Ghana Feeder Road Prioritisation

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Summary

This paper describes a feeder road prioritisation procedure recently developed in Ghana. The objective of the procedure is to prioritise investment in feeder road improvements in order to maximise the economic and social benefits. The paper provides details of the technical analyses upon which the procedure is based and describes a trial carried out in one District.

The main strength of the approach is that it combines extensive community participation together with a prioritisation index where social and economic benefits are estimated from predicted changes in accessibility and road roughness. Engineering costs form part of the prioritisation index. A specific procedure was developed for quickly estimating change in road condition and the associated engineering costs for different interventions.

Background

Project

The Department of Feeder Roads (DFR) of the Ministry of Roads and Transport (MRT) in Ghana, in co-operation with the UK Department for International Development (DFID), set up a programme of feeder road improvements in nine Districts in the north east of the country in 1999. Many of the feeder roads in these Districts were in very poor condition, often impassable during the wet season. However it was unlikely that funding could be found to rehabilitate all feeder roads in the Districts. A procedure was required to identify and prioritise those roads which would provide greatest economic and social benefit for the funds invested.

Prioritisation Methodologies

Ghana has used various methods in the past for prioritising rural road investment. These include the consumer surplus and the producer surplus approaches, which look at transport cost savings and increases in agricultural output respectively as transport costs fall. The conventional consumer surplus approach is based on predicted changes in transport costs for existing motorised traffic. A particular problem with this approach is that if a road becomes very difficult for a motor vehicle to use, or even impassable, at certain times of the year then there may be little or no motor traffic to measure in order to calculate transport cost savings. Furthermore, within the general approach there may be no guidance as to how to estimate benefits from traffic that switches from alternative modes to motor vehicle use as the road improves.

There are a number of difficulties with the producer surplus approach. Firstly the approach (as interpreted in Ghana) has centred around particular specified crops such as cocoa or maize. An obvious problem arises with communities that grow other crops or have other sources of income, for example, fishing or the provision of services such as food sales to passing traffic. In this situation these communities may lose out in the allocation of road investment. A more fundamental problem with the producer surplus approach is that it is in fact extremely difficult to identify the extent to which net agricultural output will respond to changes in accessibility. Although there have been many impact studies of road investment, their impact is difficult to interpret because of the huge range of conflicting factors that can influence agricultural productivity even if "control observations" are included in the impact study. For example, time based analyses are hampered by differences in weather, crop diseases, changes in national and local crop prices and the farmers' response including variations in crop composition and land use. Cross-sectional based analyses are hampered by the real geographical diversity of the rural economy (based on differences in cultural background, population density, market access and resource endowment) that are so often overlooked. Besides these drawbacks,

existing procedures did not give sufficient emphasis or weight to the need for social access benefits or community consultation.

Consultant Team

A team of two economists (John Hine and Simon Ellis), a social development expert (David Korboe) and an engineer (Simon Done) was asked to produce the new procedure.

Prioritisation Procedure

Requirements

The procedure was to meet the following requirements:

- Responsive and accountable to the priorities of road users. The procedure should address the needs of those who will use the roads rather than the wishes of those who construct and maintain them. To do this, the procedure should include means for establishing the needs of the rural communities and should include presentation and justification to them of the results of a technical analysis.

- Address poverty and gender issues. The procedure should not ignore the views of the more vulnerable sections of the rural communities – women, the elderly, the infirm and the poor. When views are sought, all sections of the communities should be included.

- Equitable. The project area had a history of ethnic conflict. The procedure should ensure that all ethnic communities have opportunity to benefit from the road improvements.

- Suitable for decentralised decision making. As in many countries, there are current plans to decentralise responsibility for feeder roads to the Districts.

- Transparent. Any road ranking or selection should be immune to adjustment by individuals for local political or commercial gain against the wishes of the community.

- Simple. If the procedure is to include the opinions of rural communities, it should be understood by them and capable of rapid explanation. Therefore it should be as simple as possible, while not being too simplistic as to omit key criteria.

- Economically rational. As well as responding to local needs, which may well address non-economic priorities, the procedure should also be justifiable on an economic basis. Road improvements should not be prioritised purely on social or other non-economic grounds.

- Robust. The procedure should be based on objective measurements so that it is repeatable and reproducible.

It will be seen how the procedure complies with all these requirements, although it is noted that some, such as local road user accountability and District Assembly ownership, or social equity and economic rationality, may appear at first sight to be incompatible.

Study Visit

The Consultant Team made a number of visits to Ghana during 1999 and 2000 to learn about the project, consult with the many stakeholders (see Annex 1), and produce, present, refine and trial the procedure.

First impressions included the prevalence of poverty in the project area, the poor condition of the roads and the low volume of motorised traffic. It was realised that non-motorised traffic and pedestrian counts would help in giving due weight to the travel needs of the poor and that it would be vital to consider appropriate levels of road improvements and devise new methods for accounting for road condition.

Summary of the Procedure

1. First round of improvements

   Approximately 50% of the funds are allocated equally between the nine Districts in the project area. This is to ensure an equitable spread of the funds. For each District steps 2 – 4 are carried out.

2. Consultation

   The objective of this step is to derive a list of candidate roads from within the District. The candidate roads are ranked by local communities prior to a technical analysis in step 3.

   Consultation begins with a phase of preparation. The Project Team managing the improvements employs a local NGO or other organisation to act as Facilitator for the consultations. They are given training in the procedure. The Project Team and the NGO then explain the procedure to the District Administration and learn about the District and its communities, networks and so on. They meet with the Works Sub-Committee who will be overseeing the procedure in the District and try to ensure that it has a range of technical and social skills reflecting the likely priorities of the communities. They carry out interviews with service providers in order to learn about the condition of the roads from those who use them regularly. The final preparation is to brief various District agencies, such as those responsible for agricultural extension and adult literacy, and generate publicity on the forthcoming consultations and prioritisation.

   Roads are then nominated. The process begins at the Unit level (there are typically 10 Units in an Area and 10 Areas in a District), where the Facilitators explain the procedure, assist the communities in identifying what is important to them and where problems currently exist, and then use this to obtain nominations. Meetings are also held at the Area level with stakeholders, such as traders and transport operators, who are not resident in a Unit.

   Candidate roads are selected from the nominations at an Area Meeting. The objective is to select two candidate roads per Area. All nominated roads are visited by road authority staff and local residents and summaries are prepared. The roads are ranked on the basis of the summaries. Ideally this ranking will be by consensus, but if this is impossible a pair-wise method, using agreed criteria such as population served or isolation from a health centre, can be used. The top two roads in the ranking become the candidate roads from the Area.

   Candidate roads from all Areas are presented at a District meeting where the objective is to carry out an initial ranking of the candidate roads. After the facilitators have presented summaries of the earlier consultations, the roads are ranked in a similar manner to that at the Area meetings – by consensus or by pair-wise comparison using agreed criteria.

   The consultation ends with a list of the District's candidate roads, an initial ranking and a map showing the settlements and the candidate roads in each Area.

3. Technical analysis of candidate roads

The objective of this step is to assess the candidate roads on economic and social grounds and to produce a ranking based on this assessment.

Detailed surveys are carried out on candidate roads. These surveys record:

- Population within the natural catchment of the road. A road in a populated area will benefit more people than one in an unpopulated area. The benefits to those living along the road (side population) are calculated a little differently to those who would normally use the entire road length (terminal). Populations at the near end of the road (proximal) are unlikely to use the road and are not counted.
- Location of important facilities. If a population is more than 10 km from a facility, the population is defined as being isolated. The social benefits which accrue from road improvement and reduction of this isolation are used in the analysis and are explained below.
- Traffic by mode, from pedestrians and bicycles (with and without load) to trucks and buses. A two day count is normally sufficient if resources are low. It is important not to count on 'exceptional days' such as public or religious holidays. All traffic on a route must be counted, the count site should be away from a village centre and the count should include the pre-dawn and evening periods.
- Road condition in terms of degree of roughness, and duration of impassability and traffickability problems. These three conditions affect travel in different ways and are discussed below.
- Road improvement *costs* for both providing access and full rehabilitation. Both levels provide different benefits to the road user and, again, are discussed below.

These surveys are used to calculate the various *benefits* which may come from improving the road. These benefits include:

- Reducing vehicle operating costs (VOCs) as roughness is reduced
- Saving time and money as traffickability problems are eliminated
- Opening up an impassable road
- Giving easier passage for non-motorised vehicles
- Providing the opportunity for modal switch
- Providing access for social purposes
- Providing access to transport services
- Reducing isolation from important facilities (see below)
- An additional social benefit can be included if roads focus on areas of poverty

The list of candidate roads may include some where improvement would be inappropriate. A road leading to a District border and connecting with one in poor condition, or a road not forming part of a coherent network may serve little purpose if improved. Attention will be drawn to these in step 4 to give the communities the opportunity for their de-selection.

Candidate roads are then ranked. To do this, the total benefits are divided by the road improvement costs to give a Prioritisation Index. Roads are ranked in order of descending Prioritisation Index. Only one road per Area (that with the highest Index) is included in the ranking in order to achieve geographic spread of the funds within the District. Roads are then selected from the ranking by Index until the available funds are exhausted.

4. Return to consultation

The objective of this step is to compare the technical ranking (step 3) with the earlier District ranking (step 2), and to achieve consensus on the final selection of roads for improvement.

The facilitators return to a public hearing and confirm that the procedure has been followed correctly. They present the ranking based upon the Prioritisation Index and indicate which roads would be selected up to the available budget. Comparison is made with the initial ranking obtained during step 2 and a final ranking and selection agreed.

A meeting is held with the District Administration to explain the selection and to begin making any necessary plans for the improvement works. An optional meeting may follow where changes may be proposed to the prioritisation procedure for subsequent rounds.

5. Second round of improvements

The remaining funds not allocated in step 1 (approximately 50%) are used for more road improvements. In this round the project area is considered as a whole so that the funds are spent most appropriately regardless of location. In this round, it is possible to incorporate a District poverty weighting factor into the Prioritisation Index. This factor gives weighting to roads in Districts which have been identified by a central Common Fund as having a high incidence of poverty (defined using an estimate of average income).

The Prioritisation Index of candidate roads which were not selected in the first round is recalculated with this District poverty weighting factor. Roads are then ranked and selected for improvement as during the first round.

The list of candidate roads will be retained for several years for further rounds of improvement as they occur.

Key Points of the Procedure

Gradual network improvement

It is true that the results from a simplified procedure may be inexact. However, it is also true that a phase of improvements is unlikely to be undertaken only once. More likely is a cycle of improvement, regular and secure maintenance, economic and social growth followed by improvement of more roads. An important road overlooked during one cycle is likely to be included next time. The priority is to ensure that investment is made on roads where growth will be sustained and is not wasted on roads where it will not; the exact order of the improvements is less critical.

Poverty and gender focus

The procedure addresses poverty and gender issues in a number of ways. When accessibility is poor and transport services are expensive and infrequent, poor people in Ghana tend to walk, head-load, and use bicycles. Most headloading is in fact undertaken by women. Hence using conventional procedures by only ascribing benefits to motorised vehicle traffic will tend to exclude the needs of the poorer sections of the population. However the poor will benefit if accessibility is improved through the increase in service frequency and reduced fares. Ascribing benefits directly to pedestrians and non-motorised vehicles will ensure that the transport needs of the majority of the population are represented. The second round of the procedure also permits roads in Districts with recognised levels of poverty to be given a positive weighting when they are being ranked against roads in other Districts.

Clear definition of 'poor road condition'
Roads in a variety of conditions may be classed as poor, but affect traffic and impose a cost on the traveller in a number of ways.
An **impassable** road will prevent journeys being made, will require a long detour or will involve a change in mode, perhaps to headloading around the obstacle. All these alternatives impose costs on the road users. Impassability is normally associated with short sections, often at water crossings, and clearly has a major impact upon accessibility.
A road with **traffickability problems** will be passable with care, but the journey will not be easy and some drivers will be dissuaded from travelling. Many journeys will be made with inappropriate vehicles, perhaps a tractor and trailer, when a pick up would have been more efficient. Traffickability problems may be found at any section along a road and have a significant impact upon accessibility.
A **rough** road may be uncomfortable to travel on, may cause higher VOCs and passage may be slow but not difficult. Drivers are very unlikely to cancel a journey simply because of its roughness. Roughness is normally associated with long lengths of carriageway and has very much less impact upon accessibility than impassability or traffickability problems. Extreme roughness is classified as a traffickability problem.

Clearly the impact upon the rural communities is very different in each case. The procedure is careful to distinguish between these conditions and to calculate costs and benefits accordingly.

Clear definition of 'road improvement'
It is first important to consider the effect of improving roads from each of the various road conditions described above.
Eliminating **impassability** will permit journeys to take place that would otherwise have been impossible. Detours may not be necessary and travellers may change mode from headloading to motorised transport.
Eliminating **traffickability problems** will permit the use of more efficient vehicles and will reduce costs as travel times drop.
Improving a **rough** road will reduce the VOC burden on the vehicle owners.

The procedure considers two levels of road improvement. The first is to address all the sections where traffickability problems or impassability exist. This level will provide reliable, year round access to road users but will not address roughness. The second is to address all sections where traffickability problems, impassability or roughness exist. This level of improvement will fully rehabilitate the road. Rehabilitation will bring more benefits to the road users but the works will cost more. The Prioritisation Index will indicate if the extra benefits were worth the extra investment.

Consultation
Widespread consultation took place as the procedure was being produced. Some of the important results of this consultation include the following.

- It was important for the communities to identify the important facilities to which they wanted access. In all cases they gave priority to health centres and markets. In very few cases did they give priority to schools. Given that children rarely have the opportunity of a bus ride to school in these areas, that might not be surprising, but it is noted that school access is normally prioritised in externally driven rankings.

- Local people were asked what they wanted from their roads. They responded by placing emphasis on the improvement of unclassified links, being able to rely on a road being open all year round, a smooth surface without tree roots which cause punctures, and the opportunity to earn income along the road. Further, they wanted reliable access for many people, rather than high standard roads for a few. Although these priorities are well documented, hearing them unprompted from the communities reinforced the focus on access provision over full rehabilitation works.

- Gender issues were raised during consultation. It became clear that women make more trips during a day than men, but that these trips are frequently on paths and tracks and so are ignored by those only interested in improving engineered and classified roads. The women also expressed much interest in being involved in decisions relating to their road and path network. The need to specifically address the transport needs of women was highlighted when many male leaders dismissed their opinions despite, during consultation, the women proving to have a greater understanding of household security issues than the men.

The simple act of consulting achieves a high degree of local involvement and accountability. The fact that the consultations gave results which might not have been expected further increases the value of this important step.

Calculating the Benefits of Road Improvements

Within the Prioritisation Index, traffic-based benefits (for both motorised traffic and non-motorised traffic) are estimated as a change in transport costs derived from a change in road condition. Social benefits (based on population and access to markets and health facilities) are also calculated from a series of factors multiplied by changes in transport costs. The details are given below:

Motorised traffic benefits

The procedure identifies three main areas where motorised transport benefits are derived from improved access.

1) Benefits associated with improved levels of road roughness using the conventional relationships between road roughness and VOCs. Table 1 shows the VOCs for different levels of road roughness.

2) Benefits from infrastructure improvements that improve the traffickability of a road. In this context, it is defined that a road has traffickability problems when the percentage of wet season traffic falls below 50% of the dry season traffic.

3) Benefits from infrastructure improvements that improve the passability of a road. In this context, it is defined that a road has passability problems when the road is completely closed to motorised traffic for either all or part of a year. As with 2) this will generally be a problem during the wet season. Table 2 contains the multipliers associated with traffickability and passability.

Note. For consistency of definition, if a road has a passability problem at a certain time of the year then it is deemed not to have a traffickability problem at the same time. If there is doubt, passability problems are more severe and take precedence.

Hence:

	Days with no problems
+	Days with traffickability problems
+	Days with passability problems
=	365

Table 1: Benefits to motorised transport from roughness reductions

Infrastructure quality	VOCs per vehicle kilometre (US cents)
Good Gravel (IRI 6)	45
Average (IRI 9)	52
Poor (basic access) (IRI 12)	57
Extremely poor (IRI 17)	75

Table 2: Factors associated with seasonal access constraints to motorised transport

Seasonal access constraint	Factor x VOC
Impassability	7
Traffickability	2

Non-motorised transport benefits

Many prioritisation techniques ignore benefits to non-motorised transport (NMTs) but research has shown that a considerable proportion of the transport burden is carried by NMTs and that they benefit from improved infrastructure. The parameters shown in Tables 3, 4 and 5 show that there are substantial benefits to NMTs where there is no existing transport services but these decrease to very small benefits where basic access is already established (ref).

The largest benefits are associated with extremely poor quality access where there are no transport services. Infrastructure improvements in these situations are most likely to lead to a change of transport mode i.e. from bicycle to truck. This type of modal change has the potential to deliver large transport cost savings.

The inclusion of NMTs, particularly headloading, allows gender inequalities in the transport burden to be addressed. In many parts of Ghana women carry the overwhelming proportion of headloads. This procedure recognises this and gives benefits to the increased probability of modal shift and/or the time savings associated with walking on improved infrastructure.

Table 3 Benefits to NMTs where infrastructure is improved from impassable or extremely poor access and where there are no useable transport services

	Benefits in US cents per km			
	Headload (>10kg)	Walk	Cycle (load)	Cycle (no load)
Good Gravel	11.4	2	5.4	0.5
Average Condition	11.3	1.9	5.3	0.4
Basic access	11.2	1.8	5.2	0.3

Table 4 Benefits to NMTs where infrastructure is improved from impassable or extremely poor access and where there are some existing transport services

	Benefits in US cents per km			
	Headload (>10kg)	Walk	Cycle (load)	Cycle (no load)
Good Gravel & Average Condition	2.2	0.5	1.1	0.1
Basic access	2.1	0.4	1	0.1

Table 5 Benefits to NMTs where infrastructure is improved from basic access

	Benefits in US cents per km			
	Headload (>10kg)	Walk	Cycle (load)	Cycle (no load)
Good Gravel	1.1	0.2	0.5	0
Average condition	1.0	0.2	0.5	0

Social Benefits

Many low volume rural roads are impossible to justify on purely economic grounds. However, many of the roads will provide an essential social and economic service in enabling communities to reach health facilities, markets, education and to visit friends and relatives. Problems with access to these services are very often greatest with the poorest communities and where physical access is extremely poor. To build these factors into the prioritisation procedure, four parameters have been included as shown in Table 6.

1) A social access benefit component has been included which gives a greater weighting to roads in high population areas. The social access benefit is calculated by multiplying the population index by the population that depend on the road by the average distance travelled along its length and by the change in transport costs for motorised transport (per km). It is recognised that both the adjacent population to the road section and the populations adjacent to other road sections (that also depend on the road) need to be included. (The Population Index refers to a multiplier of population, expressed in vehicle movement terms, to cover an additional traffic volume for a desirable minimum amount of social movement. The suggested value is 1 to cover 5 return trips per year, per person, in a vehicle taking an average of 10 people.)

2) A poverty benefit component has been included which gives a greater weight to roads which run through the poorest one third of districts (as listed by the Common Fund Allocation Procedure). The poverty benefit component is calculated through the use of a poverty weighting factor that is multiplied by the social access benefit component.

3) A benefit component for isolation from health facilities has been included. As with social access and poverty, this benefit component is population dependent. The benefit component is calculated by multiplying an 'isolation from health facility' index by the social access benefit component. Where communities have identified isolation from health facilities as a key factor and where the midpoint of the road is more than 10 km from a health facility, this benefit component will apply.

4) A benefit component for isolation from markets has been included. Isolation from markets was highlighted through consultation with the communities as being of highest concern. Where communities have identified isolation from markets as a key factor and the midpoint of the road is more than 10 km from an urban market, this benefit component will apply. In this case the 'isolation from markets' index will be multiplied by the sum of motorised and non-motorised transport benefits.

Table 6 Social criteria indices

Social criteria	Social index characteristic
Social Access (Population)	1
District Poverty (Yes/No)	0.5
Isolation from health facilities (Yes/No)	0.5
Isolation from markets (Yes/No)	0.1

Calculating the Prioritisation Index

The Prioritsation Index is calculated as follows:

$$\text{Prioritisation Index} = \frac{\text{Total Traffic Benefits and Social Benefits}}{\text{Engineering Costs}}$$

For each road two different Indices are calculated based on the benefits and costs from the provision of access, and the benefits and costs from full rehabilitation.

Estimating the Costs of Road Improvements

Because the procedure is based upon a benefit:cost ratio, it is necessary to estimate the cost of the road improvement works. Since local resources and capacity are limited, it is necessary to survey a road and estimate costs in a minimum of time and in a straightforward manner. It is felt that this survey method should permit between 20 and 50 kilometres to be surveyed and costed in a day after a short period of training, depending on whether the surveys are carried out in the wet or the dry season.

The procedure is used to prioritise one road over another. However, as explained above, the procedure is also able to indicate the most appropriate level of improvement – the provision of reliable, year round access or full rehabilitation to provide access and reduce roughness.

The Cost Estimation Survey is based upon the identification of the Access Category of sites along the road. Access Categories are defined as follows.

Access Category A
This refers to sites where, for local vehicle types:
- Year round access is impossible even in an emergency.
- Road users are in danger of injury.
- The road is under water for time periods of more than two consecutive days.

Access Category B
This refers to sites where, for local vehicle types:
- Year round access is possible, but unreliable.
- Access is likely to be lost in the near future.
- Road condition is likely to deteriorate as each vehicle passes.
- Road condition is likely to deteriorate as each rainstorm passes.
- The road is badly eroded.
- Motor vehicle speed is reduced to below normal walking speed.
- Cyclists are forced to dismount.
- Vehicles are liable to damage as they pass.

Access Category C
This refers to sites where, for local vehicle types:
- Year round access is possible, and reliable.
- Road condition is stable.
- Deterioration is unlikely in the near future under existing conditions.
- Surface roughness is not enough to slow motor vehicles to below walking speed.

The use of the term ‘local vehicle types’ refers to the need to assess problems and provide solutions on the basis of the vehicles which will use the road. A truck with a 2.4 metre axle is used as the standard vehicle for designing roads in Ghana, although this could be reduced on roads where such trucks are very unlikely to travel. However, it must be noted that improved access is likely to generate more, and heavier, traffic and that subsequent size limitations may prove restrictive. A degree of prediction is required.

During the survey, the road is divided into sections of variable length, but of uniform condition. For instance 50 metres of eroded carriageway may be followed by 2 kilometres of corrugations. Each section is allocated a single solution (comprising a set of activities), for instance grade, clear drains and cut grass, or construct a culvert and dig all necessary drains.

The procedure states that for any road access is provided by treating all sections of Access Categories A and B, while the road will be fully rehabilitated by treating all sections of Access Categories A, B and C. Therefore grouping all sections by Access Category, multiplying the recorded quantities (for example, length of grading, area of bush clearing or volume of embankment) by unit rates, and adding up the costs will give the cost of access provision or rehabilitation.

It is implicit in the procedure that improvement works, when required, are constructed to a consistent high standard and robust to an excess or rain or traffic. Access provision does not imply lower quality work than rehabilitation – it just implies that works are carried out where necessary to provide access rather than to reduce roughness. It is acknowledged that the isolated nature of accessibility works can cause problems. For example, many parties – road authorities, rural communities, and contractors – often believe that users will consider that a poor job has been done. Also contractors find accessibility works difficult to manage profitably. The decision is ultimately down to those involved in the programme, but it is felt that the trial described below demonstrates that, when issues are openly discussed, the benefits of low cost widespread access will be accepted.

A bridge may cost more than a length of gravelling, but will last longer and have lower maintenance costs. To account for the long term benefits of durable but initially costly structural works, all such costs are halved at this stage in the calculation.

These costs are then divided into the calculated benefits (rehabilitation gives additional benefits of reduced VOCs) to give the prioritisation index for two levels of improvement on the road. The higher of the two indices is then used in the technical ranking at District level and will determine, if the road is selected, whether it is provided with access or is fully rehabilitated.

The dangers of the survey method include inaccurate unit rates, inadequate coverage with a limited list of the available solutions, and errors in assigning Access Categories. The initial reaction from the trial was that the costs, even though intended purely for cost comparison, would be accurate enough for budgeting purposes, although more complete feedback will follow once the improvement works begin.

Assessing the Condition of the Road

The prioritisation procedure calculates the benefits which come from the change in road condition. The benefits depend upon the duration of the periods of impassability and traffickability problems and upon the roughness of the road. The most accurate ways to record these periods would be to carry out frequent surveys, use historical records or ask local people and the most accurate way to record road roughness is through measurement. However, surveys and measurement are very costly, records are unlikely to exist and memories can often give spurious results. It was decided to provide means whereby impassability, traffickability and roughness, if not recorded elsewhere, could be estimated. The Cost Estimation Survey data appeared to provide the best information for this.

Impassability

A single site can render a road impassable. The duration of the impassability depends upon the severity of the most severe site along the road. The sites which cause impassability are normally water crossings with no structure present. Therefore the road condition survey identifies the water channel with the greatest cross sectional area since depth and length both contribute to impassability. Passability problems are unlikely to occur outside the rainy season, therefore, as the cross-sectional area increases, the road is deemed to be impassable for a greater proportion of the rainy season. The method was calibrated as follows, including an acknowledgement that a carriageway site of Access Category A will cause some impassability.

Table 7 Impassability calibration

Cross sectional area (m2)	0 – 1	1 – 3	3 – 10	> 10	C/W site of Cat A
Proportion of rainy season	¼	½	¾	1	½

Traffickability

A road is said to have traffickability problems if its poor condition deters a significant number of vehicles from travelling. The problems normally come from an accumulation of sections. A single difficult section might deter a few vehicles but many such sections will deter more. Therefore as part of the road condition survey the length of sections of Access Category A and B are summed and divided by the total road length. Since traffickability problems are associated with the rainy season, as this proportion increases, the road is assumed to exhibit traffickability problems for a greater proportion of the rainy season. The method was calibrated as follows.

Table 8 Traffickability calibration

L(A+B) / Ltotal (%)	0 – 10	10 – 30	30 – 50	> 50
Proportion of rainy season	0	¼	½	¾

In the procedure, impassability takes precedence over traffickability problems. So if a road is deemed impassable for three months and has traffickability problems for four, the calculations are based on three months of impassability and one additional month of traffickability problems. If the road is impassable for four months and has traffickability problems for three, the calculations are based only on four months of impassability.

Roughness

Road roughness directly affects the speed at which a vehicle can travel comfortably. Therefore the road condition survey records the time taken to travel the road. The speed is then correlated with roughness. This correlation will depend upon whether the survey is carried out in the wet or the dry season. The dry season correlation for a four wheel drive vehicle is as follows.

Table 9 Roughness correlation

Description	Good gravel	Average	Poor	Extremely poor
IRI	6	9	12	17
Speed (kmh)	> 60	40 – 60	20 – 40	< 20

These three relationships were calibrated using experience of similar situations elsewhere. However, they can only be proven using local information for local conditions. It is important that such calibrations are established with care and reviewed as soon as possible.

The Road Condition Survey also provides assistance in predicting the road condition after improvement. If access is provided, all passability and traffickability problems are deemed to have been solved, while roughness decreases by a single level. If the road is rehabilitated, all passability and traffickability problems will be solved and roughness will decrease to the ‘good gravel’ level.

Trial in Nanumba District

In April and May of 2000 a trial was carried out in Nanumba District in Northern Region, data for which is given in Annex 2. The trial followed the procedure described above. The budget for the round of improvements was $900,000. There had been a recent programme of Guinea Worm eradication, from which population data were taken for use in the technical analysis.

Table 10 presents the main data and results from the trial. Abbreviations have been used for the road names. Side and terminal populations are combined in the table. Those living at the proximal end of a road are not included.

Table 10 Data and prioritisation results from the Nanumba trial

Road	Area	Length (km)	Pop.	Motor traffic/ day	Costs access ($'000)	Costs rehab ($'000)	Impass. (weeks)	Traffick. (weeks)	P.Index Access	P.Index rehab	PI ranking	District ranking
D-W	Kumbo	12.9	2323	4.1	145	180	8	12	0.225	0.198	15	4
C-U	Kumbo	24.7	3011	6.4	216	299	12	8	1.296	0.920	2	1=
B-N	Kakuhi	16.7	1790	1.6	102	246	12	0	0.573	0.208	9	9
B-S	Kakuhi	5.9	1009	24.3	28.7	47.4	0	8	0.567	0.445	10	16
Y-J	Varibiegu	8.7	397	4.1	196	249	12	4	0.202	0.151	16	14
J-J	Varibiegu	14.0	4096	14.3	268	374	12	4	0.700	0.480	6	5
B-J	Nabanga	20.4	2269	5.7	118	273	12	4	1.117	0.475	3	6=
B-Ku	Nabanga	36.5	5294	2.2	153	284	12	8	1.435	0.832	1	8
B-Ko	Darikum	5.6	2891	17.6	10.4	47.6	0	0	0.872	0.255	4	13
L-B	Darikum	8.8	3640	34.2	51.0	95.9	0	0	0.358	0.295	12	12
N-D	Dachamba	13.9	3445	3.3	55.2	141	4	0	0.581	0.244	8	10
N-K	Dachamba	14.1	2358	7.7	164	250	12	8	0.872	0.573	5	11
W-J	Sunkuli	12.9	3123	9.9	145	181	8	12	0.446	0.394	11	3
W-C	Sunkuli	16.7	1276	6.3	365	449	12	4	0.288	0.223	14	1=
A-A	B-Kadibu	1.4	2818	13.1	34.2	39.4	8	4	0.294	0.282	13	15
A-P	B-Kadibu	18	2818	13.1	184.5	270	8	8	0.650	0.470	7	6=

The District ranking (derived at the earlier District meeting) selected the three roads shown in Table 11 for access provision. These are 55 kilometres long and provide access to 8,383 people.

Table 11 Road selection using District ranking

Ranking	Road	Length	Population	Cost	Cumulative Length	Cumulative Population	Cumulative Cost
1	C-U	24.7	3011	216	24.7	3011	216
2	W-C	16.7	1276	365	41.4	4287	581
3	J-J	14.0	4096	268	**55.4**	**8383**	**849**
	B-J	*20.4*	*2269*	*118*	*75.8*	*10652*	*967 (over budget)*

The Prioritisation Index (derived from the technical analysis) selected the five roads shown in Table 12 for access provision. These are 95 kilometres long and provide access to 17,650 people.

Table 12 Road selection using Prioritisation Index

Ranking	Road	Length	Population	Cost	Cumulative Length	Cumulative Population	Cumulative Cost
1	B-Ku	36.5	5294	153	36.5	5294	153
2	C-U	24.7	3011	216	61.2	8305	369
3	B-Ko	5.6	2891	10.4	66.8	11196	379
4	N-K	14.1	2358	164	80.9	13554	543
5	J-J	14.0	4096	268	**94.9**	**17650**	**811**
	A-P	*18.0*	*2818*	*184*	*112.9*	*20468*	*995 (over budget)*

The technical analysis therefore avoids expensive roads such as W-C and so is able to provide access to more people within the same budget. When the results were presented at the public hearing, those present were persuaded by the technical ranking, the roads in Table 12 providing a better overall solution than the District choice. However several people argued strongly for the inclusion of road A-P. This road involved people wading for about half a kilometre through water. However this issue was not given a high priority at the earlier District meeting. It was agreed that, despite the analysis and previous workshop, this was an important issue and should be dealt with separately.

Points of note in this example are the following:

- The provision of access ranks higher than rehabilitation on all roads. This is because of the low levels of traffic in the District. Even 34 motor vehicle per day will not generate sufficient VOC reductions to justify expensive carriageway works. It was proposed that an initial DFR intention to reserve 40% of the funds for full rehabilitation should be dropped.

- The principle of using lower levels of improvement (access provision rather than rehabilitation) to enable the benefits to be spread more widely was generally accepted.

- Two roads with relatively high levels of motorised traffic (B-S and L-B), were not ranked highly. This is because they have few passability and traffickability problems. Accessibility is already high and resolving these problems gives little additional benefit.

- Road Y-J has high traffic for its population. It is likely that this traffic is through-traffic from areas far beyond the end of the road. The lack of social benefits and the high cost of a bridge give this road low priority.

- Bridges add significantly to the cost of the improvements, especially for the provision of access. In many cases they will give the road a low ranking and prevent its selection. Culverts over small water courses are most cost effective at access provision.

- The general view expressed was in favour of labour based work methods to give income earning opportunities.

Experiences during the trial led to a number of changes to the procedure. These include the division of improvements into the two rounds as described above, and a realisation that accessibility works may be most appropriate for rural Districts. With these changes, the procedure was well received. Road improvements were planned for the roads selected by the Prioritisation Index and the procedure was used in the remaining 8 Districts.

Other outcomes

Since the prioritisation procedure was produced a number of events have indicated its acceptance and usefulness. DFR has made a number of decisions relating to the technical standards it uses for feeder roads, but has left the procedure broadly unchanged.

Some time after the road surveys, Nanumba District began a programme of rural electrification. With no external prompting, the District Administration adapted the principles behind the procedure for electrical prioritisation, demonstrating a high degree of ownership and ability.

The second round of improvements (described above in Step 5) incorporates a District poverty weighting factor. It is planned that a District road condition weighting factor will also soon be included to give weighting to Districts where the roads are in an overall poor condition.

Conclusion

This paper has described the establishment of a procedure to prioritise feeder road improvements in nine Districts in Ghana, and has described a trial of the procedure in one District which led to its acceptance and use in the remaining eight Districts. The procedure combines economic benefits with social benefits and divides the sum by improvement cost in order to rank roads by benefit:cost ratio. It uses extensive consultation before and after the technical analysis in order to reflect the needs of all rural communities and give those communities a strong sense of involvement and ownership. The paper also gives details of the methods used to calculate the benefits from road improvements, estimate the cost of those improvements and assess existing road condition.

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Annex 1 List of Key Stakeholders

Community-based groups
- Opinion leaders – chiefs, elites,
- Women's leaders
- Men not in leadership
- Women not in leadership
- Ethnic minorities

Occupational groups
- Traders in agricultural produce
- Small-scale fishermen in riverside settlements
- Fish smokers in riverside settlements
- Transport operators

Users of basic social services
- Patients and carers (health centres)
- Students (vocational training institutions)

Formal governance institutions
- Senior executives of District and MPs
- Other arms of District Assembly

Technical agencies
- Roads agencies
- Other technical agencies/ agents of DAs

Others
- Contractors
- Industrialists
- NGOs operating in the District
- DFID
- Other donors operating in the District

Annex 2 Local Government Statistics for Nanumba District, 2000

District population:	approx. 170,000
Area Councils:	8, plus 1 Town Council
Unit Committees:	109
Assembly-Persons (APs):	68, of whom 48 are elected
Population of average Unit:	approx. 1,500 (?): *500-1,000 prescribed*
Population of average Area:	approx. 20,000
Membership of Area Council:	approx. 20
Size of Unit Committee:	15 members
Units per Area Council:	12