



Implementation of Bamboo-Based Eco-Delineators to Promote Eco-Friendly Safe Driving in Rulung Mulya Village, South Lampung

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ABSTRACT

The lack of street lighting on the inter-hamlet connecting road in Rulung Mulya Village, Natar District, South Lampung Regency, poses a safety risk for motorists at night. The 3–4 kilometer stretch, which runs through plantation areas, is dark, secluded, and features numerous sharp bends, while the village budget for electric lighting remains limited. This community service initiative, conducted through the Student Community Service (KKN) program, aims to utilize local bamboo as an alternative material for road delineators to enhance visibility and driving safety in a cost-effective and eco-friendly manner. The implementation followed a participatory approach comprising five stages: (1) surveying and mapping hazard-prone points, (2) processing the bamboo raw material, (3) painting and applying reflective stickers, (4) on-site installation, and (5) evaluating nighttime visibility. The project successfully installed 55 bamboo delineators at 10 accident-prone locations connecting Hamlets 1 through 5. Field evaluations demonstrated that the bamboo delineators effectively reflected vehicle headlights, enabling drivers to clearly identify road boundaries and anticipate curves well in advance. This program has proven to be an innovative, affordable, and practical solution for addressing the lack of street lighting infrastructure in rural areas.

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Introduction

Nighttime driving safety is crucial, especially in rural areas with inadequate street lighting. Globally, traffic-related injuries remain a major public health issue, with approximately 1.19 million people dying each year. (*Global Status Report on Road Safety 2023*, 2023). Rulung Mulya Village, in Natar District, South Lampung Regency, still faces this situation. The village's settlement pattern consists of several house clusters separated by approximately 3 to 4 kilometers. The roads connecting these clusters are poorly lit and mostly run through vast plantation areas; consequently, at night, the surroundings are dark, deserted, and eerily quiet due to the lack of resident activity.

In addition to poor lighting, this connecting route winds along the contours of the plantation terrain, limiting driver visibility at night. The combination of a long route, minimal lighting, deserted



conditions, and numerous sharp curves makes the road prone to accidents—whether caused by drivers losing their way or failing to anticipate curves in time.

The lack of street lighting in rural areas is typically due to limited village funds for installing electric streetlights, particularly along long roads traversing plantations far from residential settlements. Therefore, there is a need for an alternative solution that is simple, inexpensive, and does not require electricity, yet still improves visibility for motorists. Research on village roads indicates that active road markers can boost driver confidence at night, especially in areas where installing standard streetlights is difficult. (Llewellyn et al., 2020). Another community service activity integrates reflectors with public street lighting systems utilizing photocell sensors, thereby enhancing visibility and safety for road users. (Sefiyuchanna et al., 2026).

On the other hand, Rulung Mulya Village possesses abundant natural bamboo resources that are easily found throughout the area. Bamboo is strong, lightweight, malleable, and eco-friendly, making it suitable as a structural base for road delineators; when fitted with reflective material specifically. Scotchlite these delineators serve to mark road boundaries and directions, particularly at hazardous curves. Systematic research indicates that bamboo offers a favorable strength-to-weight ratio; however, its mechanical properties vary depending on species, age, and treatment, requiring specific treatments to enhance strength and durability (Adier et al., 2023).

Given these conditions, KKN (Student Community Service) students launched a program to create and install bamboo road delineators along the quiet, winding route connecting the various settlement clusters. This program aims to utilize local bamboo as an alternative to standard road delineators, thereby enhancing visibility and safety for night-time driving without incurring high costs or relying on electricity.

Using bamboo to meet village infrastructure needs has proven beneficial in various regions, particularly because it is an accessible, cost-effective, and eco-friendly material the community can readily use (Mahmud et al., 2025). On the other hand, comprehensive road facilities such as delineators and visual signs help improve driving safety, particularly in areas with poor lighting (Fitriani et al., 2025). Similar programs carried out by KKN students in various villages also show that installing road delineators is highly effective in reducing accident risk in poorly lit areas. (Rafi et al., 2025). In Bangkeng Batu Hamlet, reflectors have been installed on a steep, undulating, and winding road that lacks adequate lighting; they reportedly help motorists and pedestrians identify the road's boundaries and direction at night. (Rezkyawan et al., n.d.). In Yosodadi Urban Village, reflectors have been installed at steep locations, sharp bends, and poorly lit areas to improve visibility and enhance safety for motorists driving at night. (Oktarina et al., 2026). In Cikasungka Village, producing road delineators from readily available, low-cost materials helps reduce nighttime traffic accidents and fosters resident participation in improving the local environment (Ramadhan et al., 2025). A

community service approach that leverages local potential is also applied in various programs, such as instruction on processing cow manure into biogas as a renewable energy source in Jambuwer Hamlet (Citasary et al., 2024). Evidence shows that most systematically studied road safety interventions (83.7%) were implemented in high-income countries, and they generally reduced accidents by about 16.7% (Akbari et al., 2024). Thus, the program to create bamboo road reflectors in Rulung Mulya Village is expected to help improve safety for motorists traveling between settlement clusters, especially at night.

Methods

KKN students carried out the project to construct and install bamboo road delineators in Rulung Mulya Village over more than three weeks. This activity was executed in stages, following the steps outlined below.

Figure 1. Flowchart of Activity Implementation Stages



1. Survey and Identification of Hazard Points

First, the KKN (Student Community Service) team conducted an on-site inspection of the routes connecting residential clusters in Rulung Mulya Village. These routes span approximately 3 to 4 kilometers and pass through extensive plantation areas. The survey aimed to identify roads that were poorly lit, secluded, or featured sharp bends and conditions that could endanger motorists at night. Based on the survey findings, the team selected 10 potentially hazardous points along the road connecting Hamlet 1 to Hamlet 5 for delineator installation.

2. Preparation and Processing of Raw Materials

On August 2, 2026, the team began processing the raw materials by cutting bamboo into segments approximately 70 cm long. In total, the program used 55 bamboo poles, distributed across



the installation sites with quantities ranging from 3 to 5 poles per location depending on specific conditions and visibility requirements. The team cleaned and washed the cut bamboo to remove dirt and sap, then dried it thoroughly to ensure durability before moving to the painting stage.

3. Painting and Marking

Once the bamboo was dry, the team proceeded on August 21, 2026, to paint reflector patterns and stencil the KKN group's name onto the delineators to identify the project. This stage also involved applying light-reflecting material (such as reflective tape or stickers) to the sections designed to reflect vehicle headlights.

4. Installation of Delineators

Once the bamboo delineators were completed, the KKN team immediately installed them on August 26, 2026, at ten pre-surveyed locations along quiet, winding roads. The number of bamboo units installed at each location varied, ranging from three to five depending on the curve's characteristics and visibility requirements. The entire process, from material preparation to installation, proceeded smoothly without significant obstacles, aided by favorable weather and the availability of adequate tools and materials.

5. Evaluation

In the final stage, the team assessed night visibility after installing delineators at all locations to evaluate the program's success.

Results and Discussion

The KKN (Student Community Service) team fabricated and installed bamboo road delineators in Rulung Mulya Village. This initiative aimed to enhance motorist safety along the route connecting various residential clusters. The road is dimly lit, quiet, and runs through expansive plantation areas. With distances of 3 to 4 kilometers between settlements, the route posed an accident risk at night. Consequently, bamboo delineators were installed to improve visibility and serve as a preliminary step toward creating a safer roadway environment.

The project installed bamboo delineators to illuminate sections of the road lacking adequate lighting. The team selected bamboo as the primary material for practical reasons. It is abundant in the village, eliminating the need to spend money on materials and making the program more cost-effective overall. Beyond its affordability, bamboo's lightness and durability supported the team's tasks of cutting, transporting, and installing the units, aligning with community development programs in other regions that use bamboo (Budiman et al., 2023). Local bamboo is also used in Kampung Cipacung, Sidamukti Village, where 17 bamboo poles support reflectors along a road stretch of about one kilometer. Residents obtained the bamboo at no cost through cooperation (Miraj et al., 2026).

Figure 2. Process of transporting bamboo from the plantation using a three-wheeled vehicle and cutting the bamboo to the required sizes.



Figure 2 above illustrates the process of transporting bamboo from the plantation to the processing site. The bamboo selected consists of mature, strong stalks to ensure the material is durable and resistant to breakage once processed into delineators. The cutting process is carried out with care and precision; each stalk is cut to approximately 70 cm to match the planned delineator design. The cutting is done slowly to ensure uniform size across all pieces, facilitating the subsequent painting stage.

Figure 3. Painting process of the bamboo delineator structure



Figure 3 illustrates the key steps in coating bamboo with paint. After cutting the bamboo pieces to uniform sizes, the next step is to coat the surfaces with white paint and stencil the KKN group name to identify the work program. This painting process provides extra protection, making the bamboo more weather-resistant while also enhancing its appearance and making it more easily recognizable to road users.

Figure 4. Bamboo delineators installed at a hazardous road location.



Figure 4 shows the final appearance of the delineators after installation. After the various processing stages, the delineators were neatly installed along stretches of road with low traffic, poor lighting, and winding curves. Each delineator features reflective material (Scotchlite) to ensure clear visibility for road users, particularly at night or in dimly lit areas.

Figure 5. Results of bamboo delineator installation at a point along the plantation road and bamboo reflector installation at a road location near the bridge connecting the hamlets.





Figure 5 documents the installation results at three of the ten locations targeted by the program. Bamboo delineators stand neatly along the roadside areas that were previously dark and lacked signage, including sections near the bridge connecting the hamlets. These delineators help drivers identify the road boundaries, particularly at night when natural visibility is limited. Other KKN groups carried out similar initiatives, installing bamboo delineators on village roads for the same purpose.

Table 1. Details of bamboo delineator installation locations in Rulung Mulya Village.

1	Border between Hamlet 2 and the neighboring village	4	High-risk spot; minimal lighting
2	Hamlet 3 border bridge	8	High-risk spot; near the bridge
3	Bridge connecting Hamlet 3 and Hamlet 4	8	High-risk spot; near the bridge
4	Road connecting Hamlet 1 and Hamlet 4 (plantation area)	5	Crosses plantation area; road is quiet and winding
5	Road connecting Hamlet 1 and Hamlet 4 (plantation area)	5	Crosses plantation area; road is quiet and winding
6	Road connecting Hamlet 1 and Hamlet 4 (plantation area)	6	Crosses plantation area; road is quiet and winding
7	Road connecting Hamlet 1 and Hamlet 4 (plantation area)	5	Crosses plantation area; road is quiet and winding
8	Road connecting Hamlet 1 and Hamlet 4 (plantation area)	6	Crosses plantation area; road is quiet and winding
9	Road connecting Hamlet 1 and Hamlet 4 (plantation area)	5	Crosses plantation area; road is quiet and winding
10	Road connecting Hamlet 1 and Hamlet 5 (plantation area)	3	Crosses plantation area.

Based on observations, all stages proceeded smoothly without significant obstacles regarding weather or the availability of tools and materials. This shows that using bamboo as a raw material for road delineators is feasible, provided there is clear planning and a division of tasks from raw material processing and finishing to on-site installation.

Once the delineators were installed, visibility at those specific points improved significantly at night. Light reflecting off the delineators allows drivers to discern the road's direction and boundaries sooner, particularly at curves that were previously difficult to navigate due to darkness and a lack of safety markers. Observations by the KKN team in the field indicate that previously dark sections of the road are now clearly visible when illuminated by vehicle headlights, enabling drivers to anticipate curves and road edges earlier than before the installation.

Figure 5. Results of the bamboo delineator trial at night, showing clear light reflection when illuminated by vehicle headlights.



Figure 5 shows the results of night-time field testing of the bamboo delineators. When illuminated by vehicle headlights, the reflective material on the delineators glows clearly from a distance, helping drivers better discern the road's boundaries and direction. The trials showed that the installed bamboo delineators performed effectively, in line with the program's objective of improving road visibility in low light or windy conditions.

However, the program also faced challenges regarding the bamboo's durability against weather conditions. Continuous exposure to rain and heat can make bamboo brittle more quickly than synthetic materials such as iron or PVC piping. To mitigate this, the team coated the bamboo surfaces with paint before installation, a measure intended to slow weathering and extend the delineators' service life in the field. A similar approach has been adopted in other regions utilizing bamboo for road infrastructure development.

This program also represents a tangible contribution by KKN (Student Community Service) participants toward enhancing traffic safety for the residents of Rulung Mulya Village, particularly for those who walk between settlement clusters at night along routes that were previously dark and potentially hazardous. This model of student service, which leverages local resources, is also evident in the durian seed waste processing program in Gampong Jering; that initiative aims to reduce negative environmental impacts while simultaneously boosting the knowledge, skills, and income of local residents (Ula & Muhazir, 2024).

Conclusion

The program to fabricate and install bamboo road delineators in Rulung Mulya Village has been successfully completed. The process spanned from initial bamboo preparation on August 2, 2026, through painting and application of the KKN group logo on August 21, 2026, to final installation on



August 26, 2026. Bamboo delineators were installed at 10 locations along the road, specifically in low-traffic areas and winding paths spanning from Hamlet 1 to Hamlet 5. The project used 55 bamboo poles in total, with each location using between three and five poles.

The program has proven effective in enhancing road visibility at night, particularly in areas that were previously poorly lit and posed potential hazards to motorists. Utilizing bamboo as the base material offers a simple, low-cost, and easily implementable solution that requires neither high expenditure nor reliance on electricity, making it a suitable option for other rural areas facing similar conditions.

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