Quantifying land use change and identifying predictors of forest clearance in Seima Protection Forest, Cambodia

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A Thesis submitted in partial fulfilment of the requirements for the degree of Masters of Science and the Diploma of Imperial College London
DECLARATION OF OWN WORK

I declare that this thesis:

Quantifying land use change and identifying predictors of forest clearance in Seima Protection Forest, Cambodia

is entirely my own work and that where material could be construed as the work of others, it is fully cited and referenced, and/or with appropriate acknowledgement given.

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<th>Full Form</th>
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<tr>
<td>WCS</td>
<td>Wildlife Conservation Society</td>
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<tr>
<td>SPF</td>
<td>Seima Protection Forest</td>
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<tr>
<td>FA</td>
<td>Forestry Administration</td>
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<tr>
<td>NFTP</td>
<td>Non-Forest Timber Products</td>
</tr>
<tr>
<td>PLUP</td>
<td>Participatory Land Use Planning</td>
</tr>
<tr>
<td>REDD</td>
<td>Reducing Emissions from Deforestation and Degradation</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Governmental Organisation</td>
</tr>
<tr>
<td>CBNRM</td>
<td>Community-Based Natural Resource Management</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>ICL</td>
<td>Imperial College London</td>
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<tr>
<td>UTM</td>
<td>Universal Transverse Mercator</td>
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<tr>
<td>GIS</td>
<td>Geographic Information System</td>
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<td>ANOVA</td>
<td>Analysis of Variance</td>
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Abstract

The effect of institutional controls and community-based natural resource management in controlling resource use is well studied. Opinions on their effectiveness in enabling sustainable resource use are generally mixed. This project focused on two villages that have undergone a participatory land use planning process to demarcate traditional resources and decentralise resource decision making power to the village level. This study utilises a spatial dataset of household plots collected during the original village mapping exercise and from a recent survey of household land use to demonstrate that household land use on average has doubled since the original survey. In addition, household socio-economic and demographic data helped to identify that established households, indigenous households, available labour, households wealth and livelihood diversity are all strongly correlated with total area of land claimed. Comparisons of land use between surveys also elicited interesting conclusions regarding the extent to which households complied with the agricultural zones and protected area boundaries established as a result of the PLUP process. The results conflict with the current understanding of land use dynamics in the region. Most notably is the result that both indigenous and non-indigenous claim similar areas of land outside the agreed boundaries. Furthermore, established households claim nearly double the amount of land as newly arrived in-migrant households and also have the same amount of land outside the boundaries. The original understanding of resource dynamics in the region has been disproven and conservation strategy now needs to refocus its aim and re-evaluate the effectiveness of PLUP in promoting sustainable resource use.

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1.0 Introduction

In eastern Cambodia, The Wildlife Conservation Society (WCS) is working in Seima Protection Forest (SPF), in close collaboration with the Forestry Administration (FA), with the objective of protecting a globally important community of endangered species, the forest landscape they inhabit and the livelihoods of the indigenous ethnic groups that live there. Historically the region’s Bunong communities have existed at relatively low densities and have depended on the forest economically, culturally and spiritually for many generations (Evans et al. 2003). The lifestyles and livelihoods of these communities had remained relatively unchanged for over 2000 years, with shifting (or swidden) agriculture the dominating practice. Subsistence rice farming and liquid resin-tapping of dipterocarp trees were the primary livelihood activities, supported by the collection of other non-forest timber products (NFTP’S) and the raising of livestock. These livelihoods had few, if any, significant environmental impacts and resulted in communities having a vested interest in preventing degradation and deforestation (Pollard and Evans. 2008).

1.1 Problem Statement

Over the last decade there has been a significant and growing threat of immigration and accelerated forest clearance, which has begun to have negative impacts on both the forest dependent communities and biodiversity. In neighbouring Snoul Wildlife Sanctuary between 2005 and 2007 2.55% of forest cover was lost per year, equating to more than twice the national deforestation average for Cambodia. The high rate of forest clearance in Snoul is attributed to the granting of economic land concessions and large scale land grabbing by immigrants from neighbouring provinces speculating for land to plant cash crops (Evans et al. 2009). These threats are particularly concerning as currently indigenous communities in SPF lack the tenure rights needed to resist both concessions and immigration and the resulting land grabs. SPF faces increasing levels of threats locally (due to rising in-migration) and increasing pressures nationally. Population rises, increasing wealth and rapidly rising prices of timber and crops are all thought to have encouraged greater pressure on forest land. It is clear that the threats to land use patterns in SPF and the livelihoods of Bunong communities are numerous and intensifying in line with Cambodia’s continual economic development.

In SPF, ethnic Khmer and Cham have begun to migrate from other provinces to marginal areas of the forest resulting in shifts in land use and changes in traditional livelihood patterns (Evans et al. 2003).
There have also been changes in livelihood strategies amongst the indigenous Bunong as some traditional livelihoods, such as resin tapping, have little potential for expansion to cater for growing populations. Resin tapping in particular is directly threatened by forest clearance and illegal logging, due to the high value placed on dipterocarp timber. Consequently, it is believed that communities are gradually adopting commercial cash cropping as their primary livelihood in order to satisfy increasing populations and to compensate for the loss of resin trees. It is also thought that the transition from swidden agriculture to cash crop agriculture is being further accelerated by the emergence of regional markets and the improvement of infrastructure.

Fortunately, for the time being, immigration to the interior of SPF is still relatively low, but it is a growing threat. The overall population growth rate in SPF averaged 5.8% per year over 2003-2008 (Evans et al. 2009). This growth is far higher than is predicted to be achieved through natural growth and indicates substantial in-migration. Although overall rates of land use change in the immediate landscape were reported to be insignificant in 2004 (Evans et al. 2009), rates of change were judged to be accelerating in areas of the landscape where excellent access combines with good soils and ineffective law enforcement. Much of the forest clearance is concentrated close to the villages of O Rona and O Am and is attributed to in-migration and land speculation (Evans et al. 2009). In both locations the presence of major roads has increased the risk of forest clearance by increasing access to markets and services and thus making the areas more attractive to live and more profitable to plant commercial crops. Since 2005, cash crops have become an increasingly important part of household livelihoods and it is believed that this transition is contributing significantly to the increase in forest clearance.

1.2 Participatory Land Use Planning

As part of the conservation efforts undertaken by WCS and the FA, a programme of participatory land use planning (PLUP), has been conducted in several of the villages within SPF. This voluntary process facilitates in developing land use plans, demarcating traditional land, clarifying management responsibilities, supporting the recognition of traditional forest use rights and attaining indigenous communal land titles for indigenous villages. As such, WCS plan to use this process as one of the key interventions as part of the reduced emissions from deforestation and forest degradation (REDD) project currently being developed for SPF. It is expected that the development of community based natural resource management will enable communities to sustainably manage their resources whilst allowing for future growth, prevent in-migration and extensive forest clearance and reduce the risk
that the community will fall victim to illegal land grabs in the future. The underlying rationale behind the project is that by designating land available for agricultural use and supporting the communal management of that land, compliance with FA regulations will be improved.

O Rona and Andoung Krarloeng are two villages that have undergone the PLUP process and as a result the two villages were mapped in 2006 and 2004 respectively, representing a key step towards formal recognition of the community’s customary rights to use land and natural resources. The formation and capacity building of village committees, as part of the PLUP process, decentralises authority and transfers responsibility to the local level. The elected village committee provides the community with social cohesion and organisation, in Andoung Krarloeng the committee have successfully repelled many attempts by outsiders to grab land and exploit village resources. O Rona has completed the PLUP process but is yet to be granted a legal land title, while Andoung Krarloeng has recently become the first indigenous village in SPF (and second nationally) to be granted a legal communal land title and to have agreed on a land use plan as part of the PLUP process. The land use plan divides community forests into zones for current and future agriculture and each household is permitted to utilise 5 ha of land within these designated communal agricultural zones.

The past mapping of household agricultural plots, as part of the PLUP process, offers an important opportunity to quantify the changing land use practices in SPF. Current understanding of land use dynamics in the area has been based largely upon observation of the change in forest cover and informal household interviews as part of on-going community consultations. The availability of past land use maps provides the opportunity to directly test some of the underlying assumptions in how land use is changing in SPF, and what is contributing most to that change. This will be of importance in assessing the relative threats in villages yet to make the transition away from traditional land use and livelihood strategies and will help WCS prioritise interventions through the identification of vulnerable communities.

Comparison of land use patterns should also elicit interesting conclusions regarding the effectiveness of PLUP to enable communities to manage agricultural expansion in a sustainable manner and in the face of a transition from subsistence to commercial cultivation. The analysis will also provide insights into the extent to which people have complied with the agricultural zones and protected area boundaries negotiated as a result of the PLUP process. In addition the analysis will provide an insight into the effectiveness of securing indigenous property rights for local people. This has broad implications for conservation practice as the securing of property rights is a commonly
used approach and is often based on the assumption that improved land tenure reduces the impact of local communities on natural resources (Naughton-Treves and Day. 2012). Here we have an opportunity to comment on this fundamental assumption.

1.3 Aims and Objectives

The overarching aim of the project was to support the understanding of resource use dynamics in this threatened landscape and to investigate the change in household land use for two villages in SPF. The project had the following objectives:

1. Quantify change in household land use for selected households.
2. Identify the importance of different household level socio-economic and demographic characteristics as predictors of forest clearance in SPF.
3. Estimate the effectiveness of PLUP to facilitate sustainable land use patterns in the face of agrarian change.
4. Assess the extent to which households have complied with the agreements surrounding land use developed as part of the PLUP process.

1.4 Hypotheses

The following null hypotheses are grouped in relation to their corresponding research objectives:

1.4.1 Quantifying Land Use Change

H1 The average area of land claimed per household will have increased during the intervening years since the last survey was completed.
N1 There will be no change in the average area of land claimed per household.

H2 The proportion of plots dedicated primarily to cash crops will have increased since the last survey was completed.
N2 There will be no change in the proportion of plots dedicated to cash crops since the last survey.
An increase in the proportion of land used for cash crops will have coincided with a decrease in the proportion of land dedicated for subsistence crops.

An increase in the proportion of land used for cash crops will have no effect on the proportion of land dedicated to subsistence crops.

The amount of land being bought and sold will have decreased due to the regulations in place from the land use plan.

The regulations implemented by the land use plan will have no effect on the amount of land being bought and sold will still be the same.

1.4.2 Household Indicators

The larger a household, the greater area of land it claims due to the increase in consumption requirements.

The size of a household will have no effect on the area of land that is claimed.

The more labour available to a household, the greater area of land it claims due to the increase in production capacity.

The amount of available labour a household has will have no effect on the amount of land that is claimed.

Households that collect a large amount of liquid resin have lower land requirements, and claim a lesser area of land.

The amount of resin collect by a household will have no bearing on the amount of land claimed.

As household wealth increases the more land the household will be able to cultivate as a result of having more resources to pay for labour, and therefore the area of land claimed per household increases with increasing wealth.

Household wealth will have no effect on the area of land claimed.

As household livelihood diversity is associated with increased wealth, the area of land claimed increases with increasing livelihood diversity.

A household’s livelihood diversity will have no effect on the area of land claimed.
H10  In-migrants claim a greater area of land on average than established households.
N10  There is no difference in the area of land claimed by in-migrants and established households.

H11  In-migrants claim a greater area of illegal land as they would not have participated in the land use plan.
N11  There is no difference in the area of illegal land claimed by in-migrants and established households.

H12  Non-indigenous households claim a greater area of land than indigenous households.
N12  There is no difference in the area of land claimed by non-indigenous and indigenous households.

H13  Non-indigenous households claim a greater area of illegal land than indigenous households.
N13  There is no difference in the area of illegal land claimed by non-indigenous and indigenous households.

1.4.3 Institutional Controls and Compliance

H14  Households that have participated in the PLUP process claim a lesser area of land than non-participants as they have land for future use secured.
N14  There is no difference in the area of land claimed between PLUP participants and non-participants.

H15  Households that have participated in the PLUP process claim a lesser area of illegal land than non-participants as they will comply with the regulations.
N15  There is no difference in the area of illegal land claimed between PLUP participants and non-participants.

H16  Households with PLUP committee members will claim lesser area of illegal land as they will fully understand the regulations implemented as part of the PLUP process.
N16  There is no difference in the area of illegal land claimed between households with PLUP committee members and non-committee mem
2.0 Background

This section will explore a select set of deterministic factors that are considered most applicable to land use change in SPF. Previous attempts at quantifying land use change will be reviewed and strategies used to contain land use change and forest clearance, with a special focus on land use planning and zoning schemes, will be scrutinised.

Understanding the dynamics of land use change and tropical deforestation has increasingly been recognised as one of the key research imperatives in global environmental change research ([Geist, H. J. 2002]). Although, land use practices vary greatly throughout the world; their ultimate outcome is generally the same: the acquisition of natural resources for human need at the expense of degrading environmental conditions ([Foley, J. A. 2005]). Land use change is expected to have the largest global impact on biodiversity by the year 2100 ([Sala, O. E. 2000]). Changes in land use not only threaten biodiversity but result in an array of environmental impacts ranging from the alteration of the global carbon cycle, resulting in local, regional and global climate change ([Lambin, E. F. 2001]), to undermining the ability of biological systems to provide ecosystem services ([Vitousek, P. M. 1997]). Furthermore, land use change and the associated forest clearance threaten forest dependent communities and their traditional livelihoods ([Tacconi, L. 2007]).

2.1 Drivers of Land Use Change

In the literature two opposing pathways have emerged in an attempt to explain land use change. Single factor causation, includes commonly cited drivers such as shifting cultivation ([Allen, J. C. 1985]) and population growth ([Ehrhardt Martinez, K. 1998]) as principal causes of land use change. However, this conservative understanding of land use change dynamics is dominated by simplifications ([Lambin, E. F. 2001]). This becomes problematic when such research underlies environment-development policies. Alternatively, most contemporary research acknowledges that land use dynamics are irreducibly complex, involving a multitude of possible causes revealing no distinct pattern ([Angelsen, A. 1999]) ([Lambin, E. F. 2001]). Attempts to identify globally dominant drivers of forest clearance and land use change have failed to do so with conviction and clarity ([Foley, J. A. 2005]). Many attempts at identifying drivers of land use change are based on secondary data ([Ehrhardt Martinez, K. 1998]) and theoretical accounts and are thus of questionable reliability ([Lambin, Eric F. 2003]). However, small scale studies that focus on household-specific ([Walker, R. 2002]), village-level and socio-economic variables and gain an in-
depth understanding of local policies, are perhaps better placed to explain the trends in land use change and to identify the most important deterministic variables relevant for policy analysis.

Many studies of land use change have taken advantage of spatial mapping software and satellite imagery to observe changes in land use over time. A combination of longitudinal satellite maps of deforestation and data on the changes in crop prices was used to understand land use dynamics in Mato Grosso, Brazil. The authors identified that forest clearance was being driven due to favourable markets for agricultural exports such as soybean and beef production (Kirby, Kathryn R. 2006). The study demonstrates that agricultural expansion is one of the most important drivers of land use change and is strongly linked to government policies and the development of roads which improve access to markets. As global markets expand and isolated regions open up to development, the remoteness of forest frontiers will continue to reduce without intervention (Pfaff, Alexander S.P. 1999). The study also presents an example of how satellite imagery can be used to monitor longitudinal changes in land use.

A regional study into land use dynamics, centred on South East Asia, combined spatial information, satellite images and formal household interviews to suggest that changing land uses were driven by widespread transitions from swidden to monocultural cash crops (Fox, J. 2005). This highlights a widespread pattern in South East Asia. A combination of government policies to both control swidden practices and increase agricultural productivity with increasing market demand creating pressures to convert subsistence crops to commercial crops are driving large scale transitions I land use practices. The study outlines the importance of collecting socio-economic data to demonstrate the proximate causes of forest clearance. It was shown that in-migration into many frontier forest areas was driven by the attraction for land to cultivate cash crops and improvements in infrastructure. These findings are also comparable to the findings of a meta-analysis of 55 Asian case studies, where land use change was also attributed to the same factors (Geist, H. J. 2002).

In summary a broadly applicable pattern has been observed across tropical regions, with the development of infrastructure and market pressures, the cultivation of subsistence crops has begun to decline and is swiftly being replaced with permanent cash crop cultivation for commercial scale. Studies utilising both social science methodologies, such as collecting household level socio-economic surveys, and satellite imagery over time are best placed to determine the factors driving land use change.
2.2 Community-Based Natural Resource Management

There is a strong argument in the literature for protected areas to adopt a more inclusionary approach towards local communities ([64 DeFries,R. 2007; 63 Ellis,E A. 2008]), due to the failures of exclusionary conservation. This argument reasons that protected areas are more effective when local communities participate in decision making specifically regarding resource management ([63 Ellis,E A. 2008]). Governments with the support of Non-Governmental Organisations (NGO’s) have sought to combat the rapid loss of forest cover in the tropics primarily through land and forest allocation as a means of supporting sustainable community resource management ([62 Fujita,Y. 2008]). The assumption goes that by defining clear resource boundaries and constructing local resource management institutions based on local participation and customary practices, communities will be empowered to take collective decisions and sustainably manage their resources into perpetuity.

There are obvious ethical considerations why communities should be involved in forestry management plans, especially when their traditional lands are concerned. It is an appealing prospect to governments, NGO’s and local people that decision making of local forestry resources is decentralised. Community management is based on the assumption that communities and community based institutions are closely connected to their resources and are most likely to foster sustainable resource use and possess the knowledge required to do so ([67 Armitage,D. 2005]). Participatory land use planning aims to establish village boundaries incorporating traditional lands with the aim to improve the tenure of their land and therefore their security. This process is suspected to have many ecological and social benefits ([65 Sunderlin,W D. 2006]). Compliance with boundaries will allow for sustainable growth of communities and villages will be less likely to allow in-migrants as they will threaten the village’s finite communal land. Communities are also more likely to work with NGO’s if they have facilitated them in acquiring legal protection for their land.

In theory community based natural resource management (CBNRM) appears to be an effective tool and has received much excitement resulting in the literature being swollen with case studies. However, CBNRM has not matched the excitement surrounding it and has faced various problems. One such problem is that of externalities, self-interested individuals making decisions in isolation rather than the common good leading to overexploitation of natural resources for private gain ([70 Hardin,Garrett 1968]). Supporters of CBNRM tend to naively assume that communities encompass
homogenous groups of people with common goals and effective, evolutionary stable mechanisms to achieve them ([71 Agrawal, A. 1999]). However in reality communities have many internal social divisions, either by gender, leadership rivalries and generation ([68 Barrett, C B. 2001]).

Successful CBNRM projects are likely to possess the following key attributes: (1) the authority, ability and willingness to restrict access and use; (2) the ability to offer incentives to use resources sustainably; (3) the technical capacity to monitor ecological and social conditions; and (4) managerial flexibility to adapt incentives and regulations to changes in conditions of the resources ([72 Ostrom, E. 1999]). Conservation organisations facilitating CBNRM schemes often fall short in meeting all these conditions. CBNRM schemes such as the PLUP project managed by WCS and FA in Cambodia attempts to avoid these shortfalls by adopting a participatory approach that includes all stakeholders. Monitoring both changes in resources uses and the local institution is essential ([68 Barrett, C B. 2001]). Land use plans need to be adaptive as resource use dynamics change, due to crop transitions for example. Local institutions need to be carefully monitored as corruption within committees can develop leading to inequality in resource use among village residents. When corrupt practices have established within an institution it can prove very difficult to reform ([71 Agrawal, A. 1999]). As CBNRM schemes often use positive incentives to encourage sustainable resource use, there is also a need for repercussions for non-compliant individuals. If the perception of enforcement is low then this will provide incentives to break the regulations.

2.3 National Context

Cambodia is now heavily integrated into regional and global trade and has one of the highest economic and population growth rates in the region (Chann et al. 2012). Cambodia was considered to have some of the most intact primary forests remaining in South East Asia (59.8% in 2006, 10.7 million ha), however, a high rate of land use change and consequent forest clearance has reduced the area of forest at a rate of 0.75% a year (75,000 hectares/year; FAO-UN. 2005). A combination of major economic reforms, international investment and demand for commercial crops has caused land use practices to change dramatically in the region ([26 Fox, J. 2005]). Numerous agro-economic concessions have become established and consequently rubber, cashew and cassava have begun to dominate the landscape. In accordance with the increase in agro-economic concessions, Cambodia has seen large scale development of infrastructure to assist in the transportation of goods to markets. This has fuelled a shift from subsistence agrarian modes of production to market-based agricultural production and industrialisation ([26 Fox, J. 2005]).
Historically, rotational swidden cultivation was the primary land use practice used by communities in relatively isolated parts of South East Asia ([2 Mertz,O. 2009]), and was shown to be a rational economic and environmental choice for isolated smallholders ([25 Mertz,O. 2002]). Rural communities in this region generally follow traditional shifting cultivation model, which is considered not to be environmentally damaging given low population densities ([3 Padoch,C. 2007]). The relative isolation of some rural communities has been disrupted by infrastructural development and as such traditional communities are now able to engage in the market economy. Communities are thus beginning to step out of subsistence lifestyles and adopting non-subsistence activities such as working for wages and growing cash crops ([36 Rerkasem,Kanok 2009]).

2.4 Study Site

2.4.1 Seima Protection Forest

The SPF covers 292,690 hectares and is located in eastern Cambodia close to the border of Vietnam. The region was identified as a conservation priority in the National Biodiversity Strategy and Action Plan (MoE, 2002). The site was previously known as the Seima Biodiversity Conservation Area, but recently it was elevated to Protection Forest status. The SPF contains a mosaic of extensive evergreen, semi-evergreen and deciduous forests which makes for a highly productive landscape harbouring numerous species many of which are globally threatened and of global importance for conservation.

The site is divided by WCS and FA into two management zones. The core area is inhabited by indigenous Bunong communities and is therefore of considerable socio-cultural importance. These communities typically live in small, remote villages with high poverty and low levels of education. In addition to shifting agriculture they are dependent on many traditional livelihoods such as the collection and trade of NTFP’s, notably wildlife and liquid resin (Evans et al. 2003). Liquid resin is considered economically crucial and largely sustainable (Evans et al. 2003) and previously represented one of the few stable sources of cash income. As rice crops can often be inadequate to ensure food security, many households rely on the income from their resin trees to purchase rice to make up the deficit (Tola & McKenney. 2003). The buffer zone is more densely populated and holds a number of settlements made up of a mixture of Bunong, Steing, Khmer and other minority ethnicities. The primary livelihood of communities in the region is agriculture, which historically
centred on shifting cultivation of upland rice and paddy rice farming in the lowlands. However, settlements are swiftly turning to cash crop cultivation the uptake of which is focused in settlements close to major roads in the buffer zone, although this transition to cash cropping is appearing in more isolated settlements (Pollard & Evans. 2008).
3.0 Methodology

The following section describes the methods used for data collection and subsequent statistical analyses. The fieldwork for data collection was conducted between 25th April and 09th July, 2012. This consisted of a pilot study and subsequent data collection in each of the 2 study villages.

For the purpose of this study the household was defined as “a group of persons sharing a home or living space who aggregate, and share incomes, as evidence by the fact that they regularly take meals together” (Marshall. 1994). The household head is the decision maker, determining how various assets should be allocated and consumption needs prioritised.

3.1 Pilot Study

The pilot study was conducted between 25th April and 29th April 2012 in the village of Sre Levi located within SPF. This village was selected based on its similarities in size and location to the principle study villages. The inhabitants of Sre Levi are predominately of indigenous Bunong ethnicity and the village is currently in an early stage of the land planning and indigenous land titling process. The methodologies described below were tested during the pilot stage, thus allowing for any problems in the data collection methods to be observed and corrected. The pilot study included one focus group, three interviews and the subsequent land mapping exercises. The pilot study provided information regarding the length of time required for each stage of the methods to be conducted. This information allowed a maximum sample size for the main study to be estimated.

In addition to this, the pilot study provided an invaluable opportunity for all team members to become familiar with each other, the method protocol (including the questionnaire) and to gain necessary experience in using global positioning systems (GPS). The team worked together during the pilot study in order to identify and correct any differences within the team in the interpretation of the questionnaire or other stages of the protocol, thus ensuring a standardised methodology. Hardcopies of the completed questionnaires and land mapping data were rigorously checked on a daily basis throughout the project in order to monitor the consistency of the data, to pick up on any errors and prevent bad habits from developing. The pilot study also highlighted the need for the rephrasing and modification of some questions. For example, the mention of the Khmer Rouge in one of the questions made some respondents evidently uncomfortable.
Furthermore, the pilot emphasised the problem of asking heads of households to give up substantial amounts of both time and energy required to show the team to their plots and demonstrate the boundaries. This issue was resolved by paying for people’s time and effort, which is standard practice for NGOs and researchers in the study villages, therefore a novel precedent was not created. The team offered 10000 Riel/2.5 Dollars for half a day’s work and 20000 Riel/5 Dollars for a full day’s work.

3.2 Managing Permissions and Perceptions

Land is a very sensitive issue in SPF, and consequently it was expected that the team’s activities would be treated suspiciously by local villagers. There were concerns that this could result in illegal plots of land being withheld from the team, thus undermining the aims of the project. Furthermore there was great potential for the research team to be perceived by the villagers as working for WCS, another NGO or as part of the conservation enforcement team managed by the FA. This perceived relationship could have created biases in the responses gathered during focus groups and interviews. For example a common problem encountered in household surveys is for people to attempt to appear poorer than they actually are in order to attract support from NGO’s. Therefore, the introduction of the project to the village chiefs and participating households was critical in gaining confidence and aligning expectations.

The project was presented to the village chiefs of both villages as a component of an existing PhD study with which they were familiar and thus ran under the permission already obtained from the appropriate commune chiefs. As commune elections were scheduled to take place whilst we were collecting data in Andoung Kraloeng, an additional meeting was required with the chief of Sen Monorom commune to reassure him of the team’s intentions not to interfere in the election process or prevent local people from voting. Signed permission letters from WCS and Imperial College London (ICL) introducing my activities were obtained and presented to village and commune chiefs to further add legitimacy to the proposed research.

It was explained to the chiefs of the villages that I was a student from ICL and that my assistants and I did not work for an NGO, WCS or the conservation enforcement team. It was made clear that any data collected by the project were done so solely for academic purposes and that respondent anonymity would be ensured. The aim of the study was presented as an investigation into household land use and that we were interested in how land use had changed during the last 8 years in
Andoung Kraloeng and the previous 6 years in O Rona. In securing permission from the village chiefs a brief overview of the methods planned was given including an estimated end date.

### 3.3 Focus Groups

Focus groups were conducted in both villages between 1st May and 4th May shortly after the initial introductions with the village chiefs. Alongside the general focus group discussions, a key informant focus group was conducted in each village exclusively with members of the village PLUP committee. The two study sites, Andoung Kraloeng and O Rona are officially recognised administrative villages; both are comprised of numerous smaller socially recognised settlements, known as kroms (from here on settlements will be used). A focus group was organised in each settlement, however, if settlement were close together then one meeting sufficed, separate focus groups were held for the more spatially isolated settlement. A village chief or settlement chief was tasked with organising participants for all focus group meetings. Individuals from the land use planning committee were asked to attend the key informant group discussion. The chief was similarly tasked with arranging participants for the general focus groups using the following requirements as a guideline for selection:

- Men and women should both be represented
- Lower and higher income households both be represented
- Members of both Khmer and Phunong families when possible

The village chief was asked not to participate in the focus groups as it was felt that his presence could subdue the responses of others. It was also decided not to combine individuals from recently settled households with individuals from historically settled households in focus groups as it could have potentially led to less realistic and restrained responses when questions were asked in relation to perceptions about new settlers. Consequently, focus groups in O Rona where there are a high proportion of Khmer immigrants were separated into newly settled households and historically settled households. However, in Andoung Kraloeng immigrants have generally been rejected by the community since the land use planning process in 2004, and therefore the focus groups did not consist of any members from newly settled households.

The focus groups began with an ice-breaking participatory activity, which involved participants listing all the current land uses that have been adopted in the village and explaining the seasonal calendar
for each crop. The main objective of the general focus groups was to familiarise the village resident’s with myself, the team and our objectives, to explore how households use the land available to them and to stimulate conversation about the PLUP process and its impacts on household livelihoods. The key informant focus groups provided a valuable opportunity to understand the village-level land use planning that each particular village had experienced, to ask questions focused on aspects of both the land use planning exercise and the indigenous land titling processes and to understand how these interventions have shaped the way the village now uses its land.

3.4 Participant Selection and Sampling Procedure

In total 114 households were interviewed, this comprised 44 households from Andoung Kraloeng, equating to a 50% coverage of the total households and 70 households from O Rona which equated to a 40% coverage of the village. The slightly reduced coverage of households in O Rona was due to the larger size of the village so the sample size was reduced proportionally.

On instruction the village or settlement chief visited selected households, described the project to them and informed them of the team’s intention to arrange an appointment with the head of the household for interview and to map the household’s agricultural land. The chief’s visit was intended to add authority to the project; it also demonstrated his support of the project which was important for gaining trust from the participants. It was important to emphasise to the chiefs that the selected participants should not be told to wait at their houses for our arrival but to carry on with their usual activities and that the team would come to arrange a specific time for an appointment. The village or settlement chief made visits to individual settlements separately and only after completing the interviews and mapping in one krom were households in another settlement notified. The team would approach households in the preceding afternoon and make appointments for the morning and for a session in the afternoon. The timing and location of appointments had to be made flexible to fit the household heads activities, but generally interviews took place in the respondent’s house and occasionally at their chamkar (agricultural plots). The timing of our fieldwork in Andoung Kraloeng coincided with the optimum time for planting cassava and rice crops, thus our interviews were generally carried out at 6am in an attempt to limit the amount of disturbance we made to the participants during this busy period.

Before commencing with each questionnaire a formal introduction was given, including the identity of the team and its aims. On completion of the interview, the participant was offered a gift such as a
pack of sweet biscuits or noodles to thank them for their participation in the research. This is expected by local villagers, in part due to the strong presence of NGO’s in the area, and failure to do this would likely have led to resentment on the part of interviewees. The structured questionnaire was designed to minimise bias by asking questions that required minimal time-recall periods and actual values rather than typical values. A significant period of time was spent in the community so that local people could adapt to our presence and become familiar with the team and our purpose. This was a strategic measure to reduce any bias that may have resulted from their perception of the project team’s motives and allegiances. During the interviews observations were noted of any indicators of either logging or hunting activities, for example customised motorbikes, which are used for manoeuvring timber from the forest. The presence of these items could indicate additional livelihood activities that the participant may have been reluctant to reveal to the interviewer.

3.4.1 Andoung Kraloeng

In Andoung Kraloeng the village chief did not have a complete list of village households from which to select participants from. Compiling an exhaustive list was considered too time consuming and above all the process of visiting each household and creating a list of people’s names could be misconstrued and create unnecessary suspicion and rumour in the village. Given that the households were located linearly along a road, systematically sampling every 2nd households and stratifying the village by settlement was felt to be the most appropriate method for household selection. This method should ensure an adequate spatial distribution of agricultural plots and a sufficient proportional coverage of wealthy and poor households, the two principle ethnicities, new households and historical residents.

The village chief in Andoung Kraloeng is not a popular or well respected figure in the community. Therefore the committee chiefs or the local settlement chiefs were favoured for the job of making the introductions to selected households. In each settlement the chief walked with the team and the selected household were identified. This also gave the team an opportunity to confirm that the households selected were indeed individual households, as in some cases buildings can be grouped closely together and it may be difficult to distinguish if they are separate family groups or part of the same economic unit. The chief then visited the households and spoke to either the household head or the spouse, this visit was made in the evening to increase the probability that they would be in residence and the household was revisited if the occupants were not home at the time.
3.4.2 O Rona

Conversely, in O Rona the village chief had complete records of the households for each settlement in the village from which to select participants from. Furthermore, although the village layout was linear, it was very spread out, undermining the justification for using systematic sampling. Consequently households were selected through random number generation.

Similarly, in O Rona the village chief was not used for the task of making introductions to the selected households. The village chief was not a popular character in the community and was also too preoccupied with his land to assist the team. Nevertheless, the local settlement chiefs proved to be more appropriate for the job and were given a list of selected household names created from the village chief’s records to visit. It was important to select some backup participants, as on presenting the list to the settlement chiefs it was common that some households had left the village and the village chiefs list had not been amended appropriately.

3.5 Structured Interviews

The purpose of the structured interviews (see appendix I) was to understand the history of land use specific to the particular household and to understand the household’s current land use e.g. crop types, how long the crop type has been grown, and what has driven any changes in crop types. The interviews also provided an opportunity to gain an insight into the diversity of livelihoods available to households and to collect key demographic data in order to identify which factors determine the area of land cultivated and how households use land. The interviews concluded with six qualitative questions requiring the respondent’s opinions or perceptions about issues relating to the PLUP process and if appropriate the indigenous land titling. The household head was targeted for interview on every occasion. If the household head was unavailable the team would revisit on another occasion. Only if the household head was unavailable for a long period of time, as was the case with individuals absent on military duty, was the spouse interviewed.

3.6 Land Mapping

Plot specific land use data were collected for each household interviewed. Each plot used or claimed by a household was measured using GPS and observations were made regarding the crops grown,
precautions made to minimise wildlife conflict and adjoining land uses and owners. The household head or a member of the household that clearly understood the layout and knew the names of the neighbouring land owners would lead the team around the boundary of each plot used or claimed by the household. GPS data was collected on the field vertices and plots were sketched so observations could be recorded of how crops are separated within a plot, all GPS data were collected using India 48N datum. Each GPS coordinate taken was written on the mapping datasheet at the corresponding vertex, this ensured a hardcopy version should anything happen to the GPS units in the field. Participant names were then matched to the participants of the land use planning exercise; households that could be matched were then compared with plot maps collected as part of the PLUP process to calculate land use changes, both in terms of area under cultivation and adoption of new crops.

3.6.1 Validating Mapping Data

The measurement of agricultural plots is a contentious issue within the study villages and there was great potential for participants to withhold sensitive plots, such as those cleared outside agreed boundaries. Furthermore, as the sampling of villages was between 40-50%, the incomplete mapping of land use resulted in additional uncertainties regarding whether the team had been shown all plots used by the households sampled. In order to monitor whether this issue had affected the quality of the data collected, recent land cover analysis and satellite imagery were used to identify if sensitive plots had been measured on completion of the land mapping of both villages. 100 random universal transverse Mercator (UTM) points were generated within un-sampled areas for each village using ARC geographic information system (GIS) software. Local guides or members of the village PLUP committee were employed to accompany the team and visit the un-sampled plots to assist in identifying the owner. The names collated were then cross-checked against the list of households already interviewed to ascertain whether any households had refrained from presenting plots to the team. The household head responsible for the plot was then approached and asked to answer the household-specific questions from the questionnaire in relation to the plot and then the plot was subsequently mapped. It was important that the household head was spoken to without accusation but as if the particular plot had been forgotten. It was essential to maintain the perception that the research team had no authority and at no point was it implied that plots were intentionally withheld.
3.7 Statistical Analysis

Before any statistical tests were performed descriptive statistics were used to explore the data and to gain an understanding as to which explanatory variables should be included in the analysis. All analyses were performed and produced using R statistical package version 2.13.1 (R Core Development Team. 2010). Graphics were performed in both Microsoft Excel and R statistical package version 2.13.1. Data were plotted to test for normality, and where appropriate, log-transformed to permit the following non-parametric statistical tests.

3.7.1 Quantifying Land Use Change

Data collected from this project was combined with the historical dataset and summary statistics were carried out to demonstrate how various aspects of land use have changed during the intervening period. Plot level proportional data was used to create graphs to demonstrate changes in the diversity of crops, importance of crops, access to land and land dedicated to subsistence crops and cash crops.

3.7.2 Household Indicators

The data collected solely from this study was used for the remainder of the analysis. Household level data collected via structured interviews was used to identify household level socio-economic variables that correlated with illegal, legal and total area of land claimed. Pearson’s correlations, Analysis of Variance (ANOVA) and Spearman’s rank correlations tests were all used to test for significance of household variables. Welch’s t-tests were used to test if there were significant differences between in-migrants and established households and between the different ethnicities in the total, legal and illegal land claimed.

3.7.3 Institutional Controls and Compliance

Household level data was also used to test whether there was any statistical significant difference between PLUP and non-PLUP participants, PLUP committee members and non-committee members in the total, legal and illegal land claimed.
4.0 Results

The following sections, in order, address the key research questions outlined by this study. Firstly, the past mapping of agricultural plots, as part of the PLUP process, provides an opportunity to quantify change in household land use between survey periods. Secondly, utilising data collected as part of the interviews, household level socio-economic and demographic characteristics correlating with household land use are recognised. Finally, the impact of the land use planning process on household land use is explored and household characteristics correlating with noncompliance are identified.

4.1 Quantifying Land Use Change

The historical dataset provided data on 171 households and 252 plots of land. Andoung Kraloeng provided information on 64 households including 89 plots of land and O Rona was represented by 107 households including 163 plots. The recent dataset consisted of 114 households and 317 plots. In total Andoung Kraloeng provided information on 114 plots of land from 44 households whilst 203 plots of land from 70 households were represented by O Rona. In summary the sample consisted of a combined 569 agricultural plots from 171 households.

The plot level data consisted of 252 plots of land and consisted of information on crop types, area measurements and plot history. Some plots were removed from the sample due to the absence of some of this data. Plots were also disregarded if they were fallow as this aspect of the study is only interested in productive land, therefore the inclusion of fallow plots may have skewed the results.

The quantification of land use change in both villages was carried out using a combined dataset of the household level data (2004/06: n = 171 households, 2012: n = 114 households). It is clear that land use in SPF has changed significantly. The area of land claimed on average by households has increased markedly, almost doubling since the original mapping exercise. Previously, the average household claimed 2.2 ha of agricultural land, whereas now the average household claims 4.1 ha of agricultural land. This difference in the area of household land was found to be highly significant ($t = -5.6154$, df = 197.819, $p = 6.577e-08$). Figure 4.1.1 summarises this comparison and also demonstrates that a higher proportion of households now have 5ha of land than before. This is interesting as under the land use plan regulations each household is afforded a maximum of 5 ha of land. The result confirms the expectations outlined by hypothesis 1, in which it was expected that land use would have increased between the two survey periods.
Comparisons of both datasets allow conclusions to be drawn in relation to the change in how land is used, for example the type of crops. Firstly, changes to the primary crop (defined here as the dominant crop in each plot if intercropping followed) were analysed. Figure 4.1.2 demonstrates that in the past cashew was most commonly used as the primary crop. Rice and other crops comprised 16\% of plots. The category ‘other’ crops includes various vegetables grown for subsistence use. Also of note is the small proportion of plots primarily dedicated to cassava production, this is probably explained because of the novelty of the crop, as it had only recently been introduced and uptake had therefore only just begun.

When compared to 2004/06 crop choice in 2012 demonstrates a substantial change in the importance of specific crop types. Most notable of these changes is cassava, which has become the dominant primary crop among villages in the space of just 6 years. It is unlikely that cashew has been directly replaced with cassava, but more likely instead that the majority of newly cleared plots since the previous survey have been used for cultivating cassava. A few plots of old unproductive cashew were known to have been cleared but mostly for planting rubber.

The emergence of rubber as a primary crop is also noticeable in figure 4.1.3. A few plots were recorded as intercropping rubber in the 2004/06 survey and this rubber is now at a mature enough
stage to produce a yield and therefore other intercropped species have been removed from the plot. The proportion of plots dedicated to rice has remained constant during the intervening period, although plots are no longer used primarily for other subsistence crops such as vegetables.

![2004/06: Primary Crop](image1)

**Figure 4.1.2:** The proportion of different primary crops that made up agricultural plots in 2004/06. Other includes crops used for subsistence.

![2012: Primary Crop](image2)

**Figure 4.1.3:** The proportion of different primary crops that made up agricultural plots in 2012. Other includes crops used for subsistence.

In 2004/06 intercropping crops with others on the same plot was common practice, as displayed by figure 4.1.4. A large proportion of this was subsistence crops such as rice and vegetables. Cassava appeared in only 29% of the plots sampled as uptake had only just begun. Overall the importance of intercropping has declined, in 2012 only 33% of the sampled plots had intercropping and this small proportion was dominated by cashew.

![2004/06: Intercropping](image3)

**Figure 4.1.4:** The proportion of different crops used for intercropping in 2004/06. Other includes crops used for subsistence.

![2012: Intercropping](image4)

**Figure 4.1.5:** The proportion of different crops used for intercropping in 2012. Other includes crops used for subsistence.
Subsistence crops have declined to 6% of the overall proportion of intercrop types. The graphs of both primary and intercropping plots highlight an important driver of land use change in the region, large scale uptake of commercial crops such as cassava, cashew and rubber as primary crop choices and the abandonment of subsistence food production.

Figure 4.1.6 and 4.1.7 display how the proportion of land dedicated to subsistence crops has not changed in between the two surveys. Although the proportion of land used for subsistence crops has declined, the decline is much less than expected. The previous graphs have shown the changes in both primary crop types and intercropping but when the bigger picture is observed the proportion of subsistence crops is still the same.

Household access to agricultural land is the method by which households initially attain their land. The methods that households use to access land have remained relatively similar since the baseline survey was conducted. Figures 4.1.8 and 4.1.9 shows that clearing forest is still the dominant method by which households initially attain new land. Buying land is still an important method of attaining land. The buying of land was expected to decline as under the land use plan regulations which stipulate that land is forbidden to be sold. However, the increasing commercialisation of land in O Rona may explain why this method of attaining land has not declined overall.
Figures 4.1.10 and 4.1.11 describes the land use and access to land respectively of plots of land cleared since the regulations established by PLUP were formalised. The use of cleared land since the PLUP process gives an insight into what is driving the new clearance. Figure 4.1.10 reveals that the vast majority of recent forest clearance was primarily for conversion to cash crops, most notably for cassava, which has replaced 76% of recently cleared forest area. Figure 4.1.10 also demonstrates that buying land is a more common practice than clearing land.

Figures 4.1.8 and 4.1.9: The proportion of different methods used to access land in 2004/06 and 2012, respectively.
4.2. Household Indicators

The general change in land use has been described and the next challenge is to identify which households are responsible for the large uptake of both land and cash crop agriculture. Is this pattern of cash crop adoption and accumulation of land homogenous among households or are there households that are particularly accountable? This section will explore household level socio-economic and demographic data and attempt to identify characteristics correlating with household land use. Table 1 presents the household variables used to explain the total area of land, as well as legal and illegal land in the statistical analysis.

Table 4.2.1: Variables used in statistical analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data type</th>
<th>Variable type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T_AREA</td>
<td>Continuous</td>
<td>Response</td>
<td>Household total area of land</td>
</tr>
<tr>
<td>T_AREA_ILL</td>
<td>Continuous</td>
<td>Response</td>
<td>Household total area of illegal land</td>
</tr>
<tr>
<td>T_AREA_OK</td>
<td>Continuous</td>
<td>Response</td>
<td>Household total area of legal land</td>
</tr>
<tr>
<td>ROOF</td>
<td>Categorical</td>
<td>Explanatory</td>
<td>Household roofing material</td>
</tr>
<tr>
<td>KROM</td>
<td>Categorical</td>
<td>Explanatory</td>
<td>Settlement</td>
</tr>
<tr>
<td>FAMILY SIZE</td>
<td>Continuous</td>
<td>Explanatory</td>
<td>Household members</td>
</tr>
<tr>
<td>LTRS RESIN PER MONTH</td>
<td>Continuous</td>
<td>Explanatory</td>
<td>Litres of resin collected per month</td>
</tr>
<tr>
<td>AVAILABLE LABOUR</td>
<td>Continuous</td>
<td>Explanatory</td>
<td>Household members between 15-65</td>
</tr>
<tr>
<td>ADULT MALE EQUIVALENT</td>
<td>Continuous</td>
<td>Explanatory</td>
<td>Members of the household are each given a standard score dependent on their age, equivalent to an adult male’s consumption.</td>
</tr>
<tr>
<td>DEPENDENCY RATIO</td>
<td>Continuous</td>
<td>Explanatory</td>
<td>Members of the household &lt;15 &amp; &gt;65 divided by members between and expressed as a percentage. This provides a measure of production available to a household</td>
</tr>
<tr>
<td>HH WEALTH</td>
<td>Ranked</td>
<td>Explanatory</td>
<td>Wealth index of material attributes</td>
</tr>
<tr>
<td>ASSET WEALTH</td>
<td>Ranked</td>
<td>Explanatory</td>
<td>Wealth index based on assets owned</td>
</tr>
<tr>
<td>LIV_DIVERSITY</td>
<td>Ranked</td>
<td>Explanatory</td>
<td>The livelihood diversity of a household</td>
</tr>
<tr>
<td>LIV_DIVERSITY+ILL</td>
<td>Ranked</td>
<td>Explanatory</td>
<td>Includes signs of illegal activities</td>
</tr>
</tbody>
</table>
Andoung Kraloeng and O Rona are both made up of five smaller settlements; these are separate administrative units but fall under same village name. Household land use is expected to vary among these settlements due to varying livelihood opportunities and economic conditions. The results of an ANOVA test suggest that total area of land claimed by households differs significantly between settlements (ANOVA, $F = 3.2312$, df = 9, $p = 0.001704$). The effect of settlement is likely to have a confounding effect on other variables tested in this analysis. Controlling for this was out of the scope of this project, but ideally it would have been included as a random effect in a linear mixed model.

Figure 4.2.1 presents the differences in household land between settlements. Most prominent is the result that households from O Rona 1, O Rona 2 and O Rona 3 appear to have much more land on average than other settlements. These settlements contain the longest established households in O Rona and are dominated by indigenous households. Settlements 4 and 5 are relatively recent extensions to the village, created from the gradual arrival of immigrant households from neighbouring provinces.

![Figure 4.2.1: A comparison of the total area of land claimed by households between settlements in both villages.](image)

Table 4.2.2 summarises the results of settlement when tested against legal and illegal land. The results of which suggest that total area of legal and illegal land claimed by households differs significantly between settlements.
Table 4.2.2: The results of Analysis of Variance tests

<table>
<thead>
<tr>
<th>Response</th>
<th>Explanatory</th>
<th>Test</th>
<th>df</th>
<th>F - Value</th>
<th>Pr (&gt;F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T_AREA</td>
<td>ROOF</td>
<td>ANOVA</td>
<td>3</td>
<td>3.7645</td>
<td>0.01286  *</td>
</tr>
<tr>
<td>T_AREA_Ill</td>
<td></td>
<td></td>
<td>3</td>
<td>2.0821</td>
<td>0.1067</td>
</tr>
<tr>
<td>T_AREA_OK</td>
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<td></td>
<td>3</td>
<td>0.7841</td>
<td>0.5053</td>
</tr>
<tr>
<td>T_AREA</td>
<td>KROM</td>
<td>ANOVA</td>
<td>9</td>
<td>3.2312</td>
<td>0.001704 **</td>
</tr>
<tr>
<td>T_AREA_Ill</td>
<td></td>
<td></td>
<td>9</td>
<td>10.472</td>
<td>2.174e-11 ***</td>
</tr>
<tr>
<td>T_AREA_OK</td>
<td></td>
<td></td>
<td>9</td>
<td>4.0068</td>
<td>0.0002018 ***</td>
</tr>
</tbody>
</table>

Pearson’s correlation tests were used to test for the significance of correlations between continuous explanatory variables and the continuous response variables, the test results are displayed in Table 4.2.3.

The total number of members of a household (family size) is significantly correlated with the total households land claimed by households. This relationship is unsurprising as it is expected that larger households will have more land due to consumption requirements and the presence of available labour to work the agricultural land.

The amount of resin that households collect is not significantly correlated with the amount of land that is claimed. This is an interesting result as much of the conservation interventions in the area have been aimed at protecting traditional livelihoods such as resin trees. This intervention follows an assumption that by protecting traditional livelihoods there will be less pressure on other forest resources. However, this result suggests that the collection of liquid resin is relatively unimportant in terms of having an effect on the total area of land used by households.

Although a household’s dependency ratio has no significant effect on the area of land claimed by households, the AME and the labour available to households are significantly correlated with total area and legal area of land claimed by households. This result suggests that the total area claimed is a product of the consumption requirements of households and household labour resources.
Table 4.2.3: The results of Pearson’s correlation tests

<table>
<thead>
<tr>
<th>Response</th>
<th>Explanatory</th>
<th>Test</th>
<th>df</th>
<th>T - Value</th>
<th>P - Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>T_AREA</td>
<td>FAMILY SIZE</td>
<td>Pearson’s correlation</td>
<td>112</td>
<td>3.9242</td>
<td>0.0001506*</td>
</tr>
<tr>
<td>T_AREA</td>
<td>LTRS RESIN PER MONTH</td>
<td>Pearson’s correlation</td>
<td>112</td>
<td>1.0301</td>
<td>0.3052</td>
</tr>
<tr>
<td>T_AREA</td>
<td>AVAILABLE LABOUR</td>
<td>Pearson’s correlation</td>
<td>112</td>
<td>4.2459</td>
<td>4.513e-05*</td>
</tr>
<tr>
<td>T_AREA</td>
<td>ADULT MALE EQUIVALENT (AME)</td>
<td>Pearson’s correlation</td>
<td>112</td>
<td>4.0378</td>
<td>9.91e-05*</td>
</tr>
<tr>
<td>T_AREA</td>
<td>DEPENDENCY RATIO</td>
<td>Pearson’s correlation</td>
<td>112</td>
<td>-1.9114</td>
<td>0.0585</td>
</tr>
<tr>
<td>T_AREA</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Spearman’s rank correlations were used to demonstrate the relationship between household indices of wealth and livelihood options and land claimed by households, the results are presented in Table 4.2.4.

Household wealth is an index of the attributes that make up the family home. Asset wealth is the combined scores of assets owned by the households. Both these wealth indices are significantly correlated with all three potential response variables, suggesting that wealth is an important determinant of the amount of total, legal and illegal land a household claims. Table 4.2.2 presents a significant effect of roof material on the total area of land claimed by a household. Roof material is widely used in social research as a proxy for household wealth, thus suggesting that the wealth of a household has a significant bearing on how much land is acquired.
The diversity of livelihoods that members of a household are involved with is significantly correlated with the total area of land claimed by households. Signs of illegal activities suggested alternative livelihoods that were too sensitive to report during the interview. When this is included into the household livelihood diversity index the significance of the correlation is increased with the total area of land claimed by households.

Table 4.2.4: The results of Spearman’s rank correlation tests

<table>
<thead>
<tr>
<th>Response</th>
<th>Explanatory</th>
<th>Test</th>
<th>S - Value</th>
<th>P - Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>T_AREA</td>
<td>HH WEALTH</td>
<td>Spearman’s rank correlation</td>
<td>132789.9</td>
<td>2.26e-07*</td>
</tr>
<tr>
<td>T_AREA_ILL</td>
<td></td>
<td></td>
<td>169929.4</td>
<td>0.0007339*</td>
</tr>
<tr>
<td>T_AREA_OK</td>
<td></td>
<td></td>
<td>183478.3</td>
<td>0.005797*</td>
</tr>
<tr>
<td>T_AREA</td>
<td>ASSET WEALTH</td>
<td>Spearman’s rank correlation</td>
<td>115204.7</td>
<td>9.946e-10*</td>
</tr>
<tr>
<td>T_AREA_ILL</td>
<td></td>
<td></td>
<td>150645.1</td>
<td>1.805e-05*</td>
</tr>
<tr>
<td>T_AREA_OK</td>
<td></td>
<td></td>
<td>198831.1</td>
<td>0.0379*</td>
</tr>
<tr>
<td>T_AREA</td>
<td>LIV_DIVERSITY</td>
<td>Spearman’s rank correlation</td>
<td>195672.4</td>
<td>0.02674*</td>
</tr>
<tr>
<td>T_AREA_ILL</td>
<td></td>
<td></td>
<td>229573.1</td>
<td>0.458</td>
</tr>
<tr>
<td>T_AREA_OK</td>
<td></td>
<td></td>
<td>221832.4</td>
<td>0.2823</td>
</tr>
<tr>
<td>T_AREA</td>
<td>LIV_DIVERISTY +ILL</td>
<td>Spearman’s rank correlation</td>
<td>184532.3</td>
<td>0.006695*</td>
</tr>
<tr>
<td>T_AREA_ILL</td>
<td></td>
<td></td>
<td>219139.3</td>
<td>0.2336</td>
</tr>
<tr>
<td>T_AREA_OK</td>
<td></td>
<td></td>
<td>214602.8</td>
<td>0.1653</td>
</tr>
</tbody>
</table>

There is a significant difference between established households (mean = 4.1 ha) and newly established households, those that have arrived during the previous 8 years (mean = 2.1 ha, \( t = 0.1438, \text{df} = 65.118, p = 0.0001929 \)) in the total area of land claimed by households. This result, displayed in figure 4.2.2, conflicts with what was initially hypothesised contradicting the impression that in-migrants were driving the observed surge in land use change. Indeed quite the opposite seems to be happening as in-migrants appear to have much less land than the established households.

Indigenous (Bunong and Steing) households have significantly more land on average (mean = 4.1 ha) than non-indigenous (Cham and Khmer) households (mean = 2.6 ha, \( t = 2.9547, \text{df} = 107.267, p = 0.003847 \)), this is displayed in figure 4.2.3. The small sample of non-indigenous households in
Andoung Kraloeng may have skewed the previous result. Therefore, a similar analysis was run focusing solely on O Rona, where both ethnicities are more evenly represented. However, a similar result was seen, in O Rona indigenous households (mean = 5.8 ha) have significantly more land than non-indigenous households (mean = 3.7 ha, t = 4.2613, df = 65.793, p = 6.62e-05). This outcome again conflicts with the hypothesis that non-indigenous households would claim more land on average than indigenous households.

**Figure 4.2.2:** The total area of land claimed by both established households and newly settled households

**Figure 4.2.3:** The total area of land claimed by both established households and newly settled households
4.3 Institutional Control and Compliance

There was a significant difference in the total area of land claimed between households that participated in the land use planning process (mean = 4.1 ha) and those households that did not participate (mean = 2.6 ha, t = 2.893, df = 104.483, p = 0.004645). This result is displayed graphically in figure 4.3.1.A There was no significant difference between participating (mean = 1.2 ha) and non-participating households (1.5 ha) in the total area of illegally acquired land (t = -3.4532, df = 77.919, p = 0.0008987). There was, however, a significant difference between participants (mean = 2.6 ha) and non-participants (mean = 0.8 ha) in relation to total area claimed per household inside the agreed boundaries, this is represented in figure 4.3.1.B (t = 5.1209, df = 109.767, p = 1.309e-06). These results suggest that households that have participated in the PLUP process are able to claim much more legal land than non-participating households.

Figure 4.3.1: Total area of land claimed between PLUP participant and non-participants (A). Total area of legal land claimed between PLUP participants and non-participants (B).

One of the central hypotheses of this study was that the clearance of land outside the agreed boundaries was being driven by an increase in non-indigenous households as a result of in-migration. It was hypothesised that non-indigenous households would be more likely to claim land outside of the agreed land use zones as they had not participated in the PLUP process. However, the analysis showed that there was no significant difference between indigenous households (mean = 0.81 ha) and non-indigenous households (mean = 1.1 ha) in the total area of illegal land claimed (t = -1.8976, df = 79.759, p = 0.06137). Households from both ethnic groups have land outside of the regulated land use boundaries. Andoung Kraloeng has a small proportion of in-migrants and this was
thought to have skewed the previous result. Therefore, the same analysis was repeated but excluding households from Andoung Kraloeng. When considering solely O Ron, there was still no significant difference in the amount of illegal land claimed by non-indigenous households (mean = 2.0 ha) and indigenous households (mean = 1.6, t = 0.7732, df = 56.265, p = 0.4426).

Another central hypothesis of this study was that land use change was being driven by newly established households who have migrated to the region to speculate for land. In addition, it was hypothesised that newly settled households would be driving the illegal clearance in the region as they had not participated in the land use planning process. However there was no significant difference between established households (mean = 1.3 ha) and newly established households (mean = 1.3 ha) in the total area of land outside of agreed boundaries (t = 0.0656, df = 66.395, p = 0.9479). In fact the two groups are both of claiming land outside agreed boundaries.

There is a significant difference between established households (mean = 2.3 ha) and newly established households (mean = 0.8 ha) in relation to the total area of land inside the agreed boundaries (t = 4.5871, df = 49.004, p = 3.135e-05), figure 4.3.2.B displays this result. There was also a significant difference between indigenous households (mean = 2.6 ha) and non-indigenous households (mean = 0.8 ha) in the total area of land within agreed boundaries (t = 5.364, df = 111.859, p = 4.441e-07), figure 4.3.2.A displays this result. These results suggest that the available legal land is being controlled by established indigenous households.

**Figure 4.3.2:** The differences between total amount of legal land claimed for both ethnicity (A) and established and new households (B)
Households containing members of the PLUP committee were shown to not have significantly more land ($t = 0.9503$, $df = 16.236$, $p = 0.3559$) nor have significantly more illegal land ($t = -0.6339$, $df = 14.077$, $p = 0.5363$) than households without committee members. However, there was a significant difference in the amount of legal land between households with committee members (mean = 2.8 ha) and non-committee member households (mean = 1.7 ha, $t = 2.2658$, $df = 20.201$, $p = 0.0346$).
6.0 Discussion

Cambodia’s growing economy and population, widespread infrastructural development, increase in foreign investment and the resulting economic land concessions are all underlying drivers of land use change in the country (Chann et al. 2012). The proximate drivers expected to be acting strongly on SPF include the widespread adoption of cash cropping in the place of subsistence agriculture and large scale in-migration from neighbouring provinces (Chann et al. 2012).

With the benefit of a baseline dataset of land use in the two villages, this study was able to quantify the change in average household land use. In the space of just six years, the average area of land claimed per household has nearly doubled in the two villages surveyed. This is a worrying statistic for the sustainability of land use in the SPF, especially as the results suggests that some households have in excess of 5 ha of land. Households are claiming more land than is permitted to use under the land use plan. This is more than the total amount of land households are permitted to utilise under the land use plan. If the land use plan is to be effective and the sustainable use of resources in SPF is to be realised then understanding the factors behind this observed increase in household land use is essential.

6.1 Quantifying Land Use Change

The analysis of land use practices demonstrates that the primary crop choice has changed dramatically. Cashew was previously the dominant crop but this has been overshadowed by the current popularity of cassava cultivation. It is considered unlikely that cashew has been directly replaced by cassava, but more likely that new plots have been dedicated to cassava cultivation rather than cashew. This view is supported by the fact that 76% of recently cleared land is dedicated to cassava cultivation. Cassava was introduced to the region around the same time that the initial survey was conducted in 2004/06. This is apparent by the very low proportion of productive land (1%) dedicated primarily to cassava during this time. A larger proportion of intercropping land was dedicated to cassava, which suggests a general mistrust in the crop amongst villagers at the time. The villages in SPF were introduced to cassava by middlemen from Vietnam. Sticks of the cassava stem were handed out and its popularity quickly grew among the communities. If grown over small areas cassava requires little capital input and the stems are freely and widely available. As cassava requires little capital input the potential profits are very large, this provides a substantial incentive to
cultivate it over other crops. However, recently price fluctuations of cassava have in some cases made the harvest of cassava unprofitable, after labour costs are deducted from the yield income.

The extensive uptake of cash cropping will invariably have consequences on the environment (Padoch, C. 2007). As households now grow crops commercially they are likely to cultivate as much as they are able to sell, which will largely be determined by the resources at the household’s disposal. Conversely, an agricultural system dominated by subsistence crops will be inherently smaller in scale, as households are only likely to grow as much as they can consume. Although there have been many changes in the dominance of particular crops, the overall picture of land use practice is still mostly the same. Subsistence crops and cash cropping make up roughly the same proportion of land now as they did six years ago. Although there appears to have been a slight decline in the proportion of land used for subsistence cultivation, however, the average area of subsistence crops per household is slightly more than before. In absolute terms area of land used for subsistence crops has actually increased in comparison to 2004/06. Households are only likely to increase the area of land of subsistence crops to match their needs, therefore the increase in cash cropping is more important relatively.

Households in SPF are increasingly reliant on purchasing vegetables imported from Vietnam instead of producing their own subsistence crops. The decline in the cultivation of vegetables is most evident in O Rona where the practice is rarely found. In Andoung Kraloeng vegetables are still intercropped amongst cashew and cassava, though this is likely due to the small trade of vegetables in the village. The pattern in O Rona does suggest that as the trade in subsistence foods reaches more isolated villages such as Andoung Kraloeng, the cultivation of subsistence crops may decline in favour of complete cash cropping. Rice cultivation has remained roughly the same during the intervening period of time between the two surveys. It is highly unlikely that households would convert paddy to suitable land for cash cropping. Paddy rice yields generally increase with age of the field and there is limited suitable land its cultivation. In addition to this the cultivation of hill rice is considered extremely labour intensive and with the advent of relatively less labour intensive cash cropping, household are potentially favouring to cultivate cash crops and then buy the rice they require using the profits.

An important observation is the emergence of the cultivation of rubber trees as a primary crop. In 2012 a total of 2% of agricultural plots were dedicated to rubber. The uptake of rubber is likely to be slower than that of cassava as a consequence of the large capital investment required.
(approximately $1000/ha), the labour required to plant them and the non-productivity of the land as the trees develops to maturity. However, wealthy households in O Rona are making the investment as the value of natural rubber continues to increase in line with the increasing costs of petroleum based rubber. In total 1% of the current land was intercropped with young rubber, the pattern emerging is for households to either remove unproductive mature cashew and plant rubber or to intercrop cassava with rubber on newly cleared land, then after 3-4 years the cassava is removed and the rubber is almost ready to provide a yield. Small holder rubber plantations provide the SPF with an interesting challenge as households can acquire a daily yield from mature trees, thus substantial profits can be accumulated which are likely to be reinvested into planting additional rubber. Rubber cultivation is likely to become widespread, particularly if households are able to generate enough capital through growing cassava. However, rubber is unlikely to replace cassava as the dominant primary crop as the capital costs are so substantial.

Methods of accessing land have for the most part remained relatively similar to before. Clearing land is still the dominant method of gaining new land and buying land is also as common. It was expected that under the land use plan and the resulting regulations in which the buying and selling of land was prohibited, this would decline. However, it is evident that land is increasingly becoming commercialised. Much of blame for selling land is placed on poor indigenous households in O Rona who are often said to sell land in order to pay medical fees. In O Rona it is also expected that households will be tempted to sell land close to the road to in-migrants, wealthy established households and wealthy households from the neighbouring district capital O Am. This land is in high demand and attracts a relatively high value, which is only expected to continue to increase as infrastructure is further developed and electricity reaches the village. As a consequence of selling land, poor households are likely to clear new plots from the forest. Clearance may also be attributed to in-migrant households; these households clear illegal land outside the agreed boundaries and replace the forest with cassava. The enforcement team now visit these sites and forcibly remove the crop just before the crop is scheduled to be harvested. However, from conversations with the offenders, who made no attempt to hide the fact that they had cleared forest in the protected area, it was widely thought that if they continued to clear at the forest boundary then eventually they would be allowed to cultivate some of the land without repercussions. It is unlikely that wealthy households are directly clearing land but are much more likely to be responsible for the increase in bought land as they look to capitalise on the agricultural expansion of cash crops.
6.2 Household Indicators

Household land use was shown to vary between settlements most likely due to varying livelihood opportunities and economic conditions. The effect of settlement was likely to have a confounding effect on other variables tested in this analysis. Controlling for this was considered out of the scope of this project, but ideally it would have been included as a random effect in a linear mixed model and its effect as a confounding variable would have been controlled for. Households from O Rona 1, O Rona 2 and O Rona 3 have much more land on average than other settlements. These settlements contain the longest established households in O Rona and are dominated by indigenous households, including the residence of the village chief and his close family, all of which claim large areas of land. Settlements 4 and 5 are relatively recent extensions to the village, created from the gradual arrival of immigrant households from neighbouring provinces.

Household size was shown to correlate with area of land claimed and is likely due to the consumption requirements of the household. A large family requires a larger amount of land to gain either income or grow sufficient food to meet the family’s needs. Large households are also likely to have more available labour. It is difficult to untangle the relative importance between consumption (AME) and production (available labour). The dependency ratio is a way of doing this, as it is a ratio between the productive and unproductive members of the household. Households with a higher dependency ratio consume more of their available labour. The results ($p = 0.06$) suggest that dependency is negatively correlated with total area claimed. This suggests that as consumption per unit labour increases, land claimed decreases. As such, it is predicted that if consumption is increase but labour is lowered (increased dependency ratio), land claims are lower, presumably because more labour is spent caring for dependents. Conversely is labour is increased but consumption is not (decreased dependency ratio), land claims increase.

The importance of resin trees to indigenous communities has been discussed and it is a central theme to WCS intervention strategies in SPF to ensure the protection of this valuable forest resource. However, the results suggest that household collection of resin has no effect on the amount of land they use. However, income from resin trees is still likely to be important to households who may use the earning to pay for labour for example.

The wealth indices used in this study were relatively simple and would have been much improved by weighting household attributes and assets against real world values. However, the indices do
provide a basic measure of wealth that is relatively reliable. Wealth indices correlated significantly with legal, illegal and total area of land claimed. This result is unsurprising as wealth facilitates the accumulation of land and enables households to pay for labour and thus use more land. It was unexpected that wealth would correlate with illegal land but as corruption is rife in the area, perhaps it is not surprising that wealthy households are able to evade punishment of cultivating crops on illegal land. The significant correlation of the diversity of livelihoods and household land claimed can be explained by the increase in the wealth of a household associated with increasing livelihood diversity. Furthermore, with the addition of illegal activities (judged by sign of illegal activities in the household) the correlation with total area of land claimed became even more significant, but interestingly there was no effect on total illegal land claimed. This suggests that households involved in illegal activities are able to accumulate more land possibly because the extra wealth enables these households to either buy or clear more land.

6.3 Institutional Controls and Compliance

Under the hypotheses outlined in section 1.4.2 established households were predicted to have similar land use as before, the majority of change in total land use was expected to be attributed to in-migrant households. However, established households have nearly twice as much land as newly settled households. This result may be because established households have had more time to accumulate more land or because enforcement in the area is generally effective in preventing in-migrants claiming land. Similarly, non-indigenous households were predicted to be driving the claiming of more land but conversely it was shown that indigenous households have a significantly more land. These results suggest that established indigenous households are in fact driving the uptake in additional land. Furthermore, households participating in the PLUP process have much more land on average than non-participants.

Households that have participated in the PLUP process have similar amounts of illegal land on average as non-participants, but have significantly more legal land suggesting that PLUP participating households may hold a monopoly over the available legal land. Non-indigenous households and indigenous households have on average similar illegal land (roughly 1ha). This is consistent still when Andoung Kraloeng is removed from the analysis. There is also no significant difference in the average amount of illegal land that in-migrant and established households claim (1.3 ha). These results have important implications for policy in the area. As indigenous established households are claiming the majority of legal land but also claiming similar amounts of illegal land as non-indigenous in-migrant
households this suggests that the land use plan is being misused. The results suggest that rather than focusing on in-migrant land use and illegal clearance, it is more likely the established indigenous households that are driving the change in land use and to a certain extent clearance of land outside the agreed boundaries.

The two communities analysed have undergone and will continue to undergo substantial changes in land use practices. The commonly held view that in-migrants consisting of Khmer and Cham ethnicities were driving the increase in land use and the clearance of forests inside the protected areas appears to be misleading. Established indigenous households are as culpable for the increase in land claimed and the clearance of land outside the boundaries agreed on as part of the PLUP process. The land use plan in O Rona has been undermined with the granting of an agro-economic concession that includes a large part of the future land use zone. Therefore, households in O Rona seem disenfranchised with the idea that PLUP can provide both land and security of it into the future. The original understanding of resource dynamics in the region has been disproven and conservation strategy now needs to refocus its aim and re-evaluate the effectiveness of PLUP in promoting sustainable resource use.
References


Appendix I

Household Questionnaires

The purpose of the interviews will be to understand the diversity of livelihoods available to households and to collect key demographic data in order to identify which factors determine the area of land cultivated and how households use land. The interview will provide an opportunity to understand the history of land use specific to the particular household and to understand the household’s current land use. The interview will conclude some qualitative questions requiring the participant’s opinions or perceptions about issues relating to the PLUP process and the indigenous land title.

TO BE COMPLETED BY KYLE:
Was the household interviewed as part of PLUP process? Yes ☐ No ☐
Previous household ID: ...................................

TO BE COMPLETED BY INTERVIEWER:
Interviewer name: ...................................
Date of interview:  /  /2012
Village name: ...................................
Krom ID: ...................................
Household ID: ...................................

DEMOGRAPHIC INFORMATION:
What was the name of the household head in 2004? .................................................................
Has your household moved here from elsewhere? ........................................................................
If moved, where from? ................................................................................................................
If moved, why did your household move to this village? ..............................................................
How long has your household lived in this village? ......................................................................

Make a record on the following household features:
Roof type: ..............................
Wall type: ..............................
Number of rooms: ..............................

What size *kompong* does your household use? ..............................

How many *kompong* does your household use per day? ..............................

How many months have you bought rice for in the last 12 months? ..............................

First in list should be the household head. List all the members of the household. Only need the names of the household head and his/her partner. [Answers in table]

<table>
<thead>
<tr>
<th>Name [in Khmer]</th>
<th>Age</th>
<th>Gender [M/F]</th>
<th>*Relationship to HH</th>
<th>**Family status</th>
<th>Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

*Possible relationship options:
A: Household Head      E: Daughter      I: Daughter in Law
B: Wife               F: Father       J: Nephew
C: Husband            G: Mother       K: Niece
D: Son                H: Son in Law    L: Cousin

**Possible family status
A: Married          C: Divorced          E: Widower
B: Single  D: Widow

Does anyone in your household have a position of responsibility? [Name and position] (E.g. PLUP committee member, policeman, commune council member, teacher, soldier)
........................................................................................................................................
........................................................................................................................................

Does your household have any of the following assets? [Answers in table]

<table>
<thead>
<tr>
<th>Asset</th>
<th>Yes or No</th>
<th>How many in household?</th>
</tr>
</thead>
<tbody>
<tr>
<td>DVD player</td>
<td>Yes ☐</td>
<td>No ☐</td>
</tr>
<tr>
<td>TV</td>
<td>Yes ☐</td>
<td>No ☐</td>
</tr>
<tr>
<td>Mobile phone</td>
<td>Yes ☐</td>
<td>No ☐</td>
</tr>
<tr>
<td>Wardrobe</td>
<td>Yes ☐</td>
<td>No ☐</td>
</tr>
<tr>
<td>Motos</td>
<td>Yes ☐</td>
<td>No ☐</td>
</tr>
<tr>
<td>Tractor</td>
<td>Yes ☐</td>
<td>No ☐</td>
</tr>
<tr>
<td>Car</td>
<td>Yes ☐</td>
<td>No ☐</td>
</tr>
<tr>
<td>Strimmer</td>
<td>Yes ☐</td>
<td>No ☐</td>
</tr>
</tbody>
</table>

LIVELIHOOD INFORMATION:

Does your household provide any of the following services? [Answers in table]

<table>
<thead>
<tr>
<th>Service</th>
<th>Yes ☐</th>
<th>No ☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>Village shop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice milling service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Produce rice wine (srasor)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generate electricity/charge battery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resin trader</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cassava trader</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cashew trader</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other...[specify]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Does anyone in your household have a job with a salary? [Name and job]
..................................................................................................................................................................................
..................................................................................................................................................................................

Do any members of your household provide their labour to other households? [How many]
..................................................................................................................................................................................

If yes, what activities?
..................................................................................................................................................................................
..................................................................................................................................................................................

If yes, how many days in the last year and how much do they make per day?
..................................................................................................................................................................................
..................................................................................................................................................................................
..................................................................................................................................................................................

How many resin trees does your household own and tap?..............................

How many Kans of liquid resin does your household collect per trip?
..................................................................................................................................................................................

How many trips are made to collect resin per month?
..................................................................................................................................................................................

How much do you make per Kan of liquid resin?
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MAKE A NOTE of any signs of logging (trucks, modified motos, luxury logs) and hunting (homemade gun, crossbow, snares) visible on the property.
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How many buffalo does your household currently own?
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How many cows does your household currently own?
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How many are draft cows?

LAND USE INFORMATION:

How many plots does your household obtain crops from? [Answer in table]
DO NOT FORGET TO ASK ABOUT FALLOW LAND, OLD CHAMKARS OR ANY LAND THAT ANYONE IN THE HOUSEHOLD MAY HAVE A CLAIM TO

<table>
<thead>
<tr>
<th>No plot</th>
<th>*Land use</th>
<th>**Access to land</th>
<th>Year of ownership</th>
<th>Estimated size (Ha)</th>
<th>Current crop(s)</th>
<th>Yrs. growing current crop</th>
<th>Intercrop (crop/years)</th>
<th>Previous crop(s)</th>
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Possible land use options:
A: Chamkar   E: Forest (uncleared)
B: Paddy     F: Building
C: Fallow

Possible access to land options:
A: Bought (how much [$]?)   D: Rent out
B: Cleared                  E: Rent in
C: Inherited (from which parents?) F: Gift (from whom?)
The plot number should be taken from above. [Answer in table]

<table>
<thead>
<tr>
<th>No plot</th>
<th>Why did you choose the current crop?</th>
<th>Why did you choose this area to grow the crop?</th>
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</table>
Record the yields and prices of crops. The plot number should be taken from the above table.

[Answer in table]

<table>
<thead>
<tr>
<th>No plot</th>
<th>Current crop(s)</th>
<th>Total production this year [kg]</th>
<th>Sale price this year [riel/kg] [fresh/dry]</th>
<th>Total production previous year [kg]</th>
<th>Sale price previous year [riel/kg]</th>
<th>Labour [No. people, No. days]</th>
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If no cash crops, what are the reasons that your household does not grow them?

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HOUSEHOLD PERCEPTION INFORMATION:

1. Does your village have rules and restrictions over where you can do agriculture? Can you briefly explain these rules and restrictions?

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2. If you want more land to grow crops how do you do this (what is the process e.g. speak to the committee or the village chief)?
3. How do you decide where to clear land? (Is this decision made for you e.g. by the village chief, committee or the FA)?

4. What happens if somebody in the village ignores the village rules on where you can do agriculture (what is the internal rules and regulations against rule breakers)?

5. How have your feelings about the security of your land tenure changed since the indigenous land titling?