and biophysical models (i.e. Lee et al. 2014), rely on secondary socio-economic data, or sample only a small number of households to model impacts and trade-offs (Asner et al. 2010; Villamor et al. 2011; Villamor et al. 2012). Much of the empirical work investigating agricultural expansion are from the Americas (Mexico, Brazil and the southwest Amazonia) (Caldas et al. 2007; Geoghegan et al. 2001; Godoy, Wilkie & Franks 1997), where the drivers of agricultural expansion differ to Indonesia's.

For Riau, Sumatra, the boom in estate crops such as rubber and palm oil are the main reasons behind agricultural expansion. Oil palm and rubber contribute to agricultural expansion in Indonesia in at least four ways: (i) as the main driver for forest clearing; (ii) by replacing forests previously degraded by logging or fire; (iii) via using the profits from timber products to offset the initial costs of plantation establishment; and (iv) indirectly, by promoting greater road access to previously inaccessible forests, by encouraging infrastructure development, or by oil palm displacing other crops such as rubber in forests (Fitzherbert et al. 2008; Gatto, Wollni & Qaim 2015).

A number of studies outside of Indonesia analyse the link between deforestation and different economic, demographic and political variables (see Brown & Pearce 1994; Angelsen & Kaimowitz, 1999 and Kaimowitz & Angelsen 1998 for a review). In their review of 140 economic models analysing the causes of deforestation, Angelsen and Kaimowitz (1999) find that in most cases, the building of roads, higher agricultural prices, low farm

wages and a shortage in non-farm employment opportunities are linked to greater rates of deforestation.

These findings are consistent with the theory of induced innovation (Boserup 1965; Ruthenberg 1980; Ruttan & Hayami 1984), which describes the responses of smallholders to pressures and opportunities brought about by exogenous factors including rural infrastructure development, population growth, and market and policy developments enabling the introduction of higher-value crops (such as oil palm).

Of particular relevance to this study, is the strong relationship between agricultural expansion and the proximity to roads such as the Trans-Sumatran Highway, which by lowering transport costs, facilitates the transport of timber and agricultural products to markets and in turn increases agricultural rents (Angelsen & Kaimowitz 1999; Angelsen 2010; Brun et al. 2015). Angelsen (1999) argues that the change in land rent is the single most important factor to understand and explain the agricultural expansion that has occurred in recent decades in Riau.

This is consistent with the Philippines, where Liu, Iverson and Brown (1993) find that accessibility and proximity of forests to human activity are the two main predictors of deforestation. The construction of logging roads and poor forest protections facilitate deforestation by allowing people to enter the previously inaccessible areas and clear logged forests, often through slash and burn techniques. This was supported by Barber et al. (2014) who find that in the Brazilian Amazon, 95 per cent of all deforestation has occurred within 5.5 km from roads or 1 km from a navigable river. In nearby Jambi Province, Sumatra, Tomich et al. (1998a) find that smallholder conversion of logged forest was significantly more likely within 10 km of main roads, such as the Trans-Sumatran Highway.

The literature shows that smallholders convert more forest to agriculture in locations that have better access to markets. Forests located near urban and village markets are more

likely to be cleared (Chomitz & Gray 1999) and forest clearing tends to exhibit a circular pattern around towns, whereas along roads, there tends to be a corridor pattern of deforestation (Mertens & Lambin 1997).

Forests areas with fertile soils/on higher quality land are at greater risk of being cleared for agriculture (Chomitz & Gray 1996; Rosero-Bixby & Palloni 1996) as are forest fragments located near previously deforested areas (Brun et al. 2015). The forest frontier is more vulnerable to clearing than large forested areas (Liu et al. 1993; Mertens et al. 2004; Rosero-Bixby & Palloni, 1996). In nearby Jambi province, Gatto et al. (2015) point to a path-dependency, whereby more intensive logging and land conversion in the past is associated with more deforestation in the future; oil palm expansion occurs in locations with ongoing logging activities.

The risk of deforestation and forest degradation is high if there are no government restrictions on forest clearing or if local authorities are not able to effectively enforce resource management laws and regulations. Weak enforcement of forestry laws means that forests are viewed as open and accessible public assets for the taking (Prasetyo et al. 2012).

Government policies also play a role in encouraging land conversion for agriculture. Input subsidies for rubber seeds and fertiliser encourage agricultural expansion and have the additional effect of artificially inflating the returns to farming on marginal lands (Barbier 1997; Duraiappah 1998). Given the availability of forest land for clearing, smallholders will continue to clear the forest and expand their agricultural production until such time that the rents from doing so are dissipated.

The conventional poverty-environment argument is that poorer families are more likely to clear the forest, either to grow crops or to cut wood, because they have shorter time horizons (higher discount rates); the counterargument says such families are less likely to do so because they lack the necessary capital to put additional land into production (see, for

example, Rudel & Horowitz 1993). However, in the case of Riau, smallholders who clear forest for agriculture, are able to at least partially fund the land clearing process by selling the cleared forest timber.

The limited availability of non-farm employment opportunities also places pressure on the forest to provide a source of income (Suyatman 1998). The decision to clear forest for agriculture is based on the private costs or benefits of their alternatives, with a bias towards the short run (Reardon & Vosti 1995). In the absence of viable profitable alternatives such as non-farm employment opportunities, smallholder farmers will continue to seek forest to clear to support their livelihoods

For rural households living in areas where land productivity, and thus household income, is stagnant or declining, the rational strategy may be to extract short-term rents via natural resources, pursuing a cycle of converting forests to agriculture. So long as there is sufficient available land for exploitation, and the cost of doing so is low, then the cycle of agricultural expansion into forests and marginal lands will continue, leading to further degradation (Barbier 1997). This cycle suggests there is ‘cumulative causation’ – a link between rural poverty, deforestation and land degradation.

Through focus group discussions and key informant interviews, this study will explore the drivers of smallholder agricultural expansion in Batabo Hill. A greater understanding of the factors influencing the smallholder agricultural expansion decision will be imperative to inform decision-making surrounding any proposed PES program in Batabo Hill and will assist with program design.

2.3 Payment for Ecosystem Services

The importance of engaging the participation of local communities in the management of protection/ conservation areas or forests was recognised by the World Bank and the Asian Development Bank who started funding integrated conservation and

development projects (ICDP) in the 1980s. These projects were based around increasing the benefits from alternative livelihood activities as a way to reduce the threats to protection areas. The community-based conservation programs of the 1990s sought to directly link biodiversity conservation with livelihoods to establish a direct incentive for local people to commit to biodiversity conservation in the long term (Berkes 2007). For policymakers, this direct approach is sensible; the rural poor are, in many instances, living in biodiversity rich areas or on the slopes of watersheds (Chomitz et al. 2006; FAO 2007), and with limited non-farm employment options, are driven to deplete natural resources to support their livelihoods, with the effects of environmental degradation then also negatively impacting on these communities in the longer term (Vosti & Reardon 1997).

Smallholders typically have limited incentives to modify land use practices or be concerned about wildlife conservation, both which have the potential to provide positive environmental externalities to the broader global community. The absence of incentives for local natural resources stewardship creates a market failure (Shrestha et al. 2007); in Sumatra, the biodiversity and wildlife species are of global significance, yet provide little value to the local poor rural households who require land to support their largely agricultural livelihoods.

Payments for Ecosystem Services⁸ (PES) programs acknowledge the local costs of conservation and address them via novel, market-oriented compensation schemes; recognising that local households are dependent on protection areas for their livelihoods needs and that alternate livelihood opportunities are scarce. Directly paying the households neighbouring the Protection Forest acknowledges that they are (one of⁹) the principal agents of change, therefore their behaviour must change in order to protect the ecosystem. It is these households that are often in the best position to protect the ecosystem (Ferraro 2001);

⁸Also referred to as Payments for Ecosystem Services programs.

⁹ Large plantation companies are also reported to have directly or indirectly (via renting from smallholders) cleared land in the protected forest.

therefore, any intervention should focus on influencing their behaviour, as paying households directly to protect the ecosystem can be far more cost-effective than more broad-based conservation interventions (Ferraro & Simpson 2002).

PES programs are becoming increasingly popular as a way to achieve conservation and development goals, and have taken off in Latin America (Pagiola, Arcenas & Platais 2005). In its simplest form, the Centre for International Forestry Research (CIFOR) define PES as (1) a voluntary transaction where (2) a well-defined Environmental Service (ES) or corresponding land use is (3) being 'bought' by a minimum of one ES buyer (4) from a minimum of one ES provider (5) if and only if the ES provision is secured (conditionality) (Wunder 2008, p.280). This definition is informed by the theoretical PES literature (Ferraro & Kiss 2002; Ferraro & Simpson 2002; Simpson & Sedjo 1996). Over a decade ago one global review identified nearly 300 PES programs in existence (Landell-Mills, Porras & Bishop 2002). However, globally, many different types of PES schemes exist which do not meet all of the five criteria (see Bulte et al. 2008a, Neef & Thomas 2009; Rebelo 2009 for a review).

PES works to promote conservation by allowing external beneficiaries of ecosystem services to make direct contractual payments to local land users in return for adopting practices that foster ecosystem conservation and restoration. PES directly acknowledges the trade-offs between the interests of private landholders and the conservation of ecosystems of global significance, and the need for compensation to bridge this gap (Wunder 2007). The potential for a PES program to achieve both environmental and poverty alleviation objectives (Zilberman, Lipper & McCarthy 2008) make this an attractive policy solution, particularly in rural areas, characterised by a high degree of poor rural households heavily reliant on natural resources of varying quality for their livelihoods.

Costa Rica pioneered the application of a PES program in a developing country context with its “Pago por Servicios Ambientales” (PSA) program. Partly funded by a fuel tax, with significant funding from GEF grants, the PES program has helped support payments to farmers and landowners to preserve forest land and has been partially credited for helping the country go from having one of the world’s highest rates of deforestation, to achieving negative net deforestation. This program recognises the global significance of Costa Rican biodiversity and involves the sale of biodiversity services in biodiversity conservation priority areas, providing a necessary ‘carrot’ to accompany legal restrictions on forest clearing in these high conservation value areas (Pagiola 2008). The Costa Rica experience provides a comparable example and important lessons from which Indonesia could draw on in PES program design.

In line with the growing concerns surrounding wildlife extinction, the application of PES solutions has been considered in a number of wildlife contexts globally. Bulte et al. (2008b) employ a cost-benefit analysis to examine the economic rationale of paying the Massai community living near to the Amboseli National Park, Kenya to improve wildlife habitat. The authors’ modelling finds that the conservation benefits of a PES scheme are large enough to support implementing such a scheme. However, the study raises concerns about possible leakage effects, whereby the payments received by households may induce the expansion of livestock herds, which in turn would lead to increased competition for forage, to the detriment of wildlife. Horan, Shogren & Gramig, (2008) consider a PES solution to address habitat loss and fragmentation, in order to prevent the extinction of endangered species. This involved a payment to landowners to allow the movement of and increase the habitat for, endangered species. Under this PES approach spatial targeting is required to capture the necessary fragments of crucial wildlife habitat - parcels of land located nearer to

the forest will generate greater wildlife habitat benefits than parcels neighbouring land in agricultural use (Lewis, Platinga & Wu 2009).

Zilberman, Lipper & McCarthy (2008) consider if land diversion programs which ask landowners to convert land from agricultural uses to other land uses such as forests or other types of native ecosystems can benefit the poor. The authors' modelling finds that land diversion programs can benefit the poor when they are owners of land that has limited potential for agricultural production but has strong ecosystem services potential, or if the ecosystem services generated in turn benefit the poor i.e. by preventing erosion or enhancing water quality. This finding has relevance for this study context, where the land quality is deteriorating, and many plots are characterised by older, less productive rubber trees.

There have been a number of successful applications of PES programs in Indonesia (See Leimona et al. 2015a; Pasha & Leimona 2011 and Suich et al. 2016 for reviews of Indonesia's experience with PES programs) and these programs are gaining more support from local government and communities because of their appeal as both an incentive mechanism and poverty reduction initiative (Antle & Stoorvogel 2009; Lipper et al. 2009; Pagiola et al. 2004). During the past 20 years, PES projects in Indonesia include ecosystem restoration concessions (Pirard, de Buren & Lapeyre 2014), watershed services (i.e. Leimona et al., 2010 ; Pasha et al., 2012), eco-certification for jungle rubber (Leimona & Joshi, 2010) and forest carbon (Leimona et al., 2006).

Lessons learned from the Rewarding Upland Poor for Environmental Services (RUPES) project of the World Agroforestry Centre (ICRAF) across multiple sites in Indonesia include the need for co-investment in environmental stewardship rather than a strict and prescriptive PES definition. This is in recognition of the lack of data, ability to map, model, measure, value and monitor ecosystem services, unclear property rights and strong linkages between poverty and environmental degradation (Leimona et al., 2015a). In this

study context, where land tenure is unclear, a broader concept of ‘rewards’ (RES) rather than ‘payments’ for ecosystem services may be more appropriate. The term ‘RES’ offers broader forms of recognition to ecosystem services providers, including in-kind rewards such as access to land and the recognition of identity and rights (van Noordwijk et al., 2004). In this context, a community forestry scheme ‘Hutan Desa’ (village forest) may be more appropriate. Recent experience with community forestry schemes in Sumatra have been mostly positive, resulting in avoided deforestation, with minimal leakage or displacement of deforestation to areas adjacent (Santika et al., 2017).

Southgate et al. (2010) use a contingent evaluation approach to investigate the potential for a PES program that directly pays land-users in Ecuador and Guatemala to stop farming a portion of their land for a period of five years. The authors’ analysis of the dichotomous-choice willingness to accept responses finds that respondent’s acceptance or rejection of compensation to reduce their farmed area is positively linked to compensation levels. Households that depend on subsistence farming, have more remote parcels or larger farms are more likely to be willing to sacrifice a portion of their land.

The value placed on nature can transcend pure monetary values, therefore PES payment levels should be negotiated between service buyers and sellers, or can instead be informed by ES provider costs (or opportunity costs) (Wunder 2013). Quantifying the opportunity cost of giving up access to land in Batabo Hill will be essential to the development of a successful PES program which balances the livelihood needs of local residents against conservation objectives. The loss of access to land in the Protection Forest (Batabo Hill) may not be fully captured by market values (Bush et al. 2013); this land may also have cultural values to local land users that are not fully captured by the market price for rubber. In the absence of observable participation behaviour, contingent valuation methods

are valuable in measuring the economic value of households giving up access to their land in the Protection Forest.

2.4 The Contingent Valuation Approach

The contingent valuation method is an often used technique to estimate economic values of ecosystems and biodiversity (Brown & Gregory 1999; Mitchell & Carson 1989; Shrestha et al. 2007). Contingent valuation methods are favoured by environmental economists to elicit values from private landholders using a 'stated preference' approach. Stated preference approaches (e.g. willingness to accept and willingness to pay) are an important tool to inform policy and program design by providing insights in the absence of observable participation behaviour.

Over the previous two decades, the literature has favoured willingness to pay (WTP) over willingness to accept (WTA) methods. A report recommendation by the National Oceanic and Atmospheric Administration panel (Arrow & Solow 1993) argues that WTP estimates are more conservative, warning that respondents may give protest bids or unrealistically high answers to WTA questions (Interis 2014). This concern stems from difficulty with controlling hypothetical bias, which is argued to be greater in WTA studies (List & Gallet 2001; Murphy et al. 2005).

However, in recent years, there have been advancements in WTA survey design including the application of inferred valuation techniques (Kaczan & Swallow 2013), cheap talk scripts (Krishna et al. 2013) and a precision point mechanism (Bush et al. 2013), all which attempt to improve the reliability and validity of WTA estimates.

Nonetheless, concerns that the WTA format is not incentive compatible for stated preference elicitation (Haab & McConnell 2002) mean that WTP has been applied in circumstances where WTA is more appropriate (Knetsch 2005). When considering which method to apply, Petrolia and Kim (2011) conclude that if the (perceived) property rights reside with the respondent, it is inappropriate to ask the respondent their WTP for land to

which they already claim ownership. Brown and Gregory (1999) warn that applying WTP when WTA is more appropriate tends to undervalue the environmental good.

In this context, and in acknowledgement of the smallholders perceived property rights, the WTA, rather than WTP approach is appropriate in this study (Interis 2014; Lienhoop & MacMillan 2007), eliciting the ‘rent out’ price required for smallholders to give up access to their land (Brown & Gregory 1999; Krishna et al. 2013).

In the wildlife conservation literature, the WTP approach has been applied to value ecosystem services in biodiversity corridors (e.g. Xi 2009) and to estimate urban households WTP for a compensation program for private landholders surrounding Nairobi National Park (Rodriguez 2012). Recent applications of the WTA approach explore farm households WTA compensation for participation in a hypothetical PES program (Kaczan & Swallow 2013; Ma et al. 2012), estimate the amount of compensation local households would require to forgo access to natural resources (Shrestha et al., 2007) and in Sumatra, ask farmers what payment they would be willing to accept in exchange for not cutting forest (Cacho et al. 2014). This study draws on their approach of Southgate et al. (2010) to estimate private land users’ WTA compensation to forgo access to their land in Batabo Hill for a period of five years as part of a hypothetical PES program. The minimum amount of compensation required to motivate a farm household to participate in such a scheme is used to estimate the potential cost of establishing a PES program.

Fears over high levels of ‘protest zeros’, non-response rates and hypothetical bias inflating estimates lead many researchers to prefer binary discrete choice approaches rather than open-ended approaches to WTA and WTP. However, in the case of double bounded discrete choice mechanisms, Carson and Groves (2007) find that the WTP estimates - are higher than those from open-ended questions, and Lusk and Norwood (2009a) demonstrate that no elicitation approach is immune to hypothetical bias. The open-ended approach is

preferable for this study as it provides scope to investigate the heterogeneity in the respondents' valuation of their land in the forest¹⁰, removing the opportunity for the respondent to simply agree with the bid amounts provided under a binary discrete-choice approach, or be influenced by starting point bias under binary choice or referendum approaches (Mekonnen 2000).

2.5 Mitigating Against Hypothetical and Social Desirability Bias

In their review of contingent valuation methods to inform the design of PES mechanisms, Whittington and Pagiola (2012) identify numerous developing country studies using stated preference techniques that fail to address hypothetical bias. Recent advancements in WTA survey design address these concerns, including the application of cheap talk scripts (Krishna et al. 2013) and the use of novel inferred valuation techniques (Lusk & Norwood 2009a, 2009b). First developed by Lusk and Norwood (2009a), the inferred valuation literature (e.g. Lusk & Norwood 2009b; Norwood & Lusk 2011; Yadav, van Rensburg & Kelly 2013) is based on the premise that there are two sources of bias in the typical contingent valuation measure - hypothetical bias and social desirability bias, which is itself a form of hypothetical bias.

Hypothetical bias can be a problem in contingent valuation where there is potential for a discrepancy between what people say they will pay or accept in a hypothetical survey, compared to what they will actually pay or accept in a real world situation. One particular type of hypothetical bias is strategic behaviour, where respondents answer in hope of skewing results and consequently any program or policy informed by the survey's findings (Kaczan & Swallow 2013). This problem arises because contingent valuation studies present hypothetical scenarios without any real consequences, and as such respondents are not bound by their response in any way. Closely related to this is another form of hypothetical bias –

¹⁰ Allowing for attachment to place and cultural and spiritual values associated with traditional and customary access to the forest.

‘yea saying’, where respondents may indicate their willingness to participate in a PES program without fully considering the associated trade-offs (Bennet & Blamey 2001).

By asking people to provide their own WTP for a good as well as what they infer others WTP would be, Lusk and Norwood (2009a) provide empirical evidence to demonstrate that people derive utility from the act of saying they are WTP for a good; thus creating a wedge between the real and hypothetical value elicited. This effect is particularly strong for goods with normative motivations (Lusk & Norwood 2009b), where differences between self and inferred valuations are found to be very large. Yadav, van Rensburg & Kelly (2013) find that self-valuations were significantly higher than those obtained via inferred valuation, with this difference being greater when normative motivations are at play.

Social desirability bias is a type of hypothetical bias which stems from the tendency for some respondents to answer in ways they perceive will garner approval from the enumerator (Maguire 2009) or conform to societal norms (Lusk & Norwood 2009). These self-image or self-presentation effects can manifest in the form of enumerator effects, whereby the respondent may answer in a way which they perceive will please the enumerator (Goffman 1963). For example, respondents may at times answer in ways they believe will be viewed favourably by others (Fisher 1993), and may consciously or subconsciously follow dominant cultural norms (Asch & Guetzkow 1951). This conforming behaviour is shaped by cultural specific determinants of shame and pride (Bond & Smith 1996; Goffman 1967), such that social desirability effects are reflective of, and unique to, the cultural context of the study (Neto 1995; Zerbe & Paulhus 1987). Consequently, social desirability bias may lead to results suggesting higher (or lower) WTA than is actually the case.

The literature on enumerator effects suggests that the gender of the enumerator can systematically and significantly affect survey responses, and bias responses in a number of ways (Blaydes & Gillum 2013; Gneezy, Leonard & List 2009). For example, when

interviewed by a woman, respondents may provide more progressive and egalitarian answers to gender-sensitive questions (i.e. Lueptow, Moser & Pendelton 1990) and be willing to report more details on sensitive topics (i.e. Hansen & Schuldt 1982).

2.5.1 The Inferred Valuation Method

The inferred valuation method seeks to overcome social desirability bias by eliminating the utility people derive from the act of simply stating what they are willing to pay or willing to accept (Yadav, van Rensburg & Kelly 2013). Inferred valuation methods control for this by asking people to predict or infer others' values for a good rather than asking people to state their own value. This can be particularly useful when participants may feel reluctant to give their opinions directly.

Because the question relates to other people's values, rather than the respondents, the theory is that the respondent gets no utility from the act of saying they are willing to pay (or accept) for a (moral) good, and therefore is not motivated to answer in a socially desirable manner (Fisher 1993). Further, Pronin (2007) argues that people tend to recognise bias in human judgement except when biases are their own, therefore this suggests that predictions of other peoples' preferences should mitigate social desirability biases.

The rationale behind using inferred valuation is that the individual respondent does not typically have knowledge of the specific preferences of the broader population. Therefore, without this information, the respondent who is asked to make the inferred valuation must instead use her own value. Because the respondent is providing other people's values, rather than their own, there should be no motivation to answer in a way that enhances one's self-image or conforms to social norms. In testing this approach, Lusk and Norwood (2009a) hypothesised, and provided empirical evidence, that inferred values are roughly equal to conventional self-reported values, adjusted for social desirability bias, and better predict actual behaviour than conventional contingent valuation methods Lusk (2009b). For

this reason, the resulting value is more appropriate for PES program design and policy development (Kaczan & Swallow 2013).

The inferred valuation method has been seldom explored in a WTA setting. Empirical applications by Drichoutis, Lusk and Pappa (2016) and Kaczan and Swallow (2013) using dichotomous choice and choice experiment, payment card approaches find that inferred valuation has little effect on elicited WTA valuations. However, WTP applications highlight the potential for inferred valuation to mitigate against hypothetical bias (Lusk & Norwood 2009b; Norwood & Lusk 2011; Yadav, van Rensburg & Kelly 2013).

The third person approach has been applied in settings where there is a tendency to overstate generosity or environmental concern (Epley & Dunning 2002; Johansson-Stenman & Martinsson 2006). Comparing the inferred valuation method to traditional stated preference values, Yadav, van Rensburg & Kelly (2013) find that individuals believe they are willing to pay significantly more than others towards conservation. In this study context, there is potential for respondents to a) seek to please the enumerator, and/or b) wish to appear relatively more willing to participate in the hypothetical conservation program, and provide a lower WTA value than their true preferences. The application of inferred valuation to this study context can help to examine the extent to which self-image effects and the utility people derive from saying they are WTA influence WTA values.

Lusk and Norwood (2009) observe that one of the key advantages of inferred valuation is that the theory underpinning the methodology is not dependent on the elicitation format used or the type of good valued, and as such, it can be expected to mitigate hypothetical bias when applied to any elicitation format. This study contributes to the emerging inferred valuation literature in two ways. First, by testing the inferred valuation method in a developing-country context. Second, by extending the empirical evidence base via the third known application of the inferred valuation method to a WTA approach

(following on from Drichoutis, Lusk & Pappa 2016 and Kaczan & Swallow 2013) and the first application using an open-ended elicitation format.

2. 6 Gender Differences

The role of gender has been examined with respect to agriculture, property rights, the control of assets, access to credit, food security and nutrition (Goetz & Gupta 1996; Meinzen-Dick et al. 1997; Meinzen-Dick et al. 2012; Quisumbing & Otsuka 2001; Sraboni et al. 2014; Wiig 2013). In agriculture, the literature has focussed on gender roles in agricultural production, the adoption of new technology, and access to institutional and organisation interventions, as well as women's empowerment (Alkire et al. 2013; Allendorf 2007; Doss & Morris 2000; Seebens 2010; Villamor et al. 2014b).

On average, women are more risk averse, less self-assertive and less competitive than men, demonstrate less self-interest, and display greater concern about the welfare of the community (Croson & Gneezy 2009; Eagly & Steffen 1984; Eckel & Grossman 2002; Leach, Joeks & Green 1995). Literature examining risk preferences has found evidence that women accept less risky asset portfolios than men (Jianakoplos & Bernasek 1998), report a lower willingness to accept financial risk (Barsky et al. 1997) and are more risk averse to gambling (Levin et al. 1998).

Empirical research suggests that women may be more sensitive to environmental risk, and that more so than men, they see the links between environmental quality and its consequences for personal well-being, social welfare and landscape health (Stern, Dietz & Kalof 1993), and that this may lead to an observed gender gap in valuations (O'Connor, 1997). Further, the presence of children has been found to influence both the mother's (Blocker & Eckberg 1989), and both parents' (Dupont 2004), level of concern for the environment, and WTP for environmental improvement.

Research from neighbouring Jambi province finds that men and women have different land use preferences and may have different willingness to accept risk associated with the

provision of ecosystem services, and that women are more active and dynamic than men in responding to external opportunities shaping land use (Villamor & van Noordwijk 2016). This is in line with observations from Eckel, De Oliveria and Grossman (2008) which found women were more likely to accept more offers than men during experimental games. For this reason, the inclusion or targeting of women in the PES program could potentially improve program uptake; in turn improving the management of local landscapes and associated ecosystem services.

2.6.1 Gender differences in contingent valuation

A growing literature is investigating gender differences in economic experiments (i.e Eckel & Grossman 2002; Eckel, De Oliveira & Grossman 2008). Laboratory experiments examining individual decision making find that there can be gender differences (or a lack thereof), however, this can depend on the nature of the task and the experimental design (Eckel, De Oliveira & Grossman 2008).

A smaller literature examines gender differences in contingent valuation (i.e Brown & Taylor 2000; Mitani & Flores 2007), however, the existing evidence is inconclusive. Using an opened ended WTP survey for donations to the Nature Conservancy, Brown and Taylor (2000) find that on average, men state significantly larger mean WTP values than women and that these differences are statistically significant, however this occurs only in the hypothetical treatment. In their sample, hypothetical bias was three times greater for males than females. In a similar study using an induced value public good game, Mitani and Flores (2007) also find that men exhibit greater hypothetical bias, and conclude that women are more likely to state their true value in a hypothetical survey than men. Contrary to these results, Johansson-Stenman and Svedsater (2012) find no significant gender differences in hypothetical bias¹¹.

¹¹ However caution this interpretation given the sample size of n=160.

Much of the contingent valuation literature examining gender differences come from developed country laboratory settings, and often test on college students; exceptions include Gneezy, Leonard and List (2009) and Prabhu (2010). However, gender differences are fluid and context specific and results may vary in a rural developing country context (Meizen-Dick et al. 2014). A recent choice experiment study conducted in the field by Kaczan and Swallow (2013) found gender differences in preferences for a hypothetical PES program in Tanzania, with females exhibiting an overall stronger acceptance of a PES program.

With the exception of Carlsson, Daruvala and Jadell (2010) there are few inferred valuation studies reporting on gender differences¹² and none, to the best of our knowledge, reports on intra-household level gender differences. The authors find that men and women do not differ greatly in their marginal WTP for donations to UNICEF and the Red Cross, however, women have a higher marginal WTP for donations to the WWF. This is consistent with results from conventional contingent valuation studies. For example, Johansson-Stenman and Svedsater (2012) find women are more willing to contribute to WWF projects than men, and Johansson–Stenman and Martinsson (2006) find that women are significantly more concerned about the environmental performance of their car than men. These findings suggest that gender differences may be linked to the type of good valued (Landenburg & Boye Olsen, 2010) i.e. humanitarian versus environmental.

Further, contrary to previous conventional contingent valuations studies; i.e. Brown and Taylor (2000) and Mitani and Flores (2007), Carlsson, Daruvala and Jadell (2010) find that women have stronger hypothetical bias than men. This is consistent with empirical evidence which finds that women are more socially orientated than men and that displaying

¹² The seminal work by Lusk and Norwood (2009a) found no statistically significant gender differences. Lusk and Norwood (2009b) had n=88 of which 73% were female so results likely capture female dominant effects.

generosity and altruism is an important part of their self-image (Mellstrom & Johannesson 2008). Women are more inclined (than men) to overstate their own generosity as a way to conform to their own self-image as well as conforming to the image society has of women.

The contrasting findings may be attributable to differences in the how the cheap talk script or the application of the inferred valuation techniques reduced bias; as there may be gender differences in how these experimental techniques are interpreted. For example, Meyers-Levy and Tybout (1989) find that women tend to be more thorough in processing information, whereas men tend to be more superficial. This is in line with the experience of Landenburg and Boye Olsen (2010) who observe that male and female respondents respond differently to the information outlined in the experimental scenario, and Carlsson, Daruvala and Jadell (2010), who suggest that in their study, the cheap talk script may have been effective in reducing hypothetical bias for men, but not for women.

Croson and Gneezy (2004) observe that while both genders are maximising an underlying utility function, the utility function that men use is less sensitive to the conditions of the experiment than the function that women use. They find that women are more responsive than men to the experimental design and implementation, such that the gender-specific ways in which participants process the premise of the experiment may be causing inconsistent results across experimental studies. However, further work on gender differences is needed to draw firmer conclusions and Carlsson, Daruvala and Jadell (2010) warn against generalising the results, recommending future contingent valuation studies take into account gender differences.

2.6.2 Intra-household Differences in Preferences

Traditionally, contingent valuation studies only interview the male head of household, and without any clear theoretical or empirical justification, assume a common preference model for the household. This model assumes either that all household members have the same preferences, pool all resources and agree on all decisions or alternatively, that one

household member makes decisions for the household (Doss & Meinzen-Dick 2015). This approach assumes that either spouse can accurately represent the entire household when making resource allocation decisions and that no matter which spouse is interviewed, the response would be the same (Bateman & Munro 2006).

An emerging literature examining intra-household resource allocation using contingent valuation methods interviews husbands and wives separately, (i.e. Lampietti 1999; Prabhu 2010 and Whittington et al. 2008) and in doing so, finds evidence of significant differences in the WTP preferences of husbands and wives for vaccines in range of developing country contexts, and thus rejects the common preference model.

For this reason, this study interviews the husbands and wives separately to capture any differences in WTA preferences, contributing to the emerging literature examining intra-household preferences using contingent valuation methods.

2.6 Summary

PES programs are growing in popularity as policymakers seek new ways to achieve environmental and development objectives. The contingent valuation method is an often used technique to estimate economic values of ecosystems and biodiversity and is favoured by environmental economists to elicit values from private landholders using a ‘stated preference’ approach. Stated preference approaches (e.g. WTA) are an important tool to inform policy and program design by providing insights in the absence of observable participation behaviour.

This chapter described the use of WTA and WTP approaches to elicit values from smallholders, and discussed the potential for the application of the novel inferred valuation technique to mitigate against hypothetical and social desirability bias. This study contributes to the emerging literature applying the inferred valuation technique by extending the empirical

evidence base via the third known application of the inferred valuation method to a WTA approach and the first application using an open-ended elicitation format.

In addition, this chapter described the literature on gender differences in economic studies and discussed the contrasting findings of gender differences in contingent valuation studies. Much of the contingent valuation literature examining gender differences come from developed country laboratory settings, often testing on college students; yet, gender differences are fluid and context specific and results may vary in a rural developing country context. This study tests the inferred valuation method in a developing-country context and contributes to the small inferred valuation literature and broader contingent valuation literature examining gender differences.

Chapter 3 Methodology

3.1 Introduction

This study involved a mixed methods research design combining quantitative and qualitative methods to address the research questions and to capitalise on the strengths of each approach, as well as compensate for the weaknesses of each. The quantitative data was collected using a structured household survey. The qualitative methods included focus group discussions and key informant interviews.

The focus group discussions and key informant interviews were conducted to identify the extent, and drivers of, agricultural expansion into the Protection Forest, Batabo Hill, and to identify the population with use rights to this land. A further objective of the focus group discussions was to explore local perceptions of how the environment is changing, and the factors driving these changes. Together, the qualitative findings helped to identify the population responsible for agricultural expansion in the Protection Forest and informed the subsequent development and targeting of the household survey.

The household survey investigated the willingness of farm households in villages surrounding Batabo Hill to accept compensation to forgo access to their land in Batabo Hill as part of a hypothetical PES program. To do so, both the male and female heads of household from 300 households in the villages surrounding Batabo Hill were interviewed.

This chapter describes the methods used to conduct the key informant interviews and focus group discussions and outlines the development and implementation of a comprehensive survey of farm households in Riau, Indonesia.

This research was conducted as part of an Australian Centre for International Agricultural Research (ACIAR) project: “Contributing to a Sustainable Agriculture Strategy for Indonesia”. The chapter begins with an overview of the key informant interviews, focus group discussions and household survey development, and is followed by a detailed explanation of the household survey research activities, including sample selection, survey design, enumerator training and data collection.

3.2 Key Informant Interviews

Key informant interviews were conducted in March 2015 by the University of Adelaide and WWF research team with village leaders and local government officers from the Kuantan Mudik Sub District office, Kuantan Singingi District office and Kuantan Singingi District forestry office. A semi-structured interview approach was taken, with the interviews covering a set of topics, allowing the conversation to flow naturally from one topic to another.

The purpose of the key informant interviews was:

1. To identify which villages were operating in Batabo Hill, and to derive an estimate of the number of villagers with land in Batabo Hill.
2. To explore the factors influencing agricultural expansion into Batabo Hill.
3. To investigate the dependence of villages in Kuantan Mudik Sub District on rubber as a means of livelihood, and the extent to which households had shifted to palm oil and the reasons for this shift.

The interviews were conducted in Indonesian, and live translated into English to allow the active participation of non-Indonesian speaking researchers. Detailed notes were taken, and later transcribed and translated into English.

The findings from the key informant interviews helped to guide the selection of villages targeted for the focus group discussions and provided a point of reference to validate the focus group discussion findings.

3.3 Focus Group Discussions

Focus group discussions (FGDs) were conducted over two days in March 2015 across three villages surrounding the Protection Forest in Kuantan Mudik Sub District- Kasang, Seberang Cengar and Rantau Sialang village. The FGDs were co-hosted by the University of Adelaide research team and WWF. Permission was sought from village heads who were asked to recruit a mix of participant's representative of the village demographics for an approximately two hour group discussion. The FGDs were held in community centres and convened by the village leader, who introduced the researchers and provided an overview of the purpose of the discussion.

The FGDs were conducted to address the following research objectives:

1. *To identify the extent of, and drivers of agricultural expansion in Batabo Hill., and identify the population with use rights to the land.*
2. *To explore the local perceptions of the changing environment, and the factors driving these changes.*

The FGDs consisted of between 10-12 participants of both genders, from a range of ages and livelihood backgrounds including oil palm, rubber, paddy, horticulture and non-farm employment. Approximately 85 per cent of participants originated from their village, and their families have been in the district for a number of generations. The remainder of participants moved from nearby villages, with a small percentage from outside the district.

The FGDs were run in Indonesian with live translation into English. The moderator was experienced in running FGDs in rural Indonesian village settings and together with the

local WWF team, established a rapport with the FGD participants. The FGDs were run as per the discussion guide and broken down into three main topics detailed below.

Topic 1: Agricultural expansion

1. Informal or formal rules about forest clearing and enforcement of forest clearing rules.
2. Land tenure/land rights over cleared forest land.
3. Agricultural expansion into the nearby Protection Forest, Batabo Hill.

Topic 2: Livelihoods

1. Local livelihoods, with a focus on understanding participant's reliance on agriculture and the local environment.
2. The importance of the rubber (latex) farming to the village, including the reasons why they farmed rubber, and the challenges surrounding this traditional livelihood.
3. Access to credit and capital investment to support business growth.
4. The shift towards new livelihoods such as oil palm, and the factors influencing this shift.
5. The availability of non-farm employment opportunities.

Topic 3: Perceptions of the changing local environment

1. Changes in the local environment over the last 10 years.
2. Perceived impacts of these changes on agricultural livelihoods.
3. The ecosystem services provided by Batabo Hill.

The moderator used the discussion guide as a prompt to discuss topics until their natural conclusion, while maintaining flexibility to explore new topics as they arose. The moderator ensured that all participants were able to contribute to the discussion, probing respondents when required to gather a balanced and representative discussion.

Butcher paper and whiteboards were employed to facilitate the discussion on Topic 3- *Perceptions of the changing local environment*, engaging participants to rank the perceived changes by importance, and to also rank by importance the ecosystem services provided by Batabo Hill. The FGDs were recorded, and once completed, transcribed verbatim and translated into English by bi-lingual researchers with the familiarity with the cultural context and experience in conducting and reporting on FGDs. This process enabled the researchers to identify the issues raised in each group discussion and to then build on the information gained and further explore this in subsequent group discussions.

Breaks were taken at intervals between the topics and refreshments were provided. To compensate participants equally for their time, both the male and female participants were paid 50,000 rupiahs, the equivalent to the daily wage and approximately five Australian dollars.

The data was validated against the key informant interviews and subsequent household survey data, allowing for the cross-checking of findings.

3.4 Household Survey Development

The household survey was developed between February 2015 and June 2015 by the ACIAR project research team to address the research objectives. The household survey explored the following research objectives:

- a) *To investigate the willingness of households in Kuantan Mudik Sub District to accept payments to give up use-rights to their land in Batabo Hill.*
- b) *To examine the sources of bias affecting the willingness to accept decision and the potential for inferred valuation methods to control for this.*
- c) *To investigate gender differences in willingness to accept, and to explore the implications for study design and program targeting.*

Household survey development consisted of three steps: building a draft of the survey in English and Indonesian, pre-testing the draft survey on farm households, and incorporating learnings from pre-testing into the final version of the survey. The household survey was designed by the research team after an extensive review of the agricultural expansion, PES, gender, contingent valuation and inferred valuation literature. Insights from the FGDs and key informant interviews directly informed the development of the household survey

In recognition of the important role which females play in household and agricultural production and decision making (Doss 2013), both the male and female head of household were interviewed. The male head of household survey included 13 modules and the female head of household survey included five modules. Both surveys covered modules on household characteristics, household labour allocation and household land, in addition to a contingent valuation component. The male head of household survey elicited additional information on household characteristics, household assets, agricultural production and sources of income. The female head of household survey elicited additional information on environmental attitudes and perceptions.

The purpose the household characteristics module was to collect information on factors such as household size and composition, including the gender, age, education levels and main activities of each household member. For the purposes of this study, a household refers to a group of people who reside and eat together most of the time. Each member must live with the others at least six months of the year unless the household has a new family member (e.g. new baby or new in-law). The head of household is defined as the person who is responsible for making decisions about agricultural production and land use; in this study, the male head of household is typically the husband and the female head of household is typically the spouse.

The household asset module sought information on housing and the ownership of household and agricultural assets. Household assets include mobile phones, computers and motorcycles. Agricultural assets include production assets (e.g. a tractor, chainsaw) and livestock.

The module on agricultural land collected information on land owned or farmed by members of the household in 2015. This information was collected at the farm plot level and included land size, land use, land characteristics and tenure system.

The purpose of the agricultural production module was to obtain information related to plantation and crop production undertaken by members of the household in the previous 12 months. The land use for each individual plot of farmed land was recorded.

To investigate gender roles in the household, both the male and female heads of household completed a module on household labour allocation, indicating which household and agricultural production tasks they and their spouse are involved in, and are primarily responsible for. In addition, to investigate the breakdown of land ownership and its influence on household decision making, both sexes recorded information on any land owned before responding to contingent valuation questions about their willingness to accept compensation to give up access to household land in Batabo Hill. This will be discussed more detail in Section 3.4.2.

Finally, the female head of household survey collected information on environmental attitudes, perceived impacts of the changing environment and the perceived benefits of the Protection Forest.

Feedback was garnered from the local research team to ensure the survey content accurately reflected the local landscape. The survey was pre-tested by a team of 13 highly trained enumerators supervised by the University of Adelaide and WWF to ensure the content was understood by the target population and able to be completed within a reasonable period

of time. Extra time was devoted to testing the environmental attitudes and perceptions questions to ensure that the ranking exercises were comprehended and able to be successfully completed. Additional care was also taken to ensure that households understood the hypothetical PES scenario and were able to respond to the contingent valuation section. Feedback from the pre-testing was incorporated into the final version of the survey.

The male and female head of household surveys were undertaken separately, in private in the family home. The male survey took approximately two hours to complete and the female survey approximately 45 minutes. To compensate both respondents equally for their time, both the male and female head of household were paid 50,000 rupiahs, the equivalent to the daily wage, equal to approximately five Australian dollars.

3.4.1 Survey Sample Selection

The survey sample area was selected based on a geographical cluster selection. Indonesia is divided into provinces that are formed by several kabupaten (district), each district consists of several kecamatan (sub-district), a sub district is then divided into desa (villages). Therefore, there are four stages of cluster sample selection to derive the final sample (see Figure 3.1)

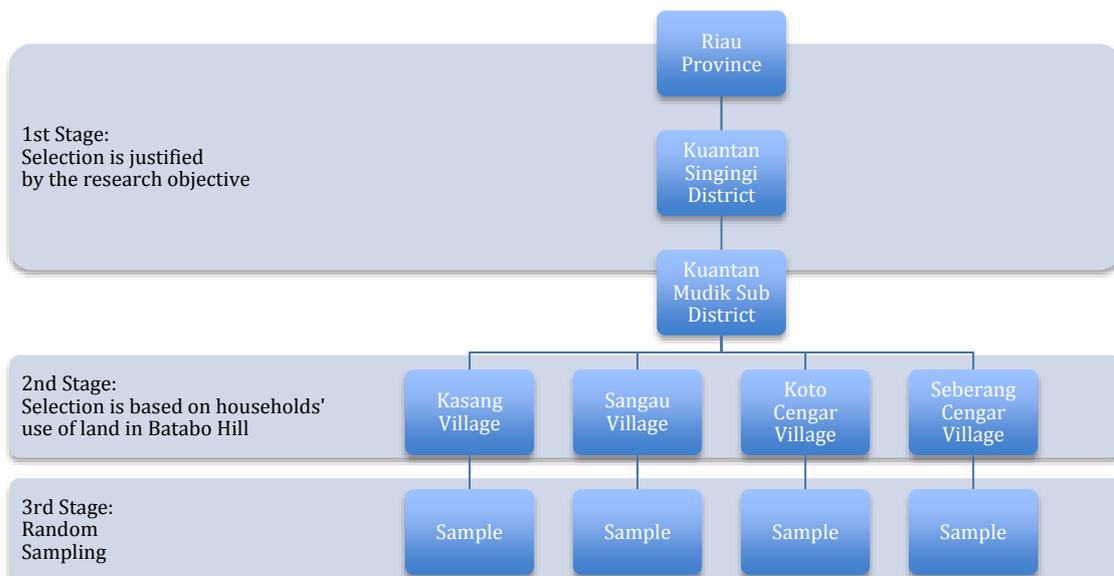


Figure 3.1. Stages of the Sampling Frame

First Stage (Province/District/Sub District Level)

The study site for this research is in Kuantan Mudik, a Sub District in Kuantan Singingi District in Riau Province, Indonesia. The province itself is in the central part of Sumatra Island. In 2014, there were 12 districts in the province, 164 sub districts and 1,836 villages (BPS 2014). Kuantan Singingi District consists of 15 sub districts, and borders with Kampar District (north), Jambi Province (south), West Sumatera Province (west) and Indragiri Hulu District (east).

Kuantan Mudik Sub District is the most western side of the Kuantan Singingi District and directly in borders with West Sumatera Province. Kuantan Mudik Sub District spans 733 km² and borders with Pucuk Rantau Sub District (east), Gunung Toar Sub District (north), Hulu Kuantan Sub District (west and north), and West Sumatera Province (west and south). With respect to topography, the Sub District resides on both flat land and hills with surface altitude 36 meters above sea level. Kuantan Mudik Sub District has a tropical climate with a temperature range of between 20 and 34 degrees Celsius. The rainy season begins from September to March and dry season lasts from April to August.

Kuantan Mudik Sub District consists of 24 villages with the Sub District office in Kasang Village. Table 3.1 lists the villages within Kuantan Mudik Sub District and their respective size and population.

Table 3.1: List of Villages in Kuantan Mudik Sub District

No	Village Name	Size (km²)	Population
1	Pantai	114	2,688
2	Air Buluh	117	702
3	Lubuk Ramo	115	1,473
4	Koto Cengar	108	900
5	Seberang Cengar	107.21	1,386
6	Sangau	9.90	1,172
7	Banjar Padang	8.50	1,051
8	Lubuk Jambi	8.10	597
9	Koto Lubuk Jambi	8.40	749
10	Kasang	12.10	1,460

11	Aur Duri	9.50	305
12	Bukit Kauman	9.90	889
13	Sungai Manau	11.10	670
14	Saik	9.20	881
15	Pebaun Hulu	9.10	684
16	Pebaun Hilir	9.20	885
17	Kinali	6.14	704
18	Pulau Binjai	9.90	903
19	Seberang Pantai	8.70	1,073
20	Luai	7.40	371
21	Rantau Sialang	7.30	784
22	Banjar Guntung	9.90	1,023
23	Bukit Padusunan	9.90	1,240
24	Muaro Tombang	7.50	482
TOTAL		733	23,072

Second Stage (Village Level)

The key informant interviews and focus group discussions revealed the prevalence of agricultural expansion in Kuantan Mudik Sub District, including in the nearby Protection Forest, Batabo Hill. Due to their proximity to and their use of land in Batabo Hill - Kasang, Seberang Cengar, Koto Cengar and Sangua villages were selected to form the household survey sample population (see Figure 3.2 which identifies the location of the villages sampled and Batabo Hill).

Kasang village directly borders with Batang Kariang, a village of West Sumatera Province. Kasang village is located at one end of the 11 km road that cuts through the Protection Forest, Batabo Hill, and Batang Kariang is located at the other¹³. Kasang is a traditional village, dominated by rubber plantations with a small amount of palm oil plantations. Koto Cengar and Seberang Cengar villages have a larger area of palm oil plantations, with around half of the land reported to have switched to oil palm. Of the land cultivated with oil palm, roughly 30 per cent are plasma farmers, and the remaining 20 per cent are independent farmers. The shift to oil palm has only occurred over the last 10 years;

¹³ The vice head of Batang Kariang Village, West Sumatra, reported that none of the villagers manage lands inside the Protection Forest, stating that outsiders from Riau Province were the population operating land in the forest.

operating land in Batabo Hill. Each village head provided village population lists with an estimate of the approximate proportion of villagers which are known to have land in Batabo Hill. The approach was to then randomly draw a sample of 75 households from the total village household census in each of the four villages¹⁴. Households were sampled unconditional on use/non-use of land in Batabo Hill. In each village, an equal number of samples were drawn.

In total, 300 farm households were surveyed, interviewing the male and female heads of household. To be eligible to participate in the survey, potential respondents had to derive at least part of their livelihood from agriculture. The enumerators verified the names on the list through household visits and households that no longer lived in the village or where the respondent/s were too old to complete the survey were disqualified and additional households were drawn from the randomly generated back-up list. From these households, all consented to participate in the survey.

3.4.2 Household Survey Design and Implementation

The survey instrument was pretested on 50 households in June 2015,¹⁵ before the final survey was conducted in July 2015. Thirteen local, university educated, experienced enumerators were trained to deliver the household survey instrument. Three of the most experienced enumerators were selected as supervisors, responsible for the respondent selection and interview quality.

To ensure a standardised approach throughout the contingent valuation component of the household survey, the enumerators were trained to read from the cheap talk script outlined in Appendix 1 (Cummings & Taylor 1999).

¹⁴ Under the random sampling technique not all households in the sample were expected to have land in Batabo Hill. Prior to interviewing the head of household there was no way to confirm whether or not they had land in Batabo Hill, therefore, we recognised that the approach taken meant that our sample would include both households with and without land in Batabo Hill, and that was the intent of the study.

¹⁵ These households were excluded from the final sample.

The enumerators clarified that households could not use the land for any purpose during this time and that the land would not be touched by program managers, instead, it would be ‘left alone’ to allow the habitat to regenerate over the five-year period, and then returned to the household.

The five-year time limit was chosen to emphasise that accepting payments would not threaten the recipient’s property rights (Southgate et al. 2010). A cash transfer was chosen in recognition that the land users (typically low income farm households) had already established a recognised right to the land, and would require compensation for this lost livelihood activity. Throughout the WTA exercise, it was made clear that this was a hypothetical situation, undertaken purely for research purposes.

The contingent valuation component of the survey followed the following structure – first using a direct valuation approach to ask (a) what the respondent would accept to give up their land for five years, followed by an inferred valuation approach, asking (b) what they think neighbour would say they would accept when surveyed, as well as (c) what their neighbour would actually accept (in a real life situation)¹⁶. Under this approach (a) is capturing the hypothetical self, (b) the hypothetical other, which is aimed at removing the social desirability/warm glow bias, and (c) the actual other, which in theory, reduces both the hypothetical and social desirability bias (Lusk & Norwood 2009a).

In the absence of social desirability bias, the amount that the respondent will infer their neighbour will say they will accept when surveyed (WTA2) is hypothesised to be greater than the amount the respondent will say they will accept themselves (WTA1). Further, in the absence of both social desirability and hypothetical bias, it is hypothesised that

¹⁶ In this case, ‘inferred actual’ is more an ‘inferred hypothetical’ as the use of ‘actual’ refers to the respondent indicating what their neighbour would actually accept. As per Cummings and Taylor (1999), the ‘actual’ value would more appropriately be phrased ‘will actually accept.’

the amount the respondent is WTA (WTA1) will be greater than what they say their neighbour would accept in a real life situation¹⁷ (WTA3).

To elicit what the respondent would be willing to accept, respondents were first asked to confirm their use right to land in Batabo Hill. Respondents who admitted to having land in Batabo Hill¹⁸ were asked to provide plot information including how many rubber trees they would need to be compensated for, the age of the trees and how many hectares of land they had.

Respondents were then asked if they would prefer to be paid monthly for five years or in a lump sum - one payment at the beginning of the five years. Respondents were asked to state what payment amount (if any) they would be willing to accept to give up their land for five years according to both their first and second payment preferences. Based on their responses, respondents were then asked debriefing questions to understand why they were/were not WTA (Arrow & Solow 1993).

This was followed by inferred valuation questions asking what respondents thought their neighbours would be willing to accept. Our approach differs to the earlier inferred valuation literature, which asked respondents what 'other people' (Lusk & Norwood 2009a) or the 'average other' (Carlsson, Daruvala & Jadell 2010; Yadav, van Rensburg & Kelly 2013) would accept¹⁹. This variation was made because the amount of compensation requested is expected to vary according to individual plot characteristics (Lizin, Van Passel & Schreurs 2015). In this context, the 'other people' or 'average other' approach would have precluded the vital plot information required to give a reference point for the valuation, and consequently, challenged the validity of the estimates. Therefore, the inferred valuation

¹⁷ Ehmke *et al.*, (2008) find that the developing country respondents (China and Niger) were more likely to exhibit positive hypothetical bias than developed country respondents.

¹⁸ Under this study approach there was no way of knowing how many households actually had land in Batabo Hill but answered no to the enumerator.

¹⁹ Johansson-Stenman and Martinsson (2006) also asked respondent to infer their neighbour's values.

questions were elicited with reference to the neighbour's plot characteristics, as a lump sum payment. The respondents were first asked what their neighbour would say they would accept when surveyed, and second what their neighbour would actually accept in real life.

As a test of the external validity of the WTA results (Kaczan & Swallow 2013), the WTA values are compared to the returns to land and the opportunity cost of producing rubber. These reference values play an important role in determining the presence of bias in the estimates and highlight any differences between the financial and economic value placed on the land. From a program design perspective, an assessment of the local opportunity costs is important for adequately designing compensation to ensure appropriate incentives are in place (Wunder 2009), specifically in contexts where the land use is illegal (Gregerson et al. 2010) and formal market values do not exist.

3.5 Data Analysis

Data analyses were conducted to address each research objective, as outlined in Chapter 1. To answer the first two objectives of this study, focus group discussion and key informant interview data were segmented by theme, and detailed analysis was undertaken, drawing connections and comparisons between the segments of data, as described in Chapter 5. To explore the third and fourth research objectives of this study, a within-sample study design was applied, merging the three lump sum WTA observations into one WTA variable to create a panel data set with three WTA observations for each of the 300 households. First, the male head of household data was analysed in Chapter 6, and both Fixed Effects and Random Effects models were employed. In Chapter 7, the analysis was extended to include the female head of household, allowing for a direct comparison between both male and female heads of households. A new approach was taken in Chapter 8 to investigate gender differences in willingness to accept, pooling the male and female data and using gender interaction variables to test for gender differences using OLS regressions.

Only the lump sum WTA values provided were used in the regression and mean comparison analysis in chapters 6-8. The values provided for the monthly payments over five years are compared to the lump sum values provided in the simple descriptive analysis in 8:32.

As outlined above, there are different and unique analytical approaches in each discussion chapter. Therefore, the details of each analysis method are explained in each chapter. Each analytical approach is related to the results and discussion. The following Chapter presents descriptive statistical analysis to provide context to the household participation decision, describing household land use, livelihoods and labour allocation. This will be important when considering how participation in a hypothetical PES program could affect household livelihoods and welfare.

Chapter 4 Descriptive Statistics

4.1 Introduction

This chapter provides an overview of the characteristics of the households sampled and describes the dependence of these households on agriculture for their livelihoods. It discusses the land use activities of these households and the transformation of the agricultural system in Kuantan Mudik Sub District and the associated agricultural expansion.

This chapter outlines how the traditional matrilineal inheritance system has undergone significant changes in recent years (Suyanto, Tomich & Otsuka 2001; Quisumbing & Otsuka 2001) in line with the rapid land use transition away from shifting cultivation towards export-orientated agriculture, namely rubber and oil palm (Villamor et al. 2014b). In addition, this chapter provides a detailed breakdown of how household labour is allocated between male and female heads of household and discusses the implications for land use decision making.

4.2 Household Characteristics

Table 4.1 presents the descriptive statistics of the survey sample. The male household heads are on average 50 years old, and the female household heads are on average 43 years old. Both the male and female heads of household have on average of eight years of formal education. The male and female heads of household have strong ties to the village, having lived in the village for around 35 and 39 years, respectively. The ties to the community go back many generations, with 86 per cent of the heads of household reporting that their grandparents are from Kuantan Mudik Sub District. Further, 94 per cent of households reported remaining in their village for Idul Fitri – an important national holiday which marks the end of Ramadan, where traditionally families travel to be together in their home village/town. Together, these statistics describe the strong attachment which households

have to village the wider district community and the surrounding landscapes, which have provided their families with livelihoods for many generations.

The mean household size is six persons, which is larger than farm households in Java, where mean household size is around four persons (Suprehatin 2016; Wahida 2015). The larger household size reflects that many households have two adult male and/or females, whether this is grandparents or adult children.

Households have limited information technology capabilities - only 19 per cent of households own a computer and only seven per cent are connected to the internet. The level of computer ownership in Riau is around the same as in Java, however internet connectivity is lower in Riau than in Java, where a recent survey of farm households in Java reported that 29 per cent of households are connected to the internet (Suprehatin 2016). However, many households access the internet via mobile phone- 95 per cent of households own at least one mobile phone, and 27 per cent of households own two mobile phones.

Motorbikes are the main source of transportation; 80 per cent of households own up to two motorbikes yet only nine per cent of households owns a car. For the majority of households sampled, a car is unaffordable and motorbikes are sufficient for their local transport needs. Nearly one third of households reported having a bank account. This is consistent with World Bank data which shows that in Indonesia in 2015 around 35 per cent of respondents aged over 15 had a bank account (World Bank 2017).

Households reported an average of \$212 in farm assets, with the most common farm asset a chainsaw (69 per cent of households). Chainsaws are typically utilised by households to clear forest for agriculture and to source wood for household needs. Other farm assets are limited, for example, tractors are non-existent, water pumps are rare (only 13 per cent of households) and spray pumps are uncommon (only 30 per cent of households own a spray pump).

Households have on average 2.39 sources of income, and overall 65 per cent of households reported having at least one source of non-farm income (from any household member), whether this is wage labour, self-employment (i.e trader), or non-farm employment. On average, agricultural income accounts for 53 per cent of household income, largely income from rubber, which alone accounts for an average of 49 per cent of total household income, highlighting how dependent many households are on this traditional livelihood. Non-farm income accounts for an average of 47 per cent of total household income.

On average, households are situated 10 metres from the nearest road of any type (including unpaved road), 220 metres from the nearest asphalt road, and 3.51 km from the Trans-Sumatran Highway – the main road which connects the villages to market. The Trans-Sumatran Highway bisects the Protection Forest, Batabo Hill, where many households operate rubber plots. Households live around 6.27 km from the Protection Forest.

For the sampled villages, the nearest rubber mill is between 20 and 50 km away, and the nearest oil palm mill is 15 to 30 km away. The distance is one of the reasons why many rubber farmers are reliant on selling their rubber to the village rubber collector, who consolidates and sells the rubber to the mill. Households are situated around 4.16 km from the nearest market where they could buy inputs to production and purchase household items.

Table 4.1: Household Characteristics

	Male		Female	
	Mean	St.dev	Mean	St.dev
Household characteristics n=300				
Human capital				
Age of respondent (years)	49.95	12.47	43.03	7.07
Education of respondent (years)	7.72	3.96	8.31	3.89
Years farming rubber	23.85	13.35	23.33	12.37
Household size	5.61	1.90		
Number of years respondent lived in village	35.08	19.07	39.09	14.2
% of households with grandparents from the district	0.86		0.86	
% of households who stayed within the village for Idul Fitri	0.94		N/A	
% of head of household's who are able to speak Bahasa Indonesia	0.93		0.95	
% of head of households who are able to read	0.90		0.89	
Assets				
Household asset index (US\$)	2925.27	4474.05		
Farm asset index (US\$)	212.85	868.25		
% of households who own a computer	0.19	N/A		
% of households with a mobile phone	0.95			
% of households with 2 mobile phones	0.27	N/A		
% of households with internet access	0.07	N/A		
% of households with < 2 motorbikes	0.80	N/A		
% of households who own a car	0.09	N/A		
% of households with a bank account	0.29	N/A		
% of households with > 1 chainsaw	0.69	N/A		
% of households with a water pump	0.13	N/A		
% of households with one spray pump	0.30	N/A		
Income				
% of income from rubber	0.48	N/A		
% of income from agriculture	0.53	N/A		
% of income from non-agricultural sources	0.47	N/A		
% of households with a source of non-farm income	0.65	N/A		
Sources of household income (no.)	2.39	1.07		
Location				
Distance to nearest road of any type (km)	0.01	0.46		
Distance to nearest asphalt road (km)	0.22	0.58		
Distance to Trans-Sumatran highway (km)	3.51	2.87		
Distance to nearest market (km)	4.16	2.54		
Distance to the protection forest (km)	6.27	5.29		

4.3 Livelihoods and Labour Allocation

Riau Province is rich in natural resources, and this is reflected in its major commodities – oil palm, oil and natural gas. Traditionally, rubber and paddy were major contributors to livelihoods in Riau, however, between the 1990s and 2000s, the oil palm industry has boomed, as intact forests and peatlands were converted to oil palm plantations (Ramdani & Hino 2013), such that Riau is now Indonesia's largest producer of oil palm, producing around 37 per cent of national production (The Economist 2015).

Agriculture is the most important industry in Kuantan Mudik Sub District and is the main source of livelihoods for the sampled households. Rubber remains the dominant traditional livelihood in the sampled villages, with many households inheriting rubber plantations from their parents. This is reflected in Table 4.2, which outlines that among male household heads, three quarters listed their main profession as rubber farming, and a further 15 per cent listing rubber farming as their secondary profession. As shown in Table 4.3, among female household heads, 42 per cent also listed their main profession as rubber farming, and a further 19 per cent listed rubber farming as their secondary profession. Both male and female heads of household have been farming rubber for around 23 years.

Table 4.2: Profession of the Male Head of Household

Profession of the male head of household (n=300)	Main profession		Secondary profession	
	Frequency	%	Frequency	%
Rubber farmer	219	73.00	45	15.00
Oil palm farmer	20	6.67	51	17.00
Paddy	1	0.33	5	1.67
Other farming or aquaculture	3	1.00	6	2.00
Self-employed trader	7	2.33	15	5.00
Self-employed -other	8	3.67	9	3.00
Agricultural wage labour	1	0.33	17	5.67
Non-farm wage labour	10	3.33	19	6.33
Non-farm employment	24	8.00	16	5.33
Unemployment	3	1.00	0	0.00
Unpaid domestic work	2	0.67	11	3.67
Other	2	0.67	2	0.67
Not applicable			104	34.67
	Mean	Std dev		
Number of years farming oil palm (years)	7.53	5.80		
Number of years farming rubber (years)	23.85	13.35		

Table 4.3: Profession of the Female Head of Household

Profession of the female head of household (n=274)	Main profession		Secondary profession	
	Frequency	%	Frequency	%
Rubber farmer	114	41.76	53	19.34
Oil palm farmer	4	1.46	10	3.65
Paddy	4	1.46	10	3.65
Other farming or aquaculture	1	0.36	3	1.09
Self-employed trader	25	9.12	12	4.38
Self-employed -other	4	1.46	1	0.36
Agricultural wage labour	2	0.73	10	3.65
Non-farm employment	21	7.66	1	0.36
Unemployment	2	0.73	1	0.36
Unpaid domestic work	95	34.67	111	40.51
Student	1	1	1	0.36
Other			2	0.92
Not applicable			57	20.8
	Mean	Std dev		
Number of years farming oil palm (years)	7.04	4.04		
Number of years farming rubber (years)	23.33	12.37		

As shown in Table 4.4, rubber production relies mostly on family labour- 72 per cent of households use exclusively family labour, and overall, 89 per cent of households use at least 25 per cent family labour. The shift from traditional agroforestry rubber production to more labour intensive monoculture farming systems has increased women’s involvement in agriculture to areas previously perceived to be men’s responsibilities i.e. rubber plantations. Women are now actively involved in rubber production, with 62 per cent of all rubber production using at least 25 per cent female labour, nearly 10 per cent exclusively female labour and a further 14 per cent using at least 75 per cent female labour.

Table 4.4: The Use of Family and Women’s Labour in Rubber Production, %

Family labour in rubber	%
100%	71.7
~ 75%	12.6
~ 50%	0.6
~ 25 %	4.0
None	11.1
Women's labour in rubber	%
100%	9.4
~ 75%	13.9
~ 50%	25.3
~ 25 %	13.7
None	37.6

Examining how the heads of household allocate their time provides further insights into gender roles in Kuantan Mudik Sub District and provides an understanding of the importance of rubber, relative to other agricultural and non-farm livelihoods in household labour allocation. Table 4.5 provides a breakdown of male and female involvement in specific tasks and allows for comparison of the male and female head of household involvement in the different elements of rubber production.

Female heads of household are involved in rubber tapping (63 per cent), rubber plot maintenance (48 per cent) and rubber marketing (69 per cent). Male heads of household have similar levels of involvement in rubber - 74 per cent are involved in rubber tapping, 68 per

cent are involved in rubber maintenance and 71 per cent are involved in rubber marketing. These statistics demonstrate that both the male and female head of household are typically involved in most elements of rubber production, with male heads of household on average, slightly more involved in rubber tapping and maintenance.

Table 4.6 provides additional detail on the extent of the heads of household involvement in a given task and describes the average hours spent on a given activity in a normal week. For most respondents, the greatest amount of time is allocated to rubber tapping - on average 21 hours for male heads of household, and 19 hours for female heads of households.

Interestingly, both genders have limited involvement with farmer group activities and have minimal interactions with extension officers (below 10 per cent for both genders across both activities),²⁰ highlighting an absence of formal agricultural knowledge and technology sharing in this area. This is well below Java, where a recent study of farm households found that 78 per cent of farmers were part of a farmer group or cooperative (Suprehatin 2016).

Oil palm is a newer livelihood in this area and is male dominated²¹; for male heads of household, oil palm is the main profession for 7 per cent, and a secondary profession for 17 per cent and they have farmed oil palm for around 8 years.

Paddy farming is rare, with only six and seven per cent of male and female heads of households respectively, reporting any involvement.

Unpaid domestic work is common for female heads of households and is the main profession for nearly 35 per cent of women, and the secondary profession for a further 40 per cent. This reflects the traditional gender roles in this region, with females largely

²⁰ This is supported by BPS statistics, which indicate there were only 13 active cooperatives of any type in Kuantan Mudik district in 2013 (BPS 2013).

²¹ However nearly 4 per cent of the female heads of household listed oil palm farming as their secondary profession. Females are typically only involved in oil palm crop maintenance, as palm oil harvesting, which requires significant physical strength, and is only undertaken by males.

responsible for managing the household. Unpaid domestic work is typically undertaken in addition to female head of household involvement in agriculture and non-farm employment and includes food preparation (95 per cent), cleaning (94 per cent), washing clothes (94 per cent) and child care (60 per cent). In an average working week, female heads of household reported spending 10 hours preparing food, seven hours washing clothes, seven hours cleaning and 30 hours caring for children. The amount of time women spend undertaking domestic duties is greater than that reported by male heads of household, who reported spending on average six hours preparing food, five hours cleaning, four hours washing and 10 hours caring for children in a given working week.

Around nine per cent of female heads of household listed self-employed trader as their main profession (i.e. kiosk), with a further five per cent listing this as their secondary profession. Women are able to operate a kiosk outside of or near their homes, which allows them to manage their domestic duties while working relatively long hours, an average of 43 hours a week.

Equally, eight per cent of male and female heads of household listed non-farm employment as their main profession (i.e. government employee), highlighting the limited availability of non-farm employment opportunities in Kuantan Mudik Sub District.

Table 4.5: Activities the Heads of Household are Involved In, %

	Male head, %	Female head, %
Involved in n=300		
Rubber tapping	74	63
Rubber maintenance	68	48
Rubber marketing	71	69
Oil palm maintenance/harvesting	31	11
Oil palm marketing	23	2
Paddy	6	7
Other agriculture	5	5
Non-farm employment i.e. teacher	26	11
Own business i.e. kiosk	15	17
Food preparation	16	95
Cleaning	23	94
Washing clothes	14	94
Child care	23	60
Receiving remittance payments	7	11
Sourcing credit	41	30
Farmer group activities	5	10
Liasing with extension officer	9	7

Table 4.6 Hours Spent in an Average Working Week, by Activity, Male and Female Heads of Household

Activity	Male mean	Std. Dev	Female mean	Std. Dev
Rubber tapping (n=221, 179)	21.47	12.14	18.54	11.75
Rubber maintenance (n=136, 98)	10.68	11.67	10.51	10.95
Rubber marketing (n=56, 21)	4.12	2.9	3.71	1.95
Oil palm maintenance/harvesting (n=73, 0)	10.12	9.83	N/A	N/A
Oil palm marketing (n=24, 0)	4.43	5.74	N/A	N/A
Non-farm employment (n=77, 30)	31.29	21.39	26.3	15.52
Own business (n=44,45)	27.47	22.71	42.9	28.41
Food preparation (n=32, 262)	6.57	4.55	10.31	5.25
Cleaning (n=46, 250)	4.66	2.8	7.12	3.97
Washing clothes (n=29, 256)	4.56	2.72	6.95	4.28
Child care (n=60, 157)	10.05	6.83	30.06	27.07

4.4 Household Land Use

As shown in Table 4.7, households have an average of 4.64 ha of land overall, this includes land in the village and any land they may have in Batabo Hill. To explore the proportion of land households that operate in the village compared to the land they have cleared in the forest, household plots were divided into two categories based on tenure security. Land classified as 'more secure' was typically in the village, and included land that had been inherited, purchased or received from the government or village. Land classified as 'less secure' refers to land which had been cleared by the respondent in the forest (i.e. in Batabo Hill or other local forests), which the household would be expected to have less secure tenure over. Households have approximately 2.5 hectares of 'more secure land' and two hectares of 'less secure land'. The mean plot size in the village is 1.75 hectares.

Households also provided details of land which they operate in the Protection Forest, Batabo Hill- see Table 4.7. For those who admitted to operating land in Batabo Hill, the average plot size is 2.73 hectares with approximately 602 rubber trees per plot, aged around 17 years and is located approximately 2km from the Trans-Sumatran Highway. The average tree age aligns with the *reformasi* period when the central authorities lost control over forest resources and decentralisation reforms meant that provincial and district forestry agencies now had responsibility for managing forest resources.²²

If households operating in Batabo Hill were to give up access to their land, this would represent approximately half of their total landholdings and would have significant impacts on household livelihoods and labour allocation.

²² As a Protection Forest, the responsibility for the day-to-day management of Batabo Hill lies with the District. The Province, however, is responsible for maintaining the integrity of the Protection Forest through the provincial forest police agency. District leaders are able to seek assistance from provincial agencies where necessary (Potter & Badcock 2001).

Table 4.7: Household Land

<i>n=300</i>	Mean	Std. Dev
Total land holdings (ha)	4.64	4.03
Total land with more secure land tenure	2.54	2.97
Total land with less secure land tenure	2.10	3.22
Average plot size (ha)	1.75	1.28
% of land lost if gave up land in Batabo Hill	0.51	0.15
Batabo Hill plot characteristics <i>n=185</i>		
Number of trees	602.12	717.87
Age of trees (years)	16.80	13.64
Plot size (ha)	2.73	2.78
Distance from road (km)	1.92	2.53
% of households with 'productive' rubber trees in Batabo Hill aged 5-25 years	33	N/A
% of households with plots <500 m from road in Batabo Hill	14	N/A

As outlined in Table 4.8, the predominant household plot land use is rubber, which accounts for 72 per cent of all plots in the sample, followed by oil palm, which accounts for 17 per cent of all plots. Paddy is less common in this area, covering only three per cent of all plots. This land use data validates the livelihoods and labour allocation data, which highlight the heavy dependence on rubber to support livelihoods in Kuantan Mudik Sub District.

Table 4.8: Household Plot Land Use, 2015

<i>n=775</i>	Frequency	%
Land use		
Oil palm	135	17.4
Rubber	557	71.78
Paddy	24	3.09
Cocoa	2	0.26
Cassava	1	0.13
Horticulture	16	2.08
Coconut	6	0.77
Secondary forest	21	2.71
Agroforestry	3	0.39
Other	10	1.29

Table 4.9 provides an overview of the land use change which has occurred in Kuantan Mudik Sub District. The table reports household plot level data, describing the initial land use when the plot was first acquired and the current land use (as at 2015). The data describes the agricultural expansion which has occurred, namely the 134 plots which have been converted from forest to rubber, and a further 25 plots which have been converted from forest to oil palm. Of the 434 plots that were planted with rubber when initially acquired, in 2015, 362 remained planted with rubber and 61 had been converted to oil palm. This suggests that while there has been some transition to oil palm, rubber remains dominant.

Table 4.9: Household Land Use Change, Previous and Current Land Use, by Plot, Frequency

Plot land use in year when first acquired	Plot land use in 2015			
	Palm oil	Rubber	Paddy	Horticulture
Forest	25	134	1	
Partially cleared		9		
Ploughed	2	1		
Fallow	32	46	4	3
Palm oil	11	1		2
Rubber	61	362	3	8
Paddy	1	1	15	4
Horticulture		2		
Secondary forest	2	1	1	
Other		1		
Total current land use (2015) - frequency	134	558	24	17
% of total current land use	17.5%	72.9%	3.1%	2.2%

As outlined in Table 4.10, 168 households indicated that they have future agricultural expansion intentions. Of these households, 87 intend to expand into oil palm, with 11 households indicating they will clear forest land to do so. Second to oil palm, 79 households intend to expand their rubber production, with 18 households indicating they will convert forest land to rubber. Traditional crops of paddy and cassava are of less interest (only one household per respective crop expressed their agricultural expansion intentions), once again highlighting the shift towards export-orientated monoculture plantations.

Overall, most households report that they will purchase village land outside their family in order to expand their agricultural production, rather than clear forest land. This suggests there is a viable commercial real estate market in operation, which provides an alternative means (to forest clearing) to acquire land, outside of the traditional inheritance system. Nonetheless, as outlined earlier, the risk of leakage should be considered in the PES program design, as households which have given up land in Batabo Hill, may simply clear land elsewhere.

Table 4.10: Household Agricultural Expansion Intentions, by Land Use and Method of Land Acquisition, Frequency

Proposed land use	Method of land acquisition						Total
	From family	Purchase village land outside of the family	Purchase land outside the village	Clear forest	Clear idle land	Allocated from village	
Oil palm	7	49	11	11	8	1	87
Rubber	10	40	6	18	5	0	79
Paddy	0	1	0	0	0	0	1
Cassava	0	1	0	0	0	0	1
Total	17	90	17	29	13	1	<u>168</u>

4.5 The Transformation in Agricultural and Inheritance Systems

Historically, Riau is characterised by the matrilineal inheritance system of the indigenous Minangkabau ethnic group (Colfer, Gill & Agus 1988), which represents the largest matrilineal society in the world (Blackwood 2008). Customary rules specific to each gender designate the management, labour allocation, decision making, and inheritance of land. Under a purely matrilineal system, women are traditionally the head of household and bequeath land and houses to their daughters and nieces. The system stipulates that the daughters have the rights to use the land and receive all income generated²³, elevating the status of women in the family.

²³ In the event that the family does not have a daughter, the land may be inherited by the son, but then passed back to the daughters in the next generation.

As outlined in Table 4.11, 19 per cent of female head of households in this study identify as Minangkabau. However, women from other ethnic groups, including the dominant ethnic group Melayu, to which 76 per cent of female head of households identifies with, also inherit land from their mother. This is consistent with findings from nearby Jambi Province, where Villamor et al. (2014a) observe the matrilineal inheritance system is also practiced by the Melayu ethnic group.

Table 4.11: Ethnicity, Heads of Household

Ethnicity	Male		Female	
	Freq.	%	Freq.	%
Javanese	6	2.21	8	3.00
Minangkabau	63	23.00	53	19.00
Melayu	198	72.00	209	76.00
Batak	2	0.74	1	0.38
Aceh	1	0.37	N/A	N/A
Nias	N/A	N/A	1	0.38
Palembang	1	0.37	N/A	N/A
Other Indonesian	2	0.74	2	0.38
Other foreign	1	0.37	N/A	N/A

Overall, as displayed in Table 4.12, 60 per cent of all female head of households inherited land, around 1.45 hectares; 75 per cent of this land is inherited from their mother and 24 per cent from their father.

Table 4.12: Land Inheritance, Female Head of Household

Inheritance n=300	%
% of women reported inheriting land	60.1
% of women reported inheriting land from mother	75.5
% of women reported inheriting land from father ²⁴	24.2
% of women who inherited one plot	32.3
% of women who inherited two plots	16.4
% of women who inherited three of more plots	12.5
Hectares of land inherited (mean)	1.45

²⁴ Two women (0.5 %) reported inheriting land from their brother.

The traditional matrilineal inheritance system has undergone significant changes in recent years (Suyanto, Tomich & Otsuka 2001; Quisumbing & Otsuka 2001) in line with the transformation of the agricultural system (Villamor et al. 2014b). As the agricultural system has transformed, land tenure institutions in customary land areas of Sumatra have shifted away from lineage ownership to joint family ownership and then to single-family ownership. There has also been a shift away from the traditional matrilineal inheritance systems²⁵ where daughters inherited the land, towards both sons and daughters inheriting land, evolving into a partial matrilineal inheritance system with the allocation of land often varying depending on land use (Suyanto, Tomich & Otsuka 2001; Quisumbing & Otsuka 2001; Villamor & van Noordwijk 2016). The large-scale adoption of perennial crops has driven the shift from communal tenure to more individual tenure arrangements in order to facilitate the incentives necessary for investment. These production shifts may be influencing the intra-household distribution of assets²⁶.

Overall, over half of all household plots in this study were inherited from family (see Table 4.13), however, many households have acquired additional land by clearing land on the forest margins and planting rubber or oil palm trees. Cleared forest land accounts for roughly 20 per cent of all household plots, and for men, who have traditionally undertaken this activity, this represents a way to obtain land outside of the matrilineal inheritance system (van Noordwijk et al. 2012).

Despite inheriting over half of all household plots from family, 77 per cent of all household plots have no record of ownership. Nonetheless, households feel that their ownership over this land is relatively secure- recognised according to customary rules by the

²⁵ Sociologists are almost unanimous in their conclusions that truly matriarchal societies no longer exist (i.e Campbell 2002), culture and societies are not static and evolve in line with external influences.

²⁶ In Jambi Province, Suyanto, Tomich & Otsuka (2001) found that wet rice land is passed down to female heirs while the rubber land passes to male heirs.

village. For those that do have a record of ownership, this is most often is a letter of land information (13 per cent), which can be obtained via the government.

The household land is largely owned and managed by the household (71 per cent). Alternatively, households enter into sharecropping arrangements (12 per cent of plots are sharecropped in and six per cent are sharecropped out). Household plots are predominantly dryland (71 per cent) and cleared forest land now planted with crops (20 per cent).

The land which households operate in Batabo Hill is outside of the traditional inheritance system, with most households clearing this land themselves over the past two decades. This method of land acquisition is likely to affect how households value this land, which is of less secure tenure²⁷, and could potentially be taken away in the future. Therefore, households would be expected to place greater value on land which they have inherited from within traditional inheritance systems and would have a greater attachment to, and more secure tenure. This may translate to female heads of households placing less value on land in Batabo Hill (relative to male heads of household), which they did not inherit, and may not have been involved in acquiring.

²⁷ Households have no formal claim to this land, the Protection Forest is managed by the Kuantan Singingi District Forestry Office

Table 4.13: Household Land Acquisition, Ownership, Tenure system and Plot Type

How the land was acquired	Frequency	%
Inherited	351	55.98
Gift	3	0.48
Purchased	121	19.3
Allocated by government/village	8	1.28
Transmigration scheme	0	0
Converted forest land	126	20.1
Cleared empty land	17	2.71
Other	1	0.16
Record of land ownership		
Certificate	17	2.26
Letter of Land information (SKT)	100	13.32
Letter of land information (SKGR)	7	0.93
Purchase receipt	39	5.19
Another form of record	6	0.8
No record	582	77.5
Land cultivation by tenure system (ha)		
Owned and managed	559	71.22
Owned-rented out	14	1.8
Owned and sharecropped out	49	6.3
Owned-lend out	4	0.6
Sharecropped from owner	98	12.5
Borrowed from owner	23	3
Protection Forest land**	36	4.6
Plot land type		
Technical irrigated	3	0.38
Semi-technical irrigated	1	0.13
Simple irrigated	10	1.27
Rainfed	26	3.31
Dryland	561	71.46
Cleared forestland with crops	159	20.25
Forestland (not cleared)	25	3.18

** Details about household land were captured early in the survey, at which stage, households had not been asked if they operated land in Batabo Hill. Due to the sensitivity around operating land in the Protection Forest, it is not unexpected that only 36 households reported operating land in the Protection Forest. Enumerators reported that it was typically not until the final component of the survey when asked directly whether they operated land in Batabo Hill, that respondents revealed this household land.

4.6 Summary and Conclusions

This chapter detailed the reliance of households in Kuantan Mudik Sub District on agricultural livelihoods, particularly rubber, which is the dominant traditional livelihood. In most households, both male and female head of households are involved in the various elements of rubber production, and as such would be impacted by forgoing access of up to half their household land as part of a PES program. Any displacement of household labour allocated towards rubber would have significant impacts on household livelihoods, therefore, in designing a PES program, it will be important for policymakers to take into consideration that households will need to source alternative livelihoods to allocate their labour. In the absence of alternative non-farm employment opportunities, policymakers may need to explore concurrent investment in non-farm livelihoods if they wish to limit the potential for additional agricultural expansion.

Further, the high levels of involvement of the female head of household in rubber highlight the importance of any proposed intervention including both the male and female decision makers, as both will have their daily livelihoods affected. For this reason, and in recognition of the traditional matrilineal inheritance systems and customs, which historically gave daughters the rights to use the land and receive all income generated, policymakers should involve the female head of household in all land use decision making, considering both their, and the male head of households individual preferences.

Chapter 5: The Drivers of Agricultural Expansion in Kuantan Mudik Sub District

“The reality in Riau is that the network of operators exploiting the forest sector is so entrenched that it is only through serious legal reform and enforcement that improvements to resource management can and will be achieved. Now that we are seeing the active involvement of local communities in the exploitation of forest resources it is likely that there will soon be few if any significant areas of forest remaining in Riau, for there is little institutional capacity or willpower to control these activities. A future issue may be that increasingly frustrated provincial and district governments, burdened with responsibility but unable to control what is happening in the field, will give up on the attempt to regulate the exploitation of forest resources. “

(Potter & Badcock 2001).

5.1 Introduction

In a visit by President Joko Widodo to Riau in 2014, the President stated: “We have to stop this. We can’t allow our tropical rainforests to disappear because of conversion to monoculture ...” (Maitar 2015). Despite this statement, there has been limited investigation into the micro-level drivers of agricultural expansion in Riau – ‘the deforestation centre of Indonesia’²⁸. To address this knowledge gap, this chapter explores the first research objective: *‘To understand the extent of, and drivers of agricultural expansion in Batabo Hill, and identify the population with use rights to this land’*.

This chapter investigates smallholder agricultural expansion in Batabo Hill through key informant interviews and focus group discussions conducted in Kuantan Mudik Sub District, Riau. To address the first research objective the analysis explores two research hypotheses:

²⁸ As coined by Yumiko Uryo, WWF.

H1: For smallholders in the villages surrounding Batabo Hill, the land clearing decision will be influenced by proximity, dependence on agricultural livelihoods, and governance arrangements.

H2: Agricultural expansion into Batabo Hill is driven by perceived future land scarcity, decreasing transportation costs and a lack of non-farm employment opportunities.

These hypotheses explore the agricultural expansion pressures faced by households, including population and labour market dynamics, government policy, and market forces; to try to understand how these factors interact to shape the smallholder agricultural expansion decision.

In addition, this chapter draws on focus group discussions and key informant interviews to examine the second research objective: *‘To explore local perceptions of the changing environment, and the factors driving these changes’*. This research objective is explored through the third research hypothesis:

H3: As agricultural expansion into Batabo Hill increases, so too does concern over ecosystem services provision.

This hypothesis investigates the extent to which smallholders understand the links between agricultural expansion and the decline in the natural resource base. Understanding smallholder awareness of the negative impacts of agricultural expansion into the Protection Forest will be important in informing the design of a PES program targeted at encouraging the revegetation of Batabo Hill.

This chapter is structured as follows: Section 5.2 provides an overview of the data and methods beginning with the conceptual framework of agricultural expansion, and including an overview of the focus group discussion and key informant interview methodology and data analysis. This is followed by a synthesis of the findings from both the key informant interviews

and focus group discussions in Section 5.3, with the summary and conclusions presented in Section 5.4.

5.1.1 Agricultural Expansion in Kuantan Mudik Sub District- a Conceptual Framework

The conceptual framework outlined in Figure 5.1 draws on Angelsen (1999) and Angelsen and Kaimowitz (1999) to help understand the drivers of agricultural expansion in Kuantan Mudik Sub District, Riau.

Four types of variables are used to explain the drivers of agricultural expansion:

1. The agents of deforestation—those individuals, households, or companies involved in agricultural expansion and their characteristics.
2. The choice variables—those decisions about land allocation that determine the overall level of agricultural expansion for the particular agent or group of agents.
3. Agents' decision parameters—those variables that directly influence agents' decisions but are external to them.
4. The macroeconomic variables and government policies—those variables that affect agricultural expansion indirectly through their influence on the decision parameters.

Figure 5.1 illustrates the relationship among these four main types of variables, providing a logical approach to analysing agricultural expansion at three different levels: *underlying causes, immediate causes and sources*.

Underlying Causes of Agricultural Expansion

The model begins by identifying macroeconomic-level forces and government policy as the underlying causes of agricultural expansion. Macroeconomic level forces include trade, economic development and agricultural policies, forestry regulations, and the decentralisation of power to the District Governments.

For example, the Indonesian Government's Master plan for Economic Development Expansion and Acceleration (MP3EI), which designates the Sumatra Economic Corridor as the "Centre for Production and Processing of Natural Resources and as the Nation's Energy Reserves", with oil palm, rubber and coal as its main activities (Ministry for Economic Affairs, Republic of Indonesia 2011), is one underlying cause. The strategic prioritisation by the government to continue to extract Sumatra's natural resources encourages agricultural expansion, placing development pressure on Sumatra's highly biodiverse forests and endangered species, including the Batabo Hill Protection Forest. Batabo Hill's designated Protection Forest status is not able to protect it from underground mining, or from road development, as evidenced by the Trans-Sumatran Highway which bisects the forest.

Further, government support for agriculture, such as subsidies for rubber seeds and for fertiliser, lowers the relative cost of production, which in turn provides incentives for agricultural expansion. In addition, the transmigration program²⁹ '*Transmigrasi*', led to an influx of migrants in parts of Sumatra, further contributing to population pressures on the land.

These factors, coupled with an absence of effective regulatory controls or sufficient resources to support enforcement mechanisms, has allowed land clearing to take place within the Protection Forest (Sunarto 2011). Corruption at various levels of government and undue influence by big companies may also be partly to blame³⁰.

²⁹ The Transmigration Program was an initiative of the Dutch colonial government, and was later continued by the Indonesian government. The program moved landless people from densely populated Java to less densely populated outer islands, including Sumatra. The purpose of the program was to reduce poverty and overpopulation on Java, to provide opportunities for hard-working poor people, and to provide a workforce to better utilise the natural resources on the outer islands.

³⁰ The Governor of Riau Province was recently jailed for issuing permits illegally to large pulp and paper companies, and the last three governors of Riau Province have all been implicated and sentenced for corruption relating to the issuing of permits or government procurement (Parker 2014). Further, a recent case in the Jakarta Corruption Court found that the chairman of the Indonesian Oil Palm Farmers Association Riau chapter bribed the current governor to obtain land conversion permits for 1,188 hectares of land in Kuantan Singingi District (Halim 2015).

Immediate Causes of Agricultural Expansion

Next, the model focuses on agents' decisions, which are influenced by household characteristics and assets and by a range of decision parameters such as markets (prices), infrastructure development, the diffusion of new information and technologies, and institutions, specifically property rights. This in turn influences household livelihood options and tenure security, and either reduces or increases the forces that encourage households to clear forest land for agriculture (Angelsen & Kaimowitz 1999; Tomich & Anas 1998a). Together, these decision parameters determine the available choices, and the respective incentives for the land clearing decision, and are the immediate causes of agricultural expansion.

One notable factor influencing agents' decisions is the construction of the Trans-Sumatran Highway over the last decade, commencing in the year 2000 in Kuantan Mudik Sub District, Riau. The highway has reduced transport costs, increasing returns to land, and in turn forest clearing. Further infrastructure development in the form of the Trans-Sumatran Toll Road (Presidential Regulation No.86/2011), as part of the MP3EI will further lower transport costs and increase forest accessibility, increasing returns to land and providing greater incentives to deforest.

Sources of Agricultural Expansion

Finally, the model describes the agents of agricultural expansion –smallholders and plantation companies -- and considers their relative importance. These agents' actions are the sources of agricultural expansion, and in theory, their respective direct contributions to agricultural expansion can be measured (however, that is not the purpose of this chapter).

As depicted in the model (Figure 5.1), the underlying causes determine the immediate causes, which can in turn influence the agents of agricultural expansion. However, it is important to note that effects can go in the opposite direction, such that the decisions agents

make can have feedback effects on market prices; while collectively, agents' political pressures and behaviour can affect underlying causes (Angelsen & Kaimowitz 1999).

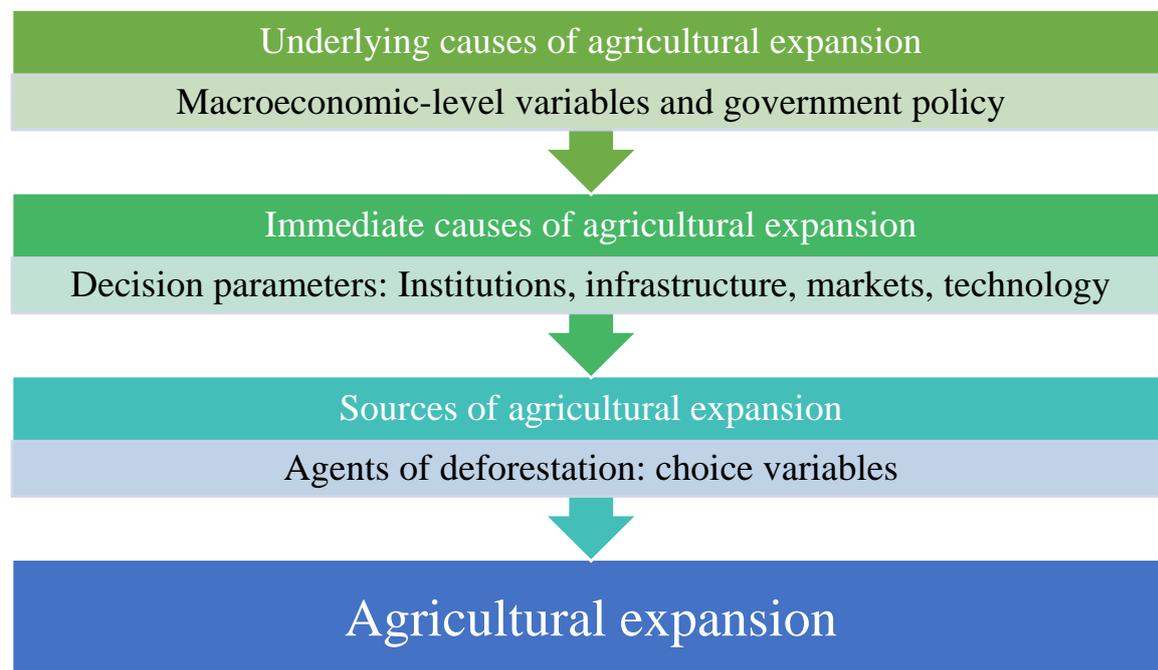


Figure 5.1: Variables Influencing Agricultural Expansion

The conceptual framework is also informed by the theory of induced innovation (Boserup 1965; Ruthenberg 1980; Ruttan & Hayami 1984). This theory underlines the responses of smallholders to pressures and opportunities brought about by exogenous factors, including rural infrastructure development, population growth, and market and policy developments enabling the introduction of higher-value crops (such as oil palm).

Most broadly, the decision to clear forest for agriculture is based on the private costs or benefits of their alternatives, with a bias towards the short run (Reardon & Vosti 1995). In the absence of viable profitable alternatives, smallholder farmers will continue to seek forest to clear to support their livelihoods.

5.2 Data and Methods

Key informant interviews were conducted with village leaders and local government officers from the Kuantan Mudik Sub District office, Kuantan Singingi District office and Kuantan Singingi District forestry office.

The purpose of the key informant interviews was:

1. To identify which villages were operating in Batabo Hill, and to derive an estimate of the number of villagers with land in Batabo Hill.
2. To explore the factors influencing agricultural expansion into Batabo Hill.
3. To investigate the dependence of villages in Kuantan Mudik Sub District on rubber as a livelihood, and the extent to which households have shifted to palm oil, and the reasons for this shift.

The findings from the key informant interviews helped to select the villages targeted for the focus group discussions and to develop the topics for discussion.

Focus group discussions (FGDs) were conducted over two days in March 2015 across three villages surrounding Batabo Hill in Kuantan Mudik Sub District- Kasang, Seberang Cengar and Rantau Sialang. The FGDs were co-hosted by the University of Adelaide research team and WWF and convened by the village leader, who introduced the researchers and provided an overview of the purpose of the discussion.

The purpose of the FGDs was:

1. To identify the extent to which smallholder households in villages surrounding Batabo Hill are clearing land for agriculture in the Protection Forest.
2. To understand the factors influencing the smallholder land clearing decisions.
3. To understand how smallholder households perceived agriculture expansion was impacting the local environment.

5.2.1 Data from Key Informant Interviews

The key informant interviews were transcribed and translated, then cleaned for errors and consistency. The data was de-identified and labelled to provide a reference point for the data, identifying the profession of the respondent and their geographical location.

The data was segmented by theme, and detailed analysis was undertaken of each segment across the dataset, drawing connections and comparisons between the segments of data. The validity of each emerging theme was tested by identifying whether this issue was repeated in other key informant interviews and if this was consistent with the findings from the FGDs.

5.2.2 Data from Focus Group Discussions

Similar to the key informant interview data, the transcribed and translated focus group discussion data was checked for consistency and cleaned to remove errors. The group discussion data was anonymised to de-identify participants. Each discussion transcript was labelled, providing a reference point for the data, allowing each group discussion to clearly identify the village location and the demographic characteristics of the participants in the group.

The data was systematically segmented by topic and question, to enable detailed analysis of each segment of data across the whole data set. This approach enabled comparisons and connections to be made between the segments of data, with markers put in place to highlight where specific issues are discussed.

Themes were identified using the principles of Grounded Theory (Glaser & Strauss 1967), whereby the themes are identified inductively, from the issues raised by the group participants. This approach has the advantage of identifying the issues of greatest importance to the participants and allows for unanticipated issues to be highlighted. The themes were compared across the three group discussions, allowing for the themes to be refined and to

highlight the collective issues and underlying themes. The validity of each emerging theme was tested by identifying whether this issue was repeated in other group discussions and also revealed in the key informant interviews.

5.2.3 Data Analysis

Both the FGD data and key informant interview data were analysed manually. Each theme was coded to identify specific sections of text where individual issues were discussed. Detailed analysis was undertaken by theme to understand the key issues and to respond to the research hypotheses. The conceptual framework of agricultural expansion outlined above was used to develop the research hypotheses.

The following section provides a synthesis of the findings from the FGDs and key informant interviews. It begins by providing background and context and then analyses the themes that directly inform the hypotheses. Textual extracts are included throughout, simply identifying a participant by focus group discussion (FGD1, 2 or 3) and gender (M or F).

5.3 Results

5.3.1 Background and Context: Rubber Farming in Kuantan Mudik Sub District

Rubber farming is a traditional livelihood activity in Kuantan Mudik Sub District, with rubber plantations typically passed down from one generation to the next. Discussions with households in Kuantan Mudik Sub District suggest that they continue to farm rubber because the establishment costs of oil palm are prohibitive, due to a lack of non-farm employment opportunities, and for some, because it is all they know. *“I inherited the rubber plot from my parents, it’s the only thing I know how to do. There aren’t many other opportunities, and it’s easier than oil palm - cheaper and simple”* (FGD1, M).

The price of rubber has decreased significantly in recent years. At the time of the study in June 2015, the price of rubber ranged between IDR 5000 to IDR 7000/kg, compared to 2010, when the price was reported to have reached IDR 23000/kg. A number of farmers report that they have continued to farm rubber, yet want to shift from their traditional

commodity to other livelihoods, such as, but not limited to, oil palm. *“There is no future in rubber, not with the low price. But the establishment costs for oil palm are too expensive, I can’t switch” (FGD2, M).* *“Farming rubber isn’t an economic decision. It is a matter of survival. There is no other choice” (FGD2, M).*

Farmers report that more than one hectare of land is required for oil palm to be profitable, given the significant establishment and operational costs. On average, households have 4.64 hectares of land³¹, and if they were to devote two hectares of land to oil palm, this would represent nearly half of total land owned, which would likely place household incomes at risk, particularly during the initial years before the oil palm trees become productive.

Latex, the output of rubber, can be sold via farmer groups, directly to rubber mills, or to the local village rubber collector. For many households, in the absence of access to formal sources of credit, the availability of credit from the rubber collector, and opportunity to receive timely cash payments for their latex, make this an attractive option, whether by choice or out of necessity.

Money that is borrowed from the rubber collector is deducted from the payment for rubber sold. Households can obtain interest free loans and pay back according to the negotiated payment schedule. Many households in Kuantan Mudik Sub District are stuck in a form of debt trap, whereby they have to sell to the same rubber collector each time to pay back their loan. The cycle continues as they always need to borrow more. The alternative, getting a loan from a bank, requires collateral and must be for a sizeable loan³². By comparison, with the rubber collector, households’ can simply borrow enough to get them by until the next sale. *“I sell my latex to the same collector every time, and borrow money from them for groceries (FGD2, F)”*.

³¹ As found in the subsequent household survey.

³² Data from the household survey highlights that only 15 per cent of households reported securing a loan from the bank.

Superior prices can be obtained if latex is instead sold through a farmer group that sells directly to the rubber mills (an average of IDR 7000/kg rather than IDR 5000/kg if sold to a collector). This allows farmers to enter into cooperative cultivation arrangements to increase quality and thus obtain a higher price. However, farmer groups do not exist in all villages (there are farmer groups in Kasang, but not in Koto Cengar and Rantau Sialang), and the transport costs are prohibitive. Selling through a farmer group requires a higher standard of latex, the buyer will not simply take all qualities of latex (unlike the rubber collector) and for some rubber farmers, the transaction costs of having to sort their rubber by quality is too high, preferring the less stringent quality requirements and associated lower price from the rubber collector. Other rubber farmers would prefer to sell through a farmer group if there was one in Rantau Sialang village, however, to do so they would have to pay off the debt to the village rubber collector first, and then pull together the initial capital to establish the group.

Capital is required to establish oil palm or to start up a business. For many households, access to a loan to invest in a business is not realistic, therefore, they simply work to make the best of their land, and acquire additional land as required to support their livelihoods.

5.3.2 Agricultural Expansion into Batabo Hill

H1: For smallholders in the villages surrounding Batabo Hill, the land clearing decision will be influenced by proximity, dependence on agricultural livelihoods, and governance arrangements.

Despite the existence of formal rules outlawing clearing land in the Protection Forest, agricultural expansion into Batabo Hill by the surrounding villagers is commonplace. Key informant interviews and focus group discussions indicate that households from villages in Kuantan Mudik Sub District are operating land in the Protection Forest while residing in the

surrounding villages, where they also operate farm land³³. Interestingly, key informant interviews with village leaders in neighbouring West Sumatra Province suggest that smallholders on the other side of the border are not clearing land in Batabo Hill, despite relative proximity. This suggests that village level governance is also a factor in the land clearing decision.

The clearing of land for agriculture in Batabo Hill is not limited to easy to access roadside plots along the Trans-Sumatran Highway and includes plots further from the road in the Protection Forest. This suggests that the extent of forest clearing in Batabo Hill is significant, and ongoing, with land closest to the road, cleared first.

The Protection Forest is viewed by the surrounding communities as a resource available to support their livelihood needs. Locals claim that the border to the forest is not clear, or that it has shifted³⁴- *“Before the border [to the Protection Forest] was 15 km away, now it is only 2 km away. The border has moved!” (FGD1, M).*

For local villagers, the need for a livelihood outweighs the fear of being evicted from cleared land in Batabo Hill or receiving yet to be enforced punishments including fines or a prison sentence. *“There is a sign threatening a fine of 50 billion rupiahs or prison if you clear the forest. People are still doing it, they aren’t scared ‘just shoot us’ they say” (FGD1, M).*

³³ At the time of the study, the only people residing in the Protection Forest were prostitutes, located in one area of housing along the Trans-Sumatran Highway.

³⁴ It is unclear if it is instead the expansion into that forest that has shifted. However analysis of the effects of Indonesia’s decentralisation on forests in Kuantan Singingi District, supports villager claims of unclear borders (Potter& Badcock 2001). The difficulties with inaccurate information, overlapping boundaries, and power struggles between forestry and planning departments, together with a lack of technical expertise in Kuantan Singingi District, is reported by Potter and Badcock (2001) to have left a legacy of uncertainty to districts as they seek to effectively decentralise power. Managing forest encroachment is impossible without accurate records of land use, land cover and boundaries.

So far, the government has ignored smallholder agricultural expansion into Batabo Hill and previous attempts by local village heads to stop the forest clearing have been unsuccessful; given the overwhelming need for livelihoods in the community.

The local Kuantan Singingi District forestry office manages Batabo Hill and is aware of the problem of agricultural expansion into Batabo Hill. Officers acknowledge that part of the problem is the continuous changes to the Protection Forest borders³⁵, which have not been effectively communicated to the surrounding villages, creating confusion and ‘grey areas’. For this reason, they fear the potential for conflict if they were to directly prevent forest clearing. Instead, the local forestry office report that they’re exploring implementing a ‘*Community Forest*’ or Hutan Kemasyarakatan (HKM) policy in recognition of the cultural, economic and social significance of the Protection Forest to the community.³⁶ Administered by the Ministry of Forestry, the policy acknowledges the role of the community in forest management and conservation. Under this policy, the local forestry office may provide permits to farmers, granting temporary rights to the surrounding communities to operate on this land in Batabo Hill. These permits carry several conditions, including allowing the planting of rubber but not oil palm and adopting practices which maintain ecosystem services; with activities that do not meet these conditions to be penalised.

The existence of a ‘grey area’ not only helps to justify the land clearing by smallholders but provides scope for the issuing of permits by the government to companies³⁷.

³⁵ Analysis from the Indonesian Centre for Environmental Law suggests that transparency is one of the keys to slowing deforestation. Districts with the lowest public availability of concession maps and other data tended to have the highest rates of forest loss during the period 2012-2014 (Maitar 2015).

³⁶“*Community Forest*” is a Ministry of Forestry policy that gives a temporary permit (35 years with evaluation every 5 years) to the community surrounding protection, protection and production forests to farm the land with several conditions (i.e. maintain the ecosystem by also planting rubber trees). This policy is often applied in areas where the community has been long had claims to the protection forest and rely on the forest resources for their livelihoods. Thus, to avoid conflict, the government tries to manage smallholder use of the forest through this policy.

³⁷ Land disputes are all-too-common in Riau, where records are often absent or incomplete and maps differ from one government agency to another. Differing maps can exist for a reason, and can serve government interests

The tenure of land cleared in the Protection Forest is not recognised by the village and cannot be certified (granting legal tenure). Nonetheless, land users feel a sense of ownership over this land, staking their claim by planting rubber or oil palm³⁸. Rubber and oil palm have roughly a 25-30 year production cycle, and take a few years to become productive; this suggests that most land users feel secure enough in their claim to the land in the short to medium term, despite a lack of formal legal protections. Some land users, however, are concerned that the land could be taken away from them in the future by the government.

H2: Agricultural expansion into Batabo Hill is driven by perceived future land scarcity, decreasing transportation costs and a lack of non-farm employment opportunities.

With the village land already fully exploited and allocated, population pressures on the land and perceived future land scarcity are the key motivating factors for smallholders to expand into the Protection Forest, either by clearing land or by buying land from others. Perceptions of future land scarcity are fuelled by land clearing by neighbouring villages and the issuing of permits to companies; creating fear of neighbouring villages and outside companies clearing all the available forestland first. Villagers allege that previously their village wasn't clearing land; however, now that they see people from neighbouring villages clearing land, they feel threatened and want to secure some of the remaining land for themselves- a typical case of the tragedy of the commons. The village leaders explain that the high rates of land clearing in the Protection Forest started around 10-15 years ago.

People from outside the villages, including larger scale operators, come to the villages surrounding Batabo Hill and offer to buy land in the Protection Forest for a high price. By

³⁸ Rubber is the predominant crop in the Protection Forest. Oil palm farming in the Protection Forest violates the informal customary rules, and as such individuals are reluctant to admit they have planted oil palm. Reports from government officials and farmers suggest there is a smaller amount of oil palm in the Protection Forest.

buying the cleared land from the local villagers, these operators are able to acquire the land, without directly being involved in the clearing of the Protection Forest. Cleared land in Protection Forest which is near to the road is valued at roughly double that of land which is further away from the road. The price premium for plots close to the road reflects the lower transport costs associated with plots adjacent to the Trans-Sumatran Highway.

The immigration from across Sumatra to Riau Province is largely connected with the establishment of the Trans-Sumatran Highway (Koizumi 2016), which has in turn, increased the demand for land with the expansion of oil palm cultivation, increasing land rents and fuelling a rush to lay claim to land.

Many villagers report wanting more land, yet there is no land available in the village, having already been exploited by an expanding population. Clearing land in the Protection Forest is viewed as a good way to acquire additional land outside of the village communal land title system³⁹.

Agricultural expansion is also driven by a lack of alternative non-farm livelihoods, with many households keen to shift into other non-farm livelihoods, given the opportunity. Some parents are focused on educating their children, at times going into debt to do so, with the hope that their children can break this dependency on farming and obtain higher paying non-farm employment “...or if they have to, become a modern farmer”(FGD 2, F). “There aren’t other alternatives to farming. The only hope is that children can leave the village and get non-farm employment elsewhere” (FGD1, F).

Further contributing to the agricultural expansion is a lack of farmer training and education, coupled with underinvestment in existing rubber plantations. There is an absence

³⁹ Kasang village follows a communal land title system whereby the land belongs to the entire village. Households have the right to use and manage the land, but can’t transfer, rent out or sell the land without first consulting the village. The communal land title system ensures that the land can be passed down to the next generation, and can’t be easily sold to outsiders. Rantau Sialang village also operate under a communal land title system, with land passed down to future generations through family inheritance systems.

of government extension targeted to rubber farming, and rubber farmers are struggling to deal with a disease known locally as ‘white mushroom root’. The treatment cost is so expensive that farmers are unable to keep up with the treatment. Yields are also limited by poor quality seeds; the absence of a local quality seed breeder means that farmers are often planting low quality seeds which in turn produce low quality rubber⁴⁰.

Farmers still farm rubber in the traditional way, they are complacent with this and many choose not to use fertiliser. A number of farmers in Kuantan Mudik Sub District are instead selling their subsidised fertiliser to supplement their income as they don’t fully understand how fertiliser use can increase yields.

While Kasang villagers have benefited from a series of government sponsored rubber replanting programs⁴¹ a number of farmers across Kuantan Mudik Sub District continue to farm trees past their productive life, resulting in low rubber quality and low yields. The underinvestment in existing rubber plantations and poor management practices limit productivity, and as such, income potential. For some, capital constraints prevent investment in farm assets such as tractors, therefore, they are stuck preparing the land by hand.

The limited opportunities for non-farm employment, together with capital constraints, place pressure on the land to provide livelihoods for the surrounding community. Clearing forest provides immediate income from selling the timber, and the newly cleared land in Batabo Hill provides new fertile land to farm.

⁴⁰ The MP3EI acknowledges the issues of low productivity and aims to increase the productivity of smallholder plantations by providing high quality seeds and incentives to support the replanting, such a subsidies and access to credit, post-harvest extension to support adoption of new technology i.e wiretapping, usage of tapping bowl, tapping knife, rain shield, clotting materials and clotting containers.

⁴¹ In 2015, the rubber replanting program covered 10 hectares and included subsidised seeds and fertiliser, as well as funds to pay for fences. Similar programs were implemented in 2013 (15 hectares) and in 2010 (65 hectares).

5.3.3 Local Perceptions of the Changing Environment

H3: As agricultural expansion into Batabo Hill increases, so too does concern over ecosystem services provision.

The focus group discussions covered changes in the landscape over the last ten years in Kuantan Mudik Sub District, with participants ranking the changes by relative importance (Table 5.1). The number one concern across all three villages was over water quality and the availability of water. Participants reported that local rivers had far less water than before the spread of oil palm plantations and that there are now dry spells in the dry season and increased flooding in the rainy season, with oil palm plantations said to be affecting the natural drainage patterns⁴².

Participants described that ten years ago water was readily available, yet now water is less available, and the available water is not clean. The villagers used to drink the water, however, now it is contaminated and undrinkable⁴³, forcing a reliance on purchased bottled water. *“In the past, anytime we drilled a well, we always find water, clean water. There is no clean water anymore. In the past, we could drink the water, not now” (FGD1, F).*

With the rise of forest clearing for agriculture, seasons are reported to now be ‘unpredictable’, with hotter weather linked to a changing climate. In Seberang Cengar village the changing climate (hotter weather and more floods) and more variable climate were top concerns. These concerns were consistent across all villages, with participants expressing worry over the future productivity of their land. Alarmingly, the hotter weather and increased flooding are only encouraging some farmers to shift from rubber to oil palm, which is reported to be more tolerant to this changing climate.

⁴² During the field visit to conduct the group discussions, the flooding was so bad in one nearby village that the village was forced to relocate to higher ground and seek temporary accommodation in tents.

⁴³ The deteriorating water quality in Riau is associated with pesticides and other agrochemicals used on oil palm plantations, runoff, and sedimentation. There are also reports of pollution from effluent discharge from oil palm processors.

The link between the spread of oil palm and the scarcity of water is widely accepted, with one village head reporting: *“The spread of the oil palm plantations is also having negative effects on existing rubber plantations, especially when the plots are close to each other... as the oil palm absorbs the water and this impacts on the quality of the latex”*.

The Rantau Sialang village has informal rules banning the planting of oil palm on village land, for this reason, fearing that this will *“take away all the water”* and have negative impacts on their horticultural and paddy livelihoods. A young woman from Rantau Sialang summarised the problem of agricultural expansion into the Protection Forest:

“The benefit of living next to the Protection Forest is that we are able to work on the land and the air is fresh and clean. Yet, if we keep clearing the land in the forest for agriculture, then the water will dry”.

Seberang Cengar village also recognise the problem of agricultural expansion into the Protection Forest, and reported that they have asked the District Government to transfer a portion of land in the Protection Forest to the village to be managed by the community as a *‘Community Forest’*, and manage it so that only rubber, not oil palm is planted, to protect the ecosystem services, and prevent further threats to village water resources.

The pressures on the land are only expected to increase, with Rantau Sialang, Seberang Cengar and Kasang villages all raising concerns about the increasing population. They report migration from other villages, and from outside the District, with the resultant additional agricultural expansion exacerbating the situation, and leading to the further deterioration of the natural resource base.

The threat to their livelihoods from a degraded natural resource base, together with the reduction in the rubber price and the limited availability of non-farm employment, were part of discussions about perceived harder livelihood conditions in Kuantan Mudik Sub District (and this ranked in the top five issues by all three villages).

Table 5. 1- Top Five Issues of Concern, by Village

Village concerns	Village		
	Kasang	Seberang Cengar	Rantau Sialang
Water availability	1	2	
Water quality	2		1
Increase in population	4	4	2
Climate change	5	1	
Climate variability		3	4
Harder livelihood conditions	3	5	5
Air pollution			3

When asked to rank the attributes they associate with Batabo Hill, respondents indicated that the attribute of most importance to them is the provision of water services benefits, in the form of improved water quality and availability (see Table 5.2). The second most important attribute was the forest as a source of food. Juxtaposed to this, is the third most important attribute- that the forest provides land that can be cleared for agriculture. This highlights the trade-offs faced by the local villagers- while they most highly value the Protection Forests water services and food, they also rely on the Protection Forest for land for agriculture.

Table 5.2: Batabo Hill Attributes, Ranked by Importance

Batabo Hill attribute ranking	Village		
	Kasang	Seberang Cengar	Rantau Sialang
The forest provides water services benefits	1	1	1
The forest provides a source of food (i.e. plants and animals)	2	2	4
The forest provides land that can be cleared for agriculture	3	6	2
The forest isn't polluted i.e clean air and water	5	3	3
The forest is a source of traditional medicines	6	4	6
The forest provides non timber forest products	7	5	7
The forest provides a habitat for local wildlife	4	7	5
The forest provides a source of timber which can be sold	8	8	8
The forest is a sacred/customary place	9	9	9
The forest provides a place for recreation and to be in nature	10	10	10

5.4 Summary and Conclusions

This chapter explores the drivers of agricultural expansion in Kuantan Mudik Sub District. Focus group discussions and key informant interviews highlight the existence of grey

areas, unclear borders, weak enforcement of the Protection Forest status, and the government issuing of land permits to companies in areas thought by the surrounding communities to be part of the Protection Forest. These factors have had the effect of spurring local villagers to then also disregard the Protection Forest status of Batabo Hill, and thus are underlying causes of agricultural expansion (Angelsen & Kaimowitz 1999). This is consistent with the theory of induced innovation (Boserup 1965), as smallholders have responded to these pressures on the land (including the rise of oil palm) by clearing land to secure their claim, in a vicious cycle that has led to a race for land, with smallholders establishing rubber or oil palm plots on the land as a way to obtain and secure land rights (Suyanto, Tomich & Otsuka 2001), such that the smallholder land clearing decision is a title establishment strategy (Angelsen 1999).

This situation is one of simultaneous intensification and the development of individual property rights, which often occurs when land values increase and when there are expectations of future land scarcity (Feder & Feeney 1993). In Kuantan Mudik Sub District, the increasing returns from cleared forest land have only increased the opportunity cost of conserving the natural forest, and spurred an inflow of migrants and companies, accelerating deforestation. This is consistent with the findings from Angelsen (1999), who argues that the change in land rent is the single most important factor to explain the agricultural expansion that has occurred in recent decades in Riau.

In line with the work by Angelsen and Kaimowitz (1999) a major immediate cause of agricultural expansion into Batabo Hill has been the development of the Trans-Sumatran Highway, which travels right through the forest, lowering transport costs and providing easy access to the land to clear for agriculture. This is consistent with findings of Barber et al. (2014) in the Brazilian Amazon, where 95 per cent of all deforestation has occurred within 5.5 km from roads, and Tomich and Anas (1998a) in nearby Jambi Province, where smallholder

conversion of logged forest was significantly more likely within 10 km of main roads, such as the Trans-Sumatran Highway.

This chapter highlights how reliant the farm households in the sampled villages are on this ecologically fragile landscape. These households have few productive assets, except land (which includes cleared forest land) and are largely low skilled farmers. Because of this, their livelihoods are highly dependent on exploiting natural resources and the ecosystem services they provide. With limited access to markets and non-farm employment, if the local environment continues to be degraded, the productivity of agricultural land will be lowered further, and the households in Kuantan Mudik Sub District will become vulnerable to the poverty-environment trap (Barbier 2010).

Overall, this chapter sheds light on the drivers of agricultural expansion in Kuantan Mudik Sub District. An understanding of the macro-economic, policy, market, infrastructure, labour market and institutional drivers of agricultural expansion in Kuantan Mudik Sub District will help policymakers and agricultural development specialists to develop targeted interventions to put a halt to agricultural expansion and focus on intensification.

Importantly, these findings support the development of targeted policy and PES programs. For example, a PES program which focuses on protecting and enhancing water services or is timed to help pay school fees may encourage higher participation rates, resulting in improved conservation outcomes. Whilst a concurrent intervention which supports the development of the off-farm sector is likely to help to reduce the pressure on the forest for livelihood provision, and in turn, support a reduction in the rate of deforestation.

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Chapter 6 Estimating the Cost of Conservation: A Traditional Approach

6.1 Introduction

As described in Chapter 1, this study examines a PES program complementing the eco-infrastructure project proposed as part of the RIMBA GEF Project. This research aims to assess the willingness of rubber producers operating within Batabo Hill to participate in a wildlife connectivity project.

Directly paying the households neighbouring the Protection Forest acknowledges that they are (one of) the principal agents of change, therefore their behaviour must change in order to protect the ecosystem. It is these households that are often in the best position to protect the ecosystem (Ferraro 2001); therefore any intervention should focus on influencing their behaviour, particularly given that paying households directly to protect the ecosystem can be far more cost-effective than more broad based conservation interventions (Ferraro & Simpson 2002).

The WTA approach has been employed to investigate farm household participation in hypothetical PES programs, (Ma et al. 2012; Kaczan & Swallow 2013), and estimate the amount of compensation local households would require to forgo access to natural resources (Shrestha et al. 2007) or in exchange for not cutting forest (Cacho et al. 2014). In two rural locations in Guatemala and Ecuador, Southgate et al. (2010) investigate the payments households would be WTA in exchange for scaling back farmed area for a period of five years in a hypothetical PES program. This chapter draws on their approach to estimate

private land users' WTA compensation to forgo access to their land in Batabo Hill for a period of five years.

This chapter addresses two specific research questions: (1) '*what amount of compensation are heads of households willing to accept to give up access to their land in Batabo Hill?*' and (2) '*what are the sources of bias influencing the willingness to accept decision, and how can the inferred valuation method mitigate against this?*' This latter question arises as the presence of hypothetical bias is common in contingent valuation studies, and not often addressed within developing country studies using stated preference techniques (Whittington & Pagiola 2012). This chapter employs an innovative 'inferred valuation' approach developed by Lusk and Norwood (2009a, 2009b), which asks respondents to infer the preferences of others in order to mitigate against social desirability and hypothetical bias.

This chapter contributes to the emerging inferred valuation literature in two ways. First, by testing the inferred valuation method in a developing-country context. Second, by extending the empirical evidence base via the third known application of the inferred valuation method to a WTA approach (following on from Kaczan & Swallow 2013 and Drichoutis, Lusk & Pappa 2016). This is also the first known application using an open-ended elicitation format.

Finally, as a test of the external validity of the WTA results (Kaczan & Swallow 2013) this chapter compares the WTA values to local land values and the opportunity cost of producing rubber. These reference values play an important role in determining the presence of bias in the estimates and highlight any differences between the financial and economic value placed on the land. From a program design perspective, an assessment of the local opportunity costs is important for adequately designing compensation schemes to ensure

appropriate incentives are in place (Wunder 2009), specifically in contexts where the land use is illegal (Gregersen et al. 2010) and formal market values do not exist.

The remainder of this chapter is structured as follows: Section 6.2 provides an overview of data and methods including the WTA method and inferred valuation approach; this is followed by the estimated results in 6.3 and opportunity cost comparisons. The summary and conclusion are presented in the final section.

6.2 Data and Methods

6.2.1 Household Survey

This chapter analyses primary data obtained during July 2015 from a survey of Indonesian farm households that predominantly grow rubber (see Chapter 3 for details). A random sample of 300 farm households was drawn from four villages in Riau in close proximity to the nearby Protection Forest, Batabo Hill. The survey consisted of face to face interviews of both the male and female heads of household. This chapter focuses only on the results from the male heads of household. The random sample included a significant amount of variation in age, household assets, time spent on rubber tapping/maintenance and distance from the Protection Forest. In addition to collecting information on agricultural land use and household characteristics, the survey included a contingent valuation component, which asked heads of households about their willingness to accept compensation to give up access to household land in Batabo Hill.

As described in Chapter 3, the contingent valuation component of the survey followed the following structure: first using a direct valuation approach to ask (a) what the respondent would accept to give up their land for five years, followed by an inferred valuation approach, asking (b) what they think a neighbour would say they would accept when surveyed, as well as (c) what their neighbour would actually accept (in a real life situation). Under this approach (a) is capturing the hypothetical self, (b) the hypothetical other, which is aimed at

removing the social desirability/warm glow bias, and (c) the actual other, which in theory, reduces both the hypothetical and social desirability bias (Lusk & Norwood 2009a).

Data analysis was carried out in STATA using a within-sample study design, merging the three lump sum WTA observations outlined above into one WTA variable so that n=900 to create a panel data set with three unique WTA observations for each of the 300 households. A Heckman's two-step procedure (Heckman 1979) was used to test for selection bias (Edwards & Anderson 1987) and both Fixed Effects and Random Effects models were employed. Detailed information regarding the methods is presented in the next section.

6.2.2 Sample Selection

Of the 300 households in the full sample, 196 respondents admitted to having land in Batabo Hill, indicated they were WTA and provided a lump sum payment amount. The remaining 104 respondents may not have provided a response to the WTA component because (a) the respondent did not have land in Batabo Hill⁴⁴, (b) the respondent was unwilling to discuss illegally cleared land in Batabo Hill⁴⁵, or (c) the respondent had other unknown reasons.

Six of the 196 respondents who admitted to having land in Batabo Hill were not willing to accept any amount of compensation. This represented two per cent of the survey sample, which is below a similar study, where 34 per cent of respondents were not willing to accept any amount of compensation (Shrestha et al. 2007). Further observations were removed that did not provide the plot size. The final usable sample analysed included 185 responses to the direct valuation questions and 148 responses to the inferred valuation questions.

⁴⁴ Under the random sampling technique not all households in the sample were expected to have land in Batabo Hill.

⁴⁵ Clearing land in the Protection Forest is technically illegal, however, informally accepted in the surrounding communities and a sensitive topic to discuss.

While the original sample of households was selected randomly, there is no reason to assume a priori that the remaining sample, after the exclusion of invalid responses (outliers or responses with missing data) is random. The potential for systematic and non-random differences between the households that either did not respond to these questions or provided an invalid response (hereafter referred to as non-responders) and the remaining sample was tested as explained below.

Heckman's two-step procedure (Heckman 1979) is employed to test for selection bias (Edwards & Anderson 1987). To examine any differences between the two groups, the selection equation included individual characteristics which could influence the dependent variable (whether or not a response was provided to the WTA question): total land holdings, household size, education and sources of income along with village dummy variables. The results from the Probit model (Table 6.1) indicate that the household heads who did not provide a WTA response were younger households, had fewer sources of income, and were less likely to be from village 1 or 2.

Table 6.1: Parameter Estimates of the Probit Model

	Probit Model
Dependent variables	WTA (0,1)
Independent variables	
Household size	0.0193 (0.1309)
Education	0.0986 (0.0646)
Age	0.03662* (.0260)
Total agricultural land (ha)	-0.0965 (0.0585)
Village 1	-3.3885*** (0.6464)
Village 2	-2.0593** (0.8524)
Village 3	-.1415 (0.2466)
Sources of income (number)	-.4521 (0.2466)**
Constant	-0.1652 (1.5582)
Log likelihood	-400.8662

$\chi^2(8)$	46.18***
Observations	900 ⁴⁶

Standard error in parentheses; *** p<0.01, ** p<0.05, * p<0.1

From the first stage Probit model, the inverse of Mill's ratio (IMR) is generated to estimate λ , which is included in Model 1 to test for selection bias. As reported in Table 6.2, the coefficient of IMR is not significantly different from zero, which suggests that the non-responders were missing randomly from the sample of respondents, therefore there is no evidence of sample selection bias (Strazzera et al. 2003). The implication of this is that the use of standard Random or Fixed Effects regression models are appropriate, and parameter estimates do not need to be corrected for sample selection bias.

6.2.3 Empirical Model

A within-sample study design is used⁴⁷, merging the three WTA observations into one WTA variable so that n=900 to create a panel data set with three unique WTA observations for each of the 300 households. Dummy variables are created for the inferred valuation measures - WTA2 and WTA3, to compare to the baseline direct valuation- WTA1, as well as variables to control for household and neighbour plot characteristics. The WTA2 dummy accounts for the effects of social desirability bias and the WTA3 dummy accounts for the effects of hypothetical bias on the WTA estimate.

First, a Fixed Effects model is run to explore the WTA decision for each household using the continuous WTA dollar amount per hectare as the dependent variable (List & Shorgen 2002)⁴⁸. The advantage of this approach is that it controls for individual household

⁴⁶ N=900 in the Probit Model as a within-sample study design is used, merging three WTA observations across the 300 households interviewed into one WTA variable to create a panel data set with three unique WTA observations for each of the 300 households.

⁴⁷ A within-sample design offers the advantage that within-sample tests can control for individual-specific effects (List&Shogren 2002).

⁴⁸ Due to the small number of respondents not willing to accept any compensation (n=6), a Tobit model would not be appropriate.

characteristics, accounting for the individual household factors that may impact or bias the predictor or outcome variables (Kyriazidou 1997). This approach is compared to a Random Effects model, which allows for the inclusion of individual household and plot characteristics to help explain the motivations behind the WTA valuation.

Table 6.2 reports the different sets of explanatory variables used in the models to understand the willingness to accept decision. The analysis only includes the households providing a valid WTA response.

Both the Fixed Effects and Random Effects models have their advantages and limitations, and the results from the Hausman test suggests that in this instance the Random Effects model is preferred.

6.3 Results and Discussion

6.3.1 Estimating WTA – Male Head of Household

Table 6.2 presents the estimates of the WTA regression models. As sample selection bias is not present (evidenced by the fact that the coefficient for IMR in Model 1 – the sample selection corrected models, is not significantly different from zero) only the results from the standard (uncorrected) Random Effects model- Model 2 are discussed. Of interest is the WTA3 dummy, which is highly significant, indicating that the amount of compensation respondents say their neighbours would actually be willing to accept (controlling for hypothetical and social desirability bias) is \$583 less per hectare than what respondents themselves say they would accept for their plot.

The dummy for productive trees⁴⁹ is significant at the 10 per cent level and positive, suggesting that respondents with rubber trees aged between 5 and 25 years old require an additional \$896 to forgo access to their plot in Batabo Hill. This is intuitive, as farmers with

⁴⁹ Rubber trees take around 5 years to become productive and become less productive after 25-30 years (FAO, 1999).

younger, productive trees are forgoing more income than those with trees past their most productive years.

While not significant, the variable measuring total household agricultural landholdings is also negatively related to the WTA value, suggesting that households with more overall land require \$115 less compensation per hectare of total landholdings to forgo access to their land in Batabo Hill. This is intuitive as households with greater landholdings have more additional land where they can employ their household labour. Isolating the effect to only land held in Batabo Hill, the variable measuring the number of hectares of land the respondent has in Batabo Hill is significant at the 1 per cent level, and negatively related to WTA. This suggests that for every additional hectare of land, the respondent is willing to accept \$202 less in compensation. On average, households with larger plots in Batabo Hill require less compensation per hectare. This result is similar to Southgate et al., (2010) who found that, on average, households with larger farms were more likely to be willing to sacrifice a portion of their land.

The dummy for plots which are less than 500 metres from the road is positive and significant at the 10 per cent level. Respondents with plots in close proximity to the road (the Trans-Sumatran highway) require an additional \$1662 in compensation. This is consistent with what was reported in the key informant interviews, with plots close to the road worth twice as much as plots further from the road. The premium placed on plots which are close to the road reflects the lower transport costs, time savings and easier access.

The village 1 and 2 dummies have negative coefficients, significant at the 10 per cent level, indicating that, on average, respondents from these villages require between \$1405 and \$1476 less compensation than respondents from village 4 (the omitted category).

Table 6.2- Parameter estimates of Random Effects (RE) and Fixed Effects (FE) models with and without sample selection correction

	FE model 1 (Corrected model)	FE model 2 (Standard model)	RE model 1 (Corrected model)	RE model 2 (Standard model)
Dependent variables	WTA (\$)	WTA (\$)	WTA (\$)	WTA (\$)
Independent variables				
Household size (no.)			-47.042 (169.506)	-58.495 (169.650)
Education (years)			-153.603 (131.664)	-15.773 (106.134)
Age (years)			-34.223 (42.985)	12.074 (34.932)
Total agricultural land (ha)			21.477 (136.000)	-115.809 (110.585)
Village 1 (0/1)			2913.704 (319.293)	-1476.028* (891.135)
Village 2 (0/1)			1977.375 (1340.461)	-1405.262* (770.402)
Village 3 (0/1)			20.373 (806.964)	-306.417 (891.714)
Sources of income (no.)			540.143 (566.819)	-13.282 (312.109)
Plot <500 m to road			1753.536* (748.144)	1662.141* (616.216)
Productive trees 5>25 years old			934.329 (650.404)	896.230* (502.351)
WTA2 (0/1)	974.142 (1148.734)	246.354 (330.656)	318.503 (407.385)	315.796 (325.838)
WTA3 (0/1)	-607.0173*** (160.484)	-579.147*** (185.288)	-584.796*** (175.335)	-583.153*** (153.832)
Tree age (years)	-38.316* (21.536)	-37.190** (30.514)	-28.651 (19.004)	-28.209 (20.431)
Land in Batabo Hill (ha)	-174.428 (118.441)	-175.740 (112.853)	-202.227** (85.002)	-202.470*** (94.867)
IMR λ	-1203.802 (1728.950)		2406.662 (3704.151)	
Constant	5727.56*** (937.80)	-5280.799*** (712.207)	2406.662 (3704.151)	5574.596* (26911.32)
χ^2 (14)	13.28* (5)	17.95*** (4)	35.86*** (15)	41.30*** (14)
R² within	0.030	0.034	0.029	0.029
R² between	0.028	0.028	0.108	0.095
R² overall	0.024	0.024	0.087	0.077
Observations	449	449	449	449

Standard error in parentheses; *** p<0.01, ** p<0.05, * p<0.1

6.3.2 Opportunity Cost Comparisons

As a test of external validity, the WTA values provided by heads of household were compared to the local land values in the villages surrounding Batabo Hill and the opportunity costs of not producing rubber. A large discrepancy between these two measures can be indicative of the existence of hypothetical bias (Kaczan & Swallow 2013)⁵⁰.

In Batabo Hill, the most profitable land use is rubber, as informal rules prevent the planting of oil palm in the Protection Forest⁵¹ (H. Perkasa, personal communication 2015). The net income from one hectare of rubber over five years provides a measure of the opportunity cost of giving up the returns from the plot in Batabo Hill. The opportunity cost was \$3,798 on average, with a range of \$2,107 to \$5,963, reflecting variations in rubber price and discount rates⁵². The mean WTA value of \$3,920 for male heads of household (presented in the next chapter in Table 7.2) is within this range and close to the mean value, suggesting that the respondents' valuations are in line with their opportunity costs.

To further test whether the WTA values provided by respondents are in line with the opportunity costs of giving up one hectare of land in Batabo Hill for five years, these estimates are compared to the market values of current household land reported by the respondent. These values were elicited based on what the respondent thought:

- a) *their plot would be worth if sold today;*
- b) *their rental income would be if their plot was rented out today;*
- c) *their profit-sharing income would be if a profit-sharing arrangement was entered into today.*

⁵⁰ Or because opportunity costs have been mismeasured, or fail to take sufficient account of heterogeneity.

⁵¹ Households operate oil palm plots outside of Batabo Hill.

⁵² Using household survey and key informant data with latex price ranging from 3,000 Rupiah/kg to 7,000 Rupiah/kg, reflective of differences in latex quality and market access. Discount rates used to calculate the NPV of rubber net income over five years ranged from 10 per cent to 20 per cent, in line with values for the region (Cacho et al. 2005, Cacho et al. 2013).

For the analysis, the household plots were divided into two categories based on tenure security. Land classified as ‘more secure’ was typically in the village, and included land that had been inherited, purchased or received from the government or village. Land classified as ‘less secure’ refers to land which had been cleared by the respondent in the forest (i.e in Batabo Hill), which the household would be expected to have less secure tenure over. On average, households had approximately 2.5 hectares of ‘more secure land’ and 2 hectares of ‘less secure land’.

The land values provided by respondents in Table 6.3 highlight the differences in tenure security, with ‘more secure’ plots valued significantly higher, on average, than ‘less secure plots’ with respect to purchase values and rental values. The purchase value for one hectare of land with rubber is \$3,316 for ‘more secure plots’ and \$2,785 for ‘less secure plots’ (such as those in Batabo Hill). The five-year rental values for ‘less secure’ land (\$2,085) and for rubber plots of all tenure types⁵³ (\$2,320) are significantly less than the compensation demanded by households to give up their plots in the targeted wildlife corridor (i.e. mean WTA of \$3,920, in Table 7.2), highlighting the price premium attached by households to these plots when asked to give them up in a survey situation.

The profit sharing income from rubber plots in the survey (\$3,470 in the last row of Table 6.3), is in line with the opportunity cost of giving up rubber production for five years (mean \$3,798). Together, these land values provide a reference to validate the WTA values, which households have an incentive to inflate beyond their true opportunity costs (Kaczan & Swallow 2013).

WTA may exceed opportunity costs if households include the cost of clearing the re-vegetated land at the end of the five years in their WTA estimate. However, the premium placed on the land in Batabo Hill could also be capturing attachment to place and customary values to the land, particularly given households longstanding family ties to the local village

⁵³ Due to the small sample size, the rental data was not broken down by land tenure categories for different land uses.

and broader district. This value is not fully captured by market prices (Bush et al. 2013) and contingent valuation methods are valuable in measuring the non-market value to households of giving up access to their land, helping to inform a level of compensation which leaves the household no worse off.

Table 6.3: Values Provided by Respondents Based on What They ‘Think’ Their Plot is Worth, \$ per 1ha

Variable	N	Mean \$/ha	Median \$/ha
Land value if purchased			
More secure land – all land uses	480	\$3,414	\$2,436
More secure land - rubber plots	323	\$3,316	\$2,486
Less secure land - all land uses	136	\$2,741	\$1,864
Less secure land - rubber plots	101	\$2,785	\$1,864
Rental income -sum of payments over 5 years ⁵⁴			
More secure land- all land uses	93	\$2,710	\$1,865
Less secure land – all land uses	38	\$2,085	\$1,120
Rubber – all land tenure types ⁵⁵	90	\$2,320	\$1,392
Profit sharing income -sum of payments over 5 years			
More secure land- all land uses	369	\$3,375	\$2,030
Less secure land- all land uses	103	\$3,430	\$2,085
Rubber plots- all land tenure types ⁵⁶	352	\$3,470	\$2,088

⁵⁴ 103 people gave rental values and profit sharing values for their plots.

⁵⁵ Do to the small sample size, the rental data was not broken down by land tenure categories for different land uses.

⁵⁶ Due to the small number of oil palm plots, the profit sharing land values were not further broken down by land tenure category.

6.4 Summary and Conclusions

This chapter explores the opportunity for a PES program to support the proposed GEF eco-infrastructure proposal. To improve connectivity in a targeted wildlife corridor in Sumatra, Indonesia, the PES program would ‘buy out’ the land from the smallholders for a period of five years, allowing time for the understory cover to regenerate, and for the wildlife to return. The results indicate that male heads of households are open to this PES program.

This chapter tests inferred valuation in an open-ended WTA elicitation format and finds evidence of hypothetical bias in the conventional WTA values, indicating that the amount of compensation respondents say their neighbours would actually be willing to accept in ‘real life’ is \$583 less per hectare than what respondents themselves say they would accept for their plot. The results indicate that respondents recognise hypothetical bias in others, and in doing so, the use of inferred questions provides a valid mechanism to mitigate against hypothetical bias in stated preference surveys. This chapter provides a contribution to the contingent valuation literature, suggesting that studies valuing goods with normative motivations consider the application of inferred valuation techniques to mitigate against hypothetical bias.

The use of the ‘neighbour’ rather than the ‘average other’ may prove a useful methodological contribution to the inferred valuation literature; particularly for future PES program design applications, and where a reference point (i.e. hectares of land) is required to give meaning to the valuation. This chapter demonstrates the effectiveness of this adaptation in eliciting inferred valuations of rural farm households.

The WTA and land-valuation opportunity costs analyses provide useful insights not only for the study site but also for other projects involving trade-offs between agroecosystems and wildlife habitat.

Traditionally, it was common for contingent valuation studies to only interview a single respondent within the household (typically the male head of household) and assume a

common preference model for the household⁵⁷. This model assumes either that all household members have the same preferences, pool all resources and agree on all decisions, or alternatively, that one household member makes decisions for the household (Doss & Meinzen-Dick 2015). This chapter takes this traditional approach and assumes that the preferences of the male head of household can accurately represent the entire household when making resource allocation decisions. However, the preferences of the male and female heads of household may not be uniform (i.e. Lampietti 1999; Prabhu 2010; Whittington et al. 2008), and for this reason, the female heads of household were also interviewed, and their WTA values are analysed in the following chapter.

⁵⁷ In recent decades, however, this is changing and contingent valuation studies often include gender dummy variables in recognition that males/females or husbands/wives do not always have the same preferences.

Chapter 7 Estimating the Cost of Conservation: Taking into Account Male and Female Head of Household Preferences

7.1 Introduction

Chapter 6 took a traditional contingent evaluation approach, utilising only the male head of household data to explore two research questions ‘*what amount of compensation are heads of households willing to accept to give up access to their land in Batabo Hill?*’ and ‘*what are the sources of bias influencing the willingness to accept decision, and how can the inferred valuation method mitigate against this?*’

The results from the male only data suggest that male heads of household are willing to accept compensation to give up access to their land in Batabo Hill. The modelling highlights the presence of hypothetical bias in WTA estimates (on average \$583 less per hectare) and shows the potential for inferred valuation technique to mitigate against this. The results indicate that male heads of household require greater compensation for plots with productive trees, and for plots which are located close to the Trans Sumatran Highway. On average, male heads of household from villages 1 and 2 require less compensation than those from village 4.

Yet these results may not be an accurate measure of household WTA. An emerging strand of the contingent valuation literature studies intra-household resource allocation and find that the preferences of husbands may not reflect those of their spouse (i.e. Lampietti 1999; Prabhu 2010; Whittington et al. 2008), rejecting the common preference model which assumes that husbands and wives have the same preferences.

In some study contexts, researchers may assume that women lack bargaining power and do not make any decisions, thus the common preference model may be appropriate. However, as outlined in Chapter 4, this study site in Riau is unique; made up largely of two

cultures, the Minangkabau ethnic group - the largest remaining matrilineal society in the world (Blackwood 2008) and the Melayu ethnic group, also reported to follow matrilineal inheritance systems (Villamor et al. 2014a). Under a traditional matrilineal system, women are the head of household and bequeath land and houses to their daughters and nieces, who have the rights to use the land and receive all income generated⁵⁸. Whilst as part of the agricultural transformation Riau has shifted towards a partial matrilineal system, where males tend to have more control over decisions, nonetheless, it is expected that the female heads of household in this study are involved in land use decision making, and that some degree of bargaining and joint decision making takes place within the household.

In recent years the role of gender and the importance of including female preferences and perspectives has been well documented in the development, agriculture and environment literature (Swallow et al. 1994; Villamor & van Noordwijk 2016). Nonetheless, there remains a gap in capturing women's values and understanding gender differences when seeking to develop environmental policies and programs, particularly in Indonesia, where research into REDD + pilots and implementation finds that women have not been included in program consultation or decision making (Dewi & Widiyanto 2013; Seyyowati 2014). This study captures the preferences of both the male and female head of household to ensure that women's voices are equally represented in informing research findings and policy and program design.

This chapter further explores the two research questions examined in Chapter 6 and extends the analysis to include the female heads of household, allowing for direct comparison between both male and female heads of households to explore the final research question:

⁵⁸ In the event that the family does not have a daughter, the land may be inherited by the son, but then passed back to the daughters in the next generation.

‘are there gender differences in willingness to accept, and if so, what are the implications for study design and program targeting?’.

Both experimental work on contributions to public goods and the contingent valuation literature provide evidence of gender differences in environmental valuation and in hypothetical bias (i.e. Brown-Kruse & Hummels 1993; Brown & Taylor 2000; Johansson-Stenman & Martinsson 2006). With the exception of Carlsson, Daruvala and Jadell (2010) there are few inferred valuation studies reporting on gender differences⁵⁹ and no known studies which test for gender differences in the field⁶⁰. The WTA analysis in this chapter, and the payment preferences and discount rate analysis in Chapter 8, provide unique insights into gender differences in preferences, challenging the traditional approach to contingent valuation studies which assumes husbands and wives have the same preferences.

This chapter is structured as follows: Section 7.2 provides an overview of data and methods including the empirical model; this is followed by the estimated results from the female head of household model in 7.3, which are compared to the male results. Simple WTA means are presented along with WTA motivations in 7.32 and 7.33 respectively. This is followed by a discussion of descriptive data capturing female head of household environmental attitudes, perceptions of the changing nature of the environment, and attachment to place. The summary and conclusion are presented in the final section.

7.2 Data and Methods

7.2.1 Household Survey

As per Chapter 6, this chapter utilises data from the household survey conducted in 2015 in Riau, Sumatra. A random sample of 300 farm households was drawn from four

⁵⁹ The seminal work by Lusk and Norwood (2009a) found no statistically significant gender differences whereas Lusk and Norwood (2009b) had n=88 of which 73 per cent were female so results likely capture female dominant effects.

⁶⁰ Carlsson, Daruvala & Jadell (2010) explore gender differences in a laboratory situation with college students.

villages in Riau in close proximity to the nearby Protection Forest, Batabo Hill. In the survey both the male and female heads of household were interviewed. While Chapter 6 took a traditional approach and only discussed the results from the male heads of household, this chapter discusses the results from the perspective of the female head of household and makes comparisons between genders.

As described in Chapter 3, and outlined in detail in Chapter 6.2.1, the contingent valuation component of the survey asked three variations of the WTA question, first asking the respondent directly, and then employing an inferred valuation approach to ask indirectly in two ways. The three lump sum WTA values are first presented in this chapter as simple means.

Next, for the empirical model, three unique variables were generated for each of the three lump sum WTA observations provided by both the male and female heads in each of the 300 households. Data analysis was carried out in STATA. Detailed information regarding the empirical models is presented in the next section.

7.2.2 Comparison of Simple Means

For those providing a valid WTA response, simple means were calculated for all three WTA measures, expressed as a lump sum payment per hectare, including:

- WTA1 (hypothetical self) - *the amount of compensation the respondent would accept to give up their land.*
- WTA2 (hypothetical other) – *the amount of compensation the respondent infers their neighbour would say they would accept when surveyed.*
- WTA3 (actual other) - *the amount of compensation the respondent infers their neighbour would actually accept in real life.*

The compensation payments requested by the male and female heads of household can be viewed as the value they place on their plot in Batabo Hill, as accepting the payment means forgoing access to that land to generate income for a period of five years.

The calculation of simple means allows for the comparison of the value directly elicited from the respondent (WTA1) against the WTA values which mitigate against social desirability bias (WTA2) and hypothetical bias (WTA3).

Paired t-tests were run in STATA to test:

- 1) The null hypothesis that social desirability bias is equal to zero.
- 2) The null hypothesis that hypothetical bias is equal to zero.

In addition, a two-sample t-test was run to test the null hypothesis that gender differences in WTA values are equal to zero.

7.2.3 Empirical Model

Following the approach taken in Chapter 6, a within-sample study design is also applied to the female head of household data, merging the three WTA observations into one WTA variable so that $n=900$ to create a panel data set with three unique WTA observations for each of the 300 female heads of household.

For comparison to the traditional male only model discussed in Chapter 6, an identically specified Random Effects model was run to estimate WTA for female heads of household (Table 7.1).

This base model (described in Chapter 6) was specified with the male head of household in mind, typically a full time rubber farmer who may have been responsible for acquiring the plot in Batabo Hill. For this reason, variables measuring total available agriculture land, and the characteristics of the plot in Batabo Hill (including the relative desirability of this plot with respect to yields, size and market access), are expected to be key factors influencing WTA compensation to forgo access to this plot.

However, field interviews and survey data suggest that female WTA may be more influenced by concern for household income and overall household wellbeing, as female heads of household are typically responsible for managing the household, including the purchasing and preparation of food, and looking after the children (as described in Chapter 4). The literature suggests that women may be more sensitive to environmental risks than men, as they see the links between environmental quality and its consequences for personal well-being, social welfare and landscape health (Stern, Dietz & Kalof 1993). This literature suggests the possibility of an observed gender gap in valuations (Bord & O'Connor 1997). Further, the presence of children has been found to influence both the mother's (Blocker & Eckberg, 1989), and mother's and father's (Dupont 2004), level of concern for the environment, and WTP for environmental improvements.

For this reason, an expanded model is used to further explore if different factors influence female head of household WTA, including variables measuring the number of working age (16-60 years) household members of either gender- as a proxy for household earning potential, as well as a variable measuring the number of under 16 year old children.

7.2.4 Measuring Environmental Attitudes and Values

This chapter is particularly interested in the connection between women, their land, and the local environment. To explore the environmental attitudes and values of female heads of household, this chapter adapts Dunlap and Van Liere's *New Environmental Paradigm (NEP) Scale*, widely used to measure pro-environmental orientation (Dunlap & Van Liere 1978; Dunlap et al. 2000). In addition, this chapter draws on the approach taken by Morgan (2015) to explore the underlying psychological drivers and barriers to pro-environmental behaviour, exploring beliefs about climate change, attachment to place, and understanding of the impacts of the changing environment on their family and community.

Using a Likert scale approach, respondents indicated their level of agreement with the statements presented (Dunlap & Van Liere 1978; Morgan 2015). All items were assessed on a 5- point scale (1= *Strongly disagree*, 5 = *Strongly agree*).

Due to resource constraints, only the female heads of household completed this module of the survey, and therefore no comparisons can be made between genders.

7.3 Results and Discussion

7.3.1 WTA Values: Mean Comparisons

Comparisons of the mean WTA values reported in Table 7.1 indicate that social desirability bias is present. Respondents (both male and female) stated that they were willing to accept much less money to forgo land-use rights than what they inferred their neighbour would say they would accept when surveyed. When asked directly, respondents reported a mean WTA (WTA1) of \$4,157 (males) and \$3,792 (females), yet they said their neighbours would only be willing to accept if the payment was increased by \$294 (males) or by \$635 (females) (WTA2 value).

Whilst the difference between their own value (WTA1) and the value they provided for their neighbour (WTA2) are not statistically significant,⁶¹ social desirability bias does appear to be present, with respondents deflating their self-reported WTA relative to the (inflated) amount they infer their neighbour would be WTA. This is consistent for both genders, and comparisons of the difference between WTA1 and WTA2 mean values indicates that females exhibited greater social desirability bias (\$341) compared to their male counterparts, however, these differences are not significant⁶².

⁶¹ Paired t-tests run to test for social desirability bias (WTA1-WTA2) failed to reject the null hypothesis that social desirability bias is equal to zero. This is consistent with the regression analysis where the WTA2 dummy was insignificant.

⁶² Two sample t-tests run to test for gender differences found no statistically significant differences between genders.

In this study context respondents appear to be utilising themselves as a reference point when evaluating others (Carlsson, Daruvala & Jadell 2010; Lusk & Norwood 2009a), using the survey to enhance their own self-image by stating a higher WTA value for their peers than for their selves (Dunning & Hayes 1996)⁶³, in turn demonstrating that they are relatively more willing to forgo access to their land for conservation than their neighbour.

Comparisons between the third willingness to accept measure (WTA3) which asks the respondent what they believe their neighbour would actually accept (in a real life situation) and the WTA2 measure - what the respondent inferred their neighbour would say they would accept when surveyed, suggest hypothetical bias is present. The results indicate that respondents infer that in real life, their neighbour would actually be willing to accept \$531 (males) or \$552 (females) less than what they stated their neighbour would be willing to accept when surveyed. Here, the magnitude of hypothetical bias is similar for male and female heads of household, with female heads of households displaying slightly more hypothetical bias on average.

Paired t-tests run to test for hypothetical bias are able to reject the null hypothesis that hypothetical bias is equal to zero. This is consistent with the Random Effects model regression results presented in 7.3.2, where in both the male and female models the WTA3 dummy coefficient is negative and statistically significant at the 1 per cent level.

The inferred valuation literature suggests that by asking the respondent what they believe their neighbour would actually accept (in real life), both hypothetical and social desirability bias are removed, and the value provided is closer to the true valuation, approximately equal to conventional self-reported (non-hypothetical) values (Lusk & Norwood 2009a, 2009b).

⁶³ Yadav, van Rensburg & Kelly (2013) control for this by asking half of the respondents to answer the inferred valuation questions before providing valuations for themselves.

Therefore, once both hypothetical and social desirability bias are controlled for, the inferred 'true value' is significantly different from the conventional WTA value provided.

For male heads of household, the estimated mean WTA3 values are lower than both the amount provided via directly questioning the respondent (WTA1) and by asking what they believe their neighbour would say they would accept if surveyed (WTA2). However, for female heads of household, the estimated WTA3 values are slightly greater than the amount provided via directly questioning the respondent (WTA1), while consistent with the male data, the mean WTA3 value is lower than the WTA2 value.

One possible explanation for this differential between WTA1 and WTA2 for both genders is that, when asked what their neighbour would be WTA when surveyed, the thought of potential program payments could have incentivised respondents to act strategically to appear relatively better value than their neighbour (Carson & Groves 2007), such that $WTA1 < WTA2$. However, the literature (Lusk & Norwood 2009a; Pronin 2006) suggests that when asked what their neighbour would actually accept in real life, the respondent recognises the hypothetical bias in others (and themselves) and corrects for it, acknowledging that in reality, they will accept less compensation than what they say when surveyed, such that in this study, for male heads of households $WTA3 < WTA2$ and $WTA1$.

While gender differences in the mean WTA values are not significant, for all three measures of WTA, female heads of households on average were willing to accept less compensation.

The literature suggests there are many reasons why women may be willing to accept less compensation to forgo access to their land in Batabo Hill. For example, the literature finds that on average women are less self-assertive and competitive than men, demonstrate less self-interest, and are more socially orientated (Croson & Gneezy 2004; Eagly & Steffen; 1984; Leach, Joeks & Green 1995). These traits can manifest a desire to be generous or a

desire to seem willing to show concern for the environment (Mellstrom & Johannesson 2008; Zelzny, Chua & Aldrich 2000), both which can be an important part of their self-image. Female heads of household may be willing to accept a lower amount of compensation in order to conform to their own self-image/the image they perceive that society has of them (Carlsson, Daruvala & Jadell, 2010), because they see more clearly the links between ecosystem degradation in Batabo Hill and their families welfare and are willing to accept less compensation for their land if this lowers the risk exposure for their children (Stern, Dietz & Kalof 1993; O'Connor 1997), or alternatively due to the nature of the tenure surrounding this land. Women's tendency towards risk aversion (Eckel & Grossman 2002) could translate to a willingness to accept less compensation for a plot which they operate under tenuous tenure, acquired outside the matrilineal inheritance system. The male head of household may have cleared this land as a way to obtain additional land outside of the traditional inheritance system, and as such, may feel a greater attachment to this land.

Table 7.1: WTA Mean Estimates, Lump Sum \$ Per Ha

	Female		Male	
	N	Estimated Mean	N	Estimated Mean
WTA1: Amount household would accept	169	3,792 (3,921)	185	4,157 (358)
WTA2: Amount neighbours would say WTA	172	4,427 (4,441)	148	4,451 (362)
WTA3: Amount neighbours would actually accept	172	3,875 (4,341)	148	3,920 (321)

*Standard errors in parentheses.

7.3.2 Comparing Male and Female Head of Household WTA

For comparison, Table 7.2 presents the estimates of WTA Random Effects models for both the male and female heads of household. This model merges the three WTA observations into one WTA variable to create a panel data set with three unique WTA observations for both the male and female heads of household.

As outlined in Chapter 6, sample selection bias is not present, therefore, for simplicity, only the results from the standard (uncorrected) Random Effects model are presented and discussed in this chapter.

The results from Model 1, identical to the model run with male data in Chapter 6, are discussed first. Of interest is the WTA3 dummy, which as per the male data, is highly significant at the 1 per cent level, indicating that the amount of compensation female heads of households say their neighbours would actually be willing to accept (controlling for hypothetical and social desirability bias) is \$630 less per hectare than what female heads of households themselves say they would accept for their plot. Compared to their male counterparts, female heads of household exhibit slightly greater hypothetical bias, around \$47 on average.

Consistent with the male model, the WTA2 dummy measuring social desirability bias is not significant. However, simply comparing the size of the coefficients between the male and female models suggests that females display slightly more social desirability bias than their male counterparts, around \$39 on average.

The variable measuring tree age is significant at the 5 per cent level, suggesting that female heads of household are willing to accept \$51 less for every year older their trees in Batabo Hill are. Tree age was not significant in the male model. However, the dummy variable measuring if the rubber trees are in their productive years, as well as the variables measuring the hectares of land in Batabo Hill and the distance of the plot in Batabo

Hill to the road, are only significant in the male model, suggesting that unlike their male counterparts, plot characteristics may not be as influential to the female WTA decision.

Further, unlike in the male model, there are no significant village effects on WTA in the female model.

Table 7. 2 Parameter Estimates of Random Effects Models- Female and Male Heads of Household WTA Comparisons

	Female	Male	Female	Male
	RE model 1	RE model 1	RE model 2	RE model 2
Dependent variables	WTA (\$)	WTA (\$)	WTA (\$)	WTA (\$)
Independent variables				
Household size (no.)	-48.835 (175.747)	-58.495 (169.650)	88.932 (297.488)	97.302 (287.995)
Education (years)	-42.884 (110.939)	-15.773 (106.134)	-28.606 (103.826)	-16.350 (106.948)
Age (years)	9.104 (27.686)	12.074 (34.932)	-7.488 (32.536)	3.444 (41.352)
Total agricultural land (ha)	-32.655 (85.091)	-115.809 (110.585)	-57.052 (76.466)	-114.678* (86.868)
Village 1 (0/1)	-826.323 (1466.42)	-1476.028* (891.135)	-766.749 (1363.066)	-1519.05* (956.320)
Village 2 (0/1)	-1499.562 (1178.028)	-1405.262* (770.402)	-1295.477 (1136.066)	-1415.219 (696.337)
Village 3 (0/1)	91.518 (1315.895)	-306.417 (891.714)	187.305 (1417.239)	-365.134 (875.968)
Sources of income (no.)	-184.212 (339.535)	-13.282 (312.109)	-258.735 (353.380)	-13.133 (408.124)
Plot <500 m to road	421.402 (666.835)	1662.141*** (616.216)	503.287 (793.473)	1656.723** (847.454)
Productive trees 5>25 years old	668.592 (795.989)	896.230* (502.351)	741.653 (838.209)	959.347* (660.136)
WTA2 (0/1)	354.1705 (463.629)	315.796 (325.838)	359.246 (465.538)	314.697 (476.151)
WTA3 (0/1)	-630.155*** (172.118)	-583.153*** (153.832)	-631.344*** (132.807)	-583.974*** (159.966)
Tree age (years)	-51.184** (25.514)	-28.209 (20.431)	-52.067* (21.669)	-27.383* (19.660)
Land in Batabo Hill (ha)	-293.205* (135.853)	-202.470*** (94.867)	-281.865** (138.959)	-204.371*** (63.135)
Working age population –female (no.)			4015.621*** (1139.236)	-275.388 (1189.387)
Working age population –male (no.)			-3898.343 (1079.070)	105.898 (1162.73)
Children under 16 years old (no.)			-514.324* (339.043)	-262.871 (324.486)

Constant	7620.799** (1957.207)	5574.596* (26911.32)	7216.369** (2966.452)	6111.343** (2893.272)
χ^2	38.70*** (14)	41.30*** (14)	138.58*** (17)	195.87*** (17)
R2 within	0.055	0.029	0.056	0.029
R2 between	0.030	0.095	0.055	0.097
R2 overall	0.032	0.077	0.059	0.080
Observations	500	449	500	549

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

In Model 2, the extended model, the sign and coefficients for the plot characteristics and socio-demographic variables are largely unchanged from those discussed in Model 1. Batabo Hill plot characteristics (such as the variables for productive trees and distance of the plot from the road) remain of more significance for the male heads of household.

The coefficients for the WTA2 and WTA3 dummy variables measuring social desirability bias and hypothetical bias also remain largely unchanged.

Of interest are the coefficients for the variables measuring number of working age females and males in the household. On average, female heads of household require an additional \$4,015 in compensation for every working age female in the household, highly significant at the 1 per cent level. Whilst not significant, this result is then reversed for working age males – on average, female heads of household request \$3,893 less compensation for every working age male in the household.

In comparison, for male heads of household, household labour of either gender is not heavily factored into the WTA decision, displaying small coefficients of no significance.

These contrasting results suggest that, when determining WTA, female heads of household consider the practical implications of the labour which is freed up from the rubber tapping and maintenance, and the availability of alternative livelihood opportunities for male and female workers. This may be because, when providing their values, females are more likely to respond to context than males (Cadsby & Maynes 1998), including the market context (Brown & Taylor 2000) and take relationships into consideration (Gilligan 1982).

This result may also reflect the relative differences in income earning potential for male and female workers, noting that in Kuantan Mudik Sub District, women working in rubber earn a lower average wage rate than their male counterparts⁶⁴, which reflects perceived differences in physical ability and productivity. Therefore, female household members renting out their labour as rubber tappers or when undertaking land preparation or crop maintenance could expect to earn less than their male equivalents.

Alternative non-rubber livelihoods for working age males could include working as a relatively higher paid oil palm labourer, non-farm labourer or skilled and experienced handyman, whereas for working age females, the alternative livelihoods are more limited, such as running their own business i.e. kiosk, or unpaid domestic work, which may not generate as stable income as daily rubber tapping.

Somewhat counterintuitive to what the literature would expect (i.e Dupont 2004), female head of households appear to be willing to accept \$514 less on average for each child under 16 years of age, significant at the 10 per cent level. Whilst also negatively related to WTA, the magnitude of the coefficient is nearly half for the male heads of household and it is not significant.

This result may be linked to the household labour effect discussed earlier, whereby as these younger children may not yet be contributing in a meaningful way to rubber tapping or maintenance for the family plot in Batabo Hill, they may not be factored into the female heads of household WTA equation as the older household members are (as there is no opportunity cost for their labour). Moreover, the findings from the focus group discussions reported in Chapter 5, highlighted the desire of mothers and fathers to invest in educating their children so that they could have the opportunity to obtain higher paying non-farm

⁶⁴ Key informant interviews with village leaders suggest women earn roughly half the wage of their male counterparts for land clearing, land preparation and crop maintenance, and in some villages, they earn up to US\$3 less per hour for rubber tapping

employment. Therefore, the rubber plot in Batabo Hill may not be expected to provide a livelihood for these children, who may instead leave the village to pursue non-farm employment opportunities.

7.3.3 WTA Motivations

Based on their responses to the willingness to accept question, respondents were then asked debriefing questions to understand why they were/were not WTA.

Figure 7.1 outlines the reasons why the male and female heads of household were willing to forgo access to their land for five years. The main reason given by both genders was for the regular income stream (35 per cent of males and 38 per cent of females). The next most common reason was to help manage the communities' natural resources (22 per cent of both males and females), followed by concern for the environment/wildlife (16 per cent of males, 17 per cent of females), the ability for this money to pay for household expenses (16 per cent of both males and females), and last, in recognition that they shouldn't be farming on this land in the Protection Forest (11 per cent of males and five per cent of females).

Comparisons between genders highlight minimal differences in reported motivations, with the female respondents slightly more motivated by the regular income stream and the male respondents showing greater acknowledgement they should not be operating on this land in the Protection Forest.

The motivations behind the WTA decision are not surprising; the desire for a regular source of income is logical given the fluctuations in rubber prices (and thus household income) over recent years. The motivation to manage the community's natural resources is consistent with community concerns, highlighted via focus group discussions in Chapter 5, acknowledging the impacts of natural resource degradation, namely agricultural expansion, on the availability and quality of water in the villages, as well as reports that at least one

village asked the District Government to transfer a portion of the land in the Protection Forest to the village to be managed by the community.

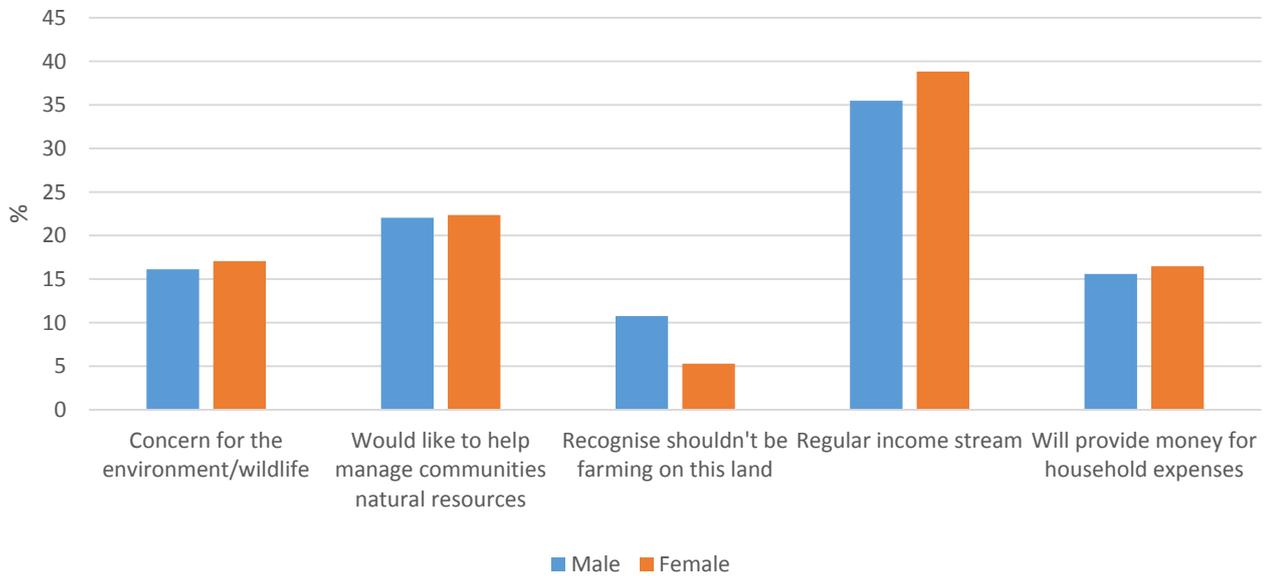


Figure 7.1: WTA Motivations, Male and Female Head of Household, %

7.3.4 Female Head of Household Environmental Attitudes and Perceptions

To explore in more detail the relationship between women, the local environment and their land, female heads of household completed an additional survey module designed to capture environmental attitudes, perceptions of the changing nature of the environment, and attachment to place. Using a Likert scale approach, respondents indicated their level of agreement with the statements presented (Dunlap & Van Liere 1978).

The results from the environmental attitudes questions (Table 7.3) show that while female heads of household feel strongly about the benefits of clearing land in the forest for agriculture (85 per cent think this is a good thing), around 60 per cent are concerned about natural resource issues such as water and soil, and 82 per cent are concerned about wildlife extinction.

Table 7.3: Female Head of Household Environmental Attitudes

Questions	Response, %				
	Strongly agree	Mildly agree	Unsure	Mildly disagree	Strongly disagree
One of the best things happening in our village is that we are converting forest to agriculture	7	78	2	12	1
It's important that we clear forest land for agriculture	9	73.5	4	12.5	1
I do not think the problem of the depletion of natural resources is as bad as many people make it out to be.	1	43.5	17	36.5	2
I find it hard to get too concerned about natural resource issues i.e. water, soil	1	29	10	57	2
I am not concerned about threats to wildlife extinction in Sumatra	2	11	4	67	15
I'm opposed to programs that conserve the forest and protect water resources	0.3	8	4	68.7	19
I would like to improve the condition of our water and soil	21	76	1	1	1
Too much emphasis has been placed on the conservation of the native wildlife i.e Sumatran tiger, Sumatran elephant	3	45	28	23	1
One of the worst things about the changing environment is that it impacts on agriculture and our livelihoods	11	60	7	20	2
Climate change and threats to the environment are greatly exaggerated	1	39	14	44	1

As shown in Table 7.4 over 80 per cent of female heads of households are concerned about the impact of the changing environment on the health and economic situation of their children and family in the coming decade. In addition over 80 per cent of female respondents are concerned about the availability of natural resources to support their family's livelihoods.

The women extended these concerns to the community in a similar magnitude.

Table 7.4: Impacts of the Changing Nature of the Environment

	Response, %				
	Strongly agree	Mildly agree	Unsure	Mildly disagree	Strongly disagree
The changing environment in my local area will have a negative impact.....					
On the health of my children and family in the next 10 years	12	68.7	5	14	0.3
On the economic situation of my children and family in the next 10 years	11	67	7	14	1
On the local natural resources that my children and family rely on for our livelihoods	11	69.7	6	13	0.3
On the health of my community	10.5	70.5	6	13	0
On the economic situation of my community	11	65.7	9	14	0.3
On the natural resources available to provide livelihoods to my community	12	66	6.5	15	0.5

Table 7.5 outlines statements designed to measure attachment to place. The results indicate that the female heads of household feel a strong connection to their land and that this land is a reflection of them, a place where they feel happy and a place which they miss if they are away for too long. Female heads of household overwhelmingly would like to pass their land on to their children, however, they express concern about the quality of the land that they are leaving behind. Further, they express concern that their children may not be able to benefit from the community's natural resources, such as Batabo Hill, as they have.

Table 7.5: Attachment to Place

Please indicate how much you agree or disagree with the following statements.	Response, %				
	Strongly agree	Mildly agree	Unsure	Mildly disagree	Strongly disagree
Everything about my land/plots is a reflection of me.	13	72	3	11	1
I feel happiest when I'm on my land.	38	59.7	0.3	2	0
I really miss my land/plots when I am away from it for too long.	26	71.3	0.7	2	0
My village is the best place for doing the things I enjoy most.	22	74	2	2	0
It would like to pass my land down to my children.	36	62	1	1	0
I'm concerned about the quality of the land that I am leaving behind for my children/family.	5	56	9	30	0
I'm concerned that my children/family may not benefit from our communities natural resources (i.e. Batabo Hill Protection Forest) as I have.	12	58	12	17	1

7.4 Summary and Conclusions

This chapter further explores the two research questions examined in Chapter 6 and extends the analysis to include the female heads of household. As per the male data, this chapter finds evidence of hypothetical bias in female head of household WTA, with female heads of household exhibiting slightly greater hypothetical bias, around \$47 on average. Consistent with the male model, social desirability bias is not significant.

Comparisons between genders highlight that different factors influence male and female heads of household WTA. Male head of household WTA tends to be more influenced by Batabo Hill plot characteristics, whereas female head of household WTA is more influenced by household labour allocation considerations. Females appear to consider the practical implications of the labour which is freed up from the rubber tapping and maintenance, and the uneven availability of alternative livelihood opportunities for male and female workers.

The mean WTA values are in line with the opportunity cost of forgoing income from household land in Batabo Hill (detailed in Chapter 6). Paired t-tests for hypothetical bias in the simple WTA means are unable to reject the null hypothesis that hypothetical bias is equal to zero and mean comparisons indicate that respondents infer that in real life, their neighbour would actually be willing to accept around \$500 less than what they stated their neighbour would be willing to accept when surveyed.

Analysis of simple mean WTA finds no significant gender differences, yet for all three measures of WTA, female heads of households on average were willing to accept less compensation. This has implications for program design and targeting – a PES program targeting female heads of household is likely to be able to secure more land for conservation than one targeting male heads of household, but alternative livelihood opportunities would need to be considered.

The environmental attitudes and perceptions module highlighted that on average, female heads of households are concerned about a) the impact of the changing environment on the health and economic situation of their children and family in the coming decade, and b) the availability of natural resources to support their family's livelihoods. This may partly explain why they are willing to accept lower levels of compensation.

Chapter 8 will take a new approach – pooling male and female head of household data to further explore gender differences and the sources of bias influencing WTA values.

Chapter 8 Exploring Gender Differences in WTA

8.1 Introduction

The results from Chapter 7 show that different factors influence male and female head of household WTA values. However, the analysis finds no conclusive evidence of gender differences in the WTA. This chapter takes a second methodological approach, pooling the male and female data to address the final research question: *'are there gender differences in willingness to accept, and if so, what are the implications for study design and program targeting?'* and to further examine *'what are the sources of bias influencing the willingness to accept decision, and how can the inferred valuation method mitigate against this?'*

A range of approaches have been taken to examine gender differences, and the results are mixed. Some suggest running separate male and female regressions (Ritten 2011), or to pool the male and female data and use gender interaction variables (Lampietti 1999), whereas others take both approaches – running separate and then pooled regressions to test for gender differences in stated preferences (Brown & Taylor 2000).

In the previous two analytical chapters, separate male and female regressions were run, allowing for comparison of the coefficients between the two models for evidence of gender differences. This chapter follows the approach of Lampietti (1999), using gender interaction variables to explicitly test for gender differences across a range of variables. This approach is chosen as gender has been found to interact with a range of socio-demographic variables including education, race, age and socioeconomic status (Aspinall & Ujam 1992; Leach, Joeks & Green 1995; Lyons 1983), and therefore the inclusion of a simple gender dummy may not be sufficient to test for gender differences (Figart 2005).

The application of two distinct methodological approaches to assess gender differences makes a valuable contribution to expanding the scarce inferred valuation literature studying gender differences.

In addition, by pooling the male and female head of household data, this chapter is able to delve deeper into the three unique WTA values provided by both heads of household; (1) looking first at the value provided by the respondent when asked directly what payment they would accept to forgo access to their land, the ‘hypothetical self’; (2) comparing this to the value the respondent infers their neighbour would say they would accept when surveyed, the ‘hypothetical other’; and (3) comparing (1) to the value the respondent infers their neighbour would actually accept in real life, the ‘actual other’. Finally, the WTA values are decomposed to isolate social desirability and hypothetical bias and examine the drivers influencing these sources of bias in WTA values.

Finally, this chapter contributes to the emerging intra-household contingent valuation literature (i.e Prabhū 2010) by examining intra-household differences in WTA payment preferences of husbands and wives. Whilst WTA has been explored extensively at the individual level, less attention has been given to investigating WTA for multiple decision makers from the same household. Empirical evidence finds that preferences may differ by gender (Van Parag & Booij 2003; Anderson et al. 2004), and that when examining intertemporal choices, there may be heterogeneity within the household (Schaner 2015; Yang & Carlsson 2012).

Differences in payment preferences and the relative utility individuals receive from the payment type could impact on the household participation decision in a PES program and their relative commitment to the program over its life. Therefore, it is important to explore the payment preferences of household heads, as these will have implications for program design and targeting.

This chapter is structured as follows: Section 8.2 provides an overview of data and methods including the empirical modelling approach; this is followed by the estimated results

from the pooled male and female OLS regressions and payment preferences analysis in 8.3. The summary and conclusion are presented in the final section.

8.2 Data and Methods

8.2.1 Data from the Household Survey

As per the previous two chapters, this chapter utilises data from the household survey conducted in 2015 in Riau, Sumatra. A random sample of 300 farm households was drawn from four villages in Riau in close proximity to the nearby Protection Forest, Batabo Hill. The survey interviewed both the male and female heads of household and this chapter discusses the results from the pooled male and female head of household data, making comparisons between genders.

8.2.2 OLS Regressions

To further explore gender differences in WTA, a new methodological approach was taken, pooling the male and female head of household data to generate a new cross sectional data set with $n=600$. Dependent variables were created using the three unique lump sum WTA observations (WTA1, WTA2 and WTA3). Three separate OLS regression models were run using identical independent variables to examine how the variables influence the unique WTA estimates.

To explore the WTA decision for each of the heads of household, the first model uses WTA1, the direct WTA valuation, using the continuous WTA dollar amount per hectare as the dependent variable. This model represents the conventional WTA approach, simply asking the respondent directly what they would be willing to accept, and does not control for hypothetical or social desirability bias.

The second model features the WTA2 value as the dependent variable, which measures what the respondent believes ‘their neighbour would say they would accept when surveyed’, which in theory, mitigates against social desirability bias (Lusk & Norwood

2009a). By controlling for social desirability bias, the extent to which this source of bias influences WTA estimates can be examined.

The third model features the WTA3 value as the dependent variable. As outlined in Chapter 3, the third WTA question asks the respondent ‘what their neighbour would be willing to accept (in a real life situation)’. In theory, this question, by asking what they believe their neighbour is willing to accept rather than the respondent themselves, mitigates against social desirability bias, and by asking what they would accept in ‘real life’, mitigates against hypothetical bias. In the absence of both sources of bias, this value (WTA3), is thought to be closer to the true valuation (Lusk & Norwood 2009a, 2009b).

In addition, dependent variables are generated to isolate the two types of bias. First, a variable is generated to measure social desirability bias (calculated as $WTA2 - WTA1$) and second, a variable is generated to measure hypothetical bias ($WTA3 - WTA2$). Model 4 and Model 5 feature OLS regressions with these measures of social desirability and hypothetical bias as dependent variables, modelled with identical independent variables as Models 1, 2 and 3. This allows for easy comparison of the effects of the different independent variables across the five models.

Identical variables from the expanded Random Effects model, outlined in the previous chapter in 7.2.3 and 7.3.2, are also included in the OLS models. This model specification is extended to more explicitly test for any potential gender differences in WTA (see Table 8.1). To do this, a gender dummy =1 for male is included in the model, which is then interacted with all independent variables. In addition, to explore the potential for gendered enumerator effects (Blaydes & Gillum 2013; Gneezy, Leonard & List 2009) a dummy variable =1 is included if the enumerator is male.

To try to capture the household’s agricultural expansion potential, a dummy variable=1 is included if the household owned a chainsaw. Here chainsaw ownership is a

proxy for the ability to clear additional forest land as this technology decreases the labour cost of clearing forest land (Geoghagen et al. 2001).

8.2.3 Analysing Payment Preferences

The WTA survey module included questions about respondent payment preferences. To elicit payment preferences, both male and female head of households were asked if they would prefer to be paid monthly for five years or in a lump sum (one payment at the beginning of the five years). Respondents were asked to provide what payment amount (if any) they would be willing to accept to give up their land for five years, according to both their first and second payment preferences

As part of the descriptive analysis of the payment preferences, the individual male and female heads of household monthly and lump sum WTA values were analysed; first in aggregate, to highlight the overall gender breakdown of payment preferences, and then at the intra-household level.

8.3 Results and Discussion

8.3.1. WTA Value Comparisons: OLS Regressions

Direct Valuation

Table 8. 1 presents the results of the WTA OLS regression models. The results of Model 1, where the dependent variable is WTA1 is discussed first. The WTA1 variable represents the direct valuation, directly asking the respondent how much they would be WTA to give up access to their land. This is the traditional WTA approach, which does not mitigate against social desirability or hypothetical bias.

In this model, the number of hectares of land the respondent has in Batabo Hill is significant at the 10 per cent level, and negatively related to WTA. This suggests that for every additional hectare of land, the respondent is willing to accept \$713 less in compensation. On average, households with larger plots in Batabo Hill require less compensation per hectare. This result is consistent with Southgate et al. (2010), who found

that households with larger farms were more likely to be willing to give up a portion of their land for conservation under a PES program.

Respondents with a chainsaw in the household required \$1,438 more compensation on average (significant at the 1 per cent level). Chainsaws are commonly used to clear forest land for agriculture, and this variable may be a proxy for the ability/intention to clear additional land for agriculture. Households with chainsaws may require greater compensation if infer that the PES scheme would not only be buying out their current land used for agricultural production but also the future land that they might have cleared as well. Whilst, any additional agricultural expansion is not desired, displacing the agricultural expansion to areas outside of the targeted wildlife corridor, will not negate the benefits of the PES program (Wunder, Engel & Pagiola 2008).

Inferred Valuation

Model 2

In Model 2, the dependent variable is the WTA2 value which measures what the respondent believes ‘their neighbour would say they would accept when surveyed’, which in theory, mitigates against social desirability bias (Lusk & Norwood 2009a).

The results from this model are largely similar to the results from Model 3, therefore the discussion of results will be kept brief, with a more detailed discussion of the significant results in the next section regarding Model 3.

Notable results in Model 2 include the coefficient for the household size variable, which suggests that respondents require an additional \$463 in compensation on average, for every additional household member, significant at the 10 per cent level. Interestingly, this does not apply to under 16 year old children, who may not yet be productive household labour. Respondents required \$871 less compensation on average per child under 16, significant at the 10 per cent level.

The coefficients for the number of working age male and females in a given household suggest that there may be gender differences in the way household labour is factored into the WTA decision. For example, significant at the 5 per cent level, respondents demanded \$4,689 more in compensation for every working age female (16-60 years), and \$4,755 less for every working age male (16-60 years). This gendered labour effect may reflect the availability of higher paying alternative livelihoods for men. For working age females, the most common non-rubber livelihood is unpaid domestic work (35 per cent of female head of households) or running their own business i.e. a kiosk (9 per cent of female head of households) and these alternatives may be viewed less favourably than rubber tapping.

Interestingly, when the household labour variables interact with the male gender dummy, the signs of the coefficients are reversed, such that men seek less compensation per working age female and more per working age male. While not significant, these results highlight the differences in the way male and female heads of households treat household labour when considering the amount of compensation they require to give up access to their land in Batabo Hill.

Gender differences in preferences between spouses in household decision making was also found by Whittington et al. (2008) and Prabhu (2010). For example, Whittington et al. (2008) found that although spouses reported that they would purchase the same total number of vaccines, and had essentially the same demand functions, at lower vaccine prices wives were significantly more likely than husbands to allocate vaccines to their daughters than to sons. Prabhu (2010) also found that husbands and wives differed in their decision making, noting that socioeconomic factors are likely to affect the WTP of husbands and wives differently. In this study context, it appears that there are gender differences in the preferences of male and female heads of household when eliciting WTA, such that male heads of household view household labour differently to female heads of household, and

require greater compensation for forgone rubber income from working age males than working age females.

The interaction between the male dummy and plots in Batabo Hill which are less than 500 metres from the road suggests that male heads of household require an additional \$2,595 in compensation for plots which are close to the road, significant at the 10 per cent level. This is consistent with the results from the Random Effects model in Chapter 7, which found that male head of household WTA is more influenced by plot level characteristics.

Interestingly, respondents demanded \$1,287 more compensation if the enumerator was male, significant at the 10 per cent level. This result will be discussed further in Model 3.

Model 3

In Model 3, the dependent variable is the WTA3 value where both hypothetical and social desirability bias are removed, and the value provided is closer to the 'true valuation' (Lusk & Norwood 2009a, 2009b).

The results show that respondents with rubber as their main profession were willing to accept \$3,499 less compensation, significant at the 1 per cent level. Respondents with a non-farm main profession were willing to accept \$2,742 less, significant at the 10 per cent level. Taken together, these results suggest that heads of household with a non-farm main profession require more compensation than respondents where rubber farming is the main profession. One explanation for this is that the dummy for non-farm main profession could be a proxy for wealth/ the ability to obtain alternative (non-farm) income, and this may explain why these respondents require more compensation.

In a similar PES study in Ecuador and Guatemala, Southgate et al. (2010) find that households demand varying levels of conservation payments because their source of income differs, as do the risks they face. They find that households that depend on subsistence

farming are more willing to participate in the proposed PES scheme. This is because for subsistence farming households, substituting conservation payments for some (modest) agricultural returns (by giving up this land) reduces the variability in their overall earnings, which risk-averse respondents would welcome. Applied to this study, where rubber prices have fluctuated to the current low and smallholders face challenges with disease, yields and a changing climate, a secure cash payment may be viewed as attractive, particularly by more risk averse rubber farmers.

The insignificance of the gender dummy, and in the main, gender interactions, in Models 1, 2 and 3 suggest that there is limited evidence of significant gender differences in WTA. Whilst not significant, the magnitude of the coefficient for gender (=1 for male) is large - \$1,144, and suggests that male heads of household may require greater compensation to forgo access to their land in Batabo Hill, as was found in the simple WTA means analysis in Chapter 7.

Consistent with the results in Model 2, the coefficients for the number of working age male and females in a given household suggest that there may be gender differences in the way household labour is factored into the WTA decision. Here, significant at the 10 per cent level, respondents demanded \$3,545 more in compensation for every working age female (16-60 years), and \$3,847 less for every working age male (16-60 years). Also consistent with Model 2, respondents required \$836 less on average for every under 16 year old child, significant at the 10 per cent level.

As found in Model 1, significant at the 10 per cent level, respondents with a chainsaw in the household required an additional \$857 compensation on average.

Notably, respondents demanded an additional \$1,270 in compensation if the enumerator was male, significant at the 5 per cent level⁶⁵. This suggests that there is a gendered

⁶⁵ A similar result was also found in Model 2, significant at the 10 per cent level.

enumerator bias, even when both social desirability bias and hypothetical bias are controlled for.

The impact of enumerator bias is approximately one third of the value of mean WTA (Mean WTA3 is \$3,920 for males and \$3,875 for females), suggesting that enumerator bias is more significant than both hypothetical and social desirability bias, both of which receive significantly more attention in the literature. The presence of enumerator bias questions the critical assumption that the third person approach would mitigate against the respondent using the survey situation as an opportunity for self-enhancement (Fisher 1993; Lusk & Norwood 2009a).

The gender-specific ways in which participants process experiments have been documented by Croson and Gneezy (2009) and Eckel et al. (2008) among others, as has the potential for the experimental context to induce biased responses due to self-enhancement or social desirability effects (Lusk & Norwood 2009a, 2009b; Maguire 2009). In their study employing inferred valuation methods, Carlsson, Daruvala and Jadell (2010) suggest that the laboratory situation (where respondents are observed by a researcher) may be augmenting self-image effects, and therefore, be responsible for the large differences in WTP between hypothetical and real treatments; attributing these differences mainly to women.

In their survey of women in Egypt, Blaydes and Gillum (2013) find enumerator effects related to the enumerator's religious adherence, such that the perceived religiosity of the enumerator impacted on respondents' expressions of personal piety and adherence to Islamic cultural norms. In their study, Muslim women indicated that they were more religious and adherent to Islamic cultural norms when interviewed by an enumerator wearing an Islamic headscarf. Here, Blaydes and Gillum (2013, p. 1) explain that "through psychological processes of strategic self-presentation of identity and impression management, the veil may trigger Muslim respondents to express what they perceive to be socially

desirable (i.e., more devout) responses”. These findings have strong parallels with this study, where gender rather than religion is driving the enumerator bias.

The literature on enumerator effects suggests that the gender of the enumerator can systematically and significantly affect survey responses and bias responses in a number of ways⁶⁶. In explaining enumerator effects, scholars such as Goffman (1963) suggest that respondents may answer in a way which they perceive will please the enumerator, or adhere to social norms. This is a type of social desirability bias, as respondents answer in ways they believe will be viewed favourably by others. Respondents may consciously or subconsciously follow dominant cultural norms (Asch 1951), and conform to these norms to avoid feelings of embarrassment or to feel pride (Goffman 1967). The conforming behaviour is shaped by cultural specific determinants of shame and pride (Bond & Smith 1996), such that these social desirability effects are reflective of, and unique to, the cultural context of the study (Zerbe & Paulhus 1987; Neto 1995).

In this study context, it is hypothesised that social norms and self-image effects may come into play, such that when respondents are interviewed by a man they indicate that they require higher amounts of compensation. Respondents, particularly females, may wish to appear less financially motivated /more altruistic when interviewed by a woman and thus indicate they are WTA less compensation. Men, when interviewed by another man, may be influenced by *ego*/ a desire to appear masculine. These gendered enumerator effects may reflect the local cultural norms.

A similar effect was found by Gneezy, Leonard and List (2009) in their study of gender differences in competition. The results from the experiment in the matrilineal society provide evidence of an enumerator effect, whereby both male and female study participants

⁶⁶ For example, previous studies have found that respondents provide more progressive and egalitarian answers to gender-sensitive questions when interviewed by women (i.e. Lueptow, Moser & Pendelton 1990), and are willing to report more details on sensitive topics to female enumerators (i.e. Hansen & Schuldt 1982).

were reported to be 18 per cent more likely to compete in the experiment when the experimenter was male. This result has parallels with this study, set in the oldest known matrilineal society.

As enumerator effects are a form of social desirability bias, it is possible that social desirability bias may be partially captured instead by the highly significant enumerator effects dummy, which may in turn, explain why the dummy for social desirability bias is not significant.

Table 8.1 Parameter Estimates of OLS Regression Models Estimating WTA

Variable	Model 1	Model 2	Model 3
Dependent variables	WTA 1 (\$)	WTA 2 (\$)	WTA 3 (\$)
Independent variables			
Household size (no.)	-229.15 (345.43)	463.239* (290.617)	276.25 (267.57)
Education (years)	116.78 (124.61)	-82.971 (116.317)	-27.21 (97.89)
Age (years)	-48.47 (52.94)	-22.158 (37.341)	-20.137 (35.14)
Gender	-360.14 (5026.83)	-254.241 (4360.093)	1144.858 (3577.91)
Main profession rubber	478.30 (1651.71)	-2937.851** (1442.602)	-3499.79*** (2656.47)
Main profession non-farm	-1016.07 (2024.)	-2333.648* (1700.978)	-2742.81* (2483.22)
Sources of income (no.)	45.42 (496.71)	-179.659 (390.817)	-295.09 (281.82)
Working age population – female (no.)	2856.40 (3110.81)	4689.206** (2284.283)	3545.05 * (600.37)
Working age population –male (no.)	-2396.84 (3085.81)	-4755.807** (2245.416)	-3847.45* (521.15)
Children under 16 years old (no.)	-460.474 (612.961)	-871.1955 * (486.777)	-836.132* (449.837)
Total land (ha)	175.12 (218.87)	-110.985 (109.185)	-57.51 (91.76)
Land in Batabo Hill (ha)	-713.47 * (312.16)	-162.797 (131.937)	-154.10 (83.44)
Plot <500 m to road	-10.25 (1059.01)	17.867 (933.176)	366.94 (805.65)
Productive trees 5>25 years old	734.57 (969.82)	533.669 (807.685)	510.007 (824.55)
Tree age (years)	-19.10 (37.84)	-16.850 (33.370)	1.296 (30.54)

Chainsaw ownership (0/1)	1438.88*** (742.15)	820.940 (667.223)	857.29* (561.81)
Household size x male (no.)	321.37 (488.45)	-132.801 (441.453)	-519.425 (349.87)
Education x male (years)	-80.32 (193.09)	74.148 (170.179)	23.663 (182.07)
Age x male (years)	84.28 (193.09)	-16.150 (56.176)	-19.51 (50.78)
Main profession rubber x male	-2750.27 (2296.26)	-210.801 (2274.8)	-67.36 (4515.98)
Main profession non-farm x male	-877.53 (2821.06)	-728.066 (2622.772)	-1044.80 (4155.45)
Sources of income x male (no.)	297.70 (705.61)	666.523 (594.662)	597.76 (503.91)
Working age population – female x male (no.)	-3042.84 (6896.11)	-2440.103 (5581.427)	-1765.81 (1500.87)
Working age population –male x male (no.)	2360.82 (6836.66)	2268.891 (5510.876)	2099.75 (1421.23)
Children under 16 years old x male (no.)	-56.447 (888.478)	239.345 (759.721)	473.624 (699.572)
Total land x male (ha)	-407.57 (313.00)	-34.581 (166.340)	-72.42 (152.33)
Land in Batabo Hill x male (ha)	473.63 (454.07)	-44.503 (199.599)	-32.46 (114.65)
Plot <500 m to road x male	-161.89 (1513.22)	2595.076* (1408.294)	1508.01 (12349.22)
Productive trees 5>25 years old x male	751.45 (1406.29)	234.439 (1240.695)	-888.05 (1115.65)
Tree age x male (years)	-9.29 (53.35)	11.744 (52.746)	-5.47 (49.87)
Chainsaw ownership x male (0/1)	-1256.44 (1028.41)	86.328 (946.727)	305.78 (816.25)
Male enumerator	864.13 (796.24)	1287.844* (686.212)	1270.97** (633.29)
Constant	3849.08 (3757.39)	7447.546** (3091.784)	6447.62 ** (3169.36)
F (29, 265)	1.17	1.44	1.36
P value	0.25	0.06	0.10
R2	0.10	0.15	0.14
Observations	329	293	295

Examining Hypothetical and Social Desirability Bias

The next two models feature dependent variables which are derived from the WTA estimates to provide measures of social desirability and hypothetical bias.

Model 4

In Model 4 the dependent variable is a measure of social desirability bias, calculated as WTA1-WTA2. Social desirability bias can manifest as self-image effects, via a tendency for respondents to answer in ways they perceive will garner approval from the enumerator

(Maguire 2009), to conform with societal norms (Lusk & Norwood 2009a) or via the utility from saying.

Comparing the magnitude of the coefficients indicates that respondents with rubber as their main profession are prone to less social desirability bias than respondents with a non-farm main profession. Further, respondents exhibited less social desirability bias (significant at the 1 per cent level) for every additional year of age their rubber trees are. Rubber trees start to decline in productivity after 25 years, producing lower yields, thus generating less income.

The interaction between age and male respondents highlights that older men are on average less prone to social desirability bias, significant at the 10 per cent level. The interaction between the male dummy and both the variable measuring proximity of the plot in Batabo Hill to the Trans-Sumatran Highway and tree age are positive and significant at the 5 per cent level and suggest that plot characteristics have a greater influence on male head of household social desirability bias.

While not significant, the dummy for gender is negative and suggests that overall men have lower levels of social desirability bias. This suggests that women are more influenced by social desirability bias in this study, and are more prone to self-image effects. This may lead women to tend to offer to accept a lower amount of money (as was found in Chapter 7 when analysing the WTA simple means) in order to conform to their own self-image, and potentially the image they perceive that society has of them (Carlsson, Daruvala & Jadell 2010) i.e. as more socially orientated, generous and concerned for the environment (Zelzny, Chua & Aldrich 2000). This is in line with Mellstrom and Johanneson (2008), who argue that because women are more concerned with self-esteem than men, that they use their behaviour in the experiment as a way to signal generosity.

Model 5

In Model 5 the dependent variable is a measure of hypothetical bias, which is calculated as WTA3-WTA2. Hypothetical bias occurs when there is a discrepancy between what people say they will pay or accept in a hypothetical survey, compared to what they will actually pay or accept in a real world situation. Hypothetical bias can occur in the form of strategic behaviour, where respondents answer in hope of skewing results and consequently any program or policy informed by the survey's findings (Kaczan & Swallow 2013), or via 'yea saying', where respondents may indicate their willingness to participate in a PES program without fully considering the associated trade-offs (Bennet & Blamey 2001).

The coefficient for household size is positive and significant at the 10 per cent level, suggesting respondents with larger households exhibit more hypothetical bias. While not significant, the dummy for gender is positive and large in magnitude, suggesting that men have greater levels of hypothetical bias. This is consistent with Brown and Taylor (2000) and Mitani and Flores (2007), both who find that men exhibit greater hypothetical bias, and conclude that women are more likely to state their true value in a hypothetical survey than men⁶⁷.

Table 7.3 Parameter Estimates of OLS Regression Models Estimating Sources of Bias

Variable	Model 4	Model 5
Dependent variables	Social desirability bias (\$)	Hypothetical bias (\$)
Independent variables	(WTA 2-WTA1)	(WTA3-WTA2)
Household size (no.)	-17.40 (276.96)	178.43* (105.61)
Education (years)	-184.05 (111.74)	29.84 (42.37)
Age (years)	4.42 (36.18)	-0.28 (12.32)
Gender	-1764.17 (4059.02)	1518.31 (1583.21)
Main profession rubber	-4139.39*** (1363.83)	-581.42 (523.48)
Main profession non-farm	-2983.62* (1363.83)	-454.86 (523.48)

⁶⁷ This may be because women are more responsive than men to experimental design and implementation (Croson & Gneezy 2004).

	(1635.37)	(617.41)
Sources of income (no.)	110.17	-128.19
	(380.12)	(141.87)
Working age population – female (no.)	1511.75	-1107.76
	(2208.58)	(829.18)
Working age population –male (no.)	-872.07	884.20
	(2176.61)	(815.07)
Children under 16 years old (no.)	-477.245	38.536
	(480.523)	(177.583)
Total land (ha)	-82.45	48.11
	(124.88)	(39.63)
Land in Batabo Hill (ha)	-73.47	8.53
	(130.89)	(47.88)
Plot <500 m to road	-77.64	226.14
	(838.17)	(338.74)
Productive trees 5>25 years old	8.19	33.53
	(755.03)	(293.19)
Tree age (years)	-92.85 ***	18.19
	(31.69)	(12.11)
Chainsaw ownership (0/1)	51.86	78.50
	(621.17)	(242.22)
Household size x male (no.)	-122.12	-212.65
	(403.16)	(160.24)
Education x male (years)	140.95	-36.60
	(158.21)	(61.78)
Age x male (years)	-91.52*	-3.65
	(51.88)	(20.40)
Main profession rubber x male	3962.79**	-395.80
	(2054.26)	(951.96)
Main profession non-farm x male	2445.98	-395.80
	(2384.23)	(951.96)
Sources of income x male (no.)	23.84	-160.19
	(553.90)	(215.96)
Working age population – female x male (no.)	1281.45	212.25
	(4022.74)	(2027.4)
Working age population –male x male (no.)	-1506.80	253.38
	(4864.56)	(2002.09)
Children under 16 years old x male (no.)	320.508	235.207
	(712.993)	(277.196)
Total land x male (ha)	119.12	-28.09
	(177.82)	(60.44)
Land in Batabo Hill x male (ha)	-.345	-2.48
	(238.26)	(60.44)
Plot <500 m to road x male	2863.18**	-766.14
	(1257.48)	(514.22)
Productive trees 5>25 years old x male	-1007.20	-1039.37
	(1122.12)	(451.04)
Tree age x male (years)	96.86**	-11.17
	(48.32)	(19.15)
Chainsaw ownership x male (0/1)	422.31	97.55
	(865.63)	(344.21)
Male enumerator	-127.31	-162.47
	(642.62)	(251.39)
Constant	5648.95**	-708.54
	(2954.23)	(1125.44)
F (29, 265)	1.36	1.24
P value	0.11	0.19

R2	0.15	0.12
Observations	251	292

8.32 Payment Preferences

Respondents who were willing to accept compensation to give up their land were asked if they would prefer to be paid monthly for five years or in a lump sum (one payment at the beginning of the five years). As outlined in Figure 8.1, when the data is aggregated across the sample (not examining intra-household preferences), both male and female heads of household have a preference for lump sum payments (57 per cent and 55 per cent respectively). Monthly payments were preferred by 43 per cent of males and 45 per cent of females. Therefore, in aggregate, across the sample, gender differences in payment preferences are minor; male heads of households have a small preference for lump sum payments and female heads of household have a small preference for monthly payments, which they may favour for the benefit of a regular income stream to pay for household expenses.

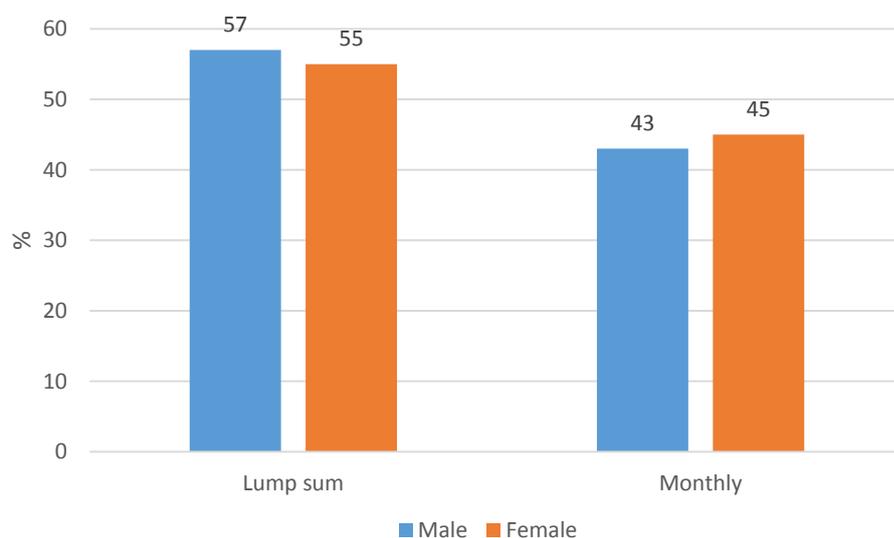


Figure 8.1: Aggregated WTA Payment Preferences: Lump Sum vs Monthly Payments, by Gender, %

However, when the male and female heads of household's preferences are examined at the intra-household level, rather than in aggregate across the sample, there is a larger difference in preferences between genders. Figure 8.2 displays the intra-household payment preferences and illustrates that only 30 per cent of male and female heads of household from within a given household have identical payment preferences (i.e. both prefer a lump sum payment).

This simple descriptive analysis of intra-household payment preferences provides evidence that household preferences are not unitary, and that it would be inappropriate to apply a common preference model which assumes either that the male and female heads of household have the same preferences and agree on all decisions or, alternatively, that one household member makes decisions for the household (Doss & Meinzen-Dick 2015). This approach incorrectly assumes that no matter which spouse is interviewed, the response would be the same.

For this reason, this study interviews the husbands and wives separately to capture any differences in WTA preferences, contributing to the emerging literature examining intra-household preferences using contingent valuation methods (Lampietti 1999; Prabhu 2010; Whittington et al. 2008).

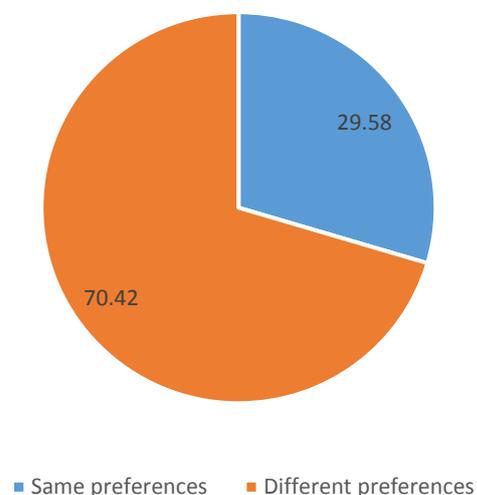


Figure 8.2: Intra-household Payment Preferences, within a given household

8.4 Summary and Conclusions

This chapter expands on the traditional contingent valuation approach taken in Chapter 6 and the gender comparisons in Chapter 7, pooling the male and female head of household data to generate a new cross sectional data set. For the analysis, five separate OLS regression models were run using identical independent variables to examine which individual factors affect the three unique WTA estimates and the sources of bias.

The results from the three WTA models suggests that there are different factors at play influencing the direct valuation (WTA1) when compared to the inferred valuation WTA values (WTA2 and WTA3).

While gender itself is not significant in any of the models, what is significant in Model 2 and Model 3 (where WTA2 and WTA3 are the dependent variables) is the gendered household labour effects, with respondents seeking up to \$4,700 more compensation for every working age female, and up to around \$4,700 less for every working age male. Interestingly, the signs on these coefficients are reversed when interacted with the male dummy (but not significant). Together, these differences suggest there may be differences in perceptions between the male and female heads of households towards household labour, and the opportunity cost of freeing up this labour.

The male dummy interaction variables employed in the WTA models 1-3 highlight minimal differences between genders which are of significance. However, a number of the male dummy interactions with plot characteristics variables are positive and significant in Model 4, highlighting the relatively stronger influence these variables have on male social desirability bias. This is consistent with findings from the Random Effects models in Chapter

7, which shows that plot characteristics had a stronger influence on male WTA, and proves the merit of the methodological approach; looking beyond the gender dummy and including gender interactions to explore gender differences (Lampietti 1999).

A notable result in this chapter is the impact of enumerator bias, (significant in Models 2 and 3) which in Model 3 is equal to approximately one third of the value of mean WTA. This suggests that enumerator bias has a more significant effect than both hypothetical and social desirability bias, both of which receive far more attention in the literature. This finding is a noteworthy contribution to the literature, and challenges the critical assumption in the inferred valuation literature that the third person approach would mitigate against social desirability bias, and prevent the respondent using the survey situation as an opportunity for self-enhancement (Fisher 1993; Lusk & Norwood 2009a). The magnitude of the enumerator bias suggests that future research take gendered enumerator effects into consideration in study design and analysis. Failure to take into account the impact of non-verbal cues – such as the gender of the enumerator – may create bias in the results.

By eliciting the WTA values of both the male and female heads of household to examine gender differences in WTA valuations, our results contribute to the small literature examining gender differences in contingent valuation and the sources of bias which affect estimates. With the exception of Carlsson, Daruvala and Jadell (2010) there are few inferred valuation studies reporting on gender differences, and none, to the best of our knowledge, which examine gender differences in household-level samples.

The analysis of intra-household payment preferences in this chapter challenges the long held assumption of uniform preferences, contributing to the emerging strand of the contingent valuation literature examining intra-household preferences. This finding suggests that, if either the male or female head of household were asked whether they would prefer a lump sum or monthly payment, on average, in up to 70 per cent of households, this payment

preference would not be representative of the household. This has important implications for program uptake, compliance and targeting.

Chapter 9: Summary, Conclusions and Policy Implications

9.1 Summary and Conclusions

Agricultural expansion is one of the leading causes of deforestation in the developing world and is especially prevalent in Riau, Sumatra, where the rapid conversion of high-conservation value forests to agriculture, typically oil palm or rubber, is leading to widespread biodiversity and habitat losses.

PES programs have had widespread application across Latin America as part of efforts to address deforestation and conservation challenges while also achieving development goals. PES programs have a successful history in Indonesia. The Indonesian government provides a legal framework for PES implementation and continues to formulate policies to strengthen PES development and implementation, especially when related to REDD+, through which Indonesia is receiving significant support from international donors.

However, in Riau, conservation experts consider that time is running out to regenerate wildlife habitats. Based on historical rates of deforestation, Riau is at risk of losing the last important forest habitats for Sumatran tigers, including the Batabo Hill Protection Forest, which is under pressure from agricultural expansion.

The GEF-funded RIMBA⁶⁸ project provides a unique opportunity to develop interventions to restore the Batabo Hill Protection Forest as a viable and sustainable wildlife corridor to link the two Tiger Priority Conservation Landscapes- the Bukit Rimbang Baling

⁶⁸ The Full title of the project is ‘Strengthening forest and ecosystem connectivity in RIMBA landscape of central Sumatra through investing in natural capital, biodiversity conservation, and land-based emission reductions (‘RIMBA project’), GEF project ID: 5285. A total of US\$9,431,763 has been allocated under indicative GEF grant financing and US\$37,777,052 under indicative co-financing. https://www.thegef.org/sites/default/files/project_documents/UNEP%2520GEF%2520RIMBA%2520PIF_05%2520April%25202013_0.pdf

Wildlife Reserve and the Bukit Tigapuluh National Park. The issue the RIMBA project seeks to address is an 11 km highway bisecting the Batabo Hill landscape. Over the past two decades, around half the original forests on five km either side of the highway have been converted to other uses, mostly smallholder rubber production and scrub.

The GEF propose building eco-infrastructure, which would involve constructing a series of bridges at key wildlife corridors to allow tigers safer pathways across the 11 km road. In all six bridges, known as ‘fly-overs,’ would facilitate the migration and dispersal of the Sumatran tiger and other animals.

In addition to constructing the eco-infrastructure, use rights to land near the six ‘fly-overs’ need to be acquired. Several hundred smallholders operate under tenuous tenure circumstances, farming rubber along the highway in Batabo Hill.⁶⁹ Therefore, securing project buy-in and land access rights from key smallholders operating in Batabo Hill is central to any wildlife connectivity effort.

For this reason, the overarching objective of this thesis is to explore the opportunity for a PES program to complement the proposed GEF eco-infrastructure option, as a way to improve wildlife connectivity in a targeted wildlife corridor in Sumatra, while not leaving smallholder households worse off. The PES program would ‘buy out’ the land from the smallholders for a period of five years, allowing time for the understory cover to regenerate, and for the wildlife to return.

The main contributions of this thesis are four-fold. First, it provides a methodological contribution to the emerging inferred valuation literature by testing the inferred valuation method in a developing-country context. Second, this research extends the empirical

⁶⁹ The farm households do not have formal legal status to the land. They do have locally recognised access rights. Large plantation companies are also known to have directly or indirectly (via renting from smallholders) cleared land in the protection forest.

evidence base via the third known study to apply the inferred valuation method to a WTA approach and the first study using an open-ended elicitation format.

Third, this research, by interviewing both the male and female heads of household is one of the few inferred valuation studies reporting on gender differences and contributes to the limited empirical evidence reporting on gender differences in sources of bias. Fourth, this research examines often overlooked enumerator effects, and provides evidence of this additional source of gender bias.

This study had five specific objectives. The first objective, addressed in Chapter 5, is to understand the extent of, and drivers of agricultural expansion in Batabo Hill, and identify the population with use rights to this land. The second objective, also addressed in Chapter 5, is to explore local perceptions of the changing environment, and the factors driving these changes.

The third objective, addressed in Chapters 6 and 7, is to investigate the willingness of households in Kuantan Mudik Sub District to accept payments to give up use-rights to their land in Batabo Hill. The fourth objective, also addressed in Chapter 6 and 7, is to examine the sources of bias affecting the willingness to accept decision, and the potential for inferred valuation methods to control for this. The fifth objective, addressed in Chapters 7 and 8, is to investigate gender differences in willingness to accept and explore the implications for study design and program targeting.

In order to achieve the study objectives, data was obtained through key informant interviews, focus group discussions and a household survey of 300 farm households across four villages in Kuantan Mudik Sub District in Riau. Villages were targeted based on a geographical cluster method and farm households were chosen via a random sample.

Thirteen experienced enumerators conducted the household survey in July 2015.

Chapter 5 drew on the qualitative analysis from the focus group discussions and key informant interviews to verify that farm households in the surrounding villages were operating land in Batabo Hill and that these households view the Protection Forest as a resource available to support their livelihood needs. Locals claim that the border to the forest is not clear, or that it has shifted, and the need for a livelihood outweighs the fear of being evicted from cleared land in Batabo Hill or receiving yet to be enforced punishments. So far, the government has ignored smallholder agricultural expansion into Batabo Hill and previous attempts by local village heads to stop forest clearing have been unsuccessful; given the overwhelming need for livelihoods in the community.

It is clear that the reliance of households on the Protection Forest for their livelihoods, and the absence of alternative sources of income have, to date, prevented the effective management of the Protection Forest. However, as also highlighted in this chapter, the clearing of land in the forest for agriculture has had devastating effects on the community, particularly with respect to water quality and availability. The locals recognise the negative impacts of agricultural expansion on ecosystem service provision, therefore a PES program which focuses on improving the provision of water services would likely achieve greater acceptance.

Chapter 6 assessed the willingness of rubber producers operating within Batabo Hill to participate in a wildlife connectivity project by eliciting willingness to accept compensation to forgo access to their land in Batabo Hill. This chapter took a traditional contingent valuation approach and only interviewed male heads of household.

Applying the inferred valuation technique to an open-ended WTA elicitation format, respondents were asked directly what they would be WTA as well as what their neighbour would be WTA a) when surveyed, and b) in real life. The results from the Random Effects modelling finds evidence of hypothetical bias in the conventional WTA values, with a

statistically significant difference between what people say they would be willing to accept when surveyed, compared to what they say would actually be willing to accept in ‘real life’. This study finds that respondents recognise hypothetical bias in others, and in doing so, the use of inferred questions provides a valid mechanism to mitigate against hypothetical bias in stated preference surveys. Further, this study provides a contribution to the contingent valuation literature, suggesting that studies valuing goods with normative motivations consider the application of inferred valuation techniques to mitigate against hypothetical bias.

The use of the ‘neighbour’ rather than the ‘average other’ may prove a useful methodological contribution to the inferred valuation literature; particularly for future PES program design applications, and where a reference point (i.e. hectares of land) is required to give meaning to the valuation. This study demonstrates the effectiveness of this adaptation in eliciting inferred valuations of rural farm households.

Chapter 7 further explored the two research questions examined in Chapter 6 and extended the analysis to include the female heads of household, allowing for direct comparison to explore if there are differences in male and female head of household’s WTA values. WTA was analysed in this chapter using Random Effects modelling as well as simple mean comparisons.

The regression results found that, on average, female heads of household are willing to accept lower payments. Further, the results highlight that different factors influence male and female head of household WTA respectively (Batabo Hill plot characteristics versus household labour and the presence of children).

Paired t-tests run to test for hypothetical bias in the simple means found evidence of hypothetical bias. This is consistent with the Random Effects model regression results for both male and female WTA, where the dummy variable for hypothetical bias was highly significant.

Interestingly, the gender dummy was not significant throughout any of the modelling, nor were gender differences in mean WTA found to be statistically significant.

Chapter 8 took a new methodological approach, pooling the male and female data to examine gender differences in WTA more explicitly, using gender interaction variables. While the gender dummy itself is not significant, gendered household labour effects are present in the WTA decision.

A notable result in this chapter is the impact of enumerator bias, which is equal to approximately one third of the value of mean WTA. This suggests that enumerator bias has a more significant effect than both hypothetical and social desirability bias, both which receive far more attention in the literature. This finding is a noteworthy contribution to the literature and challenges the critical assumption in the inferred valuation literature that the third person approach would mitigate against social desirability bias, and prevent the respondent using the survey situation as an opportunity for self-enhancement (Fisher 1993; Lusk & Norwood 2009a). The magnitude of the enumerator bias suggests that future research take gendered enumerator effects into consideration in study design and analysis, as failure to do so may create bias in the results.

Finally, Chapter 8 analyses intra-household payment preferences, highlighting that only 30 per cent of male and female heads of household have identical payment preferences (i.e. both prefer a lump sum payment). This provides evidence that household preferences are not unitary, and that it would be inappropriate to follow a traditional contingent valuation approach and adopt a common preference model for the household which assumes that male and female heads of household have the same preferences and agree on all decisions.

This result validates the approach taken in this study; by interviewing the husbands and wives separately to capture any differences in WTA preferences, this study contributes to

the small emerging literature examining intra-household preferences using contingent valuation methods.

9.2 Policy and Program Design Implications

This study provides a useful evidence base for policymakers looking to design a community forestry or PES program in the Batabo Hill Protection Forest. Batabo Hill would be an ideal candidate for a demonstration RIMBA ‘Green Economy’⁷⁰ project - a PES program could be designed to achieve the projects sustainable forest management, biodiversity and ecosystem connectivity objectives⁷¹.

Since the establishment of Law 32/2004 – the decentralisation of government in Indonesia, the management of natural resources and the environment has been transferred to the local government who have the full authority to manage their natural resources to benefit their community. For this reason, community forestry and PES schemes provide a viable alternative to the unsuccessful command and control approach to managing natural resources. For the local community, who have cleared land in Batabo Hill to support their largely agricultural livelihoods, participating in a community forestry or PES program in its broadest definition is likely to be relatively more acceptable as it involves local people who are rewarded for environmental stewardship instead of a top-down command and control approach via poorly enforced regulations and unclear borders.

⁷⁰ One of the outputs of the GEF funded RIMBA project includes ‘*Green economy approach to RIMBA institutionalised and replicated through policy reforms, investments and programmes*’. The project calls for a large-scale demonstration of the RIMBA Green Economy for forests, water, carbon and biodiversity and seeks that the viability and replicability of investing in RIMBA forests and its natural capital is demonstrated for nine districts. The Kuantan Singingi District is identified as a location to meet the objectives to a) restore 13,790 hectares of restored forest in zones critical to biodiversity and ecosystem connectivity and b) apply sustainable forest management practices or protect 89,530 hectares of forest ecosystem that is critical to biodiversity and ecosystem connectivity.

⁷¹ Under the RIMBA GEF project \$1,332,387 is allocated to sustainable forestry management and the \$3,310,775 is allocated for biodiversity conservation.

The findings from this study have a number of policy implications worthy of further discussion.

9.2.1 Estimating the Cost of Conservation

Typically, PES programs base compensation payments on the opportunity cost – loss in income; which this study has estimated. Comparison of mean WTA values against local land values and the opportunity cost of not producing rubber found that respondents WTA valuations are in line with their opportunity costs. However, as was found in this study, WTA may exceed opportunity costs; the premium placed on the land in Batabo Hill could also be capturing attachment to place and customary values to the land⁷².

This is where contingent valuation methods are valuable in measuring the non-market value to households of giving up access to their land, helping to inform a level of compensation which leaves the household no worse off. This is important for policymakers, as payments purely based on opportunity costs can be too low, and this can threaten participation rates (Falconer 2000; Wossink & Wenum 2003). The WTA and opportunity cost analyses provide useful insights not only for this study site but also for other projects involving trade-offs between agroecosystems and wildlife habitat.

9.2.2 Program Design and Targeting

How much land in Batabo Hill is needed to support the eco-infrastructure proposal's wildlife connectivity objectives? Under the eco-infrastructure proposal, land needs to be acquired from smallholders to construct the bridges, but additional land on either side of the bridges to encourage the animals to use the underpass is also required. The cost of securing land leading to, and surrounding, the eco-infrastructure is not included in the \$6 million construction budget.

The corridor concept means only specific areas need to be acquired for a successful

⁷² WTA can also be lower than opportunity costs, particularly when respondents have altruistic motives for joining conservation programs (i.e. van Noordwijk et al., 2012)

outcome. With advice from tiger and conservation experts on the most important blocks of land near the eco-bridges, a PES program could target a subset of priority households where the wildlife connectivity payoffs are greatest, piloting the program and establishing the necessary institutional arrangements. One issue to consider is whether farmers who have given up their land as part of the program will simply clear new land elsewhere. However, displacing the agricultural expansion to areas outside of the targeted wildlife corridor will not negate the benefits of the PES program (Wunder, Engel & Pagiola 2008).

The finding that, on average, female heads of household are willing to accept lower amounts of compensation has important implications for policymakers and for researchers. For policymakers, by taking into consideration the value placed on the land by both the male and female head of household, it is possible to more accurately estimate the cost of acquiring the land in Batabo Hill (assuming both heads of household are involved in the decision in real life), as well as potentially increase the amount of land enrolled and hence the cost effectiveness of the program.

Taking a traditional approach and only involving male decision makers could disempower female decision makers and foster gender inequality. This study makes an important contribution by including women's voices in land use decision making, seeking to end this exclusion by ensuring that women are equally represented from the early stages in informing policy and program design.

Interestingly, the results of the separate gender models highlight that different factors influence male and female head of household WTA, for example, male WTA is more influenced by Batabo Hill plot characteristics, whereas female WTA is instead influenced by household labour allocation considerations, specifically the opportunity cost of the lost income by working age females. Drilling down further into household labour effects, gender differences appear to be present as heads of household require significantly more

compensation for each working age female and significantly less compensation for each working age male.

These gender differences may reflect the limited alternative employment opportunities for women in Kuantan Mudik Sub District, such that the opportunity cost of their displaced labour is greater, and this source of income is not easily replaced. Working age males have more alternative employment opportunities, including working as a relatively highly paid oil palm labourer, non-farm labourer or as a skilled experienced handyman. For working age females, the alternative livelihoods are more limited, such as running their own business i.e. kiosk, or unpaid domestic work, which may not generate as stable income as daily rubber tapping.

In many households in Kuantan Mudik Sub District both male and female heads of household are involved in the various elements of rubber production, and as such would be impacted by forgoing income from up to half their household land as part of a PES program. Therefore, in designing a PES program, it will be important for policymakers to take into consideration that households will need to source alternative livelihoods to allocate their labour, particularly female household labour, and in the absence of alternative non-farm employment opportunities, policymakers should explore concurrent investment in non-farm livelihoods if they wish to: a) limit the potential for additional agricultural expansion, and b) limit the potential for working age females to be unemployed.

Policymakers designing PES programs in developing country contexts typically consider who they are targeting within the household, and how this may impact who has control over resources and expected welfare outcomes (Haddad, Hoddinott & Alderman 1997). Whether the program targets an individual decision maker or joint decision makers can influence the respective bargaining powers of men and women (Agarwal 1997), which in turn can lead to different welfare outcomes for the household (Duflo &Udry 2004;

Fafchamps & Quisumbing 1999), and influence program compliance (Argawal 1992). With the potential for the opportunity cost of the forgone rubber income to be greater for the female heads of household, and for this to have negative flow-on effects for their bargaining power within this household, policymakers may wish to consider targeting the female heads of household for the program payments, in effect replacing the lost income from rubber with an alternative, reliable income stream, which will improve their respective bargaining power within the households.

A growing body of empirical evidence finds that resources in the hands of women will have a greater positive impact on outcomes for children than similar amounts of resources controlled by men (Allendorf 2007; Imai et al. 2014; Quisumbing 1996). Policymakers are often interested in targeting outcomes that benefit children, particularly health and education outcomes. For this reason, there has been a clear shift towards improving the decision making role of women to enhance household welfare (Kabeer 1999), with a number of policymakers deliberately targeting development initiatives and welfare programs towards women to promote their role as the primary decision maker (De Brauw et al. 2014). Recent empirical evidence from an impact evaluation of a cash transfer program in Northern Nigeria by the World Bank Gender Innovation Lab finds that women receiving unconditional cash transfers worked more, particularly for their own businesses, spent more on consumption, saved more and were more food secure (Bastian, Goldstein & Papineni 2017). In addition, women used the cash transfers to increase investment in their own businesses, spending more on businesses inputs and increasing profits.

Gender considerations are particularly pertinent in Indonesia, where there is a concern (i.e. from CIFOR, FAO, UNDP and REDD+) that the growing number of PES forestry programs include, and benefit women. Recent reports from Kalimantan and Aceh indicate

that women are excluded from REDD+ program activities (Dewi & Widiyanto 2013; Seyyowati 2014).

To remedy systemic discrimination related to decision-making at the household, community and state levels, the UNDP recommend that gender be fully integrated into PES benefit-sharing schemes (UNDP 2011). This would ensure that women and their families receive the financial benefits from program participation. As an added benefit, there is strong evidence that shows conservation outcomes are improved in forestry projects by providing women with more powers in decision-making (World Bank 2012). Therefore, the inclusion of women is a win-win.

For the reasons outlined, and in recognition of the traditional matrilineal inheritance system, which historically gave daughters the rights to use the land and receive all income generated, policymakers should at the minimum involve the female head of household in all land use decision making, considering both their, and the male head of household individual preferences.

In addition to gender considerations, findings from the focus group discussions suggest that, to enhance program uptake and acceptance, policymakers could highlight that giving up this land for agriculture will help to protect and enhance water services – the number one concern raised by participants. Further, policymakers may wish to consider quarterly cash payments to help households pay school fees. Recent experience from Nigeria suggests that monthly cash payments cost twice as much to deliver as quarterly payments; noting that since larger quarterly cash transfers are just as effective as monthly transfers, program managers could significantly lower the cost of delivering cash transfer by designing a quarterly payment system (Bastian, Goldstein & Papineni 2017).

9.2.3 Addressing the Drivers of Agricultural Expansion

This study sheds light on the drivers of agricultural expansion in Kuantan Mudik Sub District, which can assist policymakers, extension and agricultural development specialists to

develop targeted interventions to put a halt to agricultural expansion. Findings from the focus group discussions and key informant interviews highlighted that unless the underlying drivers of agricultural expansion are addressed, such as clear borders which are agreed upon, credible enforcement mechanisms, effective governance arrangements, and alternative non-farm livelihoods, there is a risk that the cycle of agricultural expansion will simply continue.

The relationship between the environment and the rural poor is so intertwined that any intervention looking to reduce the rate of environmental degradation must take into account the people deriving their livelihoods from natural resource assets. Environmental conservation and poverty alleviation goals can only be compatible if there are alternative livelihood options. This is particularly important in Kuantan Mudik Sub District; with limited access to markets and non-farm employment, if the local environment continues to be degraded, agricultural land will (further) lower in productivity, and households will become vulnerable to the poverty-environment trap.

Increasing non-farm employment is thus one approach which can be a win-win solution for rural development; by drawing household labour away from the farm and reducing pressures on the land, while increasing household income; the availability of non-farm employment can decrease rates of agricultural expansion (Theyson 2009). Evidence from Mexico (De Janvry & Sadoulet 2001) suggests that education is a key factor in determining participation in higher paying non-farm activities, therefore not only could policymakers look at increasing the availability of non-farm employment, but also simultaneously improving access to quality education, so that future generations have the skills required to work in relatively higher paying non-farm occupations.

Improving the acceptance and enforcement of the Protection Forest status of Batabo Hill requires the establishment of management practices and forest borders that are accepted by the local community. An important initiative which policymakers could draw on to do this

is the ‘One Map, One Riau’ project, piloted by the World Research Institute (WRI) Indonesia, in recognition of the inadequacy of the current mapping. This project supports the Indonesian government’s ‘One Map Policy’ (Presidential Regulation No. 9, 2016), which aims to reduce conflict by compiling competing land claims on a single map and convening multi-stakeholder meetings to find solutions. Policymakers and program specialists can utilise the early mapping to support the design of a PES or community forestry program and to start the significant and highly complex work surrounding land tenure, using this to feed into developing a credible platform for sustainable land and forest management in Riau.

Property rights play a crucial role in the success of any PES scheme. As Demsetz (1967) argues, property rights should not be interpreted narrowly using a strict legal notion of “right” but instead be interpreted as the ability for the holder to make choices about how to utilise their asset. In the context of the PES mechanism, property rights should help to clearly define who holds the respective right over ecosystem services.

In this study context, where land tenure is unclear, a broader concept of ‘rewards’ (RES) rather than ‘payments’ for ecosystem services may be more appropriate. The term ‘RES’ offers broader forms of recognition to ecosystem services providers, including in-kind rewards such as access to land and the recognition of identity and rights (van Noordwijk et al., 2004). In this context, a community forestry scheme ‘Hutan Desa’ (village forest) may be more appropriate.

This was the experience from Lampung Province, Sumatra where an innovative work-around was applied using the Forestry Ministerial Decree 31/2001 which recognises *Hutan Kemasyarakatan* (HKM) or community-based forestry management and grants a five-year tenure of land as long as the community forms a farmer group (Pasha & Leimona 2011; Pasha et al. 2012). Using this mechanism, the PES scheme in Lampung is able to provide secure temporary property rights to groups of farmers under the PES scheme for at least five

years, with the potential to extend to up to 25 years (Fauzi & Anna 2013). This provides a good example of how a PES scheme could work in Batabo Hill, in the absence of formal property rights.

New technology can also help. One example includes work by Peruvian economist De Soto to pilot the use of a *global property registry system* using decentralised blockchain technology to allow for property rights and claims by individuals to be publicly recorded and globally verified (Nelson 2018). Under this system, using the decentralised ledger technology, rural households in Riau could record their formal and informal property rights in a permanent, transparent and verifiable manner. Acknowledging these claims may increase community support for a PES program, and provide the necessary security that participation in the program will not threaten claims to this land and that this land will not be acquired by a company or the government in the meantime.

A further benefit of the blockchain platform is that it could help identify not only where land ownership lies, but also where there are competing claims, highlighting where informal or customary claims to land may differ to the legally designated land use. This could help authorities, policymakers and interested NGOs such as GEF, WWF and REDD+ partners to understand the extent of the informal and competing land claims outside of the legal system, which in turn can provide the evidence to inform the design of targeted policy and programs.

Recognisable property rights support sustainable development, allowing smallholders to borrow, invest, and help themselves, so that when any potential PES program cash payments end, program participants remain better off. As highlighted in Chapter 4, 77 per cent of households surveyed have no record of land ownership (this includes land in the village), only 29 per cent of households have a bank account, and only 15 per cent of households have received a loan from the bank. Focus group discussions highlighted how this

impacts livelihoods; participants described how the credit constraint prevents investment in establishing a farmers group, starting a business or investing in their existing land. This in turn fuels agricultural expansion as households acquire additional fertile land to support their livelihoods. Therefore, the provision of recognisable property rights is expected to provide alternative ways for households to generate livelihoods.

Finally, to further combat agricultural expansion, policymakers may wish to consider a complementary agricultural intensification program which could help smallholders to increase yields from their existing land, rather than simply clearing additional land elsewhere.

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Appendices

Appendix 1 Cheap Talk Script from Household Survey

Pak/Ibu, as I mentioned at the beginning of this interview, the University of Adelaide and WWF are doing this study for the provincial governments in Sumatra

An important objective of this study is to understand how the forest benefits local communities. For example, forests provide soil erosion benefits, water conservation benefits, wildlife habitat and for some people an important source of wood for buildings, plants for food or things like honey to sell for income.

Of course, clearing forest land to plant crops also provides income and jobs for local households from their rubber and oil palm production. But this means the more forest land is cleared for agriculture, the less and less forest land is available to provide watershed benefits, soil erosion benefits and wildlife benefits.

So for this study, what we would like to know from you is how much your plot in Batabo Hill is worth to you as agriculture. We want to ask you how much money you would want to 'give up' your land in Batabo Hill for five years. During the five year period, your plot in Batabo Hill would be left completely alone. After five years, your plot in Batabo Hill is returned back to you.

The scientists tell us that leaving Batabo Hill alone for five years is a good amount of time for restoring important forest benefits to animals and for erosion protection.

This study wants to know how much you need to be paid to give up the income you make from your land in Batabo Hill for the five years. You can be paid one full payment at the beginning of the five years or you can be paid every month for five years.