

The *do-nou* method: Encouraging Groups of Smallholder Horticulture Farmers to Take Responsibility for the Maintenance of Rural Access Roads in Kenya

Stephen M. Nzioka^{1*}, Grays Kiplagat², Yoshinori Fukubayashi³ and Jiro Aikawa⁴

¹ Smallholder Horticulture Empowerment & Promotion Unit Project, P.O. Box 19024-00100, Nairobi, Kenya.

² Horticultural Crops Development Authority, P.O. Box 42601-00100, Nairobi, Kenya.

³ Community Road Empowerment, 20-13, Mukaihata-cho, Higashishiokoji, Shimogyo-ku, Kyoto, 600-8213, Japan.

⁴ Japan International Cooperation Agency, 5-25, Niban-cho, Chiyoda-ku, Tokyo, 102-8012, Japan

Inaccessibility of rural areas in Kenya makes it difficult for smallholder farmers to deliver their produce to markets. A new approach to provide rural access roads was introduced by Kenya's Ministry of Agriculture under the Smallholder Horticulture Empowerment Project (SHEP). This involved technology transfer to teach the *do-nou* method (a Japanese term for soil bags) to farmer groups. This technology is labor-intensive, but can be applied to spot improvement of roads using only locally available materials, such as used gunny bags (e.g., woven sacks with plastic fiber) and sandy or granular material. Here, we discuss the sustainability of this method. After SHEP was complete, 24% of the groups trained by SHEP staff implemented *do-nou* versus 13% of indirect groups (who were trained by SHEP trainees). We examined the factors that contributed to implementation of the *do-nou* method and developed recommendations on how to expand the method to more groups and thereby improve rural access roads. The following factors were key: (1) the group should be located closer than 8 km from a paved road, and the length of the road section to be maintained should be less than 90 m; (2) the terrain and soil type should require little engineering input; (3) materials and transportation must be locally available; (4) stakeholders must become involved; and (5) groups must be empowered and have strong leadership. Based on these findings, we recommend that training be conducted at the farmer group sites, that it should account for feasibility based on terrain and soil type, that farmer groups and their leaders should be empowered to approach stakeholders, and that communities should mobilize themselves to conduct road maintenance. It is also important to sensitize stakeholders about the willingness and ability of the farmers to conduct road maintenance using the *do-nou* method so that the stakeholders will provide assistance for the road work.

Key words: Farmer groups, Marketing of produce, Trainings, Rural access roads, Sustainability, Structure questionnaire

Introduction

The majority (85%) of rural feeder roads in Africa are estimated (Wasike, 2001) to be in poor condition, with accessibility limited to dry seasons in most cases. The inadequate and poorly maintained rural feeder roads that connect villages and farming areas with each other and with market centers represent a major gap in rural transportation in many countries (Wasike, 2001). The importance of rural roads and transport in agri-

cultural development has been recognized in the past, and has also been underscored by World Bank's Long Term Perspectives Study of Sub-Saharan Africa (World Bank, 1989).

Riverson *et al.* (1991) reviewed 127 projects with rural road components in Sub-Saharan Africa funded by World Bank and stressed the urgent necessity to develop a coherent Rural Road strategy and support for institutional capabilities in each country of Sub-Saharan Africa. Lebo and Shelling (2000) recommend

Received: September 3, 2012, Accepted: December 16, 2012

* Corresponding author: Smallholder Horticulture Empowerment & Promotion Unit Project, P.O. Box 19024-00100, Nairobi, Kenya.

Tel: +254-72-561-9471, E-mail: sm_nzioka@yahoo.com

spot improvement as key to the least-cost design for provision of basic access on rural transport infrastructure and labor-based approaches are best-suited for the implementation. However, to put this approach into practice, a variety of constraints, such as political pressure and road agency and donor preference for high-standard, high-cost roads need to be overcome (Lebo and Shelling, 2000).

The authors belong to Ministry of Agriculture (MOA) and Horticultural Crops Development Authority (HCDA) in Kenya who have been working with farmers closely for farmers capacity building have concerned on the reality which the farmers are still struggling to gain the access to the markets due to the deteriorated road condition. Instead of waiting for outcome of the development of a coherent Rural Road strategy and support for institutional capabilities stressed by Riverson *et al.* (1991), and being enhanced with the innovation of the method for spot improvement (Kimura and Fukubayashi, 2007), the authors were motivated to evolve demand-driven and participatory program under the agriculture development project to mobilize local resources for rural road maintenance. The objective of this study is to develop the concrete and practical method for rural road improvement from the learning of the pilot project of the applications of the spot improvement by farmers groups.

Ministry of Agriculture, Draft National Horticulture Policy (Ministry of Agriculture in Kenya, 2011, Internal Report) indicated that most roads in agricultural areas of Kenya are impassable by motorized transportations, especially during rainy seasons, resulting in heavy losses of produce as a result of an inability to deliver produce to markets or of the untimely delivery of produce. As a result, the government has proposed to develop and maintain access roads and other roads leading to markets, and that the roads be upgraded to all-weather status, to facilitate timely delivery to markets. The government believes that this will promote community and private initiatives to construct and maintain rural access roads (Ministry of Agriculture in Kenya, 2011, Internal Report).

Several key issues affect the rural transportation infrastructure in Kenya: a lack of appropriate frameworks to encourage community participation in the planning, creation, and management of the rural transportation infrastructure; a lack of ownership of the rural transportation infrastructure; a lack of coordi-

nation among diverse institutions that have some responsibility for rural roads; a lack of resources for implementation; a lack of personnel trained in the development and maintenance of a rural transportation infrastructure; a lack of ability to mobilize the existing capabilities within communities; a lack of a clear understanding of the different needs of different members of rural households; and a lack of knowledge of the benefits of creating and maintaining a rural transportation infrastructure (National Forum Group, 1996).

Inaccessibility of rural areas in Kenya prevents smallholder farmer groups from delivering their produce to markets. Several projects aimed at improving rural roads in Kenya have been implemented by institutions responsible for the transportation infrastructure; however, maintenance of these roads has been a challenge.

A new approach to solve the problem of rural access roads was introduced by Kenya's Ministry of Agriculture under the Smallholder Horticulture Empowerment Project (SHEP), which involves cooperation between the Kenyan and Japanese governments and was implemented from 2006 to 2009. The approach involved technology transfer to teach the *do-nou* (the Japanese term for soil bags) method to farmer groups to improve their access to markets. The *do-nou* method is labor-intensive, but it can be applied to spot improvement of roads using only locally available materials, such as used gunny bags (e.g., woven sacks with plastic fiber) and sandy or granular material (Kimura and Fukubayashi, 2007). A typical cross-section of a road maintained using this method is shown in Fig. 1. The existing rut is excavated to a depth of 20 cm and trimmed to accommodate the 2 layers of *do-nou*. The *do-nou* filled with soil are laid in the trimmed rut and compacted manually. 2 layers of compacted *do-nou* reinforce each tire track so as to provide enough bearing capacity to the traffic load. The *do-nou* and the road on either side of them is then covered with soil to form the surface layer of 5 cm after compaction. Drainage ditches 30 cm deep are dug on both sides of the road surface.

Most importantly and uniquely, this method of improving rural access roads relies fully on each farmer's willingness to participate in road maintenance and thereby obtain a link to markets. Because the *do-nou* method does not require expensive or complex equipment and materials that would not be available or

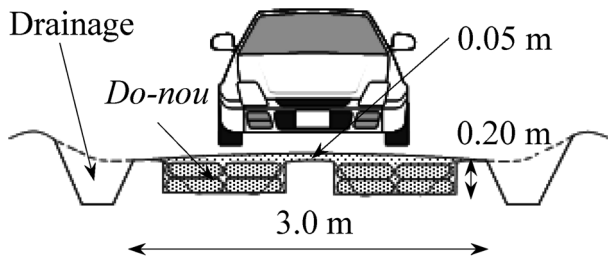


Fig. 1. Standard cross section of a road maintained using the *do-nou* (bags of soil) method.

affordable in most parts of rural Africa, it is a feasible way for farmer groups to maintain their roads. All of the work is done manually and the process is participatory; farmer groups are trained in how to implement the method, and because it only requires labor and local materials, they can maintain their roads without relying on outside assistance (Kimura and Fukubayashi, 2007). The method is simple and effective; as a result, farmer groups who have participated in the construction projects were encouraged by the results, and felt sufficient ownership of the roads that they became motivated to continue road maintenance.

In this paper, we describe technology transfer under SHEP to teach the *do-nou* method to farmer groups that are willing to initiate road maintenance work on rural access roads. Based on our discussions with groups who participated in the project, we discuss the sustainability of this method. We conclude by discussing the factors that contributed to implementation of the *do-nou* method with the goal of developing recommendations on how to disseminate and expand the method to improve rural access roads.

Technology Transfer to Farmers

The Smallholder Horticulture Empowerment Project (SHEP)

The 3-year SHEP started in November 2006 under the technical cooperation program between the Government of the Republic of Kenya (GOK) and the Japan International Cooperation Agency (JICA). It was implemented by the SHEP Team, which consisted of members appointed by MOA and Horticultural Crops Development Authority and by JICA. The project's overall goal was to improve the livelihoods of smallholder farmers in the target districts (discussed later in this section). The project aimed to improve the livelihoods of smallholders by empowering farmers

through improved access to markets and improved bargaining power by minimizing losses of produce before and after harvest. One desired result was that target groups would develop the capacity to improve the rural infrastructure for production and transportation of goods without requiring extensive or ongoing government aid. The success of this effort would be indicated by the number of farmer groups who implemented the *do-nou* method in rural transportation infrastructure development (GOK-JICA Joint Evaluation Team, Evaluation report, 2009, unpublished).

The SHEP target districts were Bungoma District, in Western Province (in 2008, this was subdivided into the Bungoma East, West, North, and South districts); Trans-Nzoia District, in Rift Valley Province (in 2008, this was subdivided into Trans-Nzoia East and West districts, and Kwana District); Kisii District, in Nyanza Province (in 2008, this was subdivided into Kisii Central and South districts, and Masaba District); and Nyandarua District, in Central Province (in 2008, this was subdivided into Nyandarua North and South districts). These districts were selected based on three major criteria: (1) the area had high potential for crop production, (2) local crop production was primarily by smallholders, and (3) the area had a relatively high poverty rate (here, defined as an annual capital income <US\$360). These districts had medium to high potential for agriculture, and 80 to 100% of the households were engaged in farming. Agricultural production was dominated by smallholders with an average cultivated area of less than 4,000 m². In addition, the poverty rate ranged from 45 to 62% of the population, and most of the poor were smallholders.

SHEP implemented the technology transfer program. The groups consisted of farmers who grew the same agricultural crops and worked together for cultivating and selling the crops; however, sometimes the group members were scattered over a wide area (up to 10 km²). A group facilitator was assigned by MOA to each group. Target groups included *direct* beneficiaries, which were smallholder farmer groups in the target area that were trained by the SHEP team and *indirect* beneficiaries, which were smallholder farmer groups that received training from group facilitators who had previously been trained by the SHEP team.

The "SHEP Approach" was a training package developed by the SHEP team. It refers to specific training sessions for both farmer groups and group facilitators assigned by MOA and included training in

the *do-nou* method. After knowing the contents of trainings provided through SHEP Approach, the farmer groups selected their interesting training topics and requested formally to SHEP. Based on their demand, trainings were conducted to the farmers groups and their facilitators.

Technology transfer to farmer groups

Technology transfer was provided by the SHEP team to 42 *direct* groups and 77 *indirect* groups (GOK-JICA Joint Evaluation Team, the SHEP Final Evaluation Report, 2009, unpublished). The training used the following process:

1. The group met and developed an action plan.
2. The group selected a road committee that identified the impassable sections of the road that should be maintained by surveying the sites. During these surveys, the road committee worked with SHEP staff in the case of *direct* groups, while for *indirect* groups with the group facilitators in charge of the respective group, to create a detailed maintenance plan, especially for drainage, and obtained approval from owners of the adjoining land to permit the drainage.
3. The group planned to obtain training, which included ways of building consensus on road maintenance through a local form of meeting (a *baraza*) among members of the farmer group and of the community, setting a date for maintenance of the road, and confirming all arrangements related to the proposed road work.
4. Gathering of the tools and materials for training. Tools included standard farm tools such as shovels, 16-L jerrycans, at least 50 of *do-nou* bags (locally available 45 cm by 60 cm gunny bags), compactors, materials to fill the gunny bags (such as sand or coarser materials, gravel, or *in situ* soil).
5. Stakeholder involvement to assist in procuring materials and transportation of the materials. The stakeholders included the County Council, the Provincial Administration, and the Ministry of Irrigation and Water.
6. Preparation of a request for training and submission to the SHEP team.
7. Receipt of the *do-nou* bags, which were provided by the SHEP team to offset shortage after approval of the request.
8. Demonstrations to and training of the direct

groups by members of the SHEP team. For the indirect groups, the demonstrations and training were provided by group facilitators who were previously trained by the SHEP team.

9. Maintenance of other sections of the road by farmer groups.

Positive responses and impacts of the training

Here, we describe one representative example of a positive response to the training and the resulting impacts. The Wihoki Self Help Group was trained directly by a SHEP team, and a demonstration of the *do-nou* method was conducted for some particularly bad road sections. After the demonstration, the road sections had improved dramatically. The group demonstrated what they had learned from SHEP to a Member of Parliament and showed the certificate they acquired through the training and implementation. The group received a contract for road maintenance (400 m) through the Member of Parliament's Constituency Development Fund and earned KSH 116,000 (ca. US\$1,381) for 11 days of work in September 2010. The group taught their skills to other (indirect) groups. The Wihoki Self Help Group was also allocated a budget for road maintenance from another project, the Smallholder Horticulture Marketing Programme.

The *do-nou* method has been applied in the construction of several other forms of rural infrastructure, such as building retaining walls, reinforcing soft foundations, construction of dam walls to permit water harvesting, construction of cross drains (culverts), and prevention of flood water from flowing over dikes. A Kenyan farmer group has applied the technology to make the floor for zero grazing units and water harvesting walls.

Sustainability of the Do-nou Technology

We assessed the sustainability of the *do-nou* method for both the *direct* and *indirect* SHEP groups. We used a structured questionnaire to collect data from participants in the project and then analyzed the factors that contributed to implementation of the *do-nou* method.

Data collection and analysis

We obtained data from two sources: (1) Two surveys were carried out to learn whether the direct and indirect groups carried out any other work using the

do-nou method. (2) We consulted the SHEP Final Evaluation Report, 2009 (GOK-JICA Joint Evaluation Team, unpublished).

We developed structured questionnaires using standard survey design techniques. The questionnaires were administered by SHEP group facilitators and the chairmen of the groups. The first survey was conducted in March 2012 to learn whether additional work was performed after the end of SHEP. The second survey was carried out in June and July 2012, and identified the conditions under which farmer groups had implemented the *do-nou* method:

1. The distance of the farmer groups from paved roads or rural roads maintained by the Kenya Rural Roads Authority (KERRA).
2. The lengths of the sections of the roads that were maintained.
3. The terrain in the area where the roads were maintained.
4. Soil characteristics in the roads.
5. The availability of construction materials and transportation to the maintenance site.
6. Constraints that the groups faced.
7. Stakeholder involvement in the group's road maintenance.

We sampled 20 of the 119 groups from four districts that participated in the *do-nou* training and demonstrations: 5 groups in Bungoma District (2 *direct* and 3 *indirect* groups), 6 in Kisii (3 *direct* and 3 *indirect*), 5 in Nyandarua (2 *direct* and 3 *indirect*), and 4 in Trans-Nzoia (3 *direct* and 1 *indirect*). The sampled groups were selected based on the fact that they subsequently implemented additional projects by applying the *do-nou* method.

Data on group empowerment indicator (GEI) and leadership levels were obtained from the GOK-JICA Joint Evaluation Team, Final Evaluation Report, 2009 (unpublished). GEI was obtained using the SHEP Group Empowerment Indicator checklist to assess the change in a farmer group's capabilities after training. GEI ranged from 1 to 5, with 5 representing the best response to training. The GEI checklist was used to assess farmer groups based on three indicators (leadership, cooperation among members, and gender equality). Each indicator was measured using its own checklist. The GEI value equaled the lowest value for the three indicators that were evaluated. The leadership levels also ranged from 1 to 5, and several aspects of leadership were considered both qualitatively

(awareness about their roles, decision-making process, initiative in group operations, ability to listen to member voices, member confidence in their leader, elections done democratically) and quantitatively (the number of management committee meetings held, the number of general meetings held, whether the leader was selected (a score of 0) or elected (a score of 1) was assigned, whether by-laws were developed with member consent (a score of 1) or without member consent (a score of 0) was assigned. Again, a value of 5 indicated the best leadership. The leadership level equaled the lowest value of these indicators (SHEP Group Empowerment Indicators, 2007, unpublished)

Results and discussion

Table 1 shows the total number of direct and indirect groups that implemented the *do-nou* method. We found that 10 direct groups (24% of all direct groups) and 10 indirect groups (13% of all indirect groups) implemented this method. We categorized the indirect groups based on the type of training: training in which demonstrations were conducted by the SHEP team, as in the direct groups; training in which participants were invited to demonstrations by the SHEP team and *do-nou* bags were provided for road maintenance in their own area; and training in which *do-nou* bags were provided without a demonstration. Demonstrations at sites managed by farmer groups were most successful. The 20 groups which implemented this *do-nou* method after SHEP completed were given a questionnaire survey and the conditions under which they worked were assessed.

For these groups, the distance from a paved road or a rural road maintained by KERRA ranged from 2 to 12 km and averaged 5.9 km (Table 2, Fig. 2). The length of the problematic road sections ranged from 50 to 130 m and averaged 79.9 m (Table 2, Fig. 3). Both averages differed between the direct and indirect groups (Table 2). The proximity of farmer groups to paved or well-maintained unpaved roads could have encouraged the groups to maintain their road infrastructure. The histograms in Fig. 2 and 3 show that farmer groups located less than 8 km from a paved or well-maintained road were most likely to implement the *do-nou* method. Improvement of the problematic road sections also had to be feasible using only locally available materials, farm tools, and labor, since these were the only resources available to these groups. The method was also feasible because the sections to be

Table 1. Number of SHEP groups that implemented the *do-nou* method.

District	Description	Direct	Indirect			Total
		Demo	Demo ^a	Invited ^b	Bags ^c	
Bungoma	No. of trained groups	10	2	13	5	20
	No. of groups that implemented the method	2	1	1	1	3
	%	20	50	8	20	15
Kisii	No. of trained groups	11	2	15	2	19
	No. of groups that implemented the method	3	2	1	0	3
	%	27	100	7	0	16
Nyandarua	No. of trained groups	11	2	10	6	18
	No. of groups that implemented the method	2	1	2	0	3
	%	18	50	20	0	17
Trans-Nzoia	No. of trained groups	10	0	14	6	20
	No. of groups that implemented the method	3	0	1	0	1
	%	30	0	7	0	5
Total in 4 Districts	No. of trained groups	42	6	52	19	77
	No. of groups that implemented the method	10	4	5	1	10
	%	24	67	10	5	13

^a Indirect groups that were involved in the demonstrations at their area.

^b Indirect groups that were invited to a demonstration conducted for other groups and who received *do-nou* bags.

^c Indirect groups that received *do-nou* bags without being involved and invited to demonstrations.

Table 2. Distances of groups from a paved road or a road maintained by KERRA, and lengths of the problematic sections of the road that were maintained.

	Mean value		
	For the 20 sampled groups	For the direct groups	For the indirect groups
Distance of the group from a paved road or a road maintained by KERRA (km)	5.9	6.6	5.2
Length of the problematic section that was maintained (m)	79.9	84.5	75.2

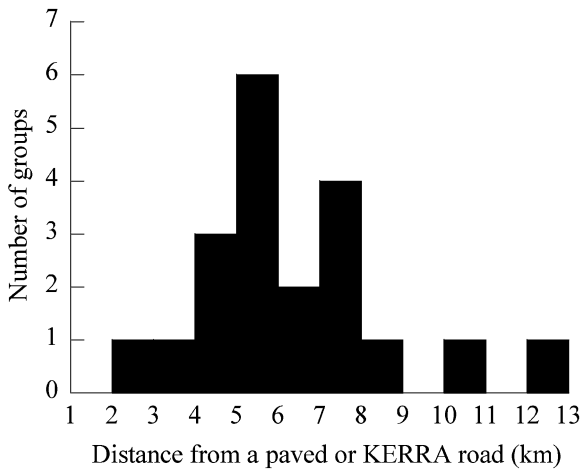


Fig. 2. Histogram of the number of farmer groups within each distance class from a paved or KERRA road.

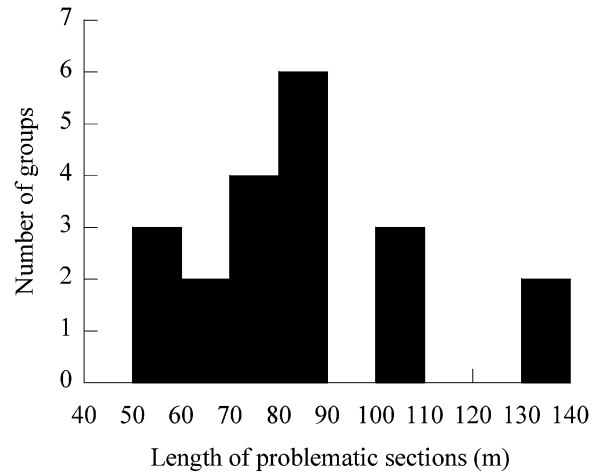


Fig. 3. Histogram of the number of farmer groups within each category for the length of the problematic road sections that were maintained.

maintained were short, making it possible to maintain them using only manual labor, since heavy machinery was not available and materials were not abundant. Figure 3 suggests that the feasible length was generally less than 90 m, though farmer groups were sometimes willing to work on longer sections.

The terrain where the farmer groups maintained their roads were generally either flat or had a gentle slope. The most common soil type (60%) was loam, but soil textures included clay loam (20%), sandy loam (10%), and sandy clay (10%). These results suggest that only soils with a moderately coarse to coarse texture on gentle or flatter slopes could be feasibly maintained. It might be impossible for farmer groups to conduct road maintenance using the *do-nou* method on steeper slopes or in clay soils, since this would require more engineering inputs such as sophisticated designs and more advanced materials. The sites with “black cotton” (clay) soils would require more engineering inputs, better designs, and more advanced materials that were beyond the resources available to the farmer groups. The results concurred with those of Wasike (2001), who observed that construction problems related to soil conditions, and topography constrained rural road programmes in Kenya, such as the Rural Access Roads Programme and the Minor Roads Improvement Programme, leading to a failure to meet their targets.

All 20 groups had access to granular materials and were able to transport them to the road sections that

were improved, although how they obtained transportation varied: 30% of the farmers groups received transportation support from their County Council or other stakeholders, but 70% could afford to hire private transportation. The National Forum Group (1996) indicated that non-availability of resources for implementation of rural transport infrastructure development was a major challenge. Thus, local availability of materials and of transportation were key factors that enabled the farmer groups to implement the *do-nou* method by themselves.

The largest proportion (40%) of farmer groups obtained support from the provincial administration for community mobilization, 30% received support in the form of community mobilization and transportation provided by County and municipal Councils, and 20% of the groups received support in the form of community mobilization and sand or coarser material provision; the remaining 10% of the groups received support in the form of community mobilization and financing. Support from stakeholders was clearly necessary for the farmer groups to implement the *do-nou* method. Inputs such as community mobilization to obtain labor and materials and financial support helped the farmer groups to do the necessary work. The National Forum Group (1996) observed that a lack of clear and coordinated responsibility among the diverse institutions responsible for development and maintenance of the rural transportation infrastructure was an important issue. Wasike (2001) indicated that the operation and

Table 3. Group empowerment indicator (GEI) and leadership level values.

	Mean value			
	All SHEP groups	The 20 sampled groups ^a	Direct groups	Indirect groups
Group Empowerment Indicator (GEI)	2.6	2.5	2.4	2.5
Leadership Level	3	3	2.8	3.2

^a These groups implemented the *do-nou* method practice after completion of SHEP training.

maintenance of roads in Kenya depended on how much a community understood and valued the benefits provided by the infrastructure, on stakeholder participation that ensured the infrastructure was needed and supported, and on giving people a sense of ownership of and responsibility for the roads.

Our results also suggest that the farmer groups who implemented the *do-nou* method were well empowered and led by strong leaders, because they were able to prepare for road maintenance by themselves, and then worked successfully on the roads. Table 3 shows the average GEI and leadership values for all SHEP groups combined, as well as for the direct and indirect groups. Both the direct and indirect groups were empowered, with a combined average GEI value of 2.5, and also had strong leadership, with a mean value of 3. The average GEI levels indicate that the groups were aware of the benefits of forming a group and the leadership level indicated that group leaders were able to work effectively with group members to build their confidence and their ability to obtain the necessary materials for working on the road maintenance by themselves (SHEP Group Empowerment Indicators, 2007, unpublished). The results agree with those of Alsop and Heinsohn (2005), who observed that empowered groups have the ability to make effective choices and translate their choices into the desired actions and outcomes. The results also agree with those of Wattam (1998), who indicated that the following factors contributed to a community's participation in road maintenance: a perceived need for these roads by the community, and willingness to consult the community and stakeholders before implementation of the project to ensure community ownership of and support for the project. The farmer groups in our study areas were large and also met Wattam's criterion for homogeneity,

as they were ethnically and religiously homogeneous and hence could share the benefits of having good roads.

Various constraints faced the farmer groups: 50% of the groups indicated that community mobilization was the greatest challenge versus 25% for procuring the sand or coarser material, 15% for procuring the bags, and 15% for the logistics of filling the bags with the sand or coarser material and transporting them. As we previously noted, the farmer groups managed those constraints by obtaining assistance from stakeholders. However, they still needed to overcome the constraints. It was difficult for farmer groups to mobilize the community to participate in the implementation of road maintenance, even though the *do-nou* method only uses locally available materials and manual labor. However, obtaining both the materials and the labor requires community mobilization. The community sometimes believed that the farmer groups who had requested training and demonstrations also received funding from SHEP. This made it difficult to build consensus on the need to participate in the road maintenance work. However, the involvement of stakeholders such as the provincial administration can help to mobilize the community. The National Forum Group (1996) identified the need to identify and disseminate information on positive examples of community participation in developing and maintaining rural transportation infrastructures.

Conclusions

In this paper, we describe a new method to solve the problem of improving and maintaining rural access roads. The approach was based on technology transfer to teach the *do-nou* method to farmer groups under Kenya's SHEP. The goal was to encourage farmer

groups to take initiative for maintaining rural access roads using a method based primarily on locally available resources (i.e., granular materials and manual labor). Some farmer groups responded positively and implemented the new method by involving key stakeholders. However, relatively few groups implemented this method: only 24% of the direct groups and 13% of the indirect groups. We found that the following factors made these groups more likely to implement road maintenance using the *do-nou* method:

1. The farmer group was located less than 8 km from a paved road or a road maintained by KERRA, and the problematic sections that were maintained were less than 90 m long. Farmer groups understood the need to link their farms with paved roads, but it was only feasible to do this when the distance to the higher quality roads was short. The maintenance was feasible using the *do-nou* method because only locally available materials, tools, and labor were required and because the road sections to be maintained were relatively short (less than 90 m), making the work feasible using manual labor rather than heavy machinery.
2. The terrain considered suitable for this work had either gentle slopes or was flat, and the *in situ* soils mostly had coarse textures (i.e., loams rather than clays). Under such conditions, maintenance did not require large engineering inputs, complex designs, or advanced materials.
3. Stakeholder involvement was the key to mobilizing the community, obtaining materials and financing, and obtaining transportation of the materials. However, when these conditions were met, the farmer groups had an incentive and an opportunity to maintain roads by themselves.
4. Farmer groups were generally empowered, understood the benefits of road maintenance, and had strong leadership that both organized the work and created links with key stakeholders. This gave them access to local construction materials such as sand or coarser material and access to local transportation with support from stakeholders.
5. The *do-nou* method is based on manual labor, and community mobilization was a key constraint that limited implementation of the method.

It should be noted that these factors were based on our analysis of data that were collected only from the farmer groups that implemented the new method. Despite this limitation, the results provide insights into how to revise the training methods and implement the training more effectively.

Since smallholder farmers are the main beneficiaries from road maintenance, we believe that encouraging Kenyan farmers to take the initiative to implement maintenance of rural access roads is an important first step. In the next section, we will provide recommendations on the other necessary steps.

Recommendations

The current technology transfer approach requires revision

We recommend that training be conducted at farmer group sites where the implementation conditions are feasible, and that the training empower the farmer groups and their leaders to approach stakeholders and mobilize their community. It is also important to sensitize stakeholders about the willingness and ability of farmers to perform road maintenance using the *do-nou* method before they will provide assistance to support the work. Making key players in the agencies responsible for rural road maintenance and making local authorities aware of the importance of this work will contribute to the improvement of rural roads in Kenya. To obtain support from stakeholders, District Management Teams that include the District Agricultural Officer, the SHEP Desk Officer, and the Horticulture Crops Development Authority station manager should be encouraged to link farmer groups with the stakeholders who can help them. To help farmer groups acquire materials such as the *do-nou* bags, groups should use second-hand bags (e.g., cement packages) and any other woven bags with a 50-kg capacity that are readily available. Agricultural engineers in districts that contain SHEP model groups should be trained through “train the trainer” courses to help them guide more farmer groups to apply the new method on rural roads. The Agricultural Engineering Department of the Ministry of Agriculture should also implement training on rural road maintenance using the new method to enable more smallholder farmers throughout the country to benefit from an improved rural transportation infrastructure.

Acknowledgements

We thank two JICA experts who worked with the Smallholder Horticulture Empowerment and Promotion unit project, Mr. Naoki Hashimoto and Ms. Harue Kitajima, for their support. We also thank the SHEP Unit Leader of Ministry of Agriculture, Ms. Francisca Malenge, and the entire SHEP Unit team for their support during the writing of our paper. We are grateful to JICA for furnishing the information required to write this paper. Prof. Makoto Kimura of the Graduate School of Kyoto University developed the *do-nou* method, and we are grateful for his technical advice on the SHEP training.

References

- Alsop, R., Heinsohn, N., 2005. Measuring Empowerment in Practice: Structuring Analysis and Framing Indicators. World Bank, Washington, D.C., USA. Policy Research Working Paper 3510.
- Kimura, M., Fukubayashi, Y. 2007. Geotechnique for Rural Infrastructures to Empower Communities, Theme Lecture. In: Nitin, S. (Ed) Proc. 13th Asian Regional Conference of Soil Mechanics and Geotechnical Engineering, Vol. 2., Allied Publishers Private Ltd., Kolkata, India. pp. 260–267.
- Lebo, J and Schelling, D. 2000, Design and Appraisal of Rural Transport Infrastructure: Ensuring Basic Access for Rural Communities, World Bank, Washington, D.C., USA. World Bank Technical Paper No. 496
- Ministry of Agriculture, 2011. Ministry of Agriculture Draft National Horticulture Policy, Division of Horticulture, Crops Development and Management Department, Nairobi, Kenya. (Internal Report)
- National Forum Group on Rural Transport and Development in Kenya, 1996. First National Workshop on Rural Transport and Development in Kenya, Introduction.. In: K. O. Atieno (Ed) Proc. of the First National Workshop on Rural Transport and Development in Kenya, Vol. 1, National Forum Group on Rural Transport and Development in Kenya, Nairobi, Kenya. pp. 8–10.
- Riverson, J., Gaviria, J. and Thriscutt, S. 1991. Rural Roads in Sub-Saharan Africa, Lessons from World Bank Experience, World Bank, Washington, D.C., USA. Technical Paper No. 141.
- Wasike, W.S.K. 2001. Road Infrastructure Policies in Kenya: Historical Trends and Current Challenges. U.S. Agency for International Development, Nairobi, Kenya. KIPPRA Working Paper No. 1. http://pdf.usaid.gov/pdf_docs/PNADS064.pdf. (accessed on 6 November 2012)
- Wattam, M. 1998. Community Participation in Rural Transport Infrastructure. IT Transport Ltd., Ardington, UK.
- World Bank, 1989. Sub-Saharan Africa: from crisis to sustainable growth: a long-term perspective study, World Bank, Washington, D.C., USA.