Road Network Stabilization Program in Ghana

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Over the past two to three decades, road networks in most African countries have expanded more extensively than the respective maintenance budgets and institutional capacities. Consequently, the level of maintenance of the roads has been low. During the same period, there was excessive overloading of the road pavements with axle loads far above pavement design capacities. As a result, large sections of the networks deteriorated rapidly. The experience in Ghana is similar to, or worse than, that of many other African countries. By the beginning of 1988, 30 percent of the trunk (main) roads were in good condition, with 30 percent in fair condition, and 40 percent in poor condition. Expenditure on road maintenance, though substantial relative to the overall national budget, was nevertheless not yielding expected returns. Something had to be done quickly to arrest the situation and save the road network and the economy from imminent collapse. It was postulated that to minimize total transport costs, including expenditures to rehabilitate the roads, a condition mix for the network, as a whole, of 70 percent good, 20 percent fair, and 10 percent poor would be optimal. Taking into consideration budgetary constraints, a practical program for clearing maintenance backlog and stabilizing the network at the optimal condition mix was drawn up for execution in 7 years. The annual budget required to execute the program was found to be two to three times that of the budget at that time. In addition to the introduction by the government of Ghana of the road fund to increase the road maintenance budget, assistance was sought from the World Bank for the execution of the program. Individual road sections to be rehabilitated under the program were selected through engineering and economic studies conducted by local consultants in association with some foreign consultants. Work is being executed through local and international competitive bidding. In spite of initial delay in the start-up of the program, the project is proving to be highly successful.

Road deterioration is a worldwide phenomenon. All new roads, whatever the method of construction or the materials used, deteriorate with time and use. It is the actions taken to contain the situation that make the phenomenon either insignificant or alarming.

A study in 85 developing countries that received World Bank assistance for roads indicated that these countries had a rapid expansion of their road networks during the 1960s and 1970s. Unfortunately, maintenance budgets and institutional capacities did not increase at the same rate. As a result, large road networks, built at great expense, were not adequately maintained (*1*). The situation worsened as vehicles with axle loads far exceeding design capacity used the roads. The combined effect of all these is the rapid deterioration the roads have gone through.

It is estimated that about $90 billion will be required over a 10-year period to reconstruct the failed sections of the roads, to strengthen existing pavements that have been stressed to the limit, and to execute routine and periodic maintenance activities on these roads (*1*). It is predicted that if nothing is done to improve the management of these roads, the eventual repair bill could easily increase two- to three-fold.

The situation in countries in Africa is similar to, or worse than, that of other developing countries elsewhere. Over the last two to three decades, there has been a rapid construction or reconstruction of sections of the road network. By 1985, sub-Saharan Africa had about 130,000 km of paved roads, 355,000 km of gravel roads, and 425,000 km of earth roads and tracks (*2*). For reasons already stated, it has not been possible to keep up the right level of maintenance. As a result, most of these countries have large portions of their networks (usually exceeding 45 percent) in poor condition. The related economic loss to each of these nations is astronomical.

About $15.0 billion will be required to reinstate sections of the network that have deteriorated beyond economic repairs. A further $1.8 billion is required annually for routine and periodic maintenance and pavement strengthening (*2*). Most of these nations can ill afford these heavy expenditures from their dwindling revenue from the exports of their commodities the prices of which keep falling on the world market. A way must be found out of the dilemma to prevent a total collapse of the road transport system, and therefore the economy.

Ghana is no exception. The trunk roads in Ghana consist of 5 782 km of paved roads and 8 352 km of gravel roads, giving a total of 14 134 km. Most sections of the trunk road network were built or reconstructed in the period from the early 1950s to the late 1970s, but have suffered from serious neglect of maintenance subsequently. By the beginning of 1988, about 40 percent of the trunk roads were in poor condition, 30 percent in fair condition, and only 30 percent in good condition. Because of the inadequate maintenance, a great deal of backlog of road rehabilitation has built up that urgently requires to be cleared. In addition, normal routine and periodic maintenance should be executed annually. For several years, funds available for periodic maintenance covered only 20 percent of the estimated needs. A total collapse of road transport is imminent if this trend is allowed to continue.

A collapsed road transport system would inevitably lead to a collapsed economy and this has not been the vision of this nation. It is the vision and hope of the government and the people that Ghanaians would ride on reasonably smooth and safe roads. To achieve this vision, the backlog of maintenance must be cleared and a reasonable level of routine and periodic maintenance must be sustained. This cannot be achieved in 1 year. It has to take place over a reasonable period of time

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and yet not spread out over so long a period as to make it ineffective. The Road Network Stabilization Program is a practical approach towards achieving this vision. The program for clearing the backlog of maintenance until stabilization is reached is described. It is hoped that this will be achieved in 7 years, when normal routine and periodic maintenance will be sustained to keep the network at a reasonable level of service.

ROAD NETWORK IN GHANA

Background

Ghana, a former British Colony (Gold Coast), is located in West Africa between longitudes 1°12′ E and 3°15′ W and latitudes 4°45′ N and 11°11′ N. The nation became independent in 1957 and a republic in 1960. It has an area of 239,000 km^2 and a population of about 13 million (1984) with an annual population growth rate of 2.6 percent. The climate is tropical with temperatures normally ranging between 18°C and 35°C. It has a rolling terrain with hilly areas rising to a maximum of about 880 m. The terrain is generally flat in the south around the capital, Accra, and in the northern part of the country. Annual rainfall varies from about 710 mm around Accra to about 2,180 mm in the western region. Located in the tropical forest zone, farming forms the greatest vocation of the people. Cocoa is the leading export crop; timber follows in third position after minerals. In recent times, the production of grain and pineapple has been on the increase. As its former name (Gold Coast) suggests, Ghana is rich in gold. Other minerals mined include manganese, bauxite, and diamonds. Exploration of crude oil continues and it is hoped that fields yielding commercial quantities will soon be found. Apart from the smelting of alumina to aluminum, the nation's industry is in infancy. Ghana, however, has a great potential for industrial development.

Development of the Road Network in Ghana

Before 1910, practically no motorable roads existed in the country and there was little need for them. Road construction was started seriously at the beginning of the second decade together with the systematic reconstruction, in concrete and steel, of old timber bridges and culverts on the main roads.

The rapid development of roads in the 1920s was slowed down during the great depression of the 1930s. The pace of road construction was quickened again from 1949. At this time, the Public Works Department (PWD) maintained 1,053 km of bituminous-surfaced roads and 3,332 km of gravel roads. This rapid development continued in the 1950s, 1960s, and 1970s. Table 1 shows the growth of the road network in Ghana.

Condition of Present Road Network

The approximately 14,000 km of trunk roads in the country have been classified functionally as primary, major secondary, and minor secondary roads. The classification is not based on traffic but the long-term function the road is expected to perform. Primary roads link up regional capitals, major population centers, and Ghana itself to neighboring countries. They are also corridors for large movement and long-distance journeys. Secondary roads, on the other hand, serve as collectors between the feeder roads and the primary system and provide regional cohesion. Table 2 presents the lengths of roads in the various classes.

TABLE 1 GROWTH OF THE ROAD NETWORK IN GHANA

YEAR	LENGTH OF TRUNK ROADS - KM		
	GRAVEL	PAVED	TOTAL
1949	3,332	1,053	4,385
1953	3,946	1,760	5,706
1955	3,979	2,230	6,209
1960	4,013	3,059	7,072
1965	5,408	3,512	8,920
1970	6,620	4,258	10,878
1975	7,538	4,838	12,376
1980	7,753	5,419	13,172
1985	8,053	5,601	13,654
1989	8,352	5,782	14,134

TABLE 2 LENGTH OF ROADS BY FUNCTIONAL CLASSIFICATION

ROAD CLASS	LENGTH	AVERAGE DAILY TRAFFIC
Primary	3,998 (28%)	100 - 4,000
Major Secondary	4,181 (30%)	100 - 1,000
Minor Secondary	5,955 (42%)	50 - 300

In 1960/1961, resources for road maintenance and rehabilitation were greatly reduced. This, obviously, resulted in reduced maintenance. The situation was worsened when large semitrailer trucks were allowed into the country towards the latter part of the 1960s. Roads that had been deteriorating slowly moved at a quickened pace on the path of deterioration. Even though the desire to solve the problem was high, as far back as the mid-1970s, not much could be done without adequate funding. By the end of 1987, 40 percent of the trunk road network was in poor condition, 30 percent in fair condition, and only 30 percent in good condition. Although the total length of paved roads did not change much, the length of sections with high-level pavement (portland cement and asphaltic concrete) increased more than three-fold from about 150 km in 1985 to about 588 km in 1989. This increase is the result of the reconstruction of roads with high traffic volumes.

Traffic Levels

The levels of traffic on the trunk road network in Ghana are currently not high. As presented in Table 3, the average ADT is less than 1,000 vpd over 76 percent of the paved roads and less than 200 vpd over 78 percent of the gravel-surfaced roads. On most sections, the medium- and heavy-truck traffic accounts for less than 30 percent of total volume and has equivalent standard axle load factors that range from about 1.5 to 3.0. These do not seem exceptionally high in comparison to those in other sub-Saharan countries. However, measurements over the past 2 to 3 years on recently reconstructed roads indicate some excessive overloading of the pavements. Also, the traffic growth on some of these reconstructed roads is far in excess of predicted growth factors.

Pavement Strength

The road pavement in most cases consists of 150 mm of gravel subbase, 150 to 200 mm of gravel base, followed by either a single or double surface dressing. In a few cases, the surfacing is either portland cement concrete or asphaltic concrete. The subgrade strength, as measured by the California bearing ratio (CBR) ranges from 5 to 15 percent on average. These values are fairly suitable for normal pavement construction. In most cases, the pavement structural number (SN) varies from 1.5 to 3.0. The design for gravel roads calls for 150 to 200 mm of well-compacted, good-quality gravel surface. Yet, in many cases this has not been replenished in a long time.

Road Deterioration Cycle

Studies (*1*) conducted in several parts of the world show that new paved roads deteriorate slowly and almost imperceptibly during their first 5 to 10 years, if inadequately maintained. This phase is followed by a phase of increasing deterioration as the road condition changes from good to fair. Without timely intervention, the rate of deterioration becomes even faster, leading to structural failure of the pavement. At this stage, the road is in poor condition. This relationship can be shown as the roughness of the road against time. Gravel roads that are not maintained deteriorate more rapidly and at a fairly uniform rate throughout their life cycle.

In Ghana, it is estimated that with basic routine maintenance including patching of potholes and timely repair of cracks and edge failures, a newly constructed paved road can remain in good condition for about 10 years; thereafter, in fair condition for another 7 years. While it is in fair condition, it can be restored to good condition with a thin overlay or a surface reseal. If no periodic maintenance is performed during this time, the pavement will deteriorate into poor condition. At this time, a total reconstruction or resurfacing of the pavement will be required to restore the road to good condition (see Figure 1). On this basis, and assuming uniform age distribution of the roads, it is conjectured that about 1/10th of the paved roads in good condition will make the transition to fair condition each year and about 1/7th of the roads in fair condition will move to poor condition during the same time. For gravel roads, the corresponding fractions are both assumed to be 1/7th.

TABLE 3 TRAFFIC DISTRIBUTION OVER THE TRUNK ROAD NETWORK

ADT RANGE (vpd)	PAVED ROADS		GRAVEL ROADS	
	KM	%	KM	%
> 3000	142	3	-	-
1000 - 3000	1,207	21	58	1
500 - 1000	1,288	22	380	4
200 - 500	2,039	35	1,441	17
50 - 200	1,030	18	3,409	41
< 50	76	1	3,064	37
TOTAL	5,782	100	8,352	100

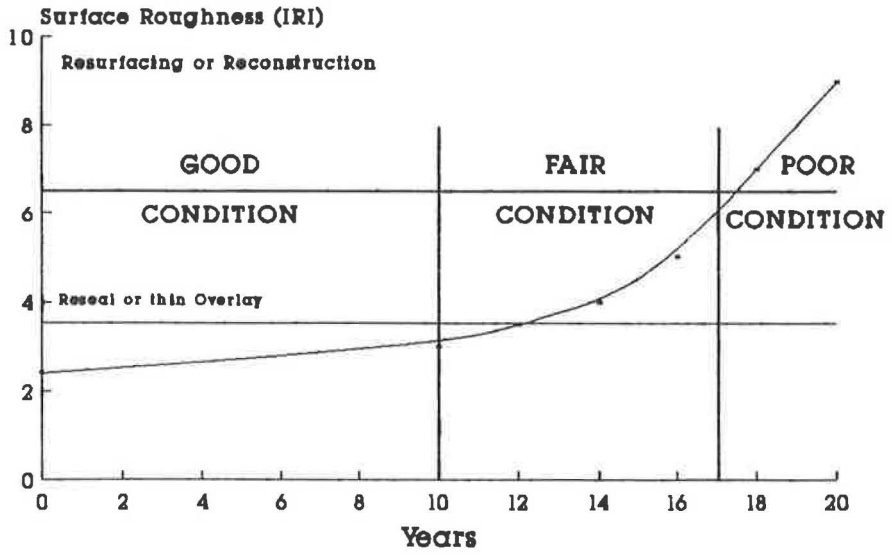

FIGURE 1 Road deterioration phases.

Road Maintenance and Rehabilitation Options

In order to arrest road deterioration, some maintenance and rehabilitation activities have to be carried out. It is assumed that basic routine maintenance will be executed in each case and does not form part of the options. Paved roads in fair condition are normally resealed or a thin overlay applied to bring them from fair to good condition. The estimated cost of the resealing is $22,000 per km. (Incidentally, application of thin overlays on previously surface-dressed roads has presented some problems in recent times in Ghana and is not much favored.)

Roads in poor condition are restored to good condition either through resurfacing or major rehabilitation. In resurfacing, the existing surface is scarified, a new base is laid, and it is then surface dressed. In most cases, sources of failure can be attributed to poor drainage. Some drainage reconstruction, raising or rebuilding of embankment, and minor shoulder repairs are often included in resurfacing operations. The estimated cost for resurfacing varies from $35,000 to $65,000 per kilometer. For the network stabilization program, $50,000 per kilometer was assumed. Where the paved road is badly deteriorated, major rehabilitation or reconstruction is carried out. Activities include major drainage repairs, realignment, and minor earthworks and the construction of new pavements or reconstruction of the pavement. The estimated cost for the major rehabilitation is $250,000 per kilometer.

ROAD REHABILITATION PLAN FOR NETWORK STABILIZATION

Basic Principles

Studies conducted by the World Bank in Kenya, Brazil, and India, and from which the Highway Design and Maintenance Standards Model (HDM) and the Expenditure Budgeting Model were developed, indicate clearly that transportation cost can be minimized if total transport cost of the network (construction cost + maintenance cost + vehicle operating cost) is minimized (*1*). In a road network, this objective is achieved by keeping the roads at an optimal mix of the different conditions of the roads in the entire network.

Even if funds are unlimited, the optimal program is not necessarily to keep 100 percent of the network in good condition at all times. Past studies in other countries (*3*) have shown, for example, that periodic maintenance on the very low-volume paved roads [the average daily traffic (ADT) less than about 200 vehicles per day (vpd)] is difficult to justify economically, particularly under budget constraints. Such roads warrant only routine maintenance including patching of potholes and sealing of cracks until such time as the traffic increases sufficiently to justify pavement reconstruction.

Assumed Optimal Mix

When the rehabilitation plan was being developed in Ghana, not enough data were available to determine the optimal mix for the trunk road network, even though the HDM was available. In the interim, a decision was taken to have a desirable mix consisting of about 9 600 km in good condition, 3 000 km in fair condition, and 1 500 km in poor condition. A breakdown by surface type is presented in Table 4.

Assuming it is planned to stabilize the network to the desirable condition mix presented in Table 4 within a given number of years, the target condition mix to be achieved at the end of each year can be determined by spreading the difference between the existing condition and the desired condition equally over the plan period. The actual length of roads that qualify for periodic maintenance or rehabilitation can then be worked out in each category by taking the difference between the predicted condition mix at the end of the year without maintenance and the target mix to be attained in that year.

TABLE 4 DESIRABLE CONDITION MIX OF THE TRUNK ROAD NETWORK

ROAD TYPE	UNIT	GOOD	FAIR	POOR	TOTAL
Paved	KM	4,282	1,000	500	5,782
	%	74	17	9	100
Gravel	KM	5,352	2,000	1,000	8,352
	%	64	24	12	100
Total Network	KM	9,634	3,000	1,500	14,134
	%	68	21	11	100

Seven-Year Stabilization Program

The selection of the length of period for the stabilization program was dictated primarily by the availability of funds to carry out the program and also by the development of the institutional arrangements for the implementation of the program. It came out that the optimal stabilization period would be 7 years for the paved roads and 5 years for the gravel roads. Table 5 presents the 7-year stabilization program derived in the manner described, except that to fit the physical output to the budget requirements, to build up the major rehabilitation requirements, and to build up the major rehabilitation program slowly over the 7-year period, it was necessary to alter the intermediate target lengths in some years.

Under the plan shown, the gravel road network will stabilize in 5 years. The periodic maintenance needs on the paved network will stabilize in 7 years, during which time the backlog requiring major rehabilitation would also be cleared. As indicated in Table 5, the program requires 918 km of regraveling in 1988, increasing to 1,224 km in 1992, and stabilizing thereafter to 765 km per annum. As more and more roads are added into the good-condition category, resealing needs will increase steadily from 50 km in 1988 to 285 km in 1995 and thereafter, whereas resurfacing needs will decrease from 409 km in 1988 to 83 km in 1995 and thereafter. Major rehabilitation and strengthening of the badly deteriorated roads is planned to increase from 150 km in 1988 to a high of 270 km by 1992 before decreasing to 222 km in 1994 and 60 km annually thereafter (Table 6).

The periodic maintenance expenditure in the first 5 years amounts to $28 million per annum, decreasing to $18.8 million over the next 2 years, before stabilizing at $15.8 million per annum thereafter. Funds required for major rehabilitation increase gradually from $37.5 million in 1988 to $67.5 million in 1992, falling off to $55.5 million in 1994, and to $15 million per annum thereafter.

The portion of the combined network that is in good condition increases steadily from about 30 percent to about 70 percent at the end of the plan period and is kept at that level with funds that are well within the existing maintenance budget. During the same period, the portion of roads in poor condition decreases from about 40 percent to about 10 percent, and the portion in fair condition decreases from 30 to about 20 percent. Figure 2 shows graphically the projected trunk road network condition on the assumptions that the expected maintenance and rehabilitation works under the program are carried out fully each year and that no significant expansion of the network takes place through new construction during this time.

With increased budgetary allocations, the backlog of road maintenance could be cleared and the network stabilized in 5 years (Table 7). Even though there is the advantage of the network stabilizing in a shorter time, the nation would be saddled with heavy expenditures during the first 3 years (additional $39 million compared to the 7-year program).

The 7-year option builds up gradually over the first 3 years at budgetary levels within the reach of the government of Ghana and projected World Bank [International Development Association (IDA)] credit. One other advantage is that the institutional and construction capacities would have built up gradually to a maximum by 1992, using both local and external contractors, with the latter being phased out by the time the network is stabilized.

Though the 10-year program would require even less annual outlays, yet considering the delay in economic returns for the investment this may not be the optimal economic solution. The expenditure profiles for the three options are shown in Figure 3.

Stabilization Program with Inadequate Funds

If funds are not made available to embark on the accelerated program of clearing the backlog as stipulated, then it can be shown that with only the current committed level of funding (approximately $16 million for periodic maintenance and $25 million for major rehabilitation), it would take about 20 to 30 years to accomplish the same task of stabilizing the network to the desired condition mix. This effect is shown in Figure 4.

IMPLEMENTATION OF THE PROGRAM

The first phase of the Road Network Stabilization Program is being implemented by the Ghana government with World Bank (IDA) support under a Transport Rehabilitation Project (TRP–1). The project, originally planned for execution in 1988 and 1989, is likely to extend into 1991.

TABLE 5 NETWORK STABILIZATION PLAN (1988 THROUGH 1995) AND PROJECTED ROAD CONDITIONS

YEAR	ITEM	PAVED (5782 km)			MAJOR REHAB	GRAVEL (8352 km)			TOTAL COST (mn $)	
		GOOD	FAIR	POOR		GOOD	FAIR	POOR	PER.MTC.	MAJ.REH.
1988	Starting Position	1,593	1,236	2,953		2,672	2,989	2,691		
	Percent Distribution	28	21	51		32	36	32		
1989	Without 1988 M&R Prog.	1,434	1,219	3,130		2,290	2,944	3,118		
1988	Expected M&R Prog.	609	-50	-409	-150	918	-153	0	28.0	37.5
1989	With 1988 M&R Prog.	2,043	1,169	2,571		3,208	2,791	3,118		
	Percent Distribution	35	20	44		35	31	34		
1990	Without 1989 M&R Prog.	1,839	1,206	2,738		2,750	2,851	2,752		
1989	Expected M&R Prog.	644	-104	-375	-165	994	-257	-737	28.0	41.3
1990	With 1989 M&R Prog.	2,483	1,102	2,198		3,744	2,594	2,015		
	Percent Distribution	43	19	38		45	31	24		
1991	Without 1990 M&R Prog.	2,234	1,193	2,355		3,209	2,758	2,385		
1990	Expected M&R Prog.	680	-150	-345	-185	1,071	-361	-710	28.0	46.3
1991	With 1990 M&R Prog.	2,914	1,043	1,825		4,280	2,397	1,675		
	Percent Distribution	50	18	32		51	29	20		
1992	Without 1991 M&R Prog.	2,623	1,186	1,974		3,668	2,666	2,018		
1991	Expected M&R Prog.	710	-160	-330	-220	1,147	-467	-680	28.0	55.0
1992	With 1991 M&R Prog.	3,333	1,026	1,424		4,815	2,199	1,338		
	Percent Distribution	58	18	25		58	26	16		
1993	Without 1992 M&R Prog.	3,000	1,212	1,571		4,128	2,573	1,652		
1992	Expected M&R Prog.	777	-212	-295	-270	1,224	-572	-652	28.0	67.5
1993	With 1992 M&R Prog.	3,777	1,000	1,006		5,352	2,001	1,000		
	Percent Distribution	65	17	17		64	24	12		
1994	Without 1993 M&R Prog.	3,399	1,235	1,149		4,587	2,479	1,286		
1983	Expected M&R Prog.	650	-235	-165	-250	765	-479	-286	18.8	62.5
1994	With 1993 M&R Prog.	4,049	1,000	734		5,352	2,000	1,000		
	Percent Distribution	70	17	13		64	24	12		
1995	Without 1994 M&R Prog.	3,644	1,262	876		4,587	2,479	1,286		
1994	Expected M&R Prog.	637	-262	-153	-222	765	-479	-286	18.8	55.5
1995	With 1994 M&R Prog.	4,281	1,000	501		5,352	2,000	1,000		
	Percent Distribution	74	17	9		64	24	12		
1996	Without 1989 M&R Prog.	3,853	1,285	644		4,587	2,479	1,286		
1995	Expected M&R Prog.	428	-285	-83	-60	765	-479	-286	15.8	15.0
1996	With 1989 M&R Prog.	4,281	1,000	501		5,352	2,000	1,000		
	Percent Distribution	74	17	9		64	24	12		
1996	Expected M&R Prog.	428	-285	-83	-60	765	-479	-286	15.8	15.0

M&R - Maintenance and Rehabilitation

Engineering Study and Design

Four local consultants in association with foreign firms were engaged to study the road network and to determine the nature of periodic maintenance required on the various sections of the network and to order the anticipated projects by priority. The country was divided into four geographic zones and each consultant was assigned one zone to study. Table 8 presents the road lengths studied.

The data gathered included information on road characteristics, pavement condition, properties of materials, traffic volumes and distribution, etc. The major component of economic benefits was taken as the reduction of vehicle operating costs (VOCs). The World Bank's vehicle operating cost submodel was used to derive the VOCs as a function of road roughness and topography for seven different types of vehicle in Ghana. These were then supplied to all four consultants for use in their economic analysis.

From data collected, maintenance activities to be executed were determined and plotted on line diagrams. Work quantities were estimated for each type of activity and extended to cost.

TABLE 6 SEVEN-YEAR NETWORK STABILIZATION PLAN (km)

YEAR	RESEALING	RESURFACING	REGRAVELLING	TOTAL PERIODIC MTCE	MAJOR REHAB	TOTAL COST	
						PER. MTCE	MAJ. REH.
1988	50	409	918	1,377	150	28.0	37.5
1989	104	375	994	1,473	165	28.0	41.3
1990	150	345	1,071	1,566	188	28.0	46.3
1991	160	330	1,147	1,637	220	28.0	55.0
1992	212	295	1,224	1,731	270	28.0	67.5
1993	235	165	765	1,165	250	18.8	62.5
1994	262	153	765	1,180	222	18.8	55.5
1995	285	83	765	1,133	60	15.8	15.0
1988-89 TRP-1	154	784	1,912	2,850	315	56.0	78.8

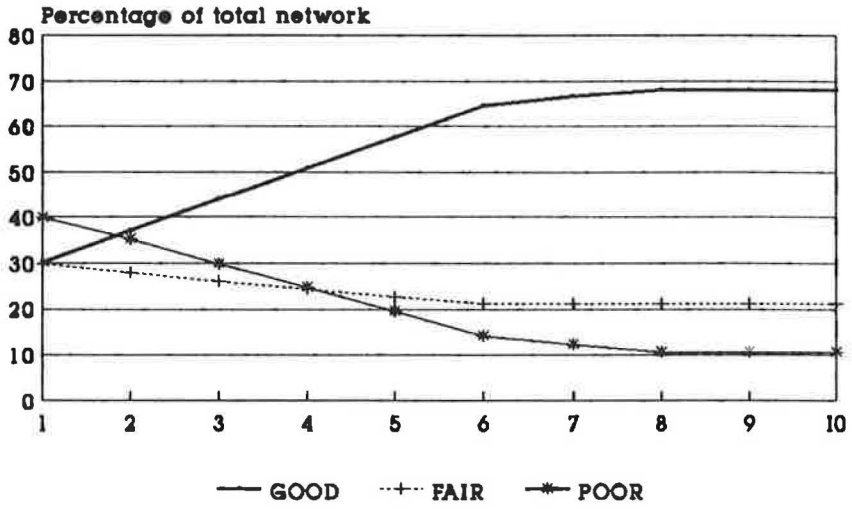

FIGURE 2 Projected network condition with accelerated stabilization program.

Priority Rating of the Works

From the Benefit and Cost streams, the Net Present Value (NPV) and Economic Rate of Return (ERR) were determined for each road section. Table 9 presents the result of the economic analysis for Eastern Region in Zone 4. High priority was assigned to projects with high ERR values, with 15 percent as the cut-off point.

Executing the Program

Tender documents were prepared in packages suitable for local competitive bidding (LCB) as well as international competitive bidding (ICB). The LCBs were valued at less than about $0.5 million each, whereas the ICBs were valued at around $5.0 million each. For TRP–1, there were three phases of LCB and one phase of ICB. Tables 10 and 11 show packaging for LCB Phase 2 and ICB Phase 1, respectively, for Zone 4.

LCB Phase 1 projects were put to tender in June 1988 and awarded for execution towards the end of 1988. By the end of 1989, most of the works had been completed. LCB Phase 2 projects were awarded toward the middle of 1989 and are expected to be completed in 1990. With the scarcity of funds, LCB Phase 3 projects were delayed. A portion of the Phase 3 projects was being awarded in early 1990 and the remainder will be awarded towards the end of 1990 for execution in

TABLE 7 COMPARISON OF NETWORK STABILIZATION PLANS (COMBINED PERIODIC MAINTENANCE AND MAJOR REHABILITATION)

YEAR	FIVE YEAR PLAN		SEVEN YEAR PLAN		TEN YEAR PLAN	
	LENGTH km	ANNUAL EXPENDITURE Mn$	LENGTH km	ANNUAL EXPENDITURE Mn$	LENGTH km	ANNUAL EXPENDITURE Mn$
1988	1,700	73	1,527	66	1,320	42
1989	1,840	80	1,638	69	1,410	50
1990	1,971	95	1,754	74	1,460	56
1991	1,820	83	1,857	83	1,510	59
1992	2,097	83	2,001	96	1,555	61
1993	1,193	31	1,415	81	1,620	67
1994	1,193	31	1,402	74	1,605	69
1995	1,193	31	1,193	31	1,480	64
1996	1,193	31	1,193	31	1,323	44
1997	1,193	31	1,193	31	1,243	35
1998	1,193	31	1,193	31	1,193	31

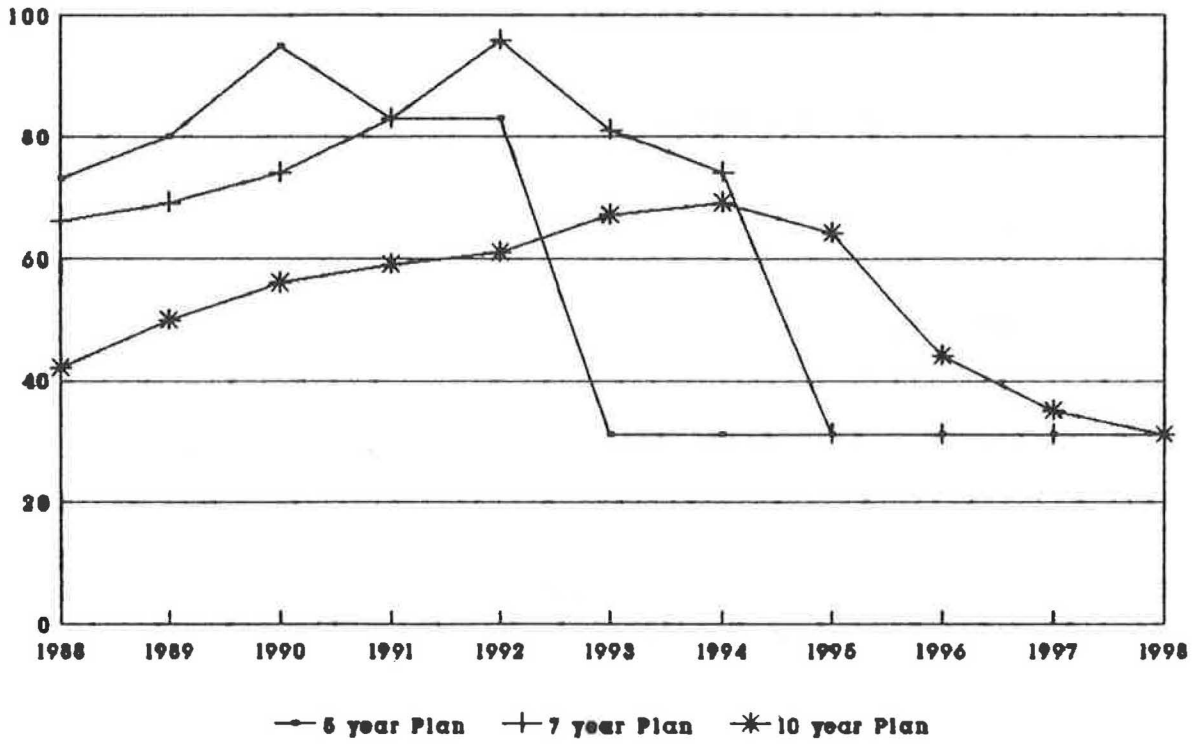

FIGURE 3 Comparison of annual expenditure for alternative programs.

1991. ICB projects were put to tender in 1989 and are undergoing various stages of approval. Work expected to start from January 1990 may now start from July 1990 for completion by the end of 1991.

Funding of the Program

As derived, the program called for almost two- to three-fold increase in the annual budget allocation for periodic maintenance of trunk roads made to Ghana Highway Authority in 1986 and 1987. With the first 2-year slice of the program estimated at $56.0 million, external funding was required. Under the Transport Rehabilitation Project (TRP-1), IDA pledged $26.2 million for the program. Some cofinancing expected under the project did not materialize. Ghana Government is therefore financing the balance from a road fund and the consolidated fund of the central budget.

As a result of this and other factors, the project could not fully start in 1988 as projected. Secondly, it is being spread over 3 years as against the original 2-year period. Table 12 shows the expenditure plan for the 3-year period.

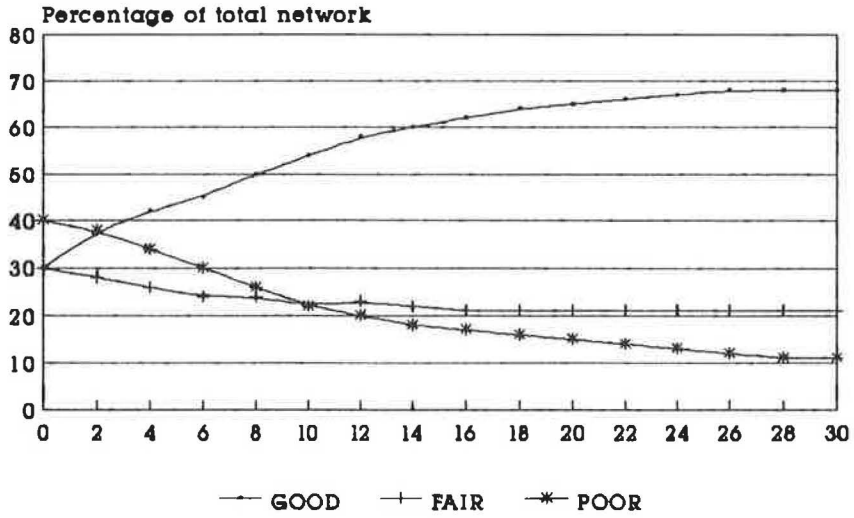

FIGURE 4 Projected network condition without accelerated stabilization program.

TABLE 8 LENGTHS OF ROADS ASSIGNED TO CONSULTANTS FOR STUDY

ZONE	REGIONS	LENGTH OF ROADS STUDIED		
		PAVED	GRAVEL	TOTAL
1	Northern Upper East Upper West	222	1,061	1,283
2	Ashanti Brong Ahafo	509	605	1,114
3	Central Western	356	616	972
4	Eastern Greater Accra Volta	609	362	971
TOTAL		1,696	2,644	4,340

The government of Ghana intends to double proceeds from the road fund in 1990 to ensure that the execution of the program does not deviate completely from the plan.

Technical Assistance

Because clearance of the backlog represented a significant increase in the workload handled by the Ghana Highway Authority, the World Bank–aided project included a technical assistance component that provided key personnel in the areas of project management, planning, and maintenance supervision. With the training of counterparts in these areas and with the provision of logistics support, the respective units of the Ghana Highway Authority are being strengthened, such that the Authority would be able to plan and execute successfully similar and complementary projects in the future. Under the same project, advisory, training, and financial services are being provided also to the local contractors, to enable them to bid competitively and to procure necessary construction equipment. The planned program for 1988/1989 is expected to be achieved by the middle of 1991, at which time plans will also be finalized for implementation of the next 2 or 3 years' program under a Transport Rehabilitation Project, Phase 2 (TRP–2).

Two Years of Network Stabilization Program

Even though the Network Stabilization Program did not take off fully, as expected in 1988, some periodic maintenance works were executed by local contractors and the Mobile Maintenance Unit of Ghana Highway Authority. Totals of 660 km of regraveling, 93 km of resealing, and 82 km of

TABLE 9 TRUNK ROAD MAINTENANCE STUDY FOR EASTERN REGION ROAD NETWORK STABILIZATION: GENERAL SUMMARY, ZONE 4, EASTERN REGION

NO.	ROAD NAME	Surf Type	Length (km)	1988 ADT	Gen ADT	Cond Rating	Proposed Mtce (km) Regrav	Reseal	Resurf	Misc	Est Cost (m¢)	Cost/ km (m¢)	NPV @ 15%	NPV Cost	ERR %
	EASTERN														
5	Koforidua-Asesewa	P	45.9	378	-	V. Good		4.3	41.6		260.6	5.7	934.0	3.6	69
6	Nkurankan-Adukrom-Tron	P	36.5	488	48	V. Good		20.7	13.8		122.4	3.4	849.8	6.9	175
7	Tron-Somanya-Kpong	P	16.1	1503	-	V. Good		1.8	14.3		80.9	5.0	1309.8	16.2	391
8	Manfe-Akropong-Adukrom	P	10.9	567	-	Fair		8.9	2.0		67.1	6.2	69.2	1.0	32
9	Koforidua-Adawso-Manfe	P	32.1	752	-	Fair		10.8	21.3		217.0	6.8	718.9	3.3	56
10	Adoni-Asikuma	P	26.3	999	-	Poor		22.8	3.5		90.1	3.4	782.8	8.7	160
11	Adoni-Akosombo	P	9.5	838	-	Fair			9.5		67.6	7.1	227.7	3.4	56
12	Somanya-Akuse-Asutuare	P	24.0	663	-	Poor		8.6	15.4		64.3	2.7	957.7	14.9	227
13	Tema-Kpong-Adoni	P	65.4	1942	-	Fair		54.3	11.1		229.9	3.5	3541.3	15.4	170
14	Aburi-Dodowa	P	19.9	1499	-	Fair		12.6	7.3		84.8	4.3	519.9	6.1	107
15	New Tafo-Bunso	P	18.2	324	164	V. Poor		1.2	17.0		119.9	6.6	395.6	3.3	89
16	Adeiso-Asamankese	P	25.3	301	76	Poor			25.3		198.9	7.9	268.9	1.4	35
17	Asamankese-Kede	P	40.0	332	83	Poor		2.7	37.3		231.7	5.8	589.1	2.5	67
18	Manso-Osenase	P	19.5	178	45	Poor			19.5		98.9	5.1	157.8	1.6	39
19	Akim Oda-Manso	P	11.4	1624	-	Fair		9.1	2.3		59.4	5.2	423.4	7.1	95
20	Akim Oda-Achiase-Amanfopong	P	13.5	502	-	Fair		5.9	7.6		100.0	7.4	695.5	7.0	113
21	Akim Oda-Ofoase-Ntornang (a)	P	15.5	483	-	Poor			15.5		86.2	5.6	339.7	3.9	98
22	Akim Oda-Ofoase-Ntornang (b)	U	46.2	50	13	Poor	46.2				108.2	2.3	9.6	0.1	17
23	Nkawkaw-Ntronang	U	26.6	89	23	Poor	26.6				55.0	2.1	81.1	1.5	38
24	Anyinam-Abodom	U	43.3	79	20	Poor	43.3				103.0	2.4	91.6	0.9	31
25	Kwaben-Abonaso-Asuom	U	19.8	51	14	V. Poor	19.8				48.0	2.4	10.6	0.2	20
26	Kade-Asuom	U	19.1	102	-	Fair	19.1				37.1	1.9	68.4	1.8	41
	Regional Sub-total		**585.0**				**155.8**	**163.7**	**264.3**	**0.0**					

TABLE 10 GHANA HIGHWAY AUTHORITY, PLANNING DIVISION, TRUNK ROAD MAINTENANCE BY CONTRACT—SUMMARY OF LCB PHASE 2, ZONE 4, JUNE 30, 1989

NO.	ROAD NAME/(Section)	Lot Nos	Surf Type	Length (km)	Proposed Mtce (km) Regrav	Reseal	Resurf	Misc	Est Cost (m¢)	Remarks
	GREATER ACCRA									
9	Sege-Mepe	1,2	U	27.0	13.8		11.2	2.0	96.3	Awarded
10	Kaseh-Ada (10-21)	3	P	11.4		11.4			62.8	Awarded
11	Doryumu-Ayikuma (8-12)	4	P	3.6		3.6			11.4	Awarded
	Regional Sub-total			**42.0**	**13.8**	**15.0**	**11.2**	**2.0**	**170.5**	
	EASTERN									
12	Anyinam-Abodom	1	U	43.3	43.3				100.5	40% Complete
13	Asamankese-Kade	2,3,4	P	40.0		2.7	37.3		300.9	10% complete
14	Adeiso-Asamankase	5,6	P	25.3			25.3		206.8	22% complete
	Regional Sub-total			**108.6**	**43.3**	**2.7**	**62.6**	**0.0**	**608.2**	
	VOLTA									
15	Kpando-Tokor	1	U	4.5			0.6	3.9	47.4	Awarded
16	Dabala-Srogbe	2	P	8.4		6.2	2.2		149.5	Negotiation
17	Kpando-Gbefi-Golokwati	3	U	6.8		1.3		5.5	70.0	Awarded
18	Akatsi-Wute-Ziope	4	U	28.3	28.3				65.4	Awarded
	Regional Sub-total			**48.0**	**28.3**	**7.5**	**2.8**	**9.4**	**332.3**	

Exchange rate (Oct.'88): $1.00 = Cedis 229.

TABLE 11 GHANA HIGHWAY AUTHORITY, PLANNING DIVISION, TRUNK ROAD MAINTENANCE BY CONTRACT—SUMMARY OF ICB PHASE 1, SEPTEMBER 15, 1989

NO.	ROAD NAME/(Section)	Region	Surf Type	Length (km)	Proposed Works (km) Regrav	Reseal	Resurf	Misc	Expected Cost ($) FC(m$)	LC(m$)	Total($)
	LOT NUMBER 1										
1	Adomi-Asikuma	Eastern	P	26.3		22.8	3.5				
2	Adomi-Asikuma	Eastern	P	9.5			9.5				
3	Ho-Denu	Volta	P	102.5		31.4	71.1				
4	Ho-Anyinawase	Volta	P	19.4		11.8	7.6				
5	Asikuma-Anyinawase	Volta	P	24.0		19.6	4.4				
	Subtotal (Lot 1)			**181.7**	**0.0**	**85.6**	**96.1**	**0.0**	**3.3**	**980**	**1,870**
	LOT NUMBER 2										
1	Koforidua-Asesewa	Eastern	P	45.9		4.3	41.6				
2	Nkuraken-Adukrom-Tron	Eastern	P	36.5		20.7	15.8				
3	Tron-Somanya-Kpong	Eastern	P	16.1		1.8	14.3				
4	Nanfe-Akropong-Adukron	Eastern	P	10.9		8.9	2.0				
5	Koforidua-Adawso-Nanfe	Eastern	P	32.1		11.0	21.1				
6	Adomi-Kpong	Eastern	P	10.0		1.6	8.4				
	Subtotal (Lot 2)			**151.5**	**0.0**	**48.3**	**103.2**	**0.0**	**3.2**	**996**	**1,853**

resurfacing were completed. Also, about 98 km of major rehabilitation works was completed. In 1989, 1 143 km of regraveling, 13 km of resealing, 115 km of resurfacing, and 64 km of major rehabilitation works were completed. The effect of these works on the road condition is presented in Table 13, which fits the 10-year Network Stabilization Plan (Table 7) a lot more than the 7-year plan.

Although the condition of paved roads remained virtually static, there were vast improvements in the condition of gravel roads. It is observed that regraveling is being executed mainly by LCB contractors, whereas resealing and resurfacing are to be executed predominantly by ICB contractors. The current position is therefore explained by the fact that ICB contracts have delayed considerably.

CONCLUSION

After publication of the World Bank's policy study on *Road Deterioration in Developing Countries* (*1*), Ghana is perhaps the first country that has addressed itself to the need for developing a practical program for clearing the backlog of road maintenance and preventing further loss of the valuable investments made in its infrastructure.

The program is developed in such a way that the backlog of maintenance will be cleared on the gravel roads in 5 years and on the paved network in 7 years. The portion of the network in good condition will improve from about 30 to 70 percent, whereas at the same time the portion in poor condition will reduce from 40 to about 10 percent in 7 years. The maintenance expenditure required thereafter will stabilize to within manageable levels annually to maintain the network at the desirable condition level. The program is in its second year of implementation and is already proving to be highly successful.

The key elements of the program that have made it successful so far may be identified as follows:

1. The program is spread over a realistic time period and takes into account the continuing deterioration of the roads during this period.
2. Although the funds required for implementing the program are greater than past allocations under government budget, they are not unrealistically high with external financing. In addition, the plan is accompanied by a doubling of local funds and a commitment by government to leave the project intact in its current and future public investment programs.

TABLE 12 GHANA HIGHWAY AUTHORITY, 1989 THROUGH 1991 PERIODIC MAINTENANCE EXPENDITURE PLAN (million cedis)

ITEM	TOTAL	1989					1990					1991				
		1st Q	2nd Q	3rd Q	4th Q	Total	1st Q	2nd Q	3rd Q	4th Q	Total	1st Q	2nd Q	3rd Q	4th Q	Total
Works already Awarded:																
On-going works ('88)	48	12	36			48										
LCB Phase 1	2,914	600	758	934	622	2,914										
LCB Phase 2	2,215	36	56	106	531	729	531	531	106	318	1,486					
Planned Awards:																
LCB Phase 3 (a)	1,864				460	460	460	460	84	400	1,404					
LCB Phase 3 (b)	4,900						700	700	350	700	2,450	700	700	350	700	2,450
LCB Phase 4	4,250											1,275	1,275	425	1,275	4,250
	200	20	20	40	120	200										
Other Works (c):																
1990	3,684						1,105	1,105	369	1,105	3,684					
1991	3,800											1,140	1,140	380	1,140	3,800
ICB Phase 1 (d)																
For. Comp.	6,069						1,524	909	615	909	3,957	909	909	294		2,112
Loc. Comp.	4,460						1,115	669	446	669	2,899	669	669	223		1,561
GRAND TOTAL (Cm)	34,404	668	870	1,080	1,733	4,351	5,435	4,374	1,970	4,101	15,880	4,693	4,693	1,672	3,115	14,173
For. Comp. ($m)	22.7	0	0	0	0	0	5.7	3.4	2.3	3.4	14.8	3.4	3.4	1.1	0.0	7.9
Loc. Comp. (Cm)	28,335	668	870	1,080	1,733	4,351	3,911	3,465	1,355	3,192	11,923	3,784	3,784	1,378	3,115	12,061
Financing Plan:																
Balance from 1988	734	261	449	24		734										
World Bank/IDA (e):																
For. Comp. ($m)	22.7						5.7	3.4	2.3	3.4	14.8	3.4	3.4	1.1	0.0	7.9
Loc. Comp. (Cm)	1,566	157	161	256	933	1,507	59				59.0					
Road Fund	7,610	250	260	800	800	2,110	625	625	625	625	2,500	750	750	750	750	3,000
Funding Gap (Budget Topping Up)	18,484	0	0	0	0	0	3,227	2,840	730	2,567	9,423	3,034	3,034	628	2,365	9,061

Notes: (a) Amount already tendered: CM 1715 and ready for tendering : CM 149
(b) To be tendered November 1989 and June 1990
(c) Consists of Improvement; drainage; town roads, bridge maintenance works and MMU
(d) ICB Lot 9 (Tamale - Makango Rd. and Tamale town roads) not included
(e) Balance to IDA 1858: $24.5m + credit 1601: $4.0m

TABLE 13 EFFECT OF 1988 AND 1989 WORKS ON ROAD CONDITION

YEAR	ITEM	PAVED 5782			MAJOR REHAB	GRAVEL 8352		
		GOOD	FAIR	POOR		GOOD	FAIR	POOR
1988	Starting Position	1,593	1,236	2,953		2,672	2,989	2,691
	Percent Distribution	28	21	51		32	36	32
1989	Without 1988 M & R	1,434	1,221	3,127		2,290	2,944	3,118
1988	Actual M & R	273	-93	-82	-98	660	-110	-550
1989	With 1988 M & R	1,707	1,128	2,947		2,950	2,834	2,568
	Percent Distribution	30	20	50		35	34	31
1990	Without 1989 M & R	1,536	1,138	3,108		2,529	2,850	2,973
1989	Actual M & R	193	-13	-115	-64	1,143	-296	-847
1990	With 1989 M & R	1,728	1,125	2,929		3,672	2,554	2,126
1985	Percent Distribution	30	19	51		44	31	25

3. The World Bank–financed project includes a technical assistance component that helps fill the gaps in skilled manpower required in the Ghana Highway Authority for the implementation of the project.
4. Local consultants are being used and the local construction industry is being developed and strengthened under the project.
5. About 90 percent of periodic maintenance is by contract and awarded on the basis of competitive bidding.
6. The project is being closely monitored and supervised by the Ghana Highway Authority with the assistance of local and foreign consultants.

Some events at the implementation stage contributing to delay include

1. Lack of cofinancing, and
2. Long contract award process for ICB contracts.

As a result of these, the 1988/1989 project has shifted to 1989 through 1991 and the network is likely to stabilize in 10 years instead of 7 years as originally planned.

The condition of gravel roads has improved according to plan because these have been executed on a timely basis by local contractors. Because of the delay in executing ICB contracts (mainly on paved roads), there has been no improvement in the road condition of paved roads.

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