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Analysis of the contemporary drivers of deforestation and forest degradation in Southern Sierra Madre Region, Philippines

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ABSTRACT

The Philippines is known for its diverse flora and fauna. Unfortunately, threats to limited natural resources have been pervasive due to decreasing forest cover. In solving deforestation and forest degradation (DFD), it is important to know the practices and policies that contribute to the status of the forest. Unfortunately, these drivers and policies vary temporally and spatially. With the changes in the world and the Philippines in the past years, updating the causes of DFD is imperative. This study seeks to provide an up-to-date analysis of the key drivers of deforestation and forest degradation in Rodriguez, Rizal, and General Nakar, Quezon, in the Southern Sierra Madre region of the Philippines. The determination of the local stakeholder perception of the drivers of DFD was done through Focus Group Discussions (FGDs) and a review of the literature. The study identified several key drivers of DFD, including upland farming, infrastructure expansion, timber poaching, quarrying, and charcoal-making. Despite the efforts of the two municipalities to address the previously identified drivers of deforestation, such as agricultural expansion, wood extraction, and infrastructure extension, the FGDs exposed the persistence of the drivers of deforestation. The study found that some policies and programs have not effectively addressed the root causes of deforestation. There have been challenges in implementing forest policies and programs due to resource constraints and governance problems. It was also noted that several environmental and societal disruptions possibly affected the area's forest protection and monitoring activities, hence the increase in illegal activities. This study recommends that forest policies and initiatives must

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also keep up with the changes in DFD, capitalizing on the knowledge and experiences of the local stakeholders.

INTRODUCTION

Deforestation is a natural phenomenon, and events such as wildfires significantly influenced the Earth's original forest cover more than 10,000 years ago. Anthropogenic factors, such as agricultural expansion, soon followed because of the increase in population and industrialization. Before the 1950s, forest cover could still recover, with abandoned agricultural lands turning into forests (Houghton, 2015). The decline in forest cover was accelerated by the increasing population and rising demand for agricultural lands for food production (Ritchie, 2021). Since 1990, around 420 million hectares of forests have been lost globally. According to FAO (2020), the global forest cover is more than 4 billion hectares (31%) today. Research shows that deforestation and forest degradation (DFD) affect biodiversity (Yasuoka & Levins, 2007), climate (Durieux *et al.,* 2003; Potter *et al*., 1975), and livelihoods (Boafo, 2013), among others. Hence, there is a growing concern about addressing DFD. The United Nations launched its Reducing Emissions from Deforestation and Forest Degradation (UN-REDD) program in 2008. It aims to lessen carbon emissions from the forest and foster carbon sequestration (FAO, 2021). In the Philippines, the government implemented the National Greening Program (NGP), which seeks to reforest millions of forest lands alongside Executive Order No. 23, which bans logging on natural forests. The Department of Environment and Natural Resources (DENR) takes pride in this initiative as it increased the country's forest cover from 6,839,718 hectares in 2010 to 7,226,394 hectares in 2020 (FMB-DENR 2020; FMB-DENR 2010).

Despite the increasing national forest cover, some studies still report cases of DFD (Tumbaga, 2023; Perez *et al*., 2020). In General Nakar, Quezon and Rodriguez, Rizal, forest cover continued to decline from 2016 to 2022, showing the continuing deforestation in Southern Sierra Madre (Israel *et al.,* 2023). Thus, there is a need to have an in-depth examination of why DFD continues to occur. This study aims to comprehensively assess the issue of DFD in the Southern Sierra Madre and evaluate the implementation status of programs and projects designed to combat DFD. This study sought to obtain a present-day analysis of the key drivers of DFD in Rodriguez, Rizal and General Nakar, Quezon in the Southern Sierra Madre region, Philippines, based on the knowledge and experiences of the local stakeholders.

Study Sites

This study was conducted in Rodriguez, Rizal and General Nakar, Quezon, both within the Southern Sierra Madre region in the Philippines (Figure 1).

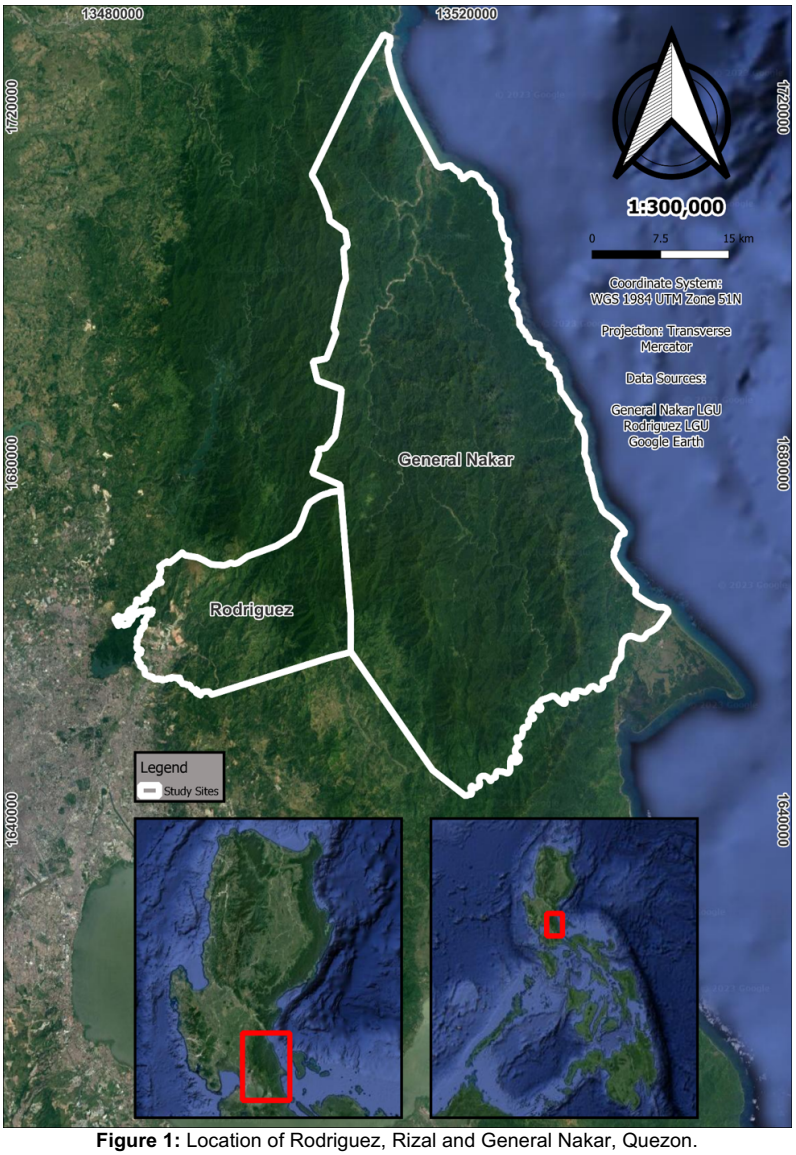

Figure 1: Location of Rodriguez, Rizal and General Nakar, Quezon.

The municipality of Rodriguez (formerly Montalban) is north of Rizal province. Surrounding the municipality are Metro Manila (west), Bulacan (north), and Quezon (east). It has a total area of 40,287 ha. It is also part of the headwaters of the Upper Marikina Watershed and Kaliwa Watershed. It is a first-class municipality and one of the country's most populous municipalities, with a population of 443,954 in 2020. Its proximity to Metro Manila makes it a good site for relocation projects and landfills (Bartilad, 2016). The Municipal Environment and Natural Resources (MENRO) and DENR Provincial Environment and Natural Resources (PENRO) – Rizal manages the forest resources of Rodriguez.

The municipality of General Nakar is in the northern part of Quezon province. It is surrounded by the province of Aurora (north), provinces of Rizal, Bulacan, and Nueva Ecija (west), the municipalities of Real and Infanta (south), and the Polillo Strait and Lamon Bay (east). It has a total land area of 163,547 ha. It houses several watersheds, such as the Agos, Kaliwa, Kanan, and Umiray watersheds. These watersheds supply water to Metro Manila and nearby areas. It is also a first-class municipality with a population of 34,225 in 2020. It has a high potential for rural development, tourism, aquaculture/mariculture, and agroforestry. Locals in the municipality have a high dependence on forests. Their major sources of income are agriculture, fishing, upland cultivation, and selling of non-timber forest products or NTFPs (Future of Forest Work and Communities, 2018). Forest resources management in the municipality is under the Sustainable Integrated Area Development (SIAD) office under the local government unit of General Nakar and Community Environment and Natural Resources (CENRO) - Real of DENR.

MATERIALS AND METHODS

This study gathered the perception of local stakeholders on the drivers of DFD in their area through focus group discussions (FGDs) and key informant interviews (KIIs). FGDs and KIIs allow for in-depth grassroots examination of the drivers of land cover change in the area (Twongyirwe *et al.,* 2018). A dialogue design was developed to facilitate discussion during the FGDs and KIIs. The dialogue design comprised questions about the stakeholders' forest-related activities, their perception of their municipality's forest cover, causes of deforestation and forest degradation, and how these causes can be addressed. Specific questions were also included for each stakeholder regarding their contributions to deforestation and forest degradation, as well as their role in solving the problem of deforestation and forest degradation.

The discussions were conducted with the local stakeholders in each of the municipalities. Stakeholders invited to the FGDs were initially based on previous studies on the site (Carandang *et al.,* 2013; Bugayong *et al.,* 2016). Further, an initial consultation with the local government units (LGUs) was also conducted to identify relevant stakeholders. The stakeholders were grouped according to their interests. Separate FGDs were done in each of the stakeholder groups. The stakeholder groups were local policy implementers, forest users, the private sector, civil society organizations, and non-government organizations (Bugayong *et al.,* 2016). Local policy implementers comprised government offices (e.g., LGUs, DENR) that develop and implement municipal policies. Forest users were represented by barangay officials, youth groups, and women's organizations. Private sectors are companies within the municipalities that use forest resources, such as mining and quarry operators, subdivision owners, cooperatives, as well as schools and universities. Civil society organizations (CSOs) and non-government organizations (NGOs) are advocacy groups that work on forest-related projects or activities in the municipalities. Forty-three participants in each municipality attended the FGDs (Table 1). The participants were invited through the partnership with SIAD and MENRO in General Nakar and Rodriguez.

Table 1: Number of participants that attended the FGDs.

Stakeholder Group	Municipality			
	General Nakar, Quezon		Rodriguez, Rizal	
	Male	Female	Male	Female
Local policy implementers	4	12	7	7
Forest users	12	9	7	6
Private sector		1	3	7
CSOs/NGOs	1	4	3	3
TOTAL	17	26	20	23

RESULTS AND DISCUSSION

The various FGDs and KIIs sessions revealed cases of deforestation and forest degradation in General Nakar and Rodriguez. Direct drivers include upland farming, infrastructure extension, timber poaching, small-scale mining, quarrying, charcoal making, and natural disasters. These proximate causes are driven by demographic factors (*e.g.*, increase in population), economic factors (*e.g.*, poverty, high demand, economic growth), and institutional and governance factors (*e.g.*, lax implementation of laws, lack of monitoring). Landslides and typhoons are common natural hazards in both municipalities that also cause deforestation and forest degradation. For instance, Typhoon Karding (September 2022), Typhoon Ulysses (November 2020), and Typhoon Lando (October 2015) brought intense rainfall and wind, which caused flooding, landslides, and the destruction of forests and agricultural crops (Morillo, 2022; Rivera, 2015).

a) Upland farming

Upland farming is common in both municipalities. Most FGD participants term upland farming as *kaingin* or shifting cultivation, which indigenous peoples and upland migrants

mostly practice. *Kaingin* is part of the culture of the Dumagat Remontado tribe, which also resides in the two municipalities (Ibanez *et al*., 2018). Persoon and Minter (2020) states that this practice is often described negatively and is considered a form of using resources that is wasteful and inefficient. Forested areas were often cleared or burned and planted with root crops, pineapples, bananas, coconuts, and ginger. After harvesting, the farmers move to other forested areas to clear and plant again. Some respondents also shared instances where local communities were given coconut seedlings as part of a government project and were planted in forested areas. FGD participants mentioned that the practice of kaingin persists because the local community perceives it as positive as their primary source of income. One farmer mentioned during the FGD,

> *"Sa amin nagkakaingin, habang kami ay nag-aani at kumakain ay maganda sa amin." (For us, farmers, while we have harvest and something to put in the table, kaingin is good.) (FGD, famer mixed sex).*

Participants from the academe emphasized the importance of education in correcting the views of the young generation and providing them with alternative livelihoods when they earn a degree.

Recent studies have reported that kaingin remains one of the major contributors to forest disturbances in the country, as highlighted by various studies. *Garcia and Principe (2024)* identified kaingin as a pressing concern in the Kaliwa River Forest Reserve (KRFR) in the southwestern part of the Sierra Madre Mountain Range. Similar issues have been documented in Palawan *(Canlas & Blanco, 2024; Vergara et al., 2024)* in Benguet *(Poclis et al., 2024)*, among other areas. Similarly, unsupervised kaingin poses significant challenges for the indigenous people (IP) in environmental governance. This issue affects various indigenous groups, including the Agta in Isabela *(Belmonte et al., 2024)*, the Tagbanua tribe in Aborlan, Palawan *(Quilang, 2024)*, the Tau't Batu in Rizal, Palawan *(Tangonan, 2024)*, and the Hanunuo Mangyan people in Mansalay, Oriental Mindoro *(Melendres & De Guzman, 2024)*. These findings highlight the urgent need for sustainable land management strategies and culturally sensitive environmental policies and programs to address kaingin while supporting the livelihoods of indigenous communities.

b) Infrastructure extension

Infrastructure projects such as roads, dams, urbanization, and tourism establishments were also cited as causing deforestation and forest degradation. Road as a driver of DFD includes construction of new roads and widening existing roads. Kaliwa Dam is also one of the government's biggest projects in solving the water shortage problem in Metro Manila. The dam is a 63-meter-high reservoir with a 27.7-km-long water conveyance tunnel (Racho, 2023). Many advocacy groups and conservationists are against the project because of environmental concerns (Cordero, 2018). The dam is within the Kaliwa Watershed Forest Reserve, meaning its construction may disturb the area's high biodiversity (Malabrigo *et al.,* 2014). When asked about their stand on the Kaliwa Dam, local policy implementers said, "*We cannot do anything about it as the national government approved it*" (KII, local implementers mixed sex). Some participants near the project area supported the project as it would improve their area and provide instant money from payment of their farms and lands that would be affected by the project. One of the residents near the Kaliwa Dam project site said

> *"... talagang kami ay sumang-ayon sa dam. Ang hinaharap po namin doon ay, unang-una, 'yun pong kalsada dahil noong nagkaroon po kami ng kalsada, naiiringan po 'yung pagpapalabas namin ng kalakal. ... 'yung mga halaman ko po roon ay mismong kalapit ng site. Ang sabi ko po doon sa MWSS, kung ito ay masisira, para sa akin hindi talagang mapipigil natin 'yan. Bilang proyekto ng ating pamahalaan at ng ating pangulo ay baka maaari po nama'y, aking hiling ay, lahat po ng tanim ko doon ay pwede naman pong bayaran." (We agreed to the project because of the road. In our area, roads are very important for us to bring our products to the market. I have crops near the project site. My wish to MWSS is if they destroy it while building the dam, they have to pay for it.) (FGD, forest users mixed sex).*

In Rodriguez, most of the infrastructure extensions mentioned are related to urbanization and the rise of residential areas. This is because Rodriguez is one of the relocation sites for displaced families from Metro Manila (Ortega, 2020). As of 2021, there were 15 resettlement projects of the National Housing Authority (NHA) in Rodriguez, covering 31,715 housing units (NHA, 2021). Similarly, there is also ongoing construction in the Upper Wawa Dam in Rodriguez. The dam seeks to provide 500 MW of electricity to Metro Manila (Enerdata, 2017). One participant from the FGD expressed his dismay regarding the damage inflicted on Mt. Lagyo because of dam construction. The participant mentioned,

> "*Yung sa [Wawa] dam. Syempre, kami, mga samahan ng tour guide, isa kami sa naapektuhan. Kasi ginawa siyang [Mt. Lagyo] semento…, hindi na siya pwedeng akyatin ngayon kasi flat na siya eh." (As regards to [Wawa] dam, of course, we, tour guides, were also affected because they have cemented Mt. Lagyo. It can no longer be hiked because the mountain was flattened and concreted.) (FGD, forest users male).*

During FGD, instances of building infrastructure inside protected areas for tourism were also reported. Participants mentioned the illegal construction of rest areas at Puray Falls, which led the local government to issue a cease order. Accordingly, tourism establishments within protected areas became rampant because of the sale of rights. These rights are sold to wealthy individuals from nearby cities, eventually turning the areas into tourism sites. According to the FGD participants, tenurial holders sell their rights as it provides them 'instant cash.'

Similar studies have identified infrastructure development as a key driver of deforestation and forest degradation. In addition to population growth, infrastructure expansion has been recognized as a major factor influencing land cover change in the Bago River Watershed in Negros Occidental, as highlighted in the report by Tuble (2024). Likewise, Buchadas *et al*., 2024 highlights several failed infrastructure projects that have led to significant forest disturbances. For instance, specific projects fostered land uses such as tobacco production, which directly contributed to deforestation in Zambia. Additionally, abandoned projects in Indonesia exacerbated forest degradation, increasing the risk of wildfires. These cases emphasize the need for sustainable planning and environmental safeguards in infrastructure development to prevent unintended ecological consequences.

a) Wood extraction

Local communities still rely on timber to construct their houses and boats. These cases are being allowed by the local

government as long as the harvesting is for personal use. FGD participants also mentioned illegal logging. Wood traders do this from nearby areas like Infanta, Mauban, and Bulacan. Illegal logging activities are difficult to monitor because of poor accessibility to the area, and forest rangers are often limited. In CENRO-Real, there are only 20 forest rangers. Of these, three forest rangers are assigned within General Nakar. These are complemented by the 48 forest protection officers (FPOs) of LGU General Nakar. In addition, forest patrollers lack resources such as vehicles and equipment that will keep them safe in patrolling. Hifume (2024) identified several key challenges in combating illegal logging in the Philippines, highlighting the complex and elusive nature of illegal logging networks, the limited enforcement capacity of authorities, and the need for international cooperation and coordination. These factors make it challenging to regulate and curb illegal logging activities effectively, emphasizing the need for strengthened policies, enhanced enforcement mechanisms, and cross-border collaboration to address this persistent issue.

Contractualization is also an issue at the local DENR offices. Trained forest rangers sometimes leave the organization when their contract ends. This is inefficient for DENR as they need to hire and train new forest rangers again. There are also cases of corruption where illegal loggers are paying forest rangers to pay no heed to their illegal activities. In addition, participants during the FGD shared that illegal loggers harvest in small volumes so they can easily transport the logs and will not get noticed by forest rangers. The former mayor of Rodriguez was exposed as being involved in illegal logging in Puray by providing permits to transport illegally cut trees (Adraneda, 2005).

b) Small-scale mining

Small-scale mining was particularly mentioned in General Nakar. According to the FGD participants, an unidentified person is financing the miners. Trees are cut down and used as support for the tunnels being built. The case was already reported to the local government and CENRO-Real. According to LGU General Nakar, they do not have the mandate to stop the illegal mining activity. In addition, the CENRO-Real does not have deputized Mines and Geosciences Bureau (MGB) personnel to deal with the issue.

The environmental impact of small-scale mining extends far beyond deforestation (Anyona & Rop, 2022; Kinyondo & Huggins, 2021). It also contributes to soil erosion, water pollution, and biodiversity loss, posing significant ecological and socio-economic challenges. One of the most critical issues using toxic chemicals, particularly mercury, in gold extraction. Mercury contamination can leach into soil and water bodies, poison wildlife, and create severe health risks for local communities (Pant *et al.,* 2024).

c) Quarrying

The expansion of quarrying was also mentioned in Rodriguez. According to the FGD participants, since the Build, Build, Build (BBB) program of the national government was implemented, there has been an increase in the number of quarry operators in Rodriguez. From 2002 to 2020, quarried areas doubled in size (Asido, 2023). As of 2021, the municipality has three Mineral Production Sharing Agreements (MPSAs) and nine quarry permits (MGB, 2021). Quarrying is one of the income sources of the local government of Rodriguez. Through Sangguniang Bayan Resolution No. 01-175 dated November 8, 2001, the provincial government of Rizal has proclaimed a portion of Barangay San Isidro as quarry zone (MGB, 2021). The global issue of unsustainable sand extraction is causing severe environmental damage. Excessive mining harms rivers, deltas, and coastal ecosystems, leading to land loss from erosion, lower water levels, and reduced sediment supply, all of which threaten biodiversity and ecosystem stability (Kumari *et al.*, 2024; Okorondu *et al*., 2022).

d) Charcoal Making

Charcoal remains a commonly used forest product in both municipalities and continues to serve as a primary cooking fuel in the Philippines (Inzon *et al.,* 2016). Local stakeholders report that charcoal is also a product of *kaingin,* wherein forested areas are intentionally burned and some byproducts are charcoal. In some instances, charcoal producers also cut down young trees for charcoal production. These practices are largely driven by poverty and absence of alternative livelihoods.

e) Natural hazards

Natural hazards, including typhoons and landslides, are prevalent in both municipalities. One particularly significant event recalled by the local stakeholders in General Nakar was Typhoon Winnie in 2004, which triggered widespread landslides throughout the area. Most recent typhoons that affected the municipalities include Typhoon Karding (September 2022), Typhoon Ulysses (November 2020), and Typhoon Lando (October 2015).

The identified DFD drivers and their respective areas of observation were consistent with the results of mapping conducted by Israel *et al.* (2023). The significant forest areas transitioned to agriculture in barangays Umiray, Pagsangahan, and Lumutan in General Nakar and barangays Macabud, Mascap, Puray, San Isidro, and San Rafael in Rodriguez can be attributed to the upland farming in the area. The opening of the forest canopy due to timber poaching resulted in increased shrublands in both municipalities. The increase in built-up areas in barangays Umiray, Pagsangahan, Mahabang Lalim, and Lumutan in General Nakar and barangays Macabud, Mascap, Puray, San Isidro, and San Rafael in Rodriguez may have been contributed by the construction of roads, houses, and tourism infrastructure. The increase in open areas in barangays Umiray and Lumutan in General Nakar can be due to the presence of small-scale mining.

The identified drivers of deforestation and forest degradation are similar to previous studies of Carandang *et al.* (2013) and Bugayong *et al.* (2016). This implies that despite the efforts to curb deforestation, the problem is still prevalent. Some drivers of DFD evolved with the changes in policies and the country's situation (Gabriel, 2023). Most timber harvesting was already classified as timber poaching compared to large-scale logging caused by logging companies with timber license agreements (TLAs). Since 1987, the government has not issued TLAs, and they were replaced by Integrated Forest Management Agreement (IFMA), Socialized Industrial Forest Management Agreement (SIFMA), and Community-based Forest Management Agreement (CBFMA), which focus more on co-management with families, communities, people organizations, and private organizations (Bugayong, 2006). Thus, timber poaching as a driver of DFD is mainly caused by individuals or the local community. As mentioned during the FGD, cutting trees is unavoidable, as trees are one of the primary needs of the local communities. Poverty and lack of alternative livelihoods also make it difficult to stop timber harvesting in the area (Hifume, 2024). In addition, national government programs such as the BBB program of the Duterte Administration increased the quarry activities and construction of infrastructure such as dams and roads in the area, which contributed to deforestation and forest degradation.

Table 2: Drivers of deforestation and forest degradation in General Nakar, Quezon.

Proximate Causes	Underlying Causes	Actors Involved	Areas of Observation
1. Upland farming	Poverty, lack of alternative livelihoods, increase in population, and conflicting programs/projects	Upland migrants, indigenous people	General Nakar: Lumutan Rodriguez: Puray, Macabud, San Rafael, Mascap
2. Infrastructure extension	Improvement of public services, increase in population, lax implementation and monitoring of policies, no proper land use zoning, and insecure tenure	Government, local communities, private sector	General Nakar: Magsikap, San Marcelino, Sablang, Maligaya, Canaway, Umiray, and Pagsangahan Rodriguez: San Isidro, Burgos, San Rafael, Puray
3. Timber poaching	Difficulty in monitoring and law enforcement, poverty, lack of alternative livelihoods, dependence on forest resources, and lack of cooperation among local communities	Local communities, timber traders	General Nakar: Baybay, Pagsangahan, San Marcelino, Magsikap, Maligaya, Canaway, and Umiray Rodriguez: Puray, San Rafael, Mascap, Macabud
4. Small-scale mining	Difficulty in monitoring, unclear roles of law enforcers	Small-scale miners and financiers	General Nakar: Lumutan and Umiray
5. Quarrying	High demand for aggregates	Quarry operators	Rodriguez: San Rafael, Macabud, San Isidro, San Jose
6. Charcoal making	Poverty, lack of alternative livelihoods	Local communities	General Nakar: Lumutan, Pisa, San Marcelino, and Maligaya Rodriguez: Puray, Macabud, San Rafael, Mascap, San Isidro
7. Natural Disasters			

Local initiatives to combat DFD

In response to continuous DFD in the two municipalities, the local government, the DENR, and NGOs are implementing programs and policies to combat DFD. Some of these programs and policies are enumerated below.

a. Reforestation activities

Most of the activities being conducted involved tree planting. The national government has been implementing the National Greening Program (NGP) since 2011, which seeks to reforest degraded forest lands in the country (EO 26 s. 2011). Many local communities were beneficiaries of the NGP. According to them, the NGP provided them with an alternative livelihood while helping them increase the forest cover of their municipality. Quarrying companies also conduct tree-planting activities as part of their Corporate Social Responsibility (CSR).

b. Provision of alternative livelihoods

Local communities were tapped to become forest patrollers and field guides in ecotourism sites. In this way, the local government fosters a participatory approach to forest management while providing them with other sources of income (Chechina *et al.,* 2018). NGO such as the Haribon Foundation implemented the Women GO project, to capacitate women in forest management and the Citizens' Action to Monitor Ecosystems (CAME) project to involve local stakeholders in forest monitoring activities. Thus, the local stakeholders were empowered to become stewards of their forests.

c. Use of sustainable technologies

Sustainable technologies such as the Sloping Agricultural Land Technology (SALT) were introduced in General Nakar as an alternative to unsustainable upland farming such as kaingin (Malla, 2014). The FGD participants also mentioned the charcoal briquette project of the Department of Science and Technology (DOST) in Rodriguez as an alternative to charcoal.

d. Ecological champions

It is also critical to have ecological champions that ensure forest conservation is considered in all programs and plans of the municipality (Furomo & Lambin, 2021). The LGU of General Nakar is envisioning an ecological pathway to become a Center for Biodiversity. According to the FGD participants, the LGU is mainstreaming biodiversity conservation and protection in all their programs by ensuring compliance with various Philippine environmental laws and regulations and local environmental ordinances, being felt and accessible, and being transparent to the community.

e. Effective communication and coordination

Active FGD participants in Rodriguez were the DENR personnel who are members of the indigenous communities. According to the two IP participants, their involvement in DENR makes coordination and communication with their communities easier.

Challenges and issues in addressing deforestation and forest degradation

Despite the efforts and commitment of the government to address deforestation and forest degradation, they still face numerous challenges that could explain why deforestation and forest degradation are still pervasive.

a. Lack of resources

One of the issues raised during the FGD was the lack of significant resources. DENR offices in Quezon and Rizal had expressed their concern regarding the insufficient human resources and budget for forest protection in the area, as well as the issue of insecure tenure to some forest protection officers. On the other hand, the LGU of General Nakar has stepped up its environmental law enforcement. On top of the municipality's Internal Revenue Allotment (IRA), most of the forest protection and conservation activities, including the hiring of a Forest Protection Officer (FPO) per barangay, are funded through a share of the proceeds from the Umiray–Angat Transbasin Project (UATP) as part of their CSR.

Similar concerns about the lack of sustained funding support for forest protection have also been reported by Wiset *et al.* (2023) in Leyte and Biliran provinces.

b. Policy and institutional challenges

Forest management, protection, and responsibilities were devolved to LGUs to foster stewardship of forest resources. However, the devolved functions of LGUs have limitations, particularly in apprehensions and confiscations of forest-based products. Under the local government code (RA 7160), LGUs cannot apprehend forest law violators; only the Philippine National Police (PNP) is authorized. One participant noted that this policy hampers the effectiveness of forest environmental policy enforcement.

Some of the country's forest policies also have unintended or indirect impacts on forest cover. For instance, the EO 23 has prevented legal timber extraction from natural forests, resulting in illegal logging and timber poaching (Paqueo & Israel, 2016). The stringent rules for acquiring permits prevent individuals and the private sector from complying with the legislation.

The FGDs revealed that the LGU of General Nakar desired to provide access and control to timber resources to the local community through co-management, as forest resources have become one of the local communities' primary needs. Unfortunately, the DENR does not have clear guidelines on how the LGU and the local communities can operationalize this on the ground.

c. Lack of harmonization among government offices

Government offices' lack of harmonization of plans, activities, and projects of government offices is exhibited by having a 'silo mentality,' where they work in isolation and do not coordinate their plans with other agencies. One reason for the lack of coordination is the overlapping of mandates and duties among different government agencies, which results in confusion and inefficiency (Cagalanan, 2014).

d. Unsustainable projects and initiatives

The participants raised the issue of sustainability of alternative livelihood projects, which are only viable during the project duration. The target beneficiaries may not continue the project after its implementation. The LGU of General Nakar reported the low adoption of SALT because it was laborious. There was also a decline in the number of locals doing charcoal briquettes in Rodriguez because of its lack of marketability.

CONCLUSION

Despite ongoing local and national efforts, deforestation and forest degradation remain critical issues in the Southern Sierra Madre region. The study identified several key drivers of DFD, including upland farming, infrastructure expansion, timber poaching, quarrying, and charcoal-making.

Policy and governance interventions must strengthen law enforcement and allocate sufficient resources for forest monitoring. Increasing the number of forest rangers, enhancing their training and equipment, and establishing clear mandates for inter-agency coordination are essential to improving the effectiveness of forest protection efforts. LGUs, in collaboration with DENR, should also streamline and harmonize policies to reduce redundancies, such as overlapping mandates that can delay enforcement actions.

Information, Education, and Communication campaigns for forest-dependent communities are crucial in addressing DFD. Indigenous Peoples and other forest users must be educated on the long-term environmental impacts of unsustainable practices and encouraged to adopt more sustainable farming techniques. Promoting alternative livelihoods such as ecotourism and sustainable agroforestry can help reduce their reliance on forest resources. Additionally, engaging these communities in forest management through co-management agreements and participatory governance models can foster a stronger sense of ownership and accountability for conservation efforts.

Infrastructure development in forested areas, including quarrying, dam construction, and urban expansion, should be subject to more stringent environmental impact assessments and continuous monitoring. Governments must ensure that such projects minimize environmental harm and mitigate unavoidable forest loss through reforestation initiatives and corporate social responsibility programs that support both local communities and broader conservation efforts.

RECOMMENDATIONS

While the findings provide valuable insights, they are based on the perceptions of chosen stakeholders and may not fully represent the entire population of General Nakar and Rodriguez. To strengthen future studies, conducting a more extensive survey with a larger and more diverse sample size to capture a broader range of perspectives is recommended. Additionally, incorporating long-term ecological monitoring and socioeconomic assessments could provide a more comprehensive understanding of deforestation and forest degradation dynamics in the study areas.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest in preparing this article.

CONTRIBUTIONS OF INDIVIDUAL AUTHORS

MJC Gabriel was the project leader and took part in the research conceptualization, data collection, data analysis, and manuscript writing. KPR Israel was also involved in the project, doing the land cover change analysis, data collection, and manuscript writing. BZH Ugat, WP Hintural, and MMM Baldonado helped with data collection, analysis, and manuscript writing.

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