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Need, Greed or Customary Rights -
Which Factors Explain the Encroachment of Protected Areas?
Empirical Evidence from a Protected Area in Sulawesi, Indonesia

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Abstract

The encroachment of protected areas for agricultural and livestock production is an important challenge for nature conservation in developing countries. The driving forces of encroachment are debated – major arguments focus on (1) the need of local people to cultivate land inside protected areas due to poverty, (2) commercial interests of cultivating inside protected areas, which indicates free-riding (“greed”), and (3) resistance against protected areas caused by disregard of customary rights. The paper contributes to this understanding by analyzing the encroachment of a National Park in Sulawesi, Indonesia. The analysis is guided by a theoretical framework which acknowledges that most individuals are neither purely altruistic nor entirely self-interested. The empirical analysis combines data from a village-level survey with information from a satellite image and other spatial data. The following factors had a significant influence on the extent of encroachment: (1) population density in the area, which is related to needs, (2) the availability of suitable land inside the Park, which indicates “temptation”, and (3) the extent of land that was already cultivated before the Park was established, which points to customary rights. Community agreements on conservation are discussed as a policy approach that can address all three factors.

JEL classification: O13, Q12, Q57

1 Introduction

Protected areas are the major policy instrument for nature conservation. The number of protected areas has tripled over the last twenty years. Around 12 % of the earth’s surface is now protected, an area that exceeds that under crop production (IUCN, 2003). Nevertheless, biological diversity continues to decline at alarming rates, and conservation organizations argue both for an expansion of the network of protected areas, and for a better enforcement of regulations in already established protected areas. Both strategies are likely to increase conflicts with local communities, who continue to lose income and development opportunities

due to restrictions on farming and livestock keeping in protected areas. Major efforts have been made to address these conflicts by developing alternative income sources for communities living in the vicinity of protected areas, including eco-tourism, and by involving them in the management of protected areas. These approaches have been labeled integrated development and conservation, community-based wildlife management and collaborative management. In spite of these efforts, encroachment of protected areas for agricultural production continues to be a major problem. Encroachment can be defined as the illegal use of land inside protected areas. In a study on threats to National Parks in ten countries, encroachment by agriculture and livestock was identified to be the most important threat (IUCN, 1999: 12).

The driving forces of encroachment are subject to debate (compare Horowitz 1997). Development-oriented organizations emphasize poverty as a major reason for encroachment. Conservation organizations point out that encroachment is often carried out by well-connected better-off farmers for commercial interests. Advocacy groups for indigenous people call attention to the fact that the establishment of protected areas often violates customary rights – so that protected areas constitute an encroachment of indigenous lands rather than vice versa. The question of what drives encroachment – need, greed, or customary rights - is of high importance for the design of appropriate conservation and development strategies. Yet, this debate remains based on ideological arguments, rather than empirical evidence. The present paper contributes to overcoming this problem by (1) developing a conceptual framework for analyzing the driving forces of encroachment, and (2) conducting an empirical analysis for the case of a protected area in Sulawesi, Indonesia.

2 Conceptual Framework

A conceptual framework that contributes to resolving the debate on encroachment has to accommodate different behavioural assumptions regarding the question as to how individuals

react to state regulations. On the one hand, one may assume that decision-makers – while optimizing – respect the regulations of state and society – an assumption underlying the “traditional” *homo economics* in neo-classical economics. On the other hand, one may assume that decision-makers violate regulations if the benefits of doing so outweigh the costs, taking the probability of enforcement and risk behaviour into account. Models of the New Institutional Economics are based on this assumption of opportunistic behavior. The fact that encroachment happens indicates that the first assumption is unrealistic. However, empirical studies on deforestation in the tropics show that protected areas do in fact contribute to conservation even though enforcement is very low, indicating that the second assumption does not completely describe decision-making either. As IUCN (2003) notes, many proclaimed protected areas in developing nations exist more on paper than in practice. Still, in a study on land use change in the Brazilian Amazon, Mertens et al. (2002) found that the dummy “presence of a reserve” reduced deforestation. Analyzing land use change in Central Sulawesi, Maertens (2004) found that a dummy for “location inside the national park” reduced the probability that a plot is cultivated. Simulating the removal of the legal protection to the Darién Park in Panama, Nelson et al. (2001) predict an increase in the deforestation of the Park area, even though the ability to enforce restrictions was limited by the small number of Park personnel. Deininger and Minten (2002) found a significant influence of the protection dummy and concluded that protection did reduce the threat of deforestation in Mexico, even though it failed to eliminate deforestation altogether. These findings are in line with a survey of 93 protected areas in 22 tropical countries, which found that protected areas are effective in reducing deforestation (Bruner et al., 2001).

In light of this empirical evidence, it is useful to presuppose that real world actors are not entirely self-seeking, neither are they purely altruistic. Assuming that most actors occupy some middle ground, Zusan (1993) suggested a framework that captures different degrees to

which individuals are prepared to deviate from norms in response to “temptations”, i.e., to gain material advantage at the expense of violating a norm. This framework, which is presented in Figure 1 is useful for analysing the encroachment decision, as it captures the trade-off between the disutility caused by violating a state regulation with the utility caused by the economic benefits derived from encroachment.

Figure 1

The x-axis indicates the extent of the departure from the regulation, which can be measured as the size of the land illegally cultivated inside a protected area. The y – axis indicates the economic benefits derived from this violation of the rule, which can be measured as the net benefit derived from agricultural production inside the protected area. The curve can be interpreted as an income possibility curve of the household (to be added to other income sources of the household). As this income is derived from agricultural production, the standard assumptions of agricultural production theory apply, hence the curve displays decreasing marginal returns and is influenced by the agro-ecological potential of the respective area, the available technology, and input and output prices, which are influenced by infrastructure and markets. Assuming a risk-neutral decision-maker, one can deduct the expected costs of enforcement (multiplying the level of fine with the probability of being fined) from the income possibility curve. This will shift the curve Y (which becomes an expected income possibility curve) downwards.

The indifference curves I in Figure 1 capture the trade-off between the utility of the income derived from cultivating inside the Park and the disutility arising from violating the regulation, i.e. the disutility arising due to conscience rather than fear of enforcement. I_1 , I_2 and I_3 represent three decision-makers who have different preferences with regard to this trade-off. According to standard micro-economic theory, a household will maximize its utility at the point of tangency of the income possibility curve Y and the respective indifference

curve, which leads to the encroachment levels E_1 , E_2 and E_3 (see Zusman, 1993, for a formal treatment). The indifference curves may be influenced by factors such as personal ethical standards, the extent to which respecting “law and order” is part of the country’s or region’s political culture, and the behaviour of local leaders. Creating awareness about the value of nature conservation may shift the indifference curve to the left-hand side, thus reducing the level of encroachment. Increasing the productivity of agricultural production will lead to an upward shift of the income possibility curve Y , thus increasing encroachment. This reflects a typical argument formulated by conservation groups against the “integrated conservation and development” approach. In line with this argument, Maertens et al. (2006) found that increased productivity due to improved technologies did indeed lead to an expansion of cultivated land and an encroachment of forests in Central Sulawesi. However, this effect was only observed if such technologies were not input and labor intensive.

The indifference curve I_3 depicts a decision-maker, for whom the violation of the norm does not incur any disutility. One interpretation for such an indifference curve is that this decision-maker displays a pure opportunistic behaviour. However, a decision-maker does not consider the establishment of the protected area as legitimate may also have an I_3 indifference curve. While the first case captures the “greed” argument, the second case refers to the “customary rights” argument in the encroachment debate mentioned above.

Figure 1 also shows how the argument that encroachment is driven by poverty, or need, can be addressed in this theoretical framework. The income derived from cultivation inside the protected area that is required to fulfil the household’s basic needs is indicated by line Y_{\min} . In order to fulfil these needs, a household with the difference curve I_1 in Figure 1 has to encroach the area E_1 in order to fulfil its minimum requirements Y_{\min} . Encroachment is no longer a choice according to the subjective valuation of the utility of income versus the utility of adhering to norms. While one can debate the shape of the indifference curves below Y_{\min} (see

Nakajima, 1986), a household that needs to violate a regulation in order to the basic needs will end up at a lower utility level (indicated by curve I_1'). This captures the intuition that it is not useful to declare a protected area in locations where the land to be protected is needed to meet the households' basic needs because other income opportunities are absent. Rather than improving conservation, this will only impose an additional burden (disutility) on those poor households that care about the law.

While it is not possible to observe the indifference curves of the households directly, these theoretical considerations make it possible to identify the variables that have to be taken into account in an empirical study of encroachment, as explained below.

3 Research Area and Data

The data for the empirical analysis was collected in a National Park and its surrounding area in Sulawesi, Indonesia. The Park covers an area of 218,000 ha and is characterized by a high degree of endemism. The research area comprised the five sub-districts, in which the National Park is located. There are 117 villages located in these districts, of which more than half have a border with the National Park. Agriculture is the major income source. The dominant crops are irrigated paddy and cacao and coffee.

This study is based on the following two types of data sources: (1) A socio-economic village-level survey conducted in 80 villages, and (2) the results of a satellite image interpretation and other spatial data, including a road map and a digital elevation model. This analysis includes those villages that have that have a border with the National Park (46 of the 80 villages).

The village survey was conducted in 2001 in 80 of the 117 villages in the research region. The villages were selected by stratified random sampling. Stratification criteria included distance to the National Park, population density and ethnic composition (proportion of immigrants). In each of the selected villages, a focus group of villagers was interviewed, using a standardized questionnaire. Information on land use in the research area was derived from the

interpretation of a LANDSAT image of 2001. The interpretation was supported by ground truthing. Land use classes included forest, open forest, water, paddy rice, other annual crops (maize, peanuts, upland rice), coconut, coffee & cacao, grassland, reed and settlement.

As no satisfactory data on village boundaries could be obtained, Thiessen polygons were constructed to link the spatial data to the village survey data. As the polygons assign each point in space to the nearest village centre, the procedure appears useful with regard to the study of land use decisions because, considering transport time and costs, one can assume that villagers are more likely to cultivate areas that are located closer to their settlement.

4 Analysis and Results

Based on the considerations in Section 2, the area cultivated inside the Park can be considered as a function of

- the variables that influence the need of households to cultivate inside the Park (push factors, related to the considerations on Y_{\min} in Figure 1),
- the variables that influence income possibility curves of the households from cultivation inside the Park (pull factors, shifting the Y curve in Figures 1 upwards), and
- the variables that influence the households' preferences with regard to income and the violation of formal norms (indifference curves I in Figure 1).

Table 1 lists the variables that have been selected to capture these factors empirically and Table 2 shows the descriptive statistics of these variables.

Table 1, Table 2

The dependent variable is the total area encroached per village. To avoid problems of heteroscedasticity, we used the natural log of this variable in the regression. Since the villages differ considerably in size, the village population is included as predictor variable. The population density in the district, in which the village is located, was used as an indicator of

population pressure. The number of households without land indicates the pressure on the Park arising from inequality of land distribution and related poverty. Since non-agricultural income sources have a potential to reduce the pressure on the Park, the number of households with such income sources was included.

The availability of land suitable for agriculture outside the Park, and the possibility to expand the paddy cultivation outside the Park were included as factors that reduce the pressure on the Park. Using the digital elevation model and the road map as data sources, we defined “suitable land” as land below a slope of 20 degrees and situated within a distance of less than 3 km to the road. Slope also serves as a proxy for soil quality in the research area.

The availability of suitable land inside the Park, defined according to the same criteria, was included as a pull factor. The travel time to the next major market was also included as a pull factor, because of its impact on the value of the crops that are marketed. As an indicator of traditional land use rights inside the Park, we considered the extent of the area that was already cultivated before the Park was established. We did not include variables indicating enforcement, such as the presence of a Park Guard, or variables indicating NGO activities to promote conservation, because they are likely to be endogenous.

Table 3

Table 3 displays the results of the OLS regression.¹ With the exception of the variables “suitable land outside the Park” and “village population,” the variables show the expected signs. The variable “suitable land inside the Park” and the variable “area cultivated before the Park was established” were significant at the 5 % level, and the variable “population pressure

¹ According to the F-statistics, we can reject the hypothesis that all variables are zero. The R-square of 0.51 and the adjusted R-square of 0.39 appear reasonable considering the comparatively small sample size of 46 observations in a cross-sectional data set. The highest condition index was 9, which does not indicate a potential multicollinearity problem. Casewise diagnostics showed that the highest Cook’s Distance was 0.6, which indicates that no individual case had an undue influence on the model. Plotting the standardized predicted values against the standardized residuals and performing the Breusch-Pagan test showed that heteroskedasticity was not a problem.

in the district” was significant at the 10 % level. The standardized beta-values in Table 3 show that these three variables also had a comparatively strong influence on the extent of cultivation inside the park. The number of landless households also has a comparatively strong influence, however the significance level was only 19%.

5 Discussion and Conclusions

The empirical results of the regression model indicate that all three factors discussed in the theoretical section – needs, opportunities (“greed”) and indigenous rights – play a role for encroachment in the case considered. The three variables with significant influence in the regression model were (1) population density in the area, which can be related to needs, (2) the availability of suitable land inside the Park, which is an indication of opportunity or temptation, and (3) the extent of land that was already cultivated in the present area of the Park before the Park was established, which is an indication of customary rights.

These empirical results suggest that policy efforts to improve the management of protected areas have to simultaneously address all three concerns – needs, “greed” and customary rights. An important case in point - which has also been highlighted in earlier studies (compare Chomitz and Grey; 1996; Cropper et al., 2001), is avoiding the creation of pull factors by placing roads close to protected areas – or vice versa – by placing Parks close to roads. Both our theoretical considerations and the empirical results suggest that strengthening law enforcement without at the same time reducing the need for encroachment created by poverty will not be a viable policy option. Agricultural development programs aiming to alleviate poverty, however, may also increase the income opportunities from encroachment. An approach practiced in the research area to overcome this problem are “Community Agreements on Conservation”. These agreements have been negotiated between NGOs that provide development assistance and the village communities, which made a self-commitment not to extend the cultivation inside the National Park. Traditional village authorities helped to

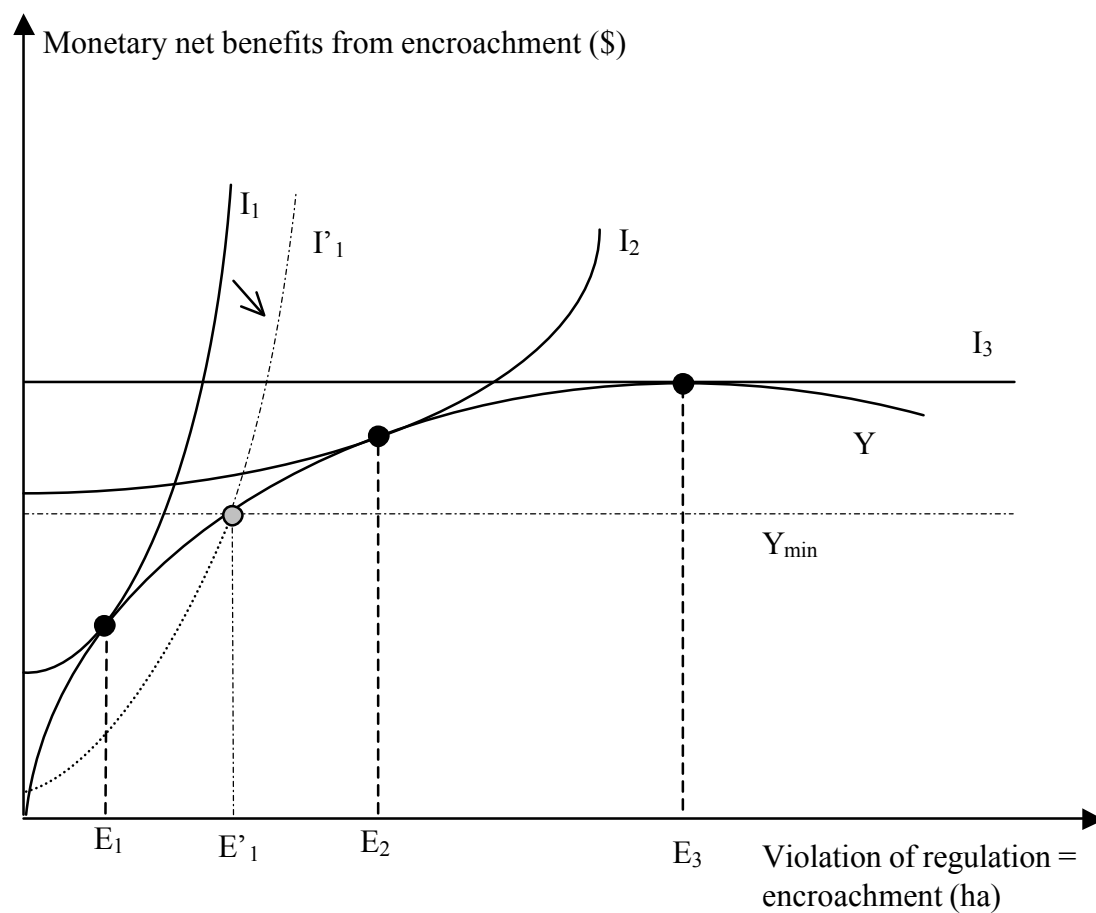
enforce these commitments. The success of such approaches will depend on the effectiveness of the projects in raising local incomes, especially of the poor. The Community Agreements on Conservation are also a promising tool to deal with the issue of indigenous rights. In several villages, the Park Management and the village leadership have signed Community Agreements on Conservation that acknowledge the traditional rights of local communities inside the Park. The communities agreed not to expand the cultivation inside the Park and to contribute to the enforcement of other Park regulations, such as illegal logging. While it is still too early to evaluate the effectiveness of these agreements, they constitute a promising tool to overcome conflicts between the goals of conservation, poverty alleviation and the recognition of customary rights.

References

- Bruner, A., R. E. Gullison, R. E. Rice and Fonseca, G. A. B., 2001. Effectiveness of Parks in Protecting Tropical Biodiversity. *Science* 291(5):125-128.
- Chomitz, K. M. and Gray, D. A. (1996). Roads, Land Use, and Deforestation: A Spatial Model with Application to Belize. *World Bank Economic Review* 10(3):487-512.
- Deininger, K. and Minten, B., 2002. Determinants of Deforestation and the Economics of Protection: An Application to Mexico. *American Journal of Agricultural Economics* 84(4): 943-960.
- Horowitz, L. S., 1997. Encroachment of Protected Areas by Small-Scale Actors: An Examination of Issues, Conservation International.
- IUCN, 1999. Threats to Protected Areas: Summary of a Survey of 10 Countries Carried out in Association with the World Commission on Protected Areas. Gland, The World Conservation Union.

- IUCN, 2003. The Durban Accord. Vth World Parks Congress of the International Union for the Conservation of Nature (IUCN) on “Benefits Beyond Boundaries”, Durban, 2003. www.iucn.org/wpc2003.
- Maertens, M., 2004. Economic Modeling of Agricultural Land-Use Patterns in Forest Frontier Areas. Theory, Empirical Assessment and Policy Implications for Central Sulawesi, Indonesia. Dissertation.de - Verlag, Berlin.
- Maertens, M., Zeller, M., and Birner, R., 2006. Sustainable Agricultural Intensification in Forest Frontier Areas. *Agricultural Economics*. 34, 1-10.
- Mertens, B., R. Pocard-Chapius, M.-G. Piketty, A.-E. Lacques and Venturieri, A., 2002. Crossing Spatial Analyses and Livestock Economics to Understand Deforestation Processes in the Brazilian Amazon: The Case of Sao Félix do Xingú in South Pará. *Agricultural Economics* 27: 269-294.
- Nakajima, C., 1986. Subjective Equilibrium Theory of the Farm Household, Elsevier, Amsterdam etc.
- Nelson, G. C., V. Harris and Stone, S.W., 2001. Deforestation, Land Use, and Property Rights: Empirical Evidence from Darién, Panama. *Land Economics* 77(2): 187-205.
- Zusman, P., 1993. Participants' Ethical Attitudes and Organizational Structure and Performance - Application to the Cooperative Enterprise, in: Csaki, Csaba / Kislev, Yoav (Eds.): *Agricultural Cooperatives in Transition*. Westview Press, Boulder, pp. 23-54.

Figure 1: Decision-making on encroachment



Source: adapted from Zusmann (1993: 31)

Table 1: Variables used in the Empirical Model

Variable	Indicator	Data source	Exp. sign*
Dependent variable			
Encroachment	Area per village cultivated inside the National Park	Satellite data	
Predictors			
<i>Push factors</i>			
Village population	No. of inhabitants of the village	Village survey	+
Population pressure in the area	Population density in the district, calculated for the area outside the Park	Village survey	+
Land availability outside the Park	Area of land outside the Park with less than 20 degree slope and less than 3 km distance to road (in short: suitable land outside Park)	Satellite image	-
Possibility to expand irrigated land	Possibility to extend irrigation (dummy: yes/no)	Village survey	-
Inequality of land distribution	Percent of households without land	Village survey	+
Alternative income sources	Percentage of villagers with non-agricultural income	Village survey	-

<i>Pull factors</i>			
Availability of suitable land inside the Park	area of forest land inside the Park (within the Thiessen polygon of the DEM village) with slope of less than 20 degree and less than 3 km distance to road (in short: suitable land inside Park)	Satellite image	+
Market access	Distance of the village to the major market	Road map	-
<i>Customary rights</i>			
Cultivation of land inside Park area before border was established	Area inside the Park reported to be cultivated before Park boundary was established	Village survey	+
* + / - indicates that the variable is expected to increase / decrease the area cultivated inside the Park.			

Table 2: Descriptive statistics of variables used in the model

	N	Mean	STD	Min	Max
Encroachment (ha)	46	76.3	112.5	0.5	524.8
log Encroachment (ha)	46	1.4	0.7	-0.3	2.7
Village population (persons)	46	1,168	934	286	4,676
Population density in district (persons per km ²)	46	41.1	42.1	12.6	124.1
Suitable land outside Park (ha)	46	1,009	1,055	0	5,053
Possibility to expand irrigated land (yes=1, no=0)	46	0.4	0.5	0.0	1.0
Number of landless households	46	23.6	48.6	0.0	230.0
No. of households with non-agricultural income	46	40.9	56.2	0.0	283.0
Suitable land inside Park (ha)	46	451	498	0	1,955
Travel time to Palu (hours)	46	4.6	4.4	0.8	17.1
Area cultivated before Park was established (ha)	46	33.9	68.9	0.0	427.0

Table 3: Regression Results

	B	STD	Beta	t	Sig.
(Constant)	1.034	0.261		3.957	0.000
Village population	- 5.2 E-06	0.000	-0.007	-0.038	0.970
Population density in district	4.8 E-03 *	0.003	0.290	1.749	0.089
Suitable land outside Park	6.0 E-05	0.000	0.090	0.622	0.538
Possibility to expand irrigated land	-0.188	0.215	-0.134	-0.877	0.386
No. of landless households	3.3 E-03	0.002	0.230	1.340	0.189
No. of households with non-agr. income	- 5.4 E-04	0.002	-0.043	-0.291	0.772
Suitable land inside Park	4.4 E-04 **	0.000	0.314	2.027	0.050
Travel time to Palu	- 2.8 E-02	0.024	-0.173	-1.135	0.264
Area cultivated before Park was established	3.1 E03 **	0.001	0.303	2.436	0.020

R-squared: 0.511

Adjusted R-squared: 0.389

F 4.180

Sign. 0.001***

Durbin-Watson: 2.203