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WILDLIFE CONSERVATION POLICIES AND INCENTIVES TO HUNT: AN EMPIRICAL ANALYSIS OF ILLEGAL HUNTING IN WESTERN SERENGETI, TANZANIA

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Wildlife conservation policies and incentives to hunt: An empirical analysis of illegal hunting in western Serengeti, Tanzania

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Abstract:

This paper investigates factors determining participation and effort in illegal hunting, using cross-section survey data from households in western Serengeti, Tanzania. One purpose of the analysis is to study the impact on illegal hunting of the integrated conservation and development project established in this area, namely the Serengeti Regional Conservation Project (SRCP). The paper also investigates how the pattern of crop production in agriculture, market accessibility and wildlife-induced damage to crops and domestic animals affect illegal hunting. The empirical results suggest that effort in illegal hunting is inversely related to participation in SRCP. The results also show that the likelihood of illegal hunting is a decreasing function of the amount of agricultural land cultivated for maize production. Further, the hunting effort is negatively related to the size of cotton- and maize land, as well as wildlife-induced damage to crops and domestic animals.

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1. Introduction

Protected areas – such as national parks and game reserves – have long been regarded as crucial in wildlife conservation. However, the establishment of protected areas has often excluded local people from the use of these areas and, during the past decades, this kind of exclusionary protected area management has been viewed as having failed to preserve wildlife in developing countries (Kiss 1990, Barrett and Arcese 1995, Gibson and Marks 1995). Today there is a growing recognition that the successful management of protected areas depends on the co-operation and support of the local people living with wildlife. In response to this, Integrated Conservation and Development Projects (ICDPs), aiming at changing rural inhabitants' incentives to exploit the resources of protected areas through benefit-sharing schemes and awareness building, are frequently adopted. The benefit-sharing component might include direct utilization of wildlife and income transfers from the tourism sector, as ways of compensating the local people for restricted access to the protected area. If substitutes are not available or inconsistent with the conservation objective, ICDPs could provide alternatives that attempt to, for example, improve access to agricultural markets and increase agricultural incomes (Wells and Brandon 1992). The perception in most projects is that the local people will switch from illegal hunting to legal (agricultural) activities if the latter generate greater revenue.

The main purpose of this paper is to investigate the impact on illegal hunting of an ICDP based on direct utilization of wildlife. In addition, the analysis focuses on the relationship between illegal hunting and agricultural conditions such as land use, types of crops, market accessibility and wildlife-induced damage to agricultural output. In order to do this, the paper uses cross-sectional survey data from households in western Serengeti, Tanzania. The survey was conducted in the period June to August 2001 among local communities along the western border of the Serengeti National Park. This area has experienced a rapid growth in human settlement (Campbell and Hofer 1995, Barrett and Arcese 1998) that coincides with a marked increase in the number of poachers arrested in the park (Arcese et al. 1995). Today Serengeti National Park and its surrounding game reserves contain the world's largest ungulate herds (Sinclair and Arcese 1995, Barrett and Arcese 1998), but Sinclair (1995, page 24) states "the illegal killing of the migrant ungulates by poachers is potentially the most serious threat to the Serengeti ecosystem".

The rest of the paper is organized as follows. Section 2 presents the theoretical reasoning for the hypotheses on illegal hunting. The data set is presented in Section 3, while the empirical specification and the estimation results are presented in Section 4. Finally, Section 5 contains a summary and discussion of the main findings in the paper.

2. Hypotheses

ICDPs have recently been the focus of attention because of the untested assumptions behind their strategies. In the theoretical bio-economic literature, Barrett and Arcese (1998) reveal possible undesirable effects of free distribution of game meat to the local people using wildebeest exploitation in the western Serengeti as an example. They investigate the impact of this strategy on illegal hunting in a household model with no market for game meat, and where the household derives utility from consumption of game meat, agricultural output and leisure. They show that the household will respond to distribution of game meat by substituting legal meat for illegal meat. Consequently, this strategy reduces illegal hunting[1]. See also Johannesen (2004).

The existing ICDP in Serengeti – the Serengeti Regional Conservation Project (SRCP) – is based on game meat distribution to the local people (SRCS 1993, SRCS 1995, Rugumayo 1999). The main purpose of the present analysis is to investigate any differences in illegal hunting between households who participate in SRCP and households outside of the project. Based on Barrett and Arcese (1998) it is expected that illegal hunting falls with the amount of meat from SRCP. In addition, in order to capture other strategies of SRCP, such as awareness building and education of game scouts, the analysis investigates whether participation in the project in general has a negative impact on illegal hunting.

In order to promote wildlife conservation there have been repeated proposals to implement policies that improve economic conditions in the agricultural sector. For instance, Brown et al. (1993) suggest that improved labour productivity in agriculture will divert labour away from hunting and, thereby, reduce the pressure on wildlife. This relationship is also derived from e.g. Smith (1975) and Skonhoft and Solstad (1998) in standard hunter-agrarian

[1] However, because game meat is considered a normal good, free distribution enhances the total demand for meat. Hence, the model implies that game meat distribution increases the aggregate offtake and, consequently, reduces the degree of wildlife conservation.

household models where the household diverts labour between wildlife harvesting and agricultural crop production. In these models, an exogenous increase in cultivated land might increase the productivity of labour in agriculture and, consequently, shift the allocation of labour towards agricultural production. Based on these results it is expected that an increase in cultivated land will reduce illegal hunting. In the same way, in the case of domestic animal keeping, a larger herd is also expected to reduce illegal hunting.

Another important feature that may affect illegal hunting is that wildlife roaming outside protected areas damages agricultural output. Skonhoft and Solstad (1998) demonstrate that increased damage reduces the marginal benefit of labour in agriculture and, thus, more effort will be allocated to hunting. Another aim of the present analysis is therefore to investigate whether more extensive damage to crops and domestic animals increases illegal hunting. For other references on wildlife-induced damage, see e.g. Huffaker et al. (1992), Carlson and Wetzstein (1993), Bulte and van Kooten (1996), Schulz and Skonhoft (1996), Skonhoft (1999), and Zivin et al. (2000).

Marketing opportunities tend to be limited in regions surrounding protected areas due to remote location and lack of good roads and infrastructure. Agricultural output is therefore more likely to be selected for subsistence use rather than for sale in small towns or other regional markets. In order to increase local incomes, several existing ICDPs attempt to improve market accessibility through, e.g., road construction and the promotion of marketing associations (Brandon and Wells 1992). However, Brandon and Wells (1992) question the underlying assumption that increased income reduces illegal hunting. They claim that this understanding is based on an implicit assumption of a fixed income need and that illegal hunting stops once this need is covered. Instead, they assert that local people are unlikely to switch from illegal hunting to legal activities unless the latter generate more income and fit into an overall strategy of utility maximization. The present analysis attempts to investigate whether there is less illegal hunting among households who participate in, or have greater access to, agricultural markets, than households who do not.

Finally, and in line with the standard result of hunter-agrarian models, the analysis investigates whether an increase in the size of a household increases illegal hunting.

3. Data collection and descriptive analysis

3.1. Data collection

The empirical analysis of illegal hunting is based on survey data from the Serengeti and Bunda Districts along the western border of the Serengeti National Park. The survey was conducted in six villages, equally divided between the districts, and counts 297 households. 166 and 131 households are from Bunda and Serengeti, respectively. Four of the villages, or 148 households, participate in the SRCP while, as confirmed by the village executive secretaries, no village project exists for the remaining two villages, or 149 households. For a further description of the survey, see Appendix 2.

All hunting reported in the survey is illegal and one main purpose of the empirical analysis is to investigate the impact of the SRCP on this activity. The project was implemented in 1993/94 and includes fourteen villages spread evenly between Serengeti and Bunda Districts. The SRCP's strategy to select project villages has not been based on thorough studies of illegal activities, but rather on their location in relation to the western border of Serengeti National Park. All of the project villages are located along this border, but at some distance from the border[2]. The SRCP distributes game meat to the project villages from a harvesting quota set equal to each village by the government, i.e. the Ministry of Natural Resources and Tourism. The responsibility of the SRCP is to organize hunting and bring the meat to the respective villages. The villagers buy the meat at a price set by agreement between the SRCP and the village authorities and below the price of illegal meat.

In addition to game meat distribution, the SRCP has assisted the establishment of village-level institutions responsible for managing the fund from the hunting quota revenues. These funds finance village projects such as schools and dispensaries. The SRCP is also responsible for the set-up and training of game scouts in the project villages. Finally, the SRCP works with awareness-building in order to improve the relationship between the local people and the park. This includes public meetings at village level, seminars and training courses on wildlife utilization and management, and other wildlife tasks. For a broader overview of the activities of the SRCP, see Rugumayo (1999).

3.2. Descriptive analysis and the sample

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[2] The SRCP intends to involve the project villages in the future management of the outer areas located between the villages and the park border.

The households were asked about their participation in illegal hunting, hunting trips, and targeted species. The reported species are wildebeest, zebra, gazelle, topi, and impala. In Table 1, 80 households, or 27 per cent of the sample, report that some household members are involved in illegal hunting. The participation rate differs between sub-groups of the sample. For instance, 32 per cent of the SRCP households participate in illegal hunting, while this is the case for only 22 per cent of households outside the SRCP. Hence, despite the advantages of living in a project village, participation in illegal hunting is more widespread in the SRCP villages. This demonstrates the need for further investigation of the relationship between illegal hunting and participation in the SRCP. The participation rate also varies between districts, 22 per cent in Bunda District and 34 per cent in Serengeti District.

Table 1 about here

As demonstrated in Table 2, the hunters can be divided into two groups. This division is also important for the empirical specification of the model in Section 4. The first group of hunters (55 per cent of the hunters) report that they go on hunting trips, while the second group (45 per cent) does not go on hunting trips. Here, hunting trips are defined as trips that last for several days and where the hunters usually hunt within the protected area. The hunters who do not go on hunting trips hunt closer to their homes and within the village area. They hunt during the annual wildebeest migration when wildebeest enter village land during the dry season. See Sinclair and Arcese (1995) for a description of the wildebeest migration. Several of these households report that they kill wildebeest when they coincidentally enter their agricultural field or yard. This indicates that hunting in the home area is less time consuming than going on hunting trips.

While the hunting grounds differ between these groups, the targeted species are the same; wildebeest is the major species, followed by gazelle, zebra and topi. In addition, both groups report that they hunt both as a source of income and for domestic consumption. However, the groups differ when it comes to the reported income from illegal hunting. Ninety six per cent of households who go on hunting trips earn income from this activity, while this only applies to 33 per cent of those who hunt in their home area (not shown in a table)[3]. One plausible

[3] The two groups of hunters identified in this survey must not be confused with the ‘subsistence’ poachers from the local community and ‘organized’ and professional poachers from outside as defined by Leader-Williams and Milner-Gulland (1993). In this survey, all hunters come from the local community, they all use traditional hunting methods

explanation of the observed differences in income is that the average offtake is considerably higher among households who go on hunting trips (13.86 ± 30.39 animals), compared to hunting in the home area (2.25 ± 1.99 animals).

The fraction of hunters reporting a positive number of hunting trips differs between sub-groups of the sample. For instance, 43 per cent of the hunters in the SRCP villages go on hunting trips, while the same rate for hunters outside the SRCP is 73 per cent. The participation rates differ even more between the districts: 86 per cent of the hunters in Bunda go on hunting trips, while only 30 per cent of the hunters in Serengeti report the same.

Table 2 about here

In agricultural production, these households produce seven main crops: cotton, maize, millet, sorghum, cassava, potatoes and beans. Cotton is the only cash crop and is only produced for sale. The food crops are, on the other hand, mainly produced for household consumption, or for both consumption and sale. As seen in Table 3, crop production is the major income-generating activity. However, the proportion of households earning income from the respective activities differs between the districts. More households earn income from crop production in Bunda (86 per cent) than in Serengeti District (60 per cent), which may be explained by variation in the crop composition between districts. Seventy three per cent of the Bunda farmers grow cotton, while the same number in Serengeti is 6 per cent. Eighty six per cent of the farmers in Serengeti grow maize, compared to 54 per cent in Bunda. Further, a significantly higher proportion of Serengeti farmers produce maize for sale compared to Bunda farmers[4]. However, this is not enough to offset the income advantage of cotton production in Bunda.

The remaining crops in the study area are mainly grown for own-household consumption. Millet is the major crop in this group, and is produced by 63 per cent of households. In

(i.e. wire snares, pitfalls, traps, knives, machetes etc. (see Arcese et al. 1995) and they all hunt for meat (for domestic consumption or for sale). In line with the terminology used by Leader-Williams and Milner-Gulland, both groups are therefore subsistence hunters.

[4] The Kruskal-Wallis test rejects the null hypothesis of equal means between the districts. Interested readers may contact the author for this result and Kruskal-Wallis tests on differences in mean income below.

contrast to the cotton and maize producers, the millet producers are evenly distributed between districts.

Domestic animal keeping, the second major income-generating activity, covers cattle, goats, sheep and poultry. Table 3 shows that the rate of households with positive income from this activity is higher in Serengeti than in Bunda. Finally, 110 households earn income from non-agricultural activities. These include selling fish, charcoal, local brew, running small shops etc[5]. Again, the rate of participation differs between the districts, 40 per cent in Bunda and 33 per cent in Serengeti. However, testing for differences in mean income from non-agricultural activities shows it is significantly higher in Serengeti. When it comes to reported income from crop production and animal keeping, the data set reveals statistically significant differences in mean income in favour of the district with the highest participation rate. However, there is no significant difference in the mean total income between the districts. Hence, while the districts differ in type of income generating activities, there is no significant difference in mean income.

Table 3 about here

The proportion of households earning income from crops and/or domestic animals is lower in SRCP villages than in non-SRCP villages, while the proportion of households earning income from non-agricultural activities is higher in SRCP villages. Mean total income is significantly higher outside SRCP villages.

Wildlife-induced damage to crops and domestic animals is reported by households to be caused by elephant, baboon and bushpig, while damage to domestic animals is caused by hyenas (livestock), eagles (poultry) and mongooses (poultry). Households were also asked to indicate the damage level as ‘no damage’, ‘very little’, ‘much’ or ‘very much’. The second row in Table 4 shows that some 86 per cent of respondents complained that wildlife causes ‘much’ or ‘very much’ damage to crops. This number seems high, and a further investigation of the reported damage percentage shows a considerable variation within each response category. However, the survey reveals that the mean damage percentage increases between

[5] The complete list of ‘other’ activities also includes selling water, honey, and fruit, house rent, carpentry, making spears, and employment (teaching or other work at school, wildlife management, village secretary, other employment). Only 8 respondents in the sample households (less than 3 per cent) report that they have formal employment.

the categories and the means differ significantly. Still, there are some serious measurement problems regarding reported measures of crop damage. One problem is that respondents may overestimate both damage impression and percentage in the hope for future compensation. A second and equally important problem is that the respondents found it difficult to estimate the percentage crop damage. Instead, they reported the approximate number of acres damaged as a percentage of the number of acres cultivated. It is therefore important to note that this measure reflects neither the exact share of output damaged, nor the value of the loss.

Table 4 about here

As seen in the fifth row of Table 4, far more households report that they experience ‘no damage’ to domestic animals compared to reported crop damage. Still, some 60 per cent complain that wildlife causes ‘much’ or ‘very much’ damage to domestic animals. When it comes to the number of animals killed or injured, the reported numbers vary considerably within each response category. Some inconsistency may be present, but the variation may also reflect varying dependence on domestic animal keeping among households.

4. Empirical specification and estimation results

As already seen, three different types of households were observed in this survey. The first type were all households who do not participate in illegal hunting. The second and third types contain all households who participate in illegal hunting, the second group being all who hunt within the village area, while the third group all who go on hunting trips.

The starting point of the empirical analysis is to analyse the household’s decision to participate, or not, in illegal hunting. Section 4.1 presents the empirical specification and estimation results of this decision problem using a Probit model. However, because some hunters go on hunting trips, while others hunt within the village area only, it is adequate to consider the households’ decision problem as one where they choose whether i) to not participate in hunting, to participate in hunting but ii) no hunting trips, or iii) to go on hunting trips. The Probit framework is therefore extended by presenting an ordered probit model, where the individual households are classified into three categories i)-iii). Finally, Section 4.2 presents a model of the number of hunting trips, i.e. hunting intensity.

4.1 Participation in illegal hunting and ordered groups

4.1.1 Empirical specification and variable definitions

The probit specification of the empirical model is given in equation *(1)*[6].

(1) $$E_h^i = \begin{cases} 1 & \text{if } E_h^{i*} > 0 \\ 0 & \text{0 otherwise} \end{cases}$$, where

$$E_h^{i*} = \beta_0 + \beta_1 SRCP + \beta_2 DISTRICT + \beta_3 L^i + \beta_4 D_{CROP}\_1^i + \beta_5 D_{CROP}\_2^i$$

$$+\beta_6 M^i + \beta_6 DISTANCE + u^i$$

Here, $E_h^i = 1$ if household *i* participates in illegal hunting, while $E_h^i = 0$ otherwise. The explanatory variables in equation *(1)* represent the starting point for all three empirical models in Section 4, but other specifications will also be presented. *SRCP* is a dummy for participation in the SRCP and takes on the value one for SRCP households and zero otherwise. The dummy *DISTRICT* is included to capture district-specific characteristics of the data set and equals one for Bunda households and zero for households in Serengeti. L^i is the number of acres cultivated for crop production by household *i*. $D_{CROP}\_1^i$ and $D_{CROP}\_2^i$ are dummy variables for 'much' and 'very much' crop damage, respectively. $D_{CROP}\_1^i$ ($D_{CROP}\_2^i$) takes the value one if the household reports 'much' damage ('very much' damage) and zero otherwise. Both categories 'much' and 'very much' are expected to increase the probability of hunting over the 'no or little' damage level. M^i is the number of household members. *DISTANCE* is the distance from the household's village to the national park. Finally, u^i is the error term.

Other specifications of the model will also be included. First, in order to capture the impact of different types of crops on the probability of participation in illegal hunting, the explanatory variable *L* will be replaced by the number of acres devoted to cotton *L_COT*, maize *L_MAI*, and millet *L_MIL* in the respective households. These crops cover some 66 per cent of the total amount of cultivated land in the study area. Second, two dummies are included to reflect

[6] See Johnston and Dinardo (1997) chapter 13.

market availability. *COT* is a dummy that equals one for cotton producers and zero otherwise. *MOT_MAI* is a dummy reflecting whether some maize is produced for the market or not. It equals one for producers reporting that some maize is produced for sale and zero if maize is produced for own consumption only. Because market accessibility is expected to increase agricultural incomes, we tested whether the coefficients of *COT* and *MOT_MAI* are positive. Further, an interaction variable *L_MAI*MOT_MAI* is included in order to investigate whether the relationship between illegal hunting and maize production differs between households who sell maize on the market and those who do not. Millet is produced for own consumption only but not all its producers face a missing output market. Therefore, we interacted *L_MIL* with *COT* and *MOT_MAI*, and tested whether the relationship between illegal hunting and millet production differs between households who have access to the relevant markets and those who do not.

Third, the base model excludes animal assets and damage to domestic animals in order to avoid a considerable reduction in the number of observations (see below). Still, because domestic animal keeping is widespread it is of interest to investigate the impact of this activity as well. The explanatory variable Y^i measures the number of domestic animals in household *i*, while $D_{ANIMAL}\_1^i$ and $D_{ANIMAL}\_2^i$ are dummies for wildlife-induced damage to domestic stock. The latter are defined in the same way as the dummies for crop damage. Finally, instead of focusing solely on participation in the SRCP, the variables *MEAT_1* and *MEAT_2* are dummies for the amount of meat bought from the SRCP. *MEAT_1* (*MEAT_2*) takes the value one if the household report '5 to 10' kilo ('more than 10' kilo) and zero otherwise. Both categories are expected to have a non-positive effect on the number of hunting trips over the '0 to 5' kilo category. Summary statistics of the variables are reported in Table A3.1 in Appendix 3.

The Ordered Probit model can be used to model a discrete dependent variable that takes on ordered multi-nominal outcomes for each individual household. This applies for the three groups i) non-hunters, ii) hunters, but no hunting trips, and iii) hunters who go on hunting trips. As argued earlier, hunting in the village area seems to be less time consuming than to go on hunting trips in the protected area. The model is therefore expressed as[7]

[7] However, if we assume that hunting in the village area and hunting in the protected area are equally time consuming, there is no ordering of the dependent variable. In this case, a multinominal logistic regression is used

$$(2) \qquad E_h^i = \begin{cases} 1 & \text{if } E_h^{i^*} \leq c_1 \\ 2 & \text{if } c_1 < E_h^{i^*} \leq c_2 \\ 3 & \text{if } c_2 < E_h^{i^*} \leq c_3 \end{cases}$$

where the latent variable $E_h^{i^*}$ is defined as in equation *(1)* for the base model. c_z represents the cut-off points between successive alternatives $z = 1,2,3$. Here, the ordered probit natural ordering yields $E_h^i = 1$ for group i), $E_h^i = 2$ for group ii), and $E_h^i = 3$ for group iii).

4.1.2 Estimation results

Table 5 reports the Probit and Ordered Probit estimates for the base model as well as the alternative specifications. First, the coefficient of the political variable *SRCP* in Probit regression (a) is positive and significantly different from zero. This suggests that the probability of participation in illegal hunting is higher for SRCP households compared to households outside SRCP. However, this result is not stable across the different model specifications. On the other hand, the first three columns show that participation in hunting gives a significantly negative coefficient with respect to the district. That is, the probability of illegal hunting is higher for Serengeti households.

The Probit model (a) suggests that the amount of cultivated land has no impact on the decision to participate in illegal hunting. When controlling for domestic animal keeping and the corresponding damage in model (b), the coefficient of *L* is negative but only significant at the ten per cent level of significance[8]. However, when distinguishing between the amounts of land devoted to cotton, maize and millet in model (c), the coefficient of maize is negative and significantly different from zero at the 1 per cent level of significance[9]. Hence, the type of crop grown seems to affect the probability of illegal hunting. However, participation in, or

to analyse the probability of hunting in the village and probability of hunting in the protected area. The results are reported in Table A1.1, Appendix 1, where 'no hunting' is the comparison group.

[8] In model (b) the sample is reduced due to missing observations on damage to domestic animals.

[9] The coefficients of *L_COT* (*L_MIL*) are also insignificant when omitting the variables *L_MIL* (*L_COT*) and *L_MAI*.

access to, markets seems to have no impact on the decision to hunt[10]. No other variables are significant in the Probit models[11].

Table 5 about here

The next step is to look at the ordered probit analyses of the probabilities of refraining from illegal hunting, to hunt illegally in the village area, or to go on hunting trips. While the district seems to affect the decision to participate in illegal hunting, the Ordered Probit estimation results in Table 5 demonstrate that this variable is less significant when we distinguish between the different types of hunters.

For ordered Probit model (c), the probability of hunting in both the village area and the protected area are decreasing functions of maize production. However, and consistent with the Probit analysis, these probabilities seem to be independent of market accessibility.

In contrast to the Probit analysis, 'very much' damage to crops increases both the probability of hunting in the village area and the probability of going on hunting trips over 'no or very little' damage [12]. See model (c) Tables 5 and 6. Recall from Section 3 that the major species causing crop damage do not represent the targeted species for hunting. Hence, illegal hunting in the village area does not seem to be a way of getting rid of problem animals, but rather a way for the households to compensate themselves for the loss of agricultural production.

[10] In model (d) the sample is reduced due to missing observations on motivation for maize production.

[11] The coefficient of *DISTANCE* is also insignificant when *DISTRICT* is omitted from the model. In addition, the coefficients of Y, D_{ANIMAL}_1 and D_{ANIMAL}_2 are insignificant if included in models (c)-(d). The same applies to the ordered probit model.

[12] As mentioned in Section 3, the survey gives information on the number of acres damaged as a percentage of the number of cultivated acres as well. When using an estimate of the number of acres damaged instead of damage impression, the coefficient is not significantly different from zero. This result corresponds well with the insignificant coefficient of the amount of cultivated land L. As already seen, however, the types of crop produced seem to affect the group probabilities. Therefore, one may also expect the amount of damage to the respective crop to affect the group probabilities. Unfortunately, however, there is no data on damage to types of crops. Instead, the empirical models control for damage impressions, variables of which are subjective measures of the dimension of wildlife-induced damage.

Finally, model (c) shows that the coefficient of the number of household members is negative and significantly different from zero at the five per cent level of significance. This is in contrast with the theoretical prediction. However, this result should be interpreted with care as the data set contains information about the number of members in each household but, unfortunately, lacks information about age composition, children's school attendance, etc. That is, the data set contains no accurate measure of the number of household members capable of working. *M* counts all members of the household, frequently ranging from small children to elders, but not the number capable of working.

Table 6 about here

4.2 Hunting trips

4.2.1 Empirical specification

In the following, a Tobit model is used to analyse hunting intensity. For those who go on hunting trips, data on the number of trips and average number of days per trip was captured, whereas we captured no effort data for those who hunt in the village area. Instead, the empirical analysis of hunting intensity is related to the number of hunting trips, where this number equals zero for those who hunt only within the village area. Due to our inability to compare hunting effort of households hunting in the village area (i.e. zero trips) and non-hunters (i.e. zero hunting effort), however, it seems difficult to apply the Tobit model to the whole sample. The analysis is therefore limited to the sub-sample containing only hunters. That is, it investigates factors determining the hunting intensity conditioned on participation in illegal hunting[13]. The Tobit model is given in *(3)*[14]

(3) $$E_h^i = \begin{cases} E_h^{i*} & \text{if } E_h^i > 0 \\ 0 & \text{otherwise} \end{cases}$$

where the latent variable E_h^{i*} is defined as in *(1)* for the base model.

[13] A Heckman two-step model of the decision to hunt has been considered. However, all parameters were insignificant, which indicates that the variables cannot simultaneously determine the decision to hunt and hunting intensity.

[14] See Johnston and Dinardo (1997) chapter 13.

4.2.2 Estimation results

Table 7 reports the Tobit estimates. The coefficient of *SRCP* has a significant negative sign in models (a)-(d), which indicates a lower hunting intensity among hunters from SRCP villages compared to hunters from villages outside SRCP. Model (e) demonstrates, however, that the amount of meat bought from the SRCP has no impact on hunting intensity[15]. Instead, the significant negative sign of *SRCP* in (a)-(d) may reflect the presence of village game scouts, awareness building, or the establishment of village wildlife funds in the SRCP villages. The latter has financed investments in school and dispensary facilities and reduced the tax burden for the individual household. These factors may have reduced the antagonism towards wildlife among hunters in the SRCP villages and may therefore explain the significant negative sign of *SRCP*.

The Probit analysis demonstrated that households from Serengeti are more likely to participate in illegal hunting than households from Bunda. The Tobit estimation results show, however, that the number of hunting trips is lower for hunters from Serengeti. Hence, while the Serengeti households are more likely to *participate* in hunting, hunting *intensity* seems to be higher among the Bunda hunters.

Model (a) and (b) show that the amount of land cultivated for crops has no impact on the number of hunting trips. When distinguishing between land devoted to cotton, maize and millet in model (c), the coefficients of *L_COT* and *L_MAI* are negative, and significant at the one per cent level. In contrast, hunting intensity is an increasing function of the amount of land devoted to millet. This result is surprising but may be due to millet, as apposed to cotton and maize, being produced only for own consumption. This may indicate that increased production for the purpose of consumption increases hunting intensity. However, there is no evidence that market accessibility affects the relationship between hunting intensity, and millet and maize production respectively. See model (d).

The theory predicts a positive impact of wildlife-induced damage on hunting intensity. The estimated coefficients suggest that the number of trips is significantly higher for households experiencing 'very much' damage to crops over the 'no or little' damage level. In addition,

[15] This is also the case when including *MEAT_1* and *MEAT_2* in models (b)-(d).

model (b) shows that more extensive damage to domestic animals, as well as reduced animal stock, increases the number of hunting trips[16, 17].

Table 7 about here

5. Discussion and concluding remarks

Incentives to hunt illegally are detrimental to wildlife conservation in protected areas in developing countries. Understanding the underlying motivation for illegal hunting is crucial if sound advice is to be provided to policymakers who are attempting to both conserve wildlife and promote economic development. Despite this, little empirical attention has been paid to the issue.

This paper estimates models of the probability of hunting illegally in general, the probability of hunting in the village area and in the protected area respectively, and hunting intensity within the group of hunters. Cross-sectional data from a household survey in western Serengeti, Tanzania, is used to identify factors determining the patterns of illegal hunting in this area. The empirical results suggest that the probability of both illegal hunting in the village area and in the protected area are independent of participation in the integrated conservation and development project in western Serengeti, namely the Serengeti Regional Conservation Project (SRCP). In contrast, hunting intensity is lower for hunters from SRCP villages. However, it is important to note that a conclusion on the impact of the establishment of the SRCP cannot be based on this result only, as the data set analysed here contains no time series. Further, even for a fixed intensity of illegal hunting, the hunting activity of the SRCP may have an unintended impact on wildlife conservation (see Barrett and Arcese (1998) for a theoretical and numerical analysis). Further investigations of the impact of the SRCP on illegal hunting and wildlife conservation is therefore of major importance.

The analysis reveals another important relationship, namely that hunting in western Serengeti seems to be related to land use in agriculture. While the total amount of land has no impact on the probability of hunting and the number of hunting trips, some types of crops are detrimental to the hunting activity. Households who use a relatively large acreage for maize

[16] The same applies if Y and D_{ANIMAL}_1 and D_{ANIMAL}_2 are included in models (c)-(e).

[17] Note, however, that a problem of causality may be present here, as households with fewer trips are able to spend more time protecting their land and animal assets.

production are less likely to hunt, both in the village area and in the protected area. Further, the intensity of hunting is negatively related to the amount of land cultivated for maize, as well as cotton. However, there is no support in this analysis for the view that the ability to sell food crops will reduce illegal hunting. Nonetheless, policies that stimulate increased maize and cotton production and reduced millet production have the potential to reduce hunting pressure. However, it is important to note that any agricultural expansion involving land clearing may have a negative impact on wildlife conservation due to reduced wildlife habitat.

Wildlife imposes damage on agricultural crops, and the empirical results indicate that the impression of ‘very much’ damage to crops, as well as ‘much’ or ‘very much’ damage to domestic animals, increases hunting intensity among the hunters. These results should encourage policymakers to take initiatives to reduce and prevent wildlife-induced damage, such as encouraging fencing, chasing problem animals out of villages, and so forth. Another option is to compensate the local peasants for the costs of living with wildlife. There are, however, some obvious pitfalls to this strategy; people may overestimate the damage and a compensation scheme may attract people from other areas and thereby increase human pressure on the park borders.

In summary, our empirical results show that hunting intensity is lower for hunters from SRCP villages. Other initiatives that may reduce illegal hunting include encouraging increased cotton and maize production and more extensive use of damage control. Further, such attempts may add more to local income than can be expected from SRCP as it works today (see also Barrett and Arcese (1998)). The data set shows that the average income from agriculture among cotton producers is some 88 000 tzh, which is more than twice that of non-cotton producers. By comparison, records from the SRCP show that expected revenue from the meat-distribution program is some 2 300 tzh per household. These figures imply that the potential gain from the SRCP for the individual household is very limited. In order to fulfil the joint objective of wildlife conservation and improved welfare within local communities, focus should also be on agricultural policies.

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Tables

Table 1: Distribution of reported participation in hunting.

	Number	Participation	No participation
Total sample	297	80 (27%)	217 (73%)
SRCP	148	47 (32%)	101 (68%)
Not SRCP	149	33 (22%)	116 (78%)
Bunda District	166	36 (22%)	130 (78%)
Serengeti District	131	44 (34%)	87 (66%)

Table 2: Distribution of households involved in hunting.

	Number	Hunting in village area	Hunting trips
Number	80	36 (45%)	44 (55%)
SRCP	47	27 (57%)	20 (43%)
Not SRCP	33	9 (27%)	24 (73%)
Bunda District	36	5 (14%)	31 (86%)
Serengeti District	44	31 (70%)	13 (30%)

Table 3: Number of households earning income from various activities.

	Crops	Domestic animals	Non-agriculture*
Total sample	220	153	110
SRCP	100 (68%)	58 (39%)	66 (45%)
Not SRCP	120 (81%)	95 (64%)	44 (30%)
Bunda District**	142 (86%)	74 (45%)	67 (40%)
Serengeti District**	78 (60%)	79 (60%)	43 (33%)

*Non-agricultural activities do not include hunting.

**Per cent of the number of sample households in the respective sub-group.

Table 4: Distribution of reported wildlife-induced damage to crops and domestic animals.

Response categories:		No damage	Very little	Much	Very much	Total	P*
	Number of respondents	24	18	72	180	294	
Crop	% of respondents	8.2	6.1	24.5	61.2	100	
damage	Mean % damage	1.7	12.3	17.8	22.6	19.1	0.000
	Number of respondents	73	12	70	55	210	
Damage	% of respondents	34.8	5.7	33.3	26.2	100	
domestic	Mean pultry lost/injured	1.2	2.7	5.5	9.4	5.1	
animals	Mean livestoc lost/injured**	0.26	2.3	2.0	3.4	1.9	

*P is the observed significance level. The null hypothesis of equal means is rejected for $P \leq 0.05$

**Here ‘livestock’ includes cattle, goats, and sheep.

Table 5: Probit and Ordered Probit estimation results. t-values in parentheses

	Probit				Ordered probit			
	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
CONS	-0.265 (-0.80)	0.271 (0.61)	0.129 (0.34)	-0.447 (-0.76)				
SRCP	0.388** (1.98)	0.382 (1.56)	-0.060 (-0.23)	0.048 (0.12)	0.197 (1.06)	0.176 (0.76)	-0.277 (-1.11)	-0.132 (-0.34)
DISTRICT	-0.536*** (-2.80)	-0.740*** (-3.05)	-0.645*** (-2.69)	-0.135 (-0.37)	-0.224 (-1.25)	-0.419* (-1.85)	-0.225 (-1.00)	0.240 (0.70)
L	-0.015 (-0.85)	-0.061* (-1.91)			-0.012 (-0.69)	-0.058* (-1.81)		
L_COT			-0.081 (-1.16)				-0.105 (-1.49)	
L_MAI			-0.209*** (-3.63)	-0.102 (-1.20)			-0.198*** (-3.61)	-0.131 (-1.50)
L_MIL			0.002 (0.03)	0.054 (0.56)			0.023 (0.40)	0.089 (0.96)
COT				-0.063 (-0.16)				-0.152 (-0.42)
MOT_MAI				0.507 (1.10)				0.485 (1.10)
*L_MAI*MOT_ MAI*				-0.159 (-1.45)				-0.128 (-1.17)
*L_MIL*COT*				-0.153 (-0.80)				-0.187 (-1.00)
L_MIL MOT_MAI*				0.047 (0.32)				0.021 (0.15)
Y		-0.006 (-0.95)				-0.008 (-1.26)		
D_{CROP}_1	0.489* (1.72)	0.244 (0.69)	0.361 (1.20)	0.389 (0.98)	0.456* (1.66)	0.252 (0.73)	0.319 (1.11)	0.350 (0.90)
D_{CROP}_2	0.310 (1.23)	0.010 (0.03)	0.417 (1.56)	0.380 (1.06)	0.400* (1.64)	0.108 (0.34)	0.514** (2.00)	0.461 (1.32)
D_{ANIMAL}_1		0.313 (1.29)				0.430* (1.86)		
D_{ANIMAL}_2		-0.106 (-0.37)				0.044 (0.16)		
M	-0.035 (-1.40)	-0.014 (-0.46)	-0.410 (-1.57)	-0.049 (-1.51)	-0.043* (-1.76)	-0.026 (-0.83)	-0.051** (-2.02)	-0.055* (-1.74)
DISTANCE	-0.026 (-1.29)	-0.024 (-0.97)	0.009 (0.35)	0.012 (0.32)	-0.019 (-1.04)	-0.018 (-0.79)	0.013 (0.59)	0.015 (0.41)
Log-likelihood	-161.555	-107.220	-138.526	-94.751	-220.101	-146.107	-193.736	-126.775
# obs.	293	210	269	189	293	210	269	189
R^2_{adj}	0.056	0.112	0.130	0.115	0.030	0.074	0.082	0.093

***, ** and * significant at 1, 5 and 10% respectively. Table A3.1, Appendix 3, reports the variable definitions.

Table 6: Marginal effects Ordered Probit model. t-values in parentheses

	$\partial Pr(E_h = 1)/\partial x$				$\partial Pr(E_h = 2)/\partial x$				$\partial Pr(E_h = 3)/\partial x$			
	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
SRCP	-0.064	-0.053	0.083	0.036	0.020	0.017	-0.033	-0.013	0.044	0.036	-0.050	-0.022
	(-1.07)	(-0.76)	(1.13)	(0.35)	(1.05)	(0.76)	(-1.11)	(-0.34)	(1.06)	(0.76)	(-1.13)	(-0.35)
DISTRICT	0.073	0.127*	0.068	-0.066	-0.023	-0.040*	-0.027	0.024	-0.050	-0.087*	-0.041	0.042
	(1.25)	(1.86)	(1.00)	(-0.69)	(-1.24)	(-1.77)	(-1.00)	(0.70)	(-1.24)	(-1.81)	(-0.99)	(0.68)
L	0.004	0.017*			-0.001	-0.006*			-0.003	-0.012*		
	(0.69)	(1.86)			(-0.69)	(-1.68)			(-0.69)	(-1.86)		
L_COT			0.031				-0.012				-0.019	
			(1.51)				(-1.45)				(-1.51)	
L_MAI			0.059***	0.036			-0.024***	-0.013			-0.036***	-0.022
			(3.94)	(1.55)			(-3.10)	(-1.43)			(-3.96)	(-1.55)
L_MIL			-0.007	-0.024			0.003	0.009			0.004	0.015
			(-0.40)	(-0.96)			(0.40)	(0.94)			(0.40)	(0.96)
COT				0.041				-0.015				-0.025
				(0.42)				(-0.42)				(-0.42)
MOT_MAI				-0.140				0.049				0.091
				(-1.05)				(1.11)				(1.00)
*L_MAI*MOT_MAI*				0.035				-0.013				-0.022
				(1.19)				(-1.14)				(-1.19)
*L_MIL*COT*				0.051				-0.019				-0.032
				(1.01)				(-0.98)				(-1.01)
*L_MIL*MOT_MAI*				-0.006				0.002				0.004
				(-0.15)				(0.15)				(0.15)
Y		0.002				-0.008				-0.002		
		(1.28)				(-1.21)				(-1.28)		
D_{CROP}_1	-0.158	-0.077	-0.101	-0.103	0.044*	0.024	0.037	0.036	0.114	0.055	0.064	0.068
	(-1.59)	(-0.70)	(-1.06)	(-0.84)	(1.77)	(0.74)	(1.12)	(0.90)	(1.50)	(0.68)	(1.01)	(0.80)
D_{CROP}_2	-0.126*	-0.032	-0.147**	-0.117	0.041	0.010	0.060**	0.046	0.084*	0.022	0.087**	0.072
	(-1.70)	(-0.34)	(-2.12)	(-1.42)	(1.60)	(0.34)	(1.98)	(1.33)	(1.71)	(0.34)	(2.10)	(1.43)
D_{ANIMAL}_1		-0.135*				0.040*				0.095*		
		(-1.79)				(1.79)				(1.72)		
D_{ANIMAL}_2		-0.131				0.004				0.009		
		(-0.16)				(0.16)				(0.16)		
M	0.014*	0.008	0.015**	0.015*	-0.004*	-0.002	-0.006*	-0.006*	-0.009*	-0.005	-0.009**	-0.009*
	(1.77)	(0.83)	(2.04)	(1.77)	(-1.68)	(-0.81)	(-1.91)	(-1.64)	(-1.77)	(-0.83)	(-2.02)	(-1.75)
DISTANCE	0.006	0.005	-0.004	-0.004	-0.002	-0.002	0.002	0.001	-0.004	-0.004	0.002**	0.002
	(1.04)	(0.79)	(-0.60)	(-0.41)	(-1.03)	(-0.78)	(0.59)	(0.41)	(-1.04)	(-0.79)	(0.60)	(0.41)

***, ** and * significant at 1, 5 and 10% respectively. Variable definitions are reported in Table A3.1 in Appendix 3.

Table 7: Tobit estimation results. Dependent variable is number of hunting trips; t-values in parentheses

	(a)	(b)	(c)	(d)	(e)
CONS	-2.088	3.503*	-0.847	2.551	-1.942
	(-0.81)	(1.69)	(-0.41)	(1.03)	(-0.75)
SRCP	-3.443**	-2.944***	-5.881***	-5.117***	-6.522*
	(-2.40)	(-2.92)	(-4.23)	(-2.75)	(-1.94)
MEAT_1					3.926
					(1.20)
MEAT_2					1.691
					(0.46)
DISTRICT	5.632***	3.365***	6.038***	7.054***	5.634***
	(4.32)	(3.61)	(5.20)	(5.31)	(4.31)
L	0.023	-0.100			0.038
	(0.17)	(-0.58)			(0.29)
L_COT			-0.918**		
			(-2.30)		
L_MAI			-0.927***	-1.934***	
			(-2.76)	(-2.76)	
L_MIL			0.558**	0.411	
			(2.02)	(1.34)	
COT				-4.441***	
				(-2.96)	
MOT_MAI				-0.202	
				(-0.10)	
*L_MAI*MOT_MAI*				0.891	
				(1.15)	
*L_MIL*COT*				1.066	
				(1.09)	
*L_MIL*MOT_MAI*				0.030	
				(0.04)	
Y		-0.137***			
		(-2.80)			
D_{CROP}_1	3.036	1.806	2.771	1.776	2.840
	(1.26)	(0.99)	(1.53)	(0.88)	(1.18)
D_{CROP}_2	4.837**	3.902**	4.875***	3.678*	4.811**
	(2.11)	(2.37)	(2.78)	(1.94)	(2.11)
D_{ANIMAL}_1		4.272***			
		(4.33)			
D_{ANIMAL}_2		4.572***			
		(3.76)			
M	-0.087	-0.337	-0.100	-0.147	-0.094
	(-0.43)	(-2.07)	(-0.71)	(-1.05)	(0.47)
DISTANCE	-0.126	-0.209**	0.108	0.081	-0.153
	(-0.97)	(-2.20)	(0.92)	(0.55)	(-1.17)
Log-likelihood	-145.692	-83.999	-119.530	-71.979	-144.480
# obs.	80	55	75	48	80
R^2_{adj}	0.132	0.289	0.198	0.278	0.139

***, ** and * significant at 1, 5 and 10% respectively. Table A3.1, Appendix 3, reports the variable definitions.

Appendix 1

Table A1.1: Multinominal Logit estimation results. t-values in parentheses.

	Village area				Protected area			
	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
CONS	-1.585** (-1.94)	-1.195 (-1.03)	-1.045 (-1.10)	-2.178* (-1.64)	-1.769** (-2.12)	-0.750 (-0.68)	-1.234 (-1.37)	-2.389 (-1.449
SRCP	1.727*** (3.59)	2.370*** (3.29)	1.328** (1.95)	1.232 (1.39)	-0.133 (-0.29)	-0.311 (-0.56)	-0.947* (-1.65)	-0.853 (-0.88)
DISTRICT	-3.093*** (-5.19)	-5.333*** (-4.20)	-3.403*** (-4.80)	-3.043*** (-2.68)	0.519 (1.14)	0.288 (0.53)	0.576 (1.04)	1.808** (2.06)
L	-0.047 (-0.94)	-0.095* (-1.22)			-0.018 (-0.41)	-0.144* (-1.77)		
L_COT			-0.028 (-0.17)				-0.237 (-1.45)	
L_MAI			-0.219* (-1.63)	-0.004 (-0.03)			-0.380*** (-2.64)	-0.597* (-1.92)
L_MIL			-0.084 (-0.61)	-0.008 (-0.03)			0.101 (0.73)	0.367 (1.49)
COT				0.310 (0.29)				-0.445 (-0.55)
MOT_MAI				0.617 (0.62)				0.664 (0.63)
*L_MAI*MOT_ MAI*				-0.259 (-1.08)				0.159 (0.45)
*L_MIL*COT*				-0.024 (-0.04)				-0.466 (-1.13)
L_MIL MOT_MAI*				0.070 (0.21)				-0.159 (-0.47)
Y		0.003 (0.17)				-0.035* (-1.81)		
D_{CROP}_1	1.136 (1.60)	1.360 (1.29)	1.091 (1.44)	1.258 (1.32)	0.922 (1.31)	0.762 (0.84)	0.625 (0.85)	1.088 (0.90)
D_{CROP}_2	-0.231 (-0.38)	-0.713 (-0.78)	-0.073 (-0.11)	0.140 (0.17)	1.208* (1.86)	0.999 (1.12)	1.460** (2.17)	1.658 (1.48)
D_{ANIMAL}_1		-0.655 (-0.90)				1.197** (2.26)		
D_{ANIMAL}_2		-1.888** (-2.01)				0.715 (1.08)		
M	0.002 (0.02)	0.064 (0.66)	-0.014 (-0.20)	-0.083 (-0.93)	-0.108** (-1.94)	-0.080 (-1.17)	-0.119** (-1.97)	-0.106* (-1.43)
DISTANCE	-0.002 (-0.04)	-0.007 (-0.11)	0.012 (0.24)	0.050 (0.59)	-0.032 (-0.67)	-0.028 (-0.49)	0.032 (0.56)	0.052 (0.57)
Log-likelihood	-191.366	-115.387	-166.625	-110.238	-191.366	-115.387	-166.625	-110.238
# obs.	293	210	269	189	293	210	269	189
R^2_{adj}	0.156	0.269	0.210	0.211	0.156	0.269	0.210	0.211

***, ** and * significant at 1, 5 and 10% respectively. Table A3.1, Appendix 3, reports the variable definitions.

Appendix 2: The survey

During the period of June-August 2001 I conducted interviews in 297 households in Serengeti and Bunda Districts. In order to capture the human-wildlife interface, six villages located along the western border of the Serengeti National Park were selected for participation in the survey. Four of these villages participate in SRCP. The households were picked at random from complete lists of names, and the number of households from each village was determined by weighting the villages by their respective size. Each village in the area is divided into several sub-villages. In order to reflect the distribution of households over the village area, each sub-village was weighted by their respective number of households. In each household, whenever possible, the head of the household was interviewed. The interviews were conducted in Kiswahili with translation assistance from two local Tanzanians.

Based on experience from test interviews in Bunda, a strategy was developed on how to go about with the questionnaire in general and especially the sensitive questions on illegal hunting. In order to gain confidence from the local people, we also spent much time in the villages and had two inhabitants in each village to visit the households in advance in order to explain the purpose of the survey. The interviews took place in the home of the respective household.

Some caveats should be made as the data set have a few weaknesses that are common for questionnaires. First, information on income is likely to be understated because some respondents are suspicious and fear that the information will be handed over to the district and central government for taxation purposes. Second, the quantitative data on plot size under various agricultural uses are given by the respondents' subjective estimate, which may be subject to errors. The same applies to the estimated wildlife-induced damage to crops and livestock. The reader should be aware of these problems when reading the paper.

Appendix 3: Tables

Table A3.1: Description of variables and descriptive statistics.

Variable	Description	N	Mean (st. dev.)	Min	Max
SRCP	=1 if household lives in a SRCP village, =0 otherwise	297	0.5 (0.5)	0	1
MEAT_1	=1 if 5-10 kilo meat is bought from SRCP, =0 otherwise	296	0.27 (0.45)	0	1
MEAT_2	=1 if >10 kilo meat is bought from SRCP, =0 otherwise	296	0.13 (0.33)	0	1
DISTRICT	=1 if household lives in Bunda, =0 if household lives in Serengeti	297	0.56 (0.5)	0	1
L	Acre cultivated land	297	7.387 (6.409)	0	55
L_COT	Acre cotton production	275	1.271 (2.234)	0	20
L_MAI	Acre maize production	273	2.615 (4.524)	0	50
L_MIL	Acre millet production	275	1.364 (1.725)	0	11
COT	=1 if household produces cotton, =0 otherwise	273	0.47 (0.50)	0	1
MOT_MAI	=1 if maize is produced for cons. and market, =0 if maize is produced for cons. only	191	0.36 (0.48)	0	1
*L_MAI*MOT_MAI*	Interaction term acre and motive maize production	192	1.91 (4.69)	0	50
*L_MIL*COT*	Interaction term acre millet and cotton production	275	0.57 (1.15)	0	10
*L_MIL*MOT_MAI*	Interaction term acre millet and motive maize production	210	0.45 (1.16)	0	11
Y	Number of domestic animals	277	20.23 (26.12)	0	150
$D_{CROP\_}1$	=1 if household report much crop damage, =0 otherwise	294	0.24 (0.43)	0	1
$D_{CROP\_}2$	=1 if household report very much crop damage, =0 otherwise	294	0.61 (0.49)	0	1
$D_{ANIMAL\_}1$	=1 if household reports much damage to domestic animals, =0 otherwise	229	0.33 (0.47)	0	1
$D_{ANIMAL\_}2$	=1 if household reports very much damage to domestic animals, =0 otherwise	229	0.27 (0.44)	0	1
M	Number of household members	296	7.14 (4.54)	1	38
DISTANCE	Distance from the village to the national park (km)	297	8.38 (5.07)	2	17