EVALUATION REPORT
INFRASTRUCTURE SUBSYSTEM
NORTH SHABA RURAL
DEVELOPMENT PROJECT

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SUMMARY

The previous evaluations referring to this sub-system were noted. The individual units of the sub-system were noted. The individual units of the sub-system were evaluated and were generally found technically efficient in their work, but not very effective in teams of uses of Project resources, budgeting, and programmation of work.

The sub-system management unit was the exception. This unit does not function at all.

The sub-system is not sustainable now. Funding was studied and while it appears that, on paper, sone internal funding might work, it is really not feasible. Only external long term funding will sustain this sub-system in the forseeable future.

It is recommended that, unless the U.S. decides to remain in the area for political reasons, the sub-system stop operations by October 1982.

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FOREWORD

The task of evaluation is never an easy one and requires the cooperation of many individuals.

In making an evaluation, the scope of work is always foremost in the mind of the evaluator. He must always try to get as many facts, as many viewpoints, and as much data as possible.

The same people may be re-contacted several days running and asked the same question. Sometimes, contradictory statements may be given, and the evaluator must decide in the light of other evidence which version, what fact, or what result should be followed.

Each item must be analyzed. All aspects must be reviewed and analyzed.

A case in point is "evaluation of utilization of existing resources, including the efficiency and effectiveness of labor in road building, bridge building and rehabilitation."
Can an evaluation be complete if such factors as effects on resources of other subsystems, relation to other sub-systems, interference by other sub-systems etc, are ignored?

Relationships with other sub-systems, instances of unwarranted interference and non-replies to demands are touched in this report, since they affect the efficiency and effectiveness of an organization.

I believe that this report represents a fair and impartial evaluation of the infrastructure sub-system, including its effect on

other sub-systems as well as effects by other sub-systems on this one.

I wish to thank the following for their frankness in their discussions with me:

Citoyen Shukulu; Chief of the Sub-system
Mr. P, Keasey ; Expatriate Advisor
Citoyen Ambwa ; Bridges and Buildings
Mr. C.Calnam ; Expatriate Advisor
Mr. J.Loftin ; Road Rehabilitation
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I also wish to thank the chefs de chantiers, the equipment operators, the many drivers and laborers who cooperated in my research effort.

In addition, the contributions of Mr. R. Ackerman, PMU, Citoyen Useni, R & V, Citoyen Sedzabo, IT, Bill Dalrgmpte, DGF, and Mr Ed Salm, Pilot and life line of the PNS were of considerable help in my effort.

A note of thanks is due to my fellow team members for all their help: Dave Redding, Joseph Campbell, Everett Headrick, Henry Wiggin, Andrea Black-Michaud, Sylvia Watts and Betsy Stepphens.

Additionally, a big thank you to Citoyen Luamba, Citoyen Pezo, Mme Yaskey,Citoyenne Mwimba, Citoyen Mobula and a special mention to Citoyen Kamwaka, whose typing in difficult circumstances warrants commendation.

I wish to note the excellent cooperation and help from Mr. David Leong, who attempted to make this task as easy as possible and, without whom, this report could not have been made.

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Last, but not least, I wish to thank Citoyen Mateso, Director of the Project, for his views on the Project.

Kongolo/Kinshasa
May 8,1982

CHAPTER ONE

SCOPE OF WORK

In April of 1982, a multi-disciplinary team was sent to the North Shaba Rural Development Project in order to evaluate the project. As part of this evaluation, a Rural Roads Engineer was required to visit construction sites as well as make random road and bridge checks, to evaluate extent and quality of construction, rehabilitation and maintenance of the infrastructure sub-system of this project.

Specifically, the Engineer was charged with:

(a) the evaluation of the potential longevity of the road and bridge infrastructure
(b) the identification of the elements necessary for optimum life
(c) the evaluation of the current manual maintenance system
(d) the evaluation of the utilization of existing resources including the efficiency and effectiveness of labor in road building, bridge building and rehabilitation
(e) the evaluation of the efficiency and the effectiveness of the equipment maintenance system
(f) an estimate of the requirements for continued maintenance and expansion of infrastructure development after Project termination (sustainability) and determination of sources of finances, skills and institutions to perform required tasks.
(g) the determination of what extent farmer groups may assist in maintenance
(h) the evaluation of the appropriateness and effectiveness of training, both formal and informal, and assess future needs.

Additionally, after intra-team discussion, it was decided that the replicability/adaptability of the sub-system should also be evaluated.

CHAPTER TWO
HISTORY AND BACKGROUND

The objective set forth in the PP of the North Shaba Rural Development Project was to start a self-sustaining rural development process in eastern Zaire, primarily by increasing small farmer production of maize.

The PP foresaw the start of the project in late 1976 with external (AID) funding to cease in late 1982 and Government of Zaire funding to end in 1986.

The infrastructure sub-system had severe implementation delays among which were two major armed conflicts nearby, a major flood in mid-1979 and severe delays in the arrival of necessary equipment.

In mid 1979, an evaluation of the Project was performed by Dimpex, Inc. However, due to the above mentioned delays, there was little to evaluate and the report was mainly a recommendation for future efforts on the Project.

In August of 1980, an addition to the original PP was signed and authorized the extension of the LOP for an additional twelve months, to end in 1983.

In 1981, an evaluation of the Project was performed by the Project Consultant, DAI. Finally, in early 1982, the Project Infrastructure sub-system sub-contractor, Morrison-Maierle made an evaluation and some recommendations for this sub-system.

CHAPTER THREE

FINDINGS AND EVALUATIONS

3.1. ROADS

3.1.1. Description

The rehabilitated roads are constructed as single lane, unsurfaced dirt roads, ranging from approximately 10 feet (3 meters) in width to 14 feet (4.2 meters) in width. This has mostly been accomplished by motorized clearing and blading of the existing ground.

Side borrow was rarely used to raise the road grades, and in many areas, the road level is still well below that of the surrounding ground. This situation prevents the use of effective crossroad drainage. However, side ditches and outlet ditches, when maintained, keep the run-off away from the road.

To date (April 1982), about 520 kilometers out of 724 kilometers have been re-habilitated. Of these, 68 kilometers have been re-surfaced with laterite.

3.1.2. Potential Longevity of Roads.

Based upon a random inspection of the roads which have been completed, the following potential of the roads can be expected:

- With no maintenance, on dirt roads, the total road including

roadway, side ditches and outlet ditches will deteriorate and be generally unusable within one year, assuming the same level of traffic of the past two years. With heavier rainfall than before, complete deterioration may occur within one rainy season.

- If the traffic levels increase appreciably to meet the expected increase in production, then the roadway might remain clear to at least vehicle width by the action of the vehicles themselves. However, with no maintenance, the ditches would still become clogged, and the road would still have erosion. Road failure would then still most likely occur within one year, dut to oversaturation of the soil and the roadbed, and erosion of the road surface.

- On surfaced roads (laterite), the surfacing may last two years or more depending on several factors, such as traffic levels, severity of rainy season and original construction techniques. If the surfacing is lost, then the remaining dirt road would deteriorate within an additional year, giving a total life of a resurfaced road of three years, or more.

3.1.3. Necessary Elements for Optimum Road Life

Proper maintenance is an absolute necessity in order to prolong and optimize the usable life of any road.

Once a road is properly built, including adequate drainage, there are generally two types of maintenance functions to adequately retain the use of the road, i.e. routine maintenance and periodic maintenance.

Rehabilitation, although generally performed by reinforced maintenance crews, is not strictly a maintenance function, and is not treated as such in this report.

Routine maintenance is the regular, scheduled work performed throughout the year by a maintenance crew, including blading of road surfaces, shaping, cleaning culverts, clearing and reshaping ditches, cutting vegestation and patching potholes.

Periodic maintenance is also regular work performed by a maintenance crew, but not on a yearly basis. Rather, the work is done every 2 or 3 years, based on field inspections. These include resurfacing sections of roads and emergency repairs as a result of damage due to flooding, or high intensity rains.

The following maintenance operations are necessary to optimize the road life:

- Blading and shaping of the road to provide an even and smooth riding surface, and to repair erosion drainage. Due to the very nature of the operation, this is best done by motorized means. The frequency of this operation depends on the degree of rideability and usability of the road that is required. This, in turn, depends on traffic levels, weather, and road materials characteristics.

The local project roads should receive this operation once or twice a year, as long as the traffic is not excessive. The regional priority roads within the project should be thus worked three or four times per year.

It should be noted that none of the rehabilitated roads have received this type of maintenance. As a result, roads rehabilitated in 1979 and 1980 practically require almost total rehabilitation due to brush on the road, erosion, pot-holes, clogged ditches, etc.

- Repair of isolated areas (patching) such as potholes, surface erosion, failed shoulders and soft spots should be made as soon as observed. This can be a labor intensive operation as far as the placement and smoothing operation is concerned.

If no acceptable material is available nearby, then adequate material will have to be trucked in. Stock piles should be set up ahead of time along the roads. Then patching can be promptly made a necessary.

Again, no indication of this maintenance was observed on any of the rehabilitated roads.

- Resurfacing is a periodic operation, dependent on levels of traffic, severity of weather, and surfacing characteristics.

Based upon present traffic levels, and observed conditions, this should be done every two or three years.

However, to prevent excessive loss of surfacing material, blading and shaping must still be performed once or twice a year.

- Cleaning and repairing culverts are very necessary routine maintenance operations. This requires very little or no mechanization, and can be done with hand tools.

The frequency of this operation depends on the severity of the weather, but normally should be done at least once a year, <u>before</u> the start of the rainy season.

The existing culverts appear fairly clean, but only due to the force of the running water itself. There are weeds and brush that should be cleared away from inlets and outlets.

- Cleaning and re-shaping of ditches is another routine maintenance operation that can be performed with labor intensive methods using hand tools, or done by the grader when blading and shaping.

Since the ditches are partly filled with material that spills over from the roadway during the year, this operation should be coordinated with blading and reshaping the road in order to be able to re-use the spilled material on the roadway.

Cleaning and reshaping ditches should be completed before every rainy season. In addition, the ditches should be kept as clear as possible during the rainy season, even if the personnel have to work in the rain.

- Roadside maintenance, a routine maintenance operation, can also be performed with labor intensive methods using hand tools.

This operation includes grasscuting, brush and tree trimming, erosion control on right of way and litter pick up from the roadway.

Care must always be taken to minimize the grass cutting and brush trimming at the outside of the ditch line in order to minimize the possible erosion caused by run off.

This is the only operation which was noted on the rehabilitated roads, but on less than 40 percent of the roads.

3.2. BRIDGES AND CULVERTS

3.2.1. Description

As of April 1982, 30 bridges and culverts had been completed,

with 18 to 20 additional culverts planned.

One bridge is reinforced concrete. There are ten masonry arches. The abutments are rubble protected, but only in some cases.

The culverts are ARMCO pipe, ranging from a diameter of 80 cm to a diameter of 2 meters. These have masonry headwalls, constructed of rock and mortar, with some rubble rip rap at the outlet.

3.2.2. Potential Longevity of Bridges and Culverts.

Based upon visual inspection of the completed bridge and assuming no failure of foundations due to scouring, the concrete bridge should be usable for about twenty years.

However, the concrete was never tested, nor a slump test conducted. There was no mix control nor was there any cement testing. In addition, the concrete apparently was not properly cured.

Therefore, it is strongly recommended that close inspection for structural failures be performed yearly.

The masonry arches appear well enough constructed to have a usable life of 20 years if proper maintenance of the wing walls is performed. Care must be taken to prevent erosion in back of the wall as well as to prevent undermining.

Several arches have signs of possible underscouring and should be closely watched.

Metal culverts, with proper precautions, have been known to last the economic life of major roads (20 years). However, this presumes adequate and routine maintenance practices, such as cleaning and preventing scouring.

3.2.3. Necessary Elements for Optimum Bridge and Culvert Life.

Proper maintenance practices will optimize bridge and culvert lives. A major factor in proper maintenance is inspection and prompt identification of deterioration and/or damage. Such inspections should be yearly, especially at the end of the rainy season.

The repairs included in bridge maintenance operations include approach roadway repairs, deck surfacing repair, realignment and cleaning of the stream channel, abutment repair, foundation repair and painting of any steel surfaces.

Culvert maintenance includes cleaning out the culvert of silt and other materials, repairing any damage by underscouring at entrance or exit, and headwall repair, if necessary.

As mentioned in Section 3.2.2., special attention will have to be paid to the concrete bridge due to the lack of controls in its construction.

The arches have received no maintenance and there are indications of erosion along the wing walls and some under scouring.

The metal culverts have weeds and brush which are starting to clog some exits and entrances.

3.3. EXISTING ROAD AND BRIDGE MAINTENANCE

3.3.1. Existing Organizations

There are only three organizations within the project area which are presently capable of conducting maintenance operations:

- Office des Routes (OR)
- Project North Shaba Special Brigade (PNS)
- Estagrico

The Office des Routes is charged with the maintenance of National and Regional routes, but generally is not responsible for maintenance of local interest roads. However, there is a convention between DOA and OR that requires the maintenance of Regional and National roads in the PNS area by OR that expires Jan 1, 1983. However, to date, little maintenance of these roads has been done by OR. Additionally, the OR seems incapable of even maintaining the other regional routes near the Project area.

The Special Brigade has been concerned only with the rehabilitation of the project roads and the construction of bridges and buildings. As such, it has not been involved in the routine or periodic maintenance of the roads.

Estagrico is responsible for the maintenance of 434 kilometers of road west of the PNS area. In addition, as a result of a PNS-Estagrico Convention dated May 19, 1981, PNS rehabilitated roads have or will be turned over to Estagrico for routine manual maintenance by cantonnage operations. To date they are responsible for the 520 kilometers of rehabilitated PNS roads, with additional kilometrage due to be added as the Special Brigade completes the rehabilitation work.

Estagrico receives countepart funds for this work. In 1981, 2.2 million zaires were allocated, of which they have used only 400,000 zaires.

3.3.2. Organization and Resources

As aforementioned, Estagrico is the only organization presently conducting routine maintenance on PNS roads.

The maintenance program is supposed to employ a worker (Cantonnier) responsible for 2 kilometers of road. He is supervised by a Capita, who is responsible for 30 cantonniers, covering 60 kilometers of road. A Road Maintenance Supervisor controls the Capitas.

For the PNS roads presently being maintained by Estagrico, there should be at least 8 Capitas supervising over 250 Cantonniers.

The equipment on hand as of the date of this report is minimal. There is one land rover for the supervisor, 2 dump trucks, 1 bicycle per Capita and 1 wheelbarrow per Cantonnier on some roads.

The supervisor has no assistance and has an overly large area to supervise, ranging from south of Nyunzu to west of Kongolo.

3.3.3. Evaluation of Maintenance Program

The maintenance program began in July, 1981 on 294 kilometers of rehabilitated roads. In September, the Supervisor arrived and by the end of year Estagrico was responsible for the maintenance of about 460 kilometers of road. Cantonniers were hired to maintain these roads, including 30 who had originally worked directly for

the PNS Project.

In the Project area, the rainy season begins in October and ends in April with January and February normally dry. The cantonnier, during the rainy season, should do roadside maintenance, patching, and clearing and shaping of ditches.

Depending on the soil condition as well as the severity of the weather, roadside maintenance has to be performed three or four times a year. It has been estimated that a Cantonnier can do 100 meters per day, taking 20 working days to do 2 kilometers of roadside maintenance. As a result, the ditch clearance and patching operations are lagging and have not been done, except at a very few locations.

Heavy repairs are supposedly done by groups of Cantonniers working under the direction of a Capita.

Specifically, under this arrangement, the Cantonniers:

- Clean roadside ditches
- Clean outlet ditches
- Clean culverts
- Fill pot-holes
- Perform roadside maintenance
- Perform bridge maintenance

Generally speaking the maintenance work done by the Cantonniers when they are working is poor. The only work that was observed is cutting grass and some brush. This is partly explained, that since a good portion of these Cantonniers are farmers, planting and repairing their homes take precedence over road maintenance. As a result, there are sections of road that do not have any maintenance at all, due to a lack of available labor.

Additionally, the lack of adequate and competent supervising contributes to the poor maintenance apparent on some roads, and there is no regular inspection process of the roads to ensure proper maintenance practices.

Bridge maintenance appears almost non-existent. Some approach fills appear eroded, and approach roads appear somewhat separated from the bridge structure.

The culverts appear in somewhat better condition. Nevertheless, some are cluttered with debris, choked at the entrance with weeds and some indicate underscouring at the outlet.

As previously noted, the only activity which was observed during the inspection of the roads was the cutting of grass which is starting to envelop the roadways. There was absolutely no patching or filling in of pot holes, observed. Apparently, no culvert maintenance was being practiced.

In summary, it is apparent that the Estagrico maintenance operation as observed is not sufficient to sustain the rehabilitated roads.

3.4. EXISTING EQUIPMENT MAINTENANCE

3.4.1. Existing Facilities

The Estagrico maintenance facility covers approximately 2500 square meters, which includes vehicle storage within the compound.

The northernmost building is a maintenance shop with eight bays, four of which are grease bays. The bays are somewhat smaller than practicable and make the maintenance of large vehicles and road

equipment difficult to be completed under cover.

The storage room (warehouse) has few parts and is badly maintained. Parts such as fuel and air filters are covered with dirt and dust, which effectively ruins them as spare parts.

The easterly building includes a carpenter shop, a foundry, a welding shop and a machine shop. It is relatively well maintained and most of the equipment is in operating condition, except the carpentry shop which is pratically non-operable, due to lack of replacement parts.

The area has several covered areas which are full of unusable scrap, and in general presents a cluttered and inefficient appearance.

The PNS Special Brigade has maintenance space at Kongolo for at least 8 vehicles, including heavy equipment. There is only 1 grease bay. This maintenance is supported by a warehouse which is now orderly and well kept.

There is a machine shop, with lathes in good condition, capable of making some spare parts. There is a foundry, capable of small castings. The carpentry shop, presently used for furniture for the Ngaba Center, is sufficiently large to support the maintenance facility.

There is sufficient storage space for the entire equipment fleet of the Brigade.

There is also a PNS facility at Nyunzu. There is space to maintain three vehicles under cover.

There is warehouse and fuel storage facilities, and the compound is sufficiently large to store the maintenance fleet.

3.4.2. Evaluation of Existing Equipment Maintenance

The present Estagrico facility would not be capable of maintaining the equipment of the Special Brigade.

Additional buildings, enlargement of the working bays, enlargement of the parking area, better and more spare parts storage, a welding shop, and a larger parking compound are among the additional facilities which would be needed, if Estagrico was charged with maintenance of the Special Brigade equipment.

The four Estagrico mechanics are not capable of maintaining any heavy equipment and are capable of performing only normal vehicle maintenance, and that, under constant supervision.

Additionally, four mechanics and one supervisor are not enough to both maintain the road equipment and the cotton equipment.

The addition of buildings and maintenance equipment such as lathes, welders, etc, would severely overload the electric generating capacity which is now available at Estagrico. At present, they are running the generating plant at capacity most of the time. Although there are additional generators in the facility, these are inoperable due either to age or unavailable spare parts.

There is also some doubt that they will be able to fulfill the maintenance requirements in the future of the aforementioned PNS-Estagrico Convention.

The PNS equipment maintenance is now fairly efficient. Although the breakdown rate is almost 20 percent, the average deadlined rate of equipment has been only 5 percent during the last year.

This has been due in part to an efficient and knowledgeable expatriate equipment specialist being on the project. His "one-on-one" training has allowed some Zairois to further their basic skills, and these have become fairly proficient in equipment maintenance. There is adequate back-up equipment such as welders, lathes, a carpentry shop and a foundry to support the equipment maintenance, although the foundry and machine shop are presently under I.T. control.

The space available for the maintenance is quite adequate for 8 pieces of equipment at one time.

On the other hand, the lack of formal training to drivers and operators (as discussed in Chapter 3.7) has been a major factor in the large breakdown rate. Inattention to periodic maintenance, such as changes of oil, inattention to cleanliness of fuel, unfamiliarity with the equipment and inexperienced drivers also contribute largely to the large breakdown rate.

As noted, the low deadlined rate has been achieved due to the equipment specialist and fairly efficient Zairois mechanics.

To summarize, the equipment maintenance personnel is quite efficient although the normal maintenance practices by the operators and drivers of the equipment are poor.

3 5. ROAD AND BRIDGE BUILDING AND REHABILITATION

3.5.1. Organization.

The PNS Special Brigade is charged with the construction and rehabilitation of the roads and bridges in the Project area.

It is composed of two road-building units, a bridge building unit, a building construction unit, a culvert crew, a carpentry shop, a machine shop, an equipment maintenance unit and a management unit.

3.5.2. Resources of the Special Brigade

The Special Brigade has the following equipment available for the performance of its activities

1 roller
1 Front end loader
3 D6 Bulldozers
3 Graders
1 5-Ton Truck tractor
1 Water truck
2 Fuel trucks
1 Flat bed truck
8 Dump trucks
7 Pick ups.

There is an additional grader, afront end loader, four dumptrucks and two pickups on order. Additional assorted shop equipment, welders, generators spare parts and tools are also available.

The local Zairois staff of the Infrastructure subsystem accounts for over fifty percent of the total staff of the project, and the budget for the Infrastructure subsystem amounts to almost two thirds of the total budget of the project.

3.5.3. Efficiency and Effectiveness of the Special Brigade

Since there are so many separate units, each unit will be discussed separately.

Generally speaking, efficient technical work implies efficient use of resources for the particular sub-project while effective work does not necessarily imply efficiency.

Moreover, efficient work on a sub-project does not necessarily mean effective use of resources of the Project.

- Road Building Units

Although the Project nominally started in late 1977, the OR did not identify the Project routes until 1979.

Organization of the units is fair except for the inclusion of field mechanics. This represents a problem to have these men nominally in the equipment maintenance unit but working under the orders of the chief of the road building units.

The road building units should normally be headed by a qualified highway engineer. Although the present expatriate advisor has done a very good job, there are instances where previous engineering experience could have saved time, work and money in the rehabilitation of the roads.

Notwithstanding the fact that knowledge of multiple languages is advantageous, technical knowledge and experience takes precedence and is required to successfully implement road rehabilitation projects such as this in a desired time frame, within monetary restraints.

However, it is to be stressed that this is not a criticism of the existing Road Specialist. In the actual work, the crews are fairly efficient. The equipment operators, who were previously trained by OR, seem to know their jobs. Morevoer, the expatriate advisor has provided some formal training in the form of films. This has been limited, in part, due to the heavy work load, and as a result, most of the training is of the "show-me" variety.

The biggest deficiency of this unit is the lack of an established work program, defining priorities and establishing needed mechanized routine and periodic maintenance. Although a work program in the shape of a bar chart has been prepared, no time limitation or priority maintenance needs were established.

As noted in Chapter 3.1.3., optimum road life depends on proper maintenance practices. The road units have never been used for the maintenance of the roads which have been rehabilitated. As a result, some of the cleared roads need blading and shaping and some rehabilitation again.

The resurfaced roads have lost almost their entire surface and need recharging. The missing routine and periodic maintenance (shaping and blading) could have forestalled recharging for at least one year.

A second failing of the unit is the lack of an established budget. Even with an unsure monetary situation, budgeting is absolutely necessary for a construction project. Knowing monetary needs, even if only as a percentage of the total budget, can make efficient planning possible, especially on a project with cash flow problems. Standard accounting practices, also require the establisment of budgetary constraints.

Note must be taken that this is not necessarily the fault of the unit itself. Proper management by the management unit should have required and established a proper budgetary procedure. This is further discussed below, when the management unit of this sub-system is evaluated.

In summary, the road units are generally efficient in the rehabilitation work. This work does not remain very effective as the maintenance portion of the tasks normally performed by these units is not done. Also, having no budgetary indications or limitations is bad practice, especially with reference to the needs of the other units in the sub-system.

- Bridge Building Unit.

The bridge building unit at present is non-existent, having been absorbed completely by the building construction unit, due to the priority of work set up for Ngaba.

The completed bridges appear well built except as previously noted in Section 3.2.

No budget for this unit has been established nor is there a current estimate of materials that will be needed to complete the bridges, such as cement and steel.

Perhaps, the greatest failing of this unit is the lack of a work program with a priority list of work. Adequate bridges, are the lifeline of a road system, and a systematized program of bridge construction must always be established. A work program, including inspection of all bridge sites, estimating construction requirements in terms of costs, time needed for construction, materials needed and coordination with road rehabilitation should have been set up.

Additionally, a qualified civil, construction or structural engineer should have been on site at the start of the project. As has been previously said, there is absolutely no substitute for knowledge and experience. Knowledge of a language will not build a bridge.

Again, no criticism of the present bridge unit expatriate advisor is intended. Again, this is further discussed in the evaluation of the management unit of this subsystem.

There is presently no maintenance of the bridges by anyone including the bridge building unit, nor is there an inspection program.

The construction activity of this unit cannot presently be evaluated as there are no bridges presently being built.

- Building Construction Unit.

This unit is using over half the labor resources of the sub-system and all the cement and construction steel as well as the majority of the construction lumber, for its activities at Ngaba and Mbulula.

The amended project paper stated ".....11 to 16 permanent housing units at Mbulula/Ngaba plus construction/rehabilitation of six permanent structures at Ngaba for the research facility and 48 semi-permanent housing units".

Unfortunately, there is no documentation available to show how this evolved to new construction of fourteen permanent structures for a training facility including permanent dormitories for 48 people and a permanent structure for equipment maintenance, spare parts storage and associated equipment storage.

Discussions with Citoyen Mateso, the Director of the PNS, has, in

my opinion, failed to clarify this point. At the time of the writing of this report, there were not even current signed plans for the center.

This has become the largest single sub-project in the Project. There is a complete lack of adequate accounting techniques and work programmation on such a large undertaking.

The construction apparently has been directed on verbal orders. Good management practices require that such orders on major activities be confirmed in writing especially in order to prevent misunderstandings.

Budgetary estimates as well as material and labor estimates must be prepared in order to evaluate the effect of such undertakings on the Project as a whole and other sub-projects of the sub-system.

In the period, May 1981 to April 1982, this unit used the following resources:

Name	Main-months*	Avg. Cost**	Total Cost (Z)
Surveyeur des Travaux	40	410	16400
Superviseur des Stocks	8	507	4056
Magasinier	7	543	3801
Aide-Magasinier	8	327	2616
Chef d'Equipe	35	643	22505
Mecanicien/Auto	37	480	17760
Mecanicien/Beton	9	324	2916
Chauffeur	59	305	17995
Commis Pointeur	21	234	4914
Electricien	11	385	4235
Pompiste	31	428	13268
Aide Pompiste	3	163	489

Name	Main-months*	Avg. Cost**	Total Cost (Z)
Menuisier	101	401	40501
Aide Menuisier	8	224	1792
Charpentier	81	282	22842
Maçons	263	318	83634
Aide-Maçons	81	268	21789
Plombier	12	261	3132
Capita m/o	35	316	11060
Manoeuvre	1404	165	231660
Gardes	19	185	3515
Commis Dactylo	7	254	1778
		Total	536,658

*From Infrastructure records

*From PMU records

Since this is for 11 months, on year equals 12/11 x 536,658 = Z 585,445, say 585,000.

There is no estimate of exactly when they will finish this construction, or how much additional material and labor is needed.

On April 29, Citoyen Shukulu finally gave me an estimate of the total materials needed for the center, which was calculated from a set of unsigned plans, but for which the estimate of costs is unavailable.

According to minutes of coordination meetings held by PMU, work started up again on this sub-project in May of 1980. Based on a 50% effort in the period May 1980 to May 1981 of the last twelve month period, it can be estimated that since May 1980, over 750,000 Zaires in labor costs alone have been expended on this construction.

In addition, there are materials, equipment, and fuel utilized for this construction which might, at least partially, have been used for other more urgent purposes.

For example, on the route going in a North-South direction, north of Ngaba, commonly known as part of the "buckle route", there is a bridge whose abutments have collapsed. The bridge is in danger of completely failing should a heavily loaded truck go over it at a high speed.

Additionally, there is a major bridge south of Nyunzu which is not traversable by loaded trucks. When such a truck reaches the bridge, the load has to be carried by hand across the bridge to an empty truck on the other side.

The lack of construction of these bridges is directly attributable to Ngaba. The minutes of the Coordination meeting of April 18, 1981, state that no bridge construction is in progress because all the masons are assigned to Ngaba.

Even the need for this construction is open to question. At a distance of 35 kilometers from Kongolo is the Ecole Technique Agricole de Kaseya-Kongolo.

It has dormitories, assembly halls, laboratories, villas for professors and other buildings, all of which are in good condition. The prefet, when contacted, would welcome its use by PNS.

Additionally, there is a seed multiplication center, owned by DOA, about 6 kilometers from the Ecole Technique.

A reason given for not using this center was that it "was out of the PNS area". However, according to the agronomists, it is in the same Agro-climatic zone and its use could have saved the PNS much of its needed resources and money.

The startling fact in the construction of this center is that, apparently, there is no set program or curriculum presently planned for its use. More discussion on this will be found in the annexes of the various sub-systems concerned with the use of the center.

This unit appears efficient in the construction of the buildings. The Zairois staff appears knowledgeable in their functions, although they require constant supervision.

The construction of Ngaba represents a lack of proper programming of priority by the management unit. Again, it is stressed that no personal criticism of the expatriate advisor of the building construction unit is intended, although some written documentation would have been appreciated, in the form of labor and material estimates for the completion of the work. Further discussion is made in the evaluation of the management unit of the sub-system.

At Mbulula, the unit has refurbished houses which are not project-owned. Houses whose straw roofs were to be replaced by new straw roofs or repaired have new sheet metal roofs installed along with complete refurbishing of the interior.

There is no programmation of work or budgetary considerations, especially in reference to other sub-projects of the sub-system. There are no construction estimates for materials, labor or time required.

This unit, with reference to the entire sub-system, represents the biggest single drain on the resources of the sub-system as well as the biggest single drain on the entire Project.

- Culvert Crew

This unit, once a part of the road building unit, operates as

a separate unit. It is under the direction of the road expatriate advisor.

The crew is fairly knowledgeable, makes efficient use of its labor resources as well as efficient use of the materials on hand, in the construction of the culverts and appurtenances.

However, this unit, again, has no program with reference to coordination with other activities of the sub-system, nor are there construction and budgetary estimates. This is evident, for example, on a project road near Ngaba, where, if a culvert is not promptly executed, the next heavy rain will completely cut the road. The existing water and attendant erosion, already make it difficult even for four-wheel drive vehicles to cross the stream.

An additional deficiency in this unit is the lack of engineering techniques in the determination of culvert sizes and sizes of appurtenant structures.

Culvert sizes are presently gauged only by observation. No drainage calculations are made. Fortunately, it appears that this has resulted in oversizing the culverts, instead of undersizing, which would have been disastrous. Oversizing is only a slight waste of resources and is very often practiced on low maintenance roads such as the PNS roads.

However, there is one location where two large pipes were placed, and the water flow backwashed and cut across the road approach to the culverts. Two additional pipes, again without calculations, were added, and now, there is consideration to replace the entire system by a bridge. This expense and waste of resources could be avoided by the utilization of proper engineering techniques, and by the proper programmation of work.

This, of course assumes, that some technically proficient personnel is available for the work.

- Carpentry Shop

The carpentry shop has been involved in fabricating doors, windows and furniture for the Ngaba center as well as for the renovation of the houses at Mbulula and some necessary furniture at Kongolo and Nyunzu.

This unit is under the direction of the chief expatriate advisor of the Infrastructure sub-system. As with all units in this sub-system, there is no systematic programmation or budgetary exercises performed.

The carpenters appear knowledgeable and efficient in the work they are doing.

- Machine Shop

Until recently, the machine shop was under the complete management of the I.T. sub-system and was almost entirely monopolized by the sub-system.

As a result, very little use of the lathes, casting facilities and other machining facilities, which are generally important to proper equipment maintenance, could be made by the Infrastructure sub-system.

This was a waste of valuable and scarce project resources and proper coordination via programmation and direction might have possibly avoided such waste. This is also discussed in the I.T. annex.

- Equipment Maintenance Unit

The equipment maintenance unit is described in Section 3.4.

Additional note must be made, however, of the lack of adequate accounting practices and warehouse control which was existing throughout the life of the project up to the present.

Moreover, squabbling among the sub-system over control of material in the warehouse exacerbates relations between the sub-systems.

Good management practices dictate that warehousing be under the general control of management but under the direct control of the equipment advisor. This is especially important for inventory purposes and equipment allocations. The personnel in the warehouse must be cognizant of the various parts stored there as well as the uses of the parts and the manner in which they are used.

Requisitions must be proper. They should state clearly part name, purpose, number, and authority of the requisition. Accounting should be advised for proper charges to various sub-systems as the parts are used.

Receipt of ordered parts should be promptly processed and concerned sub-systems promptly notified. The warehouse should have "charge books" for each sub-system with programmed budgets to control the requisitions by each sub-system.

The equipment maintenance should have folders for every piece of equipment on the Project, including pick-ups, as is presently done, for most of the equipment.

Every repair, routine maintenance, periodic maintenance, special maintenance and fuel use should be noted in the folder. Labor charges,

material charges, and replacement parts, should also be noted.

Such charges should be debited as a charge to each piece of equipment as a cost of operating such equipment and such charge debited from each sub-system to which the piece of equipment belongs.

Most of these practices have now been implemented by the existing expatriate equipment specialist, although the management unit of the sub-system has not yet done so.

Since equipment maintenance is a service function, programmation is of the utmost importance to prevent breakdown of equipment due to lacking maintenance. Sufficient budgetary considerations must be given to allow complete maintenance services.

The Project management unit we well as sub-system management units must insure adherence to the maintenance program set up by the equipment maintenance unit.

As noted in Section 3.4, the Zairois staff of this unit appear to be well motivated and adequately knowledgeable.

- Management Unit

The management unit of this sub-system is under the direct control of the chief of the Infrastructure sub-system and the expatriate advisor.

It is responsible for the budgetary exercises of the sub-system, for the accounting of the expenses of the sub-system, for the budgeting of all sub-projects of the sub-system, for proper documentation of all undertakings, for proper coordination between sub-projects of the sub-system, and for proper coordination between this sub-system and other sub-systems as far as its activities coincide with other sub-systems.

Moreover, it must keep construction progress, construction estimates of materials, money and materiel, and all associated documentation required by good management and engineering techniques.

The existing correspondence and documentation file is practically non-existent. No approved budgetary exercises were found for any of the sub-projects in the sub-system.

No estimates for any of the sub-projects have been found nor future estimates for completion. Although the monthly reports describe some of the monthly activities, there is a definite lack of detailed future requirements for each sub-project. The accounting breakdown is also non-existent with respect to sub-project unit activities.

Some attempt was made to establish an organization chart. On June 7, 1981, an organization chart and bar charts of proposed work was sent to the Director and the PMU. The bar charts, however, were sketchy and no attempt was made to analyze the effect of each sub-project on one another nor to budget or estimate each sub-project.

No answer was received from the Director or PMU, although several verbal follow-ups were apparently made.

At the final session of the evaluation team, an answer was finally provided verbally. This is a span of over 10 months to get a response.

There have been instances of verbal directives by-passing the management unit of the Infrastructure sub-system. This is almost the ultimate sin in good management practice. For example, in the final session of April 30, the Director stated that he had not given directives, but only asked opinions. The sub-chief had understood this as a directive.

Good management practice in the form of written directives to the management unit would have prevented mis-understandings.

Although other sub-systems might, for purposes of "expediency", try to short-circuit a chain of command, it is imperative that the management unit of a sub-system control and prevent such attempts.

There is a lack of engineering documentation. There should be signed "As-built" plans of buildings and bridges. Detailed quantities expended for each unit of construction should be recorded as well as detailed labor charges.

This unit needs a qualified accountant to institute the proper accounting system for this sub-system. The personnel of the unit must be adequately large enough to handle the personnel problems.

Instances of lack of action due to default must be avoided at all costs. Action on personnel must be done within statutory limits and must be properly done.

Documentation on sub-system personnel must be kept as well as furnished to the Project personnel section.

In summary, this unit is not functioning properly in any respect.

3.6. FARMER AND VILLAGER ASSISTANCE

Farmer and villager assistance in maintenance of the roads is minimal. Some attempts have been made to enlist farmer aid in maintaining

roads abutting their fields, but there has been little or no success.

Since Estagrico, when they pay, hire villagers and farmers for cantonnage, there is little likelihood farmers and villagers would do maintenance for nothing, and, even as cantonniers, fields and houses take precedence over road maintenance.

Villagers do usually keep the ditches and some of the road bordering the villages free of weeds, but this is the extent of their maintenance effort.

There is also some assistance in one-time efforts such as installation of a culvert if it is of direct benefit to the village, but this is of limited value, due to the seasonal aspect of this assistance.

Additionally, there have been reports of villagers, hired as cantonniers, and given tools, of selling the tools in lieu of working.

Moreover, it seems likely that, if tools were given to the farmers and/or villagers, such tools would be apt to be used more in the fields than for the purpose for which they were given.

3.7 TRAINING

3.7.1. General

The training of Zairois personnel was foreseen as consisting of the following:

- On-the-job training
- Formal on-site classroom training
- Formal exterior (out-of-country) training.

Formal training was to be generally by TDY personnel, while on-the-job training was to be by the expatriate advisor.

Exterior training was to be in the United States or a suitable third country in organized courses.

3.7.2. On-the-Job Training

Generally, the expatriate advisors of this sub-system have instituted good on-the-job training, except in the management unit. Commonly called "one-on-one" or "show me" training, it specifically handles problems which occur but does not handle general or theoretical problems. Such techniques are especially efficient in equipment maintenance and such repetitive tasks as are found in carpentry and assemblage of culvert pipe.

Tasks on which multiple forces are used are not conducive to one-on-one training and formal classroom training is more apt to provide the needed results.

3.7.3. Formal On-Site Classroom Training

The only formal on-site training in this sub-system was performed by the road unit expatriate advisor.

This was done by way of video tapes and films on various road rehabilitation functions.

There were no other attempts at formal class training by anyone in this sub-system.

Tasks like assemblage, inventories, accounting, personnel direction and bookkeeping are much better subjects for formal classroom training than "one-on-one" or "show me" training. Unfortunately, this sub-system did not employ this type of training, except as noted above.

3.7.4. Formal Exterior Training

No documentation could be found that indicated that any attempt was made to find outside training nor that any attempt was made to define objectives of such training.

However, verbal discussion with the sub-system indicated that three Zairois members of the sub-system attended some training in Haiti and in Belgium.

Problems such as courses being only in English could have been solved by giving formal English classes on a continuing basis in the Project for all those interested.

These Zairois so trained could have been the nucleus considered for exterior training.

Moreover, there are organizations in the Francophone countries which have available curricula in road rehabilitation and maintenance, and attempts should have been made to utilize these.

CHAPTER FOUR

SUSTAINABILITY

4.1. GENERAL

It is obvious from the discussion in Chapter 3, that this sub-system, as presently constituted and as presently managed, is not sustainable now or will be after Project termination.

There are three periods of time in which to look at this sub-system:

- Before September 1982
- September 1982 - September 1983
- After EOP (1983)

The discussions that follow probe into the ramifications of each time period.

4.2. MODIFICATIONS PROPOSED FOR EXISTING SUB-SYSTEM

Regardless of what happens after September 1982, the sub-system must be modified and functionally running before September 1982.

An organizational structure and chain of command must be firmly established.

The following modifications to the existing structure is recommended:

- Chief of Infrastructure (Zairois), aided by an expatriate advisor

The Chief of the sub-system will be responsible overall for the administration of the sub-system.

He will be the direct supervisor of the sub-system management unit and oversee the chiefs of the different units within the sub-system.

- Sub-Chief (Road Unit) (Zairois), aided by an expatriate advisor

This sub-chief will be responsible for road rehabilitation and all road maintenance, but not for bridge and or culvert construction.

- Sub-Chief (Structural Unit) (Zairois), aided by an expatriate advisor

This sub-chief will be responsible for bridge building, culvert construction, building erection and miscellaneous construction.

- Sub-Chief (Equipment Maintenance) (Zairois), aided by an expatriate equipment specialist

This sub-chief will be responsible for all equipment maintenance, the machine shop, foundry, the carpenter shop and the administration and control of the warehouse.

4.3. ACTIVITIES OF THE PROPOSED ORGANIZATION

4.3.1. Chief of Sub-System

As aforementioned, he will be responsible for all final decisions of the sub-system. He shall control all exterior communications to and from the sub-system, and through the sub-system management unit, insure the proper action on the concerned communication.

He will directly supervise the sub-system management unit that will be composed of the following personnel:

- Personnel officer with assistant

Along with normal personnel duties, the Personnel officer will competently attend to all sub-system personnel problems. All necessary dossiers on all sub-system personnel shall be kept.

All hirings, firings, merit salary raises, etc., shall be done through this unit. This data shall be kept in individual folders for each person in the sub-system.

Cross reference with the Project Personnel officer shall be made on a regular basis to insure that the files in the sub-system as well as the files in the Project Personnel office are up to date.

The sub-system Personnel officer shall act promptly on all personnel problems. He will issue without undue delay all necessary paperwork dealing with any and all personnel.

Finally, he will insure that the sub-system file clerk has copies of all paperwork and actions for the sub-system files.

- Accountant with assistant

As part of his duties, the accountant will competently keep track of all financial transactions of the sub-system. He will keep track, and notify the concerned sub-system, of warehouse charges, maintenance of equipment charges and any special charges.

He shall notify Project accounting of such charges in order that Project accounting can keep proper records. He will insure that proper payroll records be kept, and that the personnel receive proper pay.

He shall retain time sheets of all personnel in the sub-system.

He will maintain records of sub-project expenditures including labor, materials, fuel, maintenance, etc. He will notify sub-chiefs with adequate advance warning if the expenses on a sub-project are passing budget limits.

He will aid the Chief of the sub-system in the preparation of the sub-system annual budget.

Such a budget will be broken down to the degree necessary to obtain information as to the costs and expenditures of any and all sub-system activities.

All sub-projects will be budgeted. If the total budget as requested by the sub-system is not granted, then the accountant, with the Chief and Sub-Chiefs will determine whether to delete some activities or phase down some sub-projects.

Proper documentation, in any case, shall be kept, including monthly cash reports.

Copies of all correspondence, final budgets, progress reports of expenses, and any or all actions shall be provided to the sub-system file.

- Training officer

In cooperation with the Sub-Chiefs, he shall arrange for formal classroom training for all suitable personnel.

He shall arrange for reading material, blackboards, chalk, etc., for all training sessions.

Where necessary, he shall arrange for formal out-of-country training for personnel. All arrangements shall be first approved by the Chief of the sub-system and forwarded to the Project Management Unit for approval by the Project Director.

All justificative material shall be annexed to the proposal to speed action by the Project Director.

Written confirmation or refusal should be requested to assure proper documentation.

He shall provide the sub-system files with all the correspondence, actions and proposals.

- File Clerk/Secretary

Along with secretarial duties, the file clerk shall keep adequate cross-referenced files of all memos, correspondence, orders, etc., pertaining to the sub-system.

A log should be kept to note date and time of receipt of all incoming correspondence. All outgoing intra-Project correspondence should also be logged with the time, date and signature of the person receiving such correspondence.

All monthly progress and cash reports should be filed and cross-referenced.

All files pertaining to the sub-system shall be complete and well-kept so that any necessary information can be easily divested.

4.3.2. Sub-Chief (Road Unit)

The sub-chief will be responsible for the road rehabilitation and mechanized maintenance required to sustain the roads, including culvert and bridge repairs, but not for the original construction of the structures.

He shall prepare a program for road rehabilitation, including labor, material and equipment estimates for each road to be rehabilitated.

He shall prepare a budget estimate for each road. Needs for fuel, equipment maintenance requirements and priority constructions shall be clearly identified.

Monthly progress reports should be made, indicating actual rate of progress versus programmed rate.

Actual uses of material, equipment maintenance facilities, labor and funds should also be compared on a monthly basis to programmed rates.

He shall coordinate the road rehabilitation activities with bridge and culvert construction to insure a smooth work flow.

A road maintenance program, with the activities indicated in Chapter 3, shall be prepared.

Budget estimates, equipment requirements, material requirements, labor needs shall be prepared.

The maintenance activities shall be planned as to interfere as little as possible with rehabilitation work. However, the maintenance work should take precedence in order to sustain and retain the effective use of the rehabilitated roads.

He shall have inspectors regularly inspect the rehabilitated roads to judge the maintenance requirements and to schedule periodic-type of maintenance in order to avoid bad degradations of the roads.

He shall notify the Chief of the sub-system if and when Estagrico cantonniers are not fulfilling the PNS-Estagrico Convention. However, he shall have the necessary maintenance performed in order to best protect the roads.

All processes, actions, notifications shall be fully documented. For expediency, some orders may be verbal, but should be followed with written confirmation.

Proper work records of all personnel, preferably in the form of time sheets, shall be kept. These shall be forwarded to the sub-system management unit for processing.

Accurate records of vacations, sick leave, absences without leave, infraction of rules, overtime, and any other personnel activities shall be kept and regularly and promptly given to the sub-system management unit.

He shall insure that equipment operators, truck driver and motorcycle users follow proper operating procedures as set forth by the equipment maintenance unit.

The road maintenance program and the road rehabilitation program shall be so set up that adequate time shall be allowed for proper preventive equipment maintenance.

The sub-chief shall notify the sub-system training officer of the unit training requirements and assist him in setting up formal training classes.

He shall, also, assist the training officer in the discovery of adequate exterior training. Selected personnel of the unit should be nominated with all justificative paper work, in order to minimize delays and work disruptions.

He shall refer all requests, orders, demands, communications, pertaining to the unit, coming from external sources, to the Chief of the sub-system for action.

He should receive written confirmation for all work that is undertaken that was not foreseen in the work program or the budget.

Proper accounting of any funds, materials, and labor shall be furnished to the sub-system accountant, by sub-project. All records kept shall be clear, consistent and non-ambiguous.

He shall maintain technical integrity in the road rehabilitation program, by using sound engineering techniques to provide low-cost efficient roads. Unsuitable material, inconsistent techniques and other unsound methodologies and or material should be avoided.

Unsuitable material shall be replaced as necessary, even if suitable borrow must be trucked in. Side borrow should be investigated at material sites as often as possible.

Grade lines should be smoothed and kept above surrounding ground as much as possible. Pavement crown slopes shall be consistent with the materials used.

Side drainage in the form of ditches shall be provided on all roads. Locations of cross-drainage requirements shall be promptly noted and turned over to the structural unit for determination of size and type of structure.

Records of all quantities of borrow, and any other materials shall be kept, especially use of fuel and oil for each road.

Upon the completion of a road, a total cost shall be determined from the records kept; including all costs chargeable to the road (labor, equipment maintenance, fuel, etc.). A cost per kilometer should then be derived, including amortized equipment costs.

This information shall be furnished to the Chief of the sub-system for further processing (to the PMU unit and SCAD).

3.4.3. Sub-Chief (Structural Unit)

The sub-chief will be responsible for drainage calculations

necessary for sizing drainage structures, for culvert and bridge construction, building erection and building maintenance.

In cooperation with the Road Unit, he shall prepare a program for culvert construction, and for bridge construction, including labor, general material requirements, and equipment estimates, for each road to be rehabilitated.

He shall prepare a budget estimated for all structures in the program for each road. Needs for fuel, equipment maintenance, cement, and priority constructions shall be clearly noted.

Monthly progress reports shall be made. Actual rates of construction versus programmed rates shall be charted.

Uses of cement, other materials, equipment maintenance facilities, labor and funds shall be recorded on a monthly basis by road and compared to programmed rates of usage.

He shall determine drainage structure sizes in accordance with accepted engineering techniques. All concrete construction shall be in accordance with accepted construction procedures. Careful control of such work shall be insured.

Conservative construction techniques shall be encouraged to minimize maintenance requirements. Grade lines of concrete structures shall be carefully set to match road profiles.

Culverts shall be carefully installed, paying attention to manufacturer recommendations and using well established procedures for such culvert installations. Adequate cover for such culverts shall be determined and promptly brought to the attention of the road unit.

Locations of culverts and bridges shall be carefully noted and recorded.

On completion of structures, total costs shall be determined, including but not limited to, fuel, cement, labor, materials, equipment, and miscellaneous activities associated with the work, such as forming. These costs will be promptly given to the road unit in order that the total road cost may be properly computed.

Records of all proceedings, calculations, and disbursements shall be clearly defined and kept.

Building rehabilitation and construction programs will be clearly defined. Priority studies should define the needs of the building construction as compared to the needs of bridge and culvert constructions.

The programmation should include labor, material and equipment estimates as well as budgetary estimates.

All processes, correspondence, actions, changes, shall be fully documented. For expediency, initial changes may be verbal, but should be followed by written confirmations.

Proper work records of all personnel preferably in the form of time sheets, shall be kept. These shall be promptly forwarded to the sub-system management unit for processing.

Accurate records of vacations, sick leave, absences without leave, infractions of rules and regulations and overtime shall be kept and regularly and promptly given to the sub-system management unit.

He shall adequately insure that equipment operators and drivers follow proper equipment operating procedures as set forth by the equipment maintenance unit.

All unit work programs shall allow adequate time for preventive maintenance to be performed on the equipment.

The sub-chief shall clearly identify and justify any possible quantity and/or budgetary overruns.

Selected personnel shall be nominated for formal training with all justifying documents to the sub-system training officer. Moreover, the training officer shall be made aware of all training needs of the unit.

All requests, orders, demands and commands which originate outside the sub-system, and which do not emanate from the Chief of the sub-system, shall be referred to the Chief of the sub-system who will then promptly act on such communication.

All work that is not in the work programs or that is extraneous to the budget shall be fully documented, especially as to cost, origin or work, purpose and time of completion. The effect of such work on programmed work and budgetary constraints shall be fully noted.

All data shall be promptly furnished upon request by the Chief of the sub-system only.

4.4.4. Sub-Chief (Equipment Maintenance)

The sub-chief shall be responsible for all equipment maintenance,

preventive maintenance, the use of the machine shop, the use of the foundry, the carpenter shop and the sub-system warehouse.

He shall prepare a program for routine maintenance of all equipment and notify all sub-system personnel through the sub-system chiefs of this program. Additionally, he shall institute a program of preventive maintenance and further publicize this program.

He shall prepare estimates for labor, material, fuel and oil for the maintenance services.

Equipment maintenance shall be performed promptly and efficiently to minimize work interruption of the units requiring the maintenance.

Files should be kept for each individual piece of equipment in the Project. All work performed on each vehicle shall be duly recorded in each respective file. Labor costs, replacement parts costs, oil and grease and miscellaneous costs shall be noted in the file.

Misuses of equipment noted during the maintenance effort should also be noted and the affected unit or sub-system notified.

A monthly report of all work shall be prepared. This report shall break down the costs by sub-system and shall be forwarded to all sub-systems as well as the management unit of the Infrastructure sub-system.

Any correspondence entered into by the sub-chief with any and all other unit heads shall be properly filed with copies forwarded to the sub-system chief.

The chiefs of sub-systems shall be notified if any equipment operators in their sub-system have failed to bring the equipment in for maintenance when due.

A corrective-action program should be defined for continued delinquencies by the same operators. This program should define penalties for infractions of the rules and regulations.

Spare part requirements estimates shall be made quarterly and forwarded to Project Management.

Truck, pick-up and motorcycle drivers should have trip logs, copies of which should be maintained in the respective equipment file.

The use of the machine shop shall be controlled by the Sub-Chief (Equipment Maintenance).

He shall set up work allocation programs and schedules to accomodate all sub-systems. A series of priority work should be set up to insure the least interruption of work in any sub-system.

All time, labor, equipment and material expended for any task shall be recorded. A monthly summary of work shall be prepared, showing tasks, total cost of tasks (including labor) and sub-systems for which tasks were performed. This summary should be forwarded to Project management, and all sub-systems, for processing.

All requests for tasks should be written. They should be clearly defined, with any time limitations that might be necessary.

All machine shop personnel shall be directly responsible to the Sub-Chief (Equipment Maintenance), and follow his orders or the orders of his representative.

The use of the foundry shall be programmed so as to minimize the use of fuel. Priority lists of tasks should be set up, with timing and urgencies noted.

Attempts should be made to combine different tasks, when possible.

Records of time, material and fuel used shall be kept and charged to different tasks.

A monthly report, of charges per task should be prepared and sent to the Project Management Unit, the Infrastructure Management Unit and all concerned sub-systems.

The carpenter shop shall be used to furnish support for all sub-systems. Therefore, it is incumbent on the Sub-Chief to prepare programmation of work.

All material and labor used for each task shall be recorded. Monthly summaries shall be prepared and forwarded to Project Management and all concerned sub-systems.

All supplies, equipment, material, spare parts, etc., shall be received by the warehouse. It shall promptly record such receipt, and if on special order by a sub-system, notify the sub-system of the receipt.

An inventory shall be conducted at least once a year, cataloguing parts by number, name, and if specifically for a sub-system, the name of the sub-system.

All demands to the warehouse shall be by requisition, that shall state very clearly, part, number, part name, purpose, and name and signature of authority to withdraw the part. Such withdrawal, shall be promptly entered into the inventory record.

The Sub-Chief shall prepare orders for new material, spare parts, etc., with enough lead time to prevent exhaustion of the supply on hand.

He shall forward such orders to the Project Management Unit for prompt processing.

He shall prepare monthly reports of activities of the warehouse, by sub-system, showing parts used and/or received. Copies of these reports shall be distributed to all concerned sub-systems.

The Sub-Chief shall be responsible for keeping personnel records of the sub-units under his direction pertaining to time worked, overtime, etc.

Copies of weekly summaries shall be sent to the sub-system management unit for processing.

All infractions of rules, regulations, any absences without leave, etc., shall be duly noted and reported to the sub-system personnel officer for action. Such reports shall be fully documented.

Finally, the Sub-Chief (Equipment Maintenance) shall insure that the sub-system management unit has copies of all pertinent correspondence, actions and requests for the sub-system files.

4.4. CONTROL AND DUTIES OF SUB-SYSTEM - 1982-1983

The second phase to be considered is the period 1982-1983.

The sub-system was slated to be turned over to OR in September 1982. However, it has been shown in Chapter 3 that:

- The OR is not capable of maintaining the National or the Regional roads within the Project area.

- The OR is not capable of maintaining its equipment nor get replacement parts
- The sub-system, by September 1982, will not have all its bridges completed. In view of past performance, it is highly unlikely that the OR is capable of or would want to build the necessary bridges.
- The road rehabilitation may not be finished by September 1982. The OR, incapable of road maintenance, would equally be incapable or road rehabilitation.

Therefore, it is strongly recommended, if the modifications proposed in Sections 4.2 and 4.3 are implemented, and if the PNS continues to EOP the Infrastructure sub-system remain within PNS.

The organization would have the capability, the organization and the experience to continue to build bridges, rehabilitate roads and to maintain the roads.

4.5. CONTROL OF SUB-SYSTEM AFTER 1983

The Infrastructure sub-system's major task after Project termination in 1983 will be the maintenance of the Project road system and other necessary activities in conjunction with its maintenance function.

There are three possibilities that can be considered, for the future of the sub-system after Project termination:

- Have OR take over the administration and activities of the sub-system
- Have Estagrico take over the administration and activities of the sub-system
- Maintain the sub-system as a separate organization.

4.5.1. OR Control of the Sub-System

The original project design foresaw the OR taking over the material, equipment, activities and functions of the sub-system, including the maintenance of the PNS roads.

The sub-system, if the modifications noted in Section 4.3 are followed, is capable of fulfilling the maintenance activities.

However, as noted in the previous section and based upon the performance of OR during the past five years as well as the difficulties in receiving adequate GOZ funding, it is very doubtful that OR could do the required maintenance on the PNS roads.

This is further evidenced by the utter lack of maintenance of some regional roads in the PNS area and the reduction in budgeted funds that OR has suffered.

Furthermore, the equipment maintenance of OR is of doubtful quality, with the equipment having very high deadlined rates.

4.5.2. Estagrico Control of the Sub-System

As discussed in Chapter 3, at present, Estagrico cannot maintain the sub-system equipment in their own facilities, nor is it likely, that, in fact of present and forecast economic conditions, they will be able to expand their facilities.

The monetary situation would make it also very doubtful if they could take over and maintain the present PNS facilities. Also, there would be a tendency to use the PNS maintenance facility for cotton equipment at the expense of road equipment.

It is to be noted, that of the roads they are presently obligated to maintain, less than 40 percent had any trace of maintenance. This is estimated on the basis of viewing at least 80 percent of the rehabilitated roads.

Moreover, the only operations the cantonniers were performing was the cutting of grass and weeds. Pot-holes and degradations were not being repaired. Except at one location, ditches were not being cleared.

There is not sufficient supervision, materials and tools for proper cantonnage operations. Improvement of this is doubtful, again given the economic, labor and logistical situation of Estagrico.

4.5.3. Maintain the Sub-System as a Separate Organization

The major drawback to this consideration is finding adequate funding. It appears out of the question to depend on GOZ funding, given its past record. Besides, if GOZ funding could be depended upon, OR might be better suited to control the sub-system.

The DOA does not have the funding capability, either, as evidenced by its difficulty in providing the Project funding.

Therefore, it is rather obvious that an alternative source of funding is required.

The most likely source of internal funding is a road tax, on merchants bringing produce to and from markets via the PNS roads or taking produce to shipping points via the PNS roads.

Control and collection of the tax could be either at railheads or at official buying counters. The tax could be based on tonnage being shipped.

The tax structure and procedure of collecting, as well as the legality within the Provincial and National tax system is left as beyond the extend of this report, and should be investigated by PNS staff, USAID and other officials, between now and September 1982, in order to provide adequate planning.

The amount of the tax is discussed later in Section 4.7.

A further possibility is the recent announcement by the GOZ of the availability of 53 million Zaires for maintenance of local interests roads (sic) to be let to local contractors capable of doing the maintenance work.

Further investigation by PNS staff and USAID to see whether the Infrastructure may touch this fund (as it has the only organization in North Shaba capable of full maintenance of local interest roads) should be done.

However, thought should be given if this is going to be a "one-time shot" or whether this will be a yearly continuing grant. Additionally, thought must also be given to past GOZ funding attempts, where good intentions have fallen victim to lack of available funds.

A third possibility is a loan from an international lending agency such as ADB or the World Bank. However, considering the present economic situation of Zaire vis-a-vis international lenders, this possibility is very remote, but should nevertheless be investigated.

The Infrastructure sub-system is well established, has adequate equipment and personnel and has adequate equipment maintenance facilities. As such, it might, on its own virtues, qualify for a loan, if some means of repaying the loan were indicated, such as a tax revenue.

A fourth possibility is a private venture consisting of a cartel of interested companies, such as the merchants in the PNS area itself. However, this is fraught with danger. Since the companies within the cartel would be competing companies, there is a possibility that there could be continual squabbling over priorities of maintenance, amount of funding by each company, lateness of contributions, etc., that could effectively freeze the maintenance effort.

Lastly, USAID could continue to finance only this sub-system after 1983 without requiring local participating funds. This would have to be on a grant basis, for if tax revenue was available, no loan would be necessary. Even if USAID finances PNS after 1983, this sub-system should be financed separately.

4.6. ORGANIZATION OF THE SUB-SYSTEM AFTER 1983

4.6.1. Organization

Regardless of the source of funding, the sub-system would be reorganized in order to be viable after Project termination.

The sub-system should be reorganized as follows:

Two divisions, each with a division chief; one based at Kongolo and one based at Nyunzu.

The division at Kongolo, where the system Director would be based, would include an administrative unit for the entire system, a road maintenance unit and the equipment maintenance and associated facilities existing at Kongolo.

The division at Nyunzu would have a road maintenance unit, a warehouse and some equipment maintenance facilities.

The equipment based at Kongolo would include a bulldozer, two graders, a front-end loader, six dump trucks, a roller, a water truck and a fuel truck.

Nyunzu would have a bulldozer, one grader, a front-end loader, four dump trucks, a water truck and a fuel truck.

The administrative unit should have the Director, a work superintendent, a personnel chief, two accountants, two clerks, two warehousement and a radio operator.

Each division would have mechanics, apprentice mechanics, equipment operators, drivers, cantonniers, capitas and other laborers as necessary.

The Kongolo division would be responsible for the roads from Kongolo to Mbulula and south to, but not including, the Makundi-Kitengetenge road.

The Nyunzu division would be responsible for the roads in the Nyunzu area, south to Makumbo and north to, and including, the Makundi-Katundu-Kitengetenge road. The Kabeya Mayi - Kalima road would also be the responsibility of this division.

For the purpose of this report, it is assumed that the roads supposedly maintained by OR at the present time would continue to be maintained by OR, e.g.; OR Route 631 (Kongolo-Mbulula).

4.6.2. Work Program

The divisions would be responsible for routine and periodic maintenance for roads, bridges and culverts. This would include the following tasks:

- Blading and Shaping of road with a motorized grader to provide a smooth and even surface.

- Roadside and outlet ditches would be reshaped and cleared, and if excess material is suitable, it would be used for roadway resurfacing.

- Resurfacing of long sections, to replace lost surface material, by motorized means.

- Patching isolated holes and degradations with suitable material.

- Cleaning and repairing culverts, including repair of headwalls, and cleaning of inlets and outlets.

- Clearing and shaping of road ditches with hand tools.

- Erosion control, as part of road-side maintenance, to prevent road-side erosion, by manual methods.

- Bridge repair, repair of bridge appurtenances, and clearing of stream channels as required.

- Vegetation control, cutting of grass, weeds and brush by manual methods.

A work program should be established by the Director in cooperation with the work superintendent and the division chiefs. In order to be able to establish such a work program, an up-to-date road inventory must be in existence or established.

This inventory, by division, should include route numbers, kilometrage, locations of drainage structures, locations of bridges, type of route (surfaced with laterite, dirt-reprofiled, trail, etc.) and various conditions of road surface, and appurtenances. It should be updated as maintenance and/or new construction is performed.

As has also been stressed in Chapter 3, the program should allow and insist on adequate equipment maintenance. Continual training should be provided to all maintenance personnel, all operators, all drivers and other concerned personnel to minimize equipment breakdown and to keep low dead-lined rates.

4.6.3. Resources Necessary for the Organization

Resources necessary for the maintenance activities, include funding, labor, material, and equipment.

The following calculations have been made, using these assumptions:

- Due to the severe financial and labor problems that Estagrico has and is forecast to have, they will be unable to perform the necessary cantonnage operations, and that these would be assumed by this organization, and

- Minimum-type maintenance, i.e., to maintain minimum levels of service, and

- The calculations are based on OR source data, PNS source data, field observations and "Road Maintenance Recommendations-PNS Rehabilitated Roads", published jointly by the Infrastructure Sub-System-Project North Shaba and Morrison-Maierle in February 1982.

For the purposes of the calculations of the necessary resources, the following task numbers and work units have been assigned:

Task No.	Description	Work Unit
1	Blading and Shaping of road with a grader and clearing roadside and outlet ditches	Km.
2	Resurfacing long section by motorized means with laterite	CM
3	Patching isolated holes and degradations with suitable material	CM
4	Cleaning and repairing culverts including repair of headwalls	No. of Culverts
5	Clearing and shaping of road ditches with hand tools	KM
6	Erosion control, as part of roadside maintenance, to prevent roadside erosion, by manual methods	Man-hours
7	Bridge repair and repair of bridge appurtenance	Man-hours

Task No.	Description	Work Unit
8	Vegetation control by manual methods	Km.

There are three types of roads in the PNS area which will be maintained by this organization:

- National and Regional routes (Class 2)
- Arterial roads (Class 3)
- Local roads (Class 4)

The divisions have the following kilometrages of the various classes of road:

Division	Class 2	Class 3	Class 4
Kongolo	65	79	390
Nyunzu	60	60	70
Total	125	139	460

All the kilometrages are estimated only and are subject to variations when all the roads are actually completed.

The following standards of work are proposed for minimum levels of service on the various classes of road.

Task No.	Criteria	Class 2	Class 3	Class 4
1	Times/yr	2	2	2
2	Frequency	2 yrs	3 yrs	-
3	Cm/Km/yr	5	4	3

Task No.	Criteria	Class 2	Class 3	Class 4
4	Times/yr	2	2	2
5	Times	3	3	3
6	Man hours/Km/yr	30	20	10
7	Man hours/Bridge/yr	60	60	60
8	Times/yr	4	4	4

Note must again be made that these are only general minimum standards used for the following calculations and that these may be varied after analysis of the maintenance experience of the sub-system in 1982-1983.

Task No.	Resources
1	1 Grader, 1 operator, 2 laborers
2	1 Grader, 1 Bulldozer, 1 Roller, 1 Front-End Loader, 4 Dump Trucks, 1 Water Truck, 1 Fuel Truck, 4 operators, 6 drivers, 4 labroers
3-8	362 Cantonniers, 24 capitas, hand tools, 2 Dump Trucks (only as needed), 2 drivers

The annual work program, then, can be computed as follows, by division:

Task No. 1

Kongolo Division

65 km x 2 times/yr	=	130 km
79 km x 2 times/yr	=	158 km
390 km x 2 times/yr	=	780 km
Subtotal		1,068 km

Nyunzu Division

60 km x 2 times/yr	=	120 km
60 km x 2 times/yr	=	120 km
70 km x 2 times/yr	=	140 km
Subtotal		380 km

TOTAL Km - Task No. 1: 1,448 km

Task No. 2

Resurfacing is assumed as 0.15 m of laterite compacted over 4.25 m width of road.

$$(0.15) \times (4.25) \times (1000) = 637.5 \text{ m/km}$$

Additionally, it is assumed that all Class 3 and Class 2 roads are or will be surfaced with laterite.

Kongolo Division

65 km x 637.5 x .50	=	20,719 CM
79 km x 637.5 x 1/3	=	16,788 CM
Subtotal		37,507, CM

Nyunzu Division

60 km x 637.5 x .50	=	19,125 CM
60 km x 637.5 x 1/3	=	12,750 CM
Subtotal		31,875 CM
TOTAL CM - Task No. 2:		69,382 CM

Task No. 3

Kongolo Division

65 km x 5 CM/km/yr	=	325 CM
79 km x 4 CM/km/yr	=	316 CM
390 km x 3 CM/km/yr	=	1,170 CM
Subtotal		1,811 CM

Nyunzu Division

60 km x 5 CM/km/yr	=	300 CM
60 km x 4 CM/km/yr	=	240 CM
70 km x 3 CM/km/yr	=	210 CM
Subtotal		750 CM
TOTAL CM - Task No. 3:		2,561 CM

Task No. 4

Kongolo Division

40* x 2 times/yr	=	80

Nyunzu Division

20* x 2 times/yr	=	40
TOTAL		120

*Assumed

Task No. 5

Kongolo Division

534 km x 2 sides x 3 times/yr	=	3,204 Km

Nyunzu Division

190 km x 2 sides x 3 times/yr	=	1,140 Km
TOTAL		4,344 Km

Task No. 6

Kongolo Division

65 km x 30 MH/km/yr	=	1,950 MH
79 km x 20 MH/km/yr	=	1,580 MH
390 km x 10 MH/km/yr	=	3,900 MH
Subtotal		7,430 MH

Nyunzu Division

60 km x 30 MH/km/yr	=	1,800 MH
60 km x 70 MH/km/yr	=	1,200 MH
70 km x 10 MH/km/yr	=	700 MH
Subtotal		3,700 MH
TOTAL MH - Task No. 6:		11,130 MH

Task No. 7

Kongolo Division

15 Bridges x 60 MH/Bridge/yr	=	900 MH

Nyunzu Division

5 Bridges x 60 MH/Bridge/yr	=	300 MH
TOTAL MH - Task No. 7:		1,200 MH

Note: Number of bridges are assumed.

Task No. 8

Kongolo Division

534 km x 4 times/yr	=	2,136 km

Nyunzu Division

190 km x 4 times/yr	=	760 km
TOTAL km - Task No. 8:		2,896 km

Based upon field observations, PNS data and general OR source data, the following productivity rates are feasible and will be used as the basis of yearly resources required:

Task	Productivity
1	8 km/day/crew
2	500 CM/day/crew
3	0.5 CM/day
4	10 man-days/Culvert (980 MH/Culvert)
5	200 M/day
6	N/A
7	N/A
8	100 M/day

Using the aforementioned calculations and productivity rates, the following annual maintenance resources requirements can be calculated:

Task No. 1

Kongolo Division

1,068 km/8 km/day/crew = 134 days

Nyunzu Division

380 km/8 km/day/crew = 48 days

Task No. 2

Kongolo Division

37,507 CM/500 CM/day/crew = 75 days

Nyunzu Division

31,875 CM/500 CM/day/crew = 64 days

Task No. 3

Kongolo Division

1,811 CM/0.5 CM/day = 3,622 days

Nyunzu Division

750 CM/0.5 CM/day = 1,500 days

Task No. 4

Kongolo Division

80 x 10 = 800 days

Nyunzu Division

40 x 10 = 400 days

Task No. 5

Kongolo Division

3,204 km/100 m/day = 32,040 days

Nyunzu Division

1,140 km/100 m/day = 11,400 days

Task No. 6

Kongolo Division

7,430 MH/6 MH/day = 1,238 days

Nyunzu Division

3,700 MH/6 MH/day = 617 days

Task No. 7

Kongolo Division

900 MH/5 MH/day = 180 days

Nyunzu Division

300 MH/5 MH/day = 60 days

Task No. 8

Kongolo Division

2,136 km/100 m/day = 21,360 days

Nyunzu Division

760 km/100 m/day = 7,600 days

Using these calculations, the available resources may be checked against the needed resources.

It must again be stressed that this is a minimum level exercise with several assumptions that will have to be verified during 1982-1983, ~~by~~ the results of the proposed maintenance program of the sub-system.

Task 1 and Task 2

Kongolo Division

Equipment Needed	Days
Grader	209
Bulldozer	75
Roller	75
Front-End Loader	75
Dump Trucks	450
Water Truck	75
Fuel Truck	75
Labor Needed	
Operator	209
Operator	75
Operator	75
Operator	75

Labor Needed (Cont.)	Days (Cont.)
Foreman	75
Drivers	810
Laborers	568

Working Days Available

Non-Working Days

Weekends = 52 x 2	=	104
Holidays (See Note 1)	=	16
Bad Weather (See Note 2)	=	80
TOTAL		200

Working Days Available - 365 - 200 = 165

Graders Needed (See Note 3)

209/165 x 1.25 = 1.58

Graders available: = 2

Bulldozer, Roller, Front-End Loader Needed (See Note 3)

75/265 x 1.25 = 1

One of each available

Dump Trucks Needed

450/165 x 1.25 = 3.4

Dump Trucks Available = 4

Nyunzu Division

Equipment Needed	Days
Grader	112
Bulldozer	64
Roller	64
Front-End Loader	64
Dump Trucks	384
Water Truck	64
Fuel Truck	64

Labor Needed	
Operator	112
3 Operators	64 each
Foreman	64
6 Drivers	64 each
Laborers	406

Working Days Available = 164

Graders Needed

112/165 x 1.25 = 1

Grader Available = 1

Other Heavy Equipment Needed

64/165 x 1.25 = 1

One of each available

Dump Trucks Needed

384/165 x 1.25 = 2.91

Dump Trucks Available = 4

Tasks 3 through 8

Kongolo Division

Man-Days Needed

3	=	3,622
4	=	800
5	=	32,040
6	=	1,238
7	=	180
8	=	21,360

Total = 59,240 days

Working Days Available

Non-Working Days

Weekends = 52 x 2 (See Note 4)	=	104
Holidays	=	16
Bad Weather (See Note 5)	=	62
TOTAL		130

Working Days Available - 365 - 130 = 235

Number Cantonniers Needed

59,240/235 = 252

252 x 1.05 = 265 (See Note 6)

Number Cantonniers Provided

(minimum) 534/2 = 267

Nyunzu Division

Man-Days Needed

3	=	1,500
4	=	400
5	=	11,400
6	=	617
7	=	60
8	=	7,600
TOTAL	=	21,577 days

Working Days Available = 235

Number Cantonniers Needed

21,577/235 = 92

92 x 1/05 = 97 (See Note 6)

Number Cantonniers Provided

(minimum) 190/2 = 95

Note 1: From GOZ and PNS data

Note 2: Rainy season Nov-Dec and Feb-Apr.

Note 3: Allow 25% additional time for maintenance and breakdowns

Note 4: Cantonniers work 6 days a week

Note 5: Some equipment "bad weather days" are not considered manual work "bad weather days"

Note 6: Allow 5% additional for accidents, sick leave, etc.

A final reminder is made that this exercise is made on the basis of providing minimum level standards. However, a final, more definitive program could still be modeled after these calculations.

4.6.4. Costs

The costs of the program described in this chapter is the most difficult item to arrive to, as there is almost no documentation from this project that could be used for the necessary calculations.

Therefore, the costs are based mostly on the derived costs presented in the previously noted references and in the references noted in Appendix A.

Task 1

182 crew days; 1500 hours grader;

Salaries	: 12,300 Z
Fuel and Oil	: 97,200 Z
Spare Parts	:119,250 Z
	228,750 Z

Task 2

139 crew days; 850 hours heavy equipment; 9600 km/truck;

Salaries	:	60,000 Z
Fuel and Oil	:	336,600 Z
Spare Parts	:	298,300 Z
		695,200 Z

Tasks 3 through 8

Cantonniers	:	832,600 Z
Capitas	:	88,800 Z
General Admin	:	72,000 Z
Equipment	:	440,000 Z
Miscellaneous	:	275,000 Z
		1,708,400 Z

Overhead Costs (assumed as 30% of total)

790,000 Z

Administration (15% of total)

395,000 Z

TOTAL COSTS = 3,817,350 Z

Replacement Parts

OR allows approximately 1,080,000 Z annually for replacement of equipment. (190,000 $US at the official rate)

In addition, there is:

Cantonnier tools	:	$120,000
Pick-Up Trucks	:	$ 70,000
Bicycles	:	$ 20,000
Motorcycles	:	$ 10,000
Spare Parts	:	$ 44,000
Subtotal		$264,000
Total $ cost of replacement	:	$454,000

Some replacement parts are available in Kinshasa and Lubumbashi which could be purchased in Zaires. There are also merchants which could provide other spare parts for Zaires.

Alternatively, a stock of replacement parts might be financed before 1983, for use after 1983, to allow this fund to accumulate to the level necessary for it to function.

Please note that the costs quoted above are estimated using the current inflation rates. Also, all conversions are done at the official rate. Using the parallel rate would require less dollars, obviously.

4.7. FUNDING AFTER 1983

There are five possibilities of funding:

- Road tax
- GOZ 53 million Zaires
- International loan
- Private venture
- Continued USAID funding

PNS maize shipping records of 1981 indicated 31,000 tons were shipped. If a tax of 200 Zaires per ton was applied, 6,200,000 Zaires could be raised from maize shipments along. Assuming a twenty percent rise in shipments by 1983, the tax would give 7,440,000 Zaires for the maintenance organization.

This would allow approximately 1,000,000 Zaires for betterment and rehabilitation of further roads.

Of course, if GOZ provides the necessary funds or a portion thereof, then the tax could be lessened.

International loans, if possible, would still require the road tax, in order to pay back the loan.

Finally, private ventures, in the form of existing companies in the Project area are in doubtful economic condition at present. However, it does seem likely that they could affort to pay 20 makuta per kilo shipped to maintain the roads.

The problem with this, as previously noted, is in having a joint venture with many companies having competing interests. The maintenance effort could be frozen with dissension between the companies. Additionally, the larger companies could control the maintenance effort to benefit only the roads they use. Moreover, there is the possibility that the maintenance organization might have its equipment maintenance facilities used by the companies for the maintenance of their equipment to the detriment of the road equipment.

Despite the above drawbacks, this is a possibility that should still be investigated especially in light of the GOZ determination to use contractors to maintain local interest roads.

4.8. EXPANSION OF ROAD SYSTEM

Given an income of 7.5 million Zaires, and maintenance expenses of 6.3 million Zaires, it is also possible to program an expansion program for the road system.

With a surplus of 1.2 million Zaires, additional segments of road could be rehabilitated. However, these must be carefully analyzed vis-a-vis the forecast produce shipments to assure that the revenue of the following year would be sufficient to include the new segments within the maintenance program.

A new analysis of the maintenance program, similar to Section 4.4.3. should be performed to verify the adequacy of the available resources, including equipment, for the revised system.

Additionally, a rehabilitation program must be set up taking into account the maintenance program, and must not interfere with the proper maintenance of the road system.

It can be assumed that as new roads are opened, production will increase. With increased production will come increased exportations, and as a result, increased revenue for road maintenance and rehabilitation.

It is estimated, based on OR source data, PNS data and field observations, that the costs of opening a road will average approximately 10,000 Zaires per kilometer. This cost, of course, will vary depending where the road is, i.e., forest, savanna, hilly terrain, flat terrain, etc.

This cost does not include an expatriate advisor, original cost of equipment, replacement parts or foreign exchange which might be needed.

This estimate does not include an equipment replacement reserve nor an administration charge since that was included in the maintenance operation.

If 500,000 Z were spent a year for the rehabilitation of roads, it can reasonably be expected that 50 kilometers of road could be opened. Additionally, if we assume an average of 5 kilometers between villages, that would give 10 villages affected each year.

Assuming an average village of 40 families with 1.5 hectare each for cash crops, this would give 600 hectares of increased production.

Moreover, if it is assumed that each hectare produces 2 tons of maize, this would given an additional production of 1,200 tons and a tax revenue of 240,000 Zaires.

This increased revenue would pay for most of the increased cost of maintenance (5,300 Z/km) the following year (50 km x 5,300 = 265,000 Zaires), while the assumed increased production in the area as a whole would take care of inflation and the rest of the increased cost of maintenance.

The above scenario includes many assumptions, but it shows that, given the proper safeguards, such a scheme could work. It warrants further investigation by the PNS staff and USAID, using data from SCAD, SNCA and DOA, as well as from private companies.

CHAPTER FIVE

REPLICABILITY - ADAPTABILITY

5.1. GENERAL

Replicability, as used in this report, is defined as the ability of duplicating the sub-system at other similar locations.

Adaptability is the ability to take the sub-system and adapting it to other similar locations.

The discussion that follows will touch upon the various elements involved in the adaption of such a sub-system, namely:

- Planning
- Implementation (Mobilization)
- Organization
- Equipment and Logistics
- Methodologies
- Funding and Accounting
- Sustainability
- Replicability - Adaptability.

5.2. PLANNING

Obviously, in planning a project, the other elements noted above must be touched on.

The location, existing road system, actual existing maintenance, actual existing facilities, desired annual progress in road rehabilitation, training facilities and available funding (including the steadiness of the local participation) must be studied in the light of the adaptation of the sub-system to another area.

It is highly unlikely that, even with proper planning, any system can be exactly duplicated from area to area. It is, however, much more likely that it could be adapted to fit particular regions or areas.

For large projects, a CPM diagram should be prepared to identify the critical tasks, as well as to identify the reasonable length of project. Cash flows and needs should be analyzed in view of the noted CPM and problem times foreseen as much as practicable.

Personnel planning the implementation of such a sub-system should be thoroughly familiar with the area to which it is wished to adapt the system. Familiarization can be done by literature, discussions of previous field visits made by associated staff and most importantly, personal visits to the area. The obvious lack of in-depth planning and programmation of this sub-system should not be duplicated elsewhere.

5.3. IMPLEMENTATION (MOBILIZATION)

The mobilization pattern used in this sub-system must not be duplicated.

Mobilization must be done in stages, especially for a sub-system such as infrastructure.

The assurances of proper housing, available food, electricity, and potable water must be made before sending a team to implement the project.

Proper mobilization of this sub-system would send the equipment specialist and the construction engineer first. They would assure living quarters and equipment facilities. Once these were assured, and the necessary equipment was on site, then the road unit, drainage unit, structural unit and administrative unit could all be mobilized without any undue delays. Of course, this mobilization would have to be coordinated, within a Project, with other sub-systems.

It is not clear, due to the lack of available information on the relative effect of each sub-system on the Project results, which sub-system should be mobilized first. However, it is clear that all the sub-systems should not be mobilized at the same time. It is also obvious that the personnel necessary to assure the living quarters, the equipment facilities, the logistics, the power facilities and potable water, etc., must be first on site.

5.4. ORGANIZATION

The organization of the sub-system, as modified in Chapters 3 and 4, can be duplicated in any region that the sub-system is established.

The duties of the sub-chiefs would vary depending on the availability of equipment, personnel, tools, etc. For example, if there was no foundry, the sub-chief - equipment maintenance might also have to build or erect a foundry, if necessary. But basically, the duties would remain the same.

The chain of command should remain the same as well as modified administration of the sub-system.

The personnel should be direct-hired by the sub-system personnel officer.

5.5. EQUIPMENT AND LOGISTICS

The equipment available for the performance of the various tasks of the sub-system is quite adequate. The amount of heavy equipment and types will vary, based on the different conditions found in different areas. For example, heavily wooded areas might require heavier bulldozers and/or more bulldozers.

The logistics have to be ameliorated for adaptation to another area. Quicker delivery of replacement parts, fuel, oil and tools would have to be developed. A CPM, of course, can go a long way in giving adequate lead time on the order of parts, but delivery must always be assured, regardless of lead time.

Also, it would ease logistic problems if all the vehicles were diesel-powered, instead of some gasoline-powered and some diesel-powered.

Additionally, if the area was savanna, with no forests to speak of, a carpentry shop might not have lumber to work with and could be deleted.

The needs for any project, based on area, terrain, time constraints, soil conditions, climatic conditions, etc., must be analyzed before adapting the equipment and logistics in any area.

5.6. METHODOLOGIES

Basic methodologies, e.g., clearing a road with a bulldozer, are easily duplicated. However, given bad soil conditions, where clay abounds, for example, will vary the current methodology of surfacing only a few project roads.

Additional methodologies should be included such as soil testing, materials testing, cement testing, concrete construction standard methodologies, drainage standards and pavement structural standards.

Pre-project testing can go a long way in determining project needs and methodology.

Road cross-sections, ditches, culverts and masonry construction may have to vary according to different conditions. The existing standards could be adapted but not necessarily duplicated as is.

Work programs, and maintenance programs will vary with climatic conditions. Again, existing programs could be adapted but not duplicated as is.

In summary, the developed methodologies used by the sub-system in implementation can be adapted to other areas but cannot be duplicated as is.

5.7. FUNDING AND ACCOUNTING

The last thing that should be duplicated is the method of funding, budgeting and accounting that has been used in this project sub-system.

The funding, budgeting and accounting should be as modified in Chapters 3 and 4. The methods so described can be duplicated, without adaptation, for any project sub-system.

However, any proper accounting system, using accepted accounting and reporting procedures could be used effectively with this sub-system, if it was conscientiously followed.

5.8. SUSTAINABILITY

With the modifications and recommendations described in Chapter 4 and in the above sections of this Chapter, the sustainability of the sub-system could be assured, given the necessary funding.

Again, an analysis as made in Chapter 4 would be required for a sub-system of a new project, to check its sustainability, and means of funding analyzed.

However, given available funding, this sub-system would be sustainable.

5.9. REPLICABILITY - ADAPTABILITY

In general, the sub-system cannot be replicated as is, but can be fairly easily adapted to other areas.

This is based on the assumption that there is proper planning, proper mobilization, organization, good equipment, well-planned logistics, adaptive methodologies, funding, proper accounting techniques, and aside from funding, is sustainable.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1. CONCLUSIONS

Based on the discussion and analyses in Chapters 3 and 4, the following conclusions can be reached:

1. While the rehabilitated roads are generally technically sound, those were note done in a programmed order of priorities. These rehabilitated roads do not have satisfactory maintenance, with some needing almost complete rehabilitation.

2. The bridges and drainage structures appear satisfactory but were built with little or no engineering design and no programming. Misuse of resources on other subprojects has resulted in some high-priority bridges not being built.

3. Existing equipment maintenance is satisfactory at this time, but only due to the extreme effort of the existing advisor.

4. OR and Estagrico are incapable of properly fulfilling their commitments to the PNS.

5. Local villager and farmer assistance in road maintenance cannot be depended upon.

6. There is no viable management of this subsystem. There is no coordination of sub-projects, no budgeting and practically no accounting system.

7. The sub-system is not sustainable now, nor can it be in the foreseeable future.

8. The insufficiencies in this subsystem can be partly attributed to poor planning, poor management, poor stateside support for sub-system staffa and relatively inexperienced expatriate advisors.

9. DOA and GOZ cannot de expected to fulfill their commitments now or in the foreseeable future.

6.2. RECOMMENDATIONS

After due consideration of the findings in Chapter 3 and consideration of the feasibility of the exercices conducted in Chapters 4 and 5, the following recommendations are made.

1. In view of the fact that sustainability can not be reached in the foreseeable future, and the lack of financial contributions from DOA and GOZ, stop AID funding for this subsystem as of October 1982 (Six months phase-out period).

2. Minimize the work at Ngaba and construct bridges and culverts on the remaining roads on a high priority basis, to be completed by October 1982.

3. Rectify the sub-system management and accounting, in the phase out period, as recommended in Chapters 3 and 4.

4. The PNS staff and USAID study and try to arrive at funding for this sub-system as expounded in Chapter 4.

5. If local funding is assured, modify sub-system, as recommended in Chapter 4, into a road maintenance organization, with no exterior funding or expatriate advisors.

6. Failing a successful attempt to find local (Zairois) funding, return to sub-system to OR.

IF, due to policy reasons, it is decided that US presence ir required in North Shaba, then the following recommendations are made:

1. Modify and reorganize the sub-system following th exercice in Chapters 3 and 4, so that the sub-system could operate as an independent organization.

2. Assign an outside independent accountant at once to perform an audit and to set up a viable accounting system.

3. Insist on a viable and feasible work program, based on the sample in Chapter 4.

4. Phase-out the expatriate advisors, with the Bridge advisor leaving upon completion of bridges and other advisors by October 1983.

5. Sub-system staff and USAID pursue a course to arrive at suitable funding or partial funding of the sub-system, possibly one of the alternative noted in Chapter 4.

6. Funding by USAID would continue but for this sub-sytem as a separate entity, and not as an integral part of a newly designed project.

IT IS MY OPINION THAT THIS SUB-SYSTEM CANNOT BE MADE SUSTAINABLE, REGARDLESS OF THE TIME SPENT, UNLESS AN ASSURED SOURCE OF FUNDING IS FOUND. BASED ON THE COUNTRY'S BLEAK ECONOMIC SITUATION AND THE FAILURE OF GOZ AND DOA TO LIVE UP TO PAST COMMITMENTS, IT APPEARS THAT ONLY EXTERNAL FUNDING CAN SUSTAIN THIS SUB-SYSTEM.

IF, FOR POLICY REASONS, USAID WISHES THE ROAD SYSTEM TO SURVIVE THEN THE QUESTION OF SUSTAINABILITY SHOULD BE DROPPED, AND USAID BE PREPARED FOR AN INDEFINITE LONG TERM PRESENCE IN THE AREA.

Appendix A

List of Reports Consulted

North Shaba Maize Production Project; Dimpex Assoc.

Infrastructure Report; Feb. 1979; Morrison, John.

Bridge Building Unit; Sept-Oct 1980; Kabler, Paul

End of Tour Report; Brooks Atkinson

End of Tour Report; Merritt Sargent

Evaluation and Recommendations to Infrastructure Subsystem; Infrastructure Subsystem and Morrison-Maierle.

Five Years Later: Progress and Sustainability in Project North Shaba; DAI

SOCIETE AGRICOLE ET COMMERCIALE DU CONGO BELGE ET DES ARDENNES S.A.R.L.

ESTAGRICO

Siège social : Kolwezi (Division Spéciale)
Siège d'exploitation :
KONGOLO - UVIRA
B.P. UVIRA No 54
B.P. KONGOLO No 96
B.P. KAL. No 527
Ident. Nat. : K 1815 0
B.C.Z. Kin. No 109733.56
B.K. KAL. No 6101731
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N.P./M.L.

Kongolo, le 29 Avril 1982.-

N/R.P.N° 0370/ [illegible]

A Monsieur L. GPIJETL
S/c P.N.S. KONGOLO.-

Monsieur,

BEST AVAILABLE DOCUMENT

CONCERNE : VOTRE VISITE DU LOIS DE LARS A ESTAGRICO.-

Tout d'abord laissez-moi vous remercier pour la façon objective avec laquelle vous avez examiné notre position de consommage manuel et les conseils judicieux que vous nous avez prodigués. -
Nous ferons tout pour les mettre en pratique -

J'ai suivi, avec tout l'intérêt et toute la réserve que requiert pareille demande, votre exposé concernant vos appréhensions de devoir éventuellement transmettre d'ici quelque temps les activités de réhabilitation routière à un opérateur inapte à assurer une continuité du travail dans l'optique prudente ou inconsciente de la valeur de la place cédée -

Vous m'avez dit qu'à première vue, notre société pourrait représenter cette certaine garantie que vous recherchez.
Vous avez [illegible] vos installations à Kongolo (atelier, aires de travail) -
[illegible]

[illegible]

[illegible] permettait de me [illegible] d'activités,

vous [illegible] d'estimation d'utilisation [illegible] toute, une étude [illegible] rédhibilité -

A l'analyse, [illegible] manquais totalement [illegible] rigoureuse et valable à vos [illegible] -

Ne désirant pas [illegible] sens ni dans l'autre, une action [illegible] pection, je vous propose de [illegible] de les étudier et de leur soumettre à notre bureau de I.M.M. Engineering qui se chargera de la réponse -

J'espère que ce projet [illegible] vous [illegible] -

Je vous prie de croire, [illegible], à l'expression de mes sentiments très distingués.-

BEST AVAILABLE DOCUMENT