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Gerald Shively
Purdue University

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Gerald E. Shively, Ph.D. (University of Wisconsin-Madison)

Department of Agricultural Economics, Purdue University
1145 Krannert Building, West Lafayette, IN 47907 USA

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Correspondence:
Dr. Gerald Shively Tel: +317 494 4218, Fax: +317 494 9176, email: shively@agecon.purdue.edu

Summary

Tropical forest destruction jeopardizes wildlife habitat. In many countries, hunting by low-income households also poses a direct threat to many species. This paper reports a study of the wildlife hunting practices of an indigenous cultural community in the Philippine province of Palawan. A survey of hunting practices was conducted among farmers living along the forest margin. The survey collected information on hunting frequency, hunting techniques, and species hunted. These data were combined with household income and demographic data to learn how socioeconomic factors influence hunting patterns and practices. Descriptive statistical procedures and regression analysis show that hunting pressure during the study period was typically greatest among resource-poor households. Poor households used the widest range of hunting implements—including modern implements such as air rifles, and low living standards were associated with greater hunting effort. Households with small farms were more likely to hunt, and were also more likely to expend greater hunting effort. Hunting was a supplementary source of food acquisition for most farmers and was found to be inferior to agricultural production in the sense that households with large farms tended to hunt less often than households with small farms. Indirect evidence suggests that higher population pressure was positively correlated with hunting pressure, and that non-agricultural employment was negatively correlated with hunting probability and intensity.

Keywords: economic analysis; hunting; poverty; Philippines; wildlife

Introduction

In the Philippines, as in other biologically rich regions of the developing world, many indigenous groups seek subsistence through hunting and periodic conversion of forest to cropland. Historically, human population densities in Philippine forests were low, fallow periods were long, and methods of hunting were traditional and generally inefficient. As a result, local ecosystems could readily withstand and recover from the impacts of human activity. Recently however, high human population growth rates have precipitated rapid forest clearing and shortened fallows (Myers 1988). Upland area devoted to agriculture in the Philippines increased 6-fold between 1960 and 1987, and much of this area increase coincided with a decline in forest cover (Cruz, et al. 1992). Estimates of total forest area losses for the Philippines range from 800-1400 km^2 yr^{-1} (Myers 1980) to as much as 2-3000 km^2 yr^{-1} in recent decades (Kummer 1992; Bee 1987). As a result of forest degradation and loss, the pressure placed on wildlife habitats has increased. For example, deforestation is considered one of the main threats to the endangered Philippine eagle (Pithecophaga jefferyi), and studies indicate that in areas where natural forest cover has been removed, only one in ten endemic bird species has successfully adapted to habitat changes (Rabor 1977). The indirect threat to wildlife from habitat loss is compounded by direct species loss due to wildlife hunting. Improvements in hunting technology have increased hunting efficiency, and rural poverty has both necessitated hunting and undermined traditional management of biotic resources. As a consequence, harvest rates for many species of wildlife exceed the regenerative capacity of local populations to the point where a large proportion of Philippine biodiversity is seriously threatened (Cox 1991; Goodland 1992; IUCN 1988).

Successful conservation efforts require knowledge of both the biological features of animal populations, and the socioeconomic forces that shape human impacts on the environment (Sajise 1993). Unfortunately, for many Philippine animal populations little is known about hunting pressure and the factors that determine who hunts and why. In response, this paper investigates the role of economic factors in explaining hunting practices along the forest margin of Palawan, a province of the Philippines. A primary motivation for this study was to examine whether economic development might complement traditional conservation measures such as demarcation and area protection. To assess the importance of economic factors in explaining hunting effort, the results from four specific hypotheses tests are reported below. These hypotheses are: (i) that high-income households are less likely to hunt than low-income households; (ii) that households with large farms are less likely to hunt than those with small farms; (iii) that large households are more likely to hunt than small households; and (iv) that households with more off-farm opportunities hunt less. I shall attempt to demonstrate that hunting arises from economic need; that low agricultural capacity increases hunting effort; and that poor farmers are likely to have the greatest impact on wildlife. These findings underscore the importance of alleviating economic hardship and ensuring equitable control of resources in protecting wildlife and securing sustainable economic development (Dasgupta and Mäler 1991).

Study Area

With 25 persons km^{-2}, the province of Palawan (1.5 million ha) is the most sparsely populated in the Philippines. It contains many of the Philippines' few remaining mangrove, mossy, and monsoonal forests, and is home to more than 200 vertebrate species—more than a quarter of all

Philippine wildlife species. Many, such as the Palawan Bear Cat (Arctitis whitei allen); the Scaly Anteater or Pangolin (Paramanis culionensis); the Southern Palawan Tree Squirrel (Sundasciurus steeri*)*; and the Palawan Peacock Pheasant (Polyplecton emphanum) are endemic to Palawan and declining in number due to habitat destruction and hunting (Gonzales 1991).

The location for this study is an upland area of Salogon, in southeast Palawan (Fig. 1). The site lies at an elevation of 500-1500 meters along a steep, forested mountain ridge near Mt. Matalingahan. Rainfall exceeds 1600 mm yr^{-1}, and the climate is characterized by a distinct dry period from January to March.

Inhabitants of the area are primarily indigenous shifting cultivators known as Pala'wan. A description and history of the Pala'wan is provided by Brown (1996). Pala'wan settlements range in size from small hamlets of 3-5 families to larger communities of up to 15-20 families. Most households practice slash-and-burn agriculture (referred to in the Philippines as 'kaingin'); in recent decades fallow periods have fallen from 10-15 years to 1-2 years. Population growth and migration from more densely populated regions of the Philippines has also led to rapid land clearing in Salogon. Newly cultivated areas are typically ecologically fragile areas that were formerly avoided. Deforestation and high erosion rates have resulted.

Poverty at the study site is evinced by low incomes and food insecurity. Average annual income is less than US $400 per household; most farms are smaller than 2 hectares; and protein-calorie malnutrition is common (Shively 1996). Households typically engage in a diverse set of activities that includes subsistence farming (rice and cassava planting); forest-product extraction (hunting, gathering, and charcoal-making); commercial crop production (maize, banana, and cashew cultivation); agricultural wage work (primarily as low-wage labourers on lowland farms);

and petty trading. Although the hunting practices of the Pala'wan are culturally-based, hunting is an economic activity that is driven by household needs. Often, temporal dimensions influence hunting. For example, hunting generally competes with other productive uses of a household's time and energy, and so hunting most frequently occurs in the agricultural off-season when extra time may be available. Similarly, household food stocks reach their lowest levels immediately prior to planting, and this leads many poor households to hunt at this time. Hunting pressure in the area is thus closely related to local agricultural capacity. Low levels of agricultural production can precipitate high harvest rates, and can also reduce wild populations indirectly through land clearing and habitat degradation. The combination of these forces throughout Palawan has led to rapidly declining animal populations, especially populations of large birds and mammals, to the point where some species face local extirpation.

Methods

Information on hunting practices were obtained as part of a socioeconomic survey of low-income farm households. The survey was conducted in 1995 by the author and researchers from the University of the Philippines at Los Baños and the Palawan National Agricultural College. A socioeconomic component of the survey, which is described in Garcia (1996), focused on characteristics of farms and economic activities among a stratified sample of 125 households living along the forest margin. Hunting data used in this study were collected during February and March of 1995 among a sub-sample of farms covered in the socioeconomic survey. This random sub-sample, which consists of 90 households, was stratified by household proximity to the forest margin. The hunting survey was conducted by trained interviewers using prepared coding sheets. Data collection relied on the head of the household's recall of successful and unsuccessful hunting trips taken by all household members. Variable recall periods were used; these ranged from 1 week to 1 year depending on the seasonality of hunting for particular species. The survey probed such topics as hunting locations, frequency of hunting trips, hunting methods, preferred species, consumption patterns, and game sales. Respondents exhibited no reticence in discussing hunting practices. Although direct confirmation of wildlife harvests was not possible, consumption data collected separately from women closely matched game harvests reported by men.

Statistical analyses of these data were used to compare household characteristics for hunting and non-hunting households. Analysis was conducted on two levels. First, patterns of hunting effort, hunting success, and hunting techniques were assessed, as were the socioeconomic characteristics (income, farm size, source of income) for households in the sample. Second, multiple regression was used to examine factors that helped to explain observed hunting patterns. In the latter case a logistic regression model was used to explain differences between households in the decision to hunt, and to derive predicted hunting probabilities for representative household. For this analysis the dependent variable was measured as 1 if the household reported hunting and 0 otherwise. In addition, a truncated-continuous (Tobit) regression model (Greene 1990) was used to predict the intensity of hunting effort. For this analysis the number of hunting trips reported by the household served as the dependent variable. Both regressions were estimated by maximum-likelihood methods using identical sets of explanatory variables. Explanatory variables included in the analysis were annual income (measured in 1995 pesos per capita (in 1995 1 US $ ≈ 25 pesos)); farm size (measured in ha per capita); proximity of the household to hunting areas (measured in minutes of travel time on foot); household work capacity (measured as the ratio of working-age to non working-age members of the household); the share of household income derived from wages (measured as wage income divided by total income); and the share of household income derived from non-agricultural income (measured as non-agricultural wages and business income divided by total income). Incomplete data for 8 households required that they be excluded from regression analysis. All reported statistical tests were conducted at the 95% confidence level.

Results

Hunting methods and patterns

Access to non-wildlife forest products (e.g. rattan, building materials) was described by respondents as 'loosely regulated by village elders,' who were described as exercising local authority over permission to cut and clear forest. Wildlife, however, was described as an open-access resource to which few restrictions applied: forest game was considered available to whoever wished to hunt. Of 90 respondents in the hunting survey, 41% reported that a household member had hunted in the previous year. Men and boys typically hunted alone or in small bands at forest margins or in the forest interior. Hunting parties frequently consisted of members from multiple households. Quantification of the exact composition of hunting parties was not possible. Conversations with hunters indicated that by-catch was rare: local codes generally require that one kill only what one intends to eat. Two cases involving live capture of parrots for sale in the pet trade were registered, but are excluded from this analysis.

Two interesting patterns emerged from the hunting survey (Table 1). First, large animals such as monkeys and wild pigs were targeted by many households but were taken in only small numbers. For example, 57% of hunting households sought wild pigs, but the average take was less than 1 animal per trip. Second, smaller animals, in particular bats, birds, and squirrels, tended to have high per-trip harvest rates and were also the target of a greater number of hunting trips. This evidence suggests that many hunters sought animals that could provide a large amount of meat, but that hunters tended to focus their efforts on small species for which hunting success was better. These patterns likely reflect higher encounter rates for smaller species.

Residents also reported that some animals were preferred to others for food. For example, only 2 households reported that they hunted Bear Cat, a viverrid, because of its strong odour and taste. Nearly all informants regarded this animal as an inferior food source. In contrast, wild pigs were consistently hunted despite low probability of hunting success.

A variety of hunting tactics were found to be employed in the quest for wild game, ranging from simple sling shots or snares for birds to crude, home-made explosives placed in the suspected paths of wild pigs (Table 2). Many households indicated that they had ‘bat poles.’ These are 3-5 m long sections of small-diameter bamboo, which have affixed to their ends a cluster of thorns or fish-hooks used to entangle bats feeding in fruit trees. Air rifles, which were assembled locally by a carpenter who carved stocks, were relatively expensive. The reported cost of an air rifle was 800 pesos (≈ US $ 32), or approximately 8-10% of annual household income. Despite their high cost, air rifle ownership was reported by 24% of those who reported hunting (Table 2). Traditional hunting implements such as blow guns, spears, and traps were the most frequently reported hunting tools: 73% of hunters used blow guns and 43% percent used spears. These implements were usually constructed by the hunters themselves using local materials. While versatile (traditional implements were used for almost all prey), they tended to be less effective than air rifles.

Determinants of hunting effort

One might expect hunting effort and intensity to decline as income, farm size, or labour costs rise. These hypotheses can be tested by linking hunting data to economic data. Table 3 shows that average per capita farm size was significantly smaller for hunters than for non hunters ($\chi^2 = 4.8$, df = 1, $\rho < 0.05$), and was much smaller for those who reported hunting inferior wild food sources such as Bear Cats, rats, and Monitor Lizards. Data reported in Table 3 also show that households hunting less desirable species were more likely to have low incomes. For example, the average income of those hunting Bear Cats (1889 pesos yr^{-1}) was 40% lower than the average income of those hunting fruit bats (3348 pesos yr^{-1}).

Farmers who hunted with air rifles tended to have lower incomes (1611 pesos yr^{-1}) than those who hunted without rifles (2240 pesos yr^{-1}). They also had significantly smaller farms ($\chi^2 = 5.2$, df = 1, $\rho < 0.05$), and derived a significantly larger share of household income from wages ($\chi^2 = 6.8$, df = 1, $\rho < 0.05$). Those who used air rifles hunted more often than those who did not (59 trips vs. 19 trips annually), and reported higher harvests (23 animal vs. 5 animals per trip).

Hunting patterns were further investigated using logit and Tobit regressions. Statistical relationships were similar in the two equations. Coefficient estimates for farm size, distance to forest, and measures of income-shares were all significantly different from zero at a 95% confidence level. Although there was a tendency for hunting probability and hunting effort to increase with income, a hypothesis that hunting patterns were directly associated with income could be rejected in both equations (Table 4). Farm size, however, was statistically important. Results indicate that an increase in farm size was associated with both a reduction in the probability of hunting and a reduction in the intensity of hunting effort (Table 4). Using the estimated coefficients from the logit regression and observed means in the sample data, calculation of the elasticity of hunting probability with respect to farm size indicates that a 1% increase in per hectare farm size was associated with a 0.8% reduction in the probability of hunting. The marginal reduction in hunting probability associated with an increase in farm size could be inferred using the parameter estimates from the logistic regression by calculating the predicted probability of hunting for a range of farm sizes, holding constant other household characteristics under consideration. This was done using three values for the share of off-farm income (0.00, 0.20, and 0.50). The analysis indicates that households with no off-farm income were the most likely to hunt regardless of farm size (Fig. 2). Furthermore, as farm size increased, the probability of hunting decreased (Fig. 2).

Distance from the forest was a statistically important determinant of hunting effort (Table 4). The average observed walking time to a hunting area was approximately 15 minutes (range 1-60 minutes). Not surprisingly, households that were farther from the forest were less likely to hunt, and hunted less often. Household work capacity (defined as the number of working-age members of the household divided by the number of non working-age members) was also negatively correlated with hunting probability and effort: holding other factors constant, households with fewer working-age members were more likely to hunt. Although the relationship was not statistically significant, the pattern nevertheless suggests that hunting may have been important for households in which earning capacities were low. Regression results also show that as the share of income derived from agricultural wages increased, so too did the probability and intensity of hunting. In contrast, as the share of non-agricultural income increased, the probability of hunting declined.

Discussion

Resource management failures (*à la* Hardin 1968) often provide a partial explanation of over-hunting in low-income tropical settings, but in many instances reductions in wildlife populations reflect improvements in hunting efficiency (due to better hunting tools such as air rifles and explosives), the relatively low socioeconomic status of residents who hunt, and an increasing number of hunters. Although this analysis failed to support the hypothesis that high-income households might be less likely to hunt than low-income households, the statistical analysis did support three other hypotheses: households with large farms were found to be less likely to hunt than those with small farms; households with greater work capacity were less likely to hunt; and households with more off-farm opportunities hunted less. The negative relationship between farm size and hunting probability provides indirect evidence regarding the role of population pressure in promoting hunting: holding farm size constant, a larger family has a smaller per capita farm, and smaller farm sizes were found to be associated with greater hunting probability and intensity.

From both economic and statistical perspectives, the source of household income was useful in explaining hunting behavior. Although one might expect hunting to be less prevalent among wage labourers, most wage labour in the sample was agricultural, and involved planting, weeding, and harvesting on larger farms. These low-wage and seasonal jobs were typically filled by members of landless households. For this reason, the pattern exhibited in the regressions (Table 4) likely reflects three facts. First, wage earners had fewer agricultural options than other households, and hence were more reliant on wild food sources than other households; second, wage earners relied on seasonal agricultural employment and therefore hunted during periods in which wage income was not available; and third, on average the relative returns to agricultural production for households with land exceeded both the agricultural wage and the returns to hunting.

Findings show that distance to the forest was negatively correlated with hunting probability and effort. Although this pattern reflects higher costs of hunting effort for those who live far from the forest, it also reflects the fact that farms farther from the forest were on less-steep and more productive land. It is important to point out, however, that many hunters reported that travel time was not an important deterrent to hunting, suggesting that the opportunity cost of their time was quite low.

The importance of improved hunting technology is underscored in this analysis by the finding that greater hunting success was associated with air rifle use. Several villagers reported that previously common birds disappeared after air rifles appeared in the community. Patterns in the data indicate that poorer households relied on air rifles more than better-off households. This may indicate one of two underlying forces, either that improvements in hunting technology substitute for agricultural production, or, as is more likely, that hunting is an important subsistence mechanism when agricultural capacity is low. Given that poor households have few opportunities to purchase land or other productive assets, an air rifle is a valuable investment that provides high returns to its owner. Better agricultural opportunities would likely reduce many farmers' need for wild food sources in the study area, and would thereby reduce hunting pressure.

Implications of Findings for Conservation Efforts

Establishment of forest preserves is an important conservation initiative in the Philippines, where approximately 60 National Parks have been established during the past century (NRMC 1983). Based on land use patterns from the study site, it would appear that efforts to delineate buffer zones for habitat protection might best focus on ravines and steep valleys. These areas typically contain the least disturbed habitat, and are the areas least likely to be valued for agricultural use by local residents. Furthermore, ravines and steep valleys in upland areas may provide wildlife corridors to maintain local biodiversity. Nevertheless, given the local perspective that wildlife is 'available for anyone who needs it,' efforts to enforce protected-area boundaries will be difficult. Furthermore, without changes in local economic conditions, delineation of protected area boundaries by itself is unlikely to provide adequate protection to hunted species. This analysis suggests that demarcation and guarding of protected areas must be accompanied by efforts to expand the set of economic opportunities available to low income households, particularly those households with small farms near critical habitats. Reducing the need for wildlife and wildlife habitat is likely to provide the greatest opportunity for conservation success.

In light of the rapid disappearance of species in Palawan, innovative approaches to balancing economic and environmental goals are needed. Given household reliance on bats and birds, incorporation of fruit or other trees into local agroforestry systems may provide a useful management tool to sustain wildlife populations while providing products for human use.

However, the sustainability of such a system critically depends on hunting pressure and overall habitat maintenance (Redford et al. 1992). For example, research from Sumatra shows that while rubber-based agroforestry systems support fewer species of plants and birds than do primary forests (Michon & de Foresta 1995;Thiollay 1995), they support roughly the same number of mammal species (Sibuea & Hedimansyah 1993).

A unified conservation strategy is provided by integrated conservation and development projects (ICDPs), which 'aim to achieve conservation goals by promoting development and providing local people with alternative income sources that sustain rather than threaten flora and fauna' (Munasinghe 1994, p. 27). These initiatives may point the way toward a more participatory approach to achieving environmental conservation while satisfying basic human needs. This study suggests that successful ICDPs will be those that (1) alleviate poverty by improving agricultural capacity and productivity; (2) limit human population growth and migration into critical habitats; and (3) reorient patterns of economic activity away from the forest.

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References

Bee, O. J. (1987) Depletion of Forest Reserves in the Philippines. Field Report Series No. 18. Singapore: Institute of Southeast Asian Studies: 60 pp.

Brown, E. C. (1996) Tribal Displacement, Deculturalization, and Impoverishment. In: Palawan at the Crossroads, eds. J. F. Eder & J. O. Fernandez, pp. 97-110. Quezon City: Ateneo de Manila University Press: x + 170 pp.

Cox, R. (1991) Philippines, In The Conservation Atlas of Tropical Forests, Asia and the Pacific, eds. N. M. Collins, J. A. Sayer, & T. C. Whitmore, pp. 192-200. New York: Simon & Shuster for The World Conservation Union (IUCN): 256 pp.

Cruz, M. C., Meyer, C. A., Repetto, R., & Woodward, R. (1992) Population Growth, Poverty, and Environmental Stress: Frontier Migration in the Philippines and Costa Rica. Washington, DC: World Resources Institute: viii + 92 pp.

Dasgupta, P. & K. Mäler (1991). The Environment and Emerging Development Issues. Proceedings of the World Bank Annual Conference on Development Economics 1990: 101-131.

Garcia, H. N. M. (1996) Soil Conservation in an Upland Farming System in Palawan: A Socio-economic Survey. SEARCA-UQ Uplands Research Project Survey Report No. 4. Los Baños, Philippines: Southeast Asian Regional Center for Graduate Study and Research in Agriculture: x + 120 pp.

Gonzales, P. C. (1991) The Fauna of Palawan. In Bountiful Palawan, pp. 184-214. Manila: Aurora Publications: 248 pp.

Goodland, R. J. A. (1992) Neotropical Moist Forests: Priorities for the Next Two Decades. In Conservation of Neotropical Forests, eds. K. H. Redford & C. Padoch, pp.416-433. New York: Columbia University Press: xiii + 475 pp.

Greene, W. H. (1990) Econometric Analysis. New York: MacMillan & Co.: xix + 783 pp.

Hardin, G. (1968) The Tragedy of the Commons. Science **162**:1243-1248.

IUCN (1988). The Conservation Status of Biological Resources in the Philippines. Cambridge: IUCN Conservation Monitoring Centre.

Kummer, D. M. (1992) Deforestation in the Postwar Philippines. Manila: Ateneo de Manila University Press: xiv + 177 pp.

Myers, N. (1980). Conversion of Moist Tropical Forests: A Report Prepared for the Committee on Research Priorities in Tropical Biology of the National Research Council. Washington, DC: National Academy of Sciences: ix + 205 pp.

Myers, N. (1988) Environmental degradation and some economic consequences in the Philippines. Environmental Conservation **15**: 205-14.

Michon, G. & De Foresta, H. (1995) The Indonesian Agroforest Model of Forest Resource Management and Biodiversity Conservation, In Conserving Biodiversity Outside Protected Areas, eds. P. Halladay & D. A. Gilmour, pp. 90-106. Gland: IUCN: 228 pp.

Munasinghe, M. (1994) Economic and Policy Issues in Natural Habitats and Protected Areas. In Protected Area Economics and Policy: Linking Conservation and Sustainable Development, eds. M. Munasinghe & J. A. McNeely, pp. 15-49. Washington, DC: The World Bank for the World Conservation Union: vii + 364 pp.

NRMC (1983) An Analysis of Laws and Enactments Pertaining to National Parks. Quezon City: Natural Resources Management Center, Ministry of Natural Resources. 127 pp.

Rabor, D. S. (1977) Philippine Birds and Mammals. Quezon City: University of the Philippines Press: xi + 284 pp.

Redford, K. H., Klein, B. & Murcia, C. (1992). Incorporation of Game Animals into Small-Scale Agroforestry Systems in the Neotropics. In Conservation of Neotropical Forests, eds. K. H. Redford & C. Padoch, pp. 333-358. New York: Columbia University Press: xiii + 475 pp.

Sajise, P. (1993) Conceptual Frameworks for Studying Biodiversity, In Regional Study on Biodiversity: Concepts, Frameworks, and Methods. Proceedings of the Southeast Asian Universities Agroecosystem Network and Program on Environment, eds. P. Shengji & P. Sajise, pp. 11-18. Xishuangbanna: Yunnan University Press: ix + 295.

Shively, G. E. (1996) Land Degradation, Soil Conservation, and Risk: Evidence From a Dynamic Model of Philippine Upland Agriculture. Unpublished Ph.D. Dissertation, University of Wisconsin-Madison: xviii + 311 pp.

Sibuea, T. T. H. & Herdimansyah, D. (1993) The Variety of Mammal Species in the Agroforest Areas of Krui (Lumpung), Muara Bungo (Jambi), and Maninjau (West Sumatra). Photocopy. Bandung, Indonesia: HIMBIO (UNPAD).

Thiollay, J. M. (1995) Are Traditional Agroforests an Alternative for the Conservation of Rainforest Bird Diversity? Three Case Studies in Sumatra. Conservation Biology, **9**:335-353.

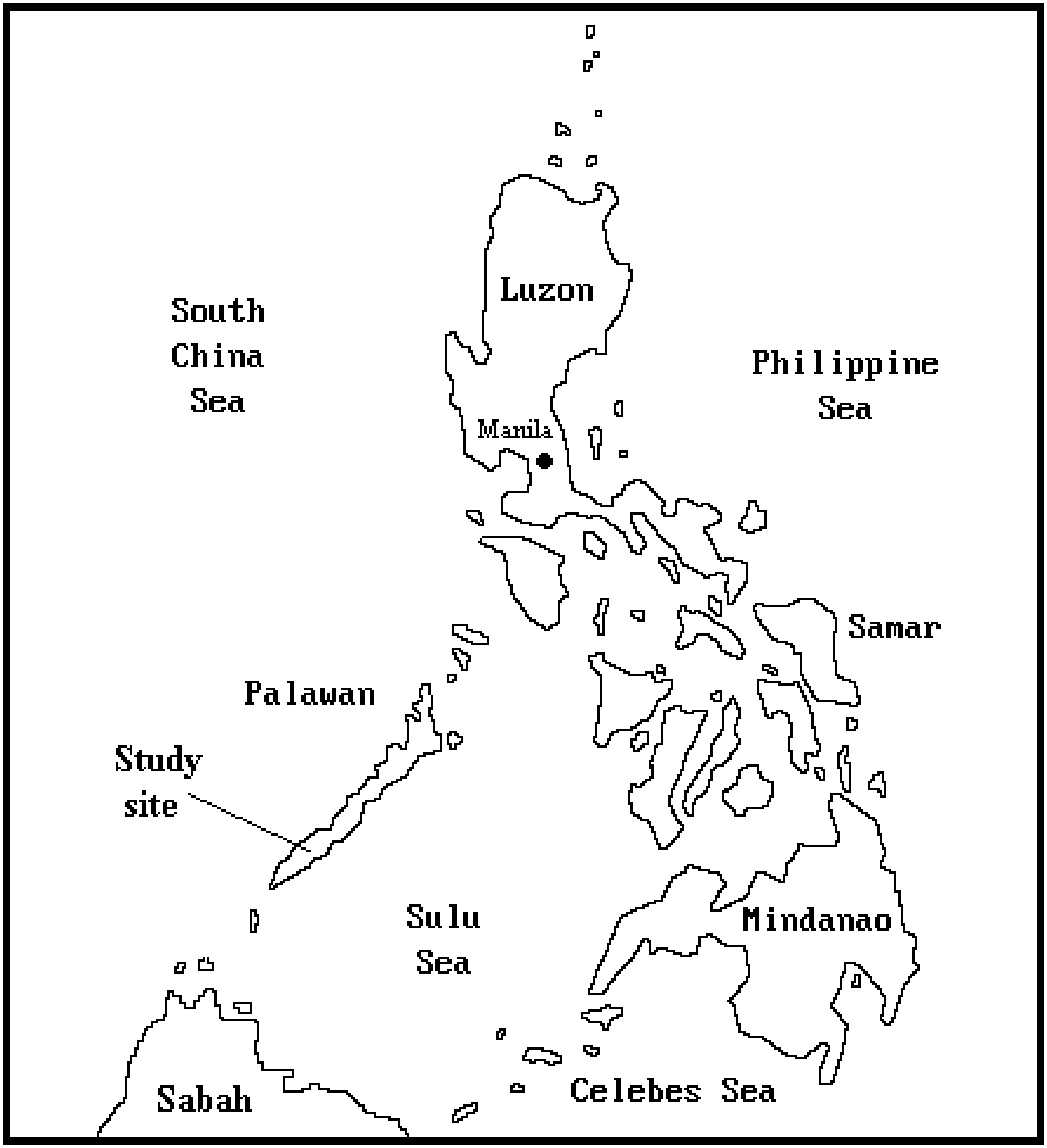

Figure 1 Map of the Philippines indicating location of study site

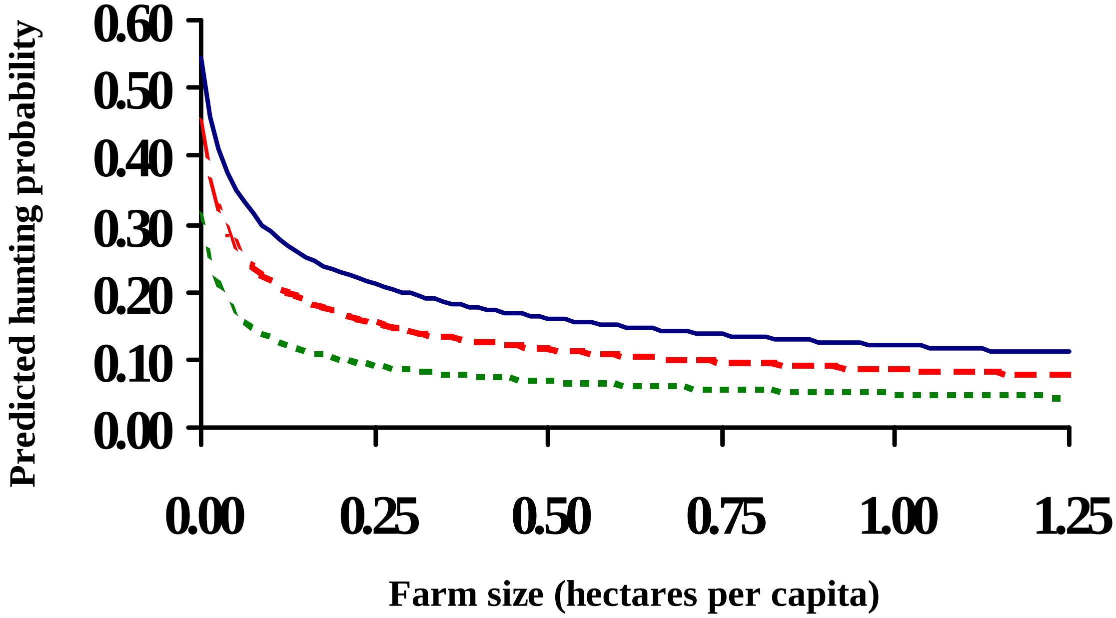

Figure 2 Farm size, off-farm income, and predicted hunting probability

Legend:

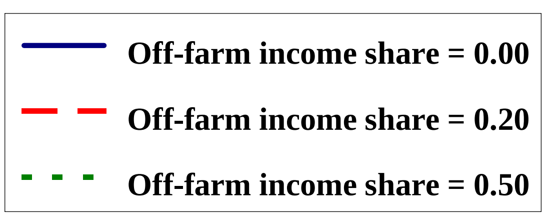

Table 1 Extent, frequency, and success of hunting in Salogon, 1995

Animal	Number of households hunting animal	Average number of trips per household per year	Average harvest per trip (# animals)
Bird (mixed or not identified)	23	22	8.3
Palawan Peacock Pheasant (Polyplecton emphanum)	10	11	4.2
Long-tailed Macaque (Macaca fascioularis)	23	8	2.3
Palawan Bear Cat (Arctitis whitei allen)	2	6	2.0
Palm Civet (Paradoxurus philippinensis)	7	11	1.0
Wild pig (Sus barbatus)	21	6	0.7
Fruit bat (Eonycteris spp., or other)*	13	20	11.7
Palawan flying fox (Acerodon leucotis)	8	15	3.9
Palawan tree squirrel (Sundasciurus steeri)	19	28	4.1
Rat (Palawanomys furrus, or other)*	1	4	50.0
Monitor lizard (Varanus spp.)	13	16	3.0
Any animal	37	15	4.7

Notes: * The Philippines has a diversity of small mammals, especially rodents and bats, many of which have yet to be classified or named. Common names typically apply to a range of related species.

Table 2 Hunting implements and extent of use in Salogon, 1995

Implement	Households reporting use	Typical uses
air rifle	24%	birds, monitor lizards, civets, squirrels
bat pole	14%	fruit bats, flying foxes
blow gun with dart	73%	bats, birds, monkeys, civets, squirrels
explosives	3%	wild pigs
spear	43%	monitor lizards, wild pigs
sling-shot	8%	birds, squirrels
snare/trap	27%	birds, civets, squirrels

Table 3 Farm size and incomes by hunting category in Salogon, 1995

Group	Farm size (ha/capita)	Annual income (pesos/capita)	Income share from wages
All households:	0.70	2317	0.10
Non hunters	0.74	2276	0.08
Hunters	0.63	2375	0.14
Those who hunted:			
Fruit bats	0.73	3348	0.10
Monitor lizards	0.61	1754	0.28
Monkeys	0.62	2074	0.16
Bear Cats	0.29	1889	0.30
Wild pigs	0.54	2300	0.11
Pheasants	0.79	3118	0.23
Rats	0.30	982	0.14
Those who used:			
Air guns	0.36	1638	0.23
Blow guns	0.61	2511	0.14
Spears	0.70	3074	0.14

Table 4 Regression results to explain hunting patterns

	Regression Model	
	Logit	Tobit
Independent variable	hunting (yes/no)	number of trips
Constant	-0.456 (2.486)	-0.066 (1.183)
Income per capita (log)	0.406 (0.288)	0.122 (0.136)
Land area per capita (log)	-1.131** (0.482)	-0.452** (0.177)
Distance (minutes)	-0.096** (0.023)	-0.035** (0.008)
Work capacity ratio (working age/non-working age)	-0.561 (0.357)	-0.247 (0.167)
Income share: wages	5.237** (2.441)	2.372** (0.958)
Income share: non agriculture	-1.936* (1.154)	-1.117* (0.601)
Value of the log-likelihood function	-35.7	-212.5
Number of observations	82	82

Note.—Standard errors are in parentheses; * indicates that coefficient is statistically different from 0 at the 90% confidence level; ** indicates that coefficient is statistically different from 0 at the 95% confidence level