Approach to Rural Road Prioritization for Maintenance by LGED: A Case Study of Phultola Union, Khulna

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Abstract

Rural roads are the last link of the transport network that fulfils demand of the product all over the country. Roads have to be maintained from time to time for ensuring serviceability. The study conducted on the Road Maintenance Branch of LGED. The objectives of the study are to investigate current road maintenance practice in LGED through interviews, questionnaires from the LGED staff and other people involved in road projects. It is found that building new roads cost lots of money, but without maintaining the roads properly, they deteriorate very quickly. The problems faced during the road maintenance are selection of road with priorities for maintenance where allocation of funding is very limited. They usually select roads for maintenance based on road IRI (International Roughness Index) value and hierarchy of roads. For example, maintain Upazila roads first which have higher IRI value then union roads. As a result, some village roads which are more important than Upazila roads are not maintained and other Upazila roads not in use for any traffic. According to LGED, per km road maintenance cost is about one third of the total road construction cost. So, it is not logical to allocate fund to those unimportant roads, where important roads are still not maintained. In this regard, four factors (road maintenance cost, road type, and settlement hierarchy and traffic volume) are considered for selection of priority road for maintenance. This may help to proper utilization of money. Settlement hierarchy is determined by centrality score, where fifteen settlements in Phultola Union are ranked based on demographic factors, service, facilities, public utilities, infrastructure and resource information. Road maintenance cost are calculated based on IRI value, where road repairing cost per km based on IRI value known to LGED officials is multiplied by total road length. The data is also analysed using a weight index method to obtain the result. From the result, it is found that 45% village road type A (Pucca) and 35% village road type B (Pucca) are given more weight than Union road.

Introduction

An efficient transportation system can add new dimension to development of a country. In order to increase efficient transportation system, it is necessary for all countries to have a transport policy, to implement such policy it is imperative to take care of the investment in road construction and maintenance. Good maintained of roads improve access between regional and rural communities. The objectives of the research are to

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study the existing road maintenance management system in the LGED that also help to identify common problems they faced during road maintenance, and to propose a new approach for improving road maintenance management system for LGED.

Most of the rural roads in Bangladesh were under responsibility of Department of LGED. Maintenance of road was directly under Branch of Road Maintenance. From the statistic of complaint from the road user is 70% on road defect or failure of the road after two or three years in road construction or maintenance. (Ahmed, 2005:8)

Derek et al (1986) described three main problems in maintenance which are inadequate financial, bad management, and poor design. (Rahman, 2013:10)

According to perception of the LGED officers, limitation of funds is the main problems in road maintenance. The second problem is no controlling high weight vehicle. As a consequence, road is frequently damaged. The third problem is bad management, which could be interpreted as idleness and waste among the maintenance personnel

The design also part of the problem in maintenance. It is important to give more attention to decide which materials and elements should use.

From the above problem, the LGED spend more money maintain and repair the road. But which road is given priority first, they cannot properly determine. So, from the study about road maintenance management system, it will help the LGED how to properly use the budget for maintenance.

Study Area

For the present study, one union was selected as a test case of for the methodology. For convenience of the research, Phultola Union of Khulna District was chosen. As LGED activity in rural area almost same in every Upazila. However, it is also a rural union of Bangladesh and therefore, the methodology may be applied for any similar rural area of the country. It has 15 villages and 16851 populations. Five types of road are existed that are shown on the map. It has 4 Mouza and 3686 acre area. Most of the land is agricultural land.

Literature Review

In order to understand the theoretical background about Road Maintenance Management System literature review was conducted through the journals, books, references, internet and articles. And the review was related to aims and objectives of the study.
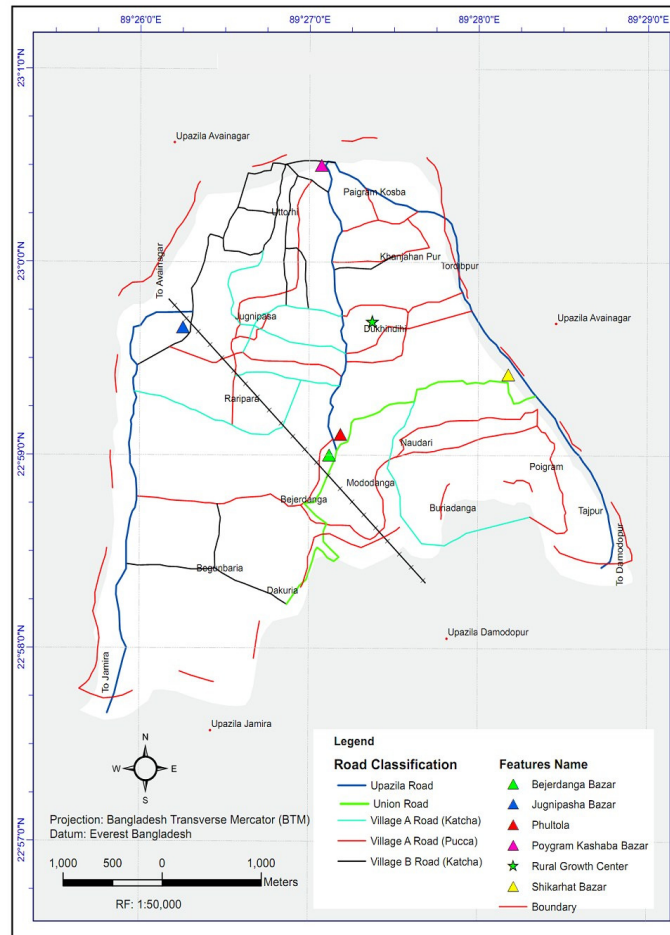
Source: Prepare by GIS
Fig. 1: Map of the Study Area

Road Maintenance Management Process

The objective of the road maintenance management process is to maintain more roads with least cost that ensure benefit of a society. (Tillotson, 1996:220-227). From their study, the main factors needed in road maintenance management process may be summarized as follows

Inventory: The purpose of the inventory data is to establish what there is to be managed and where it is located;

Condition: The condition of a road needs to be measured or assessed with sufficient precision to enable the need for repair or replacement to be established within a framework of priorities;

Traffic: The purpose of the road network is to carry traffic. The amount of traffic on a particular road is an important factor for establishing priorities for repair or replacement. The amount of traffic also contributes to deterioration;

Deterioration: All roads deteriorate. It is the rate at which deterioration will take place that needs to be understood as an essential element of a long-term road maintenance strategy;

Costs and benefits: These are the basis of prioritization within a road management system that aims to maximize benefits to society rather than respond to political pressures; Resources*:* We defined these to be the physical constraints including people and their abilities together with the equipment and materials;

Budget: This provides the financial constraint that limits repairs and replacements.

Standards and policies: These reflect the long-term plans and will be developed by predicting the future network condition in response to different budgets, different traffic predictions and different standards and policies; and

Management information: Effective decision-making and subsequent audit depend upon the quality of information. All the information involved in the various components of the system

must be readily available and in appropriate form for each of the management functions (Wahida, 2010:23)

Problems and Issues in Road Maintenance

The implications of this lack of maintenance are severe. In the first place it means that the enormous investments in capital assets that a country has placed in its rural road network are sometimes deteriorating faster than roads are being rehabilitated.

An objectively based priority program to provide justification for budget requests.

Improving Road Maintenance Management System

A properly implemented Computerized Maintenance Management System (CMMS) can serve as a powerful management tool. A systematic approach to maintenance management is needed for several reasons:

• Provide information on the current state of pavements and forecast future condition.
• Give objective alternatives for maintenance policies.
• Provide a sound basis for resource allocation and optimal use of funds.
• Increase the effectiveness of management and provide savings in expenditure.
• Provide an objective, rapid and repeatable system for decision making. (expert, 1995:33)

Methodology of the Study

At first selecting road based on questionnaire survey of the officers and staffs of the LGED member, four factors are considered in this study.

• Road Maintenance Cost
• Hierarchy of the Settlement
• Average Annual Daily Traffic Volume (AADT)
• Road Type

Then for determine the hierarchy Fifteen settlement in Phultola Union are ranked based on Demographic factors, Service, facilities, public utilities, infrastructure and resource information.

After that two types of data are collected in this study. One type of data are for determine centrality of the settlement and other are road inventory data. First type of data included several factors that help to determine centrality of settlement which are collected from Upazila Information, Planning and Budget Book December, 2014 and another is collected from LGED office of Phultola Upazila.

One of its primary data and the collection of firsthand information from the target audience. The data collection can be done through two methods as follows:

A questionnaire can be drawn up and distributed to the target personnel to obtain the required data. In this study, 10 of questionnaires were distributed to those who are involved in maintenance activities at LGED. This main purpose is to identify problem and improving the RMMS. Question asked should focus on matters related to objectives.

Interview method was used to clarify the data obtained from archives and questionnaires. This step is important to further understand the maintenance process of works in LGED. Interviews were held with maintenance officers of Department Of Maintenance, LGED.

Another is Secondary data that are obtained through LGED website, Bangladesh Bureau of Statistics, Upazila Information, Planning and Budget Book and road inventory data are collected by using RSDMS-VI data base of LGED.

After that to collect all of the data and in order to determine hierarchy of the settlement, data were analysed in terms of the socio economic characteristics of the settlement. After hierarchy of the settlement were calculated it in corporate road inventory data. Based on expert survey road repairing cost, settlement score, road type and traffic volume were weighted in between 1 to 5. After the weightage, this four factor are multiplied in percentage of importance given by LGED officers and staffs.

Finally, result is summation of all four factors and it was between 1 to 5. More is score, more it's important. It was presented in Map. Where it was also found that some village road are more weight than union road therefore research satisfy the objectives

Existing Road Maintenance Management System at LGED

- LGED conducts road maintenance in 4 years interval. Several road data are accumulated and stored. Then decision to maintenance.

- Road maintenance budget is allocated based on road condition survey. Budget is allocated first in District. Then allocated district budget is gone to concern Upazilla then union based on need assessment report of road maintenance.

- They prioritize the road maintenance based on road IRI (International Roughness Index) value if required then detailed survey is conducted.

Table 1: Road treatment based on IRI

Road IRI	Treatment
5-10	Continue
11-12	Reseal
>12	Rehab

Source: Interview of LGED Staffs, June 2015

- Detail estimate is conducted based on road condition and sent it to head quarter. Head quarter of LGED is approved the budget after the field verification of their officials.

- They used their own GoB funds as well as other international organization such as Word Bank, ADB, and KFW.

Data Analysis and Interpretation

Determination of Settlement Hierarchy

This calculation analysis and find out village wise scenario. Total 15 settlements are existed in this area. Their ranks are determined as follows.

Every service facility, utility, commerce, features etc. is divided into two groups. They are: 1.Main group 2. Sub-group. For example, region is a main group and its sub-groups are mosque, temple, shoashnaghat, graveyard etc.

Each main group is weighed from 1 to 5 and sub-groups are given scale according to the highest weight of the main group like given weight of each region is 4 and sub-groups are weighted according to the main group's weight. For example, the weight of mosque/temple is 4 and weight shoshanghat/graveyard is 3. Scores are calculated as below: $(Wm+Wsb+T)*N$,

Wm=weight of main group, Wsb=weight of sub-group, T= threshold value weight

S= Category value, L= Score for resources and road, N= number of sub-group (American, 1979:27)

Again, for every 500 people the weight will be 1. For example, a village with the population of 1000, the weight is (1000/500=2)

If any institute provides service to 500 people, then its weight will be 1. For example, a clinic at Jugnipasha serves 2426 people. So, the threshold weight of the clinic for the village will be (2426/500=4.85 ≈ 5)

For example, if calculated in score of Begunbaria settlement, then following calculations are done

Total score for population in Begunbaria

Weight 1 is assumed for each 500 people. Total population of this village is 930. So score for population is (930/500) =1.86

Total score for Pucca Road of Begunbaria

Weight 1 is assumed for each 5 km road in length. Total Pucca road of this village is 1.30 km. Personal weight of Pucca road is 5 and it is sub-group of transport (main group) which weight is 5. So the total score for Pucca road in Begunbaria is: $= (Wm+Wsb+L)$

= (5+ 5+ (1.30/5)) or 10.26

Total score for Katcha Road of Begunbaria

Weight 1 is assumed for each 5 km road in length. Total Katcha road of this village is 3.58 km. Personal weight of Katcha road is 3 and it is sub-group of transport (main group) which weight is 5. So the total score for Katcha road in Begunbaria is 8.72 *Total score for*

Pucca house of Begunbaria

There are 66 Pucca house which personal weight is 3 and the category of Pucca houses is A. It is sub-group of housing main group which weight is 4. So, the total score for Pucca house of Begunbaria is 271

Total score for Katcha house of Begunbaria

There are 95 Katcha houses which personal weight is 2 and the category of Katcha houses is B. It is sub-group of housing main group which weight is 4. So, the total score for Katcha house of Begunbaria is 291. So total Score of Begunbaria Settlement are: 580.98

Same calculations are conducted remaining 14 villages and following results are found.
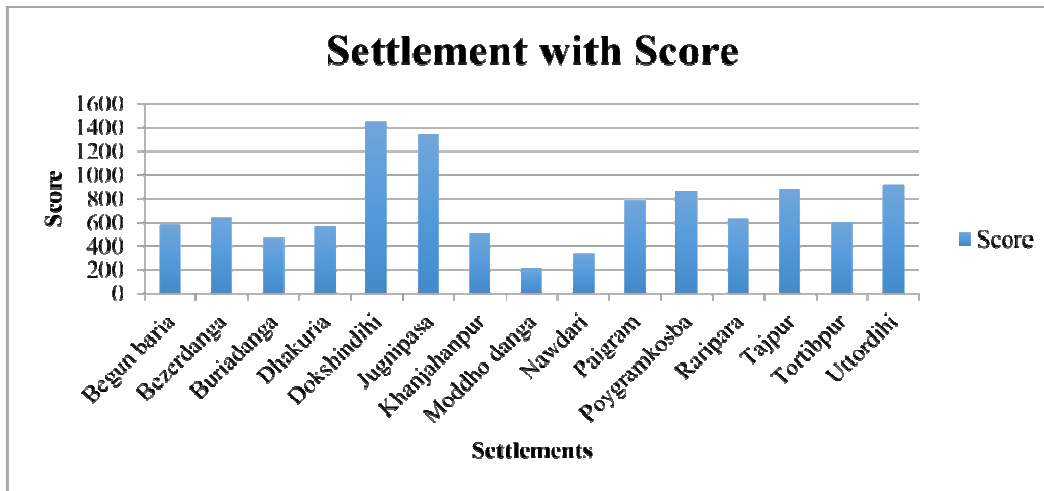
Source: Calculation Results of Centrality of Settlement

Fig. 2: Settlement with score

Finally, it can be said that form the above calculation of the settlement rank 1 is provided by Dokshindihi and rank 15 is provided in Moddhodanga.

Factors Considered Important in Road Maintenance

Four factors are considered for road maintenance management system. It was selected based on expert opinion. Four factors are included in questionnaire and asked them to rank it between 1 to 5. 1 is least important and 5 is very important. That means 1. Least Important 2. Not Important 3. Average 4. Important 5. Very Important.

After analysis the result, found that 33% of the respondent told that road repair cost are the main factors in road maintenance.
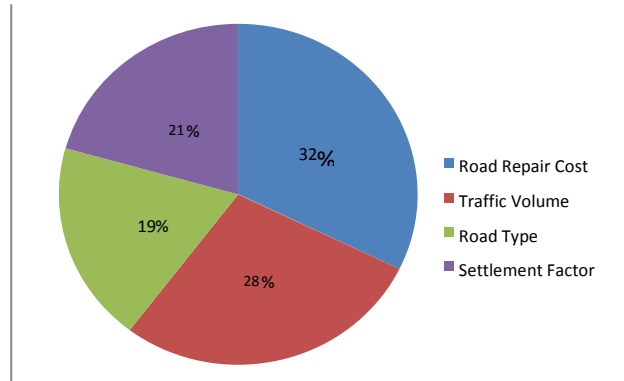
Source: Questionnaire Results from LGED staffs feedback June 2015

Fig. 3: Road Maintenance Importance Factors

Road Repair Cost

Road repair cost is calculated based on road IRI value. First, road repairing cost per km based on IRI value is known from LGED officials. Its shows that in the table, IRI value is largely influence road repairing cost.

2: Road Repairing Cost per km based on IRI

IRI	Road Repairing Cost lac per km
5-10	0.013
11-12	16
>13	2415

Source: Interview of LGED Staff, June 2015

Then multiplying cost to total road length got total road repairing cost. Finally, cost is weighted in between 1 to 5 based on expert opinion.

Table 3: Road Repairing Cost Weightage

Road Repairing Cost Lac	Weight
0-10	1
11.0-20.0	2
20-30	3
31-40	4
>40	5

Source: Weight given by expert

Traffic Volume

Average Annual Daily Traffic Volume (AADT) of each road is collected from RSDMS-VI data base. Based on expert opinion, categorized it and weight as follows.

Table 4: Traffic Volume Weightage

Traffic Volume (AADT)	Weight
0-200	1
201-400	2
401-600	3
601-800	4
801-1000	5

Source: Weight given by expert

Road Type

LGED authorities are categorized road in five categories. And they are given most priority Upazila Road, then Union Road etc.

Table 5: Road Type Weightage

Road Type	Weight
Village B Road (Katcha)	1
Village A Road (Katcha)	2
Village A Road (Pucca)	3
Union Road	4
Upazila Road	5

Source: Weight given by expert

Settlement Factor

Settlement score are already calculated. It is also very important factors based on expert survey. Incorporated it to other three factors, finally got a output. Based on settlement score, it is also weighted between 1 to 5 as follows.

Table 6: Settlement Score Range Weightage

| Settlement Score	Weight
0-200	1
201-400	2
401-600	3
601-800	4
>800	5

Source: Weight given by expert

Based on this weight, final settlement weight outcome as follows. In the Table 8. it's shows that Dokshindihi settlement score is highest 1450.66. Because, socio economic importance is high in this settlement. As a result, it is considered as rural growth centre. Moddhodanga is least score 212.6 because of its poor socio economic activity and poor transport connectivity. On the other hand, it is situated almost end of the Phultola Union.

Proposed Approach of Road Maintenance Management System

After calculation of the weightage of four factors, this four factors weight is assigned to each road. Then each factor weight is multiplied by percentage of road maintenance important factors (See Figure 3). Because importance of each factor is not equal. For example, road maintenance cost is more important than road type. Finally, we got a multiplication score. Then, each factor score is summed up as follows

Total Weight: ∑ (Road Repair Weight) = Cost Weight + Road Type Weight + Traffic Volume Weight + Settlement). The total weight is got in between 1 to 5. One is least important and 5 is best important. Below map shown road classification with weightage.
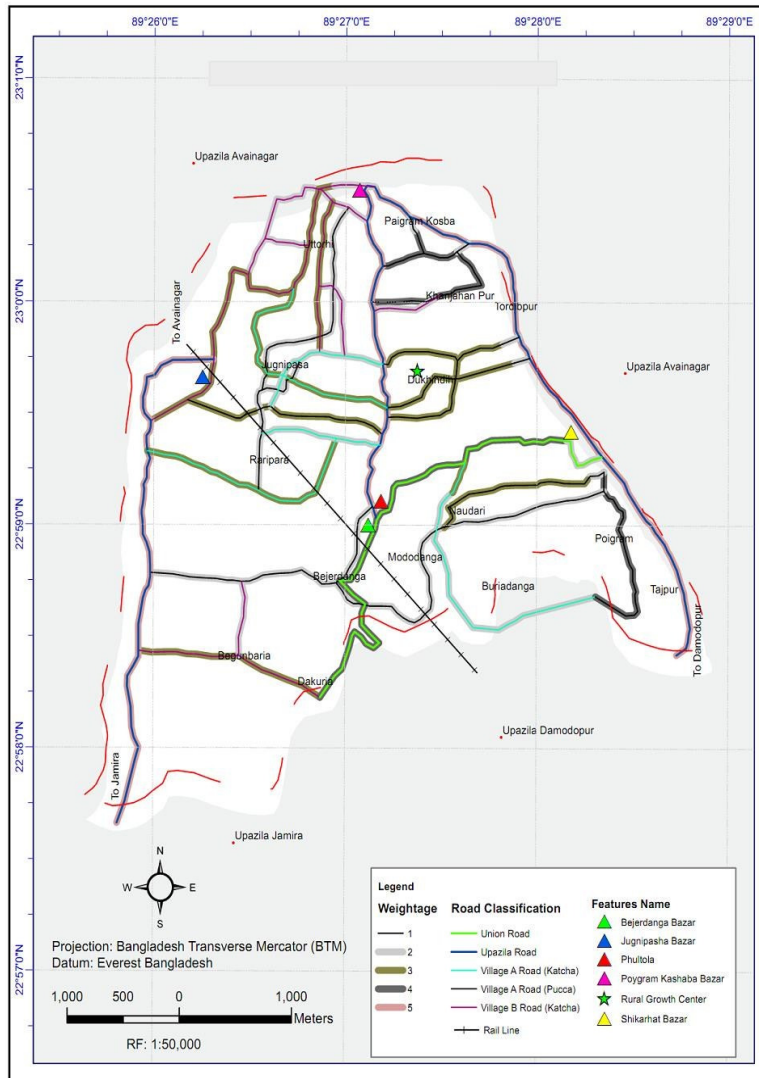
Source: Final Result based on Total Weight

Fig. 4: Road Classification with Weightage

Problems Occur During the Process of Road Maintenance Management System (RMMS):

Problems occur during the implementation of RMMS are identified by LGED officers and staffs through interviews and questionnaires.

1. Budget allocation is the main problems in road maintenance. As a limited budget, it is difficult to which road will maintain first

2. Lack of skill labour in contractor company as well as lack of necessary equipment.

3. As OTM (Open Tendering Method), Contractor try to bid in low price.

From the data gathered using questionnaires, the frequencies for the most and the least ranked problems during the implementation of RMMS System are derived from the respondents' feedback. 1. Strongly Disagree 2. Disagree 3. Slightly Agree 4. Agree 5. Strongly Agree
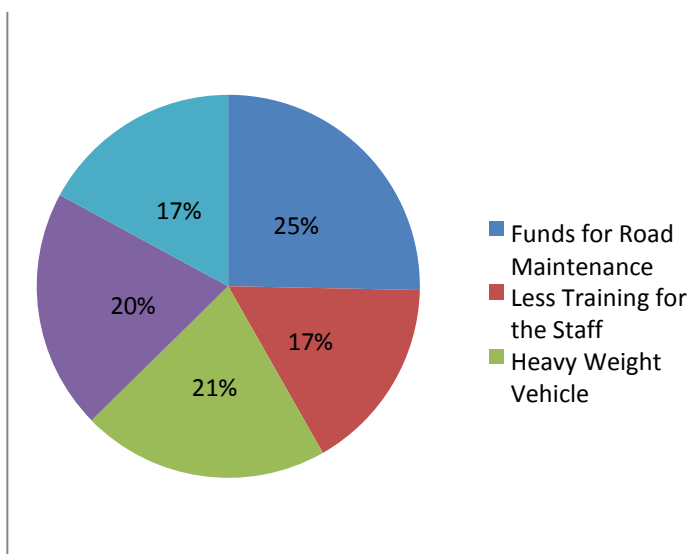
Source: Questionnaire Results from LGED staff's feedback
Fig. 5: Problems in RMMS

The table shows that most respondent agreed that problem in RMMS is 'Fund for the Maintenance' 25% whilst the least respondent agreed is 'Less Training for the Staff' 17%.

Propose of Improve Road Maintenance Management System:

From the study, was defined a few problems in RMMS at LGED. From the interview that has been conducted, it was found that there is some approach for improving the RMMS as listed below:

1. Adding more factors to road selection maintenance priority.

2. Try to complete work within a time and be economy.

Recommendations and Conclusion

From the study of Road Maintenance Management System, the priority of road selection plays a major role in determining which road will maintain. In order to achieve that, few aspects need to be considered during road selection for maintenance such as road maintenance cost, traffic volume, vehicle fleet, performance model, and road type and settlement factors etc.

From this study conclusion related to the objectives of the research are made. The conclusions are.

Expected Future Road Maintenance Management System

o It is assumed that in future tender will not publish rather it will be a package. For these reason it will help to pave the way for attracting big contactor company. As a result, those contactor company whose have sufficient equipment and technology with skill labours can help to maintain quality of works and activities.

o The entire road in this process will be constructed based on 40 ton load. For these the road will be constructed 18 feet instead of 12 feet.

Problem in Road Maintenance Management System

o For road maintenance, budget allocation is the first and final problem for this limited budget it is really difficult to maintenance road and selecting which road is maintain first.

o As an OTM (Open Tendering Method) Contractor try to bid it in low price.

o During road maintenance there is a lot of traffic which hampered the maintenance process.

Basic Approach for Improving the Road Maintenance Management System

o Try to add more factors to road selecting maintenance priority.

o Try to complete work in due time.

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