

A tale of two villages: an investigation of household land use and compliance under tenure reform in a Cambodian Protected Forest

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Abstract

In this paper, we present an analysis of individual household land use change under conservation-driven participatory land use planning and indigenous tenure reform in a Cambodian protected area. The two study villages, which were both selected as pilots in the Cambodian government's nationwide land tenure reform programme, provide informative case studies with which to explore behaviour under contrasting institutional conditions. In each village, we investigated the overall level of compliance with both the boundaries of zones designated for community land use and the community regulations created to govern land use within these zones. Structured interviews and the mapping of individual plots were conducted with 114 households, with newly arrived immigrants, non-participating and participating residents included in the sample. Household behaviour was analysed to investigate the effect of different household socio-economic and demographic factors, such as the availability of labour, wealth, livelihood opportunities, age and ethnicity, on both land use and compliance. We found that household compliance was strongly correlated with total land holdings and participation in the tenure reform process. In turn, total land holdings were found to be highly correlated with the age of the household head, household wealth and whether the household had been present in the village at the time that land use planning was conducted. Compliance levels in the two villages were found to differ significantly. Our findings highlight the importance of supporting local resource management institutions created through tenure reform, particularly in the face of strong external drivers of change, and demonstrate that positive outcomes for resource conservation can be achieved through the process of defining property rights for people living inside protected areas.

1 **1. Introduction**

2 Sparsely populated, resource rich forest habitats have frequently been subject to
3 exclusionist policies by former colonial or national governments, repeatedly failing to
4 recognise the rights of the people living inside such areas (Colchester, 2004).
5 Biodiversity conservation has a particularly chequered past in this regard, with the
6 protectionist ‘fines and fences’ approach dominating conservation practice throughout
7 much of its history (Adams, 2004). Given the high biodiversity value of many forest
8 habitats and the often weak political representation of forest peoples, it is no surprise
9 that this approach has brought conservation practitioners and forest inhabitants into
10 conflict (Brockington & Igoe, 2006). More recently, efforts to meet state
11 commitments made under the Convention of Biological Diversity (CBD) to set aside
12 areas for the protection of biodiversity have brought further accusations of ‘green
13 grabbing’ (Fairhead et al., 2012).

14 From the 1980s onwards, however, there has been increased recognition of the
15 customary rights of indigenous peoples (IPs), with both international and national
16 legislation slowly moving to reflect this. This has been reflected within conservation,
17 with Article 8(j) of the CBD, decision 7.23 of the 2005 CBD Conference of the
18 Parties and Aichi Target 18 all pledging to respect the rights and practices of
19 indigenous and local communities. Beyond international agreements, there has been
20 increasing acceptance within conservation organisations that the rights of local
21 communities must be considered, which has resulted in a movement towards the
22 principle of ‘doing no harm’ as a minimum requirement (Adams et al., 2004).

23 This change of approach is well reflected in the increasing trend towards the adoption
24 and recognition of various forms of indigenous or community conserved areas

25 (ICCAs). As of 2008, it was estimated that ICCAs encompassed over 400 million ha
26 in 28 of the world's 30 most forested states, a significant increase on similar
27 calculations from 2002 (Sunderlin et al., 2008). This represents a significant step
28 forward in the recognition of customary tenure rights, although rights related issues
29 are often not the primary impetus behind their adoption (Berkes, 2009). One argument
30 in support of ICCAs lies in their effectiveness in providing greater protection benefits
31 in comparison with more traditional forms of conservation management. Whilst there
32 is no guarantee that ICCAs will result in positive biodiversity outcomes, there is a
33 growing body of evidence that points in this direction (e.g. Bray et al., 2003; Curran
34 et al., 2004, Porter-Bolland et al., 2012). Furthermore, as payments for environmental
35 services schemes are increasingly widespread, clarification of disputed or informal
36 tenure arrangements become ever more necessary to ensure that payments are
37 effective and customary rights holders do not lose out (Engel et al., 2008; Larson,
38 2011; Milne & Niesten, 2009).

39 In part, the success of rights based approaches is dependent on the manner in which
40 they are implemented. The rise of ICCAs has coincided with greater interest in
41 participatory approaches to conservation (Agrawal & Gibson, 1999; Berkes, 2004),
42 and in this regard participatory land use planning (PLUP) approaches have gained
43 considerable support. Such approaches are thought to build upon more traditional land
44 use planning methods whilst ensuring that the process is more inclusive, make greater
45 use of local knowledge, reduce the risk of future disputes and support local level
46 institutional development (Cronkleton et al., 2010; McCall & Minang, 2005).
47 Concerns have been raised, however, regarding the effect of PLUP on local land use
48 and the degree to which land access ultimately reflects power arrangements within a
49 village. In an investigation of pilot PLUP implementation in Laos, Lestrelin et al.

50 (2011) found evidence to suggest that, despite village participation, the process
51 resulted in maintaining the status quo, with the extent of individual households'
52 access to land dependent on their power to negotiate with village elites. Despite PLUP
53 being widely applied in multiple contexts and for different purposes, published case
54 studies are rare and outcomes are often left unevaluated (Bourgoin, 2012). Where
55 case studies have been published, there is a distinct lack of analyses looking at how
56 different groups within villages have been affected by and comply with the
57 institutional changes brought about by PLUP and other participatory tenure reform
58 instruments.

59 In this study, we seek to redress this gap. We evaluate the implementation of PLUP in
60 two villages in the Cambodian uplands, investigating at the household level how land
61 use has evolved following the initiation of PLUP and indigenous communal titling
62 (ICT). We do this in the context of a dynamic but varying socio-economic landscape
63 that is driving significant land use and demographic change. In this way, we are able
64 to compare the performance of tenure reform in two villages that have been exposed
65 to different levels of institutional change.

66 We present an analysis of household compliance levels with both the legal zonation of
67 community lands and regulations governing land use within community zones. This
68 was achieved by re-measuring individual household plots for a sample of households
69 in each village and comparing land use with that recorded as part of the PLUP process.
70 We use this data to understand the extent to which the customary lands of the two
71 communities and conservation areas have been successfully protected and to analyse
72 how individual household land use and compliance have been affected by the
73 institutional changes brought about through tenure reform. Within this analysis, we

74 investigate the effect of different socio-economic characteristics thought to effect land
75 use decision-making, including ethnicity, available household labour, livelihood
76 options, wealth and residency, on the behavioural response of households to land use
77 planning and tenure reform. We believe that this provides a valuable case study from
78 which to draw lessons, not just for the implementation of tenure reform for
79 Cambodia's minority IPs, but for the PLUP approach more widely.

80 **2. Indigenous Tenure Reform in Cambodia**

81 Cambodia is home to several minority indigenous peoples, the majority of whom live
82 in remote forested upland areas, often in and around gazetted protected areas.
83 Although customs and practices vary between groups, Cambodia's IPs have typically
84 operated under a traditional system of collective customary land tenure with a strong
85 spiritual connection to the surrounding landscape, particularly forests (ADB, 2002,
86 Baird, 2000, Baird & Dearden, 2003; Fox et al., 2008; Simbolon, 2009). Traditional
87 livelihood systems relied heavily on small-scale swidden agriculture, in which only a
88 modest proportion of communal lands were cultivated at any one time. While swidden
89 land use has often been considered to have a negative impact on forest ecosystems
90 and subjected to efforts to 'stabilise' agricultural production (e.g. Lao land reforms;
91 Ducourtieux et al., 2005; Lestrelin, 2009), there is evidence to suggest that such
92 systems can be sustainable (Fox et al., 2000). In recent years, however, there has been
93 a shift in many communities away from traditional agricultural practices, with
94 increasing reliance on the production of commercial and permanent crops (Fox et al.,
95 2008).

96 Largely unaffected by the private property regime of French colonial rule,
97 Cambodia's IPs came under increasing pressure to integrate into Khmer society after

108 independence, culminating in forced integration and mass resettlements during the
109 Khmer Rouge period (1970-1979). Following Vietnamese invasion in 1979, IPs were
110 allowed to return to their ancestral lands, although many did not return until the 1990s.
111 After the 1991 peace accord, a series of laws aimed at reforming land ownership was
112 enacted, most notably the 2001 Land Law. From the perspective of indigenous
113 communities, the 2001 Land law is particularly important as it provides the legal basis
114 to secure customary land rights as well as safeguarding these rights until such a time
115 as the legal title is granted. Once title is granted, these lands are classified as state
116 private lands, meaning that they remain the property of the state but have no public
117 interest (Oberndorf, 2005). As such, communities do not hold the right to dispose of
118 their land. In order to apply for ICT, a community must first register as an indigenous
119 community (IC) and be recognised as such by the Ministry of Interior.

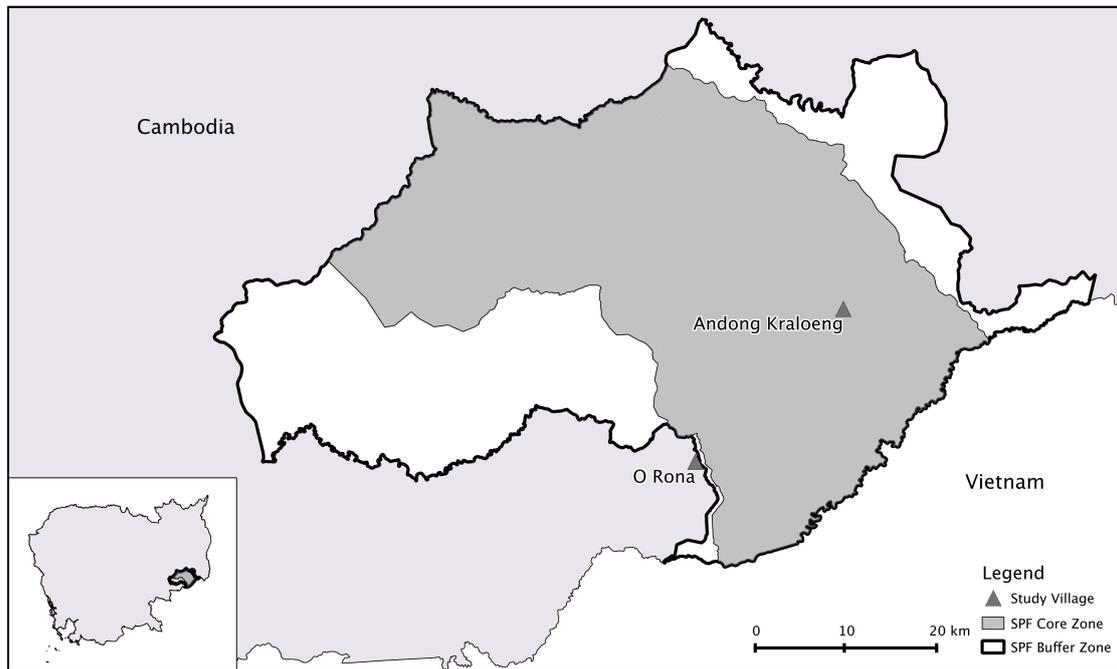
120 Whilst the 2001 Land Law provided the basis for ICT, the sub-decree detailing the
121 process by which communities can apply was not passed until 2009. For much of this
122 time it was unclear what legislation would follow, although it was widely believed
123 that the government would support PLUP. PLUP had first applied in Ratanakiri
124 Province in the 1990s and the government had subsequently shown an interest in
125 extending its use. As such, PLUP implementation was considered a first step towards
126 securing land tenure for communities and for defining the boundaries of customary
127 use within protected areas. Eventually, it became clear that PLUP would not make its
128 way into Cambodian legislation and at that point efforts switched to working within
129 the ICT framework. As a consequence of this and a lack of technical capacity within
130 the relevant government ministries, progress towards ICT has been slow, with only
131 seven villages having received title at the time of writing (a further 190 are planned;
132 Milne, *forthcoming*).

123 Despite legal reform recognising the rights of IPs and rural smallholder framers, land
124 disputes, alienation and large-scale land grabbing are frequent and widespread. While
125 large-scale land acquisitions are by no means a recent phenomenon in Cambodia, the
126 situation has been greatly exacerbated in recent years. The human rights NGO
127 ADHOC reports that 2,657,470 ha (approximately 17% of the total land area of the
128 country) had been granted as economic land concessions (ELCs) as of December
129 2012 (ADHOC, 2013). Not only has this had extreme implications for Cambodian
130 smallholder farmers but also for conservation. In 2012 alone, ELCs covering 381,121
131 ha were granted, of which over 70% occur within existing protected areas. Given the
132 high degree of overlap between Cambodia's indigenous peoples and the country's
133 protected area network, efforts to secure the customary rights of IPs may also serve as
134 added protection for protected areas.

135 **3. The Two Study Villages**

136 The study was undertaken in two villages, Andong Kraloeng and O Rona, in
137 Mondulkiri Province, northeastern Cambodia (Figure 1). Both villages are located
138 within a former logging concession in which operations were halted following a
139 nationwide moratorium in 2001. Shortly afterwards part of the concession was
140 converted into a protected area, Seima Biodiversity Conservation Area (SBCA),
141 managed by the Forestry Administration (FA) and Wildlife Conservation Society
142 (WCS). In 2009, SBCA was formally upgraded and became Seima Protection Forest
143 (SPF), covering a total area of 2,926 km². During the Khmer Rouge period, the area
144 was also totally abandoned as the predominant indigenous group, the Bunong, were
145 forcibly resettled in the lowland north of Mondulkiri, with the majority of families
146 returning in the 1990s and early 2000s. This resulted in a loss in traditional

147 knowledge of the customary land use and so, once the FA and WCS began working in
148 SBCA and subsequently SPF, they initiated a programme of working with indigenous
149 communities to map their customary use areas and to plan future land use. This
150 programme, which was piloted in Andong Kraloeng in 2003 and later expanded to
151 include other villages, involved a series of consultations with local communities,
152 following procedures based on the government's PLUP manual.



153

154 **Figure 1: Map of Seima Protection Forest (2,926 km²), showing the location of the two study**
155 **villages.**

156 Andong Kraloeng is a Bunong village, consisting of six smaller sub-village
157 settlements, located within the densely forested core zone of SPF on the main road
158 between Phnom Penh and the provincial capital, Sen Monorom. At the start of the
159 PLUP process in 2003, the village contained 89 households, the majority of whom
160 had returned to the village in the 1990s. This had increased to 124 households by
161 2012. Following consultations, a provisional IC was formed, the land of each
162 household was mapped and the former extent of customary use investigated using a
163 variety of sources (including historical topographical maps, aerial surveys, forest

164 inventories and local knowledge). On completion, a series of zones were created
165 delineating areas of different land use. The result of this process was a village area
166 covering 25,003 ha, broken down into zones for residential use (152 ha), traditional
167 agriculture (including land for expansion and rotation; 1158 ha), paddy rice (13 ha),
168 non-timber forest product (NTFP) extraction (23,584 ha), spirit forest (43 ha) and
169 burial forest (27 ha). These zones are managed by a village level committee, whose
170 members are drawn mainly from traditional village elders.

171 In addition to the creation of the different land use zones, the PLUP process supported
172 the creation of a series of rules governing household land use, made enforceable by
173 traditional village sanctions, to assist in the management of village land. These
174 regulations, which were largely drawn up from informal traditional practices, were
175 designed to allow the IC to plan for future growth but also to protect traditional
176 livelihoods. As such limits were put on the area of paddy land and permanent crops
177 allowed for each household. A village constitution, which detailed the formal
178 composition of the committee, the goals of the IC and criteria for IC membership, was
179 also drawn up. In 2008, the IC formally applied for legal recognition of their
180 customary land rights and, in 2010, this process led to the boundaries of some of
181 zones being re-drawn. Finally, in 2011, eight years after the process began a sub-
182 decree was passed recognising the rights of the Andong Kraloeng IC, making them
183 the third IC nationally to be granted rights over their customary land (UNOHCHR,
184 2011).

185 The second study village, O Rona, is located at the edge of SPF and the adjacent
186 Snoul Wildlife Sanctuary (SWS), managed by the Ministry of Environment (MoE).
187 Historically, the village was an indigenous Bunong community, which was

188 abandoned during the Khmer Rouge period and repopulated during the late 1980s and
189 1990s, but it has since been heavily affected by immigrant Khmer families seeking
190 land. This has resulted in uneven growth in the village's indigenous and immigrant
191 communities. In the period 2006 to 2012, the total number of households grew from
192 121 to 229, but only 28% of the additional households were Bunong. The nature of
193 this migration has resulted in five sub-village settlements, with two predominately
194 Khmer settlements and three Bunong settlements. O Rona is also situated close to
195 both the district capital and the border with Vietnam, and is consequently
196 considerably more integrated into the market economy than Andong Kraloeng and
197 most other Bunong villages within SPF. This has affected traditional livelihoods, with
198 a greater reliance on commercial agriculture readily apparent amongst Bunong
199 households. It also presents a greater threat to community lands from speculators and
200 immigrants. At the time that the PLUP process was initiated in O Rona in 2005, there
201 were 35 claims to land inside the traditional village boundary from households living
202 in other villages.

203 The PLUP process in O Rona followed a similar procedure to that used in Andong
204 Kraloeng. The main difference in O Rona was the number of Khmer migrant families
205 living in the village. Under the 2001 Land Law, households were entitled to claim
206 ownership of the land they occupied provided they could prove that their claim had
207 been uncontested for at least five years prior to the promulgation of the law. Land
208 claimed after 2001 was not eligible for private ownership and under law remained
209 state property. Although the PLUP process in O Rona included every household
210 living in the village, Khmer families were only permitted to retain the land they
211 already occupied. Any expansion of their land within those areas identified for future
212 agricultural use would be illegal under the 2001 Land Law. This created a two-tiered

213 system within the village with Khmer immigrant households granted fewer rights than
214 their returnee Bunong neighbours. Following the completion of zoning, the total area
215 within the village boundary was 3795 ha and consisted of zones for residential use
216 and traditional agriculture (536 ha), agricultural expansion (941 ha), NTFP extraction
217 (2274 ha) and spirit forest (44 ha).

218 With regards to the institutions created to manage the community zones, the O Rona
219 IC adopted the same rules that had previously been adopted by Andong Kraloeng to
220 govern land use within the village area, membership criteria of the IC, committee
221 composition and goals for the IC. These rules applied only to the Bunong households
222 and to the Khmer households present during the PLUP process. Recent settlers are not
223 governed by these rules as it is illegal for them to claim any land within community
224 zones. The application to have the community customary land recognised by the state
225 was made in 2009 and in December 2012, plots were re-measured, with the
226 expectation that title would be granted in 2013.

227 **4. Methods**

228 Fieldwork for the study was carried out in both villages between May and July 2012,
229 and consisted of a series of focus group discussions, household structured interviews
230 and land use mapping.

231 *4.1. Focus Group Discussions*

232 The aim of the focus group discussions was to gain a better understanding of land use
233 practices and to investigate local perceptions regarding land issues. Each focus group
234 consisted of 8-15 participants and lasted approximately two hours. In each village,
235 one focus group was held with members of the IC committee responsible for the

236 management of community zones. In O Rona, three additional focus group
237 discussions were held, which separated participants who had been present at the time
238 of the initial PLUP exercise and those who had not, as there is a strong distinction in
239 rights between newly arrived and resident households. In Andong Kraloeng,
240 immigration rates are low and the population relatively homogeneous, so this was not
241 deemed necessary.

242 *4.2. Household Interviews and Land Use Mapping*

243 Structured household interviews and land use mapping were conducted for 114
244 households, with 44 sampled in Andong Kraloeng and 70 in O Rona (approximately
245 one third of the households in each of the study villages), stratifying proportionally by
246 sub-village settlements and randomly sampling within each strata. No households
247 living outside either of the villages were sampled. This approach provided a cross-
248 sectional sample and was selected to ensure that newly arrived immigrants and newly
249 formed households were included in the study. As the original land use mapping
250 process included every plot of land within each community zone, a cross-sectional
251 survey design provided sufficient matches between the two time periods to allow for
252 simple panel analyses.

253 The purpose of the structured interviews was to collect socio-economic and land use
254 data for each household, as well as gathering information on perceptions of land
255 issues and knowledge of PLUP and ICT processes (see Supplementary Materials for
256 questionnaire used). Where possible, all interviews were conducted with the head of
257 each household and lasted for approximately 45 minutes. Following the completion of
258 each interview, all land parcels claimed by the respondent household were measured
259 by walking the parcel edge and recording the path taken on GPS. Observations were

260 made regarding the crops grown, the likely age of those crops and adjoining land uses
261 and owners to triangulate information given during interview.

262 *Land Use Mapping Check*

263 A series of 100 random points were sampled across each village area, and the owner
264 of each point identified, in order to monitor whether sensitive plots were being
265 withheld. Given that a significant proportion of households claim land illegally, it was
266 considered likely that participants might opt to withhold sensitive plots. As sampling
267 within each village was incomplete and did not cover land claimed by outside
268 interests, uncertainties existed regarding whether the team had been shown all plots
269 used by the households sampled. Recent land cover analysis (WCS, unpublished) and
270 satellite imagery were used to identify areas under cultivation. Random points were
271 generated within un-sampled areas of cultivated land for each settlement using
272 ArcMap version 10.0. Local guides or members of the village PLUP committees
273 assisted in identifying the landowner at each point. The names collated were then
274 cross-checked against the list of households already interviewed to ascertain whether
275 any plots had been withheld. This provided a measure of the number of withheld plots
276 for each village. In cases where plots had been withheld, the household head was re-
277 interviewed and the plot mapped.

278 *4.3. Spatial Compliance Analysis*

279 Land use compliance was measured against two sets of criteria: with the law and with
280 IC regulations governing land use within community boundaries. Plots measured in
281 2012 as part of this study were compared with those of each household as measured
282 during the previous PLUP process and with the various boundaries created through
283 both the PLUP and ICT processes. In certain cases, PLUP records were incomplete,

284 which had the effect of reducing the overall sample size for the compliance analyses
285 to 105 households. These spatial comparisons were carried out using Quantum GIS
286 version 1.8.0. A margin of error of 0.05 ha or 5%, depending on which was greater,
287 was used to allow for differences in digital and physical boundaries.

288 For Andong Kraloeng, these analyses were made more complicated as zone
289 boundaries were changed in 2010. This created a situation where plots that had
290 previously been compliant were made non-compliant and vice versa. In the former
291 case, plots were considered to be compliant for the purposes of this analysis, despite
292 the boundary changes. In the latter case, plots were considered non-compliant, as they
293 were outside community agricultural zones when initially cleared. For both cases, it
294 was necessary to use reported plot age, triangulated against observations made during
295 plot measurement, to check whether the plot had been cleared at the time the
296 boundaries were changed. For O Rona, the boundaries had not been changed at the
297 time of the survey so this was not an issue. In both villages, however, it was necessary
298 to correct for whether or not each household was a member of the IC. In Andong
299 Kraloeng, all non-members of the IC were excluded from holding land within the
300 community zone. In O Rona, households that were present in the village at the time of
301 PLUP were allowed to keep the land they owned at that time but any further
302 expansion was prohibited. If a household had moved to the village after PLUP, they
303 were excluded from claiming land as in Andong Kraloeng.

304 In addition to analysing land use compliance with the law, we also checked for
305 compliance with five regulations governing land use within IC managed zones. These
306 were regulations banning: 1) buying, selling or renting land, 2) clearance of spirit or
307 burial forest, 3) using over 2 ha of land for permanent crops per household, 4) using

308 over 1 ha of land for cultivation of paddy rice per household and 5) exceeding 5 ha of
309 cultivated land per household. In each case, if these regulations had been exceeded
310 prior to the rules being drawn up, then the household was considered compliant
311 provided that there were no new infractions. For example, if a household cultivated 7
312 ha of land prior to PLUP, they were allowed to keep all 7 ha. If, however, they
313 subsequently cleared more land within the community zone, they were judged to be
314 non-compliant with the 5 ha area limit. For the purposes of this analysis, only land
315 within the community zones was considered, as the IC regulations only govern land
316 use within these zones.

317 *4.4. Statistical Modelling*

318 All statistical analysis was carried out using R version 2.15.1, on RStudio version
319 0.97.314. Within R, the lme4 package version 0.999375-36 was used to analyse all
320 model. Linear and generalised linear mixed models (LMMs; GLMMs) were selected
321 using backwards step-wise selection methods based on the small sample size
322 corrected Akaike Information Criterion (AICc; Akaike, 1974; Burnham & Anderson,
323 2002). Models with the lowest AICc were selected except in cases where a more
324 parsimonious model was found with a Δ AICc value of less than two. Settlement was
325 included as the only random effect in all models (see Supplementary Materials for a
326 list of the explanatory variables considered for each model).

327 In order to model the area of household land claimed illegally, we used a hurdle
328 modelling approach to account for the high number of zero values (Mullahy, 1986).
329 Compliance with the 2001 Land Law was modelled first using a simple binary
330 variable. Subsequent modelling of illegal land area claimed was carried out only for
331 those households with some illegal land. All area variables were transformed using

332 natural logarithms. In cases where area variables contained zero values, a constant
333 equal to half the lowest non-zero value, was first added to all data points. The
334 exception to this was for the model of total area claimed per household. For this
335 model, three zero value data points were removed and the sensitivity of the
336 coefficients tested. Removing these data points did not have a significant effect on the
337 model estimates and greatly aided interpretation of the results.

338 In each case, once the final model had been selected, visual validation was conducted
339 to check for residual normality, heteroskedasticity and possible correlations between
340 fixed effects and the residuals. Over-dispersion in binomial logistic regression models
341 was checked by comparing the sum of squared Pearson residuals with the
342 approximate residual degrees of freedom.

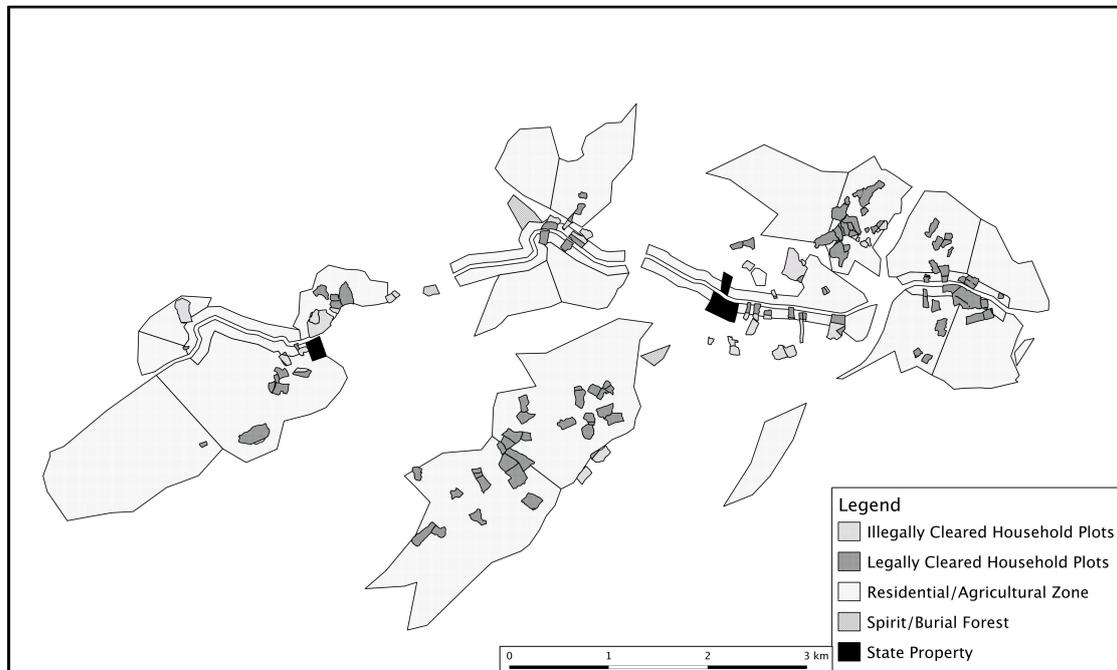
343 **5. Results**

344 *5.1. Land Use Change in the Two Villages*

345 *Andong Kraloeng*

346 In Andong Kraloeng, 44 households were interviewed, of which 43 currently claim
347 land (Figure 2). The area claimed by these households totalled 133 ha, with 119 ha in
348 cultivation. This represents a significant expansion in the average area of land under
349 cultivation per household, increasing from 1.0 ha in 2004 to 2.7 ha in 2012.
350 Extrapolating this land use for the entire village population gives a total area under
351 cultivation of 334 ha, which remains a small fraction of the 1398 ha granted to the IC
352 for agricultural and residential purposes, and shows that there remains considerable
353 scope for agricultural expansion. In practice, the total area of cultivated land within
354 the community zones is likely to be lower than this projection, as 19% of cultivated

355 land claimed by sampled households lay outside of the 2011 titled community
356 boundaries (this is a different figure from that produced by the compliance analysis
357 below due the boundary changes in 2010).



358

359 **Figure 2: Map of household land use in Andong Kraloeng for the 43 households sampled.**

360 A shift away from traditional indigenous land use systems was also observed. As such
361 systems tend to be highly diverse, with many different crops commonly grown in
362 small amounts around the edge of the same parcel of land (Baird & Dearden, 2003),
363 we limit ourselves here to discussing changes to the dominant crop in each field. The
364 most dramatic change observed is the transition to commercial agriculture. In 2004,
365 the average area under some form of cash crop cultivation was 0.6 ha per household,
366 or 60% of the land under cultivation. Much of this land, however, was also used to
367 grow upland rice varieties intercropped with the main cash crop. For instance, 0.5 ha
368 per household, equivalent to half of all land use within the village, was used for
369 cashew plantations with rice grown underneath or between young trees. On average,
370 85% of all land cultivated had rice as the dominant or intercropped crop.

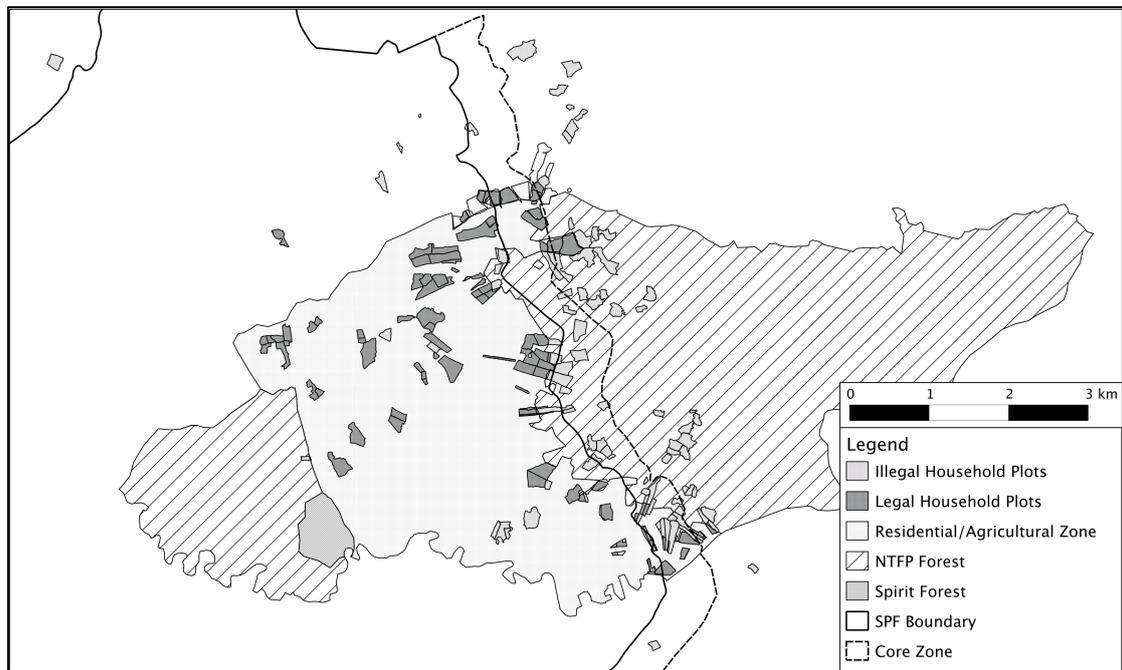
371 By 2012, the average area of cash crops had risen to 2.5 ha per household, or 93% of
372 the area cultivated, making the increase in cash crops greater than the observed
373 increase in overall land use. The majority of this increase is accounted for by the
374 emergence of cassava, a crop that was unrecorded in 2004. In 2012, the average
375 cultivated area of cassava was 1.8 ha per household (67% of the cultivated area), with
376 1.4 ha per household intercropped with cashew. In contrast, the importance of rice
377 had dropped, with only 0.2 ha (7% of the cultivated area) per household cultivated
378 with rice as the dominant or intercropped crop.

379 Not only does this show an increasing reliance on producing cash crops and using the
380 revenues generated to buy rice instead of growing it, but it also shows a break down
381 of traditional rotational farming. As of 2012, cashew, a semi-permanent tree crop, was
382 present in approximately 50% of cultivated land, much of which was formerly used
383 for growing rice. As cashew is considered to have a 20 year productive life span, land
384 that would formerly be returned to fallow, and therefore collective ownership, is now
385 being retained as individually claimed land (albeit within communal title) through the
386 planting of cashew.

387 *O Rona*

388 The average land holding in 2012 for the 70 households sampled in O Rona was 4.8
389 ha (Figure 3), significantly more than in Andong Kraloeng. This represents an
390 increase of 1.7 ha (or 55%) per household from 2006, when fields were mapped as
391 part of the PLUP process. As with Andong Kraloeng, these figures demonstrate a
392 rapid expansion in the land being cultivated. There was a significant difference in the
393 area of land claimed between households that were part of the IC and those that were
394 not. For matched households, members of the IC claimed on average 6.3 ha (up from

395 4.2 ha in 2006), whereas non-IC members claimed only 3.5 ha (up from 2.5 ha in
396 2006). This represents a similar rate of growth for both types of household.



398 **Figure 3: Map of household land use in O Rona for the 70 households sampled.**

399 Commercial agriculture was already widely practiced in 2006, with some form of
400 cash crops grown on 94% of agricultural land. In 2012, the proportion of agricultural
401 land involved in commercial cropping was essentially unchanged (88% of cultivated
402 lands), although the absolute area was much increased. The main observed difference
403 between the two time periods was the change in intercropping practices between
404 commercial and subsistence crops. In 2006, 59% of agricultural land (1.8 ha per
405 household) had a commercial crop as the dominant crop but was intercropped with
406 rice. This had fallen to just 5% of cultivated land (0.2 ha per household) by 2012.
407 Overall, the area per household on which rice was grown had contracted slightly from
408 0.8 to 0.6 ha per household. In contrast, though, the area on which it was grown as the
409 dominant or sole crop had increased from 0.2 to 0.6 ha per household, largely through

410 new areas suitable for paddy farming being cleared. This shows an increasing
411 delineation between areas assigned to growing cash crops and to rice.

412 As with Andong Kraloeng, the most dramatic shift in O Rona has been the uptake of
413 cassava, which was first introduced in 2005. Less than 0.1 ha per household was
414 being grown in 2006 but this had increased to over 3 ha per household by 2012. This,
415 in part, is driving the changes observed in rice growing practices, as cassava is often
416 sold to traders by the field. Households, often those short of labour, agree a sale price
417 set by the area of their field and quality of the cassava, as opposed to harvesting and
418 processing the cassava themselves. Consequently, it makes sense for households to
419 have separate plots for different crops, even within the same field.

420 The emergence of cassava has also changed the area given to semi-permanent crops.
421 In 2006, the average household had 2.8 ha of permanent crops, largely intercropped
422 with rice, but by 2012 this had dropped to 1.9 ha and was intercropped with cassava
423 instead. This demonstrates a trend reported during household interviews that some
424 farmers have chosen to replace areas previously planted with semi-permanent crops
425 with cassava. Overall, however, the reduction in area planted with semi-permanent
426 crops does not indicate a return to traditional rotational cultivation as cassava is being
427 grown year after year, despite fears of declining yields.

428 *Household land holdings*

429 The final selected model for the total log transformed area of land claimed by each
430 household included three significant explanatory variables (Table 1): the age of the
431 head of the household, whether or not they had arrived after the PLUP process was
432 completed and an adjusted poverty score based on the basic necessity survey
433 methodology (Davies, 1997; see Supplementary Materials for an explanation of how

434 this score was calculated). This meant that, contrary to predictions, neither household
435 livelihood options nor available labour had a significant effect on land holdings.

436 **Table 1: Parameter estimates for the household land holdings GLMM, with ln(area) as the**
437 **response variable. One random effect was included in the model: settlement (s.d. = 0.191). The**
438 **full list of variables modelled, plus their explanations, are given in Supplementary Materials.**

Variable	Estimate	SE	t value
intercept	-2.565	0.503	-5.095
age	0.015	0.006	2.526
BNS score	0.338	0.049	6.828
immigrant	-0.622	0.199	-3.132

439 There is a positive effect of age on household land holdings, predicting an increase of
440 1.5% in the area claimed for every year increase in the age of the household head. A
441 much stronger correlation was found for the adjusted BNS score. In this case a unit
442 increase in adjusted BNS score was found to result in an increase of 34% in the total
443 area claimed. This results in a predicted 232% difference in the total area of land
444 claimed between better off and poorer families. Immigrant households, however, were
445 found to have smaller land holdings, with the model estimates predicting that
446 households that arrived after the PLUP process would on average have 62% less land.

447 *5.2. Household Compliance*

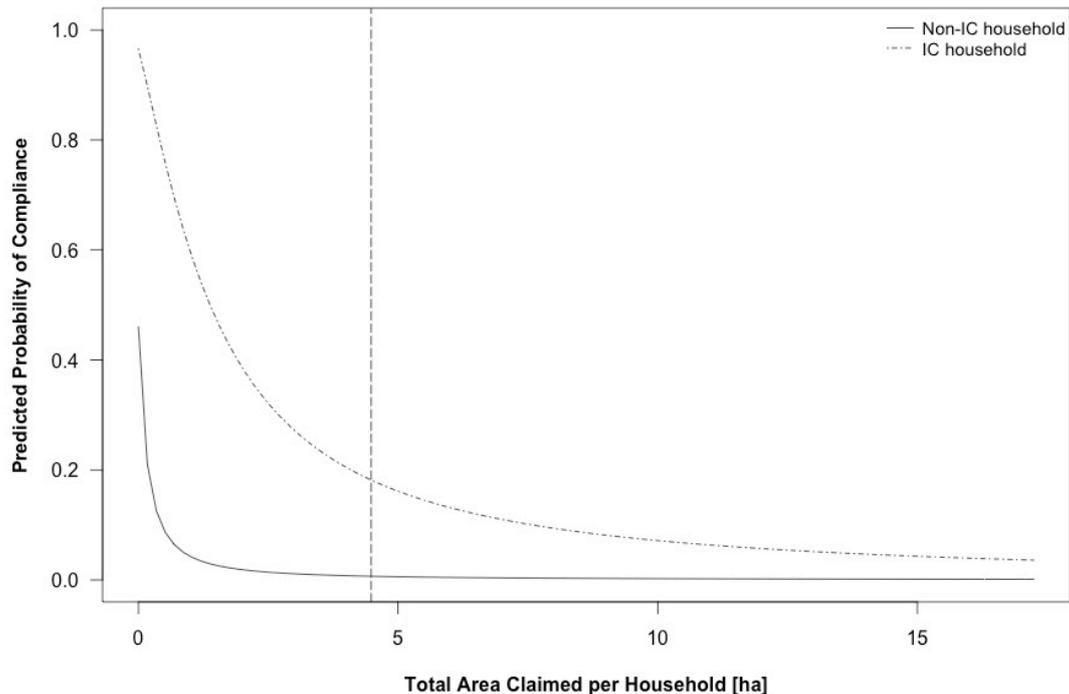
448 *Compliance with the 2001 Land Law*

449 Overall, there were high levels of non-compliance in both study villages, although
450 distinct differences in behaviour between the two were observed. In Andong Kraloeng,
451 where compliance was higher, 26% of cultivated land had been cleared outside agreed
452 boundaries, whereas the figure for O Rona was 47%. Similarly, while 52% of
453 sampled households in Andong Kraloeng were found to have some illegal land, this
454 figure was 79% in O Rona. Comparing the performance of the indigenous

455 communities within each village reduces this difference slightly, with 49% of IC
456 member households non-compliant in Andong Kraloeng and 67% in O Rona.

457 In order to investigate compliance, we first looked at whether or not a household
458 claimed any illegal land, constructing a GLMM with a binary household compliance
459 variable as the response (see Supplementary Materials for model summary table).
460 Only two explanatory variables considered for selection were included in the final
461 model: whether the household was part of the village IC and the natural log
462 transformed area claimed by each household. The difference in compliance between
463 the two villages was accounted for by the inclusion of the settlement lived in by each
464 household as a random effect in this model.

465 As the interpretation of logistic regression coefficients is not intuitive for log
466 transformed variables with constants added to account for zero values, we plot the
467 effect of the area claimed by each household for both IC and non-IC member
468 households (Figure 4). Among non-IC member households, only those with very little
469 land are likely to comply with the law. This result is, perhaps, unsurprising, as non-IC
470 members have little right to land within either village. As the majority of sampled
471 non-IC member households live in O Rona, this result strongly reflects the two-tiered
472 system that was created there. In fact, the only non-member households that have not
473 claimed land illegally are the ones that claim no land at all and provide labour for
474 other households. None of the 20 sampled non-IC member households that were
475 present in the village in 2006 were found to be compliant with the law in 2012.



476

477 **Figure 4: Predicted probabilities of compliance with the 2001 Land Law for non-IC and IC**
 478 **households. The vertical dashed line shows the average area claimed per household for the whole**
 479 **sample.**

480 Comparing the curves for IC and non-IC households reveals a strong positive effect
 481 on compliance of being an IC member. This effect diminishes rapidly, however, as
 482 the area of land claimed increases. The predicted probability of being compliant with
 483 the law for an IC member claiming the average area of land is just over 0.2,
 484 illustrating the very low levels of compliance for families with greater than average
 485 land holdings (Fig. 4).

486 The second part of the compliance hurdle analysis comprised a linear model with the
 487 log-transformed area of illegal land claimed by non-compliant households as the
 488 response. Three fixed effects were included in the final model (Table 2): the total area
 489 claimed by each household, whether households were members of the IC and whether
 490 the household head belonged to one of the region's indigenous groups. This final
 491 variable was possible because several Khmer men have married Bunong women and

492 moved into their wives' home villages. Under the rules drawn up by each IC, these
 493 households automatically become IC members even though the head of the household
 494 is Khmer.

495 **Table 2: Parameter estimates for the illegal household land holdings model, with ln(illegal area)**
 496 **as the response variable. P values significant at the 95% confidence level are shown in bold. The**
 497 **full list of variables modelled, plus their explanations, are given in Supplementary Materials.**

Variable	Estimate	SE	P value
intercept	-0.359	0.156	0.025
ln(area)	1.084	0.107	<< 0.000
IC member	-0.500	0.246	0.046
indigenous	-0.521	0.245	0.037

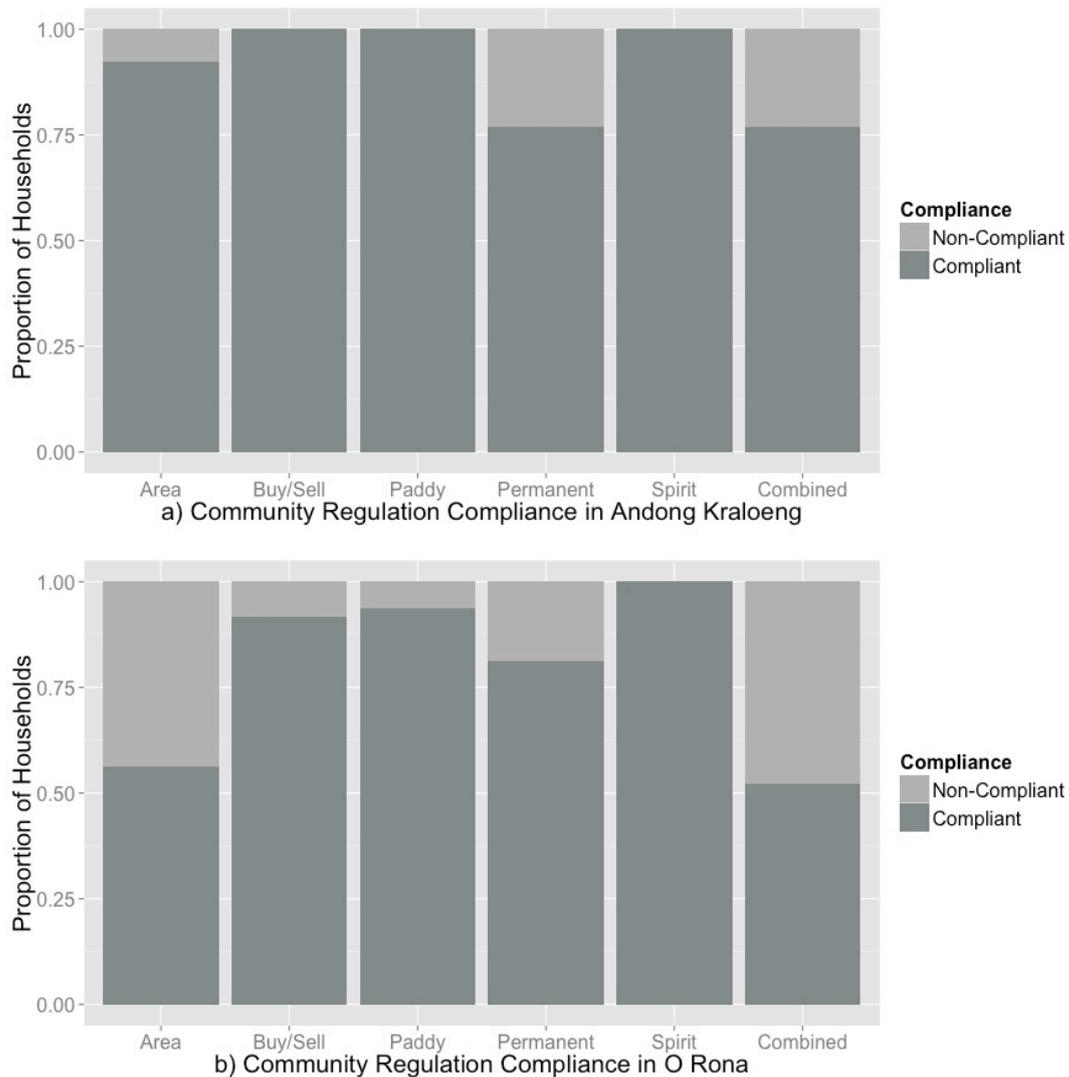
498 The results of this model again show a strong correlation between the response
 499 variable and the total area of land claimed by each household. In this case, an increase
 500 in the total area of 1% would result in a 1.1% increase in the area of illegal land
 501 claimed per household, suggesting that households claim legal and illegal land in
 502 roughly equal proportion.

503 More informative, from the perspective of evaluating the outcomes of the PLUP and
 504 ICT processes, are the effect estimates for being an IC member at the time of the
 505 PLUP process and for the household head identifying themselves as indigenous. The
 506 effects of these two variables are comparable, with an approximate 50% reduction in
 507 the predicted area of illegal land claimed in both cases. This suggests that, even
 508 among those households that have claimed land illegally, there is a positive effect on
 509 compliance from being a member of an IC. The second of these two results suggests
 510 that, holding the effect of being an IC member constant, households with indigenous
 511 heads claim less illegal land than those from non-indigenous backgrounds. As such,
 512 households headed by indigenous individuals may have a lower impact on the forest
 513 than other groups.

514 *Compliance with Community Regulations*

515 The second aspect of household compliance considered was whether households
516 complied with a set of five regulations that were drawn up as part of the original
517 PLUP agreements in each village and which govern land use within community zones.
518 Overall, IC regulations experienced a higher rate of compliance than the 2001 Land
519 Law. In Andong Kraloeng, 77% of households were found to be compliant with all
520 five IC regulations considered. In O Rona, the figure was lower, with 52% of
521 households compliant.

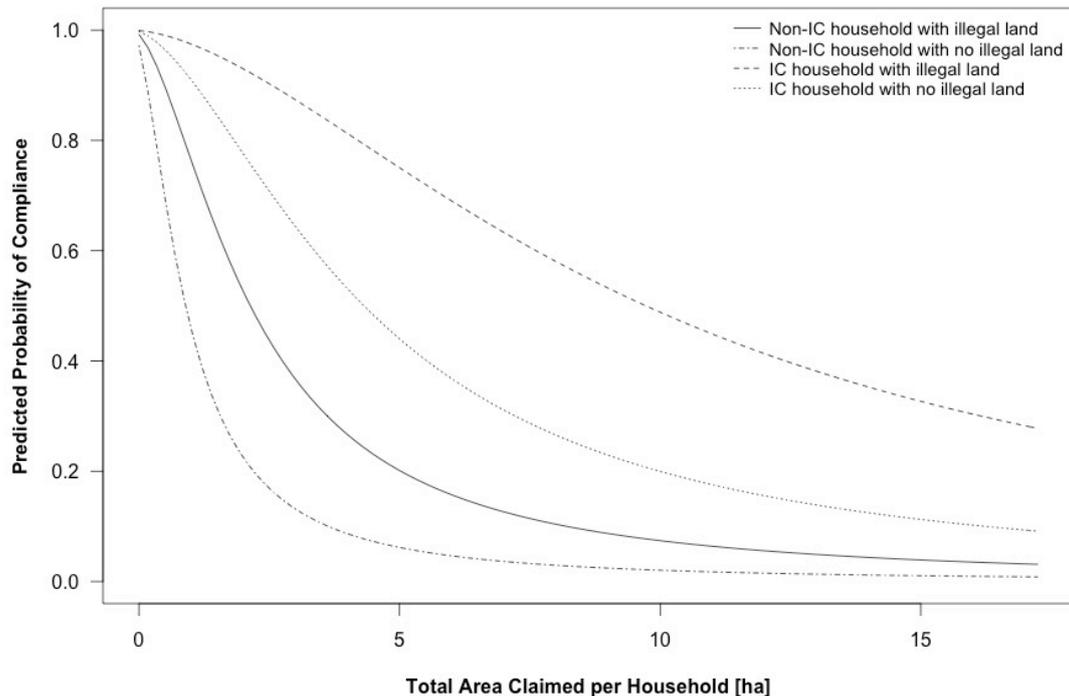
522 In Andong Kraloeng, three of the rules were obeyed by every household sampled:
523 those prohibiting the buying and selling of land, clearing land in spirit and burial
524 forest and exceeding 1 ha of paddy land (Fig. 5a). The regulation with the lowest level
525 of compliance was the limit on permanent crop area, with all households who were
526 not totally compliant breaking this rule. This reflects the changes in the traditional
527 rotational cultivation system observed earlier. In O Rona, only the ban on clearance of
528 burial or spirit forest was completely observed (Fig. 5b). In contrast to Andong
529 Kraloeng, nearly 50% of households were found to be breaking total area restrictions
530 within the community zones. In part, this was due to non-IC member households
531 claiming land that they had not possessed in 2006. At 68%, the compliance rate for IC
532 members was still lower than in Andong Kraloeng, but slightly higher than for the
533 village overall.



534

535 **Figure 5: Proportion of households sampled found to be compliant with the five IC regulations**
 536 **considered in a) Andong Kraloeng and b) O Rona.**

537 A mixed model approach to analysing IC regulation compliance was deemed
 538 unnecessary in this case, as no difference was observed in compliance between
 539 settlements. Instead, a generalised linear model (GLM) was produced, with three
 540 explanatory variables included in the final selected model: the log-transformed total
 541 area claimed per household, whether the household was an IC member and whether
 542 the household claimed some illegal land. (Figure 6; see Supplementary Materials for
 543 coefficient estimates).



544

545 **Figure 6: Predicted probabilities of compliance with IC regulations.**

546 In this plot, it is apparent that increased total area claimed by each household is
 547 associated with a significant reduction in the probability of compliance with the set of
 548 five IC regulations. This effect is most striking for non-IC members. Comparing the
 549 curves for non-IC and IC households, it is also clear that once again there is a strong
 550 positive effect on compliance associated with a household belonging to the village IC.
 551 Again, this is as expected given the two-tier system in place in O Rona, in which non-
 552 IC members were afforded little right to land. Crucially, non-member households are
 553 not represented on the committee that manages community land. It is unsurprising,
 554 therefore, that households do not comply with regulations on which they have no say.
 555 Interestingly, the correlation between compliance with IC rules and compliance with
 556 the 2001 Land Law was negative. Comparing the curves for households with and
 557 without illegal land, it is evident that households claiming illegal land have a greater
 558 probability of being compliant with the regulations governing land use in community

559 zones. This implies that households may seek to circumvent IC regulations by
560 clearing land outside of community zones.

561 **6. Discussion**

562 This study reveals households in two villages responding to tenure reform and land
563 use change drivers in different ways. In Andong Kraloeng, compliance with both the
564 land use plans that were created as part of the tenure reform process and the
565 regulations that govern land use in community zones is relatively high. In O Rona, a
566 village that has been strongly exposed to market forces and immigration, compliance
567 rates were much lower, with extensive illegal land clearance within conservation
568 areas and illegal settlement of Khmer migrants observed. The reasons behind these
569 differences are complex and multi-faceted, yet they provide valuable lessons for
570 further implementation of ICT in Cambodia, and PLUP more widely.

571 The most significant difference between the two villages is the degree to which they
572 have been exposed to outside interests. Milne (*forthcoming*) reports that over 500
573 ‘outsiders’, ranging from smallholder farmers to influential politicians, claim land
574 inside the provisional community zone in O Rona. This is in addition to the families
575 that have moved into the village unopposed. As a direct result of losing land to these
576 outside interests, the boundaries that will be included in the O Rona ICT have been
577 substantially redrawn from those that were included in the original ICT application.
578 That application contained plans for 1477 ha to be granted for communal agriculture
579 and residential use, while only 648 ha has been included within the redrawn
580 boundaries. Furthermore, the entire western NTFP forest zone, which initially covered
581 an area of 446 ha, has either already been deforested or has been designated as
582 agricultural expansion land to compensate for other losses.

583 It is debatable how much individual households have been involved in the sale of
584 community land. Access to land designated for indigenous community title claims is
585 often achieved through the use of intimidation, misinformation and stealth (Fox et al.,
586 2008; Milne, *forthcoming*). Under the 2001 Land Law, communities are not granted
587 disposal rights, which makes all sales of land within ICTs illegal, but this has not
588 stopped sales. Although we found little evidence of direct sales of land parcels, a
589 recent study of tenure policy changes introduced to O Rona after the study was
590 completed reports frequent selling of plots by Bunong to migrant Khmer families or
591 outside land speculators (Milne, *forthcoming*). Such sales are considered shameful
592 and, hence, frequently carried out in private (Fox et al., 2008). As such, reported
593 compliance with the ban on buying and selling land in O Rona may under-estimate
594 actual sales. However, a comparison of land mapped for IC households matched
595 between the two time periods (and for whom the head of the household has remained
596 the same) shows that 74% of the land mapped in 2006 has been retained. Given that
597 households are expected to have given some of this land as wedding gifts when their
598 children married, it is possible that the case of IC households selling land in use has
599 been overstated (although this does not preclude the selling of previously unclaimed
600 community land).

601 Whilst the extent to which IC households have been involved in the sale of land to
602 outside interests is unclear, it is evident that the influx of external claims on
603 community land has had a negative impact on IC households. In interviews, IC
604 members frequently expressed frustration at their inability to exclude outsiders and
605 the loss of community land. For example, one woman told us that “before people used
606 to try to stop the immigrants, but now we fear outsiders because they are rich and
607 powerful.” It is clear to them that their claim on the land, although recognised under

608 law, is insecure, thereby eroding one of the main benefits of the provision of tenure.
609 Only 6% of IC members in O Rona reported that they felt secure in their tenure, with
610 most respondents worried about economic land concessions or powerful immigrants
611 taking their land (in comparison 72% of IC respondents in Andong Kraloeng felt
612 secure). This in turn was used as a justification for clearing outside of designated
613 community zones. As one man put it, “we have to clear outside the community
614 boundaries because there is no more land available”. Despite these pressures, however,
615 the PLUP and ICT processes appear to have benefited conservation efforts in the
616 village, as IC members were less likely to claim illegal land and when they did claim
617 illegal land, they claimed 50% less land than non-IC members.

618 In Andong Kraloeng, the IC has made a concerted effort to prevent large scale
619 migration into the village, making access to land for outside interests significantly
620 more difficult (albeit the village is under less pressure). In part, this can be attributed
621 to the village situation at the time PLUP was initiated. Unlike in O Rona, where the
622 two-tier system was necessitated in response to already high levels of in-migration
623 from non-indigenous households, Andong Kraloeng had very few migrant households
624 settle in the village. Of the 44 households sampled in this study, only five were
625 migrant households. This has contributed to a stronger sense of community identity
626 and ownership of customary lands, as well as greater belief in their right to exclude
627 outside interests from their land. As such, those conditions most commonly associated
628 with positive outcomes for tenure reform have been achieved and compliance
629 (particularly in regard to IC rules) has benefited (Ostrom, 1990).

630 The study also highlighted the importance of local institutions and management of
631 community resources. Despite the generally positive outlook for Andong Kraloeng,

632 there appears to have been a breakdown of the traditional rotational cultivation system
633 in response to the emergence of cash crops over the past decade. This does not
634 necessarily represent a failing of the PLUP process as no system can be expected to
635 remain static over time, particularly in the face of rapidly changing socio-economic
636 conditions. It does, however, underscore the importance of allowing for possible
637 changes as part of the planning process and for ensuring that the institutions that are
638 created to manage community zones have the capacity to be able to respond to those
639 changes. As agriculture becomes more commercialised in Andong Kraloeng, it
640 remains to be seen whether social institutions within the village can adapt, particularly
641 if it brings influential households into conflict with IC regulations. The results of the
642 household analyses support this, with those households with greater land holdings (i.e.
643 older, more affluent and more established households) more likely to be non-
644 compliant with community boundaries and regulations and also found to claim more
645 illegal land if non-compliant.

646 In O Rona, IC members frequently queried IC regulations and restrictions on area
647 when committee members (i.e. those charged with managing community resources)
648 and other community leaders failed to observe them. The average land holdings for
649 such leaders in O Rona was 8.6 ha, well above the limit of 5 ha set down in IC rules.
650 In contrast, similar leaders in Andong Kraloeng claimed on average just 2.9 ha, which
651 is below the village average. Similarly, there was a strong difference in perceptions of
652 the IC committee's role in each village. In Andong Kraloeng, there was a much
653 greater level of understanding that the responsibility for monitoring and sanctioning
654 households who were non-compliant with the land use plans was split between the
655 committee and the protected area authorities. Whilst 44% of IC respondents in
656 Andong Kraloeng mentioned the committee when asked who enforced the land use

657 plans, the figure in O Rona was only 17%. These results demonstrate the importance
658 of the social processes and institutions, both formal and informal, which support the
659 management of community land and maintain compliance with the defined
660 community boundaries and regulations. In O Rona, where the overall perception of
661 the local management institution, the IC committee, is seen as being ineffective,
662 corrupt and failed, the PLUP and ICT processes are considered to be externally
663 imposed interventions, and not supported. Hence, compliance is low.

664 This has important implications for how PLUP and ICT are implemented elsewhere.
665 In SPF, for example, improved road access to more remote villages, and the
666 increasing threat of land alienation caused by economic land concessions, has led to
667 the acceleration of the ICT process. Whilst this has been forced by the changing
668 institutional conditions to which these villages are exposed, the FA and WCS must be
669 careful to ensure that the necessary support of local social institutions, which are
670 critical to the successful implementation and sustainability of IC managed lands, are
671 not neglected. With its origins in the recognised need to support and empower local
672 voices, this lesson is also particularly relevant to the implementation of PLUP projects.

673 Similarly important, is the need to ensure the ongoing presence of compliance
674 monitoring, both within the community zones and the protected area, and to provide
675 external support for this where required. The considerable loss of community lands in
676 O Rona and the perceived inability of IC members to prevent it clearly demonstrates
677 that simply supporting a community through the legal processes required to apply for
678 tenure is not sufficient. External political support may be necessary to assist
679 communities in excluding outside interests from illegal land grabs. Without this the

680 security that the establishment of tenure should introduce may not materialise, leading
681 to some of the issues observed in O Rona.

682 Conversely, it may also be necessary to provide stronger enforcement of community
683 boundaries. Unenforced boundaries will fail to induce sufficient incentive for local
684 institutional development and effective management of community resources. In
685 Andong Kraloeng, where the threat of external land grabbing is low and available
686 land is far from scarce, 26% of land has still been cleared illegally. While it is
687 possible that this is due to a lack of understanding of the rules that govern land use or
688 of the where the boundaries of each zone lie, it is considered more likely that these
689 areas have been cleared despite an understanding that to do so would be illegal (90%
690 of IC respondents in Andong Kraloeng displayed some understanding of the land use
691 plan). Effective policing of such infractions are likely to increase the need to manage
692 land use within community zones more effectively also. This is supported by the
693 result of the community regulation compliance model, which suggested that
694 household may offset their non-compliance of community rules through land use
695 outside of community boundaries. As such, protected area authorities should support
696 community monitoring and exclusion of outside interests within community
697 boundaries, whilst ensuring adequate enforcement of community expansion beyond
698 those boundaries.

699 *6.1. Conclusion*

700 Through this study, we have seen how two contrasting villages have coped with
701 implementing tenure reform. In one village, the evidence presented supports the
702 proposition that tenure reform in protected areas conducted with the participation
703 indigenous communities can have positive outcomes for biodiversity conservation (in

704 this case, retention of forest cover) whilst providing communities with the rights to
705 customary lands. In the other, these positive effects have been negated by severe
706 disruption from outside interests, powerful market forces and a failure in leadership
707 on the part of those local institutions created to manage communal lands. For PLUP
708 and ICT projects to be successfully implemented in Cambodia, and further afield,
709 communities must be provided with the institutional support necessary to protect and
710 manage their resources.

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References

- Adams, W. 2004. *Against extinction*. Earthscan, London.
- Adams, W., Aveling, R., Brockington, D., Dickson, B., Elliot, J., Hutton, J., Roe, D., Vira, B. Wolmer, W. 2004. Biodiversity conservation and the eradication of poverty. *Science*. 306 (5699), 1146–1149.
- ADB. 2002. *Indigenous peoples/ethnic minorities and poverty reduction, Cambodia*. Asian Development Bank, Manila.
- ADHOC. 2013. *A turning point? Land, housing and natural resources rights in Cambodia in 2012*. Cambodian Human Rights and Development Association (ADHOC), Phnom Penh.
- Agrawal, A. & Gibson, C.C. 1999. Enchantment and Disenchantment: The Role of Community in Natural Resource Conservation. *World Development*. 27 (4), 629–649.

- Akaike, H. 1974. A new look at the statistical model identification. *IEEE Transactions on Automatic Control*. 19 (6), 716–723.
- Baird, I. G. 2000. *The Ethno-ecology, Land Use, and Livelihoods of the Brao-Kavet Indigenous Peoples in Kok Lak Commune, Veun Sai District, Ratanakiri Province, Northeast Cambodia*. Ban Lung. The Non-Timber Forest Products Project, Cambodia.
- Brockington D, Igoe J. 2006. Eviction for Conservation: A Global Overview. *Conservation & Society*, 4 (4), 24-70.
- Baird, I.G. & Dearden, P. 2003. Biodiversity conservation and resource tenure regimes: a case study from northeast Cambodia. *Environmental management*. 32 (5), 541–550.
- Berkes, F. 2009. Community conserved areas: policy issues in historic and contemporary context. *Conservation Letters*. 2 (1), 20–25.
- Berkes, F. 2004. Rethinking Community-Based Conservation. *Conservation Biology*. 18 (3), 621–630.
- Bourgoin, J. 2012. Sharpening the understanding of socio-ecological landscapes in participatory land-use planning. A case study in Lao PDR. *Applied Geography*. 34 (null), 99–110.
- Bray, D.B., Merino-Perez, L., Negreros-Castillo, P., Segura-Warnholtz, G., Torres-Rojo, J. M., Vester, H.. Mexico's Community-Managed Forests as a Global Model for Sustainable Landscapes. *Conservation Biology*. 17 (3), 672–677.
- Burnham, K., Anderson, D., 2002. *Model selection and multi-model inference*. Springer, New York.
- Colchester, M. 2004. Conservation policy and indigenous peoples. *Environmental Science & Policy*. 7 (3), 145–153.
- Cronkleton, P., Albornoz, M.A., Barnes, G., Evans, K., Jong, W. 2010. Social Geomatics: Participatory Forest Mapping to Mediate Resource Conflict in the Bolivian Amazon. *Human Ecology*. 38 (1), 65–76.
- Curran, L.M., Trigg, S.N., McDonald, A.K., Astiani, D., Hardiono, Y., Siregar, P., Caniago, I., Kasischke, E. 2004. Lowland forest loss in protected areas of Indonesian Borneo. *Science*. 303 (5660), 1000–1003.
- Davies, R. 1997. Beyond wealth ranking: The democratic definition and measurement of poverty. Briefing note. ODI workshop "*Indicators of Poverty: Operational Significance*", London.
- Ducourtieux, O., Laffort, J.-R. & Sacklokhham, S. 2005. Land Policy and Farming Practices in Laos. *Development and Change*. 36 (3), 499–526.
- Engel, S., Pagiola, S. & Wunder, S. 2008. Designing payments for environmental services in theory and practice: An overview of the issues. *Ecological Economics*. 65 (4), 663–674.

- Fairhead, J., Leach, M. & Scoones, I. 2012. Green Grabbing: a new appropriation of nature? *Journal of Peasant Studies*. 39 (2), 237–261.
- Fox, J., Troung, D., Rambo, A., Tuyen, N., Leisz, S. 2000. Shifting cultivation: a new old paradigm for managing tropical forests. *Bioscience*. 50 (6), 521–528.
- Fox, J., McMahon, D., Poffenberger, M., Vogler, J. 2008. *Land for my grandchildren: land use and tenure change in Ratanakiri 1989-2007*. Community Forestry International and East-West Center.
- Larson, A.M. 2011. Forest tenure reform in the age of climate change: Lessons for REDD+. *Global Environmental Change*. 21 (2), 540–549.
- Lestrelin, G. 2010. Land degradation in the Lao PDR: Discourses and policy. *Land Use Policy*. 27 (2), 424–439.
- Lestrelin, G., Bourgoin, J., Bouahom, B. & Castella, J.-C. 2011. Measuring participation: Case studies on village land use planning in northern Lao PDR. *Applied Geography*. 31 (3), 950–958.
- McCall, M. K., Minang, P. A., 2005. Assessing Participatory GIS for Community-Based Natural Resource Management: Claiming Community Forests in Cameroon. *The Geographical Journal*, 171, (4), 340-356.
- Milne, S. *forthcoming*. Under the leopard's skin: Land commodification and the dilemmas of indigenous communal title in upland Cambodia. *Asia Pacific Viewpoint*.
- Milne, S. & Niesten, E. 2009 Direct payments for biodiversity conservation in developing countries: practical insights for design and implementation. *Oryx*. 43 (04), 530.
- Mullahy, J. 1986. Specification and testing of some modified count data models. *Journal of Econometrics*. 33 (3), 341–365.
- Oberndorf, R. B. 2005. *Legal analysis of forest and land laws in Cambodia*. Community Forestry International, Phnom Penh.
- Ostrom, E., 1990. *Governing the commons: the evolution of institutions for collective action*. Cambridge University Press, Cambridge.
- Porter-Bolland, L., Ellis, E.A., Guariguata, M.R., Ruiz-Mallén, I., Negrete-Yankelevich, S., Reyes-García, V. 2012. Community managed forests and forest protected areas: An assessment of their conservation effectiveness across the tropics. *Forest Ecology and Management*. 268 (null), 6–17.
- Simbolon I. 2009. Law reforms and recognition of indigenous peoples' communal rights in Cambodia. In: J. Perera (ed.), *Land and cultural survival: The communal land rights of indigenous peoples in Asia*. Manila: Asia Development Bank.
- Sunderlin, W., Hatcher, J. and Liddle, M. 2008. *From Exclusion to Ownership? Challenges and Opportunities in Advancing Forest Tenure Reform*. Rights and Resource Initiative, Washington, DC.

UNOHCHR. 2011. *3 indigenous communities to receive communal land title*. United Nations Office of the High Commissioner for Human Rights in Cambodia, Phnom Penh.

Supplementary Materials

Household Questionnaires

TO BE COMPLETED BEFOREHAND:

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]**

Name [in Khmer]	Age	Gender [M/F]	*Relationship to HH	**Family status	Ethnicity

*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)

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.....

.....

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

<i>Asset:</i>	<i>Yes or No</i>		<i>How many in household?</i>
DVD player	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
TV	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Mobile phone	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Wardrobe	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Motos	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Tractor	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Car	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Strimmer	Yes <input type="checkbox"/>	No <input type="checkbox"/>	

LIVELIHOOD INFORMATION:

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

Village shop	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Rice milling service	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Produce rice wine (<i>srasor</i>)	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Generate electricity/charge battery	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Resin trader	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Cassava trader	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Cashew trader	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Mechanic	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Other....[specify]	

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?

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.....

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?.....

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?

How many cows does your household currently own?

How many are draft cows?

LAND USE INFORMATION:

How many plots does your household obtain crops from? [Answer in table]

No plot	*Land use	**Access to land	Year of ownership	Estimated size (Ha)	Current crop(s)	Yrs. growing current crop	Intercrop (crop/years)	Previous crop(s)

*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]**

No plot	Why did you choose the current crop?	Why did you choose this area to grow the crop?

Record the yields and prices of crops. The plot number should be taken from the above table. **[Answer in table]**

No plot	Current crop (s)	Total production this year [kg]	Sale price this year [riel/kg] [fresh/dry]	Total production previous year [kg]	Sale price previous year [riel/kg]	Labour [No. people, No. days]

If no cash crops, what are the reasons that your household does not grow them?

.....

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)?

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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)?

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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)?

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5. **In Andoung Kraloeng:** Can you briefly explain how the indigenous land title has affected your households land use?
In O Rona: How do you feel about people from outside of O Rona using land or settling inside O Rona?

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6. How do you feel about the security of your land tenure?

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Calculation of Adjusted Basic Necessity Survey Score

The basic necessity survey (BNS) provides a locally defined poverty index, which can be used to score households sampled in the area of the survey (Davies, 1997). In this study, we used the results of a large scale socio-economic survey, which was undertaken in Seima Protection Forest (SPF) at the time of our study of land use in the two villages and contained a BNS component.

The BNS component of this survey consisted of a series of 40 household items, assets and services. Respondent households were asked whether or not they owned the items on the list or, in the case of services, whether they had access to those services. For example one of the questions on the list asked whether the respondent household had access to a car-taxi service to and from the district capital or nearest market town. Respondents were also asked whether or not they believed that each item on the list was a basic necessity, which was defined to them (following the definition used by Clements (2012)) as the “*minimum requirement for living that all households of the community should have and no-one should not have.*”

The list was created at a one-day workshop, held at the SPF headquarters of the Forestry Administration in April 2012, and to which representatives of different livelihood zones within SPF and different wealth bands were invited. These representatives were selected by FA or WCS staff, who were able to identify suitable candidates for participation. Over the course of the one-day workshop, participants were introduced to the concept of Basic Necessity Survey and compiled the list of items. The list was proportionally populated with (i) items that everyone thought were basic necessities and that everyone would have (or would have access to) (ii) items that everyone thought were basic necessities, and around half of all people would have, but would get as they became richer and services improved (iii) items that everyone thought were basic necessities, but only some people would have, but might get as they became richer and services improved (iv) items <50% of people thought were basic necessities. The list was populated in this way to ensure that there was a good level of differentiation between households, that respondents were made to think whether or not each item really met the definition of a basic necessity and that the same list of items could be used again in the future after incomes were anticipated to rise.

Once the survey instrument had been compiled, it was piloted in three villages to ensure that the items fell roughly in proportion to the different categories identified. No items were changed following the pilot and the survey was conducted in a further 17 villages across the SPF locality, covering a total of 622 households. A BNS score was calculated for each household using only those items that over 50% of sampled households thought were basic necessities (in this case 31 items). Scores were weighted by the proportion of the sample that thought each item met the definition of a basic necessity and these scores were summed over the full list of 31 items for each household to produce a household BNS score. For example, if 95% of the sample thought that a sharp knife was a basic necessity, the BNS score for owning a sharp knife would be 0.95.

In our study, we collected asset data for a smaller list of assets and then used these assets to calculate an adjusted BNS score based on the coefficient estimates of a LMM, with BNS score as the response variable. We ran this model for the sample of 622 households that participated in the full BNS survey (Table A.1). For the purposes of this analysis, the original BNS scores were recalculated after removing those items that corresponded to the items we collected data on. Model selection was undertaken using the method described in the main text. From this, we were able to calculate adjusted BNS scores for each household in our own study, based on the asset data that we had collected.

Table A.1: Parameter estimates for the selected adjusted BNS score GLMM, with a the recalculated BNS score as the response. One random effect was included in the selected model: village (s.d. = 0.532).

Variable	Estimate	SE	t values
intercept	4.460	2.192	2.035
roof_type2	-1.791	0.536	-3.341
roof_type 3	-1.296	0.437	-2.968
roof_type 4	-0.334	0.613	-0.545
walls_type 1	3.121	2.183	1.430
walls_type 2	4.040	2.513	1.608
walls_type 3	3.092	2.282	1.355
walls_type 4	4.543	2.644	1.719
walls_type 5	3.476	2.162	1.608
owns_2cattle	0.162	0.024	6.665
owns_moto	0.724	0.244	2.969
owns_mobile	0.978	0.226	4.323
owns_dvdplayer	1.338	0.209	6.400
owns_strimmer	0.643	0.219	2.928
owns_wardrobe	0.805	0.370	2.176

Table A.2: Variables used in statistical modelling.

Variable	Data type	Variable type	Description
log_area	continuous	response	ln(total area of land claimed by respondent household)
log_ill_area	continuous	response	ln(total area of illegal land claimed by respondent household)
law_compliance	binary	response	whether or not the respondent household was compliant with the 2001 Land Law
reg_compliance	binary	response	whether or not the respondent household was compliant with the five community regulations considered
age	continuous	explanatory	age of respondent
yrs_village	continuous	explanatory	number of years respondent had lived in village
gender	categorical	explanatory	gender of respondent
indigenous	binary	explanatory	whether the head of the respondent household was an IP
AME	continuous	explanatory	household adult male equivalence with recommended daily allowances taken from Barba and Cabrera (2008)
hh_size	continuous	explanatory	total number of members in respondent household
immigrant	binary	explanatory	whether or not the respondent household lived in the village at the time of PLUP
community	binary	explanatory	whether or not the respondent household is a member of the village IC
position	binary	explanatory	whether or not the respondent held a formal position of authority
labour	binary	explanatory	whether or not the respondent was involved in wage labour
shop	binary	explanatory	whether or not the respondent household operated a shop
employed	binary	explanatory	whether or not a member of respondent's household was employed
service	binary	explanatory	whether or not the respondent's household operated a village service
BNS_score	continuous	explanatory	adjusted BNS score of respondent household
settlement	categorical	random	sub-village settlement in which respondent household lived

Table A.3: AICc values for all LMMs considered of the total area of land claimed by each household.

Model Analysed	AICc
log_area ~ age + yrs_vill + gender + indigenous + AME + immigrant + position + labour + shop + job + service + BNS_score + (1 settlement)	259.18
log_area ~ age + yrs_vill + gender + indigenous + AME + immigrant + position + labour + shop + job + service + (1 settlement)	282.46
log_area ~ age + yrs_vill + gender + indigenous + AME + immigrant + position + labour + shop + job + BNS_score + (1 settlement)	258.57
log_area ~ age + yrs_vill + gender + indigenous + AME + immigrant + position + labour + shop + BNS_score + (1 settlement)	256.22
log_area ~ age + yrs_vill + gender + indigenous + AME + immigrant + position + labour + BNS_score + (1 settlement)	255.55
log_area ~ age + yrs_vill + gender + indigenous + AME + immigrant + position + BNS_score + (1 settlement)	253.36
log_area ~ age + yrs_vill + gender + indigenous + AME + immigrant + BNS_score + (1 settlement)	251.15
log_area ~ age + yrs_vill + gender + indigenous + AME + community + BNS_score + (1 settlement)	252.60
log_area ~ age + yrs_vill + gender + indigenous + AME + BNS_score + (1 settlement)	254.32
log_area ~ age + yrs_vill + gender + indigenous + hh_size + immigrant + BNS_score + (1 settlement)	250.96
log_area ~ age + yrs_vill + gender + indigenous + immigrant + BNS_score + (1 settlement)	249.01
log_area ~ age + yrs_vill + gender + immigrant + BNS_score + (1 settlement)	247.07
log_area ~ age + yrs_vill + immigrant + BNS_score + (1 settlement)	246.73
log_area ~ age + immigrant + BNS_score + (1 settlement)	245.61
log_area ~ immigrant + BNS_score + (1 settlement)	249.57
log_area ~ age + immigrant + (1 settlement)	282.10
log_area ~ age + BNS_score + (1 settlement)	252.74
final model:	
log_area ~ age + immigrant + BNS_score + (1 settlement)	245.61

Table A.4: AICc values for all GLMMs considered of household compliance with the 2001 Land Law.

Model Analysed	AICc
law_comp ~ age + yrs_vill + gender + indigenous + AME + community + position + labour + shop + job + service + BNS_score + log_area + (1 settlement)	110.42
law_comp ~ age + yrs_vill + gender + indigenous + AME + community + position + labour + shop + job + service + BNS_score + (1 settlement)	118.10
law_comp ~ age + yrs_vill + gender + indigenous + AME + community + position + labour + shop + job + service + log_area + (1 settlement)	108.19
law_comp ~ age + yrs_vill + gender + indigenous + AME + community + position + labour + shop + job + log_area + (1 settlement)	106.54
law_comp ~ age + yrs_vill + gender + indigenous + AME + community + position + labour + shop + log_area + (1 settlement)	104.05
law_comp ~ age + yrs_vill + gender + indigenous + AME + community + position + labour + log_area + (1 settlement)	101.51
law_comp ~ age + yrs_vill + gender + indigenous + AME + community + position + log_area + (1 settlement)	99.11
law_comp ~ age + yrs_vill + gender + indigenous + AME + community + log_area + (1 settlement)	96.70
law_comp ~ age + yrs_vill + gender + indigenous + AME + log_area + (1 settlement)	101.90
law_comp ~ age + yrs_vill + gender + indigenous + hh_size + community + log_area + (1 settlement)	96.46
law_comp ~ age + yrs_vill + gender + indigenous + community + log_area + (1 settlement)	94.32
law_comp ~ age + yrs_vill + gender + community + log_area + (1 settlement)	95.19
law_comp ~ age + yrs_vill + community + log_area + (1 settlement)	92.97
law_comp ~ age + community + log_area + (1 settlement)	93.50
law_comp ~ community + log_area + (1 settlement)	93.48
law_comp ~ community + (1 settlement)	103.52
law_comp ~ log_area + (1 settlement)	99.48
final model:	
law_comp ~ community + log_area + (1 settlement)	93.48

Table A.5: AICc values for all LMs considered of the total illegal area of land claimed by each household with illegal land (i.e. all zero values excluded).

Model Analysed	AICc
log_ill_area ~ community + age + yrs_vill + gender + indigenous + AME + position + labour + shop + job + service + BNS_score + log_area	191.13
log_ill_area ~ community + age + yrs_vill + gender + indigenous + AME + position + labour + shop + job + service + BNS_score	241.61
log_ill_area ~ community + age + yrs_vill + gender + indigenous + AME + position + labour + shop + job + service + log_area	188.02
log_ill_area ~ community + age + yrs_vill + gender + indigenous + AME + position + labour + shop + job + log_area	185.12
log_ill_area ~ community + age + yrs_vill + gender + indigenous + AME + position + labour + shop + log_area	182.35
log_ill_area ~ community + age + yrs_vill + gender + indigenous + AME + position + labour + log_area	180.30
log_ill_area ~ community + age + yrs_vill + gender + indigenous + AME + position + log_area	177.53
log_ill_area ~ community + age + yrs_vill + gender + indigenous + AME + log_area	174.87
log_ill_area ~ community + age + yrs_vill + gender + indigenous + hh_size + log_area	174.30
log_ill_area ~ community + age + yrs_vill + gender + indigenous + log_area	172.89
log_ill_area ~ community + age + yrs_vill + gender + log_area	174.24
log_ill_area ~ community + age + yrs_vill + indigenous + log_area	171.82
log_ill_area ~ community + age + indigenous + log_area	170.11
log_ill_area ~ community + indigenous + log_area	167.94
log_ill_area ~ indigenous + log_area	170.08
log_ill_area ~ community + log_area	169.98
log_ill_area ~ community + indigenous	232.56
final model ($R^2 = 0.61$):	
log_ill_area ~ community + indigenous + log_area	167.94

Table A.6: AICc values for all GLMs considered of household compliance with IC regulations.

Model Analysed	AICc
reg_comp ~ community + age + yrs_vill + gender + indigenous + AME + position + labour + shop + job + service + BNS_score + log_area + law_comp	109.70
reg_comp ~ community + age + yrs_vill + gender + indigenous + AME + position + labour + shop + job + service + BNS_score + log_area	114.86
reg_comp ~ community + age + yrs_vill + gender + indigenous + AME + position + labour + shop + job + service + BNS_score + law_comp	116.26
reg_comp ~ community + age + yrs_vill + gender + indigenous + AME + position + labour + shop + job + service + log_area + law_comp	108.10
reg_comp ~ community + age + yrs_vill + gender + indigenous + AME + position + labour + shop + job + log_area + law_comp	106.31
reg_comp ~ community + age + yrs_vill + gender + indigenous + AME + position + labour + shop + log_area + law_comp	103.74
reg_comp ~ community + age + yrs_vill + gender + indigenous + AME + position + labour + log_area + law_comp	107.29
reg_comp ~ community + age + yrs_vill + gender + indigenous + AME + position + shop + log_area + law_comp	104.98
reg_comp ~ community + age + yrs_vill + gender + indigenous + AME + shop + log_area + law_comp	101.12
reg_comp ~ community + age + yrs_vill + gender + indigenous + hh_size + shop + log_area + law_comp	102.76
reg_comp ~ community + age + yrs_vill + gender + indigenous + shop + log_area + law_comp	100.62
reg_comp ~ community + age + yrs_vill + gender + shop + log_area + law_comp	98.37
reg_comp ~ community + age + yrs_vill + shop + log_area + law_comp	95.97
reg_comp ~ community + age + shop + log_area + law_comp	94.03
reg_comp ~ community + shop + log_area + law_comp	91.92
reg_comp ~ shop + log_area + law_comp	104.27
reg_comp ~ community + log_area + law_comp	92.57
reg_comp ~ community + law_comp	112.87
reg_comp ~ community + log_area	94.88
final model:	
reg_comp ~ community + log_area + law_comp	92.57

Table A.7: Parameter estimates for the selected legal compliance GLMM, with a binary compliance variable as the response. P values significant at the 95% confidence level are shown in bold. One random effect was included in the selected model: settlement (s.d. = 1.928). The full list of variables modelled, plus their explanations, are given in Supplementary Materials Table A.2.

Variable	Estimate	SE	P Values
intercept	-2.953	1.224	0.016
community	3.502	1.411	0.013
ln(area + 0.125)	-1.345	0.432	0.002

Table A.8: Parameter estimates for the selected community regulation compliance GLMM, with a binary compliance variable as the response. P values significant at the 95% confidence level are shown in bold. One random effect was included in the selected model: settlement (s.d. = 1.928). The full list of variables modelled, plus their explanations, are given in Supplementary Materials Table A.2.

Variable	Estimate	SE	P Values
intercept	1.375	0.677	0.042
community	2.479	0.762	0.001
ln(area + 0.125)	-1.685	0.432	<< 0.000
law_comp	-1.342	0.651	0.039

References

Barba, C., Cabrera, M. 2008. Recommended Dietary Allowances harmonization in Southeast Asia.

Clements, T. 2012. Money for Something? Investigating the effectiveness of biodiversity conservation interventions in the Northern Plains of Cambodia. PhD Thesis. University of Cambridge, Cambridge.

Davies, R. 1997. Beyond wealth ranking: The democratic definition and measurement of poverty. Briefing note. ODI workshop "Indicators of Poverty: Operational Significance", London.