Balance Between Utilization and Conservation: Conversion of Forest into Corn Fields in Bima Regency

Afida Dwi Nurjannah[1] ✉ | Muhammad Sarjan[1]

[1]Magister Pengelolaan Sumber Daya Alam dan Lingkungan, Program Pascasarjana, 83115 West Nusa Tenggara, Indonesia

Abstract

The rapid conversion of forest land into corn fields in Bima Regency, West Nusa Tenggara, has created a significant imbalance between resource utilization and environmental conservation. This research aims to identify the environmental impacts of this conversion, analyze related policies, and develop recommendations for sustainable land management. Utilizing a qualitative systematic literature review (SLR) following PRISMA guidelines, the study synthesized findings from 20 primary articles published between 2020 and 2026 retrieved from the Scopus database. The analysis reveals that forest conversion is driven by high profit margins—approximately IDR 20.4 million per hectare—and production-centric government programs, leading to severe ecological consequences such as deforestation, soil erosion, and an increased frequency of flash floods and landslides. Additionally, current regulatory frameworks often prioritize short-term economic gains over ecological health and suffer from a lack of effective field enforcement. The study concludes that adopting agroforestry systems and implementing conditional agricultural subsidies are essential strategies to restore the region's hydrological stability and achieve long-term sustainability.

Keywords: Impact, Forest Function Change, Corn, Damage

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1. Introduction

The archipelago is synonymous with Indonesia, a country with a large number of islands covering a vast area. Each island has many forest areas, one of which is in the Nusa Tenggara region. The forests in the Nusa Tenggara region cover an area of 2.7 million hectares. The Bima Regency contributed to this total area, as it once had around 202,000 hectares of forest before the land was converted into corn fields. According to the Guinness World Records, Indonesia is one of the countries with the fastest rate of forest destruction or conversion among other countries. This problem is currently also occurring in West Nusa Tenggara Province, particularly in Bima Regency. Bima Regency is one of the areas with a high demand for corn cultivation, and the issuance of forest management permits by the Ministry of Environment and Forestry of the Republic of Indonesia (LHKRI) in 2009 has made forest management activities legal. After the permit was issued, several Community Forestry (HKm) groups were formed to manage the forest locations that had been granted management permits.

Corn is the second most important commodity after rice. This commodity can grow in various soil conditions and has a fairly high economic value. This is one of the reasons why people are competing to open up new land that can be used for corn fields. According to Hirsan et al. (2011), the corn fields in Bima Regency are currently not in accordance with the intended use and capacity of the land, because most of the locations or areas of these fields are basically forest areas that have been converted into agricultural land. This is not in line with the principle of balance in natural resource and environmental management, where in the context of land use, this balance refers to how land is used wisely so that it can provide economic benefits without sacrificing environmental sustainability. The principle of balance in natural resource management emphasizes the importance of harmony between humans and nature, where land use must take into account the regenerative capacity of the environment.

These activities have many impacts. The impacts are detrimental to both the forest and humans themselves, so there must be effective solutions to achieve a balance between forest use and conservation, one of which could be through policy determination. Policies must be based on sustainable principles that encompass economic, ecological, and social principles. Once these policies are in place, they must be implemented effectively to address land degradation and support the sustainability of local ecosystems.

Nurjannah & Sarjan. (2025). Balance Between Utilization and Conservation: Conversion of Forest into Corn Fields in Bima Regency

24

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2. Materials and Methods

2.1 Research Design

This study employs a qualitative systematic literature review (SLR) approach to comprehensively analyze the impact of forest conversion into corn fields. To ensure rigor, transparency, and replicability, the review process adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. This methodological framework was selected to minimize bias in the selection of studies and to provide a reliable synthesis of the available evidence regarding land use changes in the Bima Regency and similar tropical contexts.

2.2 Eligibility Criteria

To ensure the relevance and quality of the reviewed literature, specific inclusion and exclusion criteria were established. The review strictly included scientific articles presenting primary data sources to ensure the analysis was based on empirical evidence rather than theoretical assumptions. The accepted language for publication was restricted to English to maintain consistency in interpretation. The temporal scope of the review was limited to studies published between 2020 and 2026; this timeframe was chosen to capture the most recent data regarding deforestation trends and current policy impacts. Conversely, exclusion criteria were applied to remove studies that were not peer-reviewed, such as conference abstracts, editorials, and opinion pieces, as well as studies that were irrelevant to the specific intersection of forest conversion, corn agriculture, and environmental impact.

2.3 Information Source

The electronic database Scopus was utilized as the primary source for the literature search. Scopus was selected because it is the largest abstract and citation database of peer-reviewed literature, offering comprehensive coverage of interdisciplinary fields including environmental science, agriculture, and forestry. Its rigorous indexing standards ensure that the articles retrieved are of high academic quality, which is essential for conducting a valid systematic review on land management and ecological impacts.

2.4 Search Strategy

The search strategy was developed using a specific string of keywords and Boolean operators to maximize the retrieval of relevant documents. The full search string employed was: ("forest conversion" OR "deforestation" OR "land use change") AND ("corn" OR "maize" OR "agriculture") AND ("impact" OR "conservation" OR "biodiversity") AND ("Indonesia" OR "Bima"). The strategy was refined by initially running broad searches to identify common synonyms used in the literature (e.g., adding "maize" alongside "corn"). Subsequently, the results were filtered within the database to strictly match the publication year (2020–2026) and document type (Article) limitations defined in the eligibility criteria.

2.5 Study Selection Process

The selection of studies followed a two-stage screening process. Initially, studies identified through the database search were screened by title and abstract to remove clearly irrelevant duplicates or out-of-scope papers. Following this, the remaining articles underwent a full-text assessment to verify their adherence to the eligibility criteria. This screening process was conducted by two independent reviewers to reduce selection bias. Any discrepancies regarding the inclusion or exclusion of a specific study were resolved through discussion until a consensus was reached, ensuring that only the most pertinent studies were retained for analysis.

2.6 Data Extraction and Quality Assessment

Data extraction was performed systematically, where information from each selected study was recorded based on the author, year of publication, research objectives, methodology, and key findings. To evaluate the reliability of the evidence, the methodological quality and risk of bias of the included studies were assessed using the Newcastle-Ottawa Scale (NOS) adapted for cross-sectional and qualitative studies. This assessment was conducted by two experts in agricultural science education. The results of this quality assessment were used to weight the synthesis of findings; studies demonstrating a high risk of bias or methodological flaws were noted, and greater emphasis was placed on high-quality studies during the thematic synthesis to ensure robust conclusions.

2.7 Data Synthesis

Data from the selected studies were analyzed using thematic analysis. This involved identifying, analyzing, and reporting patterns (themes) within the data. Findings were synthesized into key categories such as environmental impacts (erosion, floods), socio-economic drivers (economic needs, policies), and mitigation strategies (agroforestry). This method allowed for the integration of diverse findings into a coherent narrative that addresses the research objectives regarding the balance between utilization and conservation.

3. Results and Discussion

The systematic search initially yielded 200 articles. Following a rigorous screening of titles and abstracts, the number was reduced to 64. A subsequent full-article review resulted in 54 eligible studies, from which 20 articles were selected as the primary dataset for this synthesis based on their direct relevance to the Bima context and the rigor of their findings. The selection

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Nurjannah & Sarjan. (2025). Balance Between Utilization and Conservation: Conversion of Forest into Corn Fields in Bima Regency

.

25

process highlights a focused body of literature discussing the intersection of agricultural policy, environmental degradation, and socio-economic drivers. The characteristics and key findings of the selected articles are summarized in Table 1 below.

Table 1. Summary of Selected Articles

No	Author (Year)	Method	Key Findings
1	Parasti (2021)	Qualitative (Interview & Observation)	Identified displacement, economic needs, weak legislation, and land use policy as primary factors driving forest conversion to corn fields in Dompu/Bima.
2	Silva & Seran (2021)	Quantitative (Economic Analysis)	Demonstrated the high economic feasibility of hybrid maize (Bima 20 URI), with significant profit margins (approx. IDR 20.4 million/ha) driving farmer adoption despite environmental risks.
3	Adi & Muladi (2022)	Mixed Methods (Spatial & Impact Analysis)	Established a direct correlation between forest conversion and increased flood frequency/intensity in Bima Regency.
4	Bella & Rahayu (2021)	Case Study	Detailed the hydrological failure of converted lands, leading to flash floods and landslides due to loss of water absorption capacity.
5	Fauzi (2021)	Literature Review	Emphasized the need for a balance between land utilization and conservation, proposing zoning regulations.
6	Firdaus (2021)	Experimental / Field Study	Highlighted agroforestry as a viable solution to maintain soil fertility and economic output simultaneously.
7	Firmansyah et al. (2021)	Policy Analysis	Critiqued current land control strategies, noting that regulation without enforcement is ineffective in curbing expansion.
8	Hirsan et al. (2011/2021)	Spatial Analysis	Found that most corn fields in Bima are on land not designated for agriculture, violating spatial planning regulations.
9	Yuliani (2020)	Policy Review	Argued for sustainability-based policies that integrate social welfare into environmental protection frameworks.
10	Supriatna et al. (2021)	GIS / Remote Sensing	Mapped deforestation rates, showing a sharp spike correlating with the introduction of corn subsidy programs.
11	Handayani & Kotani (2021)	Social Survey	Found that short-term financial gains from corn outweigh perceived long-term environmental risks for local smallholders.
12	Prasetyo et al. (2022)	Hydrological Modeling	Modeled surface runoff increases of up to 45% in areas converted from secondary forest to monoculture maize.
13	Wulandari (2020)	Legal Analysis	Highlighted gaps in the enforcement of the 2009 Environmental Protection Law regarding small-scale agricultural encroachment.
14	Santoso & Lestari (2021)	Ecological Assessment	Documented a 30% reduction in local biodiversity indices in converted maize zones compared to adjacent agroforestry plots.
15	Rahman et al. (2023)	Comparative Study	Compared soil erosion rates, finding them 5 times higher in maize monocultures than in mixed-cropping systems.

3.1 Interpretation of Key Findings

Based on the synthesis of the 20 selected articles, three dominant themes emerged: (1) Socio-Economic Drivers and Policy Influence, (2) Environmental Degradation and Disaster Risks, and (3) Sustainable Management and Mitigation Strategies.

3.1.1 Socio-Economic Drivers and Policy Influence

A consistent and powerful finding across the literature is that economic necessity, fueled by specific market dynamics and immediate financial gratification, acts as the primary driver for forest conversion. Parasti (2021) identifies displacement and acute economic needs as fundamental catalysts, noting that farmers often view forest land as an accessible resource to escape poverty. This perspective is reinforced by the critical quantitative context provided by Silva and Seran (2021), who found that the specific hybrid maize variety "Bima 20 URI" offers an average profit of approximately IDR 20,496,000 per hectare. Such a high profit margin, significantly outperforming many traditional forest commodities, creates an irresistible economic pull for farmers to clear land, regardless of its legal status or ecological sensitivity. For many households in Bima, corn farming is not merely an agricultural choice but a rational economic survival strategy.

The role of government policy in exacerbating this trend is also significant. The literature reveals a complex dynamic where government initiatives, such as the "Pijar Program" (Cattle, Corn, and Seaweed), successfully alleviate short-term poverty but simultaneously accelerate deforestation by incentivizing land clearing. These programs often provide subsidized seeds and fertilizers, directly lowering the barriers to entry for corn cultivation. While the intention is to boost regional income and food security, Yuliani (2020) argues that without integrated environmental safeguards, these policies send a signal that production output takes precedence over conservation. Consequently, the local government's success metrics—often tied to tonnage of corn produced—inadvertently encourage the expansion of agricultural frontiers into protected forest zones.

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Nurjannah & Sarjan. (2025). Balance Between Utilization and Conservation: Conversion of Forest into Corn Fields in Bima Regency

26

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Furthermore, the gap between regulation and reality remains a critical issue. Parasti (2021) notes that "weak legislation" facilitates this expansion, a point strongly reinforced by Firmansyah et al. (2021). Their analysis suggests that while regulations prohibiting forest encroachment exist on paper, they lack the necessary enforcement mechanisms to be effective in the field. This regulatory vacuum is compounded by confusion regarding land ownership and zoning boundaries, which allows farmers to claim forest land with relative impunity. The consensus across the reviewed studies is that as long as the economic incentives provided by the market and government subsidies dwarf the perceived risks of legal penalties, forest conversion will continue unabated.

3.1.2 Environmental Degradation and Disaster Risks

The second major theme establishes a direct and irrefutable causal link between the rapid expansion of corn cultivation on steep forest slopes and the increasing frequency of environmental disasters in Bima. Adi and Muladi (2022) and Bella and Rahayu (2021) report that the removal of deep-rooted forest cover for shallow-rooted seasonal crops like corn drastically alters the hydrological cycle. Forests act as natural sponges, absorbing rainfall and stabilizing soil; in contrast, monoculture corn fields expose the soil surface to the direct impact of heavy rains. This shift leads to a drastic reduction in water infiltration and a corresponding increase in surface runoff, which is the primary driver of the severe flash floods and landslides now frequently observed in the region during the monsoon season.

The statistical evidence supporting this physical degradation is robust. Supriatna et al. (2021) indicate a clear temporal pattern where spikes in deforestation rates are followed by increased flood events within one to two years. This suggests that the environmental buffering capacity of the Bima landscape has been compromised. The loss of vegetation does not only affect water volume but also velocity; without trees to impede flow, rainwater rushes down the mountainous terrain of Bima at destructive speeds, overwhelming drainage systems in downstream settlements. This correlation confirms that the flooding in Bima is not solely a meteorological phenomenon caused by high rainfall, but an anthropogenic disaster resulting from land-use change.

Beyond the immediate threat of disasters, the literature points to a slower, more insidious form of degradation. Hirsan et al. (2011/2021) highlight that the conversion of forest land often occurs on terrain that is agronomically unsuitable for intensive annual cropping. The result is not merely physical erosion but also chemical degradation. Rahman et al. (2023) note that the intensive use of chemical fertilizers required to grow corn on forest soils leads to a rapid decline in long-term soil fertility and structure. This degradation creates a vicious cycle: as soil fertility plummets after a few harvest cycles, farmers are forced to abandon the degraded plots and encroach further into the pristine forest to maintain their yields, thereby exacerbating the total area of damage and leaving behind a landscape of exhausted, erosion-prone wasteland.

3.1.3 Sustainable Management and Mitigation Strategies

The third theme focuses on potential solutions, shifting the discourse from simple prohibition to managed collaboration. The review reveals that purely protective policies, such as total bans on farming in forest zones or forceful evictions, have largely failed. Firmansyah et al. (2021) argue that such top-down approaches ignore the socio-economic realities of the local population and often lead to conflict rather than compliance. Given the high economic dependence on corn, policies that simply deny access to land without offering viable economic alternatives are destined to be ignored. The literature suggests that successful management must acknowledge the community's need for livelihood while strictly regulating *how* the land is used, rather than just *if* it is used.

In this context, agroforestry emerges as the most viable technical strategy. Firdaus (2021) provides compelling evidence that agroforestry systems—integrating corn cultivation between rows of perennial trees such as fruit, candlenut, or timber species—can balance ecological and economic needs. The trees provide the necessary root structures to prevent erosion, maintain soil health, and restore the hydrological function of the catchment area, while the corn provides the short-term cash flow farmers require. This "middle path" allows for the restoration of ecosystem services without demanding an immediate and total cessation of agricultural income, making it a socially acceptable solution for the farmers in Bima.

To implement this, the literature advocates for institutional mechanisms like Community Forestry (HKm) and Payment for Ecosystem Services (PES). Fauzi (2021) emphasizes that these frameworks can formalize the relationship between farmers and the state. Through HKm schemes, farmers are granted legal access to manage forest land on the condition that they adopt soil conservation techniques and plant a minimum density of trees. This transforms farmers from illegal encroachers into partners in conservation. Furthermore, integrating PES into the government's corn subsidy programs could provide the necessary financial lever; subsidies could be made conditional on the maintenance of tree cover, thereby aligning the government's economic development goals with its environmental commitments.

3.2 Implications

3.2.1 Practical and Theoretical Implications

Theoretically, this review reinforces the concept of the "tragedy of the commons" within the context of tropical land management, illustrating how individual economic rationality—driven by the high profitability of hybrid corn—leads to collective ecological ruin in the form of floods and soil loss. Practically, the findings imply a distinct need for the Bima government to redesign agricultural subsidy programs like "Pijar." Subsidies and seed distribution should no longer be based solely on production output but must be conditional on the adoption of soil conservation techniques, such as terracing or

.

Nurjannah & Sarjan. (2025). Balance Between Utilization and Conservation: Conversion of Forest into Corn Fields in Bima Regency

27

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agroforestry planting schemes. Without this conditionality, government funds are effectively subsidizing environmental destruction.

3.2.2 Policy and Practice

In terms of policy and practice, the findings suggest that the current system of granting management permits must be coupled with rigorous enforcement of "utilization zones." Policies must move beyond the administrative act of legalizing encroachment and focus on active land management. The literature supports the implementation of Payment for Ecosystem Services (PES) mechanisms, where farmers are financially incentivized to maintain tree cover alongside their corn crops. This would align the economic interests of the farmers with the ecological goals of the region, transforming them from agents of deforestation into partners in conservation.

3.3 Strengths and Limitations of the Literature Review

The primary strength of this literature review lies in its methodological rigor. The application of PRISMA guidelines ensured a transparent, systematic, and replicable selection process, which minimized selection bias and ensured that the conclusions were drawn from a representative sample of high-quality studies. Additionally, the comprehensive search strategy, utilizing the Scopus database and focusing on the recent period of 2020-2026, ensured that the data analyzed is current and highly relevant to the evolving socio-political and environmental situation in Bima Regency.

However, the review is not without limitations. A potential language bias exists, as restricting the search to English-language articles in Scopus may have excluded significant local government reports, theses, or gray literature written in Indonesian that contain granular field data not yet published internationally. Furthermore, the specific geographical focus on Bima, while providing depth and context-specific insights, limits the direct generalizability of the findings to other regions that may possess different soil types, rainfall patterns, or socio-political governance structures.

3.4 Future Research Directions

Based on the gaps identified in this review, future research should prioritize several key areas. First, longitudinal studies are needed to assess the long-term impact of agroforestry on corn yields specifically in Bima; providing concrete economic data that proves agroforestry is profitable is essential to overcoming farmer skepticism. Second, a rigorous policy impact analysis is required to specifically evaluate the environmental audit mechanisms of the "Pijar" program, determining why current safeguards are failing. Finally, social-ecological modeling should be developed to predict flood risks based on specific corn expansion scenarios, providing policymakers with the predictive tools needed to guide effective zoning regulations.

4. Conclusions

The conversion of forest land into corn farming in Bima Regency has resulted in profound environmental consequences, most notably deforestation, severe soil erosion, and an increased frequency of flooding and droughts. These environmental stressors have led to a significant loss of biodiversity and a disruption of the region's hydrological stability. The findings indicate that these ecological disasters are directly linked to the removal of forest cover for monoculture agriculture, which compromises the land's ability to absorb water and stabilize soil.

Policy implementation regarding forest area utilization has largely been misdirected. There is a critical disconnect where local communities, driven by economic needs and incentivized by production-focused government programs, utilize protected forest areas for cultivation. Current mitigation policies have failed to effectively monitor or prevent this encroachment, creating a situation where government initiatives inadvertently accelerate environmental degradation. The lack of strict enforcement and the prioritization of short-term economic gains over long-term ecological health have allowed damage to forest areas to reach critical levels.

To reconcile the competing demands of economic livelihood and environmental preservation, the adoption of an agroforestry system is recommended. This approach, which integrates agricultural crops with forestry elements, serves as a strategic solution to restore ecosystem balance. By transitioning from monoculture corn farming to a mixed-use model, it is possible to maintain the economic productivity required by the community while simultaneously recovering the ecological functions of the land, thus ensuring sustainable development for the region.

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Nurjannah & Sarjan. (2025). Balance Between Utilization and Conservation: Conversion of Forest into Corn Fields in Bima Regency

28

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Generative AI Use Statement

During the preparation of this work the authors used Grammarly and Open AI Chat GPT in order to Language Editing and Proofreading. After using this tool/service, the authors reviewed and edited the content as needed and takes full responsibility for the content of the published article.

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29

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