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Locally available geotextile for maintaining unpaved roads in developing countries to enhance community resilience

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Abstract

Road authorities in developing countries recognize the need to maintain unpaved roads in rural areas using local resource based approaches rather than by attempting to meet international standards. The authors have developed a novel road maintenance technique, that we call “Do-nou”. Since 2006, we have demonstrated this technique in Asia, the Pacific, Africa and Latin America. Do-nou can be classified as a geotextile used to reinforce the shear strength of soil using only plastic crop bags, which are widely available in developing countries, and unskilled local labor. After some modification, the technique was also applied to the maintenance of unpaved roads on the clayey ground and to the construction of retaining walls for road embankment in flood-prone areas. It was demonstrated that it was practical for the communities to maintain unpaved roads in rural areas when equipped with the Do-nou technique, thereby enhancing community resilience. The Kenyan Government has recognized the Do-nou technique in its road strategy plan and has invested in training its youth on this technique for employment promotion.

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Keywords: Unpaved road; Local resource based approach; Geotextile; Developing countries

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1. Introduction

The poor condition of unpaved roads of developing countries has been considered as a serious problem hampering poverty reduction, especially in rural area. As an example of the road network in a developing country, Table 1 [1] classifies the surface conditions of each class of road in Kenya by length. Unpaved roads classified as C, D, and E have been gradually rehabilitated or maintained with labor-based technology (LBT), which is considered to be an appropriate intervention by donor agencies and road authorities. However, this accounts for only 25.3% of total road network.

LBT is intended to optimize the use of productive labor and complement the use of labor with essential equipment necessary to meet the specified technical and engineering standards [2]. These standards specify the gravel material and compaction equipment to be used while constructing the base and wearing gravel course. Thus, only qualified contractors who have the capacity to own, operate, and maintain compactors have been engaged, while community members have been solely involved as a labor force hired by contractors.

However, unclassified roads, which account for 60.1% of total road network length, have been excluded from these programs and have seen little improvement. These unclassified roads are often impassable during the rainy season, as illustrated in Fig. 1. Many people living along unclassified roads have difficulty accessing markets, hospitals, and schools due to the poor trafficability.

In order to promote shared prosperity as the World Bank Group set goals to achieve by 2030 [3] through improving livelihood of rural communities, drastic solutions regarding the impassability of unpaved roads must be found, especially those that have been left behind by development so far, including roads belonging to the unclassified category. One of the key measures to enhance the resilience of communities is enabling them to restore the trafficability of the damaged sections of the unpaved roads. The authors have developed an approach for the maintenance of unpaved road using the Do-nou technique [4]. As the approach requires only labor and locally available material, it presents an example of the Local resource based approach (LRBA) proposed in Kenya's Road 2000 Strategic Plan 2013–2017 [5]. Do-nou is the Japanese term for soilbags. However, in this study, name of “Do-nou” or “Do-nou technique” is used to signify the LRBA and not the literal “soilbags” that are primarily used as short-term or temporal measures, for example for raising barriers during flooding emergencies.

In this study, a standard structural road design is proposed based on the Do-nou technique, and the advantages of the approach are demonstrated in actual road maintenance projects conducted with communities in Asia and Africa starting in 2006. Two case histories regarding the Do-nou technique application to road maintenance by local communities are reported. The impact of technology transfer for road maintenance technique to communities in Kenya is introduced to demonstrate the potential of the Do-nou technique to enhance community resilience by improving unpaved roads.

2. Unpaved road maintenance using Do-nou technique

2.1. Structural design of road maintenance using the Do-nou technique

Table 1. Road network classification in Kenya [1]

Class	Description	Paved		Unpaved		Total	
		km	%	km	%	km	%
A	International trunk roads	2,772	1.7	816	0.5	3,588	2.2
B	National trunk roads	1,489	0.9	1,156	0.7	2,645	1.6
C	Primary roads	2,693	1.7	5,164	3.2	7,857	4.9
D	Secondary roads	1,238	0.8	9,483	5.9	10,721	6.7
E	Minor roads	577	0.4	26,071	16.2	26,648	16.6
SPR	Special purpose roads Ex. Government, Park, Crops	100	0.1	10,376	6.4	10,476	6.5
U	Unclassified roads	2,318	1.4	96,623	60.1	98,941	61.5
Total		11,187	7.0	149,689	93.0	160,876	100.0

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