CHAPTER 8: EVALUATION OF ROAD PROJECTS CONSTRUCTED USING LABOUR-BASED METHODS.

8.1. Overview of the Chapter

The programme for the development of LBW technology in Namibia was formally concluded in 2000. During the development period 1996-2000, a number of road construction projects were undertaken, in addition to the roads built during the training process. After 2000 several rural roads projects have been constructed using LBW methods under the capital development plan of the Roads Authority. Some work has also been done on some urban roads in the Windhoek Municipality. Outside the roads sector, a few earth dams and water pipelines projects were implemented by the Department of Water Affairs. A major labour-based project in Namibia which was ongoing during the study period is the construction of the railway embankment for the extension of the northern railway line from Tsumeb to Ondangwa, for a distance of 158 km.

A review and analysis of road projects constructed using labour-based methods after the training and piloting phase is undertaken in this Chapter. Basic features of the projects, implementation aspects and parameters are described and discussed. . Achievements, problems and lessons learned are highlighted and discussed.

8.2 Road Construction Projects

Road projects constructed using labour-based works methods in the period 1996–2003 are shown in Table 8.1. Approximately 340km of roads were and about N$130 million was invested.

Fifteen (15) road construction projects, for which some data is available, are reviewed and analysed in the following sections.

Year	Road No.	Description	Length (km)	Client	Consultant	Contractor	Contract Sum (N$)	Duration (Months)	Start	Finish	Cost N$/km
1996	DR3622	Onethindi-Oshigambo	21.64	MWTC	Bicon Namibia	Herma Brothers	12,213,764.00	22	Oct-96	Aug-98	564,407
1997	DR3608	Anamulenge-Ongenga	6.00	MWTC	Bicon Namibia	Onandjaba Const.	1,050,294.00	11	Mar-97	Jan-98	175,049
1997	DR3608	Anamulenge-Okalongo	5.90	MWTC	Bicon Namibia	Oshakati Building	977,672.00	12	Mar-97	Jan-98	165,707
1997	DR3605	Oluno – Uukwiyu	13.44	MWTC	Bicon Namibia	Herma Brothers	11,234,946.00	18	Feb-97	Sep-08	278,093
1997	DR3607	Oshakati-Ompundja	14.76								
1997	DR3629	Onethindi-Olukonda	12.20								
1997	DR3616	Tsandi – Onesi	13.50	MWTC	WCE	EH	5,685,387.00	18	Oct-97	Feb-99	421,140
1998	DR3616	Tsandi – Onesi	14.00	MWTC	WCE	Onandjaba	6,648,818.00	18	Sep-98	Dec-99	474,916
1999	DR3625	Oshigambo-Ondobe	12.20	MWTC	Stewart Scott	Patriot CC	4,344,335.00	15	Feb-99	May-00	356,093
1999	DR3625	Oshigambo-Ondobe	12.60	MWTC	Stewart Scott	Patriot CC	4,053,970.00		Sep-99		321,744
1999	DR3625	Oshigambo-Ondobe	6.55	MWTC	Stewart Scott	RCC	2,099,223.65	5	Aug-00	Dec-00	320,492
1999	DR3635	Okahao-Omwaanda	14.00	MWTC	Stewart Scott	Patriot CC	4,548,952.75	15	Jun-00	Apr-02	324,925
1999	DR3626	Okahao-Etilyasa	13.50	MWTC	Stewart Scott	Roadhart cc	4,749,508.00	15	Feb-99	May-00	351,815
2001	DR3614	Okahao – Iikokola	3.50	RA	Stewart Scott	Grand Track	1,461,555.09	4	Sep-01	Feb-02	417,587
2001	DR3614	Okahao – Iikokola	3.50	RA	Stewart Scott	Tsandi Constr.	1,680,788.35	4	Sep-01	Feb-02	480,225
2001	DR3614	Okahao – Iikokola	14.24	RA	Stewart Scott	Oshakati BC	4,998,134.60	15	Nov-01	Feb-03	350,993
2001	DR3636	Ondangwa-Onakamwandi	26.50	RA	WML Namibia	PCC/Roadhart cc	8,455,054.00	22	Jul-01	Feb-04	319,059
2001	DR3637	Ondangwa-Ohalushu	25.90	RA	WML Namibia	EH/Roadhart cc	8,024,043.00	20	Jul-01	Jun-03	272,001
2001	DR3638	Ongwediva-Ongha	27.50	RA	WML Namibia	Onandjaba/ Roadhart cc	7,382,409.00	24	Aug-01	Mar-04	268,451
2002	DR3614	Okahao – Iikokola	5.56	RA	Stewart Scott	RCC	2,171,195.44	7	Oct-02	May-03	390,503
2002	DR3639	Omafo – Ondobe	30.80	RA	WML Namibia	Namroad/Nexus	8,738,605.00	24	May-02	May-04	283,721
2003	DR3603	Onathinge-Onayena	8.54	RA	WML Namibia	Nexus Civils	7,710,849.00	11	Jan-03		902,910
2003	DR3443	Mpunguvlei-Katope	12.00	RA	Bicon Namibia	Thohi Constr	7,690,030.00	18	Sep-03	Mar-05	640,836
2003	DR3444	Nepara – Gava	12.00	RA	Bicon Namibia	Nexus Civils	7,710,849.00	18	Mar-03	Sep-04	642,571
		Total	343.43				129,100,029.98				

Table 8.1 Labour-Based Construction of District Roads after the LBPP: 1996 -2003 (Costs Un-escalated)(Source: MWTC/RA).

8.3. Local Contractor Capacity in Namibia

Experience in Namibia during the first Kreditanstalt fur Wiederaufbau (KfW) funded Labour-based Project I road construction projects[1] was that identification of suitably experienced Namibian contractors was difficult, despite the conclusion of an earlier training programme in 1997. Herma Brothers Pty Ltd, an equipment based contractor ultimately executed these contracts. During the second lot of similar KFW funded projects (Labour-based Project II), new contractors had emerged. In addition, the policy on LBW had been adopted by the Government, with emphasis on providing opportunities to small contractors.

Before contract documentation was completed for the new projects, a contractor capacity survey was commissioned by DOT in order to;

- Establish the then existing small contractor capacities;
- Identify measures that would support further contractor development;
- Optimize the number of contracts required for the construction of the intended projects, and
- Harmonise tender documentation and packaging in line with capacity and policy guidelines.

Two methods were used; local contractors responded to a prepared questionnaire, and the previous labour-based works project's tenders between 1996 and 2000 were reviewed (Bicon Namibia, 2000). Seventeen (17) contractors were assessed. Only seven (or 40%) contractors showed some capacity to execute labour-based road projects. A summary of results is shown in Table 8.2. It was concluded that most contractors, including those which had qualified from the DOT's training programme in 1997, did not have sufficient capacity for LBW roadworks. However, the survey showed that sufficient interest existed in Namibia for labour-based road construction works (ibid). The participation in labour-based projects tenders between 1996 and 1999 is summarized in Table 8.3 below.

[1] The KfW funded Labour-based Project I entailed 116km of gravel district roads and 8km of a bitumen road section.

Table 8.2: Results of a contractor capacity survey in Namibia

No.	Company	Size	LBW Contractor or Conventional	Capacity for LBW
1	PCC	Medium	Conventional/LBW	Yes
2	RCC	Medium	Conventional/LBW	Yes
3	Brandberg	Medium	Conventional	Yes
4	Namibbeton	Medium	Conventional	No
5	Vermeyedu	Medium	Conventional	No
6	KCC	Medium	Conventional	No
7	Salz Gossow	Medium	Conventional	No
8	Global	Small	Conventional	No
9	Hero	Small	Conventional	No
10	Holm's	Small	Conventional	No
11	RCC	Medium	Conventional/LBW	Yes
12	LB Sololutions	Small	LBW	Yes
13	Roadhart	Small	LBW	Yes
14	Onandjaba	Small	LBW	Yes
15	Oshakati	Small	LBW	No
16	EH	Small	LBW	No
17	Eino	Small	LBW	No

(Source: Bicon Namibia).

Subsequently, KfW insisted that medium sized, established road contractors be allowed to tender for the LBW road works, irrespective of whether they were labour-based or equipment-based contractors, or whether they had attended previous training on labour-based methods or not (Bicon, 2005). This requirement did not augur well with the objective of DOT of developing small labour-based contractors. Contract documents which were tailored for small contractors had to be revised and seminars held to familiarize the new entrants with labour-based methods construction principles.

Table 8.3: Participation in labour-based projects tenders, 1996-1999.

No	Road No.	Year	Number of Tenderers
1	DR3605, 3607, 3629	1996	4
2	DR3616-B	1998	3
3	DR3625A	1998	5
4	DR3625B	1998	10
5	DR3625C	1998	9
6	DR3626	1999	4
7	DR3635	1999	8

(Source: Bicon Namibia).

The results of the survey had important implications on contract sizes and targeting of contractors. In order to spread work as much as possible, the length of road given to one contractor was limited to 15km. The financial risk in such smaller contract packages is considered modest. Hence, small contractors who do not have the financial resources to provide performance guarantees for larger contracts can be accommodated. The disadvantage is that overhead and establishment costs may be relatively high in small contracts, resulting in high unit costs. This might not attract contractors who are not established in the project region. Further, packaging contracts into medium packages and linkage of their tenders in a continuous manner could attract larger contractors. Very small labour-based contractors would then have an opportunity for subcontracting.

It appears that no effort was made to address the obvious lack of capacity for LBW revealed in the survey. No training intervention was given to the participating contractors. The effect of this omission was realized later in the form of poorly supervised contracts, poor productivity on most contracts, work repetition, long completion periods and comparably, high unit costs.

8.4 Common Aspects of Roads Projects Built Using Labour-Based Methods.

8.4.1 Projects Financing

Most roads projects constructed using labour-based methods were donor financed, mainly by the Federal Republic of German (through KFW) and the Kingdom of Sweden (through SIDA), under development cooperation arrangements between Namibia and the donors. A few projects were financed internally by the GON .The donor financing mechanism has been mainly through soft loans and/or grants, with the GON paying the local VAT component in some cases. SIDA provided funding for the pilot projects and the LBW Unit of MWTC. Subsequently, the KFW funded eight (8) road projects up to 2005. SIDA has since scaled down the support for the transport sector in Namibia.

Two issues arise here. One is whether with own funding, Namibia would have been able to undertake the labour-based works programme and whether the projects implemented to-date would have been achieved. Labour-based road projects rarely pass the “economic efficiency” test in Namibia, and thus do not qualify for direct funding by the Road Fund Administration. In the absence of external financing, they can only be funded by Government. The second issue is that of sustainability. It is doubtful whether without external financing Namibia will be able to sustain the LBW programme initiative. Although sectoral expansion for the use of labour-based works methods in the development of economic infrastructure is possible through normal budget allocations, the Government will have to streamline policy implementation in the relevant sectors dealing with infrastructure and realign its spending priorities, to provide the required resources and the necessary incentive.

8.4.2 Contract Documentation

A review of contract documentation used for labour-based works roads projects in Namibia was undertaken in this study. Contracts documents generally serve the following purpose:

- To describe clearly what work has to be done.

- To define and provide product specifications.
- To specify the laws and rules applicable to the contract
- To ensure that the contractor gets paid for the work done
- To state the methodology of solving disputes
- To limit and apportion project risks to the contracting partners.

Contract documents initially developed in Namibia for labour-based works phase 2 were based on CSRA. One of the observations made by Pets and Byrnes (1993) in their evaluation of the pilot projects was that contract documentation was too complicated and did not adequately consider the limitations of small contractors. Although initially simplified to some extent, the emphasis on contract documentation has been to progressively expose the young and emerging contractors to real principles, challenges and requirements of construction contracts implementation and management. Simplified contract documents were thus gradually done away with.

Contract documents were later revised after DOT adopted COLTO. COLTO (1998) documentation is now widely used in labour-based road construction projects. Where necessary, special conditions and project specifications are customized to introduce and amplify provisions needed to ensure, promote and support the use of labour-based methods of construction. Some of the outstanding clauses in this respect in recent contract documents are quoted below.

Clause SSC 6 (1):

"The contractor shall employ the labour-based method of construction to execute the works, and shall to a greater extent focus on the application of work methods and procedures which will result in reduced reliance on heavy plant. In general, the Contractor will be required to introduce planning, implementation, administration and reporting procedures appropriate for labour intensive methods of construction"

Clause SSC 23 (3):

"The contractor shall submit to the Engineer on site at the monthly site meeting the following information:

(a). Number of casual labourers employed and the duration of employment, clearly indicating the number of ex-combatants, female and male workers.

(b) The number of ex-combatants, female and male workers in various age groups, i.e. 18 to 25, 25-35, 35-45, 45-60, above 60.

(c) The absenteeism of workers expresses as a percentage of ex-combatants, female and male workers.

(d) The planned and actual production rates achieved per activity expressed as rate per worker day.

(e) The actual worker days used per kilometre of completed road.

(f) The minimum, average and maximum walking distance workers have to walk each day to get to their place of work, summarized into appropriate gender categories.

(g) The wage rate paid per completed task.

(h) The plant and equipment used per activity.

(i) Any peculiar events affecting progress."

Clause SSC 25 (1):

"Labour-based work requires a high input of supervisory and administrative personnel with relevant background and experience. The contractor shall therefore be required to show that he has sufficient competent staff in his workforce to ensure proper supervision and follow-up".

Clause SSC 26 (2):

"Constructional plant shall be well suited for the purposes for which it is to be used with due consideration of labour-based construction methods. Construction plant used in conjunction with labour shall enhance the effective and efficient use of labour. The Employer cannot be held liable for any compensation in regard to any constructional plant that was no approved by the Engineer for use the labour-intensive construction and maintenance of the works".

Clause SSC 63 (3):

"At least 20% of the unskilled labour force shall be recruited from the feminine gender".

Clause SSC 36 (2):

In this clause, the contractor is required to indemnify the employer against any claims related to the contract.

Clause SSC 23 (3):

In this clause, the contractor is required to procure a joint insurance with the employer for the construction works, temporary works and materials on site, damage, loss or injury to neighbouring properties or persons in connection with the works. The excess amount payable by the contractor is limited to N$25000.

In the Project Specifications, the following Clauses also promote and support the use of LBW methods.

Part A: Clause 2.2.

"…… the roadworks shall be executed using labour-based methods and the contractor shall make predominantly use of labour where possible instead of constructional plant. No mechanical self-propelled equipment shall be used other than on activities which cannot be carried out by manual labour in an effective and efficient manner". Twelve (12) activities which must be carried out using labour-based methods were specified, and four (4) activities that may be executed using equipment were also listed.

Part A: Clause 8.1.

This clause provides guidelines on labour relations and community liaison obligations of the contractor and how to go about them.

Part A: Clause 8.2.

This clause describes the procedure and guidelines for recruitment of labourers.

Part A: Clause 8.3.

This clause describes the procedure and guidelines for the payment of labour. The emphasis is on the payment of labour on a task basis using the wage rate determined by the Government for occasional workers as the minimum.

Part A: Clause 8.4.

This clause describes the conditions of work on site particularly with regard to labourers, and matters related to productivity and task rates.

Part A: Clause 9.

This clause describes the reporting requirements to be adhered by the contractor, in as far labour-intensive approach is concerned.

To conclude, the contract documentation currently used in Namibia is comprehensive, but is still considered cumbersome for labour-based projects executed by small contractors. Depending on the size of contracts and the client's willingness to accept more risks, simpler documentation would be more appropriate.

8.4.3 Recruitment of Labour

The methods of recruitment of labour used in the LBPP2 were fine-tuned and adopted as formal methods of recruitment in all LBW construction projects. The procedure to be followed is specified in Clause 8: Employment and Payment Procedures; of the Project Specifications for each contract. This procedure is described in Section 4.6.3 of this report.

8.4.4 Construction Execution

In labour-based road construction projects now undertaken in Namibia, the following activities are specified to be executed by labour-based methods:

- Clearing and grubbing
- Construction of minor and major drainage structures
- Construction of haul roads and diversions
- Removal of overburden up to 1.0m depth
- Roadbed preparation

- Excavation, loading and hauling of fill material
- Loading of tractor and trailers for wearing course layer material
- Spreading of fill and gravel material
- Trimming of side slopes for cut and fill
- Culvert excavation and backfill
- Culvert wall and pre-cast deck beams
- Fencing, making and placing of marker blocks
- Finishing the road reserve
- Reinstatement of borrow pits
- Installation of road signs

The following activities are invariably executed by equipment.

- Removal of excess overburden in borrow pits
- Ripping and stockpiling gravel in borrow pits
- Hauling of gravel from borrow pits in excess of manual hauling distance
- Watering and mixing of fill layers and gravel wearing course
- Compacting of fill layers and gravel wearing course

The road formation is constructed by borrowing the fill from trenches along the toe line of the fill. Gravel is hauled using wheel barrows up to 100m and tractor and trailers are used beyond this distance. Culverts are constructed using either reinforced hollow blocks or 15Mpa concrete. The CBR of materials specified in most cases is 15 at 95% mod AASHTO.

8.4.5 Tools and Equipment

There is no central Government pool of construction equipment for hire in Namibia, so small contractors who do not own the required equipment hire from the private sector. Few equipment hire companies exist, mainly in Windhoek. Consequently, small contractors have to rely mainly on established contractors for hire of equipment. Most hand tools are imported from South Africa as the local manufacturing capacity for the tools used (hoes, pickaxes, wheelbarrows, spades, slashers, pangas, mattocks etc) is still low.

The MWTC has compiled guidelines on requirements of equipment and tools for LBW projects, for the use of contractors and contractors. For example, it was determined in the pilot road projects that the following equipment (Table 8.4(i)) is required for a small labour-based contractor. The stock of tools required on site, for a site of 100 casual labourers is shown in (Table 8.4(ii)).

(Table 8.4(i)): Equipment needs of a small labour-based contractor

Tractors	4
Trailers	6
Tractor towed graders	1
Water tanks	1
Ploughs	2
Compactors	1
Lorries	1
Pick-ups	1
Water Pumps	1
Concrete Vibrators	1
Concrete Mixers	1
Total	20

(Source: ILO ASIST/Intech Beusch)

A common problem in the construction industry in Namibia is the unavailability of plant and equipment due to generally poor conditions and old age of the equipment on the market, regular breakdown when on use and long-lead times for repair as many parts are not kept in stock. It was established also during the study that hand tools are kept in use by small contractors until they are completely worn out before being replaced. This has an adverse effect on productivity.

Table 8.4(ii): Recommended stock of tools on a labour-based site.

Item	Stock Quantity	
	Site Store Extra	Construction Site
Hoe 3½ LB	5	10
Fork Hoe	5	10
Shovel round nose	150	300
Mattocks	150	250
Pickaxe	50	150
Panga (18") (bush knife)	5	15
Slasher, grass	10	10
Spades	50	100
Garden rake	25	50
Axe	5	15
Sledge hammer 14 LB	10	20
Masons hammer	4	8
Earth rammer (hand)	10	30
Flat file 12"second cut	2	
Wheelbarrow	50	150
Claw hammer 1½ LB	3	6
Crow bar, chisel & point	10	20
Spirit level	2	6
Tape measure 100 m	1	5
Tape measure 30 m	2	8
Tape measure 15 m	4	10
Tape measure 2 m	5	15
Ranging rod, 2 m	5	15
Adjustable profile boards	5	20
Electric torch	10	2
Water bucket	5	10
Bushman saw 26" and blades	2	5
Masons bolsters	4	8
Masons trowel	4	8
Boning rods	5	10
Screeding boards	5	10
Grinding wheel	1	
Anvil	1	
Fishing line (100 m)	10	2
Sisal twine (1 kg balls)	20	6
Rope	1	1
First aid kit	3	1
Water drum (50 gal)	4	5
Watering cans	5	10
Concrete rammers	5	5

(Source: DOT, 1996)

8.4.6 Payment of Labour

In 1998, the GON determined the wage rates for occasional employees in the LBW construction projects as shown in column A of Table 8.5 below. In November 2002,

the RA, with the approval of Government, adjusted the rates as shown in column B, increasing them by about 33%. Prior to that, during 1996-1998, casual labourers were paid N$13.50 per day, which was about US$4.25/day (1996 Exchange Rate: 1US$ = 3.18N$). Wages for other categories of temporary staff were largely negotiated.

Table: 8.5: Wage rates for occasional employees in LBW Projects in Namibia.

No	Rank	A: Wage per day (N$); GON	B: Wage per day (N$); RA**.
1	Temporary Labourer	16.50	21.90
2	Leader Labourer	21.00	27.90
3	Watchmen	21.00	27.90
4	Cleaner	22.00	29.20
5	Handymen	31.00	41.10
6	Site Clerk	39.00	51.80
7	Site Storeman	43.00	57.10
8	Road Builder	43.00	57.10
9	Operator/Driver	43.00	57.10
10	Senior Road Builder	62.00	82.30

(Source: MWTC)

**Rates in Column B were applicable at the time of this study.

The current casual labour wage rate of N$21.90/day is about US$3.35 (1US$ = N$6.50; August 2005). The wage level has therefore decreased in real terms.

8.4.7 Criteria for Evaluation LBW Tenders[2]

Tenders for labour-based roadworks projects are evaluated according to the following criteria;

1. Relevant experience of tenderer. Total Points: 25
   - 1.1 Experience in comparable LBW projects. Points: 25

[2] Source: Roads Authority, 2001.

2. Schedule of construction plant: Total Points: 25

- 2.1 Own plant immediately available: Points: 25 maximum.
- 2.2 Plant on order that will be available: Points: 20 maximum.
- 2.3 Plant to be available by hired or acquisition: Points: 15 maximum.

3. Personnel Capabilities: Total Points: 40

- 3.1 Available site staff with LBW experience: Points: 10
- 3.2 Qualified and experienced own staff: Points: 10
- 3.3 Namibian content: Points: 20

4. Financial capability: Total Points: 10

The total points obtained from above counts for 20% of the final score. Contract price accounts for 80% of the final score (i.e. (Lowest tenderer/Evaluated Tender)*80 = Score.) The summary of the criteria used is shown in Appendix 7. This criterion is in line with the requirements of the Namibian Tender Board regarding preferential treatment of small local contractors and entrepreneurs.

8.4.8 Criteria for Selection of Roads

Roads selected for upgrading to gravel standards using LBW methods were proclaimed roads, mostly on existing tracks. The selection was based mainly on the Owambo Roads Master Plan of DOT (DOT, 1992). The primary consideration was traffic. Other considerations were connectivity, perceived development impact and strategic linkages. Most of the selected and built roads, although not economically viable in the strict economic sense, has a high social and developmental value in the previously underdeveloped and populated areas of Namibia.

8.4.9 Task Rates

Indicative task rates for typical labour-based works activities based on the pilot project results and experience of work performed elsewhere in Namibia are made available to contractors prior to tendering. In most tender documents reviewed the indicative task rates in Table 8.6 were given as guidelines. Contractors are free to use task rates that are higher or lower than the given rates.

Table 8.6: Typical task rates schedule for LBW in Namibia.

Labour-based Activity	Unit	Task rate
Clearing	m^2	450
Clearing dense bush	m^2	150
Stripping and grubbing	m^2	180
Grubbing dense bush	m^2	150
Roadbed preparation	m^2	180
Excavate to fill from borrow strips: Soft	m^3	4
Excavate to fill from borrow strips: Intermediate	m^3	3.5
Excavate to fill from borrow strips: Hard	m^3	2
Loading imported fill	m^3	6
Spreading imported fill	m^3	12
Overburden removal: Soft material	m^3	4
Overburden removal: Intermediate material	m^3	3.2
Overburden removal: Hard material	m^3	2
Loading gravel wearing course	m^3	5
Spreading gravel wearing course	m^3	10
Finishing side slopes	m^2	180

(Source: Roads Authority)

Typical equipment/labour combinations for gravelling given for these contracts were provided as follows:

Table 8.7: Typical equipment/labour combinations for LBW gravelling.

Haulage distance (m)	Loads per worker day (unit)	Total loose volume (m^3)	Excavation (Workers per tractor)	Loading (Workers per tractor)	Un-loading (Workers per tractor)	Spreading (Workers per tractor)
0-200	18	54	18	7	6	4
200-400	11	33	11	4	4	2
400-600	7	21	7	3	2	2
600-800	5	15	5	2	2	1
800-1000	4	12	4	2	1	1

(Source: DOT, 1996(2))

8.4.10 Contract Management

Projects in the expanded phase were handled as proper engineering projects. Design, documentation, supervision and contract management was done by various consulting engineering firms on behalf of the DOT.

It was however found during the study that some contractors, particularly the small trained labour-based contractors, do not read and understand the contents of contract documents for the smooth execution of the contract. Contract supervisors/agents had to constantly interpret and remind contractors of their obligations, conditions of contract, specifications etc. In many cases also claims for work done had to be prepared for them. This makes contract management demanding and requires a lot of patience. Discussion with one contractor and a supervisor who had been involved in some projects indicated that poor education background of contractors and supervisors is the main reason for the lack of interest in "things" they do not understand. This is considered a major hindrance to their development.

8.5 Combined Analysis of Projects Data

8.5.1 Gravel Roads Projects

Tables 8.8 through 8.20 provide a summary of important data generated from the implemented projects discussed in this chapter.

8.5.1.1 Construction Costs

A summary of road lengths (in km) of gravel roads executed in each year in the period 1997-2003 and the total contract amounts, as tendered are shown in Table 8.8 below. It is shown that the average tendered amount per kilometre in the last seven years was N$348,059.14/km. This is equivalent to US$53548.00/km[3].

[3] The exchange rate in September 2005: 1 US$ = 6.50 N$

Table 8.8: Tendered average unit costs for LBW gravel roads.

Year	Total km	Total Tendered Amounts (N$)	Cost/km
1997	65.80	18,948,299.00	287,968.07
1998	14.00	6,648,818.00	474,915.57
1999	58.85	19,795,989.40	336,380.45
2001	104.74	34,019,177.04	324,796.42
2002	36.36	10,909,800.44	300,049.52
2003	24.00	15,400,879.00	641,703.29
	303.75	105,722,962.88	348,059.14

(Source: Roads Authority: Various tender evaluation reports)

The un-escalated final construction costs are shown Table 8.9 below for selected gravel roads, for the years of construction shown.

Table 8.9: Comparison of final costs and tender amounts for selected gravel roads

Year	Road No.	Length (km)	Tender Amount (N$)	Final Contract Amount (N$)	Final amount /Tender*100	Final Unit Cost (N$/km)
1997	DR3605	13.44	11,234,946.00	11,250,704.00	99.86	278,483
1997	DR3607	14.76				
1997	DR3629	12.2				
1999	DR3625	12.2	4,344,335.00	4,275,741.72	98.42	350,471
1999	DR3625	12.6	4,053,970.00	3,695,105.45	91.15	293,262
1999	DR3625	6.55	2,099,223.65	1,670,802.66	79.59	255,084
1999	DR3626	13.7	4,749,508.00	4,618,279.54	97.24	337,101
2001	DR3614	3.5	1,461,555.09	1,321,493.00	90.42	377,569
2001	DR3614	3.5	1,680,788.35	1,477,334.00	87.9	422,095
2001	DR3614	14.24	4,998,134.60	4,346,204.00	86.96	305,211
2003	DR3443	12	7,690,030.00	7,690,030.00	100	640,836
2003	DR3444	12	7,710,849.00	7,710,849.00	100	642,571
	Total/Average	130.69	50,023,339.69	48,056,543.37	0.96	367,714

(Source: Bicon Namibia/Stewart Scott: Various project progress and completion reports)

The average construction cost per kilometre for gravel roads constructed using labour-based methods in the last decade was about N$367,714.00. This was equivalent to US$56 571.00/km in 2005.

It can be seen that there is wide variation of unit costs for new gravel roads constructed. This was not caused by an increase in construction standards, as consistency had been maintained in this regard from the beginning of the programme. Construction methods and techniques used in the programme were also common and differed little from similar programmes elsewhere. It is considered that the increase in unit costs was in line with inflation. In addition, the physical features of particular project areas influenced differences between project costs. For example, construction costs per kilometre in two projects undertaken in 2003 were slightly higher compared to others, seemingly because both projects were in areas with thick sand layers requiring modification of construction methods, and a much higher equipment utilization.

Unit costs for major construction elements on some projects are compared in Table 8.10 below. It is shown that the unit cost for road works (consisting of formation and wearing layers) is about 50% of the total unit costs, and the cost of establishment is about 26%. These costs are consistent with pilot project results.

Table 8.10: Unit costs for major construction elements on some gravel roads.

	DR3605		DR3607		DR3629	
Description	**Planned (N$/km)**	**Actual (N$/km)**	**Planned (N$/km)**	**Actual (N$/km)**	**Planned (N$/km)**	**Actual (N$/km)**
Length of road	15,03 km	13,44 km	14,76 km	14,76 km	5,78 km	12,2 km
Establishment	69 400	63 600	114 900	97 700	59 150	54 600
Roadworks	129 700	118400	126 400	121900	112 600	103250
Drainage	53 600	36 000	182 300	115300	35 600	25 500
Ancillary works	8 235	4 120	8 550	6 175	14 950	5 450
Other costs (CPA, etc.)	21 400	20 400	35 400	31 300	18 250	17 000
Average cost/km	*N$282 335*	*N$242520*	*N$467 560*	*N$372 375*	*N$240 550*	*N$205 800*

(Source: Bicon Namibia, 1999(1))

The reason for the higher cost per km for road DR3607 as compared to the other two roads is that it is situated in Cuvelai drainage basin, and major drainage structures and earthworks were required at Oshana crossings.

Examination of activity unit prices tendered in various projects shows a very wide range, considerably wider than the total tender prices. This indicates that no proper calculation is done to determine quantities of inputs, outputs and costs. No team-balancing is exercised in the tendering process. It appears that bidders first make a reasonable guesstimate of the total cost for the whole project, based on their knowledge and experience on other projects. They then proceed to split up the total on items, using some crude guideline, without too much calculation. Not too much faith can therefore be put in the contractors' unit price determinations, until such time that there is improvement in their capacity for tendering.

Table 8.11: Task rates performance on selected gravel roads (See Table 8.6).

Activity	Planned rate	Actual rate			Typical Task Rates**
		DR3605	DR3607	DR3629	
Clearing (m^2)	2000	-	1676	-	450
Grubbing (m^2)	145-240	281	281	270	180
Excavation soft to fill (m^3)	4	4.1	-	3.35	4
Excavation medium to fill (m^3)	2.5	-	2.4	-	3.5
Loading coarse material (m^3)	5.0	2.15	2.96	4.49	2
Spreading (m^2)	20	25	8	13.2	12
Loosening road bed (m^2)	160-240	137	53	220	200
Finishing-off side slopes (m^2)	160-200	58	63	34	180
Culvert excavation (m^3)	2.5	3.1	2.15	2.57	3
Concrete casting (m^3)	0.5	0.33	0.34	0.37	
Formwork (m^2)	10	3.0	3.6	0.45	
Actual/Planned				*Average*	*77%*

(Source: Bicon Namibia, 1999(1))

8.5.1.2 Task Rates Performance

There is no reliable data on the task rates performance on most roads projects implemented. Examination of submitted tenders for a few projects shows that

contractors tendered +-20% of the indicative task rates given in the tender document. This does not appear to be the result of any determination or work analysis, but rather an effort to complete all the required tender forms. Planned and achieved task rates on some projects are compared in Table 8.11 above. About three quarters (77%) of the planned task rates were achieved. Task performance and achieved task rates compares well with the typical task rates elsewhere.

8.5.1.3 Number of Tasks

The number tasks per kilometre for selected gravel roads are shown in the Table 8.12 below.

Table 8.12: Task quantity for selected gravel roads projects

Road No.	Length (km)	Duration (Months)	Total Number of Tasks	Tasks per km
DR3605	13.44	18	87878	1972
DR3607	14.76			2855
DR3629	12.20			1576
DR3636	26.50	22	46027	1737
DR3637	25.90	20	13790	532
DR3638	27.50	22	10507	382
DR3639	30.80	24	56256	1826
Total	151.10	106	214458	10881
Average			1419	1554

(Source: Bicon Namibia/WML/RA: Various project progress and completion reports)

Ignoring the number of tasks/km shown for DR3637 and DR3638 which appears to be outlyers, the average number of tasks per kilometre for gravel roads projects in Namibia is 1554 tasks/km. The number of tasks per kilometre for some construction activities is compared in Table 8.13 below for selected gravel roads. The average task rate for DR3605 and DR3629 is 1774 tasks per kilometre. The reason for the high variation between DR3607 and the other two roads was given in 8.5.1.1 above.

Table 8.13: Tasks per kilometre for selected gravel roads construction activities.

DESCRIPTION	DR3605		DR3607		DR3629	
	Planned (Tasks/km)	Actual (Tasks/km)	Planned (Tasks/km)	Actual (Tasks/km)	Planned (Tasks/km)	Actual (Tasks/km)
Clearing/ grubbing	46 /km	67 /km	46 /km	84 /km	30 /km	69 /km
Roadworks	1620 /km	1646 /km	1600 /km	2292 /km	1670 /km	1368 /km
Drainage	100 culvert	65 /culvert	208 culvert	150/culvert	100/culvert	70 /culvert
Ancillary roadworks	33 /km	45 /km	33 /km	54 /km	33 /km	41 /km
Total	1935 /km	1972 /km	2235 /km	2855 /km	1880 /km	1576 /km
Actual/Planned	1.02		1.28		0.84	

(Source: Bicon Namibia, 1999(2))

8.5.1.4 Employment rate

The average number of casual workers employed per month and the gender composition for most projects executed are summarized in Table 8.14 below.

It can be concluded from the above discussion and analysis that labour-based road projects executed in northern parts of Namibia in the last decade employed an average of 210 casual workers daily. About 42% of these were women. Given that the total planned duration for these projects (contract periods) was 340 months and between 355 and 440 months (estimated time overrun of 30%) were actually used for the completion of the projects, it is estimated that about 80 000 people were employed in the projects for various durations, with the minimum period being one month of full-time employment.

Table 8.14: Employment data for selected roads constructed by labour-based methods.

Road No.	Length (km)	Duration (Months)	Average Workers per Month	%ge Male	%ge Female
DR3622	21.64	22	264	79	21
DR3605	13.44	18	370	26.3	73.7
DR3607	14.76				
DR3629	12.20				
DR3625	12.20	15	153	84	16
DR3625	12.60	15	150	60	40
DR3625	6.55	5	-	-	-
DR3635	14.00	15	130	55	45
DR3626	13.50	15	268	46	54
DR3614	3.50	4	223	53	47
DR3614	3.50	4	223	55	45
DR3614	14.24	15	230	60	40
DR3636	26.50	22	250	39	61
DR3637	25.90	20	150	47	53
DR3638	27.50	22	150	70	30
DR3639	30.78	24	140	-	-
DR3603	8.54	11	230	78	22
	261.35	227			
Total	**261.35**	**227**	**2,931**	**752.3**	**547.7**
Average			**209**	**58**	**42**

(Source: Bicon Namibia/WML/Stewart Scott/ RA: Various project progress and completion reports)

8.5.1.5 Labour input

No detailed records were kept in most projects on the exact number of labour man-days used for various activities. The total man-days used in those projects without data, and that for the whole programme can only be estimated. The approach used

is the estimation of the average man-days per kilometre for projects which have data recorded, and use it to estimate total man-days for other projects.

Selective data was taken from projects where there was a better level of supervision and site management. For this the author has relied on the information provided, comments and qualifications made by supervisors and project engineers on project progress reports available. The total man-days per kilometre for selected roads projects with data are shown in the Table 8.15 below.

Table 8.15: Total man-days used for selected gravel roads projects

Road No.	Length (km)	Duration (Months)	Total Mandays	Mandays per km
DR3919	14.00	12	34214	2444
DR3608	14.05	24	40358	2872
DR3625	12.20	15	41228	3379
DR3635	14.00	15	45700	3264
DR3614	3.50	4	13552	3872
Total	57.75	70	175052	15832
Average			**3031**	**3166**
			Average	**3099**

(Source: Stewart Scott/RA: Various project progress reports)

It can be concluded that about 3100 man-days were required to complete a kilometre of gravel road using labour-intensive methods. The overall implication of this is that since about 350km of roads were constructed using labour-based methods, a total of about 1 085 000 man-days of employment were created. This is equivalent to about 4100 man-years of employment, and comparably, it is about 2-years of full time employment for the public service of Namibia. Given the size of the Namibia economy, the small population and the high level of unemployment, the contribution of the LBW programme in employment was significant. If sustained and improved, it has a much higher potential to reduce unemployment and poverty.

Assuming that workers completed one task per day, and taking the average wage rate of N$16.00 per task i.e. ((10.00+13.50+16.50+23.90)/4), about N$20 million

was paid to casual workers. This is about 15.4% of the total project costs. In addition, considering that;

- o casual labour wages were on average about 50% of total project's wage bills;
- o about 50% of the temporary staff other than casual labourers was employed from the project areas;
- o most male workers executed more than one task per day (Bicon Namibia, 1994);
- o male workers on average constituted 60% of the workforce; and
- o assuming that all workers completed one and half tasks per day on average,

about N$45 million was paid to workers in labour-based works projects executed in Namibia in the last decade. This is about 35% of the total project costs. Based on these assumptions, it can be concluded that the programme in Namibia was less labour-intensive than those in Botswana, Lesotho and Ghana.

8.5.1.6 Contract completion time

The contract period and the actual time used by contractors for completion of gravel road projects are compared in Table 8.16 below.

Table 8.16: Comparison of contract periods and actual completion period

Road No.	Length (km)	Contract period (Months)	Completion period (Months)	(Completion /Contract)*100%	Actual Km/Month
DR3605	13.44	18	25	1.62	2.24
DR3607	14.76				
DR3629	12.20				
DR3616	27.50	36	39	1.08	0.71
DR3625	12.20	15	16	1.07	0.76
DR3625	12.60	15	19	1.27	0.66
DR3625	6.55	5	6	1.20	1.09
DR3635	14.00	15	25	1.67	0.56
DR3626	13.50	15	17	1.13	0.79
DR3614	3.50	4	4	1.00	0.88
DR3614	3.50	4	4	1.00	0.88
DR3614	14.24	15	19	1.27	0.75
DR3636	26.50	22	38	1.73	0.70
DR3637	25.90	20	38	1.90	0.68
DR3638	27.50	22	31	1.41	0.89
DR3639	30.78	24	31	1.29	0.99
DR3443	12.00	18	18	1.00	0.67
DR3444	12.00	18	18	1.00	0.67
	282.67	266	348	1.29	0.87

(Source: Bicon Namibia/WML/Stewart Scott/ RA: Various project progress and completion reports)

It is evident that 75% of all labour-based projects undertaken were not completed on time. The average time overrun was about 30%. The average productivity planned for most projects was 1.2km/month. Actual productivity was on average less than 1.00km/month.

8.5.2 Bituminous Surfaced Roads Projects

Only two bituminous surfaced roads, with a total of 26.74 km were constructed using labour-based methods in the same period. About 3.80km were rehabilitated. As shown in the Table 8.17 below, the average tendered amount for new construction was N$877 376.00/km. Given that the two roads were built seven years apart, the correct reflection of the present cost is probably around N$900 000.00/km.

Table 8.17: Unit costs of bitumen sealed roads constructed by labour-based methods.

Year	Total km (New construction)	Total Tendered Amount (N$)	Cost/km (N$)
1996	18.20	15,136,030.00	831,650.00
2003	8.54	7,710,849.00	902,909.72
Total	26.04	22,846,879.00	877,376.00

(Source: Bicon Namibia)

Tables 8.18 and 8.19 respectively shows the labour input for the main activity categories of the new construction and rehabilitation work that involved labour. Tasks required for new bitumen sealed roads constructions are approximately double that required for gravel roads.

Table 8.18: DR3622. Summary of labour input for new construction of a bituminous road

Description	Planned (Number of tasks)	Actual (Number of tasks)	%ge of Total
Length of new construction	17,5 km	18,2 km	-
Establishment and general	None	280 per km	9.1
Clearing and grubbing	188 per km	130 per km	4.2
Roadworks	3590 per km	2 280 per km	74.7
19mm Cape seal (incl. Prime)	130 per km	160 per km	5.2
Drainage	180 per culvert	220 per culvert	7.2
Ancillary roadworks	88 per km	60 per km	2.0
Total for new road construction (	4 078 per km	3 054 per km	100

(Source: Bicon Namibia)

The number of tasks required for road formation layers was found to be about 75% of the total number of tasks. This compares well with the percentage of tasks required for roadworks on gravel roads.

Table 8.19: DR3622: Summary of labour input for rehabilitation work on a bitumen road

Description	Planned (Number of tasks)	Actual (Number of tasks)
Length of rehabilitation	3,78km	3,78 km
Road works	220 per km	257 per km
Single seal	120 per km	77 per km
Total for rehabilitation work	340 per km	334 per km

(Source: Bicon Namibia)

Planned and actual achieved task rates for the DR3622 construction activities are shown in the Table 8.20 below. Planned task rates are comparable to typical task rates established elsewhere for labour-based works (See table 8.6). The average task rates achievement is about 80%, which is slightly higher than that achieved for gravel roads.

Table 8.20: DR3622; Planned and actual activity task rates.

Activity	Planned Task Rate	Actual Task Rate	Actual/Plan*100 %
Clearing	2000 m^2	1080 m^2	54
Grubbing	160-240 m^2	210 m^2	88
Excavation	3.3 m^3	3.9 m^3	118
Loading sandy material	5.0 m^3	4.8 m^3	96
Loading coarse material	5.0 m^3	3.5 m^3	70
Spreading	12.0 m^3	19 m^3	158
Loosening roadbed	160-240 m^2	202 m^2	84
Finishing side slopes	160-200 m^2	158 m^2	79

(Source: Bicon Namibia)

8.5.3 Performance of Contractors

The performance of contractors is compared in Table 8.21.

It can be concluded from analysis and the summary in the Table 8.21 that nineteen (19) labour-based road construction projects were awarded in the period 1996-2003. Of these, eight (8) or 42% were awarded to small trained labour-based contractors. Only one (1) of these was completed on time. Five (5) contracts or 63% were terminated or taken over by other contractors due to non-performance. The performance of other established medium-size contractors in labour-based contracts had not been good either. Table 8.16 above shows that on average, 75% of all projects had a contract period overrun averaging 30%.

It is considered that the main reason for non-performance of Namibian contractors in labour-based works was the lack of competent trained and committed supervisors and site managers. Plant, tools and other problems were secondary. Work was poorly organized in most sites, task workers were not controlled, task rates were not achieved and daily productivities were very low. It is foreseen that this problem will persist in Namibia until such time that labour-based contracting is taken over by entrepreneurs, supervisors and managers with an adequate education and technical background, who will treat it as serious business.

Other performance problems have been highlighted (Bicon Namibia, 2005):

- Some contractors used large haul trucks with very high loading platforms, which proved difficult to load by labour in borrow pits. Contractors either cheated by using equipment for loading these trucks or resorted to piling material in heaps using loaders and excavators. Both solutions are undesirable in a labour-based works project
- Most of the terminated contracts were due to unrealistic contract sums, awarded against the recommendations of consultants. Some of the contracts were awarded at contract amounts which were more that 20% below the consultant's estimate agreed with the client.

Year	Road No.	Length (km)	Duration (Months)	Main Contractor	Status	Contract Sum (N$)	Contract Completed?	Comments
1996	DR3622	21.64	22	Herma Brothers	Medium mixed	12,213,764.00	Yes	No additional information available
1997	DR3608	6.00	11	Onandjaba Const	Small lbw contractor	1,050,294.00	Yes	Mentorship projects
1997	DR3608	5.90	12	Oshakati Building	Small lbw contractor	977,672.00		Mentorship projects
1997	DR3605	13.44	18	Herma Brothers	Medium mixed	11,234,946.00	Yes	Completion delayed for 7 months
1997	DR3607	14.76						
1997	DR3629	12.20						
1997	DR3616	13.50	15	EH Construction	Small lbw contractor	5,685,387.00	No	Contract taken over by Roadhart. Delayed for 2.5 months. EH paid N$74000 penalties
1998	DR3616	14.00	15	Onandjaba Const	Small lbw contractor	6,648,818.00	Yes	No additional information available
1999	DR3625	12.20	15	Patriot CC	Medium mixed	4,344,335.00	Yes	Completion delayed for 1 month
1999	DR3625	12.60	15	Patriot CC	Medium mixed	4,053,970.00	Yes	No additional information available
1999	DR3625	6.55	5	RCC	Medium mixed	2,099,223.65	Yes	Completion delayed for 3 weeks. Contractor paid N$10500 penalties
1999	DR3635	14.80	15	Patriot CC	Medium mixed	4,548,952.75	No	Contract taken over by RCC. Completion delayed for 10 months
1999	DR3626	13.50	15	Roadhart cc	Small mixed	4,749,508.00	Yes	Completion delayed for 2 months

Table 8.21 (i): Comparison of performance of contractors on selected labour-based projects.

(Source: Bicon Namibia/WML/Stewart Scott/ RA: Various project progress and completion reports)

Year	Road No.	Length (km)	Duration (Months)	Main Contractor	Status	Contract Sum (N$)	Contract Completed?	Comments
2001	DR3614	3.50	4	Grand Track	Small lbw contractor	1,461,555.09	Yes	Training section
2001	DR3614	3.50	4	Tsandi Constr.	Small lbw contractor	1,680,788.35	Yes	Training section
2001	DR3614	14.24	15	Oshakati BC	Small lbw contractor	4,998,134.60	Yes	Delayed for 3 months. Contractor paid N$200 000 penalties
2001	DR3636	26.50	17	PCC	Medium mixed	8,455,054.00	No	Contract taken over by Roadhart cc. Completion delayed for 16 months.
2001	DR3637	29.50	22	EH Construction	Small lbw contractor	8,024,043.00	No	Contract taken over by Roadhart cc. Completion delayed for 18 months.
2001	DR3638	27.50	24	Onandjaba Construction	Small lbw contractor	7,382,409.00	Yes	Contract taken over by Roadhart cc. Completion delayed for 8 months
2002	DR3614	5.56	7	RCC	Medium mixed	2,171,195.44	Yes	Delayed. No further information available
2002	DR3639	30.80	24	Namroad	Small lbw contractor	8,738,605.00	No	Contract taken over by Nexus. Completion delayed for 7 months
2003	DR3603	8.54	11	Nexus Civils	Medium mixed		Yes	Completed on time
2003	DR3443	12.00	18	Thohi Constr	Small lbw contractor	7,690,030.00	Yes	Completed on time
2003	DR3444	12.00	18	Nexus Civils	Medium mixed	7,710,849.00	Yes	Completed on time

Table 8.21(ii): Comparison of performance of contractors on selected labour-based projects.

(Source: Bicon Namibia/WML/Stewart Scott/ RA: Various project progress and completion reports)

8.6 General Comments on Implemented Projects

8.6.1 Construction Operations

Operations required to be carried out by using labour and those requiring the use of equipment are specified in contract documents for labour-based works projects. However a tendency of the contractors to use equipment instead of labour, even for activities that are labour-friendly was revealed in the study. This happened more often when the engineer's representative is not on site, despite the cost benefit to the contractor for using labour for such activities. One such activity is the road formation. Experience in Malawi shows that the cost of one kilometre of formation work using a grader is 7.5% more expensive than using labour (Hagen, et al, 1987).

Another operational shortcoming relates to the inefficient work methods. In two sites where construction was ongoing, material from side ditches was thrown to the shoulders of the road before being spread across to form the camber. According to the MWTC-LBW guideline document and experience elsewhere, material dug from side drains has to be thrown into the centre of the road in one operation. The reason for this is that by throwing the material to the centre of the road in one operation, the total work required for the formation and the camber is optimized. It is also easier to produce the required camber slope by spreading the material from the centre of the road towards the sides, than the other way round. Experience in the LCU in Lesotho had been that the neglect of this seemingly simple and straightforward procedure had disastrous erosion consequences during heavy rains (Mhlanga, et al, 1995). This made roads constructed using labour-based methods unpopular.

In addition, Section C2200 of Project Specifications describes work in connection with the construction of culverts and drifts. The culverts specified are prefabricated pipe and rectangular culverts that are factory produced to some standards. The only culvert-manufacturing factory in Namibia is in Windhoek, about 600km-1000km from northern and north-eastern parts of Namibia, where labour-based works projects are undertaken. The work specified for execution by labour is the

casting of reinforced concrete slabs for rectangular culverts, production of bricks and hollow blocks for the culvert walls, excavation and backfilling, and casting of floor slabs. As the labour effort required for the casting of culverts is estimated to be equal to the combined effort for the casting of slab covers and production of bricks/blocks, there is a significant opportunity for more job creation, skills development and savings if culverts are manufactured on site. To maintain standards and reduce costs, the client can supply the required moulds.

8.6.2 Non Adherence to Task Rates

Experience elsewhere has shown that task rates when properly used can significantly increase productivity in labour-based construction activities De Veen, 1983; McCutcheon, 1994(1), 2003). The guideline document in Namibia provides task rates that can be used in labour-based construction work. Tender rules also require contractors to submit task rates for various construction activities to be undertaken. Project analysis has shown that about 75%-80% of the planned task rates were achieved. Site visits and discussions however showed that, there is a great variation in the extent that task rates were being used in road construction projects. It was found that they were generally used for excavation works payments, while other activities like spreading were carried out against daily pay. The lack of sufficient and adequately trained site supervisors reinforces the tendency to revert to daily payment tasks because it is easier to administer. Supervisors and contractors who are not comfortable with mathematics and numbers avoid task rates at the first opportunity.

8.6.3 Productivity and Construction Costs

The average man-days per kilometre on gravel roads has been shown to be around 3100, and the productivity achieved was less than 1.0km per month. Although the required man-days are on average only 10% above the typical figure of 2800 achieved elsewhere, significantly high variations were observed in projects undertaken in Namibia, up to over 5000 man-days/km on some gravel roads. A major reason for this, and probably the high unit construction costs, is the low

productivity of labour. Productivity in the projects was on average below 50% of that achieved in pilot projects and elsewhere in similar programmes.

Some of the main factors affecting productivity in labour-based works are;

i. Motivation and experience of the workforce
ii. Organization of work
iii. The condition and effectiveness of tools and equipment
iv. Monitoring of the work processes and task workers

Major productivity problems in projects implemented in Namibia are aligned with factors (ii), (iii) and (iv) above. Task workers are reasonably motivated by the lack of alternative employment in the project areas, reasonable wage levels, and the task rates system of work. Plant and equipment availability had been a problem in virtually all projects. A major problem however was that of poor and untrained owners, supervisors and site managers. These cannot organize work efficiently and cannot adequately monitor task workers, or enforce and ensure work productivity. As a result work teams were highly unbalanced, task rates were not achieved, supervisors were cheated by workers, and payments were made for work not done. Valuable time was also lost in repeating work.

8.6.4 The Reporting System

The reporting system developed for the labour-based works in Namibia is quite elaborate. The standard forms used enable the determination of important project data like employment, productivity, output, unit costs, etc. The reporting requirements are given in Clause 9 of Project Specifications of most contracts. Samples of reporting forms are included in Appendix 6. It is considered that while the reporting system is quite comprehensive, it is also complex and time consuming. Discussions with some supervisors on previous projects indicate that they barely managed to complete the forms on time. The inherent danger of such a situation is that some data tends to be assumed, estimated, incorrect and unreliable. Thus, the need to maintain control over information in projects

generated a burden of preparing reports. As the programme matures the reporting system needs to be rationalized.

The purpose of reports at head office and at management level is to give useful information for planning and performing evaluation on progress, productivity, costs and problem areas. For this purpose reports from project sites has to be summarized and collated to be able to provide meaningful information. This requires expertise and sufficient capacity in-house. This is a problem in Namibia currently, both in the MWTC, DOT and the RA.

8.7 Impact of Roads Construction by Labour-Based Methods

8.7.1 Some Background

Infrastructure investment can have both direct and indirect influences on poverty alleviation. Indirect impacts do not manifest in the infrastructure per-se, but through the extent to which the following accompanying changes, in the case of roads, do or do not occur; employment, transport, production of goods (agriculture, industries etc), non-road related employment, socio patterns and institutions.

Employment in the road construction process provides an immediate source of income, together with changes in transport. Employment is a certain event, but the remaining changes require complimentary investments and initiatives. Employment and the potential for poverty alleviation effects are clearly enhanced by the use of labour-intensive methods, as clear benefits are identifiable. They can easily be wage targeted, and means for ensuring the participation of women have been applied. Keddeman, 1998, identified the following benefits to the poor, resulting from the use of labour-intensive methods;

- Employ five times more labour.
- Can be wage targeted on the poorest groups
- About US$3000-5000/km injected in local economy in new construction or major rehabilitation.
- Forward linkages generate multipliers in the range of 1.5-2.8.

- 25-30% of comparable equipment-intensive methods cost.

However, the cash income benefits to the poor are short-term and tend to be used on immediate consumption needs rather than for productive investment or savings. In the longer term, it is argued, benefits of improved access accrue mainly to the wealth members of the society; traders, vehicle owners, business people etc. Benefits in improved social services, which also benefits the poor, depends mainly on such services being already existing or planned to follow road improvements,

Three methods are invariably used in impact evaluation of labour-based programmes and projects.

(i) Controlled comparisons of different combinations of inputs and outputs. This is the comparison based on administrative records of projects. This is the most user-friendly; most used method to demonstrate the effect of labour-based works in comparison with equipment-based methods. The method is straightforward and can be extended to include other variables, like wages, exchange rates etc. However, it is difficult to measure indirect impacts with this method.

(ii) Logical framework analysis method; before-after and cause-effect relationship. In this approach, base-year conditions are compared with conditions during project implementation and at completion. The shortcoming of this method is that it tends to emphasize the project rather than the impact of the method of execution.

(ii) Use of macro-economic models. These cannot capture indirect effects and are mostly complex.

Three main categories of impacts can be distinguished.

- Short-term direct impacts: These are impacts directly linked to project implementation during the construction phase, including costs, employment, incomes etc.

- Short-term indirect impacts: These are defined to include opportunity costs or the income or output forgone as a consequence of participating in LIW. Indirect impacts are also estimated by analysis of the magnitude and significance of backward and forward linkages.

- Long-term direct impacts: These are impacts and effects occurring after project completion.

Key impact indicators relate to employment, income and poverty, and costs.

8.7.2 Impacts

The most common impacts of road construction on a local environment are environmental and socio-economic impacts.

8.7.2.1 Environmental impacts

Environmental impacts can be differentiated according to whether they occur in the construction phase or during the operating phase. These include opening of borrow pits, diversions, relocation of homesteads and services (construction phase), fencing, noise and dust pollution (operating phase). The impact can be direct or indirect. Examples are relocation, the opening of the right of way (direct), and secondary pollution, relocation of services (indirect). Some impacts are permanent and others are temporary. The relocation of homesteads is permanent, while diversion of way is temporary.

There were no adverse environmental impacts experienced or reported in the construction of roads using labour-based methods in Namibia. In any case, all projects were implemented in strict compliance with the existing regulations. Some work needs to be done to sustain this compliance. In comparison with equipment-intensive construction, labour-based construction is less likely to affect the environment. The main reasons are;

- There is les heavy equipment in and around borrow areas
- There is less air pollution due to haulage trucks and heavy equipment than in conventional construction methods
- Material used in labour-based methods is more environmentally and user friendly.
- Lower noise levels
- Positive social and economic impact resulting from using labour

Nevertheless, in fragile environments like the Ovambo in Namibia, utmost care has to be taken in implementation of infrastructure projects.

8.7.2.2 Socio-economic impacts

Socio-economic impacts can be separated into two categories: first order and second-order effects.

First order socio-economic effects refer to the direct effects such as employment creation, training and SMME development. These have a more direct bearing on employment creation and poverty reduction. Second-order socio-economic effects include income distribution, better access to services, multiplier effects, community participation and stimulation of local industries. The combined effect of these effects is the improvement of life in rural areas.

(i) Poverty alleviation impacts

Generally, the contribution of a LBW programme to poverty alleviation can be established by assessing the change of indicators of deprivation over a period of time after road construction projects implementation. In the short run, the impact will depend on how the wages are spent by the poor. They will most likely consume more food, as already over 60% of the incomes of the poorest people are spent on food. They may also buy small stock (poultry, goats, sheep etc) and other useful items for the home (furniture) and farm (tools). Mobility will slightly increase (through the availability of cash and road, when completed) and a better use of existing social services. Table 8.22 below provides a summary of expected short

run and long-term positive impacts. Negative impacts are possible too, such as reduction in farm production and home grown food because of time taken to work on projects, thus less benefit.

Type of Poverty	**Short-term effects** ***(Year 1,2 of project)*** **Direct Wage effects**	**Long-term impacts (Year 5 of project) Indirect effects, more jobs, cash**
Basic needs	Consume more and better food, buy soap, candles etc, improve house (variables include meals/day, quality of foods; non-food purchases , roofing)	New house; new village water supply.
Assets	Purchase bed, blanket, utensils, a few small livestock, basic tools only, no change in land ownership expected	Own more valuable items, such as radio, or small change in land ownership.
Livelihood	Have a regular source of income, probably no change in access to land/farm income, may use fewer/less severe coping strategies.	More production on-farm, start new non-farm enterprise; work more as hired Labourers; start employment among land-less; few distresses.
Services	Slight increase in visits to town, health clinic, children stay may in school, HH may travel	Durable, large increase on mobility/access; presence of new facility because of road?; use of credit
Perceived changes	Life should look better	Hope it seems better overall; perhaps worst long run for some.

Table 8.22: Potential impact on poor households of typical labour-based road projects.

There is also an indirect influence of training in poverty alleviation. If the trainees are selected from poor households, there will be a long-term contribution to poverty alleviation. Where there is a formal training recognition system and the training given is applicable to the industry at large, trained persons are more likely to obtain work elsewhere in the economy.

Durable changes that might occur can be the purchase of more and high value assets for production (oxen, plough), reproduction of the household due to improved quality of life (improved nutrition, medicals, clothing, bedding, stove,

radio, furniture etc). Improvements in the land may also become visible, through indirect impacts of the project, such as the availability of inputs and the preservation of soil through fertilizers. Although social services access is externally dependent (placement, staffing and funding say by Government), some local changes may also be visible over the longer-term. This could be the case where increased local capability in construction and cash availability eventually enables the “self-help” construction of community facilities like schools, clinics, village offices etc. Changes in the burden of fuel wood collection where wood is scarce for example may also not be apparent within a few years. Changes that might not be reasonably expected to occur over the short-term or even medium-term (five years) includes large changes in land distribution, particularly where land is already scarce. In respect of changes in the quality of life, the increase in life expectancy may be visible in the short term or may not be visible for even a decade.

Although targeted to the very poor, the existence of employment-intensive programme in rural areas also increases the value of other employees in the area, and elevates their bargaining position in the market. This occurs provided that the wage offered in the labour-based schemes is comparable to the wage paid in other employments of similar skill levels. In addition, the role of labour-based schemes as a way of combating poverty is clearly evident when natural disasters occur. Relief works can be organized in the shortest possible time, while at the same time expediting reconstruction and rehabilitation work.

Other socio-economic impacts like empowerment of the poor and food security have also been documented (von Braun, 1992).

(ii) Social-political impacts

Employment creation and financial impacts in the project areas were discussed in Section 8.5 above. In addition, many people were trained in the process as supervisors and road builders at various levels. These skills remain in the community and are used for personal or community development, and for employment seeking elsewhere. Small contractors developed have entered the market and will provide further employment to the communities.

Some remarks were made in Chapter 2 regarding the grey link between road construction or improvement and development. It was acknowledged that the interrelationship between transport improvement and the more general concepts of rural development are far from being fully understood. Nevertheless, improved networks of physical transport infrastructure providing access and mobility are accepted as indicators of rural development. The contribution of improved road infrastructure to increased rural development pace depends on a number of factors, including complementary development programmes, type and cost of transport services and incentives for new economic activities.

Access roads constructed using labour-based methods in Northern regions of Namibia have opened many populated areas which were previously inaccessible by vehicles. Services can now reach the rural villages, travel has been made easy and travel times reduced. Communities have access to service centres within and outside Ovamboland. The development impact is tremendous. The result of a rapid rural appraisal conducted in the impact study showed that 91% of the past workers in projects consider that life had improved in their areas as a result of the road improvements (Africon Namibia/EIEC, 2000).

A broader social and political impact of the programme is perhaps that the it sent a clear signal from the GON to the rural population that it cares about their development and well being, and that it requires partnership between government and beneficiaries to make such development initiatives, like roads which are necessary for access and mobility, a success. In addition, until recently there had been little experience in Namibia with involvement of local communities in development projects, even in their own areas, particularly in the scattered and relatively remote areas. It is considered that the LBW programme has raised awareness, confidence and capacity of the local population in the project areas for participation in development initiatives in their areas. This awakening will benefit other development projects in the area.

8.8 Conclusion

An evaluation of road construction projects executed using labour-based methods after the completion of the piloting phase has been undertaken in this chapter. Basic features of the projects have been described. Implementation aspects and project parameters have been documented and analyzed. Some results have been discussed.

It has been shown that about 350km of new gravel roads were constructed and approximately N$130.0 million was invested. About 80,000 people were temporarily employed for various durations. The analysis of available projects information shows that the average unit cost of construction of gravel roads in the last decade was about US$56 571/km, and for bitumen roads was US$135 030/km. Unit costs could be reduced significantly if productivity is improved. In this regard the training of company owners, supervisors and site managers was necessary to improve their performance in site and contract management. The cost of road layer-works was found to be about 50% of the total costs and that of site establishment was about 26%.

The average number of tasks per kilometer achieved for gravel roads was 1554, and for bitumen road was 3054. The average labour input used for gravel roads was 3100 man-days per kilometer. About 210 casual workers were on average employed daily for the duration of the projects, and 42% of these were women.

Analysis showed that task rates achievement was between 75% and 80%. However, the average physical productivity achieved was about 1.0km/month. This was about 84% of the planned productivity, but less than 50% of that achieved in the pilot projects.

Contract documentation for labour-based works projects improved over the years and standard COLTO documents are now used. Where necessary, customization and amplification is made to enable, support and promote the use of labour-based methods. The appropriate use and understanding of contract documents by small contractors remains a problem. An elaborate evaluation method for labour-based

works tenders has been developed by the Roads Authority, and contract management and administration is done professionally.

The performance of the trained small contractors in the awarded construction contracts was generally poor. The same can be said for the established medium-sized contractors involved in labour-based road works. About 63% of the contracts awarded to small contactors were terminated or taken over due to non-performance. Only 20% were completed on time. Overall, 75% of all contracts executed had lack of competent, trained and committed supervisors and site managers. This resulted in poorly organized sites and uncontrolled task workers who in turn did not achieve the tasks rates. Daily productivities were also very low. A lasting solution to this problem is the engagement of entrepreneurs, supervisors and managers with adequate education background and who will treat labour-based works contracting as serious business.

Other conclusions on the construction projects undertaken using labour-based works methods in Namibia are:

- The contract documentation currently in Namibia is comprehensive but is considered too cumbersome for labour-based construction projects. Depending on the size of contracts, target contractors and the client willingness to accept more risks, simpler documentation would perhaps be more appropriate.

- The increased participation in tenders for labour-based works projects by small, medium and large contractors show a continued interest in labour-based works contracts in the local construction industry.

- An experienced civil engineering contractor with no previous labour-based construction experience undertook labour-based works successfully. It was proven that roads could be built using labour-based methods by private contractors to required technical standards under normal contract conditions.

- It was demonstrated that bitumen surfaced roads can be built and rehabilitated using labour-based methods, to high standards as required by specifications.

- Community consultations by private contractors were irregular and inconclusive. This often resulted in loss of community support and labour disputes.

- Equipment held by most established contractors is not appropriate for labour-based works construction. Examples are large haul trucks with high loading platforms. These are difficult to load by labour, and demoralize labourers.

- In order to increase output or to catch up with delays, contractors sometimes execute activities reserved for labour using equipment, albeit secretively. This was facilitated by contractors' site personnel who are not trained in labour-based works, but experienced in equipment-intensive construction.

- Some contracts were awarded by DOT to small contractors at very low tendered rates, lower by up to 20% of the estimates of consultants. The reason for this is that the DOT could not convince the Tender Board that the lowest tender was not necessary the best tender. This had detrimental effects on the contractor's performance and financial situation. As a result several contractors failed.

- The fact that 63% of contracts awarded to small emerging contractors were terminated due to non-performance suggests that such contractors should not be awarded work if there are no mechanisms in place for support and mentorship.

- Termination of construction contracts generally results in higher project costs to the client, including project delays. In addition termination of a contract executed by a small contractor is destructive to the contractor and demonstrates a failure in the long term programme of small contractor

development. Termination of contract should therefore be prevented by exploring all alternatives and preventive measures.

To conclude, the LBW construction programme in Namibia had significant employment creation and local economies stimulation impacts. The major impacts were mostly developmental, due to improved accessibility. The programme has also raised awareness, confidence and capacity of the local population in the project areas for participation in development initiatives. Improvements are required to be done on a number of shortcomings observed above to maximize the benefits of employment-intensive methods approach in construction.

A comparative evaluation of the labour-based works technology programme in Namibia is undertaken in the following chapter.