

Harare, Zimbabwe

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Regional Seminar Proceedings 1993

INTRODUCTION

The seminar was held from 27 September to 1 October in Harare with a total of 80 participants from 18 countries. The participants consisted of ILO technical advisers, counterpart ministry staff and consultants engaged in labour-based roadworks. The meeting was hosted by the Zimbabwe Institute of Civil Engineers.

This seminar was the third in a series of reviews of current practice in labour-based technology, and was organized and conducted by the ILO ASIST¹ team, which is responsible for the promotion of this technology in Sub-Saharan Africa. The first seminar was held in Mbeya, Tanzania in 1990 with 21 participants from 6 countries. The second seminar took place in Mofale Hoek, Lesotho, in March 1992, with 36 participants from 14 countries².

The purpose of these seminars is to bring together labour-based practitioners from the region to discuss and exchange between the various country programmes, thereby improving the application and efficiency of labour-based methods in road construction and maintenance.

Four major topics related to labour-based road works were discussed during this seminar, namely appropriate tools and equipment, small-scale contractor development, the involvement of women and the Technical Enquiry Service of the ASIST project. A one-day field trip was organized to present the labour-based road construction and maintenance programme of Zimbabwe.

Tools and Equipment

Although labour-based methods emphasize an extensive use of labour rather than equipment, a significant part of the costs and attention of project staff is devoted to the use of equipment. Tools and equipment on labour-based projects constitute only 20-30% of the total costs on road construction and rehabilitation projects. Furthermore, appropriate and good quality equipment is essential for the achievement of high production rates and good rates and good quality work, as well as a proper working environment. The Technical Enquiry Service of ASIST tries to collect and disseminate available information and experience on this topic, which has proven to be an issue of high concern for project managers.

Small-scale Contractor Development

Traditionally, most labour-based road projects have been Government-executed work schemes. However, in recent years, the private domestic contracting industry has become more and more involved with this programme. This session presented the experience from labour-based road programmes where the roadworks have been successfully carried out by domestic small-scale contractors trained in the use of labour-based road construction and maintenance methods.

¹ASIST, Advisory Support, Information Services and Training in Labour-based Technology, a regional programme funded by NORAD, SIDA AND SDC.

²Labour-based Technology, A Review of Current Practice, Volumes 1 and 2, 26 - 28 February 1990, Mbeya, Tanzania, ILO, Geneva.

The Technical Enquiry Service

The ILO has designed a programme, funded by donors, to provide advisory support, information and training (ASIST) to labour-based road construction and maintenance programmes in Sub-Saharan Africa, with the main objective of increasing the efficiency of the management of the programmes. One of the outputs to achieve this goal is to provide a service of information collection, research, collation and distribution on subjects related to this technology. A Technical Enquiry Service within ASIST has been established to provide these services.

During this session the participants were briefed on the current status of TES and the type of services which can now be provided. Finally, the participants were requested to prioritize their information and research requirements.

To date, the Technical Enquiry Service has acquired and catalogued 1580 publications relating to labour-based technology, which are kept in a computer database. This information is available upon request for labour-based practitioners in the region.

Following a recommendation from the Lesotho meeting, TES now produces a labour-based journal covering a specific topic in each issue. The journal covers information related to one specific topic in terms of ongoing research and development, available literature, recommended reading, key contact persons, presentation of project activities, etc. The first issue of the ASIST journal was completed in May 1993 and a second issue is expected in November this year. The topic for the next issue will be appropriate design and use of tools and equipment for labour-based roadworks.

Women and Labour-based Roadworks

Labour-based road programmes have always made an effort to promote the employment of women. This session provided a review of how the various programmes have achieved this objective and how it has been received in rural societies and by project management. Finally, it was also discussed how this issue can be secured when involving the private sector in the execution of the roadworks.

Site Visit

The participants had the opportunity to visit some of the activities of the labour-based road construction programme in Zimbabwe, during a one day visit to road sites in Mutoko District.

Plan of Action

During the last day of the seminar, the participants were organized in groups, each of which prepared a set of recommendations for future action in relation to the above topics. During the final plenary discussions at the end of the day, these recommendations were further discussed and prioritized for ASIST follow up.

II STRUCTURE OF THIS REPORT

This report follows the order of the sessions as they took place during the seminar. The comments and questions related to the papers presented are summarized in a separate chapter after the presentations under each session. These summaries also include the general findings of the plenary discussions which

evolved after the various presentations. The findings of the discussion groups are presented as a separate chapter under Session 7.

Due to time constraints during the seminar, all papers were not presented in their full form. Nevertheless, this report presents the full versions of all the papers prepared for this event.

III ACKNOWLEDGEMENT

The ILO/ASIST secretariat to this seminar appreciated the crucial assistance they received from the project staff from the Zimbabwe labour-based programme in the organization and support of the 4-day event, as well as the Zimbabwe Institution of Engineers who hosted the seminar. Furthermore, we would like to thank the participants for their efforts in travelling and contribution to this seminar, and their employers for allowing for their absence and travel costs.

Regional Seminar Proceedings 1993

Handtools and Equipment - The Current Scene

By Collins Makoriwa, ILO National Professional, ASIST, Kenya

SYNOPSIS

This paper looks into the current state of affairs of hand tools and equipment employed in labour-based projects in sub-Saharan Africa. Special emphasis is given to the equipment used in Kenya, Botswana and Lesotho.

Possible steps are suggested to improve current problems. These solutions are general and may not apply to all places.

Hand tools

Preamble

Through the rest of this paper, the term tools will be used to refer to hand tools whilst the term equipment will refer to machinery and its peripheral attachments.

Hand tools are the crux of the issue in labour-based roadworks. They are the main items used by labour in the construction and maintenance of roads. It is possible to construct labour-based roads using labour and tools only, but it is not possible to construct these roads using labour and equipment without the use of tools.

General

In spite of hand tools being so crucial to labour-based road construction they have not been given the attention they deserve. Generally, the labour-based road construction industry is agreed upon the types of hand tools to be used for various operations. What is generally lacking is an appropriate quality standard for the hand tools employed and a specification of the dimensions of the various hand tools.

Several institutions have drawn up standards for hand tools (BSI, ILO etc.). These standards are generally not met by projects due to several reasons. The main ones are:

Lack of awareness of the impact of good tools on the labourers' output

Incompetent purchasing officers

Good tools are not available

Legislation restricting importation of quality tools.

Lack of awareness of the impact of good tools on the labourers' output

This is actually the main reason why the tools used today in many projects are in the state they are in - despicable. This lack of awareness of the impact of good quality hand tools spreads from the project managers to the labourer using the tools. The level of awareness is obviously different.

Of course this is not to say that project managers and other senior practitioners are unaware that the quality

of the tools have an impact on the productivity of the labourer. What many of these people often are oblivious to is the impact of good quality tools on both the project costs and output.

The following example will illustrate the minimal effect an increase of tools prices contributes to the project costs.

Wages per day 80 Kshs

Cost span of spade type A 200 Kshs

Life span of spade type A 4 months

Cost of spade type B 400 Kshs

Life span of spade type B 4.5 months

Cost of mattock 400 Kshs

Life span of mattock 12 months

If spade type B is alleged to increase the productivity of the labourer, then by how much does the productivity have to increase to justify the purchase of spade type B?

Assume that in 4 months there are

$$= 4(\text{months}) * 4(\text{weeks}) * 5(\text{days})$$

$$= 80 \text{ working days}$$

If the task rate is 3.0 m³ of soil /day, then:

volume of earth moved by spade in 4 months

$$= 3 * 80$$

$$= 240 \text{ m}^3$$

The cost of labour to move this 240 m³

$$= 80 * 80$$

$$= 6400 \text{ Kshs}$$

The cost of tools to move 240 m³ of soil is

(Sample calculation for spade type B: $4/4.5 * 400 = 355.60 \text{ Kshs}$)

Tools Cost in operation Kshs

Spade A 200.00
Spade B 355.60
Mattock 133.40

Thus the excess costs incurred due to use of spade type B is 155.60 Kshs.

The use of spade type B can be justified if during the four months it is employed it can save 156.60 Kshs. Where would this saving be made?

Now 155.60 Kshs is about two days labourer wages. Thus if the user of the tool is able to finish the task that would take him 80 days then the purchase of spade B is justified.

In this example a 100% increase in the price of a spade can be justified if it results in a 2.5% increase in productivity. A mere increase in the task rate from $3\text{m}^3/\text{day}$ to $3.075\text{m}^3/\text{day}$!

It is this sort of impact of the quality of hand tools on the productivity that needs to be imprinted in the minds of the policy makers in the labour-based road construction business.

In the above example even if the increase in cost results in an increase of productivity that just breaks even, there are non-quantifiable benefits to be attained. These would typically be less fatigue, less wear on the user's hands, increased motivation for the labourer etc. If the spades actually lasted longer (as would be the case in reality), additional benefits would include less hassle of tools procurement and replacement.

After following this computation we are forced to conclude that the typical excuse of having no money to purchase good quality tools does not hold water.

What about the lower level of people engaged in this labour-based road construction business? These people usually have to contend with what they have available. This is not to say that they have no role to play. In fact theirs is as important as the decision to buy appropriate tools. Field workers need to be taught the benefit of keeping their tools in good condition.

The productivity of the tool increases by as much as a factor of two when the tool is actually kept in good shape. Thus pangas, hoes, pickaxes etc. have to be sharpened and kept sharp. It is thus in the interest of all parties to ensure that the hand tools are kept in good shape. A system needs to be set up on every site to ensure that tools are maintained in order. It is also important to train the labourer on what the attributes of good hand tools are.

Incompetent purchasing officers

Often, the actual purchase of equipment is done by administrators who have no technical knowledge about either the tools themselves or the job they are to be used for (e.g. government tender boards etc). As a result, their decision is often based solely on the price.

Good tools are not available

This is a tricky situation although all may not be lost. It is important to realise that most of the tools are manufactured are intended for use in the agricultural industry (with the exception of mattocks and

pickaxes). They are thus of sufficiently good quality for this purpose.

In such a case the first thing to do is to identify a local firm with the capacity to produce good quality hand tools. Usually if the batch of hand tools to be procured is substantial, the firm will be willing to adjust the standards of the hand tools.

In Southern Africa, where there is a big mining industry, which demands and provides an effective market for good quality hand tools, there is a big difference in the quality of the hand tools available on the market. Nonetheless, if arrangements are made to purchase a bulk order from a single manufacturer, it is often possible to ensure that the hand tools supplied will be of sufficiently good quality. Thus the market as a whole cannot adjust its standards for the road construction industry but a single manufacturer can usually meet the standards.

Alternatively, one can draw up a tender document with explicit quality requirements that will result in the tendering firms actually increasing the quality of the hand tools.

Legislation restricting importation of quality tools

When all attempts to obtain locally manufactured hand tools of appropriate quality have failed then one has to turn to the foreign market. The main problem is usually government legislation restricting the importation of such items.

Technical issues

A good hand tool basically is a tool that will aid the person performing the specified task to achieve the task with the least possible effort and with a minimal cost to the project.

What are the attributes of a good tool?

The user will not have to expend unnecessary effort due to a poor posture, poor grip etc. It is also imperative that a good tool lasts a reasonable length of time if it is to meet the second criterion. Although the time the tool lasts has been shown to have a relatively small impact on this issue.

Several studies have been conducted into the performance of hand tools and they all clearly show that the prime object to be met by good quality hand tools is that they should increase the productivity of the labour. This is because hand tools contribute a minimal portion to the cost of labour-based road construction.

Handles

The various aspects of the handles of hand tools that need to be taken into consideration when purchasing are:

the shape (variation of X-section along length),

finish and

length.

The main function of a handle is to enable the user of the tool to apply the tool head to the job in hand. The shape of the handle thus has to facilitate this procedure. The sketches below show appropriate hand tool handles. These dimensions should not be taken as absolute but rather as guidelines highlighting the good

aspects of handles.

Cross-section			Length			
Point (1)	Point (2)	Point (3)	Head A	Waist B	Grip C	Overall L
52 x 78	40 x 66	30 x 42	165	235	500	900

The finish of the handle saves excessive wear on the user's hands. A good tool handle should be sanded and preferably varnished. The wood thus has to be of a type that does not splinter. The handle should be sufficiently long to result in an ergonomic posture of the user.

For spades and shovels, the best handles seen are the type made of iron which can either be welded onto the head of the tool or cast out of one piece. A common problem is the weakening of various elements of the spade. Thus the heads and handles of spades if riveted to the handle tend to loosen with use.

Tool heads

Spades also have to be sharpened on the outer edge of the blade prior to use. If the spade is then used on sandy soils (highly abrasive) the spade will remain sharp throughout.

Hoes, mattocks and pickaxes also have to be sharpened. Here one has to be careful about the angle the blade of the implement is sharpened to. If the blades/points of these implements are sharpened to a small angle the result is a rather weak edge.

It is also important when purchasing these tools to ensure that the eye of the tool is oval and tapered. This ensures that a reasonably tight bond can be achieved between the handle and the head.

Equipment

Preamble

The use of various equipment in labour-based road construction programmes has a long history-plagued with problems!

The technology is an intermediate between heavy construction and standard agricultural equipment. This cat is what causes the procurement problems for labour-based practitioners. There are few standard designs that adequate fro the industry. Today, standard agricultural tractors are employed for hauling and modified agricultural trailers or trailers based on agricultural designs are widely employed by the industry.

The type of equipment employed varies from project to project but basically these are the equipment types employed in most labour-based project.

tractors,
trucks,
trailers,

towed graders,
browsers and
roller (dead-weight/vibrating, towed/self driven).

General

In an attempt to solve various problems associated with equipment use in labour-based works, various things have been tried. The current trend is to pass more of the responsibility to the private sector by:

hiring of plant and equipment from the private sector,
giving out the maintenance task to private workshop or
using contractors to do the jobs that require equipment.

The hiring of equipment from the private sector tends to result in more efficient use of the equipment in question. Among the equipment that could be hired from the private sector are lorries and rollers. There are other types of equipment that may be difficult to hire from the private sector e.g. towed graders. This is because such equipment is not commonly used in other industries and thus is not widespread.

For one to be able to hire equipment at a reasonable price there must be sufficient supply of the piece in question. Thus if there is only one grader in a country, the hire cost for that grader may be more than the computed price of owning one. There also must not be a competing industry offering high prices for the equipment. This has been a problem in Kenya with the labour. During harvesting time, the farms pay relatively better than labour-based works and thus all the road workers "disappear" into the farms.

An intermediate between fully renting equipment is to own equipment but to have it serviced by outside workshops. The principle advantages of this arrangement are:

less down time

no need to stock a huge bastion of spares parts which may never be used

Irrespective of the policy adopted when purchasing or receiving equipment grants, one has to avoid any odd makes of equipment. Thus it is no use buying a very robust reputable make of tractor if you will be the only user of that make in the country. In fact the most important thing when purchasing equipment apart from the operating costs is the availability of spares.

If a project has equipment it is imperative that a regular servicing schedule is drawn up for each piece of equipment.

Technical issues

Tractors

Tractors are employed in labour-based works mainly to haul various implements. The main uses are to haul trailers, browsers and towed graders. A problem is that the standard agricultural tractor is not designed for rigorous haulage purposes and thus run out of life after only five years use in the labour-based road construction business. On the other hand the same tractors last about seven to ten years when employed in other industries. The right piece of equipment to use for these jobs should be haulers specifically designed

for the job.

Why then are tractors used instead of haulers? The main reason is that haulers cost much more than tractors. With an average cost factor of two times the cost of an average tractor, many project managers find it difficult to justify the cost of the hauler.

The other feasible option is to use lorries instead of the tractor-trailer combination. Here the other disadvantage is that the truck is not a very versatile implement. A truck cannot be efficiently used to haul other paraphernalia that are useful in labour-based road construction sites. Thus while the tractor may be used to tow trailers, bowsers, towed graders, rollers etc, the lorry cannot be effectively used except for bed haulage. The cost of trucks also does not compare favourably with the cost of tractors.

The other disadvantages of the other system is that lorries are also not very robust animals. They require more care than tractors and are susceptible to damage due to poor handling because for several peripheral devices.

Trailers

Trailers are in use in several labour-based projects. They are used to haul gravel and for camp support activities. They have been in use in labour-based road construction programmes for about 20 years. Ironically several designs are still being tried out with a very high failure rate.

The road construction industry is faced with a problem because standard agricultural trailers are too weak to be used for labour-based roadworks. On the other hand, standard trailers, robust enough for labour-based works are way overboard for small labour-based projects. Thus several projects have to arrive at a suitable design and have it trailer-made for the project.

Most projects use trailers of size 3m^3 to 4m^3 . This size is appropriate if the haulage distances are small—typically less than 4 km. As the haulage distances increase, either the volume of the trailer has to be increased or the haulage speed increased to keep the exercise economical. Here is where usage of trucks becomes more economical. Recall that 3.5m^3 of soil weighs about 5.2 tonnes. Small trucks have typical capacities of seven tonnes. A standard agricultural tractor has a maximum speed of slightly over 20 km/h. A typical seven tonne truck will comfortably do 40 to 60 km/h on country roads, speeds unattainable by a tractor even when unhitched.

There are thus two options for projects faced with long haulage distances:

use lorries for haulage of gravel or

use tractors with either increased speed and or larger trailers attached.

If the project manager decides to implement the first option, he will immediately solve all haulage problems. On the other hand he loses the dexterity of the tractor. Usually he will also have to contend with higher maintenance costs.

The second option is a bit tricky because even the "fast" tractor/hauler will usually do a maximum speed of only about 30 km/h. In fact with tractors, the limiting factor when it comes to speed is the driver's comfort. In fact experiments have been conducted in this field in Kenya on gravel roads and it was observed that above 18 km/h the drivers have to stand up because the ride becomes too rough.

"On slopes from 0-5% pulling an empty trailer, the speed is limited by the driver's ability to stay in the

seat. This speed limit depends on the condition of the road surface. On the test roads, fairly smooth RAR's or MR's this speed was 16-18 km/h."¹

1

Ministry of Public Works Roads Programme
Minor Roads Programme
Technology Unit Report TR 2
Tractor Field Trails

A more rational approach to the issue would be to employ trailers of larger capacity—say 6m³. The problem is a monstrosity of such dimensions would weigh about 12.8 tonnes. Two tonnes for the unladen trailer and 10.8 tonnes for the payload. This type of trailer cannot be towed by the standard 65 hp hauler, and a larger hauler of capacity > 110 hp is required to haul this load. If this tractor/hauler is to be used to haul gravel only, then the investment will be difficult to justify. On the other hand if the hauler/tractor is to be used for other operations, especially gravelling in heavy laterite soils, then purchase of the hauler can be justified.

Also to be considered is the available turning space for the tractor/trailer combination. Hence for projects situated in hilly terrain there may not be sufficient turning space for a tractor/trailer.

Trucks

Trucks are not commonly employed for haulage of gravel in labour-based projects except in Lesotho where they are extensively used. This may be due to the very hilly terrain (no turning space). Small rucks of seven tonne capacity are definitely more productive and economical than the tractor/trailer combination especially for long distance haulage (> 5 km). The only disadvantage of employing trucks is that the truck cannot be used for other purposes such as towing a grader etc.

Roller

The type of roller used in labour-based works is generally a huge dead-weight roller of between two and five tonnes. Self propelled vibrating hand rollers are widely used in Ghana and Lesotho. In several countries no compaction is done on the gravel deposited on the carriageway.

Dead weight rollers produce results that are comparable to vibrating roller if a sufficient number of passes is made. It is important to ensure that the size of the roller specified when purchasing is proportional to the rate of work output. Nevertheless experience has shown that very small roller are usually not able to run for sustained periods of time. An example is the Bomag range of rollers. These rollers are excellent but on labour-based road construction sites, only the Bomag 90S has proved robust enough to survive the tasks it is applied to.

Hitches

There are basically three types of hitches available:

ball and socket joint,
pin and eye,
hook and eye.

The ball and socket joint is the most robust of the three types of eyes. It needs to be regularly checked to

ensure the cup bushes in the socket are not worn out. It is also the most expensive (US\$ 1000 in Europe). It cannot be fabricated in a small workshop. A ball and socket arrangement is usually needed for heavy towed equipment e.g. towed graders.

The pin and eye arrangement is simpler than the ball and socket joint and the various components can be fabricated in a relatively simple workshop. This type of hitching arrangement allows the pin to wobble in the eye, otherwise when the trailer applied a torque on the tow bar, detrimental stresses would be induced in the whole hitching apparatus.

The various elements in the hitch could be fabricated such that either the towing eye fails under stress (end bearing failure) or the towing pin fails. It is safer to choose the former because if the pin shears, the failure is usually abrupt unlike end bearing failure which occurs slowly with time.

Some attempts have been made at fabricating towing eye units with a bush in the eye. The idea is to restrict the wear and tear to the bush only so that only the bush will have to be replaced. The problem is that for an unbraked trailer, the towing pin is constantly hammering against the towing eye and this constant jarring knocks out the bush in about two weeks of use. In Kenya the solution has been to simply cut the towing eye unit out of a steel plate 1" thick. This is then welded as it fails under end bearing stress, and after a few times of welding, the whole unit is replaced.

The eye and hook hitch is basically like the pin and eye except that the pin has been substituted for a hook. There are no advantages of having a hook instead of a pin especially if the hitching apparatus has a mechanism to prevent the tow bar from accidentally unhitching from the top of the pin or hook. In fact the problem with using a hook instead of a pin arrangement is that the hook cannot be fabricated in the workshop, whilst for the pin even a standard old king pin from a lorry or tractor can be used for the pin.

Anyway whatever the towing arrangement one goes for it is important to ensure that all towed apparatus is compatible with the tractor hitch.

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II. Handtools and Equipment for Labour-based Construction: Lesotho's Experience

This paper provides information on hand tools and equipment which the Labour Construction Unit (LCU) in Lesotho has used to implement construction projects by labour-based methods. It reviews research and development work undertaken by the LCU regarding compaction equipment, use of ox-carts and donkey panniers, cost comparison of haulage by tipper and haulage by tractor and trailer, improvement of existing hand tools and efforts to secure local manufacture of good quality hand tools suitable for labour-based technology.

Introduction

Efficiency of labour-based construction technology depends heavily on the use of suitable heavy duty hand tools and simple items of equipment. The tools should be suitable in shape, size, weight and balance, strength and sharpness and of good construction. Therefore it is very important for those countries which apply the technology to improve the design of their existing hand tools in order to raise productivity and enhance efficiency of the technology. Local manufacture of tools is very desirable in order to sustain continued improvement.

This paper examines the status of hand tools and equipment used in Lesotho to carry out labour-based construction projects.

Hand tools available in Lesotho

The hand tools available in Lesotho are all imported from the Republic of South Africa (RSA). The Labour Construction Unit (LCU), which is the Government department charged with responsibility to implement labour-based methods, buys hand tools from the local suppliers who import them from the RSA. The LCU labourers are very familiar with these tools from their previous employment in the mining and construction industries in the RSA. They are very skilful in their use. However, they are resistant to the use of new and strange tools such as the mattock.

Excavation only

So far, the pickaxe and crowbar are the only hand tools used for excavation work. They are very suitable for the dense non-cohesive and stiff and stony cohesive soils found in Lesotho.

The handle for the pickaxe is made from hardwood and its head weighs about 3 kg. The crowbar comes in small, medium and large sizes and measures between 1.5 m and 1.8 m long. One end is chiselled while the other end is either wedged or hammered. The weight varies between 7 kg and 11 kg.

Excavation and loading

the shovel has so far been the only tool used in Lesotho for heavy excavation of soft cohesive and loose granular material. It is an excellent loading tool for all materials except wet clay which sticks to the tool. There are two types: round and square nose shovel. The latter and the spade are seldomly used on the LCU construction sites. Long-handled shovels are rare and they are used only for desilting culverts.

Spreading

The shovel and heavy duty rake are used for spreading out fill material and gravel. The handle of the rake or spreader is made from metal tubing and its head is made from thick flat iron. The rake has about 16

prongs and each is about 75-100 mm long.

Compaction

Steel hand rammers are used for small compaction work. For large compaction work, the vibrating pedestrian-operated roller, Bomag BW-90s, is used. Compaction of restricted areas, such as beddings for culvert pipes where the BW-90s cannot be used, is done by a hand-operated compacting plate.

There is no animal-drawn compaction equipment in Lesotho.

Haulage

The wheelbarrow is extensively used for hauling distances not exceeding 200 m. There are two types in Lesotho: an ordinary household wheelbarrow which has a shallow and wider tray, and the construction wheelbarrow with a narrower tray. In 1988 the LCU introduced the third type, of Swedish origin.

For hauling distances over 200 m, the LCU uses a combination of tractor and trailer and tipping trucks; the latter being more economical and extensively used. There are no animal-drawn carts for haulage of construction materials even though there are many ox-carts used by farmers for agricultural purposes in the country.

Rock drilling and breaking

Tools for rock breaking are steel chisels in various sizes, stone (4 lb) hammer, crow bar, sledgehammer, and feathers and wedges. A skilful labourer can easily produce between 0.35 m³ and 0.5 m³ of broken sandstone by using a stone hammer and chisels. The sledgehammer alone is a good tool for breaking small stones and boulders. The crowbar is driven by hand into cracked rocks or boulders and then used as a lever to split the rock. Feathers and wedges are placed inside a line of holes drilled into a rock or boulder, and the wedges are sledgehammered in succession to split the rock or boulder.

Light equipment for rock drilling and breaking range from hilti drills, pionjahr and pacebrakers for small quantities of work. For large quantities up to 2,000 m³ of rock breaking, a 175 cfm or 250 cfm compressor is recommended. Similarly blasting is recommended as the most economical method of breaking rock when quantities are more than 2,000 m³.

Review of research and development work

With regard to hand tools and equipment suitable for labour-based technology, the LCU undertook the following research and development work:

use of dead weight concrete roller

use of ox-carts and donkey panniers

cost comparison of haulage by tipper and haulage by tractor and trailer

improvement of existing hand tools

local manufacture of hand tools.

Dead weight concrete roller

The first concrete roller was made on site and used to compact the runway of Seshote Air strip in

December 1977. It had a cylindrical shape of 45 cm diameter and 90 cm height. It was designed to be pulled by labourers. Gravel was watered to bring the moisture content to an optimum.

Compaction was done in layers of 75 mm. The compaction results on the final 15 cm layer were satisfactory after a reasonable number of passes. The gravel was of fine material.

The concrete roller was then used on a number of airstrips during 1978 but its use was later discontinued for the following reasons:

1. It was only good for fine gravel which is rarely found in Lesotho.
2. It required a large number of labourers to push it on gradients exceeding 4%. Since the terrain in Lesotho is rugged, the land is characterised by gradients of more than 4%. So this roller was found to be unsuitable.
3. One-tonne pedestrian vibrating roller was easily available and it was capable of compacting the 15 cm layer of gravel in one stage, pulverising stony gravel and it had no difficulty with the rugged terrain.

Ox-carts and donkey panniers

The LCU was keen on testing the viability of ox-carts and donkey panniers for haulage of fill and gravel for its labour-based construction projects.

In 1986 the LCU bought donkey panniers for use on the construction of the access road to Tebellong Hospital in Qacha's Nek District. There were many donkeys in the area owned by the villagers who were very interested in the project. The LCU had expected good cooperation from them to hire their donkeys for provision of gravel. It was a big surprise to the LCU when the villagers refused to hire their donkeys to haul gravel using panniers. Then the use of donkey panniers was abandoned.

In the same year, the LCU bought a number of ox-carts for use on the regravelling of Mazenod-Mokema Road which traverses a highly active agricultural area. The farmers who owned cattle were approached to negotiate commercial hire by the LCU. The farmers refused to hire their animals. They said that animals were for agricultural purposes only.

Very disappointed, the LCU continued with its decision to test the viability of ox-carts for haulage of gravel. Two oxen were bought and brought to the Training Site at Ha Thetsane. The two animals were then used to provide gravel for the Training Site.

Unfortunately, recorded productivity data for haulage by ox-cart unsatisfactory. However, observations made during the test period indicated that the ox-cart was not a viable method of hauling gravel in Lesotho where terrain is very rugged with steep gradients. It was observed that the animals had difficulty in pulling a loaded cart uphill and to restrain the cart while going downhill.

The trailers were of two types: tipping, and flatbed trailers had two axles, and though required extra person days to unload, were more easily manoeuvrable than the tipping trailers which had one axle.

At the end of the project the LCU compared recorded data for haulage distance and type of terrain as follows:

No. of tractordays (trd) per km = 61

No. of 6 m³ tipper days (tpd) per km = 30

Hire rate for combination of tractor and trailer per hour at 1985 prices = M28.00

Hire rate for tipper per hour at 1985 prices = M24.00

No. of working hours per day = 9 hours

Cost comparison per km

Tipper & Trailer cost = 61 trd x M20/hr x 9hrs/day = M15,372

Therefore, the cost of a combination of tractor and trailer was found to be more than double the tipper cost under same conditions.

Improvement of existing hand tools, Tuesday /12/93

During December 1987 and January 1988 the LCU commissioned a Tool Specialist to assess the situation of hand tools used by the Unit.

In his report the Tool Specialist indicated that good quality tools available in Lesotho were pickaxes, crowbars and sledgehammers and the poor range of tools were shovels, rakes and wheelbarrows.

According to his terms of reference, the Tool Specialist was to produce designs and prototypes of good quality tools to replace those identified as poor and unsuitable for heavy manual work. He made the prototypes of a wheelbarrow, heavy duty rake, hand rammer, filling tray and yoke. The two most welcomed prototypes were the wheelbarrow and heavy duty rake.

The heavy duty rake was a good quality tool. It was very different from, and much superior to, the existing range of rakes which were only good as garden tools. Its prongs were made from thick steel plate and the handle was made from metal tubing. This was unquestionably the right tool for heavy manual work on the construction site.

The wheelbarrow prototype appeared to be an ideal wheelbarrow, one which carried a big load, was easy to balance, push and tip, and lasted longer. However it was desirable to field test the prototypes before large scale production.

In the field the performance of the new wheelbarrow was compared with that of the existing construction wheelbarrow imported from the RSA. The following were observed during the field tests:

Area of Comparison Existing Wheelbarrow New Wheelbarrow

Capacity

Position of load with respect to the wheel

Wastage

Manoeuvrability

Ability to push

Ability to tip

Stability

Capable of holding 65-70 litres

Load between the wheel and the legs so that some of the load was carried by the pusher

Very little wastage of contents due to narrow and deep tray or bucket

Easy to manoeuvre because of good shape and size of bucket

Easy to push with the pusher carrying part of the load

Tipped easily with its bumper acting as fulcrum

Would stand unsupported on a sloping ground while carrying full load

Capable of holding over 70 litres

Load almost over the wheel and nearly all the load carried by the wheel

Contents easily spilled because of wide and shallow tray or bucket

Not easy to manoeuvre because of the wide and shallow tray with a rectangular shape

Easier to push with almost all the load carried by the wheel

Difficult to tip, had no bumper

Needed support when loaded and standing on a sloping ground, otherwise started to move by itself

Local manufacture of hand tools

As part of his terms of reference the Tool Specialist assessed the potentiality of existing workshops in Maseru to manufacture the prototypes. He visited the workshops and talked to the owners who were invited to a half-day demonstration of the prototypes.

In his report, he stated that manufacture of hand tools for which prototypes had been made was quite feasible in Maseru. He provided the LCU with a list of interested manufacturers who were later contacted to be issued with a government order to commence manufacture of hand rammers, heavy duty and wheelbarrows. Eventually only one manufacturer was able to produce wheelbarrows and heavy duty rakes. Production of these implements was good until the 1991 riots in Lesotho. The manufacturer's premises were damaged. Since then the production of wheelbarrows has been very limited and nothing for heavy duty rakes.

Conclusions and recommendations

1. The availability of good quality hand tools and simple items of equipment is a prerequisite for good organisation of work and for availability of skilful labourers. (These three are the most important factors for the success of

labour-based works). Therefore countries practising labour-based technology should take strong measures to avail themselves of good quality hand tools.

2. Local manufacture is very important for sustained improvement of existing hand tools because it is easier to deal with local rather than foreign firms. Therefore countries practising labour-based technology are urged to have functioning local manufactures of good quality tools for use in heavy manual work.

3. The engineers and their labour force should be educated to change their biased attitudes towards good quality hand tools foreign to them. Similarly expatriate engineers should resist the tendency to introduce inferior tools which they have used at home or elsewhere into a country where existing tools are of good quality and need only minor improvements.

4. Proper handling of tools, storage and maintenance is very essential to ensure longer life. For example a pickaxe can be completely destroyed by a bad blacksmith when he resharpens the tool.

III. LCU's Experience with Compaction Equipment and its Crushing Effect

By Dejene Sahle, ILO Technical Adviser, Labour Construction Unit, Maseru

Background

The Labour Construction Unit (LCU) is constructing/upgrading roads in the rural areas of Lesotho. Annually the LCU constructs more than 60 km of rural roads all over the country. The roads upgraded by the LCU have the following specifications:

Class B and below

surface type gravel

carriageway width 6 m

Before construction, some roads had an Average Daily Traffic (ADT) as high as 45 vpd, mainly small passenger buses and pickups. Traffic counts made after construction has showed a 25% increase. This makes it essential that some sort of compaction is required at least to take the initial traffic load.

Compaction in the LCU

At each construction, site, compaction is applied at three stages, i.e. excavation to level, camber formation, and gravelling. At each stage the compaction length is about 100 m. As the compaction length and thickness are small, heavier equipment are not recommended. Hence the LCU has been using pedestrian vibrating rollers for the past fifteen years. Good results are achieved using the Bomag BW-90's. See

Appendix 1 for the specification.

From LCU's experience the aforementioned rollers have the following advantages:

relatively easy to operate—only on day's training is enough

easy to maintain

do not require big and sophisticated equipment to transport—could be loaded on a small trailer and towed by a 4 x 4 pickup

parts are easily available locally

comparatively less costly.

If the basic preventive maintenance is conducted regularly, these rollers could work at relatively high performance for longer periods without major breakdowns. The major causes of breakdowns on these rollers are the following:

changing gears (forward reverse) without stopping

driving the rollers for longer distances, i.e. transporting from one place to another

continuous running of the engine for longer periods.

Compaction is done in layers of 150 mm at each stage i.e. excavation to level, camber formation, and gravelling. Water bowsers of 1000 litres capacity are used for watering the compaction area.

Test samples taken from the field have showed more than 90% compaction. Usually these results are achieved after 7 to 10 passes.

Gravelling

All roads constructed by the LCU have a gravel surface. Before starting quarry excavation test samples are collected and sieve analysis conducted to determine the suitability of the gravel.

After excavation, the gravel is loaded on trucks without ant sieving. Bigger sizes of stones will be identified visually and removed at the quarry before loading and at the site while spreading. In cases where quarries with well-graded gravel are not available in the area, we are obliged to use what is available. This results in using larger size aggregates. This will gave the following effects:

corrugations will be formed straight after construction

less riding comfort within a very short time

requires grading or filling a few weeks after completion.

Such roads will have high maintenance cost as they require light grading more often than usual or requires spreading of a layer of materials on the surface. Usually regravelling is planned at a seven year cycle in the LCU. This regravelling cycle will not be met if bigger size stones are to be used. Bigger size stones are crushed in two ways:

using a mason's hammer for bigger sizes

crushing using rollers while compacting.

The LCU is undertaking field tests to find the crushing effect of the Bomag BW-90. Two gravel samples are collected, i.e. one dumped gravel before spreading, and a second sample after the gravel is spread and compacted. Then sieve analysis of both samples will be conducted to establish the crushing effect of the rollers during compaction.

Although the crushing effect depends among other factors on hardness of the rock and number of passes, initial results have been satisfactory.

Appendix 1: Manufacturer's Specification of the BOMAG BW-90S

Operating Mass kg 1350

Dimensions

Rolling Width mm 900

Drum Diameter mm 550

Overall Width mm 1060

Overall Height mm 1200

Overall Length mm 3470

Edge Clearance mm 275

Drive

Engine Hartz

Model E89FG

Fuel Diesel

Continuous Output

DIN 6271 IFN kW 9.0

Gov Eng Speed rpm 2500

Fuel Consumption l/hr 3.0

Drive System-Mechanical

Speed 1st km/hr 1.6

2nd km/hr 2.8

Climbing Ability

With vibration % 35

Without vibration % 35

Vibratory System-

Mechanical

Exciter Rotating eccentric weights in centre of both drums

Director of vibration Vertical

Centrifugal Frequency Hz 55

Force KN 60

Fuel Tank litre 11

Water Litre 100

IV. Equipment Maintenance

**By Jim Hamper, CIDA Mechanical Engineer,
Ministry of Public Works and Housing, Nakuru, Kenya**

Introduction

The purpose of this paper is to present some ideas for discussion on the maintenance and procurement of suitable tractor based equipment used in road maintenance.

As the geographical and economic conditions vary from country to country, it cannot be stated categorically that one piece or design of equipment that works well in one area will necessarily be successful in another. Recognizing this, it should be noted that the view expressed in this paper are the results of the experience gained through the Rural Access and Minor Roads Programmes in Kenya.

Equipment maintenance

The maintenance of equipment is an important and integral component of the road maintenance sector. For the reader to have a proper perspective on the topics of this paper, only the following types of light duty equipment will be considered:

Agricultural Tractors 45 - 60 hp. 2 WD.

Land-Rovers As service vehicles

Trailers 3 m³ Non tipping

Trailers 3 m³ Tipping as an option

Lorries 7 tonne flat bed

Motorcycles 125 - 175 cc

It is assumed that all equipment is owned by the ministry and all repairs and maintenance is done in-house as opposed to farming out to dealers and/or local repair shops.

In the beginning of the Rural Access and Minor Roads Programmes in Kenya the idea was to have a self-contained roads into so that it would be easier to maintain and manage their own fleet separate to the existing Government workshops.

Initially all repairs and maintenance was done on a district basis; this meant maintaining one major repair centre for each district. As the programme grew, this concept became impractical both cost and management wise. In the case of the Rift Valley it meant maintaining and staffing nine separate workshops. A result of this was that many jobs such as engine and gearbox overhauls were being repeated far sooner than was necessary.

With this view in mind, it was then necessary to establish a network of repair and maintenance depots for the RAR/MRP.

In Kenya, this was accomplished on a Provincial basis, with one central workshop for major repairs supporting districts and field workshops. This system was established in 1989/90 and is now operating in three provinces. One example of this system is the Rift Valley Province where the establishment of one central or regional workshop and nine district base workshops are currently maintaining a fleet of 494 pieces of light duty equipment. Over the past year, with this system, an average fleet availability rate of 87% was achieved (see Appendix 1 for a three year comparison).

The Regional Workshop output for the past year consisted of fifteen major overhauls of engines, gearboxes and differentials in addition to thirty-four major repairs to other components. All minor repairs and programmed servicing was carried out in the district workshops.

Following is a brief description of the functions and responsibilities of these workshops:

Role of the Regional Workshop

The main activity of each Regional Workshop is to provide a major repair and rehabilitation service for all district base workshops within their catchment area. This includes the introduction and operation of a unit exchange scheme.

Under this scheme, when the Regional Workshop receives a worn or damaged unit from the districts, it will immediately dispatch a working unit from the regional store, if one is available. The damaged unit will then be thoroughly inspected, overhauled and tested, where possible, before being placed in the regional store as available for exchange.

All stages of dismantling, rebuilding and testing of a reconditioned unit will be monitored by the Regional Mechanical Officer Workshop as a complete unit (not disassembled). The exception to this is tractors, in which case the whole machine will be brought to the Regional Workshop. Therefore, tractor unit assemblies are non-exchangeable units and will be overhauled only at the Regional Workshop, and then delivered back to the district when completed and tested.

Each unit assembly submitted for exchange must be accompanied by a District Request form giving details and reasons for exchange, including causes of any damage, excessive wear, etc.

Serial numbers of all exchanged units will be systematically logged and equipment history cards updated as required by both District and Region.

Units or unit assemblies that should be available for exchange are as follows:

Engines Gearboxes Differentials

Final drives Alternators Brake discs

Brake drums Pressure plates Flywheels

Re-cored radiators Hydraulic pumps Injector pumps

Starter motors Steering boxes

Role of the District Base Workshop

The main emphasis for District Base Workshop operations will be preventative maintenance, exercised through a programme of planned service schedules, together with regular equipment inspections and monitoring of equipment fleet condition.

Every District Base Workshop will be responsible for undertaking the specified scheduled servicing of the equipment fleet under its control. All repair work will be limited to component replacement, removal and refitting of unit assemblies and adjustments only. Much of the servicing will be carried out during regular routine site visits.

The District Workshop duties may be summarized as:

P.M. servicing Brake systems

Suspension repairs Removal and replacement of exchange units

Steering system Tires and tubes

Electrical system Other minor repairs

Fuel system except pumps

In terms of operating the unit exchange scheme, the Officer-in Charge of the District Base Workshop shall have responsibility for assessing whether an assembly should be despatched for exchange. In case of doubt the Regional Mechanical Officer can be consulted.

All worn units being despatched for exchange must be labelled with the unit serial number, details of equipment item being removed and a brief description of condition and cause of failure.

It is very important for the efficiency of the maintenance system that the District Base Workshops **DO NOT** embark on repairs which are the responsibility of the Regional Workshops.

Role of the District Field Workshop

The District Field Workshop will service tractors, trailers and bowser only with the support of the District Workshop. The main emphasis in field workshop operations will be adjustments, inspection and reporting.

Other items for attention will include tire and tube repair, wheel bearing adjustment and replacement,

tightening and replacement of nuts and bolts and daily greasing of tractor trailer hitches.

Any other action that is not specified will require permission of the Officer-in-Charge of the District Base Workshop.

Equipment operators have responsibility for pre-start up checks and inspection, including refuelling, greasing, oil and water levels and tire pressure checks. The operators should be made aware of the important role they play in first level Preventative Maintenance.

The field mechanics will also be responsible for undertaking a "walk around" reportable inspection of all tractors, trailers and bowsers.

In establishing an equipment maintenance program of this type, several actors must be considered:

Establishment of the physical workshops with appropriate tools and equipment

This problem may be overcome by the use of existing Government workshops or new construction with donor assistance. As these are not sophisticated workshops the cost is not prohibitive.

Work force - are they available and well trained?

The three tier workshop system described above will help to minimize this problem by assigning the better qualified mechanics to the central workshop where the major repairs will be carried out. The lesser skilled mechanics would then be assigned duties in the district and field workshops for minor repairs and servicing.

Tractor-trailer hitching systems

The most common and preferred type of hitch is the hydraulic pick-up hitch with a pin and eye coupling as opposed to a rigid draw bar. Some manufacturers such as Ford and Massey Ferguson were able to supply this type of hitch as standard equipment. Others such as International were not. Because of this the MRP had to design a suitable hitch for its International fleet. After several revisions this hitch was developed to a satisfactory level and is not available from M.S. Trimborn Agricultural Engineering, Nakuru, Kenya (a sketch of this hitch appears as Appendix 2).

As an option to the pin and eye style, a ball and cup type coupling could be used. In most cases with the ball type, wear would be reduced and would allow for better lateral movement. One disadvantage to the ball type would be higher replacement costs as in most cases these coupling units would have to be forged or imported.

A second consideration for the hitch is the actual tractor to which it would be attached. A lot of the new model tractors in the low horse power range (45 hp) are being produced with lighter differential housings. This makes it virtually impossible to mount a robust hitch assembly. The 55 to 65 horsepower range still maintain suitable housings.

One inherent problem is the constant loosening of the mounting bolts fixing the hitch to the tractor housing. This problem was most apparent with the International tractors where no suitable pick-up hitch was available from the manufacturer for MRP use. We overcame this problem by the use of one of the following methods:

When the hitch is first fitted to the tractor and all of the mounting bolts are torqued to a specified tension, the heads of each bolt are spot welded to the hitch sub frame. The use of washers under the head of the bolt

is not recommended.

the second option is the use of studs and nuts in place of bolts. With this system, "locktite" is used on the threads in the tractor housing and again a sport weld is recommended between the nuts and the hitch sub frame (see sketches in Appendix 3).

Tips for minimizing hitch pin and towing eye wear

Sketch

Trailers

Many different designs and types of trailers have been used and experimented with over the years. Some of the more pertinent encountered with these earlier designs are as follows:

Four cubic meter standard trailer

Loads were too heavy for the lighter horsepower tractors in use. Physical size of these trailers made manoeuvrability difficult on narrow roads and restricted turning areas. Heavier loads caused frequent axle and chassis breakage resulting in high maintenance costs and down time.

Hydraulic tipping trailers

Frequent and costly failures to hydraulic system.

Trailers with unloading doors (front, back and sides)

These trailers require constant repairs to misaligned doors, failures of hinges and latches. Most of this damage could be attributed to improper loading and carelessness in latching the doors prior to transporting.

The most significant problems encountered in all types of trailers was poor structural design and the use of inadequate material by manufacturers.

From years of experience with these trailers, one design for a standard three cubic meter trailer has been developed. This trailer was designed by MRP personnel in cooperation with a local engineering firm. Some of the improvements include an improved sub-frame design for better weight distribution which has eliminated sub-frame and drawbar breakage. It has sloping sides and front panel with an open back. This resulted in easier product removal and a lower profile for easier loading. An improved bucket design incorporating 3 mm plate and additional external bracing has eliminated body cracks and sagging floor panels. Axle load rate has been upgraded to 7000 kg and fitted with 900 x 20 tires. This has eliminated axle breakage and with the use of the 900 x 20 tires we have experienced fewer punctures also. These tires are manufactured in Kenya thus eliminating the extra cost of importing the more common balloon type tire. This trailer can easily be manufactured by any reputable firm or purchased from M.S. Trimborn Agricultural Engineering, Nakuru, Kenya.

This current design has been in use for the past five years. On a fleet of 150 trailers an availability rate of 95% is being maintained. Only minimal maintenance is required to wheel bearings and towing eyes.

NOTE:

The unloading time for this type of trailer as opposed to a trailer with doors may be slightly longer but the advantage of minimal down time due to repairs on doors, hinges and latches far outweighs this disadvantage.

For information purposes, a sketch and technical specification sheet for this trailer can be found in Appendix 4.

Tipping trailers

As mentioned earlier, the hydraulic tipping trailer met with very little success in the Minor Roads Programme. This was basically due to the high maintenance costs to the hydraulics, and excessive down time. In an effort to improve on the efficiency of equipment used in labour-based road maintenance, staff at MRP Nakuru have been experimenting with a self-tipping non-hydraulic trailer. This trailer was designed and six prototype trailers were manufactured in Nakuru. These six trailers have now been working in the field for the past six months. The results to date have been fairly good. As there are still a few minor alterations to be made to the design and the field tests are not complete, no recommendations will be made at this time for this trailer. The Regional Office in Nakuru is hopeful that by this time next year they will be able to offer a successful design for a non-hydraulic tipping trailer.

Procurement

As stated earlier, one of the problems encountered was the use of unsuitable materials and poor workmanship in manufacturing. What is of prime importance in the procuring of equipment is that the supplier is capable of delivering quality goods. Secondly, clear and concise specifications should be supplied to manufactures/suppliers. Thirdly, during the manufacturing process there should be constant monitoring of work in progress by the client's representative. During this monitoring special attention should be paid to such items as quality of material, welds and adherence to specifications.

Below is a sample of such details to be included in a contract document for manufacturing trailers.

1. *Quality Control:* The premises shall be made open for appointed MoPW staff, before awarding of tender, to ascertain suitability of premises and after tender is awarded for continuous inspection of work in progress to avoid repeat jobs which would have otherwise been detected later, i.e.:

- (i) concealed welding points
- (ii) use of unsuitable material

Premises:

- (i) allocation of workshop space
- (ii) allocation of workshop personnel and their qualifications
- (iii) allocation of workshop equipment & tools
- (iv) availability of materials.

2. *Delivery*: Payment will be initiated after delivery of every 5 trailers to the Mo)W/MRP yard in Nakuru. (This includes t extra rims, 5 extra stub axles and 10 extra towing eyes).

Delivery Schedule:

First 5 to be delivered will be tested in the field. After completion of the tests the supplier will inspect these trailers together with appointed personnel from the MoPW and decide on any improvements of modifications.

These improvements or modifications will not be subject to any price increase.

3. *Registration*: The supplier will be responsible for all registration (and fees).

4. *Warranty*: Tender to indicate length of warranty per road from date of delivery.

5. *Costs*: Prices quoted must indicate:

(i) VAT and Duty paid

(ii) VAT and Duty exempt

6. *Contract*: The contract shall be valid for two years.

Technical specifications for 3 cubic metre trailer

1. *Size*: The trailer shall be 3 cubic meter capacity of the following dimensions:

Total height to top of body 1300mm

Total length 4800mm

Inside dimensions of "bucket"

Top width 2000mm

Bottom width 1500mm

Length 3150mm

as per drawings, the body of the trailer ("bucket") shall be all steel plate of 3mm thick reinforced by cold pressed channel of 40 x 80 x 3mm of intervals as shown on attached drawing.

2. *Axle*: Shall be made of 2U hot rolled still channels of 100 x 50 x 4mm. Welded together with the stub axle *welded* between them. There will be a distance of 100mm between wheel and the body. Total length of the channels 1860mm.

Total length of the stub axle 500mm

Tyre size 900 x 20 12 ply. The axle shall be located 1100mm from the back of the chassis.

3. *Chassis*: The middle member of the chassis shall be of 2 U channels of 160 x 65 x 6mm welded together

with long stitch welds (except on joints) to form a box in cross section and is extended beyond the bucket to form the draw bar of 1130mm in length as per drawings.

4. *Details:* Stub axle type GS 6006-1 (axles 80 x 80mm)

Axle related load 7000 kg.

(i) Wheels:

UN-braked, 6 studs

Tyre size 900 x 20 x 12 ply

(ii) Towing eyes:

to be used DIN 11026(E) - 40A 0 42mm

inside hole diameter 45mm

(iv) Rims:

7.0 - 20 with lock ring

Each trailer to be delivered with one extra stub axle, one extra rim, and two extra towing eyes

(v) Painting

One primer coat

Two coats MoPW yellow

Appendix 1: Equipment Availability

Appendix 2: Trailer Hitch Designs

Appendix 4: Trailer Designs

V. Equipment: A Manufacturer's Perspective

By Bell Equipment Company S.A. (Pty) Ltd, South Africa

Introduction

The function of a supplier is to link customer requirements to suitable and available equipment. In other words, the conversion of a need into a practical and economic solution.

Several very interesting needs were uncovered during the Mbeya and Lesotho conferences. These

statements are reproduced below and we will attempt to link the need or problems stated to some possible solutions and suggestions:

"Likely cost savings in grading by adoption of heavy tractor towed grader technology are in the order of 40% over existing methods" - reference Roads 2000, Lesotho Congress.

"Adoption of tractor technology for the equipment operations would offer flexibility based on the simplest large power source: the tractors could be used for towing gravel haulage trailers, roller, bowsers and mobile accommodation when not grading.

Standardization on tractors would significantly reduce spares costs and procurement problems.

All the tractor attachments could be manufactured in Kenya" - reference Roads 2000, Lesotho congress.

"Tractor/trailers have an economic haulage distance of 2 km - 5 km" - reference Mbeya Labour-Based Technology Report, February 1990.

"The largest problem faced by all participants was finding a reliable supplier within the Southern and Eastern Africa region of a well designed, well manufactured trailer" - reference Mbeya Labour-Based Technology Report, February 1990.

"Kenya has 25 260 km of gravel roads requiring maintenance, and a re-gravelling requirement of 3 160 km per annum. The average re-gravelling output over the last 5 years has been 240 km per annum" - reference Roads 2000, Lesotho Congress.

Discussion

Cost savings with towed graders

Little can be added to the indisputable fact that towed graders do offer substantial cost savings over self propelled graders when applied to the maintenance of rural roads.

The potential savings, however, can be eroded or totally eliminated if haulage equipment towing the grader is unsuitable for any reason at all.

We offer some suggestions regarding minimum guidelines to ensure effective grading in terms of performance and equipment life:

Motor graders are generally equipped with torque converter transmissions. This is done to provide efficient transfer of engine power to the drive wheels at all times. It therefore is logical to assume that if a haulage tractor can be provided with a torque converter type transmission, this would contribute greatly to the effectiveness of the grading operation.

In most instances it will be necessary to have a haulage unit offering 4WD traction and adequate tyre options to provide good traction and tyre life. Normal open centre agricultural tyres are fine for ploughing but are not suitable for hard road surfaces, so it is normally preferable to use industrial tyres similar to those on self propelled graders.

Heavy duty towed graders require adequate horsepower and it is suggested that a minimum of 110 horsepower be provided in order to efficiently tow a 5 tonne grader.

It is essential that a heavy duty hitching device be provided on the tractor, not only to effectively handle the high loads which a grader will impose on the hitch, but also to ensure that there is weight transfer from the grader not only onto the rear driven axle but onto the front axle as well. It is futile to specify a 4WD hauler unless at least some of the weight is transferred to the front axle. Most agricultural tractors employ a simple swinging drawbar type hitch with hook and eye coupling. This tends to lift the front axle of the tractor.

Both the haulage equipment and the towed grader need to be of robust design and manufacture and be as simple as possible to maintain. Repairs should be simple undertake as they are mostly done infield and costs should also be low. It is preferable to have a completely external hydraulic system incorporating external pumps, separate hydraulic tank and full filtration.

Flexibility

The tractor and drawn implement concept is well established and certainly offers many advantages over dedicated pieces of equipment. Not only is dedicated equipment expensive to purchase, but it is even more costly to have this equipment standing idle through lack of work. A system utilizing one prime mover and several drawn implements is therefore more cost effective.

What needs to be avoided, however, when following the multipurpose route is to ensure that the equipment is adequate for the task intended. All too often multipurpose machinery is limited in it's ability to do what is intended as well as being limited in terms of longevity.

it is important to ensure that the drawn equipment is therefore well designed and manufactured to high structural integrity standards.

The Bell range provides an exceedingly wide range of drawn implements and equipment, which is purpose designed for many rural road maintenance and construction applications.

Standardisation

This is an important aspect and should be viewed in conjunction with information relating to population of similar equipment in the country under consideration.

Consideration should also be given to parts availability, parts pricing and sourcing of parts.

Local manufacture

Bell are in a position to supply, as indicated, a wide range of towed implements.

We would be happy to work in conjunction with local manufacturers to ensure that maximum benefit is obtained from local manufacturing facilities and abilities, thereby reducing foreign exchange expenditure and providing additional local inputs.

Economical haul distances

We would agree with a maximum economical haul distance for a tractor of some 5 km, though this of course would depend very largely on the product being hauled and the road conditions involved.

As the Bell hauler is purpose designed for haulage applications, it has a considerably higher road speed than most conventional and agricultural tractors. The normal safe road speed for Bell haulers is 40 km per hour.

Economical haul distances can therefore be extended quite considerably before the truck option becomes more economical. We would suggest that haulage distances of up to 10 km -15 km be acceptable for the Bell haulage tractor, though this of course would be highly dependant upon the design and capacity of the trailer.

Each application would have to be studied separately, but it would almost certainly be cheaper to utilize one 110-120 tip hauler over 15 km with a payload of 7m³ than to use two tractors and four trailers of 3m³. Where distance is greater than the loading time allows, one can use two 14 tonne trailers to one Bell hauler for even better economy.

Fuel cost per tonne hauled is of prime importance.

Trailer design

Much has been said and written about the ideal trailer design for rural road and re-gravelling applications.

While not denying the need for small trailers in some applications (this is perhaps where the animal drawn trailers come into their own), we feel that to employ even small contractors to haul trailers with capacities of as low as 3 tonne is highly uneconomical, and that considerably larger tipping trailers should be considered, even if they were of a design allowing for manual loading. Some criticism has been levelled at hydraulic tipping arrangements due to the possibility of contamination. A properly designed system could provide more than adequate protection from dirt ingress.

We would suggest that the ideal trailer, especially for gravelling operations, be hand-loadable with a capacity of 5-7m³, hydraulically tippable and of single axle configuration. It should also be possible to hydraulically unhitch the trailer during the loading operation and to operate two or more trailers in any one application, to maximize the prime mover.

Gravelling and maintenance requirements

The re-gravelling task and maintenance through use of drawn graders would seem to be the biggest application for a mixed technology of labour-based methods and tractor towed methods.

If the figures offered by Kenya are anything to go by, there must be hundreds of thousands kilometres of roads throughout Africa requiring re-gravelling and grading every year.

Instead of providing each region with equipment which is capable of undertaking re-gravelling and grading in addition to the other more labour-intensive operations, we would suggest a complete re-gravelling/grading mobile team. The equipment would include two and four-wheel-drive haulers in combination with hand-loadable tipper, heavy duty graders, mobile workshop and accommodation units.

When moving from area to area these units can be formed into a complete train, eliminating transport difficulties from site to site. Two or even three trailers could be towed in one train dependent on local road ordinance regulations.

The grader could be hitched behind a unit of mobile accommodation, while the tipper trailer could form up with the mobile workshop. Ideally this maintenance unit should be almost entirely self sufficient, and independent.

The Mechanical Advantages of Bell Rigid Haulers

Heavy duty chassis

The fully fabricated main beam type chassis is constructed of the finest tensile steels available. The chassis is prefabricated on fully rotating jigs to ensure integrity of welds and alignment is maintained. This purpose design chassis allows for absorption of shock loads from rough terrain without affecting the major drive train components.

Repair work and maintenance are easy tasks as access to the engine and transmission has been incorporated into the design, as is simple removal and installation of components.

The axle

A 10 tonne capacity, heavy duty driving axle improves ground traction, stability and production, while the planetary gear hub reduction system with full floating side shafts reduces stress on main drive line component. All this combines to reduce operating costs considerably.

Brakes

The simply yet effective braking system has been designed specifically for high speed haulage and maximum trailer loadings. Large diameter air operated brakes provide efficient brake capacity in all conditions and come equipped with a fail-safe park brake which applied and air released.

Transmission

The fully automatic transmission allows for easier operation by less experienced operators. The single stage torque converter, with lock-up clutches fitted to the larger models, ensures smooth clutch engagement efficiencies and optimum gear ratios provide the best method of transmitting torque to the drive train. This significantly speeds up haulage cycle times, enabling road maintenance teams to be quickly relocated between sites.

Engine

The Deutz air-cooled engine has proved itself over many years to be well suited to rural applications, where temperatures can be extreme and dust presents a major problem.

Hitch assembly

A heavy duty hydraulically-operated ball hitch is incorporated on all Bell haulers. As the hitch point is situated forward of the rear axle, weight is also transferred to the front axle for maximum stability and safety.

Cab and body

The Bell hauler incorporates a fully-enclosed cab as standard equipment, providing a safe and comfortable working environment for the operator. High tensile steel is used in the construction of the cab and body to minimize damage to mudguards and bonnet, as well as to protect the operator.

Other factors

When considering the purchase and specification of any equipment, be it the haulers or the towed items, certain other aspects need to be given further consideration.

Ease of maintenance

It should be borne in mind that the with equipment generally operating far away from an established workshop, the maintenance procedures need to be simple and easy to undertake even by unskilled workmen.

Reliability

Once again mechanical reliability is especially important as the equipment operates far from an established maintenance base. Mechanical reliability is therefore of the utmost importance i the maintenance team are to provide economical services.

Longevity

All too often the lowest priced equipment is purchased due to capital availability issues.

It is not unusual for agricultural tractors to have a very limited life span. Experience over almost 20 years indicates an almost infinite economic life for the Bell hauler.

The Rural Roads Department in Botswana report a life in excess of 10 years for their Bell haulers, and there is every indication that this can be extended almost indefinitely with interim overhauls.

Many of original tractors manufactured 18 years ago have given in excess of 70,000 hours of economical production. This factor will obviously have a major effect on overall cost calculations over the machine life time.

Back-up and support

All too often lowest tender prices are accepted without due regard to the extent of locally available product support. It is important that technical expertise and readily available parts are available in the relevant country.

The availability of alternative sources of supply of spare parts should also be given consideration.

VI. Intermediate Equipment to Support Labour-based Roadworks: Development, Testing and Evaluation of Prototype Equipment

By Robert Petts, Consultant Engineer, Intech Associates, UK

SYNOPSIS

Labour based techniques have been successfully and increasingly used in developing countries in the last two decades as a more appropriate alternative to heavy plant methods for roadworks. Significant improvements have been made in road construction and maintenance techniques, manpower and works management, training, and institutionalization through the efforts of the ILO and other committed parties. Developments in the intermediate technology equipment required to support certain operations have unfortunately received less attention. This paper reviews the current situation and needs, and some of the problems encountered in developing the support equipment required for labour based roadworks. Reference is made to recent experience on labour based pilot projects in Kenya and Namibia. Proposals are

made for improving the availability of good designs and specifications for intermediate equipment, and guidance on their fabrication in developing countries.

Introduction

Over the past two decades labour-based road construction and maintenance programmes have been established in a large number of developing countries in Africa and Asia. As the costs of imported heavy civil engineering plant have risen and the problems associated with keeping them running have increased, the attractions (both economic and social) of using local labour resources have become more convincing.

The International Labour Organization (ILO) have contributed significantly to the establishment and success of many of the labour-based programmes through assistance and support in the development of appropriate technical and management approaches, and institutional framework and training.

During the initial years of development considerable efforts were made to develop designs and specifications for the necessary handtools and intermediate equipment required to support the labour-based operations. The Rural Access Roads Programme (RARP) Technology Unit and others carried out important research and development in this area. Publications such as references 1, 2, 3 summarize the recommendations developed from this work.

Local manufacture of low and intermediate technology items to support labour-based roadworks is the logical progression in the development of local resources. Many of the items of handtools and equipment can be manufactured locally. Although the capability varies from country to country, selective initiatives can improve capacity at relatively low cost. Local manufacture promotes self sufficiency, employment and sustainability.

In recent years a range of problems has developed, constraining the efficiency of many labour-based programmes through the inadequate provision of hand tools and equipment. This is evident from evaluations of recent or ongoing projects. The author's most recent experience has been gained on programmes in Kenya and Namibia, although the problems encountered are commonly found on other roadworks in Africa and Asia. Further work is now required to counteract these constraints to enable the most appropriate handtools and equipment to be procured and supported on all labour-based programmes.

The importance of appropriate and good quality handtools was demonstrated by the ILO (Reference 4); labour productivity can be substantially reduced by the use of worn out, weak, the wrong, or poorly designed handtools.

Even on labour-based programmes the procurement and operation of equipment and transport consumes a large portion of the funding. Reference 5 et al estimate that this amounts to 20 - 30 % on large programmes such as the Rural Access Roads Programme (RARP). Considering the range of problems discussed in this paper, there is potential to substantially reduce equipment costs on labour-based programmes through a concerted and rational approach to tackling the current constraints.

The Current Problems

Experience with the implementation or review of labour-based programmes in a number of countries (Reference 6,7 et al) has enabled some of the current problems to be identified. This section attempts to summarize the problems for discussion. The experience is based on a number of African and Asian countries and the problems are often common to a number of the countries. The constraints have been grouped for ease of identifying possible counter measures.

General

Procurement is often carried out by civil engineers or administrators with inadequate knowledge of mechanical engineering or fabrication materials, or by mechanical engineers with insufficient appreciation of appropriate technology requirements.

A core problem is the lack of suitable products "off-the-shelf" in most developing or developed countries. Furthermore there are no international recommended standard DETAILED designs and specifications for key items of equipment for labour-based roadworks, that have been developed through experience or rigorous testing.

The lack of standard designs and specifications often leads to unco-ordinated ad-hoc attempts to develop suitable equipment through local commissioning of prototypes. Unfortunately insufficient attention is usually paid to the process of planning, procuring, testing, evaluation of, and dissemination of the experiences of these prototypes. Usually there is no mechanical engineering expertise involved sensitive to the needs and constraints of the technology, i.e. the requirements that the designs must be:

- Simple,
- Robust,
- Durable *in the operational and maintenance environment experienced,*
- Appropriate for its intended use,
- Able to be made *with available local skills and resources,*
- Able to be maintained and repaired *with local skills and facilities, and with the spare parts readily available.*

Quality

Labour-based roadworks usually require good quality handtools and equipment able to stand up to the adverse conditions experienced. Standard agricultural items available on the local market are usually adequate for their intended use, however they are often of inadequate quality for roadworks.

The required high quality items are often not available "off-the-shelf"; requiring to be specially imported, or locally fabricated to order.

Designs and specifications

Many of the available designs and specifications are not sufficiently detailed to ensure a good quality and robust product from local manufactures.

Some of the available design are not appropriate for local fabrication or for their intended use.

Procurement system

Most road authority procurement must be carried out through the government system. This usually requires the acceptance of lowest tendered price without adequate regard to quality. Where national standards are available they are often based on agricultural quality items and are usually only established for common items. There is sometimes resistance by tender boards (who often include representatives of local industry) to accept special conditions which exclude commonly available products.

Procurement by tender often takes several months and local manufacturers will often only procure raw

materials after being awarded contracts. The small markets for the products and raw materials, long supply lines from developed countries, bureaucratic importation procedures, weak local currencies and inflation, make prediction of delivery dates and costs difficult for local manufacturers. It is of little surprise that the suppliers often discover that they are eventually unable to provide the manufactured item at the original tendered price and make a reasonable profit. Withdrawal from tender commitment or late delivery are also commonly experienced.

Local manufactures

Local manufactures often experience some of the following problems:

- Small or irregular local market
- Inability to set up efficient production line
- Bureaucratic or other constraints to import/export
- High cost or shortage of raw materials
- High inflation
- High cost of borrowing
- No effective patent control - they are often reluctant to invest in innovative ideas as competitors will copy successful developments.

There are usually inadequate acceptance/handing over procedures to ensure that all production models are to an acceptable standard (an approved prototype of detailed designs and specification). Similarly, effective warranties or arrangements to rectify faults on locally manufactured items are rarely included in the procurement contracts. There are usually insufficient arrangements for the stocking or provision of spare parts.

Developed country manufactures

Many of these manufactures no longer offer low or intermediate technology handtools and equipment, probably for a range of reasons such as:

High home labour costs

Weak, irregular or distant markets

Payment or foreign exchange problems

More attractive returns from supplying developed world markets.

Recommendations for improvement of handtool and equipment provision

This Section makes some recommendations for improving the environment for handtool and equipment provision for labour-based programmes. With the trend towards greater use of the private sector for roadworks in developing countries, it will be particularly important to provide proven designs to contractors in which they can confidently invest.

Handtools

Establish and keep up-to-date a register of manufactures worldwide who supply construction quality handtools for roadworks.

Promote the inclusions of specifications for construction quality handtools in national standards in developing countries, including testing and acceptance procedures.

Equipment

establish and keep up-to-date a register of manufacturers worldwide who supply low/intermediate technology equipment for roadworks.

Co-ordinate the identification of needs, planning, securing funds, procurement, testing, evaluation of, and dissemination of experience for, prototype items for equipment and handtools.

Mobilize the experience and resources of established institutions, e.g. road and agricultural sector research establishments, and universities with a research and development capability. Encourage independent testing and evaluation of designs by these organizations.

Establish international specifications and detailed designs for equipment for labour-based roadworks. Interim/provisional guidelines be available if insufficient knowledge or experience currently exists for a particular item.

Urgently promote the establishment of specifications and designs for the items of equipment most commonly used on labour-based programmes. Figure 1 makes recommendations on these priorities.

Figure 2 indicates the potential for developing tractor based attachments to support labour operations. Most of these items could be fabricated in developing countries under suitable arrangements, or could be locally assembled with the provision of Knock-Down-Kits. Figure 3 includes other items of equipment for which detailed designs and specifications should be readily available.

Establish guidelines for the procurement process for non-standard, prototype or locally fabricated items of equipment, including: initial specifications/briefs, identification of possible suppliers, supplier selection for bidding, documentation, tendering/negotiating, refinement/finalization of contracts, monitoring/testing/modification/acceptance during fabrication, acceptance procedures on delivery, arrangements for follow up warranty/support/spares.

Promote the interest of tractor and attachment manufacturers in labour-based roadworks and the needs of the sector. Encourage their collaboration or initiatives in developing/refining designs. Promote the establishment of Knock-Down-Kits arrangements in countries with very limited existing indigenous manufacturing skills.

Establish recommended spares stocks to be provided with initial items of equipment for common equipment types.

Figure 1: Priorities for establishing standard designs and specifications

The following items of support equipment are commonly required on labour-based programmes. Standard detailed designs or specifications should be available to any person responsible for planning or procurement of support equipment. These items are not presented in any order of priority.

Small (50-60hp) wheeled agricultural tractor (incl ROPS),

Heavy duty automatic pick-up hitch for tractor hauling trailers,

Heavy duty fixed hitch for other items,

Towing eye and fixing for all tractor towed items,

3 cubic metre gravel haulage trailer,

Tractor towed deadweight rollers,

hand or animal drawn deadweight rollers,

Rough terrain supervision motorcycles,

Culvert moulds,

Haulage wheelbarrow.

Figure 2: Agricultural tractor attachments for roadworks

The following attachments can be fitted to wheeled agricultural tractors for road construction, rehabilitation and maintenance. Often only minor modifications are required, such as the fitting of a heavy duty (automatic pick-up or fixed) hitch. However the designs and fabrication need to be robust for roadworks use:

Light towed graders (& up to 3 tonnes)

Heavy towed graders (over 3 tonnes)

Towed drags

Towed gravel haulage trailers

Towed deadweight rubber tyred rollers

Towed deadweight smooth steel wheel rollers

Towed deadweight ribbed/club-foot steel wheel rollers

Towed accommodation/workshop caravans

Lime stabilization harrows/mixer attachments

Towed water bowser/sprayers

Towed fuel bowsers
Towed bitumen heaters/distributors
Towed compressed air breakers
Towed mobile stone crushers and screens
Towed premix manufacture equipment

Figure 3: Other equipment items for which standard designs and specifications should be available

Bitumen slurrybox for tractor or other haulage
Concrete pavior block casting machine (manual/simple hydraulic
Animal drawn carts

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Introduction

By definition, labour-based road construction and maintenance methods consist of an appropriate combination of utilizing labour complemented with a limited use of equipment. Equipment for

labour-based road works is mainly utilized for operations such as haulage of materials and water, compaction, grading and rock breaking. Well-designed and maintained tools and equipment are important as they determine the productivity as well as the quality of the works carried out. It is therefore important that the tools and equipment used for labour-based construction and maintenance activities are properly designed to stand heavy wear and tear, and the normal abuse of a road work site.

The most common scenario is that 20% - 30% of total construction costs are attributed to the equipment use. However, 90% of all headaches of project managers are related to the use of equipment. The workers turn up and perform every day, but the equipment breaks down. Malfunctioning equipment is very often the most common item which jeopardizes the progress of a road project.

ASIST collects and disseminates information on the design, use and performance of the equipment used by labour-based programmes in the region in order to provide better advice and recommendations to new projects. However, ASIST does not yet have complete confidence in which is well suited to labour-based road construction and maintenance programmes. Furthermore, experience has shown that it has been difficult to agree on standard choice and designs on equipment.

This issue was further addressed by looking into the following key questions:

Is commercially available equipment really suitable for labour-based road works?

Are existing modified designs appropriate?

How can appropriate designs be developed?

How can appropriate designs be manufactured and procured?

Specifications and Quality Assurance

During the production of tools and equipment, it is extremely important to monitor the manufacturer in terms of quality assurance. Before a contract is awarded, it is important that the client makes sure that the company can effectively carry out the job (work-shop facilities, skilled staff, liquidity, etc.) Before production commences, all materials should be quality tested. During production, the quality of the works should be controlled at all stages of the manufacturing.

It is also recommended that the stores staff or site supervisory staff keep a record on the lifetime and performance of tools from various suppliers.

In addition to national design standards, the ILO has prepared design specifications for various handtools and equipment used for labour-based works. However, for various reasons some countries have now dropped their original design standards, which has resulted in the deterioration in quality of government purchases.

Procurement Procedures

Lack of design and quality specifications may present a problem for achieving a certain quality level on equipment. However, a more common problem is often due to organizational aspects. In many cases, government purchasing procedures represent a serious obstacle in obtaining the desired quality of tools and equipment. The project management staff may be fully aware of what specifications are required, but fail to convince the tender board or the procurement officers that the cheapest bid may not always be the best alternative.

The issue of procurement procedures is not only limited to the government procedures in the country in which the works are carried out. Programmes which receive financial and technical assistance from bilateral donors, the World Bank and the UN-agencies, are obliged to follow the purchasing regulations of these organizations. In most cases, the purchasing officers of these organizations are not aware of the special demands and considerations which should be made when supplying equipment to labour-based programmes.

Procurement procedures are very often the reason for the difficulty in standardizing the equipment fleet. This leads to increased maintenance costs since it forces the mechanical workshops to deal with a larger variety of spare parts.

From the above, it is obvious that certain measures are required to obtain the desired level of quality and specifications for tools and equipment for labour-based works. The immediate solution would be to clearly specify these in the tender documents. If foreign aid is involved, these issues should be addressed in the project agreements between the donor and the recipient government.

Correct use of Hand-tools and Equipment

The optimal choice of tools and equipment also varies from place to place, depending on the site conditions, type of works carried out, type of soils, local skills, etc.

Site supervisory staff are trained in the proper use and maintenance of tools and equipment. Since the labour is temporarily employed, they are not provided with any formal training in the use of tools and equipment. However, the supervisors are responsible for instructing the workers and ensuring that tools are properly used and maintained.

The workers are often very conservative concerning the proper use of handtools. Local traditions lead to a reluctance among the workers to use new tools. In Lesotho, the LCU tried to introduce long wooden-handled shovels: however, this did not catch on, although it has been proven that long handles are ergonomically better. Finally they had to accept what the workers wanted to use.

Choice of Appropriate Hauling Equipment

Much effort has been made in designing appropriate hauling equipment for labour-based road programmes. The main types of hauling equipment used are wheelbarrows, animal-drawn carts, tractors and trailers and trucks.

Donkey-carts

So far, it is only the labour-intensive district programme in Botswana which has successfully introduced the use of animal drawn haulage on a wide scale. It is believed that this method also has potential in other countries where animal-drawn transport is commonly used in the rural areas. Donkey-carts have been proven to be competitive for hauling distances up to 3 km.

It should be noted that there are certain limitations to the method, such as hauling distance and the availability of animals in the vicinity of the road site. Secondly, the recent drought in Botswana reduced the use of donkeys since fodder became scarce. During this period many owners were not willing to hire out their animals. However, now that the drought is over, it has become easier to rent donkeys again and the programme is once again using donkey-drawn carts for gravelling purposes.

Tractor and trailers

The most common means of transport on labour-based road construction projects are 3 m³ trailers hauled by agricultural tractors. The great advantage of using trailers is that more than one trailer can be used from each hauler. This means that while one trailer is transported to the site, another trailer can be loaded. Furthermore, the trailers provide a low loading height, which enhances loading carried out by manual labour.

In Kenya, the experience is that the standard Masey Ferguson 65 Hp tractor is appropriate for hauling purposes. In other countries it is felt that the agricultural tractors are not sufficiently robust for road works. Some projects have experienced that the hauler requires an independent frame which bears the load imposed on the machine - not as agricultural tractors, where the engine is an integral part of the frame and carries part of the load imposed on the tractor.

Several manufacturers can produce tractors according to specifications appropriate for labour-based works if requested, as long as the order is of a certain size and number of units. Bell Equipment in South Africa manufactures good quality purpose-built haulers: however, these may be on the large side for labour-based works are the 75 Hp and 10 Hp, but these models are too heavy and are similar to the heavier versions only with smaller engines. However, if requested this design could be modified if the market requires it.

Experience has shown that agricultural trailers are not designed for road works. Instead, the Minor Roads Programme has designed a more robust trailer which has shown a satisfactory performance. This non-tipping trailer can be locally produced and provides a simple-but-durable design which stands up to the loads and strains imposed on the equipment. With the current solid design of the MRP trailer, it cannot be overloaded. It consists of 3 m³ bucket mounted on an A-frame, with a 7000 kg single axle and 900 x 20 truck tires. The loading capacity of the trailer corresponds to the applied task rate system. It has neither side doors nor tailgate. Hydraulic tipping has been omitted, since this item very often breaks down. Decoupling of hydraulics on trailers in a dusty environment several times a day can easily ruin the hydraulics system.

Trucks

Trucks are used for hauling of gravel when the transport distances from the gravel sources are too long for effectively using tractors and trailer. The main disadvantage with trucks is that they are more difficult to load when using manual labour. However, this problem can be solved by proper organization of the gravel pit.

Cost-comparisons

Choice of appropriate equipment should only be done after a proper analysis of the various available equipment has been carried out. This calculation should be based on the current price levels of the various types of equipment in the country, as well as service and repair facilities, hauling distances, amount of work envisaged, availability of equipment from contractors, etc.

Project staff do not carry out the required analysis to arrive at the optimal choice of hauling equipment for the specific conditions related to their project. As an example, the Rural Access Programme in Kenya ordered 500 tractors for short hauls, which are currently used for hauls of up to 20 km.

Furthermore, very little data has been collected on cost and performance in order to compare the competitiveness of tractors and trailers versus the of trucks or other means of transport. In many cases, equipment orders for new projects are based on decisions made on already ongoing programmes

replicating their choice of hauling equipment. This may lead to badly-made decisions, since a series of conditions may change from one country to another. Items such as import taxes, repair facilities and availability of domestic transport contractors and local manufacturers are important factors which determine the competitiveness of various types of equipment. As an example, Kenya has very competitive prices on tractors due to the fact that they are locally produced, and therefore exempt from import taxes. In the neighbouring country, Tanzania, tractors are not produced locally, leading to a less advantageous picture for tractor-trailer alternative.

These cost comparisons should be carried out on a regular basis, complemented with a proper monitoring of the running and maintenance costs of the current equipment fleet the project possesses.

Optimal Size of Equipment

Compaction

The most common compaction equipment used on labour-based road projects are pedestrian vibratory rollers. The labour-based programmes in Ghana and Zimbabwe are currently testing out the use of larger, self-propelled vibrating rollers.

The advantage of the self-propelled rollers is that they are more comfortable to operate and they can maintain more easily a smooth camber. The main disadvantages are that they are more costly and due to the increased size, they are more difficult to transport. In addition, it is evident that more sophisticated rollers need a larger variety of spare parts which may lead to longer down time and reduced availability rates.

In Ethiopia the pedestrian rollers are still preferred. On steep side cuts in mountainous terrain, it was experienced that, due to his elevated position, the operator on self-propelled rollers felt unsafe when compacting on the fill side of the road. Therefore they did not move sufficiently far out on the fill side, leaving the outer section of the road poorly compacted.

When selecting appropriate compaction equipment, the size of the rollers should be carefully adjusted to the size of your operation. Once again, a proper cost analysis should be carried out, including taking into account available service and repair facilities in the country.

This is even more important when involving small-scale domestic contractors for the execution of the road works. These firms do not possess a considerable amount of capital, and in many cases the most limited investment in equipment will represent a major economic venture. In such cases it is extremely important to select a set of equipment which (i) the contractor is able to finance and which represents an amount that can be recuperated in a not-too-long period, and (ii) can be used for other purposes and job contracts outside the road sector.

Transport for Supervisory Staff

Transport for site inspection is often a considerable cost item on labour-based road projects. The means of transport used for this purpose ranges from bicycles to expensive four wheel drive vehicles.

In Namibia the roads authorities have decided to introduce 4-wheel motorbikes for the site supervisory staff.

Bicycles and motorbikes have been successfully used for routine maintenance inspectors in some road programmes. When supplying staff with this type of transport, experience has shown that the lifetime of

this equipment has been considerably extended when it has been sold to the staff, thereby transferring the responsibility for mechanical maintenance to the supervisor.

Towed Graders

Zimbabwe has established a solid and positive experience on towed graders providing good performance and availability. The labour-based programme in Kenya is currently trying to replicate this in the Roads 2000 project¹. The strategy of Roads 2000 is to maximize the use of labour for routine maintenance works only using equipment for activities where use of labour is not feasible. As a result, 5 tonne towed graders drawn by a 108 Hp tractor are used for grading the running of the road. The side drains are still maintained by labour.

In Tanzania, trials showed that towed graders performed very well. Light grading of the running surface did not deform the camber.

Rock Breaking Equipment

Due to mountainous and rocky terrain, Lesotho has tried out several types of rock-breaking equipment. These studies showed that as long as it was technically possible, manual methods were cheaper than the use of equipment.

However, the choice of optimal rock breaking methods relies on the amount and type of rock to be excavated. This activity must be tuned into the other site activities in order to avoid delaying other operations. In certain areas of Lesotho with long road sections of rock excavation, drilling and blasting are the only viable alternative.

Fire on rock works well in Zimbabwe and Ghana: however, the method has failed when applied to some rock types found in Lesotho and Nepal.

Role of Local Manufacturers

The role of domestic manufacturers in the supply and maintenance of tools and equipment to labour-based road projects remains to be fully exploited in most countries in the region. A great deal of the tools and equipment used on labour-based road projects do not require any sophisticated technology and can be produced locally.

In Sierra Leone the roads authorities experienced that locally produced machetes manufactured from used vehicle springs performed better than imported models.

Local manufacturers often have a limited production capacity. It is therefore important to plan well ahead when engaging small domestic suppliers. In some cases it may be necessary to split the order into several smaller quantities, thereby matching the size of order to the capacity of the manufacturer.

A second problem for small suppliers is that they are more vulnerable to cash flow distortions due to delayed payments from the client. In some countries, local manufacturers are not interested in delivering to government agencies because they are unable to pay on time.

Previous efforts have shown that to further involve the local manufacturing industry requires a solid effort in terms of identification of suppliers, quality assurance, follow-up on payments, etc. The ILO should play a stronger role in promoting the use of local manufacturers.

Preventative Mechanical Maintenance

A preventative equipment maintenance programme is very important in order to achieve high availability rates and low equipment hire rates.

In Kenya, recent studies have shown that the costs of mechanical maintenance were reduced by 35% - 40% after the new organization of the workshops was introduced in the Minor Roads Programme.

For an equipment fleet of 500 units, the Kenya MRP requires a total of 26 qualified mechanics, 8 at regional level and 2-3 in each of the 9 districts. The mechanics and operators were trained at the Kisii Training School.

In order to achieve good quality workshops, ad-hoc repairs on-site should be avoided as much as possible. Mobile repair units provide better quality maintenance and repair works. In addition, old equipment or parts of it should be replaced ahead of time before major breakdown occurs on site. The below table describes the lifetime of most common equipment in the Minor Roads Programme.

Equipment lifetimes in MRP, Kenya

Equipment	Lifetime	Annual Usage
Landrovers	10 years	25000 km/year
Motorcycles	4 years	8-9000 km/year
Tractors	10 years	6-7000 km/year
Truck	8 years	20 000 km/year

Maintenance of hand-tools is another major area where improvement can be made. It is important to train the tool-keepers in proper maintenance of tools in order to provide the workers with good quality equipment, thereby improving site productivity and the working environment.

Further Action

Co-ordination of Efforts

There is a high demand for a co-ordination of efforts in research and development of appropriate design of light construction equipment for labour-based road works. Since the country programmes do not pass on their info to other programmes, tests and failures of equipment are often repeated.

One of the purposes of establishing the Information Services of ASIST is to ensure that important experience gained in the various labour-based programmes is shared with other practitioners. ASIST in collaboration with a project can also initiate further research and development in specific fields as and when requested by its clients. However, in order to meet the demands and be able to prioritize its activities, ASIST needs an initial input in terms of ideas and initiatives from the managers of the various labour-based programmes.

Several proposals for action are recommended in the paper presented by Robert Petts. Parties interested in

carrying out these recommendations and in how to contribute to these issues should co-ordinate their inputs through the ASIST Technical Enquiry Service.

Guide to Tools and Equipment

There is a demand for guidelines on appropriate design and specifications for tools and equipment for labour-based road works. The ILO Guide to Tools and Equipment, published in 1981, should be revised and updated to include the recent developments of the technology. A great deal of experience has been gathered since the guide was first published.

When introducing small-scale contractors to labour-based road works, it is particularly important to recommend proven designs of affordable equipment which can easily be maintained and allows for a certain flexibility of use in different sectors.

If the ILO can provide detailed recommendations on design and specifications for tools and equipment, the project managers can use this as a reference to convince donors of what is required.

Secondly, the revised version of the Guide should also describe appropriate procurement procedures for obtaining high quality equipment as well as guidelines for an increased involvement of local manufacturers.

Project Background

With financial assistance from DANIDA and SIDA, the Government of Zimbabwe, through the Department of State Roads of the Ministry of Transport, commenced in 1991 a road rehabilitation programme using labour-based methods and local resources. A first pilot site started in 1991 with technical assistance provided by a Danish consultancy firm, COWIconsult. Under this project, demonstration sites have been implemented, management procedures and administrative systems have been developed and tested and staff trained. This project was positively evaluated in 1993 and it has been proposed to expand and institutionalize these activities during a six year period starting mid 1994. SIDA and DANIDA will continue to provide financial and technical support, with 35% of the invest costs for the works being provided by the Government of Zimbabwe.

Design Standards

The design of these roads complies with the design standards used by the Department of State Roads for low-volume all-weather gravel roads. Figure 3.1 shows the cross section of the roads being constructed by the labour-based programme.

The roads originally dirt tracks which are now upgraded to a 6 m carriage way with a 15 cm gravel layer. The roads alignment runs through tribal communal lands in slightly rolling and rocky terrain. Before the rehabilitation works, access was restricted to the dry season, with approximately 20 vehicles per day. The average daily traffic on the completed road section has been registered at 50 - 70 vehicles per day.

Work Methods

The projects are executed using labour-based construction methods complemented with light equipment for compaction and hauling of gravel and water. All earthworks are carried out by manual labour. Excavation of gravel, drainage, camber formation and installation of culverts is done by hand. Gravel is transported by tractor drawn trailers but loaded, unloaded and spread by labour. Compaction is carried out by Bomag pedestrian rollers. Gravel sources have been located in the vicinity of the road alignment.

DANIDA Project

The DANIDA assisted project started out with the upgrading of 28.7 km of Road 185 in Mudzi and Mutoko District. These works were completed in August 1993, the project commenced construction on Road 278 and has so far completed 21.2 km.

The work has been carried out by extensive use of labour combined with a fleet of light equipment. Operating at full strength, the project has employed around 400 labourers, divided into two teams. Each team has 5 supervisors, with ne being in charge overall per team. This construction unit has experienced a maximum output of 4 - 4,5 km gravelled per month during the last half of 1992 and the beginning of 1993.

The equipment pool consists of the following:

- 6 tractors MF 390
- 12 Tinto non-tipping trailers 3 m³
- 4 Bomag pedestrian rollers 950 kg
- 2 water bowsers 4500 l (Tinto)
- 2 water bowsers 1000 l (Tinto)
- 2 Honda water pumps
- 2 generators 11 & 5 kVA)
- 1 tipper truck (to be replaced by a 5 tonne flat bed truck)
- 2 Toyota Hilux single cab
- 2 Honda motor bikes

Table 3.1 and figure 3.2 and 3.3 summarize the costs and labour productivity achieved so far on this project.

Road No.	Prod. km	work days	Wd/km	Cost	Cost/km
185	28.72	99,084	3,450	2,572,264	89,564
278	21.2	54,883	2,589	1,311,633	61,869
Total	49.92	153,967	3,084	3,883,897	77,802

Table 3.1 Production and Cost Data (Zimbabwean Dollars)

Major Constraints

Long and expensive water haulage during the dry season, particularly May to November 1992.

Inadequate cement supplies for drainage works.

Considerable down time on the tractors and trailers as the equipment got older. This is mainly related to the hitch, fuel injectors, rims and tires on the tractors, and lacking A-frame on the trailers causing the trailer axle to become loose, and cracking o the bucket.

Figure 3.2

Figure 3.3

Senior staff salaries for engineers, and partly superintendents and stores assistants.

Staff housing and office units. These are costed instead on a monthly hire charge basis.

Expatriate staff salaries and accommodation, and supervision vehicle costs.

Miscellaneous costs such as classroom rental, photocopier, computer, etc.

Labour Statistics

Each of the road construction projects has provided temporary employment to approximately 1300 unskilled workers recruited from the nearby villages, of which on average 25% were women. The duration of their employment has varied, with approximately 50% recruited for a minimum period of three months. Table 3.2 summarizes the total numbers employed and their gender distribution.

Road No.	Men		Women		Total to date
185	1065	76%	327	23%	1,392
278	906	73%	336	27%	1,242

Table 3.2 Employment Data

90% of the works carried out by the unskilled labour has been organized as task work. The daily wage rate for casual unskilled labour is currently 8.73 Z\$/day (US\$ 1.34).

With financial assistance from SIDA and with technical assistance provided by the Swedish consulting firm SWEROAD, rehabilitation works commenced in April 1993 on the 18 km Mutoko -Nyamazuwe section of Road 185. Currently this project is progressing with a monthly production of 4 km executed by two teams of 200 labourers. Each team is assisted by an equipment fleet consisting of 3 tractors and 6 trailers, 1 water bowser and 2 rollers (1500 kg). Average number of work days is currently 2269 wd/km. The project is expected to be completed by November 1993 at a final cost of 70 000 Z\$/km (11 500 US\$/km).

Project Background

With financial assistance from DANIDA and SIDA, the Government of Zimbabwe, through the Department of State Roads of the Ministry of Transport, commenced in 1991 a road rehabilitation programme using labour-based methods and local resources. A first pilot site started in 1991 with technical assistance provided by a Danish consultancy firm, COWIconsult. Under this project, demonstration sites have been implemented, management procedures and administrative systems have been developed and tested and staff trained. This project was positively evaluated in 1993 and it has been proposed to expand and institutionalize these activities during a six year period starting mid 1994. SIDA and DANIDA will continue to provide financial and technical support, with 35% of the invest costs for the works being provided by the Government of Zimbabwe.

Design Standards

The design of these roads complies with the design standards used by the Department of State Roads for low-volume all-weather gravel roads. Figure 3.1 shows the cross section of the roads being constructed by the labour-based programme.

The roads originally dirt tracks which are now upgraded to a 6 m carriage way with a 15 cm gravel layer. The roads alignment runs through tribal communal lands in slightly rolling and rocky terrain. Before the rehabilitation works, access was restricted to the dry season, with approximately 20 vehicles per day. The average daily traffic on the completed road section has been registered at 50 - 70 vehicles per day.

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Small-Scale Contractors

1. [Improve Your Construction Business](#)
2. [To what extent can Experiences in Training Contractors and their Staff be carried from one Country to Another?](#)
3. [Labour-based Contracting: Contractor Management](#)
4. [Labour-based Contracting: Uganda's Experience 98](#)

I. Improve Your Construction Business:

Entrepreneurship Training for Small-scale Contractors in the Labour-based Road Sector

By Claes-Axel Andersson, ILO Improve Your Construction Business Programme

SYNOPSIS

This paper starts with a brief introduction to the Construction Management Programme of the ILO followed by a description of the Improve Your Construction Business (IYCB) programme, from how it was developed or a contractor training project in Ghana to the present plans for geographical and sectoral expansions. The paper ends with a discussion on the possibilities of applying the material and methodology for more specialized parts of the construction sector such as labour-based road maintenance and construction based on a presentation of the recently started project "Entrepreneurship training for labour-based road maintenance contractors" in Lesotho.

The ILO Construction Management Programme

Introduction

Since the middle of the 1970s, the ILO has been in the forefront of the development of national construction capacity and in the dissemination of construction management knowledge and skills. The growth of the ILO Construction Management Programme (CMP) has been aligned with, but separate from, the development of infrastructure programmes relying on the cost-effective utilization of locally available human and material resources.

Drawing on the results of 20 years' practical experience and research, the CMP offers a unique service in international construction industry development. It is based on the application of professional engineering and management skills coupled with extensive experience from numerous projects in Africa and Asia. A particular strength is the range of training methodologies that have been built up and tested in practical technical co-operation projects. Examples are the forthcoming International Construction Management (ICM) series of textbooks for large construction firms, the Inter-active Contractor Training (ICT) modules to develop basic construction management skills, and the Improve Construction Business (IYCB) handtools and workbooks for owners and managers of small construction enterprises.

History

In the early 1970s support by the Overseas Development Administration (ODA) enabled the United

Kingdom-based Intermediate Technology Development Group Ltd. (ITDG) to pioneer management training for owners and managers of small contracting firms in newly independent developing countries. The demand for this assistance grew rapidly, and it became clear that it would be more appropriate for the work to be taken forward by a larger organization with greater resources and more extensive international links. The ILO, with its highly reputed general Management Development Programme and special interest in the development of small enterprises, sized this opportunity and started to promote programmes to assist the development of indigenous construction industries in member states. The development of this Programme has proceeded through three distinct phases:¹

1. Exploration of needs and priorities; development of pilot training materials.
2. Pilot regional programmes, including seminars and workshops, to discuss experience, formulate strategies, and test out and publish training materials and prospective publications.
3. Institution building, primarily through the design and implementation of national technical co-operation projects.

The first phase from the mid 1970s to 1980 was exploratory in more senses than one, since the needs of domestic construction industries in developing countries had been generally neglected and the ILO was unsure of its potential role in providing assistance to its member states in the specialist field of construction management. During this period the programme was run on a part-time basis by various ILO officials without any background in construction, and relied heavily on outside consultants for its field activities. The main event was a three week "training of construction management trainers" course for Africa held in Nairobi in 1976, and the three Publications as its "small building contractor" series².

The outcome of the exploratory phase was a growing appreciation of the importance of this neglected group of owners and managers of small enterprises, and the Government of Norway agreed to support an ILO project for the African region "to create in the participating countries a basic capability for delivering management training to small-scale building contractors". This provided a firm base for the establishment of the Construction Management Programme, and the first full-time Director was a qualified civil engineer who was also a management specialist and had extensive experience in developing countries.

With an experienced professional engineer in charge, the Programme began to benefit from the application of a more systematic and goal-oriented management style. Thus the second phase included an examination of the policy constraints which adversely affect the performance of domestic construction industries in developing countries in the books "Foundations for change"³ and "Guide-lines for the development of small-scale construction enterprises"⁴, while the earlier training initiatives were consolidated with the publication of three Interactive Contractor Training (ICT) modules⁵ and an accompanying book "Training contractors for results".⁶ It led naturally into the third phase which began with an examination of the policy constraints which adversely became clear that more emphasis needs to be put on institution building in order to achieve sustainable sectoral development. The lessons learned during these studies have been distilled in the recent book "Building for tomorrow".⁷

Current activities

A complete review of experience during the initial phases led to a decision to develop a comprehensive and distinctive range of products and services covering three main areas of activity:

management of technical cooperation projects;

consultancy and advisory services;
training and management development.

Table 1. *Construction Management Programme: Main activities*

The ILO was among the first international organizations to appreciate the need to develop a range of construction management training systems and methodologies to suit the special needs of its member states. These needs themselves are far from uniform, and range from large and sophisticated construction organizations employing computer-based management information systems to small contractors specializing in the construction and maintenance of rural roads using labour-based techniques. With these considerations in mind, the CMP has been engaged in a major effort to develop a range of products and services to support its technical cooperation, consultancy and advisory activities. CMP publications can be divided into five categories:

- Conceptual studies and information papers
- Practical manuals
- International Construction Management text books (ICM)
- Interactive Contractor Training modules for trainers (ICT)
- Improve Your Construction Business handbooks and workbooks (IYCB)

Since the main focus of this paper is on training of contractors for the labour-based public works sector the following section will focus on the IYCB materials and methodology which are specifically designed to improve the performance of small construction enterprises (for a complete list of publications, see Appendix I).

The Construction Management Programme was transferred from the Management Development Branch to the Policies and Programme for Development Branch (E/DEV) in April 1993. The previously established link between CMP and the labour-based public works activities of E/DEV was thereby strengthened. The contractor training programme in Lesotho is a pilot project concerning utilization of previously developed training material (the IYCB material) when training contractors in this specific sector. Before presenting and discussing the Lesotho programme more in detail it may be helpful to describe how the IYCB materials and methodology were developed.

Improve Your Construction Business

Target group

The CMP had already developed the Inter-active Contractor Training (ICT) training modules for construction enterprises of modest size. However, the target group for this material is sufficiently well established to employ a number of specialist managerial and supervisory staff and apply conventional construction management techniques. The many owners/managers of much smaller enterprises, or whom the management of their enterprises is a personal and part-time activity, required a more basic approach.

Improve Your Business (IYB)

In its search for means to assist this target group, the Construction Management Programme drew upon the experience of another ILO programme - IYB or "Improve Your Business". IYB consists of self-teaching material that introduces the user to basic management techniques such as business analysis, financial analysis (accounting, key ratios, etc.) and activity financial planning. The material is packaged neatly in the form of a "handbook" and companion "workbook", and includes checklists and a reference guide,

together with advice on how to prepare an action plan and practical suggestions on how to bring the plan to fruition.

IYB had proved very successful in assisting small traders and manufacturers of simple products but, as CMP experience had shown, it was not sufficient when trying to cater for the specialized needs of small construction enterprises. A useful definition of a small business (and small construction businesses) is that it is one in which the manager or owner spends much of his or her time actually carrying out the function of business⁸, so it follows that there are disadvantages in separating management from technical training. Indeed ILO thinking on small enterprise development now emphasises the importance of a sectoral approach to training and consultancy.⁹

Improve Your Construction Business

The answer seemed to be for the CMP to draw upon the experience of the IYB programme and develop a system which would meet the specific needs of small contractors called IYCB or Improve Your Construction Business. Rather than attempt to produce a generalized version and then test it in field conditions, it seemed best to develop the system in one country so that it would be possible to work practically with both the beneficiaries and the individuals and organizations who could provide training, advice and continuing assistance.

Luckily this idea coincided with a request to prepare a technical cooperation project to improve the performance of local construction enterprises in Ghana, which certainly offered a demanding environment and was of particular interest in view of the Government's action to secure an effective transition from a centrally planned economy to one based on enterprises within the private sector. Thus it seemed probable that if a system could be successfully developed in Ghana, it would be very likely to be suitable for replication in other countries with comparable problems and aspirations.

The Ghana IYCB project

Many small-scale contracting firms in Ghana claim to be capable of implementing basic building and infrastructure projects, but fail to deliver quality work at reasonable cost within designated completion periods. Clients, consultants and the contractors themselves all appreciated that these enterprises needed help, and the Government of the Netherlands was approached to support an ILO-executed Improve Your Construction Business project. In view of the ILO's emphasis on institutional support to ensure sustainability, the enthusiastic support of the Civil Engineering and Building Contractors Association of Ghana (CEBCAG) and the existence of a well-established management training institution in the Management Training and Productivity Institute (MDPI), was seen as two main pillars for the project to rely and build upon. The planning of project implementation started in early 1990.

The duration of this first IYCB project was two years and the promised outputs were somewhat optimistic for such a short project:

- 10/15 trainers/councillors to be trained;
- owners/managers of 120-150 small-scale construction enterprises in selected secondary towns in Ghana to be trained;
- development of IYCB handbook, IYCB workbook and trainers' guide.

Assessing problems and needs

The mainly step was to determine the problems, practises and needs of the target group.¹⁰ This was done by circulating a questionnaire asking for a statement of problems and suggesting possible topics for training in six broad categories and was supplemented by face-to-face discussions with individual owners and managers at fact finding workshops in all ten provinces. These sessions were effectively "small-scale construction enterprise clinics" and respondents saw a "great need" for training in 42 topics, and there was general agreement that inadequate (or non-existent) construction management training was at the root of many of their problems. For example, contractors complained that "bank financing is difficult to obtain and is very expensive at 30 per cent interest". Following discussion, the complainants admitted that contractors generally have a poor repayment record and few have the skills to keep accurate accounts and make reliable forecasts of costs and cash needs. Thus it was decided that the training workshops should include discussion of the accounting needs of the small contractor, training in basic book-keeping and accounting, and advice on how to prepare a simple cash flow projection for a small building contract.

Another serious problem was that "a claim for payment has to go through no less than 30 separate stages before the cheque eventually reaches the contractor, and the whole process never takes less than 14 weeks (and often a good deal more)". Although training alone would not solve this problem, it was accepted that the workshops could help by developing the skills that contractors need in order to prepare certificates in a form that enables them to be rapidly and easily checked by the officials (50 or more!) through whose hands they pass.

The project team grouped the identified problems into ten different clusters as seen in Table 2 below.

Table 2. Ghana building contractors: Identified major problems

Problems
1. Contractual procedures
2. Inadequate market opportunities
3. Financing the work
4. Obtaining performance bonds
5. Site operations
6. Quality control
7. Availability of plant
8. Lack of skilled labour

9. Manufacturer's problems
10. Getting paid

Result-oriented training

The preliminary discussions gave the project team a clear insight into the way in which these contractors run their business and the type and nature of the training required. What they were seeking was practical advice on how to improve the performance of their businesses, so it was decided that the IYCB workshops should be strongly result/action oriented with little formal lecturing, and heavy use of "action learning" groups to discuss problems and tackle them as case studies.

The sessions on estimating and tendering, for example, should enable each participant to produce a model of the bidding process to suit his or her own business environment, so the training was planned in eight successive steps (see following box).

Table 3. IYCB Training Example: Estimating and Tendering

1. The participants take measurements and notes during a site visit, then:
2. Prepare their own simple working drawings and site layout, then:
3. Produce a basic set of standard specifications, and:
4. Design a simple contract, then with the working drawings:
5. Prepare a list of quantities which allows them to:
6. Calculate direct project cost, and then to:
7. Estimate indirect project cost, and finally:
8. Prepare a quotation or bid.

Project strategy

With the training priorities identified, the project team faced three main tasks before the workshop programme could commence:

- preparation of training material;
- formulation of a strategy for training delivery, and;
- planning a 3-week training of trainers course.

In keeping with the findings of the training needs survey, the original versions of the handbook and workbook were each divided into six sections. It quickly became apparent that the result would either be to omit or gloss over matters of essential importance, or to end up with books that were too bulky to be readily used by the target group. The only answer seemed to be to split up topic into three broad subject areas, each with their own handbook and workbook, which would have the additional advantage that

readers could start by tackling those areas of their business which were in most urgent need of improvement.

For small contractors, estimating and tendering are crucial activities. Construction is a fiercely competitive industry; profit margins are often low and a small mistake on pricing a tender document can make all the difference between a worthwhile profit and a serious loss. Furthermore each individual project is taken on at a fixed price and represents a significant proportion of the contractor's annual turnover, so one serious error in pricing a single project can undermine the stability of the enterprise as a whole. Yet many small contractors lack even the most elementary grasp of cost accounting, and estimates could frequently be more accurately described as "guesstimate". Thus the first handbook and workbook were entitled "Pricing and Bidding". The two priority topics of project planning and productivity are essentially site activities, so the second handbook and workbook covered "Site Management". This left the range of activities concerned with managing the enterprise as a commercial entity, including ensuring a reasonable balance between workload and resources, which comes under the general heading of "Business Management".

Selection of training cohorts

The number of participants at the training of trainers course was decided to be 18, which is the maximum for the kind of highly participative sessions that were judged necessary to achieve the project's team building objectives. The figure of 18 was significant, since all ten CEBCAG Regional Committees demanded that they should participate in project activities and the manufacturers of building materials also sought assistance. The answer seemed to be to form six three-person teams or "cohorts", one of which would work with the manufacturers while the other five should each be responsible for delivering training and consultancy advice to contractors in two adjoining regions.

The building materials' cohort was made up of manufacturing specialists and the five contractors' cohorts were well balanced, each containing one MDPI trainer together with one CABACAG member from each of the two participating regions. Preliminary enquiries showed that the demand for training far exceeded the provision in the project document; CEBCAG's regional members requested that the proposed 8-10 workshops of 1-2 weeks duration should be increased to 6 workshops of one week in each of the 10 regions, or 60 workshops altogether. In response to this request, the Government of the Netherlands agreed to support a 6-month project extension which would permit this increased output, and would also increase the number of owners and managers of construction business who would benefit from the programme from between 120 and 150 to more than 200.

Project outputs

In Ghana the IYCB project is an indisputable success. The formal project outputs have been substantially exceeded:

- 18 trainers have been trained (10/15 promised),
- 200 contractors trained (120/150 promised);
- 3 handbooks, 3 workbooks and a trainers' guide developed (one of each promised).

The new interest in contractors and their potential contribution to national prosperity cannot be measured by statistics alone; CEBCAG and its members feature regularly in the local press and members of training cohorts are generally proud to be part of the national IYCB team. The sustainability of improvements can never be guaranteed, but it is very encouraging that MDPI, together with CEBCAG, continues to deliver IYCB training in all regions of Ghana one year after the local project activities terminated in the autumn of 1992.

Lesotho, Entrepreneurship Development for Labour-based Road Maintenance Contractors

Applying the IYCB system

IYCB is now about three years old, and the Ghana project has shown that the concept has worked well in one country. The IYCB approach has potential for a geographical expansion and will probably also develop from its original focus on building contractors into several specialist sub-sectors such as the manufacture and distribution of building materials, building maintenance and labour-based road construction and maintenance.

A number of African countries have shown interest in using this methodology to increase the productivity of their local construction industries and some proposals have resulted in concrete initiatives. A pilot project, testing the validity of the IYCB concept in Kenya, is presently being evaluated to determine whether a full-scale intervention is feasible. A similar test has been prepared for Malawi and previously mentioned, a project to apply the IYCB concept to the development of labour-based road maintenance contractors in Lesotho started in April 1993.

Lesotho, background

In Lesotho, as in most countries which have initiated labour-based road construction and maintenance programmes, these activities have so far generally been organized on force account using labour recruited from local communities. The Labour Construction Unit (LCU) located within the Ministry of Works was founded in 1977 with two primary objectives; to promote efficient use of labour based construction methods in Lesotho and to create as much gainful employment as possible. It has since grown into a substantial organization with more than 260 support staff and a manual labour force of about 1,800 and is currently responsible for routine and periodic maintenance of about 700 km of gravel roads.

A long-term (20 years) LCU development plan was prepared in 1989, envisaging reorganization of the LCU. In line with general GoL policy, the LCU now intends to involve the private sector in undertaking the works, provided they can adapt to labour-based, employment-intensive techniques. This will entail considerable initial support and training for the contractors and government supervisory staff, but will significantly reduce the projected government establishment while substantially increasing private sector employment and achieving overall cost savings and greater operational efficiency and flexibility.

The Lesotho construction industry is currently dominated by foreign and non-Basotho, locally-based contractors. There are no domestic contractors specializing in roads and civil construction and domestic building contractors are poorly capitalized and lack essential managerial and business skills. This project is based on a step-by-step approach to contractor development helping them take advantage of relevant market opportunities. The niche market of labour-based road maintenance is one which offers potential growth and an opportunity for domestic contractors to develop the basic business and technical skills that will be needed if they are to take a larger share of the market for civil works.

Selection of participants

The fact that no domestic civil works contractors exist means that the training, in addition to management aspects, also must fully cover the basic technical aspects of road maintenance. Another complication was the absence of an apparent group to recruit the trainees from. Consideration was given to three alternative sources for recruitment of routine maintenance and regravelling contractors. Firstly, existing domestic building contractors having the advantage of understanding the competitive nature of the construction

industry but lacking experience and plant for the road sector. Secondly, haulage contractors owning tipper trucks which could make them competitive for regravelling, although their experience in building contracting is limited and thirdly, LCU road supervisors - particularly Senior Technical Officers (STOs) and Technical Officers (Tos) - having relevant technical knowledge and experience but might lack capital and business experience. The selection of suitable LCU staff members to participate in the training course in order to later on administer the contractors work was done by LCU themselves.

Based on the tremendous interest in participating, it was decided that 14 potential contractors (project document: 10 No.) should accompany the three LCU representatives in the first round of training that started in May 1993. When carefully assessing the prospective road maintenance contractors the likelihood of creating or strengthening a suitable contractor was emphasized. The conclusion was that relevant business experience was made an important criteria in the selection process.

After assessing expressions of interest from all three groups mentioned above, the selected 14 was composed of one very experienced and highly appreciated STO in LCU while the other 13 had their background in contracting or other construction related companies, either as owners or in a managing capacity. After one week of training, when the general conditions and associated risks for a contractor in the labour-based field had been presented, the former STO opted for staying on as LCU staff member and followed the rest of the training in that capacity. It was, of course, much better to opt out at this stage, before putting his and his family's savings at risk, but it was also another illustration showing that a technician, perfectly mastering those aspects of running construction work, does not necessarily make a successful contractor.

Training concept

Given the participant backgrounds it was considered necessary to offer them an integrated programme where classroom and practical training is mixed. The first step was a six-week "class-room" training that started on the 10th of May this year. Following an assessment during this course it was decided that additional training on "contracts and tendering" as well as practical on-site training was needed before the trainees could take on their test-contracts.

The first of these contracts, routine maintenance, running up until Christmas, is to start towards the end of September, so the contractors are currently mobilizing their resources. An assessment of the contractor's performance on the first contract will be undertaken in mid-January 1994, and their second test contracts (regravelling) are supposed to cover the time between February and June next year.

Training material

The IYCB material is designed according to a modular concept and its three original titles 1. "Pricing and Bidding", 2. "Site Management, and 3. "Business Management" each cover a coherent group of subjects. This main set of three Handbooks and three corresponding Workbooks are written so they can be used both for self-study and in a classroom setting. A Trainer's Guide, containing suggested exercises, discussion topics, suitable handouts and general training advice will be available to help the trainer design a contractor training programme that fits the identified needs of the trainees.

Training materials has unfortunately often been developed on a project related basis. This has led to numerous "re-inventions of the wheel" where previously developed material was completely ignored when designing material for a new project. Everybody, including the "training adviser", realizes, of course, that it would be useful to build upon existing material but either because he/she does not know it exists or

because the material actually he/she finds is too country- or region-specific it is seldom of any help when designing methodology, books etc.

In order to achieve flexible and generally applicable material, these aspects need to be considered already during the design stage. Applying this principle does not mean that you do not adjust the training programme and your material to local conditions but rather that, for instance, "country-specific" rules and regulations are covered in separate modules that can be used together with the knowing local conditions well enough to be able to prepare exercises etc., based on local conditions, if the general ones in the Workbook do not correspond with the situation where the contractors are to work.

When developing the IYCB package, it was primarily designed for general building contractors. Building was seen as the best basis for "general material" since it covers a larger number of activities compared to most other sub-sectors, for example road contracting. It includes virtually all stages and aspects of contracting normally forms the "centrepiece" of the domestic construction industry in virtually all developing countries.

By choosing building as the basis for the material, several positive features were automatically gained. The most obvious being it that represents the largest market for training but even more important, a better position to create or strengthen contractors for long-term survival or even expansion on the market. If you aim at creating strong small scale contractors, available to carry out contracts several years down the road, the danger of too much specialization and accompanying inflexibility must be avoided. The ups and down of all domestic construction markets need to be bridged. By their size and often accompanying limited amount of resources tied in sector-specific plant they are more flexible than their colleagues in the medium sized companies but have less financial resources to overcome temporary changes in the market.

Although the three IYCB books use building contracting as a basis, the emphasis is primarily on the business and entrepreneurial aspects of running a small-scale contracting firm. These aspects are fairly similar regardless of which part of the construction business you work in. All contractors need to ensure all their indirect costs are included in their bids, plan deliveries of building material and prepare a simple cash-flow for a project to take one from each of books No. 1,2 and 3.

To extend the IYCB concept and facilitate tailor-made training for other sub-sectors than building contractors, a set of complementary Handbooks and Workbooks is planned to be developed when suitable projects are available. For the Lesotho project a ROMAR (Road Maintenance And Regravelling) package, currently only in draft form, is one of the outputs listed in the project document. This package covers all the technical aspects of how to maintain and regravell secondary roads using labour-based methods. Another output, to be produced in the project's later stages, is guidelines for an extended training, incl. training material, covering construction and rehabilitation of labour-based roads (ROCAR).

Training course

The six-week training course held in May-June this year in the LCU Training Centre in Teyateyaneng was divided into two major parts. The first three weeks covered the technical ROMAR material while the following three weeks were voted to the management aspects.

This entire course provided, because of the participants practical background, a mixture of short lectures, site visits, discussions and tutorials. The subjects were generally presented using a three-step approach where step one is an introduction and presentation by the trainer, often using examples from the Handbook. In the following step the trainees were given some exercises/problems to solve, either individually or in

groups, and the last step was for the trainer to evaluate the trainee's results on the exercises and clarify and complement previous training, if necessary.

To ensure that the trainees are able to use the knowledge gained from each of the different training modules not only individually but also when interacting in a normal business environment a number of group tutorials were given where several skills had to be employed simultaneously. These tutorials were often coupled with a site visit to further underline the linkage between theory, learned in the class-room, and practical application in the normal small scale contractor element of the linkage between generally applicable training material and the local conditions pertaining.

An example:

1. The importance of undertaking a proper site inspection before preparing a bid was presented and discussed in the class-room, using IYCB Handbook 1 as a basis.
2. The trainees solved some exercises from the Workbook.
3. A tutorial was given where the trainees, after a site visit to an LCU site, should list all the necessary background information they discovered concerning location of gravel pits, where and how to establish a site camp, etc.
4. The trainees results were evaluated and some clarifications and explanations were given in a follow-up session.

The fully incorporate local laws, rules practice and regulations in the training some guest lecturers were invited to cover items such as local labour legislation and safety & health regulations. This is seen as a most important component in view of ILO's commitment to showing contractors that lower cost and higher productivity can be achieved by good management while adhering to standards and regulations.

The first training session in Lesotho was highly appreciated by the participants that felt well prepared for their future tasks although they expressed a wish for repetition of selected parts of the training all through the programme.

Issues for discussion

1. Special needs of business training
2. Links between business and technical training
3. Characteristics of the ideal trainer
4. Training needs of client staff who will supervise contractors
5. How to select contractors for training
6. Value of a modular approach to training material preparation
7. Methods improving feed back from projects on training systems and case studies
8. Evaluation of training

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Appendix 1

ILO Construction Management Programme

Products and Services

1. Conceptual studies and information papers

The five conceptual studies produced by the CMP are intended to provide policy-makers with ideas and suggestions on new ways of improving the competitiveness and performance of national construction industries.

Foundation for change (1984) examines the patterns of organization of construction industries in developing countries, and shows how the institutional framework could adapt to make better use of local human and physical resources.

Guidelines for the development of small-scale construction enterprises (1987) distils and analyses the extensive experience of the ILO in devising and implementing management development and training programmes for small-scale construction enterprises.

Training contractors for results (1987) provides guide-lines for the assessment of the management training needs of contractors, and delivering integrated training programmes to enhance technical, managerial and financial skills.

Building for tomorrow (1991) is a handbook of ideas, methods and techniques to help national construction industry development institutions to improve performance. It is based on four case studies of successful institution building, and offers a 12-point action plan that will have an immediate impact on the performance of the institution.

Training on tap (forthcoming) examines the scope for applying modern distance learning techniques to provide cost-effective training for construction managers and supervisors.

The Construction Information Papers (CIP/-) are the outcome of practical research on issues of international interest. The series was started in 1991, and current titles are:

CIP/1 *Small-scale construction enterprises in Ghana: Practices, problems and needs* (1991)

CIP/2 *The construction industry in Nepal: Practices, problems and needs* (1991)

CIP/3 *Women can build: Women's participation in the construction industry in Sri Lanka* (1991)

CIP/4 *A strategy for the China International Contractors' Association: CHINCA* (1991)

CIP/5 *Room for improvement: a study of women building workers in Bombay* (1992)

CIP/6 *The impact of the ILO Construction Management Programme on the development of small construction enterprises* (1993)

CIP/7 *Building her future: Guidelines for encouraging women's participation in construction industry development projects in India* (1993)

2. Practical manuals

These four manuals provide succinct advice for practising construction managers, and take special account of the needs of managers in developing countries.

Managing construction projects (1984) is a fully illustrated guide to planning and controlling the construction process from briefing through to commissioning, and is based on internationally accepted procedures.

Construction management and technology: A bibliography for developing countries (1987) countries, divided into three sections "Maintenance strategy", "Maintenance management" and "Maintenance methods".

Improving site productivity in the construction industry (1987) provides a practical and readable introduction to the application of work study techniques in the construction industry.

3. International Construction Management (ICM)

This series of text books (all forthcoming) has been written to assist engineers and other construction professionals who will be involved in bidding for, negotiating and managing major international construction projects.

The titles are:

International project accounting

International bidding case study

Project finance

Bid preparation techniques

Technology transfer

International project marketing

Managing international construction projects (Management guide for senior management)

4. Interactive Contractor training (ICT)

This range of training modules for upgrading the management skills of construction managers and owners of small and medium-scale construction firms contain learning texts together with worked examples, exercise and simulations. They also provide a model of how learning-effective material for construction managers should be structured.

Module 1 : Estimating and tendering (1987) provides the basis for a simple, but comprehensive, introduction to the calculation of quantities and pricing techniques.

Module 2 : Project planning (1987) describes how enterprises can improve profitability through effective planning, the preparation of schedules for labour and materials, and the forecasting of cash flow throughout the project. It also contains sections on network analysis, and offers advice on putting the plan into action.

Module 3 : Site productivity (1987) describes specific ways of improving productivity including better site layout, more effective supervision, measuring site activity and reviewing work methods.

5. Improve Your Construction Business (IYCB)

The Improve Your Business system (forthcoming) consists of **three handbooks** and **three workbooks** covering all the essential aspects of managing a small construction enterprise. They can be used for self-study or in training courses in conjunction with the **Trainers' guide**.

The titles are:

Pricing and bidding

Site management

Business management.

Construction Management Publications

Currently in Print

Building maintenance: A management manual, by Derek Miles and Paul Syagga (London, Intermediate Technology Publications for the ILO). - 1987 - 213pp. ISBN 0 946688 92 3

Construction management and technology: A bibliography for developing countries, compiled by R.H. Neale (Aldershot, United Kingdom, Gower for the ILO). 1987 - 122pp. - ISBN 0 566 05379 9

Foundations for Change: Aspects of the construction industry in developing countries, by G.A Edmonds and D.W.J. Miles (London, Intermediate Technology Publications for the ILO). 1984 - 143pp. ISBN 0 946633 00 1 hb

Guide-lines for the development of small-scale construction enterprises (Geneva, ILO). 1987 - 136pp.

ISBN 92-2-10569-3

Improving site productivity in the construction industry, by A. Heap (Geneva, ILO) 1987 - 124pp. ISBN 92-2-105694-5

Managing construction projects: A guide to processes and procedures, edited by A.D. Austen and R.H. Neale (Geneva, ILO). 1984 - 158pp. ISBN 92-2-103553-0

Training contractors for results: A guide for trainers and training managers, by Tor Hernes; edited by Derek Miles (Geneva, ILO). 1988 - 114pp. ISBN 92-2-2106253-8

Building for tomorrow: International experience in construction industry development, by Derek Miles and Richard Neale (Geneva, ILO). 1991 - 238pp. ISBN 92-2-107284-3

Training Manuals

Inter-active Contractor Training (Module 1: Estimating and tendering; Module 2: Project planning; Module 3: Site productivity), by Tor Hernes; edited by Derek Miles (Geneva, ILO). 1988 ISBN 92-2-105994-4

Construction Information Papers

CIP/1 Small-scale construction enterprises in Ghana: Practices, problems and needs, by Derek Miles and Jon Ward (Geneva, ILO). 1991 - 56pp. ISBN 92-2-107847-1

CIP/2 The construction industry in Nepal: Practices, problems and needs, by Derek Miles and John Ward (Geneva, ILO). 1991 - 40pp. ISBN 92-2-107940-6

CIP/3 Women can build: Women's participation in the construction industry in Sri Lanka, by Claes-Axel Andersson (Geneva, ILO). 1991 - 57pp. ISBN 92-2-108093-5

CIP/4 A strategy for the China International contractors's Association: CHINCA, by Derek Miles and Professor K.N. Vaid (Geneva, ILO) 1991 - 62pp. ISBN 9202-1-8157-5

CIP/5 Room for improvement: A study of women building workers in Bombay, by Vinita Shah (Geneva, ILO) 1992 - 63pp. ISBN 92-2-108439-6

CIP/6 The impact of the ILO Construction Management Programme on the development of small construction enterprises, by Derek Miles (Geneva, ILO) 1993 - 19pp. ISBN 9202-108817-0

CIP/7 Building her future: Guidelines for encouraging women's participation in construction industry development projects in India, by Vinita Shah (Geneva, ILO) 1993 - 39pp. ISBN 9202-108xxx-x

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II. To What Extent Can Experiences in Training Contractors and Their Staff be Carried from One Country to Another?

Ghana and Tanzania: A Case Study

by Kwaku Osei-Bonsu, Chief Technical Adviser, Moshi, Tanzania

Introduction

It has often been said that "Experience is the best Teacher". However, the issue being discussed in this paper is whether experiences in training a group of contractors in one country could be carried to another.

This paper presents some of the central themes which have arisen in the implementation of the contractor training programme for rural road rehabilitation and maintenance in both Ghana and Tanzania. Since this is a case study, it is considered appropriate to briefly give some background information on the socio-economic environment pertaining in the two countries to the start of the training programmes.

Socio-Economic Environment

Ghana has an area of 239,000 km² and a population of 15 million of which over 70% live in rural areas. Agriculture constitutes the life blood of the economy and the country has a road network of 14,400 km of trunk and 22,000 km of rural roads. Most of the rehabilitation, improvement and maintenance works are contracted out to local contractors with a small percentage of the works being carried out by force account operations.

The move from force account to contracting started well over a decade ago, thus an environment for contracting had been created. Thus, an environment for contracting had been created. Thus, as of December 1991 only 2 out of the about 400 classified Road Contractors were foreign based.

Tanzania which is about four times the size of Ghana has a population of 25 million of which over 80% live in rural areas. Just as other developing countries, agriculture is the mainstay of the country's economy and the country has a total road network of 82,000 km of which 42,000 km are designated as Regional and District roads. The roadwork contracting sector in Tanzania on the contrary is very weak or simply stated as non-existent. There were only 43 "classified" road Contractors as at June 1992. The Government's policy prior to the recent liberalization programmes did not encourage the establishment of locally based road contractors. As a result

the only contractors operational were either foreign or state owned and substantial percentage of the works had to be executed by force account brigades.

Project Objectives

With regards to the Ghana project, it was experimental in the sense that it was among the first in Africa to help a group of rather small private contractors develop the ability to employ cost effective and technically appropriate labour based approaches to rural road improvement and construction.

The Kilimanjaro project which forms part of a \$ 1 billion Integrated Road Project Co-ordinated by the World Bank is based on the Ghana model with some new elements of contracting routine maintenance. The Project has been mandated to train 30 Contractors of which only 3 will be involved in rehabilitation.

Training Strategy

The development of any new abilities of an organization is always a very difficult and complex process. This normally involves several carefully designed steps which should be relevant to conditions for which the new system is being developed. It is a well known fact that quite a number of projects aimed at developing private companies have failed because trainees have been made to solve problems in environments totally different from that prevailing in real life in their organizations.

The training package developed in Ghana which could conveniently be termed as "ILO Training Package" adopts a "three prong" approach to the training of contractors namely

- The classroom Training Phase
- The Field Training Phase and
- The Trial Road Phase

This package recognises the interdependence of the 3 phases and takes into account of the phasing periods.

The Classroom phase deals with the normal teaching of principles of road building and maintenance whilst the Field Training phase is to expose the trainees to conditions similar to ones they will be encountering on their sites. Although this phase is run by the project staff, an attempt is made to simulate that of a private contractor.

In the Trial road phase, the five trained supervisors are made to demonstrate effective team work by operating in the same environment (real life situation) as a private contractor.

Whereas in Ghana this package has been adequately tested for its effectiveness over a number of years, the Kilimanjaro project has just entered into the trial road phase of the programme for the first batch of 6 contractors.

To be able to address the question of transferring experiences in training contractors from one country to the other there is also the need to consider in detail the approach in the pre-training, training and post training phases.

Pre-Training

The major difference between the two models concerns the number of players involved in the implementation of the programme.

In the Ghana model, two players are involved namely the Ministry of Roads and Highways represented by the Department of Feeder Roads and the Contractor. The project is thus considered an integral part of the Ministry and decisions taken are implemented without reference to a third party.

The Kilimanjaro model involves three players, - the Ministry of Works (MOW), the Contractor and the National Construction Council (NCC) which is the Implementing Agency but acts in an advisory capacity. Thus, unlike in Ghana, decisions taken by NCC will have to be referred to the Ministry of Works for approval in Tanzania.

The pre-training phase is considered to be the most crucial phase where experiences could be ported from one country to the other. It is vital that the planning of the pre-training phase is done properly to ensure commitment from contractors as well as the trainees.

The Training needs analysis carried out on the Contractors and their trainees revealed that there were some slight differences between the two countries i.e. as at the time of start of the Ghana project and the current condition in Tanzania.

Selection of Contractors

Ghana

Most of the small contractors identified at the inception of the project for training were already involved in the execution of roadwork using heavy machinery. Thus it could be said that these contractors had some knowledge of contracting.

The selection criteria currently in use was evolved over a number of years after some modifications had been made to the original one developed for the programme. The criteria for selecting Contractors takes into consideration the following factors:

- (i) Contractors' ownership of Equipment;
- (ii) Contractors' fixed assets;
- (iii) Supervisory Capacity of the Contractor vis a vis the education/training background of staff;

- (iv) Experience of the firm in roadwork;
- (v) Educational background of the Managing Director

Tanzania

The factors listed in 5.2.1 with some slight modifications were considered in establishing the selection criteria for contractors.

Since most of the potential Contractors who responded to our questionnaire were Building Contractors, the factor on experience in roadwork was replaced with the number of workers handled by the Contractor on building projects. The marking scheme was therefore skewed to favour mainly the up and coming Contractors bearing in mind that the major thrust of the project is on maintenance for which most of the established Building Contractors do not find attractive.

Selection and Acceptance Process for Trainees

Ghana

Contractor's trainees are not screened before being accepted for training. The Department of Feeder Roads only stipulates that a selected Contractor submits certificated of 4 trainees with a minimum educational background of GEE O' level.

A one week intensive revision course in basic mathematics is conducted for all trainees at the start of the classroom training. Since trainees are accepted before being examined, the Training section finds itself in a tight corner and thus takes on the responsibility of running classes for the weaker ones.

Tanzania

A minimum educational background of form four was adopted (equivalent to the GCE'O' level in Ghana) and the trainees were interviewed and tested in basic mathematics before being accepted to the first training course. The major problem identified with the first batch of trainees was their inability to fully understand lectures conducted in English.

The Project further refined the process of screening trainees by developing and making available a set of guidelines to selected contractors which stresses on the importance of choosing well qualified candidates for training. This approach involves the Project providing the Contractor some set questions which the Contractor uses to screen his trainees before submitting them for interview and further testing at the project office Fig (1).

The assessment of the capabilities and requirements of the trainees has enabled the project to make some modifications to the course content with the resultant effect of the shortening of the duration of the classroom and practical site training periods from 23 weeks to 16 weeks. It is premature to comment on the effectiveness of this approach however it is hoped that within the next six months, the project should be in a position to evaluate the course.

Training Phase

A comprehensive and clearly communicated training activities has been defined in the Kilimanjaro Project document based on the structure developed for Ghana. The training which is tailor made and very practically oriented provided a starting point for preparing our training programme to suit the local conditions.

Classroom Training

As already stated, this phase deals with the teaching of basic principles in road construction and maintenance. References were made to the standards and codes prevailing in the country and the course content consisted primarily of topics appropriate to the Tanzania conditions.

For the management training, which is attended by the Managing Directors and their Site Agents, the focus is centred on Contract Administration, Costing and Estimating, Work Planning and Programming and Preparation of claims.

The fundamental difference in approach between the two countries is that a lot of emphasis is placed in the use of profile method in setting out in the Kilimanjaro Project as opposed to the Ghana Project. Also training needs analyses are carried out on all contractors selected for training in Kilimanjaro to enable the project identify their deficiencies and weaknesses.

Site Training

A rotational system is used in Ghana whereby a trainee is made to supervise an activity each week until he/she has been exposed to all the activities on the road.

This system was initially adopted in Tanzania but currently the five trainees from each of the six contractors are assigned 500 metres stretch and are made to plan and execute the works with the project providing all the inputs required.

The payment of trainees during the site training phase by the Project to ease the financial burden on the Contractors and also the issue of paying bonuses to workers for completing their tasks were ideas ported from the Ghana project although some slight changes have been effected. For example, the maximum bonus paid to the worker is 4 days compared to 14 day in Ghana and workers are paid every fortnight.

Also from the onset of the Kilimanjaro project the issue of late delivery of equipment which was experienced at the inception of the Ghana project was envisaged and thus arrangements were made to hire equipment for the training programme. The initiative taken based on past experiences has enabled the project to successfully complete the first training course with the second one only 8 weeks from completion in spite of the fact that the Project is yet to take delivery of the training equipment.

Another area where one could rely on ones experiences is the preparation and administration of contracts. The rehabilitation of the model road in Tanzania had to be executed under a contract with MOW. The Project had to develop unit rates from first principle based on the Ghanaian experience by adjusting data on productivities achieved on a force account ILO project within Tanzania.

Post Training Phase

Trained Contractors in Ghana are classified immediately after the training phase. Trial contracts are executed on schedule of rates and all securities are waived for the Contractors. The DFR through a Financial Institution provides the contractor with basic equipment on a hire purchase arrangement and the firm is expected to rehabilitate a 5km road in 4 months.

Slight changes were made to the system used in Ghana and proposed for adoption in Tanzania, however the Ministry of Works expressed the concern that since these Contractors had not been classified no recognition will be given by the Regional Tender Board for the award of the contracts. Secondly the

Ministry was not in a position to waive the provision of performance bonds.

To circumvent these problems, it was agreed that NCC acts as a Management Contractor by entering into a contract with MOW and subletting the works to the six trained Contractors.

The current arrangement has resulted in amendments to the special conditions of contract to incorporate all the changes effected.

Conclusion

Building up the capacity of the Domestic Construction Industry could be a difficult task and the trainer's responsibilities in transferring such experiences should first and foremost be to study and understand the environment within which the programme is to be implemented. This should then be followed by identifying correctly the resources required to meet the objectives of the programme, analysing these resources and finally proposing a framework for the utilization of these resources.

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III. Labour-based Contracting: Contractor Management

A case study in Kenya

By Bruno Illi, NORCONSULT, Nairobi, Kenya

Introduction

In September 1991, Norconsult was commissioned to administer contracts and to develop guidelines for labour based gravelling operations through the implementation of 96 km of gravelling contracts. The terms of reference were amended in March 1992 to change the emphasis from gravelling to training.

Objectives and Scope of Work

The objectives of the project were to establish guidelines for the selection, training and supervision of small, local contractors in labour based gravelling operations.

In order to achieve this, we had to:

- identify suitable contractors
- establish training needs and methods and liaise with the Kisii Training School to undertake the training
- develop contract documents and select contractors
- supervise and monitor contracts.

Structure of the Programme

The programme initially comprised 22 activities over a period of 12 months. This was later revised and extended to include a second tender exercise. The four major activities in the programme were preparation, road appraisal, training and practicals/contracts. These are illustrated in the following chart.

Preparation

Trial Site

To test the technology and the procedures a contractor was appointed to undertake reshaping and gravelling on a section of road 6.5 km long which was identified as a demonstration and trial site. Although the task rates recommended by the Minor Roads Programme were achieved, the result was not satisfactory because the contractor was not familiar with the technology and therefore did not want to employ it, and consequently paid no heed to the consultants instructions.

Selection of Contractors

Advertisements were placed in the three daily papers in January 1992 and notices displayed at the district headquarters of the target districts. As a result, total of 64 companies registered their interest in the training programme. Small-scale contractors were identified with the assistance of the Ministry's representatives in the respective districts. After reviewing the contractors' qualification data (organization, personnel, education, equipment, past contracts etc.) 24 firms were short-listed, gave a written test and were interviewed. Contract managers from 12 of these firms were selected for training.

Selection of Foremen

During the contractor selection process, it was noted that most contractors did not have sufficiently qualified candidates for foreman training. Over 300 applications were received in response to advertisements. After initial screening the number of candidates was reduced to 24, all of which were invited to sit a written test and oral interview. Finally, twelve candidates were selected for training.

Training Material

As all selected participants were either university graduates or holders of a polytechnic higher diplomas, the ILO Engineers manual and the MRP Technical Manual were considered appropriate as course documentation for the contractors. In addition to this, hand-outs were prepared for special subjects such as planning, reporting, pricing contracts documents etc.

For the Foremen the Kisii Training School Manuals (Overseer, Technical Manual, Headman's Maintenance handbook etc.) and selected hand-outs were used as background material. Specific training materials for road contractors are not available and should be developed.

Tools

The availability and suitability of hand tools was investigated and it was found that quality and price varied considerably. Hand tools available in Nairobi were of very poor quality and were not considered suitable for heavy work in quarries. In the absence of a better alternative a full set of tools was purchased from suppliers in Nairobi for the contractors.

Templates, camber and profile boards, which were redesigned by the consultant, were manufactured by one of the contractors, and supplied to all course participants.

Road Appraisal

Based on the available study report on Rural Access Roads (RAR) gravelling backlog, an input of 300 mandays/km were anticipated for reshaping. However, the following problems were apparent with the

majority of roads proposed by the Districts:

- they required extensive reshaping;
- they required additional drainage works;
- they were not accessible;
- they had nor or unsuitable quarry sites; and
- they were either technically or financially not considered feasible.

In view of this a new set of roads was reviewed and provisions were made for:-

1. more extensive training (rehabilitation, drainage works, gravelling);
2. expanded contract documents; and
3. gravel surveys.

Training

Contractor Training

The objective here was to introduce the contractors to labour based construction and gravelling techniques developed under the RAR and MR Programme. It comprised two one-week sessions at Kisii and four two-day sessions in Thika. The syllabus covered:

1. Project Planning, Supervision and Reporting Systems
2. Labour Based Road Construction and Maintenance Methods
3. Labour Intensive Gravelling Methods
4. Pricing, Tendering and Implementation of Labour Based Contracts.

An average attendance of 85% was recorded. Lecturers from the ILO and the Ministry of Public Works & Housing (MOPW&H) assisted in conducting the contractor training course.

Practical Assignments

It was also important for the trainees to acquire and develop practical skills in the effective use of labour based techniques. Each of the contractors were initially awarded a fixed rate contract for the reshaping and gravelling of a 3 km section of a rural access road (Assignment I). Two contracts were then awarded through competitive bidding, each for reshaping and gravelling a 5 km section of rural access road (Assignment II).

Foreman Training

The foreman training programme covered four main subjects, comprising classroom lecturers and practicals as indicated below:

	Classroom Weeks	Practical Weeks
(a) Labour-based road improvement	3	4
(b) Gravelling	1	3

(c) Contract Procedures	1	3
(d) Motorcycle riding & Maintenance	1	1
Total Weeks	6	9

10 participants successfully completed their training course in Kisii and were subsequently appointed as foremen on fixed rate contracts (3 months), and also on the two contracts awarded to contractors based on competitive bidding (6 months each).

Results

Trained Contractors/Foremen

In May 1993 course certificates were issued to 9 participants on the contractor training course and 9 participants on the foremen training course.

Gravelled roads

The average construction costs for contracts awarded in January 1993 ranged between US\$ 5100 and US\$ 11,600 per km, depending on the reshaping/reconstruction requirements and the transport distances for gravel. The cost of the main components of the work are set out in Table 1.

Contracts Documents

In view of the size of the contracts and the extent of the construction work which includes earthworks, drainage works and gravelling, it was considered necessary to prepare full tender documents covering the following aspects:

- A. Conditions of Tender and Instructions to Tenders
- B. Form of Agreement
- C. Conditions of Contract
- D. Specifications
- E. Drawings
- F. Bills of Quantities

Due to the special nature of the work, the conditions of contract included a number of clauses particularly relevant to labour based contracts, and gave special emphasis to management and labour issues.

Similarly brief specifications and measurement guidelines were provided for all items to supplement the details given in the Technical manual.

Apart from the standard cross sections, headwalls and culvert bedding details, a map and the quarry plan the road improvement plan forms MRP-E2 (B) and (F) were provided as contract drawings.

The Bills of Quantities were split into 7 different sections covering the main work components.

Costing/Tendering

As the local contractors were not accustomed to normal tender procedures and competitive pricing, the first

set of contracts were awarded on the basis of fixed rates determined by the consultant. Prior to this, a special seminar was held with the contractors to discuss tender procedures and pricing during which each rate was analyzed and adjusted accordingly.

The contractors were given the first opportunity to submit competitive tenders for 6 contracts in January 1993. These contracts were scheduled for completion by late July/early August 1993. Competitive tenders for a further 7 contracts were received in June and some were awarded in Engineer's Estimates, while 40% of the tenders were within $\pm 15\%$.

Apart from one contractor who submitted his tender document an hour after the deadline, all bidders complied with the conditions of tender.

Planning and Reporting System

The contractors were trained in the use of simple forms for estimating their input, costing the works, drawing up a work programme, and monitoring progress.

Project Outcome

The results of the programme indicate that:

Rehabilitation and gravelling of roads undertaken by private contractors can be technically and financially feasible provided there is sufficient work to keep contractors interested and payments due to them are made regularly.

The quality of workmanship achieved by contractors is equal or higher than that by force account. Donor finance is still required to cover the cost of continuation of the training programme for subsequent intakes of trainee contractors (SIDA is likely to finance the second intake up to December 1995).

The road network considered suitable for rehabilitation and gravelling by contractors is in excess of 24,000 km. With an output of between 12 to 24 km per contractor about 165 to 330 contractors would be required to cover the total network.

in view of the above the training potential should be substantially increased, and continued technical assistance will be required.

Problems Encountered

Institutionalization

Institutionalization of the procedures in the districts was difficult for the following reasons:

Districts do not have the necessary funds to provide transport and facilities required for the satisfactory planning and monitoring of contracts;

Tender procedures currently used in the districts are not streamlined enough to handle tenders of this size and nature efficiently;

Districts do not have a sufficiently steady cash flow to guarantee timely payments to contractors;

Due to their frequent transfers/changes, it has been difficult to effectively involve district personnel in the development of the programme.

Gravel Sources

Extensive gravel surveys are required to identify quarries with gravel of acceptable quality and quantity within reasonable distance of the project roads. Furthermore natural gravel appears to be a scarce resource

and alternative materials have to be considered, e.g., quarry waste, crushed rock, etc.

Training Capacity

The high resource requirement, particularly during the field practicals, made it difficult to train more than 10 to 12 contractors at the same time. The training course currently takes about 24 to 30 months from inception to completion. The training capacity must therefore be increased.

Seasonal Movement of Labour

During certain times of the year, and depending on the activities within the area at that time (e.g. planting, harvesting, etc), labour may be a scarce resource. It may therefore be necessary to stop contracts for short periods during these times.

Hand Tools

Tools are of very poor quality and negatively affect work output. Efforts must therefore be made to improve the quality of steel quality, the handles and the design of the individual items. Standards for these items have been provided by ILO but do not seem to be complied with.

Contractor Management: Procedures and Arrangements

Our experience from the project indicates that the following measures are required in order to successfully implement labour based contracting programmes:

1. Studies and trials need to be undertaken to ascertain the viability of labour based contracting which will depend on:

- the types of operation
- type of roads
- traffic
- labour availability
- contractor availability/capacity

2. The Government must make a policy decision where routine and periodic road maintenance should, in future, be undertaken by small-scale contractors rather than by force account.

3. In line with No.2 above, the Government will have to study the implications of this decision with regard to staffing, funding, tender and payment procedures. In this connection a decision has to be taken as to whether the preparation of documentation and contract supervision is to be undertaken by the Ministry or by private consultants.

4. There must be sufficient and qualified personnel to plan, prepare the documentation, tender and supervise such contracts.

5. Personnel must be trained in all aspects (planning, contract documentation, tender procedures, supervision, monitoring, payment procedures, etc.) both at headquarter- and district-level.

6. Tender procedures must be streamlined so that:

- only qualified and registered contractors are short-listed. A special register should be established for registration of trained labour based contractors;
- the tender board composition is reviewed;

transparent contract award procedures;
award procedures are simplified and speeded up.

7. Standard contract documents suited to labour based methods have to be developed to include:

simplified conditions of tender
simplified conditions of contract
specifications pertinent to labour based methods
appropriate methods of measurement
simple Bills of Quantities.

8. Sufficient funding must be provided and payment procedures streamlined to guarantee timely payment to contractors.

9. Continued employment of contractors should be guaranteed through planning and budget provisions. Satisfactory performance on the part of the contractor can only be achieved by providing further training for foremen, contract supervisors and contractors (eg. seminars, lectures, etc)

10. Contractors must be involved in setting out policies and in the development of new techniques and procedures.

11. Social aspects need to be considered, particularly in terms of employment conditions and background of the contractors.

Table 1

SIDA Gravelling Project Estimated Cost in US Dollars - January 1993

Activity	Light Reshaping	Heavy reshaping	Reconstruction
1. Preliminaries	500 to 660	540 to 700	890 to 1055
2. Reshaping	990	1220	4160
3. Drainage	855	1440	2000
4. Gravelling	1560	1660	1560
5. Haulage	1175 to 2810	1175 to 2810	1175 to 2810
Total/km	5080 to 6875	5935 to 7730	9785 to 11585

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IV. Labour-based Contracting: Uganda's Experience

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Introduction

The Labour-based contracting for the routine manual maintenance of the classified network was launched in January, 1993 in order to respond to the renewed initiative of keeping the already reconstruction

rehabilitated roads well maintained.

Over the past six years the government has reconstructed/rehabilitated over 45% of the classified network and 10% of the rural feeder roads. There was mounting need therefore to adequately protect this investment.

The existing Road Maintenance Policies coupled with their constraints could be no means enable the timely application of effective maintenance to the network.

This led to the formulation of new strategies geared towards solving the setbacks and constraints of the previous maintenance system - hence the adoption of the labour-based contracting option for the routine manual maintenance.

This paper is based on the Uganda experience in implementing the labour-based contracting programme for routine maintenance of its classified network. The organizational set-up of the Ministry of Works, Transport and Communication (MOWTC), the implementing Ministry, together with a review of the Road Network under its jurisdiction is briefly presented.

The new strategies in the Road Maintenance Initiative and the evolution of the labour-based contracting options is discussed.

The adopted methodology and implementation approach of the labour contracting programme is described together with the outcome and experience so far.

The paper finally outlines the future programmes in respect to labour-based maintenance approach.

The Road Network

The National Road Network

Uganda has a network of roads, amounting to approximately 30,000 km. It is most typically categorized into three main groups:

- (i) Classified Roads - which amount to 8,085 km or 27 percent of the road network and come under the responsibility of the Ministry of Works, Transport and Communications (MPWTC);
- (ii) Feeder Roads - which amount to 21,000 km of road or 70 percent of the total network and come under the responsibility of the Ministry of Local Government (MOLG); and
- (iii) Urban Roads - which amount to 1,000 km or three percent of the network and come, again, under the MOLG through the urban and authorities.

The Classified Main Road Network

The classified main road network forms the principal inter-urban linkages. The structure of the network is shown in Table 2.1 below.

Table 1: Classification of the main road network (km)

Classification	Paved Roads	Gravel Roads	Total
Class I (Primary)	1,798	2,084	3,882
Class II (Secondary)	127	2,392	2,519

Class III (Tertiary)	171	1,513	1,684
	2,096	5,989	8,085

Class I roads are defined as those roads crossing national borders linking regions, Class II are those connecting Districts and Class III are inter-District. The network has been fully inventoried and a 7-day traffic survey is carried out at least once a year every February.

Organization Set-up

The overall management of the classified road network is under the Ministry of Works, Transport and Communications while local authorities under the Ministry of Local Government are responsible for rural feeder roads. The work is executed through District Engineers based in the field.

Road Network Condition

Inadequate road maintenance and often total neglect during the 1970s and early 1980s resulted in the road network deteriorating into an appalling state of disrepair. A maintenance study undertaken in 1982 estimated that only six percent of the main roads had been resealed or regavelled in the previous ten years. By the end of 1985, only 350 km out of 2,000 km of bituminous trunk roads were in good condition, while all the gravel trunk roads were in poor condition.

The condition of Rural Feeder Roads (RFP) was not any better. In 1986 about 25% of the REPs were impassable during rainy seasons. Even during dry seasons the passable REPs were very rough thereby increasing vehicle operating costs. As a result vehicular traffic on the RFPs had reduced by 50% and it is estimated that, at least 30% of agricultural potential remains untapped.

At the moment 26 percent of the main road network while 60% of the RFPs are in a poor or very poor state. This essentially represents the current maintenance backlog that needs rehabilitation prior to effective and planned maintenance.

Road Maintenance Policy and Strategies

Policy Direction

(a) The application of effective and planned maintenance to the entire network, on a priority basis ensuring that:

(i) Adequate maintenance measures applied in a timely manner and at the right place.

(ii) The measures are most appropriate and most cost effective.

(b) The adoption of appropriate and sustainable institutional, funding and operational reform policies and strategies.

The evolution of the new strategies involved a two-fronts approach:

(a) Domestic front to internally, within Government and the Ministries (MOWTC & MOLG), discuss the road maintenance problem and formulate corrective measures.

(b) An external front which ensured full participation in the Road Maintenance Initiative Programme. This

involved collaboration with the various international Financing Institutions and Multilateral organizations to prepare way for policy reform.

Medium Term Road Maintenance Strategies

In pursuance with the Road Maintenance, Initiative Programme, the policy reforms called for the following strategies, the progress of which is briefly discussed:

(a) Awareness campaign

To enlist the commitment of all, Public Road Maintenance awareness Campaigns have been undertaken and are being stepped up.

(b) Funding and Disbursement

(i) A study financed by GTZ for the establishment of a Road Fund is ongoing.

(ii) Road Maintenance Project Accounts were opened in all the Ministry of Works, Transport and Communications 21 No. districts in January, 1993.

(c) Operations

(i) Manual Routine Maintenance is to be undertaken by contract. Such work started on all the rehabilitated roads this January, 1993. The total of 2500 km has been taken on first, and will be expanded to 4000 km in 1993/94 Financial Year and then to cover the entire classified network in the Financial Year 1994/95.

Appropriate Road Maintenance Management Manual have been developed and issued to the MOWTC districts.

(ii) Mechanized operations have been reorganized into maintenance units with specific targeted output and on a performance oriented basis. A performance allowance has been introduced as a motivational consideration.

A maintenance management system has been developed and launched. A Road Maintenance Management Guidelines Manual has been produced and distributed to all District Engineers for us.

However, private contracting is to be resorted to where it proves to be more appropriate and viable in future.

(iii) Rehabilitation and Periodic Maintenance will be undertaken by mechanized contractors. At least 100 km will be let to private contractors this financial year.

The Road Maintenance Programme for 1993/94 has been prepared on the basis of the new policy options discussed above.

(d) Capacity Building

(i) A study to be founded by the World Bank for the establishment of a Plant Hire Pool is expected to start in October, 1993.

(ii) The 5 year training programme covering the training needs of the entire local construction industry is being drawn.

With the view of creating a pool of in-house trainers, 12 MOWTC experienced Engineers and 3 Senior technicians attended a 6 weeks course of Training of Trainers (ToT) at ESAMI Arusha in October/November, 1992. More ToT programmes are expected to be launched as required.

A workshop conducted by International Labour Organization (ILO) and financed by the World Bank was held in October, 1992.

As a follow up of one of the recommendations of the workshop, a training programme for the labour-based operations for all Engineers was held in May, 1993 and another one for Engineering Assistants, Road Inspectors and Road Overseers was held in June, 1993.

(e) Institutional Reform

The Study for the establishment of the Road Authority is subject to the outcome of the current Road Fund Study.

Planning of the Labour-based Programme

Basis

According to the new maintenance strategies, all Manual Maintenance has ultimately to be carried out by contract.

Ministry of Local Government has been trying the one man per kilometre task oriented contract (lengthman system) on many RFPs including unrehabilitated roads with some reasonable results.

However, this paper will mainly present the experience of the Ministry of Works, Transport and Communications programme.

Planning Phase

The MOWTC commenced a planning and preparatory phase over the period January-December, 1992. Over this period:

(i) An appropriate Road Maintenance Management Manual was developed with guidelines on the implementation and management of labour-based contracts for routine manual maintenance.

(ii) A workshop on the utilization of labour-based methods in Road Maintenance was held in September, 1992. It was jointly organized by the Ministry of Works, Transport and Communications (MOWTC), the Ministry of Local Government (MOLG) and the International Labour Office (ILO). The workshop brought together high level Government Officials, technicians responsible for the implementation of the Road Maintenance in Uganda. Donor representatives, local consultants, local contractors, and District Resistance Council Chairmen representing selected local communities.

(iii) Road Maintenance Project Accounts were opened in all the MOWTC districts and funds deposited in there. The local decentralized funds were entirely for the labour-based contractors payments.

(iv) Public awareness for the programme was identified, inventorized, work assessment and packaging was carried out, Bills of quantities were prepared in contract packages.

(v) The interested individuals/groups applied and were pre-qualified. The successful ones entered into contract in December 1992.

All was now set for commencement, and the programme was launched in January, 1993.

Labour-based Contracting (Financial Year 1992/93)

Background

Routine Maintenance by labour contracts started on the ground in January, 1993, for a six months period (Jan. - June, 1993). Over this period formulated plans were put into implementation and served very much as an experience period for the implementation, supervisors and the labour contracts.

Methodology

(i) The labour contracts implemented were of two forms. The lengthman contracts involved single individuals taking up 2 km stretches of road in a single package; while the small group contracts involved a team/group of people taking up stretches of up to 10 km.

(ii) The contracts were open for application by any interested individual/group of individuals after being advertized locally by way of information passed through the existing local government structures to the various localities.

(iii) Application Forms are available at the nearest Ministry of Works, Transport and Communications (MOWTC) station, to which completed forms are returned.

To ensure the contracts are availed to the particular people within a particular vicinity, all applicants are recommended by the Chairman of their respective Resistance Council III (Sub-county level).

(iv) Selection is carried out by the District Engineers (MOWTC) basing on, among others, previous experience (if any) in Road Maintenance, physical capability etc.

(v) Participation is opened to both men and women; and considerable effort has been taken to interested women into taking up these contracts.

(vi) The District Engineer signs an agreement/contracts with the successful applicants, and the contracts is witnessed by the District Executive Secretary.

(vii) The type of contracts adopted are fixed rate contracts whose rates are determined annually after a county-wide market-rate survey before approval by the Central tender Board. The rates are representative of the going market rates so as to ensure retention of the attracted contractors.

(viii) To ensure job-continuity throughout the year for the contractors, the workload for the various activities has been spread out evenly but taking into account the seasonal variations and applicable frequencies for the various activities. This factor also contributes to our capability to retain the successful contractors.

(xi) The supervision of the contractors is carried out by the District Engineer and his team of Engineering Assistants and Road Inspectors/Overseers each assigned to a particular section of road. The supervisory role

ranges from giving planned working instructions to contractors, inspection during execution, work evaluation and measurement etc.

(x) The measurement of work is done once a month during an end of the month inspection, together with the contractor. The final work measurement is counter-signed by the contractor and the month's payment is prepared based on it. Payment is by cheque signed by both the District Engineer (D.E) and the District Executive Secretary (D.E.S). The payments are decentralized to D.E level and is effected from project accounts at these levels. This ensures prompt payments to contractors.

Contract Documents

Every successful applicant for a maintenance contract signs a contract agreement with the Ministry (MOWTC) District Engineer on behalf of the Ministry of Works, Transport and Communications.

The contract document is small and simple and consists of a form of agreement, Bills of quantities and the specifications.

Form of Agreement (with 6 articles)

(contents)

- Obligations of contractors
- Obligations of the Ministry
- Contract Price and mode of payment
- Commencement, duration and Termination
- Modification
- Settlement of disputes

1. Bills of quantities

2. Specifications

The first set of contracts entered into in January, 1993 were for 6 months (January-June, 1993) and consisted of both lengthmen contracts and small group contracts.

The contract is signed between the District Engineer with the District Executive Secretary as his witness on one hand and the lengthmen or group leader with his witness on the other hand.

Measurements

The evaluation for the work done by the contractor is done at the end of every month during an end-of-month inspection.

This end-of-month inspection is carried out by the District Engineer, the particular supervisor, and the contractor, to evaluate work-plan issued to him.

The measurement of the progress is taken and the measurement-sheet is jointly signed by the team and thereafter used for processing payment.

Two options were left to the District Engineer in effecting progress evaluation work:

Assessing the approximate percentage of the workplan for that month which has been executed by the contractor, and pay a similar percentage of the approved Central Tender Board monthly rate. The assessed percentage must be agreeable to the contractor. Otherwise:
Take measurement of the executed work and use the approved unit rates to determine the actual payment due to the contractor.

Outcome of the Programme

The labour-based contracts programme for manual routine maintenance has been in operation over the past six months (Jan-June, 1993) on a coverage of about 30% (Approx. 2500 km) of the total classified network.

The other 70% (Approx. 5500 km) still continued under the old system of manual routine maintenance using direct labour gangs.

This obviously serves as a control network for the quick comparison with the network under the new approach. One quick result of the new system was that:

Results

(i) Output

The actual output station by station ranged from 50% to 85% performance with an average of 60%. The table below gives the order of the achievements:

1992/93 Labour-based contracts programme period of implementation Jan-June, 1993 coverage 2500 km.

Activity	Unit	Programmed (Jan-June) 1993	Achieved	%
Grass cutting	m ²	80,000,000	48,000,000	60%
Cleaning culverts	m	150,000	75,000,000	50%
Opening stream channels	m	25,000	22,500	45%
Cleaning side drains	m	675,000	303,750	70%
Clear side drains	m	9,000,000	6,300,000	80%
Clear Bush + Debris	m ²	10,000,000	8,000,000	80%
Average %				65%

(ii) Backlog

The manual maintenance backlog that had accumulated over the years was cleared within the first three to four months of commencement (Jan-April, 1993) and this enabled such stretches of the network to be reverted into a routinely maintainable state.

The performance was able to attract back most of the past experienced labour which has abandoned work out of frustration. The availability of this trained manpower enabled to smooth and efficient take-off of the

programme. The actual output of work ranged from 50% to 90% performance with a ranged average of 65%.

(iii) Training Programmes

While some of the labour contractors might have had some experience in the various maintenance activities, a great majority however are new entrants. Appropriate training therefore had to be offered to the contractors to ensure performance.

All the contractors have received on-the-job training from the supervisors by way of instructions and site demonstrations during the course of their work.

Prior to and during the six months period of operation of the labour contracts programme, the Ministry (MOWTC) had to organize appropriate relevant training for the supervisory and implementation teams (i.e District Engineers, Engineering Assistants, Road Inspectors, Road Overseers).

A workshop on the utilization of labour-based methods in Road Maintenance was organized in September, 1992. It was organized by MOWTC/MOLG/ILO and was attended among others by the MOETC District Engineers and Engineering Assistants.

A two week orientation course on the Labour-Based Contract Maintenance Programme for the District Engineers organized by MOWTC/ILO was held in May 1993.

A workshop on the Supervision and Management of labour-based contracts was organized by MOWTC in June, 1993 for all Engineering Assistants, Road Inspectors and Road Overseers involved in the programme.

The above training sessions were in addition to the all-together approach that brought all the District Engineers during other meetings and seminars in the conception and planning phase of this labour-based contractors programme

(iv) Unit Costs

An earlier attempt to come up with unit rates through competitive bidding resulted in excessively high rates. For this programme, the Ministry worked out appropriate unit rates.

Unfortunately, some of the rates like for grass cutting turned out to be low. This also affected the programme as some contractors got discouraged. The Maintenance cost trend is illustrated in the table below.

Table 3

YEAR	MAINTENANCE METHOD	AVERAGE MAINTENANCE STRETCH PER CONTRACT	ANNUAL AVERAGE COST PER KM US\$	REMARKS
1988/89	Lengthman, Direct labour	2	49	Old method

1990/91	Lengthman, Direct labour Labour Contract	4 10	18 1500	Old method Average unit rates arrived at through bidding
1992/93	Lengthman, Direct labour Lengman/Labour Rated	4 2/10	30 300	Old method Group Contract determined by MOWTC
1993/94	Lengthman, Director labour Lengthman/Labour Group	4 2/10	36 360	Old method Rates Contract determined by MOWTC

(v) Tools

The ministry had earlier on committed itself to providing the tools. This later proved difficult and not all the tools were supplied. This had some negative influence on the performance.

Other Experience

The six months period over which this programme has been implemented so far has also served as an experience attaining phase for both the supervisors and the contractors.

Similarly the various training courses over this period indeed enabled comparison of the various experiences from the countryside.

The short term experience indicates that:

(i) The level of performance was higher among the lengmen contractors than among small group contractors. This could be due to the personal/individual commitment in a one enterprise.

(ii) In effect, small group contractors never operated as "groups" as they were designed. Instead the group leader was indeed that owner of the contract who hires and fires the other supposed members of the group and also decides on the level of wages to pay them.

The other members of the group are therefore employees of the "group leader" and have no sense of ownership of the contract. The level of motivation and commitment in a group contract is therefore lower than in a lengthman contract.

In some instances the small group disintegrates into lengthmen contracts manned y the former members of the group contract.

(iii) Training of the contractors on the job is indeed continuous more so in group contracts whose internal compositions tend to frequently vary.

(iv) On the face of it, small group contractors look simpler to supervise than the lengthmen contracts by virtue of their numbers within a given road. But the effectiveness of supervision proved better in lengthmen contracts than in small group contracts.

Working instructions and plans from a supervisor are received direct by the lengthman contractor while the members of the group contract usually get it second hand through their group leader. More often than not, the group leader is not directly engaged in the execution and is not available on the road all the time.

(v) This programme was targeted for the direct participation of the people living in the rural communities along the roads. The Ministry implemented four categories of payment rates applicable to different areas in the country.

The trend of contractors that emerged was such that for those areas where the rates were appropriately, the majority of contractors were lengthmen and small groups contractors in the range of 4-6 km, with direct participation by the rural dwellers as from the areas where the areas were appropriately high there were few lengthmen contractors with the majority of contractors being taken by small group contracts with stretches of 10-30 km. The rural dwellers mainly were secondary participants in these contracts, being employed by the owner of the contract.

The level of pricing the contracts therefore influences the pattern of contracting. Where the rates are low the profit margin is also low, and the contracts are small and are taken by people who personally participate in the execution. Where the rates are high, the profit margin is high and therefore the contracts are large and utilize secondary employment of the labour force in the locality.

(iv) Labour contracts for routine manual maintenance is recently implemented strategy. There is need for continued training and re-training of the implementing/supervisory team who will in turn train the contracting teams.

(vii) There should be a continued annual review of the rates for the various activities to keep them realistic, applicable and up to date.

(viii) To keep a good level of strained contracting manpower, the contractors should be easily renewable subject to performance, so that people already trained are retained.

Future Programmes

Expansion of the Programme

The labour-based contracting programme started during the 1992/93 financial year (F.Y) corresponding budgetary provisions have already been made in line with this planned increase.

Improvements to the Programme

From the experiences gained in the 1992/93 Maintenance Programme, major improvements have been put in place. These include the following:

- (i) A revised 'Road Maintenance Management Guidelines' booklet has been prepared, mass produced and issued to District Engineers and relevant staff.
- (ii) The Maintenance activities have been increased from 6 to 12 and appropriate production rates and cost unit rates determined.
- (iii) It is of interest to note that grass cutting, tree planting and tree nursing have been included as part of the Ministry's contribution to environmental protection.
- (iv) Work-method statements for the different activities and specifications have been given.
- (v) Revised contract documents have been mass produced for use by the stations.
- (vi) A document for use by the labour contracts entitled "Maintenance Guidelines for Labour Contractors" has been mass produced.
- (vii) Contractors are now issued with Half-Yearly Work Plan
- (viii) The Monthly Reporting Form has been improved.
- (ix) A comprehensive training programme for labour-based activities is being developed.

Donors will be contracted to assist with logistic support and provision of Training experts.

Conclusion

The labour-based contracting programme for the routine manual maintenance of the classified network has so far been a success with a glaring impact.

It is of course reorganised that the successful implementation of this maintenance programme was made possible because of the full commitment and support of the Government of Uganda, and the MOWTC, the executor, in particular.

There has been particular enthusiasm showed by the contractors towards this programme. Much as the programme of the full commitment opportunity to the rural dwellers in the localities, it does increase their awareness of the road in their midst, as their property worth protecting from undue encroachment and misuse.

The involvement of the local leaders in selecting the people to participate in the programme means that similar channels can be exploited in a reverse way, to educate the masses on the importance of the road as their facility one feature of the programme is that the traditional tools mainly used for agricultural activities in the localities are the ones suitable for this programme.

Therefore the purchase of the various tools for the road work by the successful contractor is easily welcomed since the tool set is applicable both on the road and on the farm.

I. Women and Labour-Based Roadworks in Sub-Saharan Africa

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SYNOPSIS

Reviewing project-related literature, this paper explores the incidence of, and attitudes towards, rural women's participation in labour-based road works. Synthesizing findings regarding the social and economic impact on female participants and their households suggests that labour-based road works meet an essential employment need for some categories.

Because of the dynamic nature of road work activities, caution must be exercised in interpreting the results of survey data which normally provides only a snapshot impression. Generally, in rural societies where the opportunity costs of labour are low, both men and women have adapted rapidly to the somewhat alien concept of labour-based road works. Many case studies demonstrate the viability of female participation in almost all roadwork tasks. The low-wages, however, ordain that women participants' economic returns are modest. Nonetheless, road works are a welcome source of income for asset-poor women.

Introduction

For at least a decade there have been efforts by some aid agencies to promote the employment of more women in public works including those on roads [Van den Oever-Pereira 1984]. It remains a complex and, in some respects, controversial subject although there is now a growing body of experience and literature ranging from a priori attitudinal surveys, to routine project monitoring reports incorporating gender aspects, to studies specifically concerned with the impact of project employment on the lives of participating women.

Most of these women-centred investigations have been conducted with respect to projects with main objectives other than the employment of women. The efficient construction, rehabilitation or maintenance of physical infrastructure remains the goal of most projects. Few of the studies have been based on rigorous scientific methods of sampling and analysis. As such the evidence is very uneven in quality and often impressionistic. Despite these limitations a great deal of useful experience has been accumulated. The purpose of this paper is to examine project efforts to employ women, identify attitudes and obstacles that have been experienced, and summarize what is known of the results that have been achieved in such projects.

Theoretical Considerations

There are two key assumptions which underline most donor efforts to promote greater female involvement in public works. First, the existence of a (female) labour surplus in rural areas is implicitly taken for granted. Second, and more explicitly, it is generally asserted that rural women need to earn cash for economic welfare and power enhancement within the household. Each of these assumptions will be considered in turn.

"Rural Surplus Labour" Assumption

This is a standard assumption of Western economists which can be traced back to a number of influential theorists. W.A. Lewis proposed a model for areas with rural land scarcity, and argued that because of low returns to labour, migration to urban industrial jobs with higher productivity would enhance national development. [Lewis 1954]. Since the publication of Lewis' seminal article, economists have, over the last 30 years, revised the view that urban migration is such a beneficial outcome. But they have generally not revised the rural surplus labour assumption and it continues to be applied to rural areas throughout the Third World, notably Sub-Saharan Africa (SAA).

Going further back, Malthus, Ricardo and Karl Marx, all held the view that rural land shortages were inevitable and created a "labour surplus". Karl Marx saw rural surplus labour arising from a process of primitive accumulation whereby peasants were dispossessed of their land and means of production by capitalists and became exploitable as proletarians. Although the process envisaged by Marx may not have materialized everywhere, one can argue that growing rural landlessness is increasing in its incidence in some African countries. According to 1988 data, landlessness is thought to affect more than 11% of SSA's rural population. Among those countries for which figures are available, the three most severely affected in SSA are Lesotho (26%), Ethiopia (16%) and Kenya (13%). [Jazairy et. al. 1992].

Nonetheless, these proportions are not large compared with Asia and Latin America ¹.

Furthermore, such incidences of landlessness cannot be equated with rural surplus labour. There are strong counter arguments which cast doubt on the universal relevance of the surplus labour assumption in terms of African conditions, especially as it is applied to women.

Ester Boserup's work offers an alternative and more realistic approach so far as SSA is concerned. [Boserup 1965, 1970, 1981]. She assumes that the nature of land usage in agricultural systems is never fixed. Over time and in the absence of significant capital investments, both land and labour usage is intensified as the density of population on the land increases. There are many stages of this evolution before one could claim that there is a rural labour surplus that cannot be absorbed and must therefore leave agriculture. Such a stage is usually associated with absolute landlessness. Until this stage is reached, the need for labour in agriculture becomes greater with increasing population density rather than less ².

The intensification of land use introduces all sorts of time-consuming labour activities. With the abandonment of long-fallow shifting agriculture, involving the natural regeneration of the soil, there is an increased need for weeding and soil fertilizing activities, as well as the possibility of introducing animal husbandry and the labour demands of fodder crop production as grazing land availability decreases. The main inference of Boserup's perspective is that in some circumstances labour-based road works could be in competition for labour with, rather than alleviating a labour surplus in, peasant household agricultural production units.

"Women Need Cash Earnings" Assumption

Who would dispute that poor women need cash earnings? But this is not the only question to pose in the case of women's involvement in labour-based construction. No doubt, cash would be helpful to some if not the majority of women, but the process of earning cash can raise many problems which begs the question of whether or not earnings cash is the dominant priority in all rural women's lives. Very often,

and related to the Boserup line of reasoning, the alleviation of female labour time constraints is a more pressing need for rural women in SSA.

African farming systems have been undergoing extremely rapid change over the past century. Rapid population growth has triggered the transition from land and labour-extensive systems, to systems with heavy labour inputs. But whose labour has been intensified.? So much of African agriculture has traditionally been what is known as female farming. In other words, men were involved in activities such as hunting and defense while farming was left to women.

¹ Sub-Saharan Africa's rates are about a half that experienced in Asia, or a third that of Latin America and the Caribbean.

² This statement assumes that capital investment is held constant as is so often the case in contemporary African smallholder agriculture.

Colonial policies magnified this gender dichotomy, channelling men into wage labour and cash crop production, leaving women responsible for household food production. To the present, women continue to be the mainstay food producers, while men are involved in cashcropping and off-farm activities.

Women's intensified work day includes agricultural labour, so-called "housework" and childcare. Their labour is expended without the convenience of labour-alleviating devices which is in sharp contrast to Western women's relatively advantaged access to domestic technology. Domestic technology improvements, labour-saving appliances, men's help with childcare, and state provisions for childcare, have played a role in women's lives in the West making it possible for them to work "outside the home" to earn cash. These factors are virtually absent in SSA. Under these circumstances, it may not be realistic to expect that many African rural women will have the time, energy and spatial mobility to work on labour-based road construction. For women to benefit from cash earnings opportunities, it might be necessary for household labour-saving improvements to be introduced first. [Bryceson 1993]

Furthermore, it is necessarily the case that cash earnings will represent an improvement in rural women's economic welfare and power relations within the household? Rural African societies tend to be characterized by relatively low levels of market development. Studies suggest that attitudinal foundations of power and resource control within African households are complex and cash earning does not necessarily give women enhanced status. [McCormack et. al. 1986] In fact, in some societies men view female earnings as theirs to have and control. [Mbilinyi 1987] With these reservations in mind regarding the context and potential benefits of women's participation in these reservations in mind regarding the context and potential benefits of women's participation in income-generating labour-based roadworks we can turn to a review of project outcomes.

Project Experience

Overview

To many people labour-based road works embody two alien ideas:

- (i) it is possible to improve and maintain roads manually; and
- (ii) women can participate fully in such activities.

Despite the novelty of these concepts, the appearance and growth of women's participation in labour-based roadworks to the levels currently prevailing in many African rural societies demonstrates

remarkable adaptability. It has entailed the expansion of work tasks undertaken by women, relative to those considered traditional in their societies, and, in some instances, has afforded women entry into skilled job categories.

However, attitudes and practices vary from place-to-place even within one country. There is a learning curve and rates of change have been very uneven in each locality. Moreover it has to be borne in mind that road sites are dynamic locations: they open, close, shift, and have a fluctuating mix of tasks and thus labour requirements. Thus, any survey is likely to be no more than a snapshot of a fast changing situation. Great caution should therefore be exercised in trying to draw general conclusions from observation at a particular point in time of a given project.

³ The sequel to the RARP the Minor Roads Programme was reported in 1988 to have a participation rate of 17%. [Wamalwa 1988]

Currently in Africa the percentage of female workers is generally a fraction of that of males, with figures in the range of 10-30 % not being uncommon [Riverson et. al. 1991]. By contrast, in Bangladesh the CARE road maintenance programme deliberately targets destitute women who comprise almost the entire workforce [Adeeb 1989].

In Kenya and Tanzania some projects reached levels of about 50-80% female participation. The women were single, and usually mothers. [Norconsult 1988, Scheinman et. al. 1989]. They were predominantly drawn from among those with few land assets and the economically worse off. It is thought that the difficult economic situation these women found themselves in, forced them to seek employment on road works. This tends to be confirmed by evidence from Madagascar showing women walking 2-3 hours daily each way to work . [NORAD 1992]

Experience on the Kenya Rural Access Roads Programme

The labour-based Rural Access Roads Programme (RARP) in Kenya is one of Africa's oldest and most successful. It is instructive, therefore, to begin by considering the experience of women on the RARP and how this has changed with time. [Devres Inc. 1984].

In the early years, after the start in 1974, about 16% of the RARP work force was female who, on average, tended to be more economically disadvantaged than male workers ³. Female labourers were seldom heads of household, had more children, owned less land and fewer assets, and averaged less education than male workers.

Female workers also has less prior wage work experience than men, and those who had worked for wages before the RARP project had received lower pay. Once accepted in the RARP, however, women were treated equitably, receiving the same pay and work schedules as males.

The percentage of women participating in the programme increased over time, for initially women were not considered capable of road construction work. As fewer men were willing to work for Ksh 7.9 per day, more women entered the programme. Later, a doubling of wages, in May 1980, resulted in increased competition for available jobs and women tended to be replaced.

To the degree that the RARP attracted female workers, it reached the most needy in the rural areas, many of whom depended on the RARP wage to meet their basic needs. However, job recruitment was principally through sub-chief's (baraza) meetings, not normally attended by women. A recommendation

of a study on road workers was to target recruitment efforts to the most needy, particularly women and the landless.

Since the RARP labour-based road works have met varying degrees of success with regard to women's involvement in other countries in SSA. The remainder of this paper concentrates on various aspects of the employment of women, noting some contrasts with other parts of the developing world.

General attitudes towards the suitability of roadwork for women

In most case studies, the general perception of the rural dwellers themselves seems to be that road work is a low status activity undertaken by those who have no real alternative means of enhancing their standard of living. It is considered "poor people's work". [NORAD 1992]. "We are poor and that is why we work on the road; because we have no money at all". [Scheinman et. al. 1989].

The socio-economic status of the area in question plays an important role in the attitudes of people towards the prospects of employment on road projects. The availability of alternative sources of employment and the relative wages paid appear to be the main determining factors. Thus, in one area of Kenya only a quarter of women wished to be road workers whereas in another, more deprived area, the proportion increased to two-thirds. [Lexow et. al. 1989]. Clearly, in deprived areas the lure of cash, however poor the wages may seem in relation to average values in other sectors of the economy, is a strong incentive. [Milimo 1987].

The belief that it is culturally inappropriate for women to seek employment outside the household does not seem to be quite so prevalent as it used to be. There appears to be a wider appreciation that some women need to work and earn for economic reasons. A priori surveys in Zambia indicated that 70% of both men and women thought road work was a task that could be undertaken by both sexes. [Milimo 1987]

In some countries there is virtually no task discrimination between the sexes. In others, women themselves shun the most arduous activities such as excavation in rocky soils, on steep slopes, or in quarries [NORAD 1992]. However, there are countries where women are still only allowed to undertake the relatively lighter and poorer paid activities such as water collection, grubbing or road maintenance. [Norconsult 1988, COWIconsult 1988, Ghanexim Economic Consultants 1990]

The restrictions imposed largely by men is in marked contrast to the willingness of women to undertake all sorts of tasks outside those traditionally assigned to them. [Tomoda et. al. 1987]. The danger of such restrictive practices is that acceptance that women are only able to do certain tasks will inevitably lead to low participation rates. [Wamalwa 1989]

In some countries there have been deliberate attempts to reserve road maintenance for women, or at least to give them more favourable consideration for these activities than for construction or rehabilitation [Norconsult 1988, Adeeb 1989]. These are a variety of reasons advanced for such a policy:

(i) In Bangladesh "destitute" women are recognised as one of the most underprivileged groups in the country who are in need of special consideration [Adeeb 1989]. Also, the work is intermittent and offers only a modest remuneration which male heads of households might find unattractive.

(ii) There is a belief that women are more conscientious in undertaking the repetitive tasks involved. [Hussain 1993]

(iii) The fixed location of road maintenance makes it more suited to women who need work close to their homes.

(iv) In general maintenance tasks are less arduous than those of construction or rehabilitation and thus, it is felt, more suited to women.

Attitudes of men towards women working

Whilst there are cases in the literature of women being treated on an equal footing to males in all respects, there are also persistent reports of discrimination and negative attitudes by men. Some of these attitudes are deeply felt and ingrained in local culture. For this reason alone the subject is a sensitive one and needs to be treated as such.

In some cases the negative attitude of men is manifest in an outright refusal to let their women participate in work. This is often justified on moral grounds (e.g., the immorality of women working among strange men). In one case in Ghana the contractor said that the level of familiarity between the sexes was affecting the progress of the work, so he dispensed with the services of the women! [Ghanexim Economic Consultants 1990]. There are, however, counter opinions to the morality arguments. In the case of Nigeria it has been contended that no religion or tradition in the country is against income-earning by women, but are only concerned about circumstances and setting in which such income is earned. [Hussain 1993]. That is all-female gangs, as in the norm in Bangladesh⁴ might well be acceptable even in the Muslim north.

The main reason given by male road workers who are not in favour of women working on roads is that they are physically weak or because the work is thought to be too arduous. [Lexow et. al. 1989, Wamalwa 1989, Ghanexim Economic Consultants 1990]. Actual output studies from Botswana showed that there was no difference in performance between men and women even on the heaviest of tasks [Brudefors 1989]. There is a similar suggestion from Tanzania that the output of men and women was not significantly different, although it is not clear that they were doing the same mix of tasks [Scheinman et. al. 1989]

A common bone of contention by men is women receiving equal pay for road work, even for the same tasks, which is unusual in traditional activities where they receive 50-70% of the men's wage. [Hussain 1993]. This attitude is usually justified by the widespread belief that women have a lower rate of productivity. Indeed this argument has been employed to justify limiting the percentage of women participating so as not to endanger the production schedule. [NORAD 1992]. A counter argument is that women's greater dedication to tasks requiring meticulous work, and greater reliability - and thus lower turnover - more than compensates for any lower rate of productivity [Scheinman et. al. 1989, Hussain 1993]. Moreover some men have acknowledged that since women are more likely to spend their earnings for the general benefit of the family, they are prepared to accept the principle of equal pay. [NORAD 1990]

Recruitment

In practice it is well established that there are often biases against women's involvement due to the methods of recruitment. A common feature is that work is only advertised through forums in which women rarely participate e.g. the regular meetings of traditional leaders. Another bias can be the requirement to present ID cards or birth certificates which men may, but few women, have. [Wamalwa

1989, NORAD 1990]. The effort to obtain an ID card - a photograph costing nearly a day's wages, and two visits to a major town - might well be beyond the resources of many poor women. In one instance this problem was considerably reduced by only requiring proof of identity from young girls to ensure they were more than 18 years of age. [NORAD 1992]

Experience indicates that unless efforts are made to make women aware of job opportunities their numbers will remain low. [Devres Inc 1984, COWIconult 1988, Norconsult 1988]. There have been instances where women have been recruited without understanding the terms on which they were employed [Scheinman et.al. 1989]. In particular it had not been made clear that they would be liable for tax on any earnings which exceeded the minimum wage.

Participation

Caution should be exercised in interpreting quoted female participation rates observed at any one time, and then assumed to be representative of average conditions, because of their correlation with the stage of roadworks and the nature of the tasks being undertaken at that moment. This is especially the case on sites which practise the concept of "women's work" - which usually denotes haulage, grubbing, spreading and maintenance.

According to the World Bank, women's low participation rate in Africa is explained by the following factors [Roverson et.al. 1991]:

⁴ The Nordic RESP programme has succeeded in getting women to set up work teams which are contracted to develop infrastructure, and informal work teams for more routine maintenance. [Yakub 1992]

- (i) priority given to domestic activities such as milling maize, fetching water, collection of wood, cooking , etc;
- (ii) lack of information about women's eligibility for employment;
- (iii) scarcity of forewomen;
- (iv) lack of transport to the work sites combined with already mentioned time constraints;
- (v) lack of pilot projects using labour-based methods with special emphasis on women's participation.

Whilst in both Kenya and Tanzania young women were predominant female participants, with more than 60% less than 30 years of age [Riverson et.al. 1991], this cannot be assumed always to be the case. In Lesotho in the early 1980s a number of conditions - the out-migration of males to mining work in South Africa, high landlessness (+20%) and poverty - combined to produce a labour force on one nationwide project that was more than 85% female with 50% aged over 45 years [Simpson 1983]. A relatively old female labour force is also undoubtedly the case in Bangladesh since many of the "destitute" women involved have been abandoned due to their age.

A priori studies in Madagascar identified the long work day of childbearing women (10-16 hours) as a barrier to their involvement. It was predicted that they might only be available during favourable periods of perhaps 3-4 months a year and for limited hours each day. [Skjortnes et.al. 1989]. Predictions of women's limited availability, especially daily, have led to suggestions for the introduction of part-time work. [Koda et.al. 1987, World Bank 1990]. In practice there is no reliable evidence of seasonal

variability in female availability - it may exist, there is just no evidence - but on one project women workers emphatically rejected the idea of part-time work. [NORAD 1992]. An additional factor in Madagascar was that men appeared to be permitted greater substitutability than women. They were allowed to send a substitute worker if ill, but women did not seem able to do this. [NORAD 1990]

Given women's arduous working day in the hoe-based agricultural systems of SSA, it would be surprising if a high proportion of women were able to participate in public works programmes, almost regardless of the wage paid, unless special efforts were first made to tackle their daily labour time constraints. Indeed, in several Sahelian countries with heavy seasonal out-migration of men, the absence of men, leaving women with the bulk of the rural workload, is considered to be a constraint to executing public works programmes. [Von Braun et.al. 1991]

A number of factors have, however, been identified which facilitate women's participation in labour-based roadworks. Among these are:

- (i) existence of women's groups in the project area;
- (ii) familiarity with the aims of the project;
- (iii) payment in cash not kind; and
- (iv) a high number of female members in the family.

[Van den Oever-Pereira 1984]

The fourth factor, which relates to having child minders for working mothers, was not confirmed in Tanzania [Tomoda et.al. 1987]

Care is needed in setting targets as a means of enhancing female participation. In Madagascar such targets setting led to the notional figure of 25% being interpreted as a maximum. The commentators' assessment was that this level would have been exceeded under free recruitment.

[NORAD 1990]

To date women have participated mainly as casual workers. Progression into skilled grades of employment has been slow even in the long-established programme in Kenya. The latest available data (1990) indicates the following rate of participation in the Minor Roads Programme [COWIConsult 1992]:

% women	
HQ 8	
Casual, road improvement	25
Casual, routine maintenance	9
Casual, periodic maintenance	21

The low level of female participation in routine maintenance is surprising since the light, repetitive, intermittent and essentially fixed location of the tasks is generally held to suit women more than men. However, in general the main difficulty confronting women in their progression into skilled grades of employment as road overseers or inspectors is the level of education required. The majority of village women have not gone beyond primary education. Surveys in Tanzania confirmed that women expressing

an interest in road work were mostly semi-educated.

[Koda et.al. 1987]

Special provisions may need to be considered to ensure that women are able to participate on road works let to contractors. The employment of women by contractors is not a general practice in many countries [NORAD 1992, Hussain 1993] and few can be expected to feel a social obligation to do so. If contractors are left to their own devices there is evidence that working conditions for women may deteriorate - zero recruitment, gender division of tasks, irregular payments, different wages for men and women, wages lower than minimum and long working days; also, in some cases tasks have been gradually increased. [NORAD 1990, 1992, Hussain 1993]

Household implications of women's participation

Little is known about the social cost of women's participation, that is the resultant impact on child care and the health of both child and mother. Evaluations in Kenya and Tanzania have indicated that road works can become an important targeted income generator, especially for women who are not able to harvest enough food [Riverson et.al. 1991]. The extended family structure allows women to leave household activities and the caring of infants and smaller children to grandmother, older children, or other female relatives. If for any reason (e.g. pregnancies or illnesses within the family) they cannot attend their job, relatives and friends may be able to stand in for them. [norconsult 1988, Lexow et.al. 1989]

The element of family support appears crucial to a mother's ability to absorb the additional burden of road work. An impact study in Tanzania concluded that the alternative of child care facilities, to be provided by the project, as has sometimes been proposed, made little sense for activities which move everyday along the road and were likely to be completed within 1-2 years. [Scheinman et.al. 1989]

Despite the relatively low wages received on road projects, and the additional workload rendered, the evidence is that given the chance needy women will nonetheless seek employment on roads in order to earn extra income and obtain a measure of financial independence. [Ghanexim Economic Consultants 1990]. May express gratitude for the opportunity to work since there are few alternatives. [Scheinman et.al. 1989]. Women who earn wages claim that a major benefit is the fact that they "control" their money. Furthermore, this is spent mainly on food, clothing and school fees, thus contributing to an increase in the standard of living of the family. [Lexow et.al. 1989]

Labour-based road works: vital income source or destitution trap for women?

Do all women benefit from participation on labour-based roadworks? Wage levels seem to vary with the socio-economic background from which women come, and the extent of their deprivation. The most seriously deprived women are likely to be those who receive very low wages from road work. In Botswana remuneration for work on roads was set by government at 60% of the minimum casual labour wage [Lexow et.al. 1989]. In Tanzania wages were (1989) one-third of those in neighbouring Kenya and known to have been the cause of labour supply problems in some areas. Because of these low wages it has been claimed that most workers are as poor when they leave the job as when they started [Lexow et.al. 1989].

The justifications offered for such a low wage are that:

- (i) it guarantees that only very poor people will want to work;
- (ii) low wages means more jobs for more people; and
- (iii) the cost of labour-intensive road works compare favourably with those by equipment-intensive methods.

With such low wages it is unlikely that many people can invest to give long-term improvement in living standards, although a few manage to do so. [Scheinman et.al. 1989]. Earnings from labour on roads are likely to be consumed on necessities such as food, clothing and school fees. [Norconsult 1988, Lexow et.al. 1989, Scheinman et.al. 1989]. Indeed, an evaluation of the RRM project in Tanzania concluded that works on the road acted as a 'social net' by employing women who could not generate enough cash from their farms to buy clothing, sugar, cooking oil and other essentials. [Scheinman et.al. 1989]. In contrast, evidence from more generously paid work in Ghana indicates that most money earned by women was kept for investment in land, house building, trading, sewing machines and savings. [Ghanexim Economic Consultants 1990]

Some research suggests that there has been no negative effects on agricultural production of female employment. This conclusion was based on the observation that women either work in the agricultural slack season or hire others to do their farming tasks for them. [Scheinman et.al. 1989, NORAD 1992]. In Madagascar auxiliary farm labour earned 30-40% of the earnings paid for road work. [NORAD 1992]. Thus in addition to the direct beneficiaries of the programme other poor men and women indirectly received a share of the wages paid. However, on the RARP female-headed households experienced a decline in the value of agricultural production, although this was compensated for by an increase in total income earned. [Devres Inc 1984]

Conclusion

It is extremely difficult to come to any general conclusions on the benefits and disbenefits women experience when participating in labour-based rural roadworks. It is however evident, given overall low levels of female participation in such schemes and the prevailing attitudes of the women themselves, that labour-based roadworks do not represent an economic panacea.

Most rural women are already coping with extremely full work days and earning cash in the low-paid, often arduous work conditions of road sites is not alluring. Nonetheless, there is abundant evidence that labour-based roadworks are a welcome source of income for asset-poor women. Furthermore, it is possible that the demonstrator effect of such women doing non-traditional roadwork tasks could help to challenge fixed notions of the rural gender division of labour and male dominance in cash earning. If this were the case, it could have beneficial repercussions for rural women more generally, regardless of their economic standing in the rural community.

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Introduction

Labour-based district roadworks contribute to the introduction of a cash economy in rural areas. However, the wages paid to the unskilled labour are very low. To further improve the standard of living of the rural population, it is important to increase the productivity, and thereby be able to bring up the level of the wage rates, without disturbing the feasibility of using labour-based methods.

Employing women on labour-based road projects is adding an additional burden to their daily responsibilities. However, through surveys it is evident that they are very interested in this economic opportunity. One of the objectives of this programme is to alleviate poverty, and by directing it towards the female population in the rural areas, it certainly reaches the core target group.

In Zimbabwe it was experienced that, during the recent drought period, there was an increased interest in employment from women in the vicinity of the road sites. When the drought ended the interest decreased, since agricultural work was prioritized.

Wage Rate

The positive effect of piecework proves to a certain extent that there is a positive correlation between the wage rate level and the productivity rates of the workers.

However, the wage rate level is often a politically sensitive issue. In many countries, the purpose and interpretation of the minimum wage rate has been inverted, and it is applied as a maximum wage rate. Examples in Botswana and Tanzania show that the Government refuses to pay more than the minimum wage for casual labour.

In some programmes, low wage rates for unskilled labour have been used as a rationale for targeting the poorest part of the rural population. If the wage rates reach a level which is regarded as attractive by a wider group in the rural communities, the poorest are squeezed out.

In many countries (i.e., Tanzania and Botswana) the Government salary scales are lower than what is regarded as a reasonable pay for a day of manual work. In order to secure the interest and motivation of the unskilled labour, piecework and other production bonus systems are introduced. However, this results in situations where unskilled workers actually receive higher wages than the supervisors and engineers.

An effective way of avoiding the problem of rigid and too-low wage levels is by involving the private sector in our programmes. Private contractors are free to increase the wages and salaries of their staff, and can respond easier to the market forces.

However, when introducing the private sector, there is a chance that women may be excluded. It is therefore important to take special measures to secure the involvement of women at all staff levels. This can be done during the selection of contractors for training, and special clauses can be incorporated in the conditions of contract.

ASIST Information Services

By David Mason, Information Specialist, ASIST, Nairobi

History

1988

The ILO and the Swiss Development Cooperation (SDC), in collaboration with the Ministry of Public Works in Kenya (MoPW), developed and ran an International Course for Engineers and Project Managers on labour-based road programme management.

1990

A project planning workshop identified the main objective as:

to increase the effectiveness of labour-based programmes in sub-Saharan Africa

and agreed three main outputs:

training of engineers, site supervisors, senior management staff and trainers

provision of information services

conduct appropriate research and development.

1991

In October the ASIST project was launched.

The objectives set for the Information Services (IS) component were:

labour-based roadworks information to be made available to practitioners

technology information available to labour-based programmes to be improved.

The principal component of the Information Services was seen as a Technical Enquiry Service (TES). This was set up at Kisii Training School in western Kenya and staffed by a Technology Specialist and a National Professional engineer.

During the first year, the main activities of the IS involved accessioning and cataloguing documents, and carrying out research into the Botswana method of setting out roadworks.

Very few enquiries were received during this period, apparently because few people knew of the existence of the ASIST project, let alone the IS component.

1992

At the Lesotho regional seminar in March, the operation of TES was reviewed and recommendations made:

TES should be proactive rather than purely reactive

TES should sell itself and its services

TES should publish a bulletin twice a year, each issue concentrating on a specialist subject, the first of which should be on maintenance.

1993

In January, David Mason joined ASIST as Information Specialist, and Collins Makoriwa as Data systems Specialist.

In May, the first issue of the bulletin was published. About 1500 copies were distributed, mostly in sub-Saharan Africa. Each bulletin contained a registration form. About 150 have been returned to date.

In September, following an SDC review of KTS, the decision was taken to relocate the main activities of TES to Nairobi to streamline the management of documents and incoming enquiries. KTS remains as a branch office, to serve the staff and students there.

The Current Position

To date, 1580 publications have been accessioned and catalogued. The records are kept in a computer database. A keyword system allows searches to be made according to topics selected by the client.

To date, about 50 formal enquiries have been received (not including requests for advice from advisory support staff carrying out their normal duties). Most of these requests have been for publications.

During the past six months, the Information Service had undergone a change of emphasis. The setup is now as follows and has four components:

Networking

To keep practitioners in touch with each other and up to date with the latest news and developments.
publication of a bi-annual bulletin
mounting of an annual regional seminar.

Technical Enquiry Service

To respond to specific requests for publications and information.
an expert "living database" of experienced advisers
a bibliographic database of reports, publications, and other literature.

Publishing

To produce material, culled and digested from the expert and bibliographic databases, appropriate to the needs experience level of practitioners.

technical briefs

training material.

Research and Development

To keep practitioners up to date with the latest R & D findings.

maintain a watching brief on research being conducted

publish and disseminate the results of research.

Enquiry procedure

request received

enquiry form opened

computer database searched

response formulated and publications copied or purchased as appropriate

response despatched.

Small quantities of photocopied extracts are sent free of charge, as are some ILO publications such as Country Technology Reports. Commercial publications and large quantities of photocopying are charged at cost.

Finally

The Information Service exists to serve you, the labour-based practitioners. Help us to serve you better by giving us feedback. Most of you were sent a copy of the Bulletin. What did you think of it? Write and let us know, and if you want to be included on the mailing list for the next issue, complete and send in the Registration Form.

Questions Discussed in Work Groups

During the last day of the seminar, the participants were divided into working groups, each of which were given specific questions related to the previous topics addressed by the seminar during the previous days. The questions and findings as they were presented are briefly described in this chapter.

Group (1)

What are your recommendations for appropriate design and specifications for the tractor-trailer combination in relation to the:

tractor,
trailer and
hitch?

Group (2)

What are your recommendations on the desirability and type of training to be provided to contractors and consultants in terms of labour-based road construction and maintenance technology?

What new material needs to be developed?

How can existing training material be utilized in such a training programme?

Action Plan.

Group (3)

What organizational systems do we need to set up to make small-scale contracting works?

two player or three-player system

large vs. Small contractors

role/involvement of consultants

role of Government

type of contract

wage rates

FINDINGS OF GROUP 1

General

Before a decision is taken on the choice of hauling equipment, a careful analysis should be carried out on the alternative means of transport which may be appropriate (i.e., animal drawn carts, tractors and trailers, trucks). Only when a proper cost analysis has proved the viability of the tractor-trailer alternative, should the following recommendations be considered.

Tractor-trailer Combination

Various labour-based programmes have run trails using different design and sizes of trailers and tractors. Experience has shown that basic, unsophisticated and solid designs provide the most reliable services, reducing the amount of mechanical maintenance and ensuring a high rate of plant availability.

The work group tried to find recommendations for the design and specifications for a tractor and trailer suitable for gravel haulage for labour-based road works. This trailer should be considered for new projects which as yet do not possess any equipment.

The findings of Group 1 can be summarized as described in the table on the following page.

Trailers

The trailer loading capacity should be limited to 3 cubic metres.

The chassis should be carried by an A-frame and a single axle. In order to increase the traction capability of the tractor, at least one third of the trailer weight and load should be transferred to the rear axle of the tractor. The choice of tyres should correspond to the most common truck tyre available in the country.

Side doors for unloading are not recommended. Experience from Kenya shows that this item often breaks and requires a great deal of maintenance. Secondly, it has been proven through time studies that the increased unloading time is marginal. When also considering the increased availability rates of trailers without side doors, it is clear that this is the most feasible alternative.

Variations

In order to reduce the unloading time, one may experiment with the use of front side doors. However, it is recommended that the increased efficiency due to using side doors should be closely monitored and documented before it is introduced as a standard item.

A second variation may be the introduction of removable tail gates in order to increase the carrying capacity of the trailer as well as reducing spilling.

It is not recommended that new programmes introduce or initiate trails on tipping trailers. Ongoing test trails with non-hydraulic tipping trailers in Kenya are promising. However, it should be emphasized that they are still at the prototype stage. If the trails finally show positive results, this experience will be disseminated to other projects. New projects should wait with the introduction of tipping trailers until the MRP has reached its conclusions.

Equipment Item	Basic Recommendation	Variations to be considered/tried out

<p>Trailer</p> <p>Design developed by MRP in Kenya seems appropriate.</p>	<p>Size: 3m³</p> <p>Tyre size: Most common truck size 900x20</p> <p>Load distribution: Min. 1/3 on hitch</p> <p>Axle: Single axle, A-frame</p>	<p>i) Front side doors</p> <p>ii) Removable tail gate</p>
<p>1) Hitch</p> <p>2) Connection</p>	<p>Heavy duty hydraulic pick up hitch</p> <p>Pin and eye</p>	<p>Ball and cup</p>
<p>Tractor</p> <p>Supplier should have a significant market share in the client country = good spares availability</p>	<p>55 - 65 HP</p> <p>2 wheel drive</p> <p>Heavy duty rims and industrial tires</p>	
<p>WHAT</p>	<p>WHO</p>	<p>WHEN</p>
<p>ILO to produce specifications for clients to apply for tender boards.</p> <p>Incorporate these specifications into updated Tools and Equipment Guide.</p>	<p>ASIST - TES</p> <p>ILO/ASIST to incorporate manual update in 1994 operation plan.</p> <p>Direct buying donors also to follow tractor-trailer specifications.</p>	<p>November 1993</p> <p>Depending on review meeting for ASIST in January 1994.</p> <p>Whenever procurement is done by donors.</p>

Tractors

The appropriate tractor for hauling a 3 m³ trailer of gravel is a 2 wheel drive with a 55 - 65 HP engine. 4 wheel tractors are not necessary for this purpose. If the tractor is to be used for other purposes (ploughing, towed grading, etc.), one may consider more powerful models. One solution is to invest in a limited number of more powerful multi-purpose tractors. The remaining fleet of tractors with the above specifications would be entirely designed for gravel haulage.

Trailers are repeatedly hitched and unhitched from the tractor. The tractor should therefore be fitted with a

heavy duty automatic hitch which picks up and detaches the trailer automatically. The pin and eye lock is the most common lock system and cheapest solution. The ball and cup mechanism is more solid but also more expensive.

The rough environment on labour-based road sites and in the gravel quarries requires that the tractor be fitted with heavy duty rims and industrial tyres.

To ensure a regular and sufficient supply of spares, the chosen tractor supplier should have a significant market share in the client country.

If the equipment is to be used in mountainous or steep terrain, it is advised that the tractor be fitted with roll-over bars. In flat terrains this is not necessary. It is not very often that the tractors capsize due to the trailer tipping over to the side. Usually the hitch brakes before rolling the tractor over.

Further Action

The above specifications are similar to the trailer-tractor combination recently developed by the Minor Road programme in Kenya. It is proposed that these specifications be distributed by ASIST to the various labour-based programmes in the region. One way of doing this, is to publish the design and technical drawings in the next issue of the ASIST journal.

The above findings should also be incorporated in a revised version of the ILO Guide to Tools and Equipment for Labour-based Road Construction. A final decision on this activity will be taken based on the review and evaluation of the ASIST programme scheduled for January 1994.

Finally, the national executing agencies responsible for the road programmes should insist on these standardized specifications when equipment is supplied by the donors.

FINDINGS OF GROUP 2

Main Question

The main issue discussed in Group 2 was how to move labour-based road construction and maintenance from the public sector to the private sector involving domestic small-scale contractors as well as consultants.

In order to achieve this transfer, there is a great demand for training of Government staff, as well as the various levels of staff in the local construction and consultancy firms. Therefore, the group focussed on the desirability and type of training to be given to contractors and consultants.

The topic was sub-divided into the following key questions:

Is training for small scale contracting desirable?

Type of contractor development.

What material is available?

What new material is needed?

How do we integrate existing material?

How do we encourage women's involvement?

There was full agreement along the group members that a structured training programme is a key element for the successful involvement of the domestic private sector in labour-based road construction and maintenance works.

Classification of Contractors

Before a training programme is formulated, it is important to define the various types of contracting companies which can be found in developing countries. The table below provides a general description of the different types of contractors categorized according to their size and the type of works they are able to carry out.

Petty Contractors

The petty contractor is generally referred to as the one-man contractor. This category of contractors usually consists of one man firms, sometimes assisted by a limited amount of unskilled workers. They may be labour contractors, usually consisting of a businessman sub-contracted to carry out specific work relying mainly on unskilled casual labour.

Organized local community groups such as farmers associations and village welfare groups can also be classified as petty contractors.

Types of Contractors

Type Description
Petty Contractors <ul style="list-style-type: none"> •Single person •Labour only •Not registered •Basic skills
Small-scale Contractors <ul style="list-style-type: none"> •Registered •Possess basic equipment •Capital security low •Entrepreneurial skills •Technical and managerial skills
Large-scale contractors - not interested

A common feature for this group is that they are not formally registered and do not possess any capital and are therefore extremely vulnerable to cash-flow problems such as mobilization capital and late payments.

The petty contractors normally do not possess any equipment, and lack any means of transport. Due to their lack of mobility, they are normally recruited from the vicinity of the project work sites.

These contractors are mainly used for maintenance works or simple, clearly defined sub-contracts requiring a minimum of skilled labour and equipment. In Kenya, the lengthmen securing the routine maintenance of the minor roads network are organized as one-man contractors. In Lesotho, the Labour Construction Unit utilizes one-man contractors for contracting out masonry works for small bridges and culverts.

Small-scale contractors

Most domestic small-scale contractors are found in the building construction industry and the transport sector and are normally registered companies. Often limited, they still possess certain technical and managerial skills. However, experience shows that their organization requires further training in business management, accounting, mechanical maintenance, road and concrete technology, as well as in labour-based methods.

Their equipment fleet is spares and often old and poorly standardized. Before they can be used for road rehabilitation works, it is usually necessary to assist them in the acquisition of additional light construction equipment (i.e., hauling and compaction equipment).

Similar to the petty contractors, the small-scale contractors are often underfinanced and vulnerable to cash-flow distortions. Normally, these contractors do not operate their accounts through a bank. In many cases the local banks do not consider these firms as attractive clients and therefore do not provide them any service.

After receiving appropriate training development assistance, these contractors have proven to be highly efficient in carrying out both road construction and maintenance works. They have shown good supply of work, regular and timely payments, etc.: they will survive as sound construction firms and an important component of the domestic construction industry.

Large-scale contractors are often subsidiaries of large foreign multi-national companies in international competitive bidding and are often only present in the country while they are carrying out a contract. Once their assignment has been completed, they leave the country, including evacuating equipment and skilled staff. Due to this, their involvement provides a minimal technology transfer to the recipient country, resulting in a low sustainability and little institutionalization of skills and experience. In most cases, they regard the size of labour-based road contracts as too small for their interest. For these reasons, this category of contractors is not regarded as part of the beneficiary target group for training and development assistance.

Training Material

For the training and development of petty and small-scale contractors, it was acknowledged that there already exists a certain amount of training material produced by ongoing contractor development programmes in the region (ghana, Madagascar, Lesotho and Tanzania). This training material consists of (i) general literature on labour-based road construction and maintenance technology developed by the ILO, and (ii) specific material developed for contractor development and management.

In addition, the ILO has produced a series of publications on domestic contractor development and management for the construction industry in general under its Improve Your Construction Business Programme (IYCB). However, this material needs to be further developed and specifically adapted to

labour-based road works.

Required Training Material Yet to be Developed

Country Specific

When commencing on a new programme the above mentioned literature needs to be adapted into country specific training material, taking into consideration local conditions, technical standards and type of works to be carried out.

In some instances, it would be useful to translate the material into local language.

Finally, it should be adapted to the level of education among the target group, in relation to the skills of the staff of the contractors, as well as the government implementing agency, i.e., supervisors, inspectors, mechanics, administrative staff, etc.

Training of Trainers

In order to ensure a sustainable programme, it is crucial that the training capacity for this type of programme be fully institutionalized in the country. To achieve this objective, there is a demand for a structured training programme for trainers.

Available Technical and Managerial Training Material

ILO	Guide to the Training of Supervisors International Course for Engineers and Managers of Labour-based road Construction and Maintenance Programmes
LESOTHO	LCU training material
BOTSWANA	Training Course Notes for Gangleaders Training Course Notes for Technical Assistants
UGANDA	Final Preparation Report of the Transport Rehabilitation Project
KENYA	Course notes for inspectors and overseers Maintenance Management Manual
GHANA	??
IYCB	Interactive Contractor Training Improve Your Construction Business Material currently being developed for Lesotho

Selection of Contractors

Depending on the type of works to be carried out, there is a demand for developing guidelines for the identification and selection of contractors with the appropriate skill profiles.

Employment Conditions

In order to ensure smooth working relations between the workers and employers, it is recommended that a standard set of guidelines for employment conditions be developed.

Training of Local Consultants

When involving the private sector in the execution of labour-based road works, it is important not to leave out the consultancy firms. In the process of involving more and more parties in labour-based programmes, this knowledge and experience should also be disseminated to consultants. The preferred target group is local or indigenous companies, well established in the country.

In order to transfer labour-based technology to consultants, there is a demand for training. As a basis, materials already available cover the various topics required. However, this material would have to be adapted to meet the specific future role and tasks of the consultants.

In South Africa, local consultants have been involved in the design, implementation and monitoring of labour-based public works. For this purpose, they have developed a set of interim guidelines for the involvement of private consultants for this type of works, which may be a good basis for the further development of similar guidelines for other countries.

Women's Involvement

It was acknowledged that women should play an important role in this programme and should be mobilised as contractors and consultants as well as being properly represented among the work force of both skilled and unskilled labour. In order to provide equal employment opportunities to both men and women, it is essential that proper guidance be provided on procedures and actions required to achieve this objective.

Guidelines should be developed for selection and identification of contractors/consultants describing specific measures which ensure an active participation of women in the rural areas.

Further Action

Training programmes at national level should undertake the translation of the training materials into national or local languages. Furthermore, trainers should make better use of existing material as identified by the group. The Technical Enquiry Services of ALIST can assist in the distribution of the material.

Training of trainers for small-scale road contractors development programmes is important. The ASIST Training of Trainers Course is still under development and should cater for this recommendation. Through the participation of two trainers for Ghana in the ALIST Training of Trainers course in Kenya, ALIST has established a contact with resource persons in the small-scale road contractor development programme in Ghana. During their visit to Kenya, ALIST requested them to design a purpose-made course for small-scale road contractors based on their past experience in contractor training.

The registration and certification of the various types of contractors is an important issue. Identifying the unregistered contractors can often be difficult. If all contractors were registered, could also lead to improved Government recognition and commitment to this sector.

FINDINGS OF GROUP 3

Introduction

The main task of this group was to look at the organizational system required when developing small-scale contractors to execute labour-based road construction and maintenance works.

As a general remark, it was acknowledged that the type and size of the programme and works to be carried out determine the type of contractors required, as well as the need for consultants. Furthermore, the availability, size and skills of the domestic contractors and consultants influence the design of a programme. This type of project, when involving the private sector, should be programmed on a long term basis.

Role of Local Consultants

When road rehabilitation and regravelling works of a certain size are awarded to labour-based contractors, local consultants can play a useful role. For routine maintenance, petty contracts and direct control by the road agency are more appropriate.

The main advantages of involving local consultants in the design and implementation of labour-based road programmes are:

The main advantages of involving local consultants in the design and implementation of labour-based road programmes are:

Consultants represent an additional capacity (manpower, skills), which can reduce the tasks of the respective Government organizations;

The consultants can act as a neutral body;

In order to protect their reputation, they will perform their duties on time (i.e., prepare certificates leading to timely payment of contractors).

Training

Before consultants can play a full role in labour-based road programmes, there is a demand for training of the consultants in labour-based technology, as well as establishing a capacity within the Government technical line agencies to control both the contractors and the consultants. This training programme will need to be developed in line with the size of the programme and the consultancy input requirements.

Conclusions

In order to involve the private sector fully in labour-based road works, the following activities were identified:

- (i) Define tasks (terms of reference) for consultants in every phase of a programme. Attach engineers from consultancy firms to labour-based road programmes (typical consultant tasks might include prioritization of roads and technical auditing).
- (ii) Standardize methodology of project management, control and documentation.
- (iii) Clearly define roles of Government, client, consultants and contractors.
- (iv) Consultant involvement will imply selection, training, special registration, conditions of involvement, etc.
- (v) Large consultants could be used to train small consultants if tasks are well-defined.

Relationship between large and small contractors

The group discussed the possibility of using large contractors for training of small-scale contractors through sub-contracts.

Their motivation of the large contractors to carry out such a training programme will depend on their terms of reference and the main objective of the project. Is the main objective the construction works or the development of private construction firms? In case of the latter, the role of the large contractors is better defined, and he will be judged on his training role performance. His motivation and interest will also depend on his fear of future competition.

Training of small-scale contractors by large contractors could be initiated in two different ways:

- (i) Large contractor awarded contracts, but is forced to sub-contract a certain percentage of the works to smaller firms.
- (ii) Large contractor's role is defined as training and development of smaller firms only.

The second option means that project outputs should be defined in terms of competent small contractors trained in management, accounting, site management, etc.

In general, the workshop participants had limited positive experience with on-the-job training by large contractors, and, in conclusion, recommended that the Government hire individual contractor specialists to work as consultants to train and guide small contractors.

Regional Seminar Proceedings 1993

AGENDA

Regional Seminar on Labour-based Roadworks Technology

Zimbabwe Institution of Engineers, Harare, Zimbabwe

28 September to 01 October

Tuesday 28 September

08:00 - 08:30	Registration at Conquerar House
08:30 - 10:00	Session 1 Introduction to the Seminar Opening address by Rod Mitchell, Senior Vice-President of the ZIE. Scene setting - Chairperson Peter Bentall, COWIconult, Harare Seminar context and objectives by David Stiedl, Programme Director of ALIST, Nairobi, Kenya. Administration arrangements and seminar conduct by David Mason, information Specialist of ALIST, Nairobi Kenya.
10:00 - 10:30	Coffee
10:30 - 12:00	Session 2 Tools and Equipment Chairperson David Jennings, Training Adviser, kisii Training School, Kenya. Handtools and Equipment for Labour-based Construction - Lesotho's Experience by Athie Lehobo, ILO Civil Engineer, Maseru, Lesotho. Handtools and Equipment - The Current Scene by Collins Makoriwa, ALIST National Professional, Nairobi, Kenya.
12:00 - 13:30	Lunch
13:30 - 15:30	Equipment Maintenance by jim Hamper, CIDA Mechanical Engineer, Ministry of Public Works and Housing, Nakuru, Kenya.
15:30 - 16:00	Coffee
16:00 - 18:00	Intermediate Equipment to Support Labour-based Roadworks - Development, Testing and evaluation of Prototype Equipment by Roberts Petts, Intech Associates, united Kingdom.

Wednesday 29 September

08:00 - 18:00	SESSION 3 Field Visit to labour-based road construction sites.
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Thursday 30 September

08:30 - 10:00	<p>Session 4 Small-Scale Contractors Chairperson Peter Bentall, COWiconsult, Harare.</p> <p>Improve Your Construction Business - Entrepreneurship Training for Small-Scale Contractors in the Labour-based Road Sector by Claes-Axel Andersson, ILO Improve Your Business Programme, Geneva.</p> <p>Can Experiences in Contractor Training be Transfer for one Country to Another? By K.D. Osei-Bonsu, ILO Chief Technical Adviser, Moshe, Tanzania.</p>
10:00 - 12:00	<p>Labour-based Contracting: Contractor Management - A Case Study in Kenya by Bruno Illi, Norconsult, Nairobi, Kenya</p> <p>Labour-based Contracting - Uganda's Experience by W.E. Musumba, Chief Road Maintenance Engineer, Ministry of Works, Transport and Communication, Entebbe, Uganda.</p> <p>Introduction of Labour-based Contractors to the Bank - Some Pitfalls by Bashiru Sakiba, Director of Department of Feeder Roads, Accra, Ghana.</p>
12:00 - 14:00	Lunch
14:00 - 15:30	<p>Session 5 Women and Labour-based Roadworks</p> <p>The Involvement of Women in the Construction Industry in general and in Roadworks, Activities in Particular by John Howe, International Institute for Infrastructural, Hydraulic and Environmental Engineering, Delft, the Netherlands.</p>
15:30 - 16:00	Coffee
16:00 - 17:30	<p>A Review of Recent Labour-Intensive Construction in South Africa by Robert McCutcheon, Professor, Department of Civil Engineering, University of Witwatersrand, South Africa.</p> <p>Group Discussion</p>

Friday 1 October

08:30 - 10:00	<p>Session 6 ALIST Information Services Chairperson Jan de Veen, ILO Geneva</p> <p>An update of the ALIST Information Services by David Mason, Information Specialist, Nairobi, Kenya.</p>
10:00 - 10:30	Coffee
10:30 - 12:00	Findings of Group Discussions
	Closing of Seminar

Regional Seminar Proceedings 1993

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