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Southeast Asia Community Access Partnership

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LOW VOLUME ROADS WORKSHOP
Napier, New Zealand, July 2009

Low Volume Rural Road Research in Vietnam on Unsealed and Sealed Roads

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Project Need

The Ministry of Transport in Vietnam recognised an unsustainable reliance by donor programmes on unsealed gravel roads to solve the rural access problems in Vietnam.





Project Strategy

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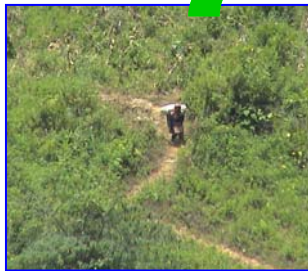
The Rural Road Surfacing Research (RRSR) programme – 2 approaches:

An assessment of how unsealed gravel roads were actually performing-the Rural Road Gravel Assessment Programme (RRGAP)

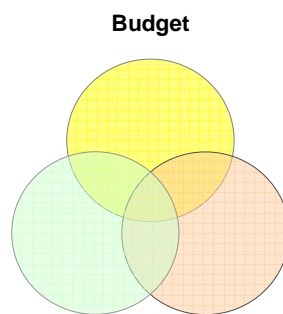
Research into sustainable alternatives to unsealed gravel – the Rural Road Surfacing Trials (RRST)



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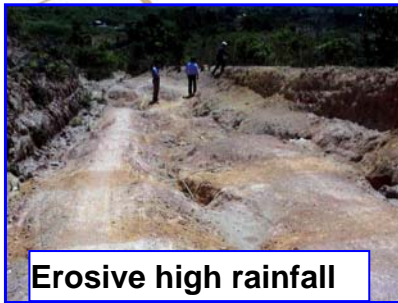
Road Environment



Road Task

Key RRSR Aim
SUSTAINABLE RURAL ROADS

Vietnam contains some particularly challenging road environments for unpaved roads.



Erosive high rainfall



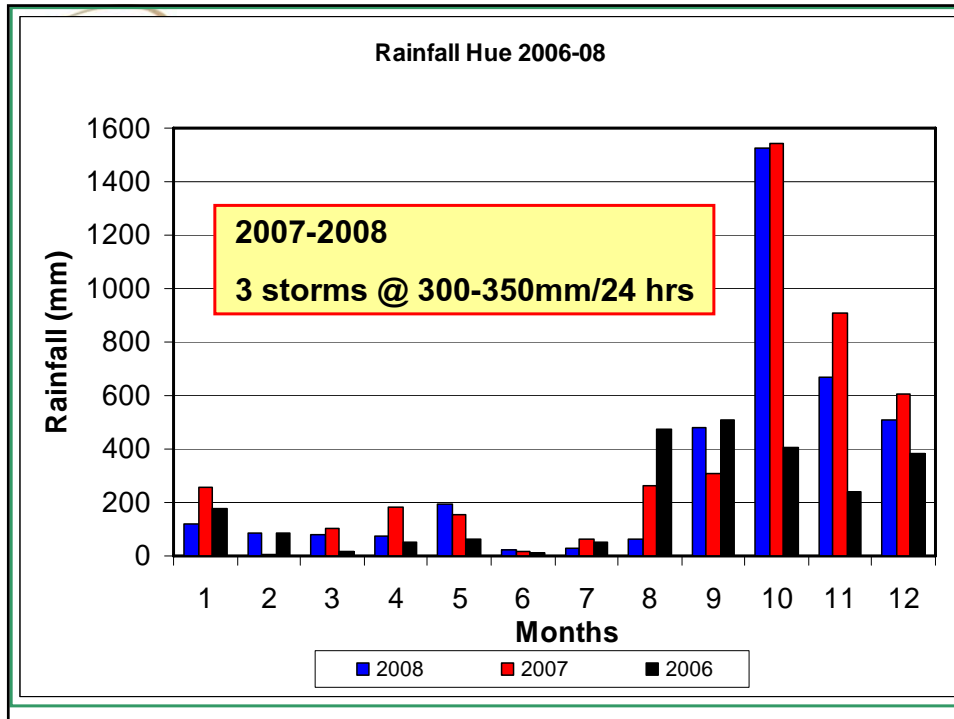
Variable terrain



Poor maintenance





Coastal floods



Traffic (Vietnam)

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	Vehicles Per Day		
	Motor Vehicles	Motor-Cycles	Cycles
Mekong	0	1718	1085
Delta	2	1110	646
Central Highlands	101	134	1064
	176	1150	106
	277	469	56
Northern Highlands	101	907	1025
	20	266	726
	148	1249	1304
	31	540	305
	67	572	776



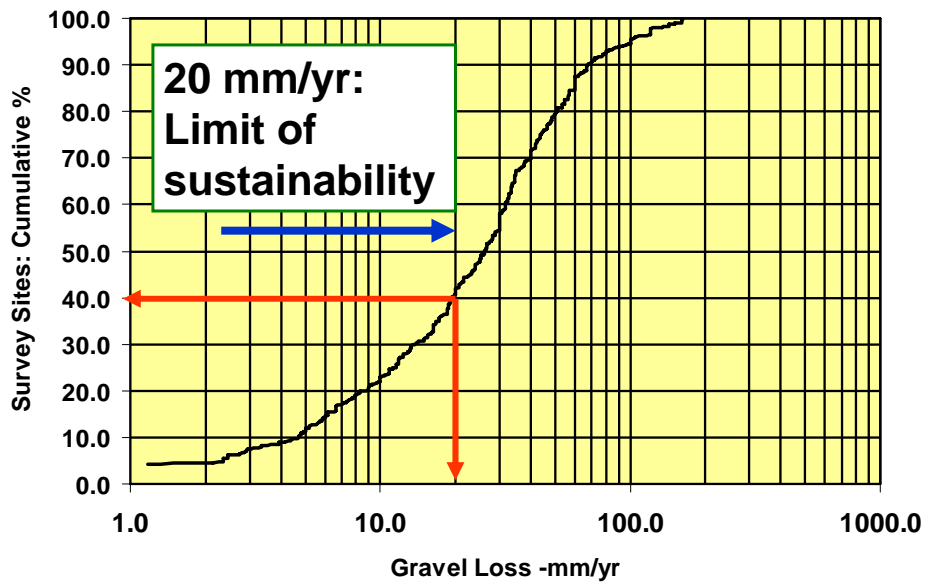
RRGAP:SEACAP 4

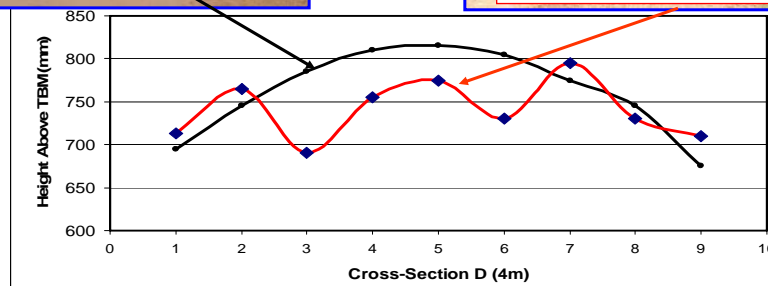
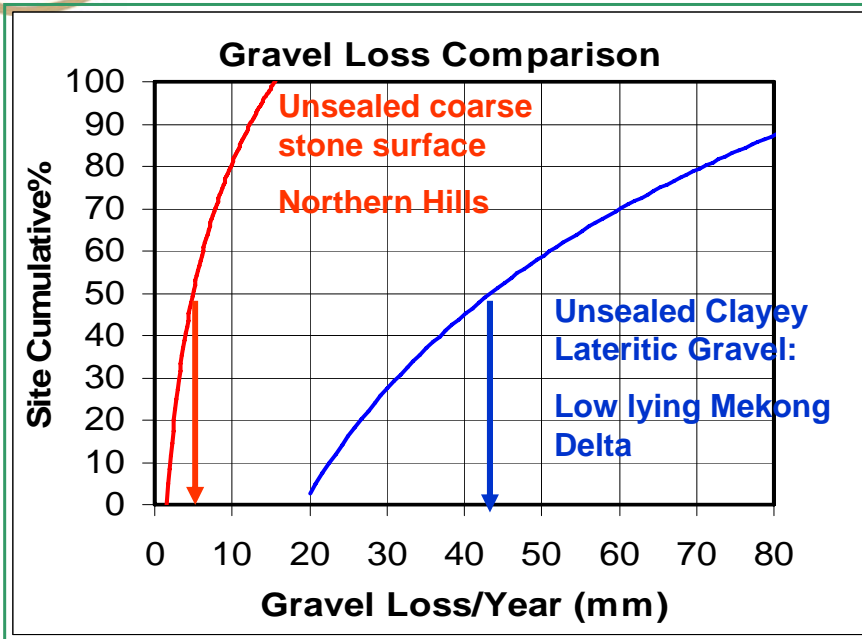
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A snap-shot of unsealed road conditions on a representative sample of existing World Bank funded road links



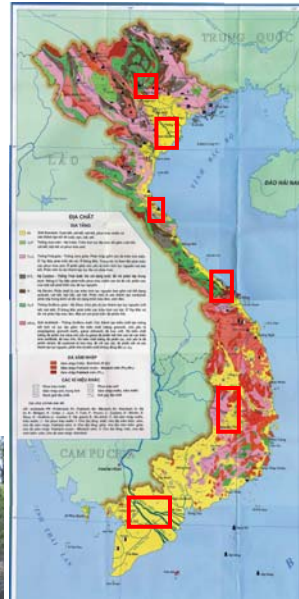
Gravel Loss - (95% Level)







RRST I & II



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Wide Range of Pavement Material Options Trialed

Emulsion seals
Bitumen seals
Unsealed gravel
Armoured gravel
Waterbound macadam
Drybound macadam
Graded crushed stone
Cement stabilised sand

Clay bricks
Concrete bricks
Cobble stones
Quarry- run
Bamboo RC
Steel RC
Non-reinforced
Concrete



Trial Selection and Design Principles

Engineering based

Appropriate to the road environments.

Local construction materials

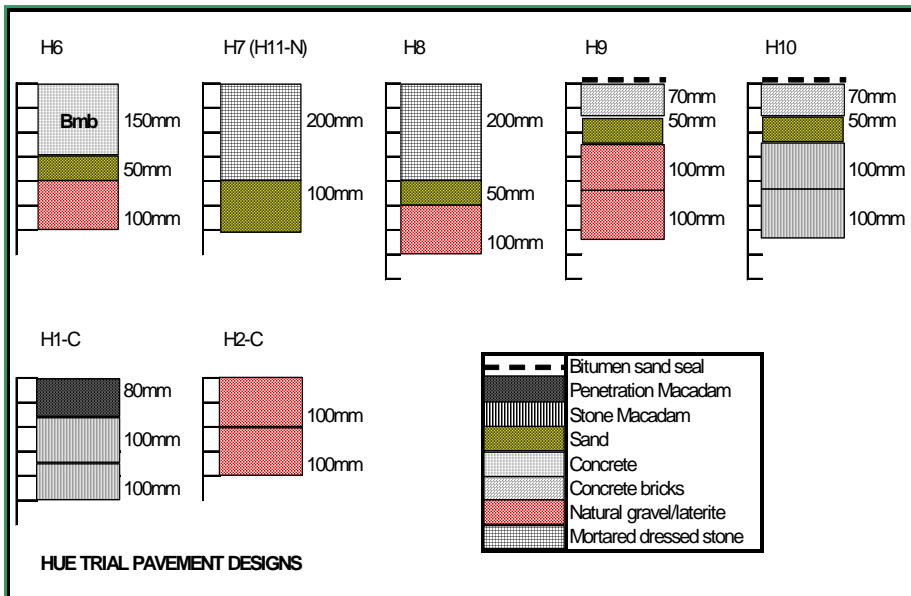
Maintenance burden in line with local resources

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Trial Options

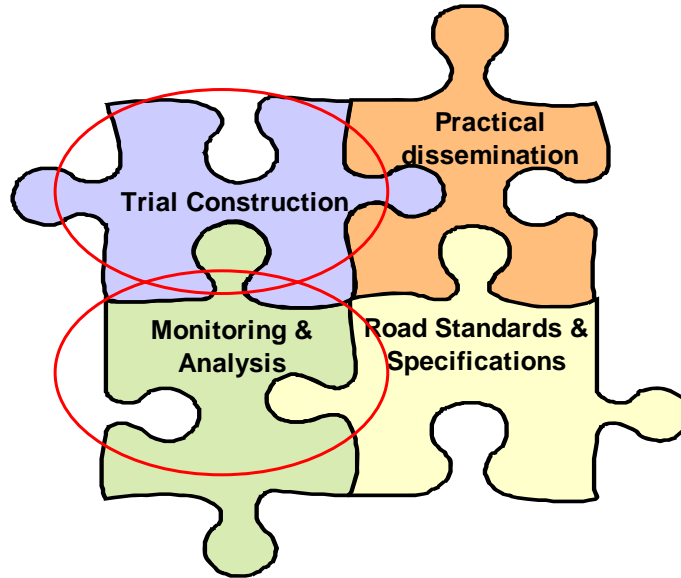
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Road Research Delivery

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Monitoring Summary

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Roads divided into 4 categories

Trial Type	Sections	Length (km)
Block	11	1.675
Concrete	24	3.025
Sealed Flexible	56	6.300
Unsealed	16	1.670





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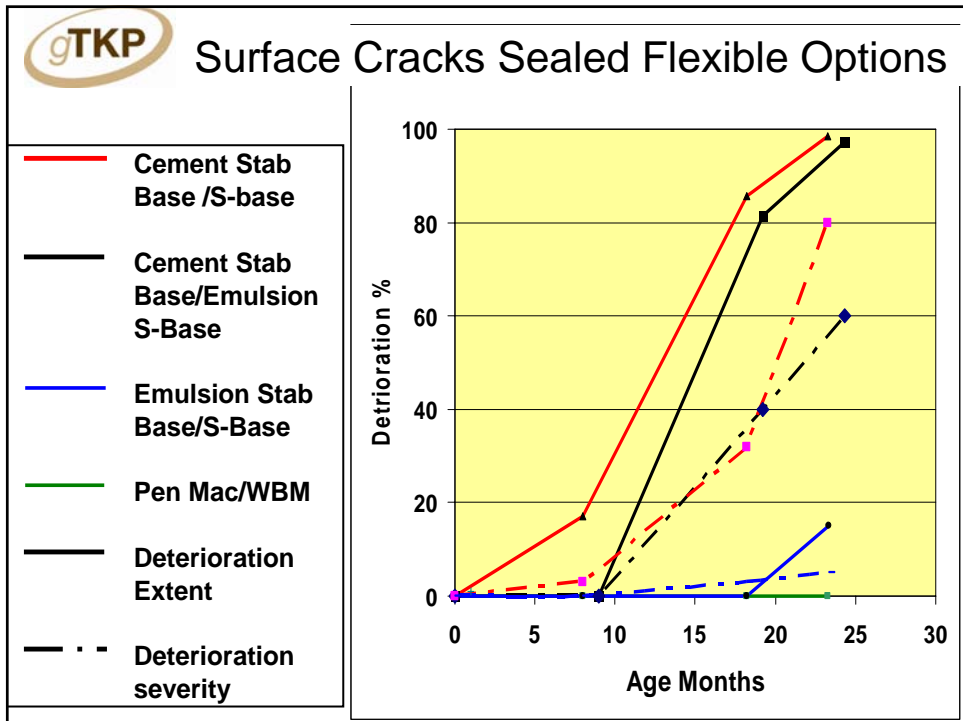
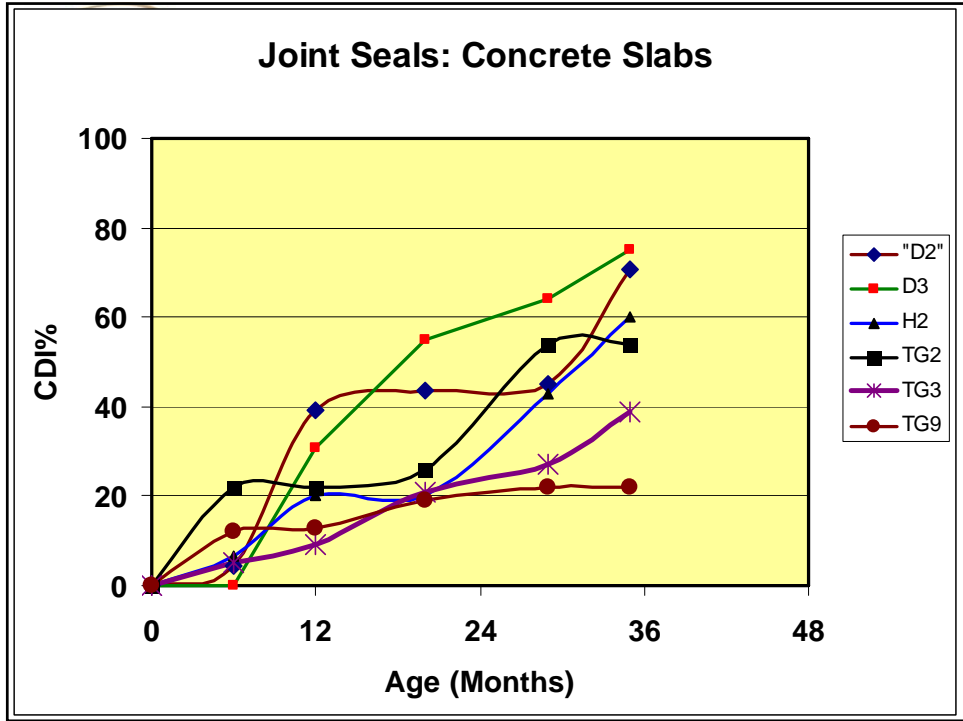
Chain	Block	Left Hand											Drain	Right Hand										
		Carriageway						Shoulder						Carriageway						Shoulder				
		Surface condition	Stone blocks	Matrix	Depressions	Ruts	Potholes	Shape	Edge	Cracks	Erosion	Run-off		Surface condition	Stone blocks	Matrix	Depressions	Ruts	Potholes	Shape	edge	Cracks	Erosion	Run-off
0	1	1	1	1	0	2	0	1	1	0	1	0	3	1	1	1	0	2	3	1	1	0	1	0
5	2	1	1	1	0	2	0	1	1	0	1	0	3	1	1	1	1	1	0	1	1	0	1	0
10	3	1	1	1	0	2	0	1	1	0	1	0	2	1	1	1	0	2	2	1	1	0	1	0
15	4	1	2	1	0	2	1	1	1	0	1	0	0	1	1	2	0	2	2	1	1	0	2	0
20	5	1	2	1	0	2	0	1	1	0	1	0	0	1	1	1	0	1	0	1	1	0	2	0
25	6	1	1	1	0	2	1	1	1	0	1	0	0	1	1	1	0	1	0	1	1	0	2	0
30	7	2	1	1	0	2	1	1	1	0	1	0	0	2	2	1	1	2	0	1	1	0	1	0
35	8	3	2	2	0	2	1	1	1	0	1	0	0	3	2	2	0	1	0	1	1	0	1	0
40	9	3	2	1	0	2	0	1	1	0	1	0	0	3	2	1	0	2	0	1	1	0	1	0
45	10	2	2	1	1	2	0	1	1	0	1	0	0	1	1	1	0	2	0	1	1	0	2	0
50	11	1	2	1	0	2	0	1	1	0	2	0	0	2	2	1	0	2	0	1	1	0	1	0
55	12	2	1	1	0	2	0	1	1	0	1	2	0	2	1	1	0	2	0	1	1	0	1	0
60	13	2	1	1	0	2	0	1	1	0	1	2	0	2	1	1	0	2	0	1	1	0	1	0
65	14	2	2	1	0	2	1	1	1	0	1	2	0	2	1	1	0	2	0	1	1	0	1	0
70	15	3	3	2	0	2	0	1	1	0	1	0	0	2	2	2	0	2	0	1	1	0	1	0
75	16	3	3	2	0	2	0	1	1	0	1	0	0	3	2	2	0	2	0	1	1	0	1	0
80	17	4	2	3	0	2	0	1	1	0	1	0	0	2	2	1	0	2	0	1	1	0	1	0
85	18	4	2	2	0	2	0	1	1	0	2	0	0	2	2	1	0	2	0	1	1	0	1	0
90	19	3	2	2	0	2	0	1	1	0	3	0	0	2	1	1	0	2	0	1	1	0	1	0
95	20	3	2	2	0	2	0	1	1	0	1	2	0	2	1	1	0	1	0	1	1	0	1	2
##	21																							



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The Road Condition Deterioration Index (RCDI)

A total deterioration index: the condition of the key factors as percentage of total deterioration (ie all visual numeric codes at their maximum defect values).
 Made up of individual factor indices (CDIs)



MAINTENANCE COST AND ROAD CONDITION INDEX

Trial sections	Age month	Repair cost of 1km of road up to 8/2008 (USD)	Road Damage Condition Index (RDCI)		Damage Extent Index (DEI)
			Pavement	Joint	
DL(3)-1	24	1212	25	69	70
TQ(1)-2	24	624	28	28	68
DN(1)-5	24	608	17	100	53
D2	36	563	1	73	3
D3	36	537	2	76	9
DaN2	24	530	3	81	11
GL(1)-2	24	516	36	21	85
HT(1)-2	24	491	3	86	5

- ❑ Mortared jointed options are probably more appropriate than sand joint options.
- ❑ Stone options: robust but rough



The results of the trials of bamboo reinforced concrete in Vietnam (together with results obtained in Cambodia) show conclusively that bamboo reinforcement in pavement slabs has no obvious advantage over **well-constructed** non-reinforced concrete



Two principal causes for poor performance stand out:

Poor quality concrete and poor support for the concrete slabs (sub-base or eroded shoulders).





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Flexible Pavements

Emulsion DBST over DBM is performing better than hot bitumen DBST over WBM.

Poor construction
- major issue.



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Unsealed Gravel

The majority of gravel control sites performed poorly- however there are clearly areas where unsealed gravel surfaces are a sustainable LVRR option provided they are constructed correctly and MAINTAINED.

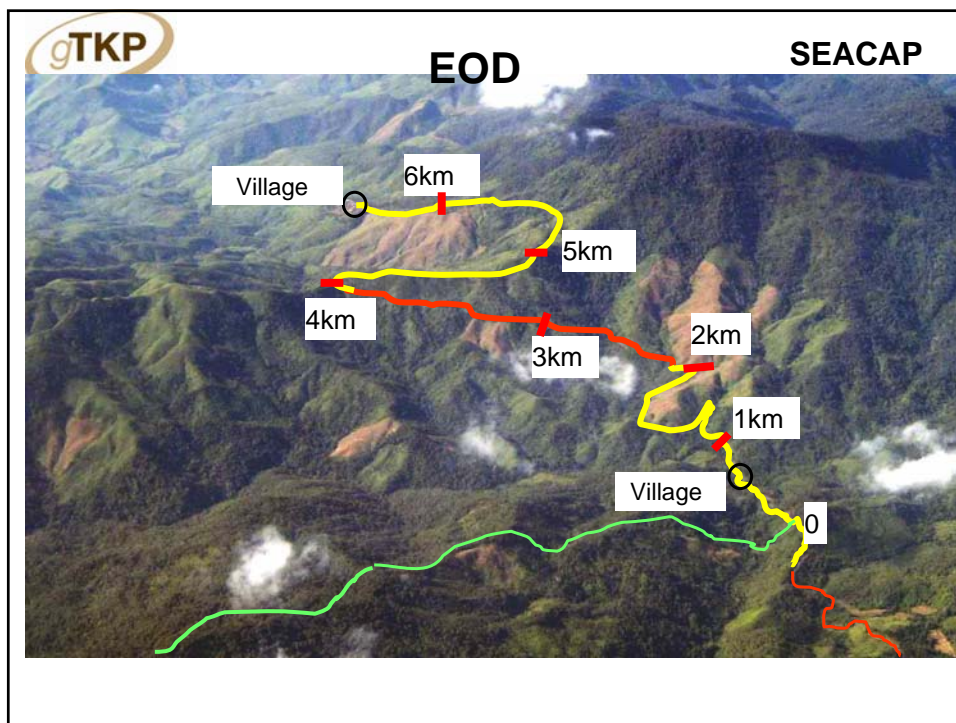
Unsealed WBM is not a satisfactory option because of loss of cohesive fines and surface loosening.



The use of natural gravel as a universal rural road surface is unsustainable in the majority of the situations in Vietnam.

Other options are available that can be competitive in **WLC** terms

The combination of **sustainable** gravel use and other trialled options within an Environmentally Optimised Design (**EOD**) process offers a potentially very useful way forward





Summary

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1. Construct Trials



2. Assess specifications & construction procedures



3. Collect data on as-built trial condition



4. Use information for assessing option suitability



Summary

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5. Assess trial costs under full-scale conditions



6. Monitor Trial performance with associated maintenance and WL costs



7 Fully disseminate and apply to all provinces



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Thank You

