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TITLE: From Road Surfacing Problems to Mainstreaming New Techniques in National Standards: Rural Road Research in Vietnam.

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ABSTRACT

The lack of year round access to many rural communities is a serious constraint to social and economic development, and poverty reduction. Poor access limits the effectiveness of agricultural, commercial, educational and health initiatives through unreliable travel and high unit transport costs for crops, goods, services and people. Previous rural transport initiatives have concentrated on the provision of gravel roads for all year rural access. However, experiences have shown that these roads, although relatively cheap to construct, are often an unsustainable maintenance burden for many authorities and rural communities, and are rarely maintained in a serviceable condition.

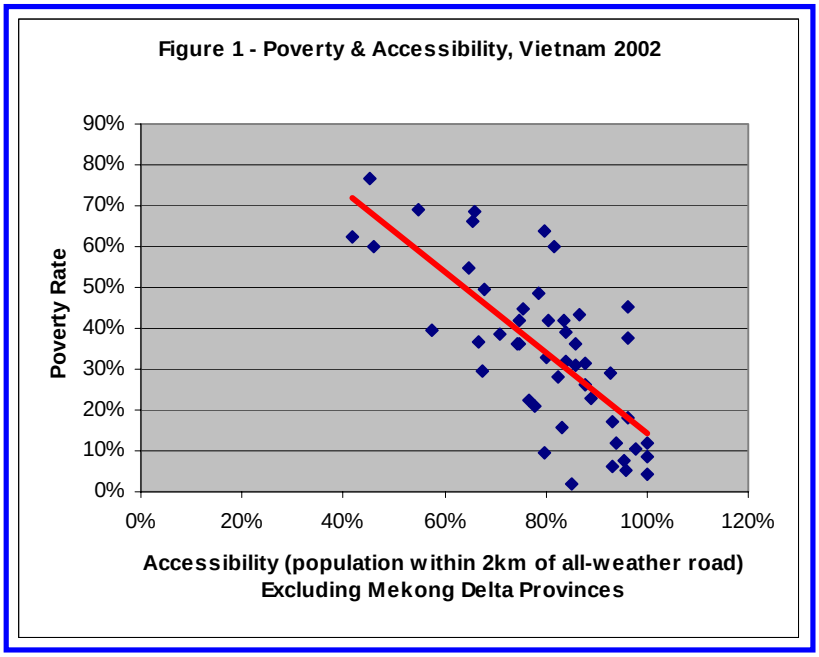
The paper describes recent DFID and World Bank funded research on alternatives to gravel roads in Vietnam and elsewhere. A range of proven, low-cost, rural road paving options is available that are suitable for construction and maintenance by Small and Medium Enterprises (SMEs). Most of these paving options require little capital investment, use labour-based techniques and can optimize the use of local materials resources. They can utilize locally made or available simple equipment, thus promoting local manufacturing and appropriate equipment ownership. For many of these techniques overhead costs could be reduced and a higher proportion of the costs could be recycled in the local community and therefore facilitate poverty reduction. The maintenance burden is usually lower than for gravel roads, and whole life costs can be cheaper than the provision of a gravel surface.

The paper also reviews the surfacing options and the process by which they are being effectively mainstreamed in the rural road sector by incorporation in the Vietnam Rural Road Standards.

KEY WORDS: Road, Access, Surface, SME, MDGs

1. BACKGROUND – THE CHALLENGE

In many developing countries, the main road network carries about 80 to 90 per cent of passenger and freight transport and it is, therefore, of key importance to the national economy. Main road networks are understandably given high priority in the allocation of investment and maintenance funds in recognition of their economic importance. Conversely, rural roads may make up over 80 per cent of the road network length, but are given lower priority in the allocation of funding because they carry much lower volumes of motorised traffic. Despite this, these rural roads are of vital importance to rural communities for their economic and social wellbeing and reduction of poverty. There is an established link between poverty and poor access (example Figure 1).



Source: Vietnam 2002 Living Standards Survey

The rural poor do not have motor cars. However they need reliable access for affordable transport or services (both motorised and non-motorised) such as bicycles, motorcycles, animal carts, minibuses, buses, whether owned or hired. Even if a bus ride is too expensive or unavailable for them, they will still depend on the transporters that bring the medicines, services and teachers to the village, or carry crops, livestock and goods. The essential challenge for engineers and road managers is therefore how to provide and maintain this rural access for the types of traffic currently in use, on a sustainable basis with the limited resources available.

Unsealed rural roads with earth and gravel/laterite surfaces comprise the greater proportion of the length of public roads in rural areas in developing regions[1]. Globally, they account for almost 60 per cent of the main road network, or about 1.2 million kilometres. In addition, there exists an estimated 5 to 6 million kilometres of designated minor roads and motorable tracks, and an extensive network of undesignated tracks and paths, probably several times the extent of the designated network[2].

Engineers have traditionally relied on the use of natural gravel/laterite as a rural road surface, due to its initial low costs and simplicity of use. However recent research[3] confirms the serious problems relating to maintenance and sustainability of such surfaces in many situations common in South East Asia. This experience is valid for certain combinations of conditions in other

1 Vietnam has a road network of approximately 210,000 km, of which over 100,000 km are to earth standard.

2 Paving the way for rural development & poverty reduction, Gourley, Greening Jones & Petts, CAFEO 20, 2002.

3 Rural Road Gravel Performance Assessment investigations in Vietnam by Intech-TRL.

regions. There are also health and environmental concerns regarding the widespread use of gravel.

2. THE LIMITATIONS OF GRAVEL

The word gravel is used within this paper to denote any naturally occurring granular material, including laterite gravel, used as a road surfacing material. Also included within this definition in many circumstances is the often more expensive graded crushed rock aggregate. Gravel is a 'wasting' surface. Material is lost from the surface of the road due to the combined action of traffic rainfall, flooding and wind.

All gravel roads lose material; however, the rate at which this loss occurs varies widely depending on the impacts of the governing road environment. It follows that a careful assessment of the road environment is necessary before any rational decision can be made as to the sustainability of a gravel surfacing option. Recent research in Vietnam (*Reference 9*) has developed general guidelines which identify the key environment factors that limit the suitability of gravel as a sustainable solution. In summary these factors are:

- Poor quality gravel
- Poor construction technique
- Long haulage distances
- High rainfall
- Flood risk
- High traffic levels
- Steep gradients (>4-6%)
- Lack of adequate maintenance

Even in simple combinations of some of the above constraining factors, gravel can be lost from the road surface at rates of more than 30 mm per year, leading to the need to re-gravel at very frequent intervals[4]. The funding and resources are usually not available to achieve this and the surface will invariably deteriorate and revert to an earth surface.

Gravel is a natural and finite resource that may occur in limited quantities. It also tends to occur in relatively thin layers (1-1.5m), hence development of borrow areas inevitably carries with it "green environment" penalties. For example, each kilometre of a 3.5m wide rural road will require the opening up and excavation of approximately a 30mx30m borrow area (assuming a 1m thick deposit layer) as well as attendant overburden dumps and access roads. In addition, once deposits are used up, subsequent periodic re-gravelling will involve longer hauls and higher maintenance costs.

Engineers and decision makers involved with rural road investment often fail to adequately advise and consult with the target beneficiaries regarding surface options, or respond appropriately to the beneficiaries' views. The accommodation of survey responses such as that shown in the box (following page) should have a greater bearing on rural road decision making processes.

One further consideration is that, by its very nature as a "wasting surface", the use of gravel surfacing can encourage corrupt practices, as the evidence of thin layer applications and use of sub-standard quality materials can be lost from the road site within months, whereas the specification compliance of more durable surfaces can be checked years after construction.

[4] Required regravelling frequencies of 3 years or less are reported in some locations.

Example survey responses on the recent provision of gravel roads

"Dust on the roads stemming from the gravel top-layer causes dust clouds on the rehabilitated roads, which is mentioned as a serious problem. All ILO villages (and about 40 per cent of the control villages) report a negative impact. Some villages clarify that families whose property directly borders to the road, complain about health problems. Where dust clouds are a serious problem, communities face the dilemma: dust clouds or no road."

Source: Reference 18.

3. PREVIOUS 'RULES OF THUMB'

Previous sector 'Rules of Thumb' indicated that gravel could be suitable for roads with traffic flows of between 50 and 200 motor vehicles per day (vpd). These guidelines suggested that earth roads would be suitable for traffic flows up to 50 vpd. However, **such guidelines are extremely misleading**, as some soils in their climatic and physical environment are totally inappropriate to support any motor traffic flows whatsoever. Furthermore, the criteria listed previously demonstrate that even gravel should never be considered for some combinations of conditions. Furthermore, research in Southern Africa has shown that low cost bituminous seals can be justified at flows of only 70 motor vehicles per day[5,6]. It is likely that full whole life costing of surface options will show that natural gravel is **NOT** the most cost-effective surface in most situations. It is necessary to be more rigorous in evaluating the options for rural and access road surfacing. Long hauls, high rainfall, high traffic, poor material, steep gradients, flooding, poor construction practices, socio-economic considerations, lack of maintenance capacity and other extremes of condition will exclude gravel from being the most appropriate surface in many circumstances.

4. THE PROVEN ALTERNATIVES TO GRAVEL

Fortunately there is a range of proven alternatives to natural gravel. Some of these have similar initial construction costs to gravel in certain circumstances. Most have better whole life cost[7] attributes and lower maintenance liabilities.

Engineered Natural Surfaces (ENS)

Poor people often rely on non-motorised transport, motorcycles and simple trucks for their transport needs. On many soils, an engineered earth road is sufficient to provide reliable basic access for these vehicle types, provided that specific, limited location constraints, such as watercourse crossings and steep gradients are adequately engineered with appropriate spot improvements. The camber and drainage must of course be maintained using appropriate, low

5 Performance of low-volume sealed roads: Results and recommendations from studies in southern Africa. TRL Project Report PR/OSC/167/99. Transport Research Laboratory, Crowthorne, Berkshire, UK, CS Gourley and PAK Greening, November 1999.

6 New approaches for the provision of low volume sealed roads. 20th Annual South African Transport Conference. Pretoria, South Africa, PAK Greening and CS Gourley, July 2001.

7 Whole Life Costs – discounted total construction and maintenance costs through the nominal life of the road.

cost techniques. Engineered Natural Surfaces therefore have enormous scope to improve access at very low costs for poor rural communities.

Engineers need to give greater attention to improving these basic access routes which often constitute more than 50% of the rural networks in developing countries. Low cost construction and maintenance techniques using local labour and simple equipment have an important role to play. These techniques are particularly suitable for implementation by small enterprises or communities. They use the locally available labour and have negligible capital requirements.

Such Engineered Natural Surfaces (ENS) can be provided for less than **US$2,000 per km** in many situations (*Reference 15*), including the necessary low cost drainage measures. Low cost grading of ENS can be achieved for as little as **US$25 per km** of grading using simple locally made equipment (Figure 2) (*Reference 19*).

Figure 2 - ENGINEERED NATURAL SURFACES: Maintainable using simple locally made equipment & basic agricultural tractors

Durable, Low Cost Surfaces

However in some circumstances the in-situ soils are just too weak to support any traffic in the wet, or dry (certain non-cohesive sands), and must be covered. For these situations, there is a range of alternative surfacing and paving options already proven in various countries that could provide appropriate, economical and sustainable alternatives to natural gravel in developing countries. Suitability will depend on local circumstances. These alternatives, involving the appropriate use of locally available materials, may be cheaper in whole-life-cost terms. Many can be carried out by small and medium enterprises using low-capital, labour based and light equipment methods.

Communities themselves could use some of the techniques to improve their own access. The alternative surfaces should have lower (and more manageable) maintenance requirements than gravel, not only in terms of cost but also by reducing the need for (imported) heavy equipment to excavate, transport and compact. Their environmental impact should be substantially less.

Figure 3

The available rural road surfacing options are summarised in Figure 4. These are all proven surfacing techniques. Guidelines on the use of these alternative surfaces and pavement layers have been compiled and successfully implemented in a number of countries. Similar documents are currently being compiled for South East Asia by Intech Associates-TRL, based on research work in Cambodia, Vietnam and elsewhere.

Figure 4: RURAL ROAD SURFACING GUIDELINES

Using Local Resource Based Methods
Focusing on the use of local labour, materials, enterprises and the community themselves.
Broad suitability guidelines are indicative only - dependant on site conditions and environment.

Number	Type of Surface	SUITABILITY FOR TRAFFIC As a Road Surface		
		Light	Medium	Heavy
1	**Engineered Natural Surface**			
2	**Soil Stabilisation**			
3	**Natural Gravel / Laterite**			
4	**Water Bound Macadam**			
5	**Dry Bound Macadam**			
6	**Crushed Stone Macadam**			
7	**Hand Packed Stone**			
8	**Telford Paving**			
9	**Cobble Stones**			
10	**Stone Setts or Pavé**			
11	**Dressed Stone**			
12	**Mortared Stone**			
13	**Stone Chippings**			
14	**Slurry Bound Macadam**			
15	**Bituminous Sand Seal**			
16	**Bituminous Chip Seal**			Note 3
17	**Slurry Seal**			Note 3
18	**Ottaseal**			
19	**Penetration Macadam (Bitumen)**			
20	**Pre-Mix Macadam (Bitumen)**			
21	**Burnt Clay Brick**			
22	**Concrete Brick**			
23	**Un-reinforced Concrete**			
24	**Steel Reinforced Concrete**			
25	**Bamboo Reinforced Concrete**			
26	**Geo-cell Paving**			
27	**Stone Chipping Blinding**			

	Type of Roadbase or Subbase	*Application suitability depends on various factors.*
1	**Soil Stabilisation**	
2	**Natural Gravel / Laterite**	
3	**Water Bound Macadam**	
4	**Dry Bound Macadam**	
5	**Crushed Stone Macadam**	
6	**Hand Packed Stone**	
7	**Telford Paving**	
8	**Slurry Bound Macadam**	
9	**Sand Aggregate**	
10	**Armoured Laterite**	
11	**Pulverised Fuel Ash**	

Traffic

Light: Mainly non-motorised, motorbikes & less than 25 motor vehicles per day, with few medium/heavy vehicles
Medium: Up to 100 motor vehicles per day including up to 20 medium (10t) goods vehicles
Heavy: Accessible by all vehicle types including heavy and overloaded trucks

Notes

1. Assumes that adequate specifications, thickness & foundations are provided for each surface type.
2. Engineered Natural Surface suitability depends on soil type and environment
3. Suitable for Heavy Traffic in Multiple Seal applications

5. SUITABILITY FOR SMALL & MEDIUM ENTERPRISES (SMEs)

The rural transport sector in many developing countries is characterized by the dominance of large construction enterprises using capital intensive methods for construction and maintenance works. These contractors have high overhead costs and their mobilization to the rural areas is expensive. Small and Medium Enterprises (SMEs) are generally poorly developed and have limited opportunities to penetrate the market.

However, if encouraged, SMEs would be particularly well suited to carrying out rural road construction of the alternative surfacing options due to:

- Possibility to be based in the rural areas with low mobilization costs,
- Low capital and set-up requirements,
- Inter-sector flexibility; possibility to provide services to a range of sectors and clients,
- Good market entry point for small entrepreneurs,
- Possibility to use affordable simple equipment, either owned or hired,
- Possibility to use local labour skills such as carpentry and masonry,
- Less pressures for corrupt practices, as they are part of the local community,
- Less opportunities for HIV-Aids infections due to less labour imported into the community,
- More of the costs recycled into the local community in employment of local labour, local tools production, local transport, local materials and profits, and consequential beneficial multiplier effects,
- Construction skills developed in the local community which can be utilized for maintenance and other activities,
- Low overhead costs.

However, investigations have shown that these enterprises often suffer from a number of constraints that prevent them from establishing, surviving and delivering low cost infrastructure services to the rural communities. These constraints include:-

- Barriers, bureaucracy or costs of establishing SMEs,
- Inadequate Government policy framework to support the SME sector for rural roads,
- Insufficient public awareness of the potential benefits of SME rural roadworks implementation,
- Engineers and decision makers lack the experience and knowledge of the techniques, costs and benefits of the range of surface options for SME application,
- Lack of appropriate contract documentation, pre-qualification & bidding procedures, standards and specifications, financial and performance audit, dispute resolution for small scale works, in place,
- Contract pre-qualification too demanding, for example 3 years previous experience of similar work,
- Contracting procedures and requirements usually (unnecessarily) demand heavy equipment holdings,
- Lack of access to capital or credit for equipment purchase or cashflow,
- Lack of opportunities to hire equipment,
- Poor contractors' capacity in costing and planning works,

- Inadequate access to low cost training, documentation and guidelines on small scale roadworks,
- Contract technical solutions are usually restricted to gravel and macadam surfaces,
- Lack of sustainable local funding for small rural road works contracts and maintenance,
- Lack of market and sustainable workload for SMEs,
- Lack of representation of SMEs (e.g. business association),
- Late and/or non-transparent payments for locally funded work,
- Corruption in award and payment for work, and finally
- The lack of mechanisms, motivation and "champions" to bring about the necessary sector changes to realize the potential of SME application of appropriate rural road surface options.

The national sector stakeholders must cooperate to overcome or minimise these constraints, drawing where possible on the experiences, knowledge and support of local sector experts and overseas partners.

6. FROM RESEARCH TO "MAINSTREAMING" IN VIETNAM

The Government of Vietnam and many rural communities were concerned regarding the durability and high maintenance burden of gravel roads in many parts of the country. This was particularly with regard to the southern Mekong delta where gravel haul distances can be up to 200km, and in the central regions where annual rainfall of up to 5 metres occurs. Periodic flooding is also a common problem throughout Vietnam. Many provincial administrations were even taking initiatives to find additional resources to upgrade gravel standard roads provided through development agencies' funding, to reduce future maintenance and rehabilitation liabilities.

From a study carried out by Rural Transport 2 (RT2) Consultants in 2001, the principal technical and economic features, and consequences of the gravel problem were highlighted. A Ministry of Transport Surfacing Options workshop in September 2001 (*Reference 20*) recommended that surfacing trials should be organised in a number of regions of Vietnam. The purpose of the trials was to develop standards, specifications and procedures for adoption of a range of surface options in appropriate situations on a national basis throughout Vietnam.

At the meetings of the RT2 review mission in November 2002, MoT, World Bank and DFID agreed an allocation of US$600,000 for the cost of RRST works in the first 2 regions. DFID agreed to fund the supervision and monitoring of the trials under a separate research programme direct appointment arrangement.

During the RT2 review mission in January 2005 it was agreed that the Trials should be extended to the Central Highlands, Northern Highlands and Red River Delta regions utilising some of the remaining funds available under the RT2. DFID agreed to fund the associated consultancy services under the SEACAP[8] initiative. This second phase Rural Road Surfacing Trials has subsequently been termed RRST-II to distinguish it from the initial RRST-I programme. The provinces and related construction budgets for the two programmes are summarised in Figure 5.

[8] South East Asia Community Access Programme.

Region	Province	Budget (US$)	Totals (US$)
RRST-I			
Mekong	Dong Thap	US$175,000	
	Tien Giang	US$150,000	
Central Coastal	Thua Thien Hue	US$150,000	
	Da Nang	US$125,000	
		Total	**US$600,000**
RRST-II			
Central Highlands	Gia Lai	US$500,000	
	Dak Lak	US$400,000	
	Dak Nong	US$400,000	
Red River Delta	Ninh Binh	US$700,000	
	Hung Yen	US$400,000	
Northern Highlands	Ha Tinh	US$500,000	
	Quang Binh	US$500,000	
	Tuyen Quang	US$400,000	
		Total	**US$3,800,000**

Figure 5 – Funding details for the Rural Road Surfacing Trials

The fundamental objective of the above programme is to mainstream a wider range of rural road surfacing options within the Ministry of Transport approved list and thus have available a matrix of road environments and relevant pavement options. In particular it is planned that the upcoming World Bank funded Rural Transport 3 (RT3) programme should benefit from this research.

Several key issues in relation to the mainstreaming process are currently being addressed under the overall Rural Road Surfacing Research (RRSR) initiative. These are summarised below.

***Ministry of Transport Approval*.** Any new pavement options must be formally approved by the Ministry of Transport before they can be adopted for programmes such RT3. This approval must

also encompass the relevant ***Cost Norms and Technical Specifications***. At provincial level these norms and specifications also have to have the approval of the relevant Provincial Peoples Committee (PPC). The RRST-I and RRST-II programmes between them have involved the drafting of new cost norms and new technical specifications. Special dispensation had to be sought for their temporary use for research purposes.

Rural Road Standards. In order to be effectively mainstreamed, any new pavement options must fit within the requirements of the Vietnam Rural Road Standards. These are currently undergoing review and revision with technical support from the RRSR projects. A proposed separation of administrative definition and road task classification from the list of approved paving solutions should allow the adoption of surfacing selection matrices relevant to the different regions in Vietnam.

***Construction Equipment*.** Much equipment currently being used by small contractors is not appropriate some of the new options for low volume commune and district roads and this is a potential barrier to effective mainstreaming. In particular there is a reliance on static rollers (8.5-12Tonne) for compaction rather than lighter vibrating options. The adoption of agricultural equipment such as tiller-tractors and rotovators for the RRST-I programme provides a flexible way forward in this regard. These equipment types need to be accommodated in the specifications and costs norms.

***Contractor Capacity*.** Local small contractors have generally up to now built to a very limited range of rural road designs. Hence their lack of experience with options such as soil stabilisation, bitumen emulsions and dry bound macadam could be considered a barrier to mainstreaming. However the experience from RRST-I indicates that usually the contractors are willing and able to adopt new practices. However, one area of concern that is receiving further attention is the inability of contractors to consistently comply with agreed materials and procedural specifications.

***Local Consultant Capabilities*.** Up to now small local consultants have had little or no experience in the effective supervision of rural road contracts. There is an identifiable need for local consultants to be made fully aware of the need for appropriate Quality Control and supplied with supervision guidelines and training.

The initiation of the RRST-II programme, which involves longer length trials (up to 1-2km), will be an important step in the mainstreaming process. Already during the RRST-II trial design process there has been a considerable involvement of local consultants and PDoT road engineers in the selection of the appropriate options. In addition to providing valuable technical feedback at a larger scale, the construction of these “real-life” trial lengths will involve a much wider body of contractors and consultants and provide greater opportunities for addressing the above issues.

From the very start of the RRSR programme, the need for effective mainstreaming of surfacing options has received the highest priority. The formation of the RRST Steering Committee by the MoT was a far-sighted and vitally important step in ensuring that ownership of the programme was seen as being firmly in the hands of Vietnamese rural road practitioners. This Steering Committee has provided an effective channel for communications between the research teams and the pragmatic requirements of the MoT. It is anticipated that the Steering Committee will play an increasingly important role in mainstreaming initiatives over the coming months and dissemination initiatives.

Apart from the Steering Committee meetings, regular briefings and workshop presentations have taken place to develop knowledge exchange and awareness of the surfacing options at provincial as well as national level and these form an integral part of the process to bring about beneficial changes to the Vietnamese rural transport sector.

Figure 6 – Initial Rural Road Surfacing Workshop chaired by Vice Minister, October 2001

7. CONCLUSIONS

A range of proven, low-cost, rural road paving options exist as an alternative to the use of problematic natural gravel as a road surface. The low cost paving options usually have a number of economic, social, health and environmental advantages over gravel. These alternative paving techniques are suitable for construction and maintenance by Small and Medium Enterprises (SMEs). Most of these paving options require little capital investment, use local resource based techniques and can optimize the use of local materials. However there are a range of constraints that currently prevent these approaches from being widely used in developing countries. Initiatives are required to be taken by governments, road authorities, contractors' associations and donor agencies to tackle these constraints to develop a vibrant market for rural infrastructure works and enable SMEs to establish and survive to deliver low cost road infrastructure solutions to the rural communities. This would provide an important improvement in the prospects for social and economic development, and rural poverty reduction in pursuit of the Millennium Development Goals.

An important part of the process of bringing about desirable sector changes to allow the use of appropriate rural road surface options and SMEs, is to develop an effective steering framework to plan and manage the introduction of new techniques, procedures and operational framework, with appropriate awareness creation, stakeholder consultation and knowledge dissemination.

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