What can I do for rural people as a Civil Engineer?

Civil Engineer
Geotechnical Engineering
Foundations, Tunneling, Retaining wall, New structures

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Professor, Department of Civil and Earth Resources Engineering, Kyoto University, JAPAN
Chairperson of Board, Community Road Empowerment (NGO)
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Crossing Sahara by bicycle (1984)

2 2 4 - 6 8 - 7 1
• Jomo Kenyatta University of Agriculture and Technology
  (1993 ~ 1999 Short Term Expert)
• African Institute of Capacity Development (AICAD)
  (2000 ~ 2007 Advisor(Engineering) in Japan)
• AFRICA-ai- JAPAN Project: African Union -african innovation - JKUAT AND PAUSTI Network Project

PAU STI: Pan African University, Institute of Basic Sciences, Technology and Innovation
How do we repair rural roads without any machine?

What can I do for rural people as a Civil Engineer.

Challenges and Good Solutions

Vehicle per day < 50

Practical construction in East Uganda

September, 2007

May, 2008
Problems in rural area (Cause of the poverty)

- River
- Farm
- Rural road (Unpaved)
- Well
- Main Road (Paved)
- Market
- Cash Crops
- Agricultural Community

Can’t Transport Agricultural Product during Rainy Season

Crops are spoiled

Can’t get money
Always waiting heavy machine!!

How to empower rural communities?
Which technology can solve the problem? (Four L)

Do-nou: GEOTEXTILE
(Japanese term of soilbag)

Prevent floodwaters from going over dikes

Building firm SUBBASE

1. Locally available material
2. Labour based
3. Low cost
4. Low technology
“Do-nou” technology!!
Compaction
How to Generate the Strength of the "Do-nou"?

1. Soil is wrapped with bag
2. External force applied to "do-nou"
3. Tensile strength is generated.
4. The soil inside the bag is reinforced.

Mechanism is simple.

Do-nou is the ultimate geotextile.

Careful work (compaction) is necessary.

Available Applicable Affordable 3 A
Characteristics of “Do-nou”

**Material**

- Plastic (polypropylene)
- “Do-nou” bag
- Bags for sugar/maize
- Material put inside the bag

**Construction**

- Labor based
- Simple
- No curing period
- Wooden mallet

**Compressive pressure**

- Bearing Capacity (250 kN)

**Size**

- 40 cm x 40 cm
- 10 cm
- 20-25 kg

**Material put inside the bag**

- Soil near the site

**Low cost material**
1952 Bridge construction in Japan
1957, National route 19th
Voice of the people who experienced road maintenance using Do-nou

• Now I am confident I can maintain the road. Initially I was not very sure I could.
• I am very happy because the road has brought about good positive changes to our community.
• Initially I felt it was a difficult job needing a lot of energy but in the end I realized it was easy.
• In the beginning we did not have idea about maintaining roads but now we have learned.
• Big improvement of the road, I got knowledge.
• I have got technology, idea and murrum road. I can do it by myself.
• I believed that the technology works on road maintenance.
1. The buyers come to the village more frequently.
2. The price of the crops, vegetable and passion fruits, have raised.
3. The income of the farmers has increased.
4. The farmers were motivated and expanded their farm.
5. The farmers became able to reach the market more early in the morning, when the price was set more highly.
6. The extension officers visit the village more frequently, then the farmers get more skill and information of the markets from them.
7. The farmers started to new project for income generation, such as fish pond.
PNG: Effect of road maintenance

Traffic volume

Construction

Maintenance

Ellection time

4WD

Truck

15/24 seater Bus

Hagen

Ialibu

Mendi

Short cut
Matrix for traffic, material, maintenance and cost

<table>
<thead>
<tr>
<th>Design</th>
<th>Amount of traffic</th>
<th>Cross section</th>
<th>Material put in bag</th>
<th>Purchase material</th>
<th>Available material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
<td></td>
<td></td>
<td>Aspahlt</td>
<td>Gravel</td>
</tr>
<tr>
<td></td>
<td>100 (Per day)</td>
<td></td>
<td></td>
<td>Crusher</td>
<td>18/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.0 Unit:m</td>
<td>Murram</td>
<td>4.4/m³</td>
</tr>
<tr>
<td></td>
<td>Do-nou, 2 layers</td>
<td></td>
<td></td>
<td>Gravel</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Do-nou, 2 layers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Do-nou, 3 layers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of maintenance</td>
<td>Low</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>High</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cost per meter (US$)

Asphalt t=0.05 Unit: m
Gravel t=0.15

| | | Coarse material | Fine material |
|----------------|----------------|---------------|
| | Asphalt | 8.3 | 21.0 | 28.5 |
| | Crusher | 5.5 | 10.8 | 14.8 |
| | Murram  | 4.0 | 7.5  | 10.5 |
| | Gravel  | 4.0 | 7.5  |      |
| | Sand    | 4.0 |      |      |
| | Clay    | 4.0 |      |      |
Impact from Spot Improvement is equivalent to that from Rehabilitation?

1. The problematic portions, which were at No.1 to No.7, were maintained.
2. In total, the portions which length was 154 m were improved using Do-nou.
3. As a result, the road from A to B, which length is 7.7 km, become passable.
4. The impact of spot improvement can be said to be equivalent to that of the rehabilitation from A to B?

Cost of Spot improvement (154 m at No.1 to No.7, Actual): **2,920 US$** (19US$/m)

Cost of Rehabilitation from A to B (estimated): **154,000 US$** (20US$/m: Basic rate)
Spot Improvement with farmers’ initiative for self development in Kenya

Total length: **20 m**
Total cost: **141 US$**
Total number of labour (personday): **18 (36 person x 1 days)**
Cost per meter (Width: 4.0 m): **7.05 US$**  ⇔  **19.0 US$** (Labour based)
Productivity per personday: **0.56 m**  ⇔  **2.0 m** (Labour based)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QTY</th>
<th>UNIT</th>
<th>RATE(US$)</th>
<th>TOTAL(US$)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>7t truck</td>
<td>2</td>
<td>trips</td>
<td>32.70</td>
<td>65</td>
<td>46</td>
</tr>
<tr>
<td>Gravel (murram)</td>
<td>14</td>
<td>ton</td>
<td>3.10</td>
<td>43</td>
<td>31</td>
</tr>
<tr>
<td>Strings</td>
<td>1</td>
<td>roll</td>
<td>2.18</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Do-nou bags</td>
<td>231</td>
<td>day</td>
<td>0.13</td>
<td>30</td>
<td>21</td>
</tr>
<tr>
<td><strong>Spot improvement using Do-nou</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>141</strong></td>
<td>100</td>
</tr>
</tbody>
</table>
Applications to Rural Infrastructure

- Retaining wall
- Dam (water harvest)

Diagram:
- **Culvert**
  - Log A
  - Log B
  - “Do-nou” filled with Murram
  - 10 cm: Murram

Measurements:
- 70 cm
- 50 cm
- 80 cm
- 150 cm
Application of Do-nou

**Backfill**

**Dyke**

**In situ Natural soil** (exclusive of Clay)

**Fine soil**

1/2 Do-nou

Gravel

10

30 “Do-nou”

Unit: cm

150

100

60

Application of Do-nou
With villager at 20 countries 140 km
Before-After (Irrawaddy-Kantah village)

Length of the improved section: 1.2 km
Duration: January ~ March, 2014 (About 2 months)

Before

After

※Kayin state scheduled for completion in May.
Project area in the worldwide: Varieties of Intervention
As of April 2015, 22 Countries

**Kenya**
Registration as local NGO
Grant from MOFA, ILO, Toyota

**Ghana**
(BOP Business approach)

**Cameroon**
(JST/JICA: Research project)

**DR Congo**
(Collaboration with consulting firm)

**Burkina Faso**
(Collaboration with social business company)

**Burkina Faso**
(Collaboration with social business company)

**Uganda**
(Support of JOCV activities and collaboration with consulting firm)

**Rwanda**
(Collaboration with Min. of Infrastructure and a student studying in Japan)

**Somalia**
(ILO project)

**Kenya**
Registration as local NGO
Grant from MOFA, ILO, Toyota

**Tanzania**
(Grant from JICF)

**Mozambique**
(Collaboration with National Road Administration)

**Zambia**
(Collaboration with the INGO)

**Bangladesh**
(Grant from JICF)

**Vietnam**
(Collaboration with Univ.)

**Philippines**
(Collaboration with Univ.)

**Micronesia**
(JICA project)

**Solomon**
(Grass roots fund MOFA)

**Tonga**
(Collabo. with NPO)

**East Timore**
(JICA/ADB collaboration project)

**Papua New Guinea**
(ADB_Grant project)

ILO: International Labour Organization
JOCV: Japan Oversea Cooperation Volunteers, INGO: International NGO
JICF: Japan International Cooperation Funds
Project area in the worldwide: Varieties of Intervention
Africa, as of April, 2015, 13 Countries

Kenya
Registration as local NGO
Grant assistance from MOFA, Toyota, ILO

Ghana
(BOP Business approach)

Cameroon
(JST/JICA: Research project)

DR Congo
(Collaboration with the consulting firm)

South Sudan
(Collaboration with the consulting firm)

Burkina Faso
(Collaboration with social business company)

Somalia
(Project funded by ILO)

Ethiopia
(Collabo. with Sci. & Tech. University)

Kenya
Registration as local NGO
Grant assistance from MOFA, Toyota, ILO

Uganda
(Support of JOCV activities and collaboration with the consulting firm)

Tanzania
(Grant from JICF)

Rwanda
(Collaboration with Min. of Infrastructure and a student studying in Japan)

Mozambique
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ILO: International Labour Organization
MOFA: Ministry of Foreign Affair of Japanese Government,
JOCV: Japan Oversea Cooperation Volunteers, INGO: International NGO
JICF: Japan International Cooperation Funds
Project area in the worldwide: Varieties of Intervention
Asia, the Pacific, as of April, 2015, 9 Countries

Bagladesh (Grant from JICF)

Japan (HQ, Administration)

Philippines (Collaboration with State university)

Micronesia (Training in JICA project)

Myanmar
Grant assistance from MOFA

Vietnam (Collaboration with university)

East Timore (JICA/ADB collaboration project)

Papua New Guinea (ADB Grant project)

Solomon (Grass roots fund of MOFA)

Tonga (Collaboration with NPO)

JICF: Japan International Cooperation Funds
A Potential for the Base of the Economic Pyramid (BOP) Business on Unpaved Road Maintenance by Community People

Resources ⇔ Business Model

Makoto Kimura
Kyoto University
Graduate School of Engineering
Sustainability (Kenya)

Training for “Do-nou” technology (CHARITY)

Association formed for rural road maintenance

Recognition by the government

Improvement of rural road

Sustainable maintenance

Business Potential

CHARITY TO JOB CREATION
Formation of Association and Registered Company

Six Farmer’s groups that acquired “Do-nou” technology (Horticulture, Peace building, etc)

They formed an association for improvement of rural road accessibility (October 2010)

Bottom -up : Empowerment both organisational structure and planning & management

Top-down : Recognition of “Do-nou” technology at the government level

Association registered as a company (September 2012)
Bottom-up Approach

Training and Practice

- Cost estimation, construction planning
- Management of plans and materials
- Quality control

Empowerment of organizational aspect
- Executive committee, Accounting, etc

Empowerment of practical aspect
- Cost estimation, construction planning
- Management of plans and materials
- Quality control

Top-down Approach

Recognition by the Government

Empowerment of organizational aspect

- Executive committee, Accounting, etc
Achievements and Effects

**Summary of constructions**
- Number: 4 sites
- Objective: Private purposes
- Section: Roads to clinics and fields
- Length: 100 m - 500 m
- Budget: 30,000 Ksh - 200,000 Ksh

**Ripple effects**
- Job creation
- Improvement of rural road accessibility
- Cooperation with stakeholders

**Construction done**
- by using skills through practical trainings
BOP Business Model – Kenya Version

Benefit brought wider range

Contribution for starting business

Japanese GV
International organizations

Ordering

Community Road Empowerment (CORE) Kenya

Funding

Technical transfer

Association (Registered as a company)

Design & Construction

Improvement of rural road

Benefit to the community people
- Improvement of accessibility
- Shortening time for travel
- Decreasing of transport cost, etc

Improvement of livelihoods
BOP Business Model – Kenya Version

Benefit brought wider range

Win-Win-Win-Relation

Japanese GV
International organizations
Kenyan GV
Government
Contractor

Win
Win
Win
Win
Win

Community Road Empowerment (CORE) Kenya

Funding

Ordering

Win

Community

Improvement of rural road

Benefit to the community people
- Improvement of accessibility
- Shortening time for travel
- Decreasing of transport cost, etc

Improvement of livelihoods

Technical transfer

Contribution for starting business

Win

33
Youth Employment for Sustainable Development

Joint Project with International Labour Organization (ILO)

Chairperson: Makoto KIMURA

Community Road Empowerment
Project Summary

1. Duration: May 2012- November 2012

2. Target Areas: Uasin-Gishu, Nandi, Elgeyo-Marakwet, Trans-Nzoia

3. Direct Beneficiaries: 500 Youths (20 Groups)
Indirect Beneficiaries: 40,000 People

4. Budget: USD 280,000 (JPY 28,560,000)
Project Objective

To empower and create employment for youth groups by initiating Do-nou Technology for rural access road maintenance in the selected counties.
Importance of Youth Employment

- No accessing to vocational trainings
- Unemployment for youths
- Increasing of idle youths
- Increasing of antisocial behaviour

Poverty and Unstable situations

Youth employment is a crucial point
[From the youths]  
*We have skills.*  
*Idle youths were reduced.*  
*We learned moral with working together.*  
*We got income.*

<table>
<thead>
<tr>
<th>Do-nou technology trainees</th>
<th>500 youths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructors trainees</td>
<td>20 youths (1 rep. from each group)</td>
</tr>
<tr>
<td>→ No. of groups who registered as companies</td>
<td>→ 11 groups</td>
</tr>
<tr>
<td>Distance of maintained roads (During trainings)</td>
<td>3,730 m</td>
</tr>
</tbody>
</table>
During Trainings 1

Learning “Do-nou” technology skills

Difficult challenges
During Trainings 2

Having new experience

Learning on how to work together
Project outcome – Improved roads

Before the training

The road situations were improved in 5 counties, 7 sites. (3,730m)

After the training
Project outcome – Create Employment

- **Companies registered**: 11 (as of March 2014)

Youth groups acquired some work after the project:

- Supervision work from Kenya Rural Roads Authority
- Construction work costs several millions in Kenyan shillings
- Culvert installation and regular road maintenance work
- Part of work for 17 km paved road
The future of Africa hinges upon motivated young people who overcome difficulties through their own power.

Japan’s Diplomacy towards Africa: “Strengthening Each Individual, One by One,” Speech by Prime Minister Abe
Make a good road for rural peoples!
Thank you for your attention!