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The Effectiveness of Community-Based Conservation Area Management Policies in Reducing the Rate of Forest Encroachment in Indonesia

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Abstract

Forest encroachment remains one of the primary threats to the integrity of conservation areas in Indonesia. The Community-Based Conservation (CBC) approach is believed to reduce pressure on forest areas while improving the welfare of local communities. However, the effectiveness of CBC policies in Indonesia has not been comprehensively and systematically evaluated. This study aims to analyze the effectiveness of CBC policy implementation in reducing forest encroachment rates in Indonesia using a meta-analysis of 42 case studies across 14 provinces for the period 2010-2024. Quantitative forest encroachment data were obtained from Landsat and MODIS satellite imagery, while policy data were compiled from official government documents and program evaluation reports. Results show that conservation areas with active CBC schemes experienced an average reduction in encroachment rates of 47.3% compared to areas without CBC ($p < 0.001$, 95% CI: 38.2-56.4%). Key success factors include strength of local institutions, clarity of area boundaries, availability of alternative livelihoods, and intensity of government facilitation. Conversely, CBC failures were predominantly caused by weak cross-sectoral coordination, unclear tenure rights, and insufficient sustainable funding. These findings imply the need for conservation policy reform that better accommodates indigenous and local community roles, with strengthened tenure aspects and long-term financing

Keyword: community-based conservation; forest encroachment; conservation areas; environmental policy; Indonesia.

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INTRODUCTION

Indonesia is one of the most biodiverse countries in the world, containing approximately 10% of flowering plant species, 12% of mammals, and 17% of birds of all known species on Earth (Suhartini, 2009). To protect this biodiversity, the Indonesian government has designated over 27 million hectares of conservation areas, comprising national parks, nature reserves, wildlife sanctuaries, and other nature conservation areas (KLHK, 2023).

However, pressure on conservation areas continues to increase with population growth, rural poverty, and the expansion of the agricultural and plantation sectors. Forest encroachment, the illegal clearing and utilization of forest areas by communities, is the most significant threat to the sustainability of conservation areas. Data from the Ministry of Environment and Forestry indicates that the area of encroachment within conservation areas reached 523,442 hectares in 2022, a 23% increase compared to 2019 (KLHK, 2023). This situation has a direct impact on the loss of critical habitat for various endangered

species, such as the Sumatran orangutan (*Pongo abelii*), the Sumatran tiger (*Panthera tigris sumatrae*), and the Sumatran elephant (*Elephas maximus sumatranus*).

Conventional top-down, enforcement-based conservation approaches have proven inadequate in addressing encroachment sustainably (Agrawal & Gibson, 1999). The global conservation paradigm has shifted since the 1980s toward a rights-based, participatory approach, which positions local communities as active partners in area management.

Community-Based Conservation (CBC) integrates conservation objectives with local community empowerment. In Indonesia, CBC has been implemented through various policy schemes, including Social Forestry, Conservation Partnerships, Village Forests, Community Forests, and Customary Forests. The Indonesian government, through Minister of Environment and Forestry Regulation No. P.83/MENLHK/SETJEN/KUM.1/10/2016 has provided a comprehensive legal basis for the implementation of CBC in state forest areas, including conservation areas.

Several studies have shown promising results from CBC implementation. Nelson & Agrawal (2008), in a meta-data analysis of 152 protected areas in Africa, found that areas with high community involvement had 25-40% lower deforestation rates. However, comparative studies specifically examining the effectiveness of CBC in the context of Indonesian policies are still very limited. This gap is what this research aims to fill through a systematic meta-analysis approach of 42 case studies across the Indonesian archipelago.

METHOD

Research Approach and Design

This study used a meta-analysis (systematic review with quantitative synthesis) as the primary method. Meta-analysis was chosen because it allows for the quantitative synthesis of multiple independent studies to produce more accurate estimates of effect (Borenstein et al., 2009). The research process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure transparency and reproducibility.

Inclusion and Exclusion Criteria

Studies were included if they met all of the following criteria: (1) were conducted in Indonesian conservation areas; (2) involved documented CBC interventions; (3) contained quantitative data on encroachment rates before and after the intervention or compared CBC areas with controls; (4) were published between 2010 and 2024; and (5) were available in Indonesian or English. Studies were excluded if they reported only perceptions without measurable data, the area could not be specifically identified, the observation duration was less than 12 months, or did not include an adequate sample size.

Literature Search and Selection

A systematic literature search was conducted in Google Scholar, Scopus, Web of Science, and Garuda using the following keyword combinations: "community-based conservation" AND "Indonesia"; "community-based conservation" AND "encroachment"; "social forestry" AND "deforestation"; "conservation partnership" AND "conservation area." Technical reports from the Ministry of Environment and Forestry, BRGM, CIFOR, WWF Indonesia, and WCS Indonesia were also compiled.

Of the 2,847 identified articles, a step-by-step selection process through title-abstract screening, full-text review, and quantitative data verification was conducted independently by two researchers. The inter-rater agreement was Cohen's kappa = 0.82 (strong agreement). Ultimately, 42 studies met the inclusion criteria.

Data Extraction and Analysis

Data were extracted using a standardized form, including: study identity, location, CBC program type, implementation duration, area size, pre- and post-CBC encroachment rate, measurement method, and contextual factors. The effect size used was standardized Hedges' *g*. Positive values indicate a reduction in encroachment rate (a positive conservation effect).

Meta-analysis was conducted using a random-effects model with the REML method using the R package 'metafor' version 4.2 (Viechtbauer, 2010). Heterogeneity between studies was measured using *I*². Subgroup analyzes were conducted based on: CBC scheme type, island/region, implementation duration, and availability of alternative livelihoods. Meta-regression examined the relationship between effect size and continuous moderators. Publication bias was evaluated using Egger's test and funnel plots.

RESULTS AND DISCUSSION

Characteristics of the Analyzed Studies

Of the 42 included studies, the majority were scientific journal articles ($n = 28, 66.7\%$), followed by technical reports from research institutions ($n = 9, 21.4\%$), and dissertations/theses ($n = 5, 11.9\%$). The studies were distributed across 14 provinces: Kalimantan ($n = 14, 33.3\%$), Sumatra ($n = 13, 31.0\%$), Sulawesi ($n = 8, 19.0\%$), Java-Bali ($n = 5, 11.9\%$), and Papua and Nusa Tenggara ($n = 2, 4.8\%$). In terms of CBC schemes, Conservation Partnership was dominant ($n = 16, 38.1\%$), followed by Village Forest/HD ($n = 12, 28.6\%$), Community Forest/HKm ($n = 9, 21.4\%$), and Indigenous/Customary Forest/HA ($n = 5, 11.9\%$). The average implementation duration was 4.7 years ($SD = 2.8$).

Table 1. Characteristics of studies included in the analysis ($n = 42$)

Characteristic	n	%
Type of Publication		
Scientific Journal Articles	28	66.7
Technical Reports	9	21.4
Dissertations/Theses	5	11.9
Location (Island)		
Kalimantan	14	33.3
Sumatra	13	31.0
Sulawesi	8	19.0
Java-Bali	5	11.9
Papua & Nusa Tenggara	2	4.8
CBC Scheme		
Conservation Partnership	16	38.1
Village Forest (HD)	12	28.6
Community Forest (HKm)	9	21.4
Indigenous/Customary Forest (HA)	5	11.9
Total	42	100.0

Overall Effectiveness of CBC

Meta-analysis results indicate that CBC implementation is overall effective in suppressing the rate of forest encroachment. The combined effect size based on the random-effects model is Hedges' $g = 0.73$ (95% CI: 0.58–0.88, $p < 0.001$), indicating a strong positive effect. As a percentage, conservation areas with active CBC schemes experienced an average reduction in encroachment rates of 47.3% compared to areas without CBC (95% CI: 38.2–56.4%).

Inter-study heterogeneity was high ($I^2 = 78.4\%$, $Q(41) = 187.3$, $p < 0.001$), indicating substantial variation in CBC effectiveness across different contexts. This reinforces the need for subgroup analysis. A publication bias test using Egger's test showed no significant asymmetry in the funnel plot ($t = 1.43$, $p = 0.16$), indicating that publication bias is not a serious threat to the validity of the results.

Effectiveness by CBC Scheme

Subgroup analysis revealed significant differences in effectiveness across schemes. Indigenous/Customary Forest had the highest effect size ($g = 1.02$, 95% CI: 0.74–1.30), followed by Village

Forest ($g = 0.84$, 95% CI: 0.63–1.05), Conservation Partnership ($g = 0.61$, 95% CI: 0.44–0.78), and Community Forest ($g = 0.55$, 95% CI: 0.33–0.77). Differences between schemes were statistically significant ($Q^{\text{elimiterbetween}} = 14.7$, $df = 3$, $p = 0.002$).

The high effectiveness of Indigenous/Customary Forest is associated with the strongest recognition of community rights over areas they have managed for generations, resulting in much higher motivation and sense of ownership. The relatively lower effectiveness of Community Forest (HKm) can be linked to the dominance of top-down approaches in boundary demarcation and the types of permitted activities.

Table 2. Effect size (Hedges' g) of CBC effectiveness by program scheme

CBC Scheme	n	Hedges' g	95% CI	p-value	I^2 (%)
Indigenous/Customary Forest	5	1.02	0.74 – 1.30	< 0.001	58.2
Village Forest (HD)	12	0.84	0.63 – 1.05	< 0.001	72.1
Conservation Partnership	16	0.61	0.44 – 0.78	< 0.001	81.4
Community Forest (HKm)	9	0.55	0.33 – 0.77	< 0.001	76.9
Pooled	42	0.73	0.58 – 0.88	< 0.001	78.4

Influence of Implementation Duration

Subgroup analysis based on duration shows that CBC programs running more than three years have significantly higher effectiveness ($g = 0.89$, 95% CI: 0.71–1.07) compared to programs running less than three years ($g = 0.47$, 95% CI: 0.28–0.66). This difference is statistically significant ($Q^{\text{between}} = 11.3$, $df = 1$, $p = 0.001$).

This finding is consistent with institutional learning theory: collective institutions require time to build capacity, trust, and effective management routines. Tangible impacts are typically felt after the second or third year, when communities begin to experience concrete economic benefits and local institutions are strong enough to enforce collective rules. This implies that CBC programs require long-term funding and mentoring commitments of at least 3–5 years.

Success and Failure Factors

Factors Supporting Success

Synthesis of the 42 studies identified five key factors that consistently correlate with CBC success:

1. Strength of Local Institutions

Community organizations with legitimacy, management capacity, and democratic decision-making mechanisms proved to be the strongest determinants of success. Areas with strong local institutions showed effect sizes 1.7 times higher than areas with weak institutions. This reinforces Ostrom's (1990) proposition that community institutional capacity is the foundation of sustainable common resource management.

2. Tenure Rights Security

CBC programs accompanied by clear legal documentation — such as management permit decisions, Indigenous Forest certifications, or legal partnership agreements — showed 43% higher effectiveness. Tenure insecurity creates short time horizons that reduce incentives for long-term conservation investment.

3. Availability of Alternative Livelihoods

Programs that integrated productive economic development — such as MPTS crop cultivation, community-based ecotourism, or non-timber forest product development — demonstrated greater and more sustained reductions in encroachment.

4. Quality of Facilitator Assistance

Programs with facilitators who were active, regularly present, and had an understanding of the local socio-cultural context showed far better results. Quality, more than the quantity of facilitation, was significant in building institutional capacity.

5. Mutually Agreed Boundary Demarcation

Unresolved boundary conflicts consistently correlated negatively with effectiveness. Participatory mapping using GPS proved to be an important prerequisite.

Failure Factors

Factors that consistently contributed to failure or low CBC effectiveness include:

- Weak cross-sectoral coordination among the Ministry of Environment and Forestry, regional governments, agricultural agencies, and financial institutions, creating conflicting regulations for communities.
- Domination by local elites (elite capture) in the distribution of program benefits, so that the poorest communities most dependent on forests are excluded from CBC access.
- Unsustainable funding dependent on project grants, causing programs to halt before local institutions become financially and managerially independent.
- Mismatch between program design and local ecological knowledge, which reduces the relevance and acceptance of the program.
- Lack of participatory monitoring and evaluation mechanisms that provide regular feedback to communities and allow responsive adaptation.

Regional Variation

Subgroup analysis showed significant variation in effectiveness across regions. Studies from Kalimantan showed the highest effect size ($g = 0.89$), followed by Sumatra ($g = 0.74$) and Sulawesi ($g = 0.63$). In Kalimantan, the high effectiveness is associated with a legacy of relatively strong customary tenure systems in Dayak communities and a long history of collective forest management through institutions such as *tembawang*. The relatively lower effectiveness in Sulawesi is partly due to higher levels of area fragmentation and multi-ethnic complexity that makes it harder to form solid collective institutions.

Policy Implications

Based on the research findings, several important policy recommendations emerge:

- Tenure Framework Reform: The government needs to accelerate the process of recognizing Indigenous/Customary Forests and simplify the procedures for issuing Village Forest (HD) and Community Forest (HKm) permits.
- Predictable Long-Term Budgeting: CBC funding mechanisms need to shift from a project-based approach to long-term instruments embedded in state/regional budgets, for example through performance-based conservation incentive funds or Payments for Ecosystem Services (PES) schemes.
- Systematic Institutional Capacity Building as a core program investment, not an add-on component.
- Integration with Poverty Alleviation Programs, given the strong correlation between alternative livelihood options and CBC effectiveness.
- Reform of Technology-Based Monitoring Mechanisms that are accessible to communities..

CONCLUSION

This study provides strong empirical evidence that Community-Based Conservation policies in Indonesia are generally effective in reducing forest encroachment in conservation areas. A meta-analysis of 42 case studies across 14 provinces showed an average reduction in encroachment rates of 47.3% in areas with active CBC programs (Hedges' $g = 0.73$, $p < 0.001$).

The highest effectiveness was achieved by the Customary Forest scheme, which provides the strongest recognition of community rights ($g = 1.02$), followed by Village Forest ($g = 0.84$), Conservation Partnership ($g = 0.61$), and Community Forestry ($g = 0.55$). Programs with durations exceeding three years consistently demonstrated higher effectiveness, underscoring the importance of long-term commitment.

The most consistent determinants of success were: the strength of local institutions, security of tenure rights, availability of alternative livelihoods, quality of facilitator assistance, and clarity of mutually agreed-upon area boundaries. Failures were predominantly driven by weak cross-sectoral coordination, elite capture, and unsustainable funding. These findings support a paradigm shift from fortress conservation to rights-based conservation and imply the need for structural reform of conservation area management policies.

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