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Assessment Quality of Road Structures Along with their Management with Special Reference to Dhunibesi Municipality of Dhading District in Nepal

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ABSTRACT

In a broad sense, quality is defined, as the absolute wellbeing of anything by which reliability can be achieved. Quality has been inseparable part of the humans in the present world. Road is the facilitator of humans with development. Hence, the requirement of quality in road structure is an emerging issue in these days. Quality management is reliable management technique to achieve quality in the final output. Thus, the proper management of quality on road structures leads to achieve the sustainable road structures. Field observation, in-depth interview (IDI), focus group discussion (FGD) and questionnaire survey are the major tools used during field investigation of the study. This study was conducted during the period from March 2022 to September 2022.The study found that the quality management of road structures is indeed the issue to be resolved to achieve sustainable road structures. Problems of qualitative road structures are poor project management, contractors mishandling, poor routine maintenance, insufficient budget, poor construction equipment, tendency of subcontract and poor prevailing policies and laws. Effective application of penalty, bonus, incentives, punishment and rewards are the probable solutions to the issue of quality of road structure and management. Furthermore, proper use of good equipment and machineries, materials in construction should be as defined in standard specification, good and independent project management, qualified workers, timely maintenance work of the road structures and finally rule of law and good governance should be in real practice. Implementation of management tools like total quality management (TQM) and Taguchi method of quality management leads to achievement of quality construction. Similarly, the study would like to suggest that the quality should be on top of priority on every phase of construction i.e. planning, designing, implementation and monitoring. Improve in policies and laws such as improved policies on control over the vehicles on the roads as per design, improved bidding process (i.e. more focus on quality assurance than low bidding process) and national periodic and routine maintenance policies of road structures.

KEYWORDS: Quality management, Road structures, Road maintenance, Road construction

ARTICLE DETAILS

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I. INTRODUCTION

Road network development in Nepal has been a priority to community and government for the past 20 years, and this trend is anticipated to continue as the nation moves to a decentralized federal administration **(Rankin et al., 2017).**

Quality has been the inseparable and incomparable part of human life as the human civilization progress grows on. All business industry are bound to obey the incomparable role of quality control over them. No economic benefit or growth are visible in absence of quality. Quality planning and quality improvement outcomes in daily human activities is achieved only through quality control in each activities. Continuous small steps on quality improvements performed in the basis of control cycle i.e. Plan Do Check Act (PDCA), may lead to a quality improvement in any project or institutions **(Phatak et al., 2012).**

For the future of road network development, understanding and practice of quality management is must. Quality must be the factor to compete on business by the organizations involved in road network development. Due to lack of proper management and proper investment and investigation by government, road network infrastructures in general are damaged. The quality management system can yield substantial quality and environmental improvement by the evolution through combination of “soft” non-technological (Culture, habits, management and leadership approach) and “hard” technological changes **(Gashi & Sadiku, 2020).**

Statistical quality control began to gain intensive popularity in Europe in the 1980s. Genichi Taguchi, a Japanese engineer and a statistician, who formulated an idea of reduction of variation that is the primary means to gain Quality improvement. According to G. Taguchi, a continuous quality improvement program consists the reduction in variation in product performance characteristics i.e. a product performance characteristic is a measure of quality that determines a product's performance in terms of meeting user requirements **(Terek & Hrnciarov, 2000).**

Constructing quality roads is essential not only for efficient use of national resources and capital costs, but also for providing safe and comfortable travel for road users at minimal operating costs. National highway construction takes place in different modes (conditions) of contracts such as Build and Transfer (BOT), Engineering Procurement and Construction (EPC) and Hybrid Annuity Mode (HAM). Each mode has different roles and responsibilities of different stakeholders in terms of funding/resource mobilization, planning, design, construction and maintenance of expressway facilities. Although contractors are primarily responsible for building quality roads, the role of other stakeholders is equally important in ensuring quality control/assurance **(MRTH, 2020).**

In the investigation of link between the quality of rural road to the allocative and technical efficiency of farm and its impact on the growth of income on them. It is found out that the quality road access enhance the technical efficiency of farm by 16% and two times the allocative efficiency **(Wondemu, 2015).**

While conducting comparative studies and interviews with the professional from both public and private sectors involved in road construction projects, it was acknowledged that the improvement on quality of road structure primarily improves the road safety, noise protection. Indirectly the quality improvement in road improves the quality of other infrastructures like buildings, improves quality of environment and social objectives **(Warsame et al., 2014).**

There is a close connection between the growth of transportation (road and vehicles) and socio-economic advancement of the country; however, the present scenario of Nepal does not seem to be satisfying. Out of 29157 kilometers of total road length, 12305 are blacktopped. Due to the lack of proper maintenance and poor construction, the condition of roads in Nepal are in miserable conditions. Due to miserable condition of road the rate of road accidents is in peak. The economic growth in nation due to construction of road networks are still lacking as expected from the development of road networks **(Bhagat, 2017).**

Road surface quality plays a fundamental role in vehicle vibration and thus impacts passenger comfort. Several routes along different types of roads in the city of Joinville were selected to collect vibration data in vehicle tests using instrumented vehicle and model fit parameters. From the results, the International Roughness Index (IRI), an index for evaluating road quality, was determined. Urban roads with high IRI values, such as cobbled roads, have been shown to cause greater vehicle occupant discomfort and indicate poor pavement quality. On the other hand, on roads with good surface quality, its IRI value is lower, which desperately improves passenger comfort **(Mello & Idehara, 2018).**

Whenever the task is performed correctly for the first time, the cost of poor quality would disappear from the loss list. Cost of poor quality (COPQ) ranges between 22 to 33% of total revenues. The COPQ is not visible and affects the entire scope and schedule of projects. Hence, the construction companies shall firstly perform the quality task for first time, if not performed COPQ analysis, system shall be implemented as per to initiate timely corrective action to reduce their hidden losses and improve quality construction **(Mahmood & Kureshi, 2014).**

II. MATERIAL AND METHODS

Research Design

The research was conducted on the basis of the methodological framework.

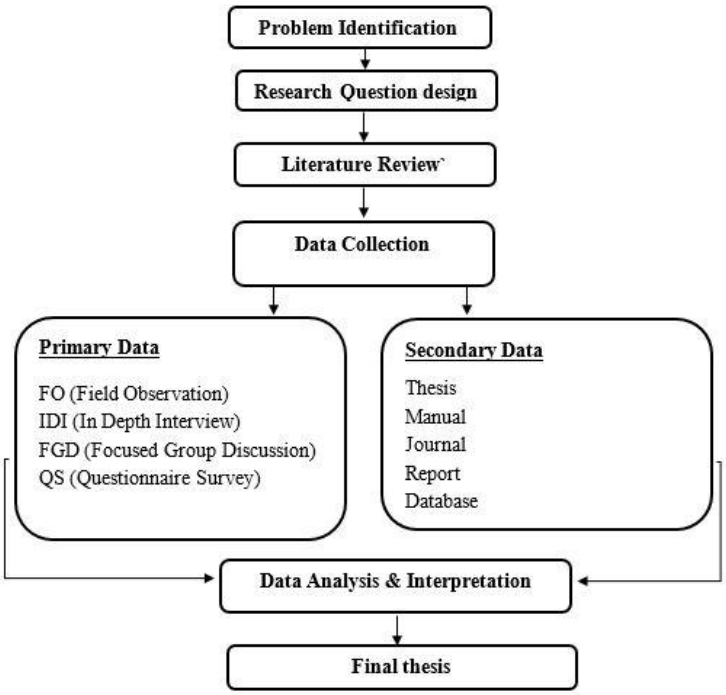

Figure i: Methodological Framework

Study area

The survey on research topic was conducted in Dhunibesi Municipality, Dhading District, Bagmati Province, Nepal. The targeted respondents were the representatives from Dhunibesi Municipality, locals and road users of roads in Dhunibesi Municipality. The municipality has an area of 96.30 sqkm with a total population of 29126 according to Nepal Census 2021. The previous Naubise, Chhatre Dyaurali and Jiwanpur Village Development Committees were merged to form Dhunibeshi Municipality during the restructuring the Nation following the federal constitution of Nepal. The Municipality is divided into 9 Wards which has a municipal office located in Khanikhola.

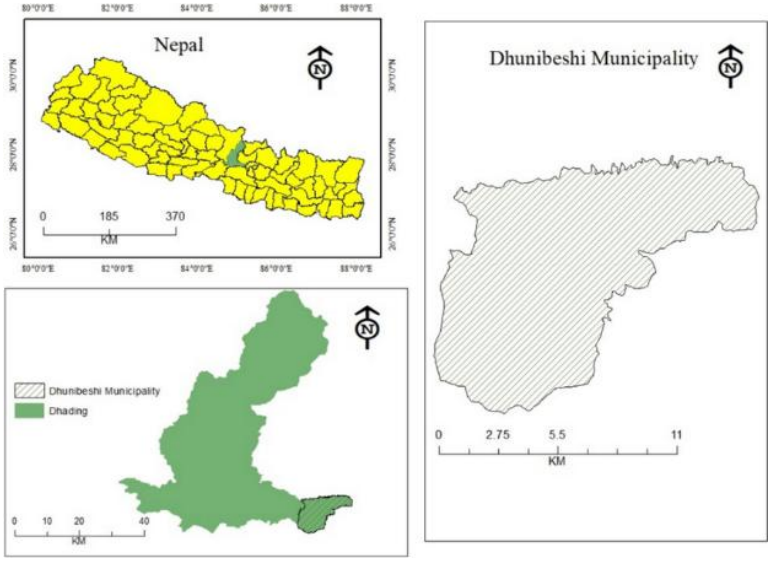

Figure ii. Map of Nepal showing Dhading district

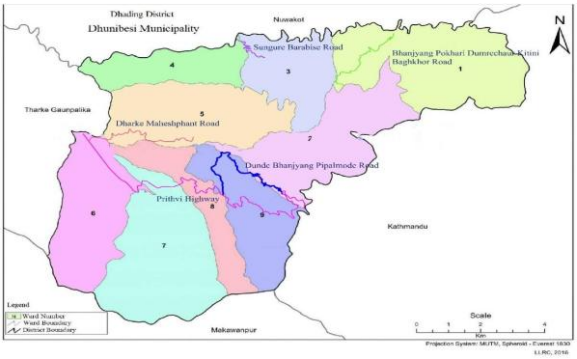

Figure iii. Dhunibesi Municipality map with municipal road visited

Sampling techniques and sample size

As the samples were taken randomly for the specific road sections, sample size was fixed using Slovin's Formula:

Sample size(n)=N/(1+Ne²)

Where, N= Total No of Population and e=Confidence Error

Total No of Population(N)=29126

Confidence Error(e)=10%

Sample size(n)=100

Even the sample size was 100, questionnaire was sent to around 150 persons, as because of expectation of poor response from respondents at time. From expected 150 responses from questionnaire survey, 124 valid responses were collected. Hence, sample size was fixed at 124 for data analysis. Purposive sampling method was adopted for this purpose with a view to gather the views of the respondents, appropriate for the research objective.

Data Analysis

The Relative Importance Index (RII) is used to evaluate the ratings of the respondents.

Study Period

The research was conducted in the year 2022 in Dhading

Data collection method:

Field observation, In-depth interviews, focus group Discussion and Questionnaires were the major tools used during the field investigation of this study

RESULTS

Total respondents based on age group

Out of total respondents i.e. 124 respondents, 54.03% of age group was found to be between 20-30 years age group, 34.68% were under 30-40 years age group, 7.26% were under 40-50 years age group, 2.42% were under 50-60 years age group and 0.81% of respondents were above 60 years.

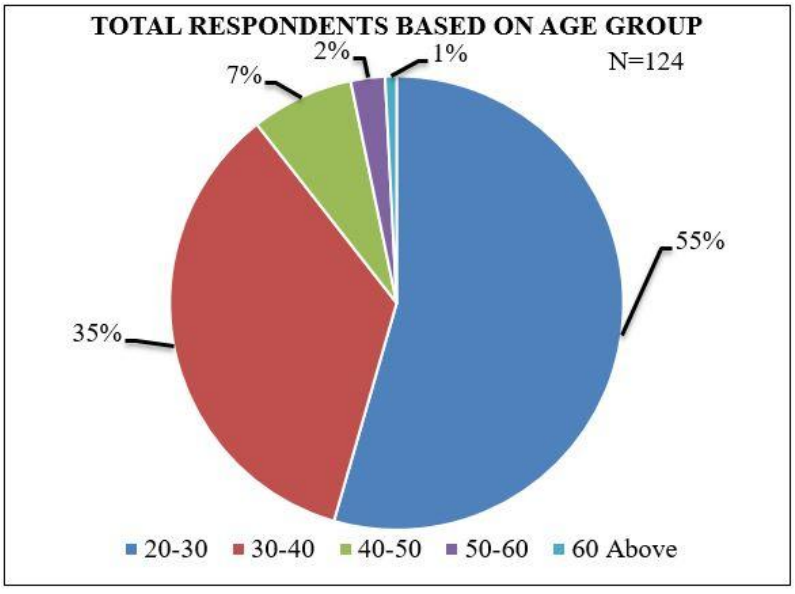

Figure iv. Total respondents based on age group

Total respondents based on gender

Out of total respondents i.e. 124 respondents, 73.39% were male respondents and 26.61% were female respondents.

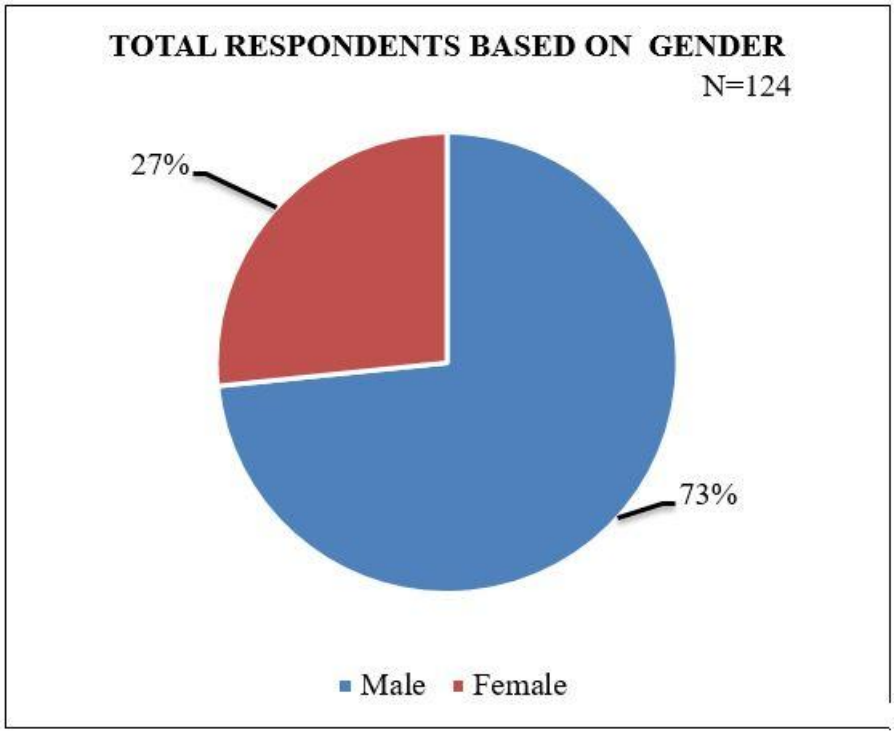

Figure v. Total respondents based on gender

Total respondents based on profession

Out of total respondents i.e. 124 respondents, 58.87 % i.e. majority of the professional responders belongs to engineering field, 20.16% of the responders were from other profession than the given options i.e. engineers, contractors, consultants, business. 9.68% of respondents were businessperson or involved in business, 5.65% respondents were consultants and 4.84% respondents were contractors.

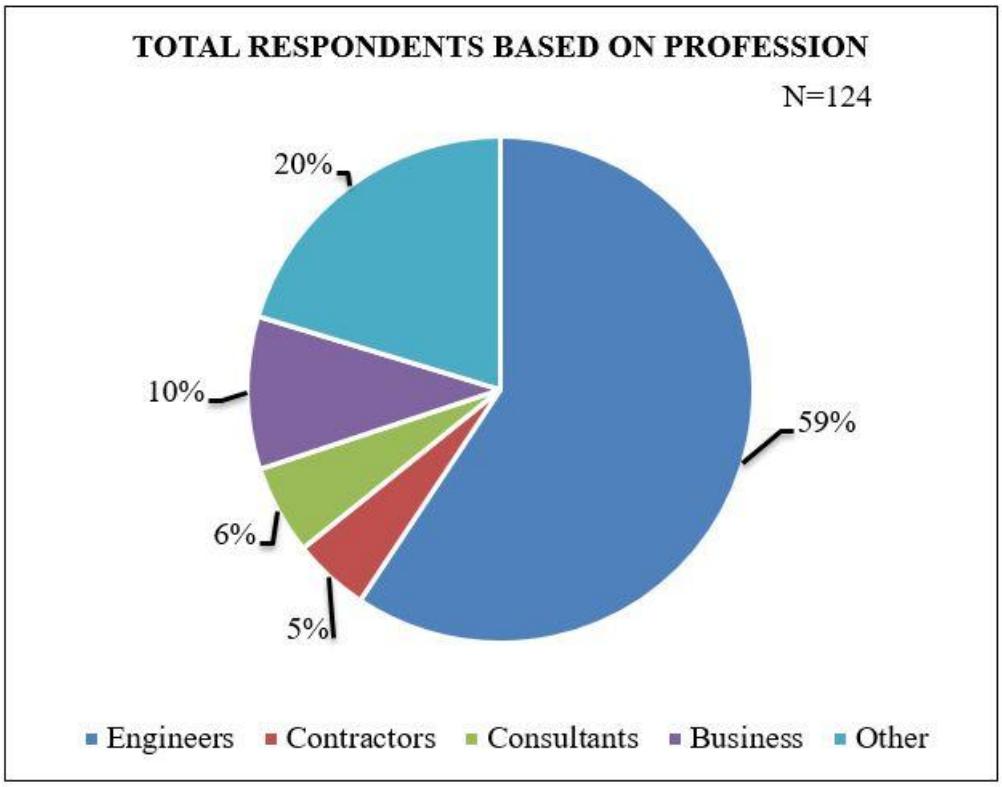

Figure vi. Total respondents based on profession

Respondent analysis on problems of quality of road structures and their management

With detailed in-depth interview and group discussion carried out with the experts and the personnel related, the 17 problems were generated to be the effective one. Out of 17 problems addressed on the problems of quality of road structures and their management. The Lack of proper maintenance/untimely maintenance achieved the highest RII=0.64, while Poor project management, contractors mishandling and ignoring test and audits achieved significant response with RII=6.2 and at the same track insufficient budget for construction received the lowest RII=0.53 by the data collected from 124 respondents.

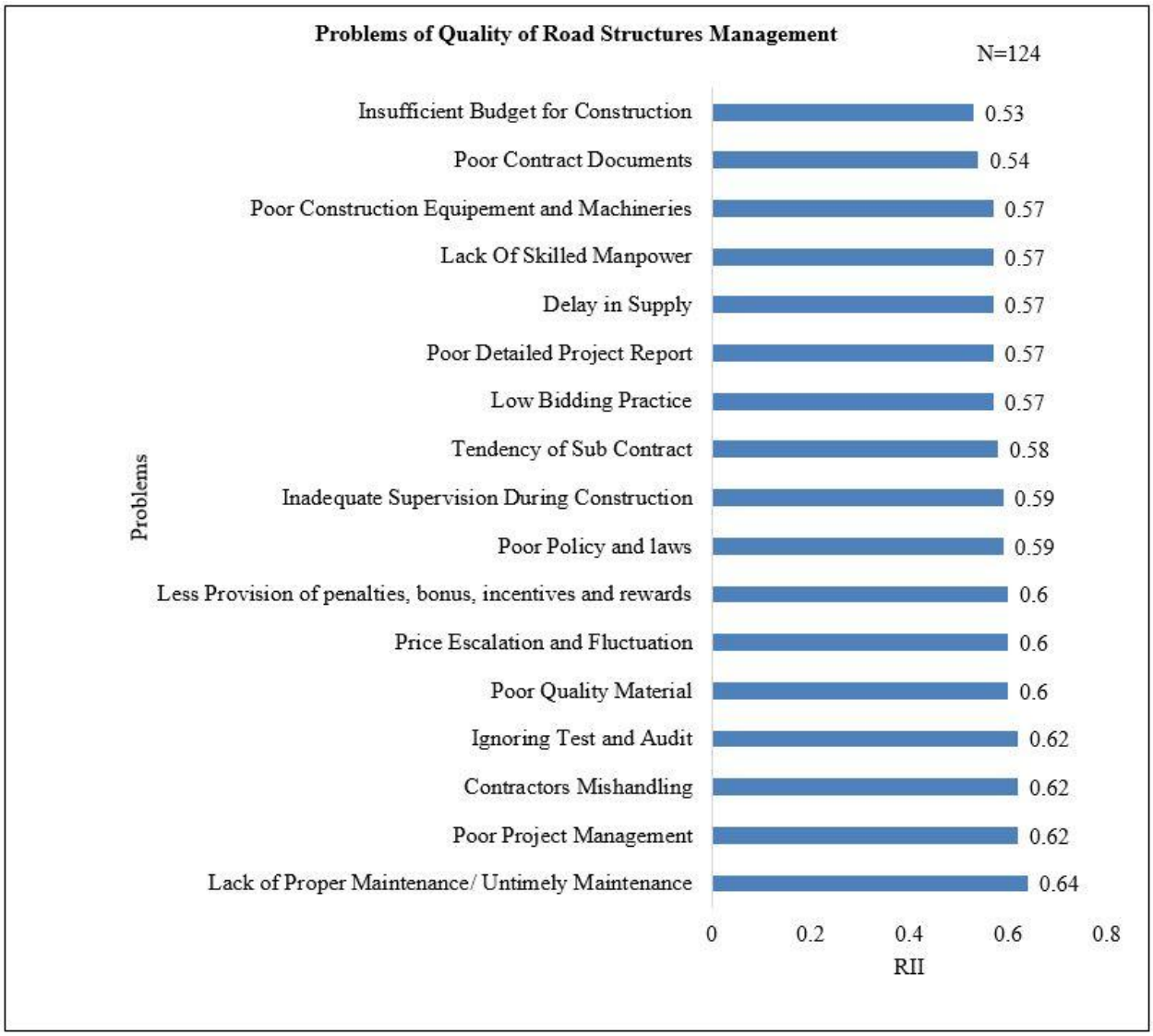

Figure vii. Problems of quality of road structures management

23 Respondent analysis on causes of lack of proper maintenance/ untimely maintenance

Out of 124 respondent who responded on causes of lack of proper maintenance/ untimely maintenance, the result with RII=0.6 as the highest on inadequate supervision by government agent and RII=0.58 as the lowest on low budget were recorded. The responses achieved on the topic are as in figure 4.2.22.

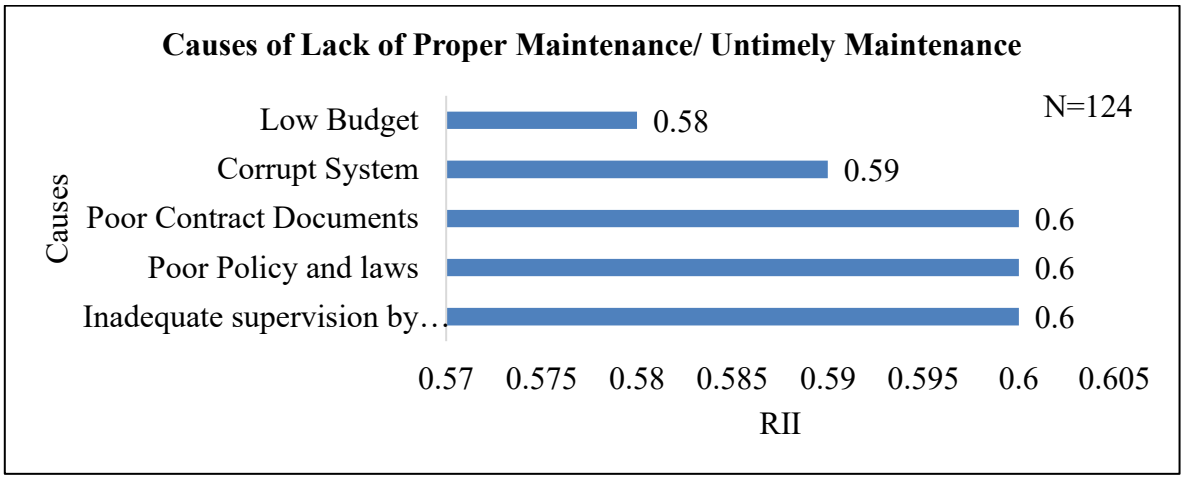

Figure. viii Causes of lack of proper maintenance/untimely maintenance

4.2.24 Respondent analysis on effects of lack of proper maintenance/ untimely maintenance

Out of 124 respondent who responded on causes of lack of proper maintenance/ untimely maintenance, the result with RII=0.6 as the highest on inadequate supervision by government agent and RII=0.58 as the lowest on low budget were recorded. The responses achieved on the topic are as in figure 4.2.23.

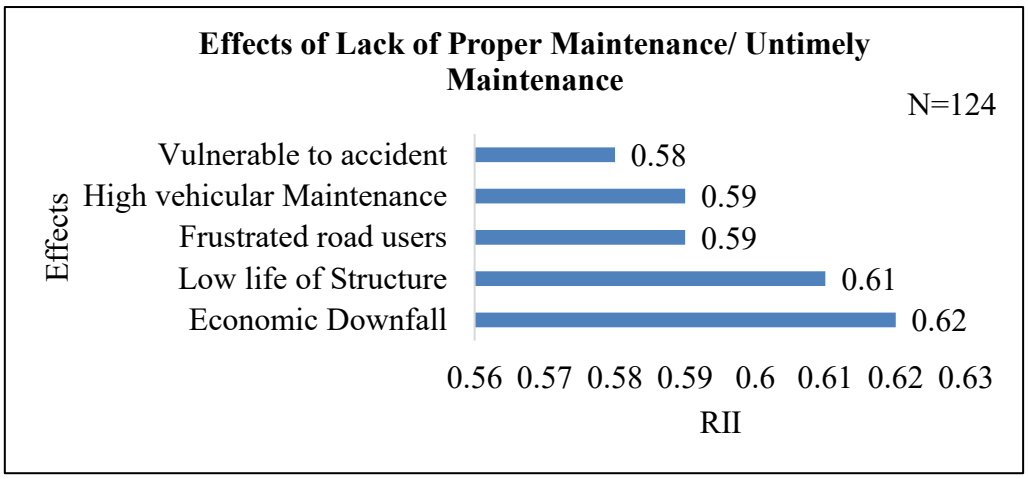

Figure. ix Effects of lack of proper maintenance/untimely maintenance

Respondent analysis on causes of poor project management

Out of 124 respondent who responded on causes of poor project management, the result with RII=0.6 as the highest on inadequacy of manpower and RII=0.57 as the lowest on inadequacy of material were recorded. The responses achieved on the topic are as in figure 4.2.11.

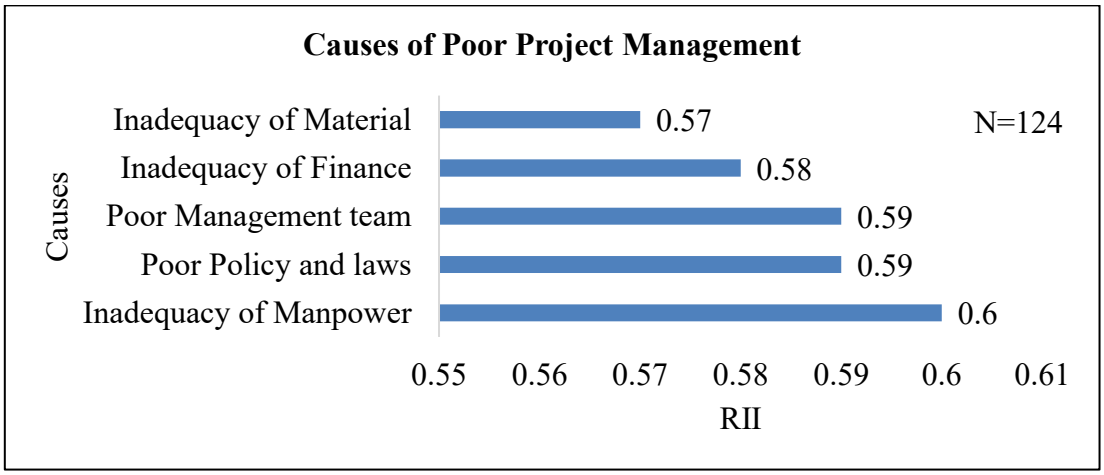

Figure. x Causes of poor project management

4.2.12 Respondent analysis on effects of poor project management

Out of 124 respondent who responded on effects of poor project management, the result with RII=0.65 as the highest on time overrun and RII=0.6 as the lowest on poor quality construction were recorded. The responses achieved on the topic are as in figure 4.2.12

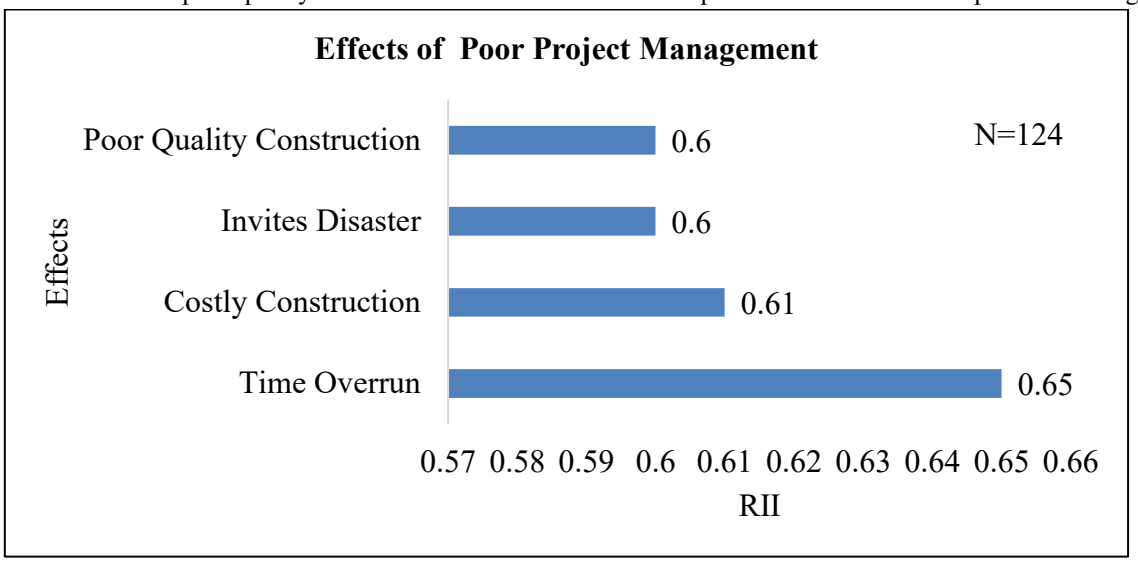

Figure. xi Effects of poor project management

4.2.15 Respondent analysis on causes of contractors mishandling

Out of 124 respondent who responded on causes of contractors mishandling, the result with RII=0.58 as the highest on inappropriate selection of consultant and contractors and RII=0.52 as the lowest on low budget were recorded. The responses achieved on the topic are as in figure 4.2.15.

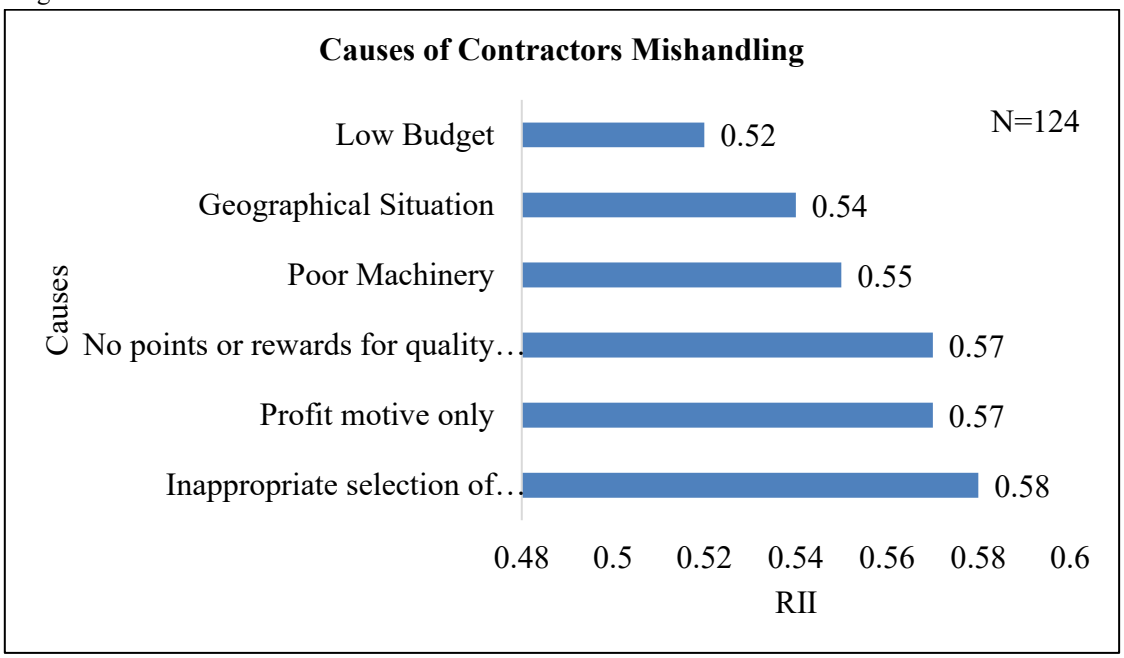

Figure. xii Causes of contractors mishandling

4.2.16 Respondent analysis on effects of contractors mishandling

Out of 124 respondent who responded on effects of contractors mishandling, the result with RII=0.61 as the highest on incomplete task and variation in project cost and RII=0.58 as the lowest on invites disaster and safety degradation were recorded. The responses achieved on the topic are as in figure 4.2.16.

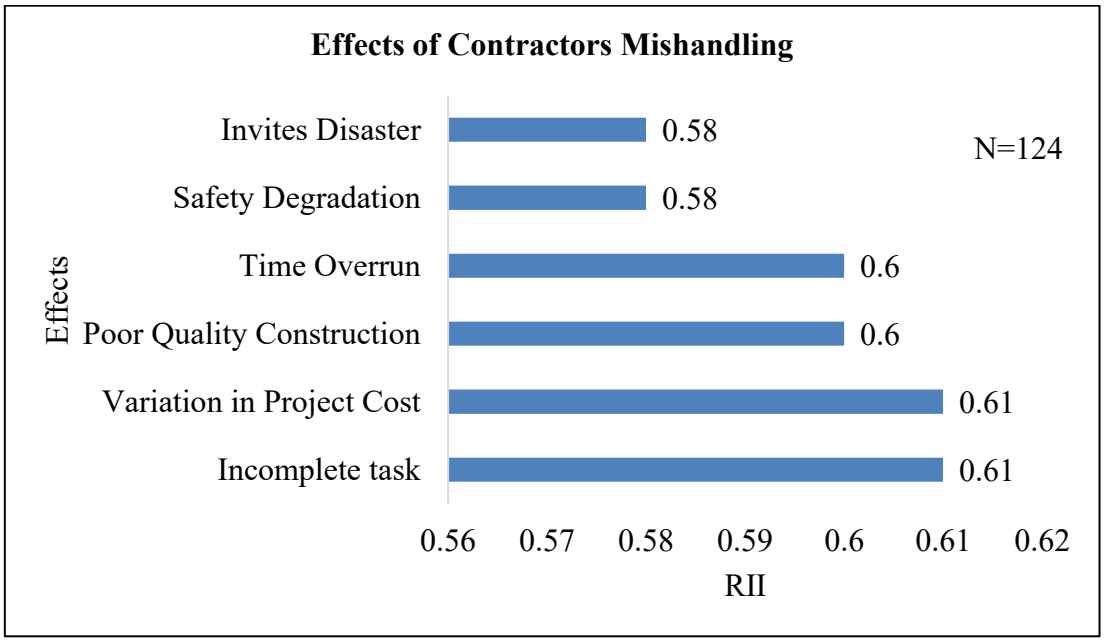

Figure. xiii Effects of contractors mishandling

4.2.17 Respondent analysis on causes of ignoring test and audit

Out of 124 respondent who responded on causes of ignoring test and audit, the result with RII=0.62 as the highest on profit motive contractor and negligence of control mechanism and RII=0.6 as the lowest on inadequate lab and equipment for testing, corrupt mentality and irresponsible quality control engineer were recorded. The responses achieved on the topic are as in figure 4.2.17.

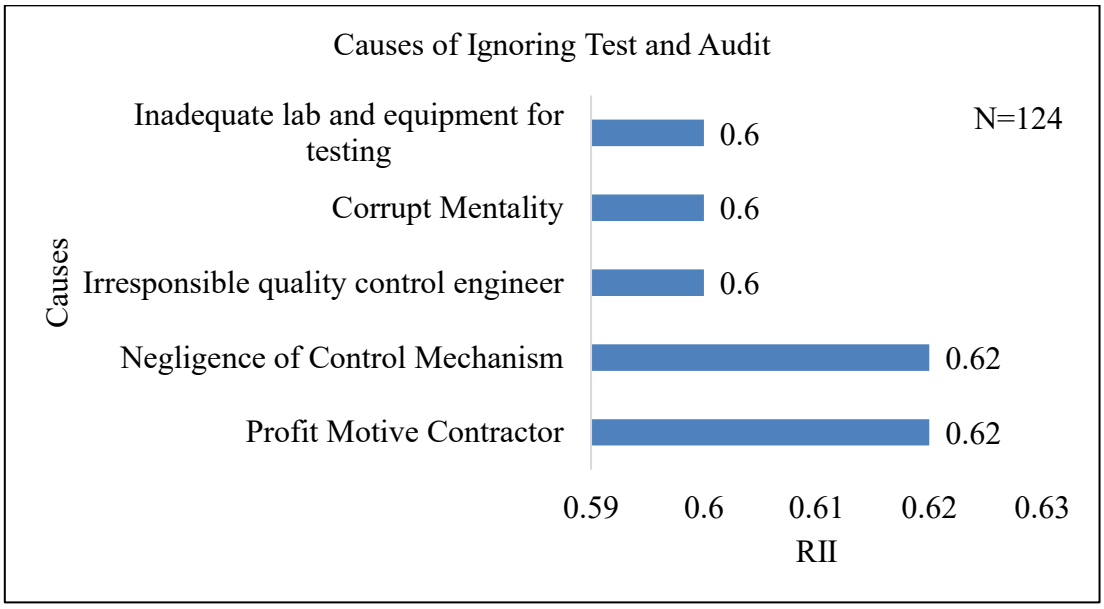

Figure. xiv Causes of ignoring test and audit

4.2.18 Respondent analysis on effects of ignoring test and audit

Out of 124 respondent who responded on effects of ignoring test and audit, the result with RII=0.64 as the highest on quality degradation and RII=0.59 as the lowest on invites disaster were recorded. The responses achieved on the topic are as in figure 4.2.18.

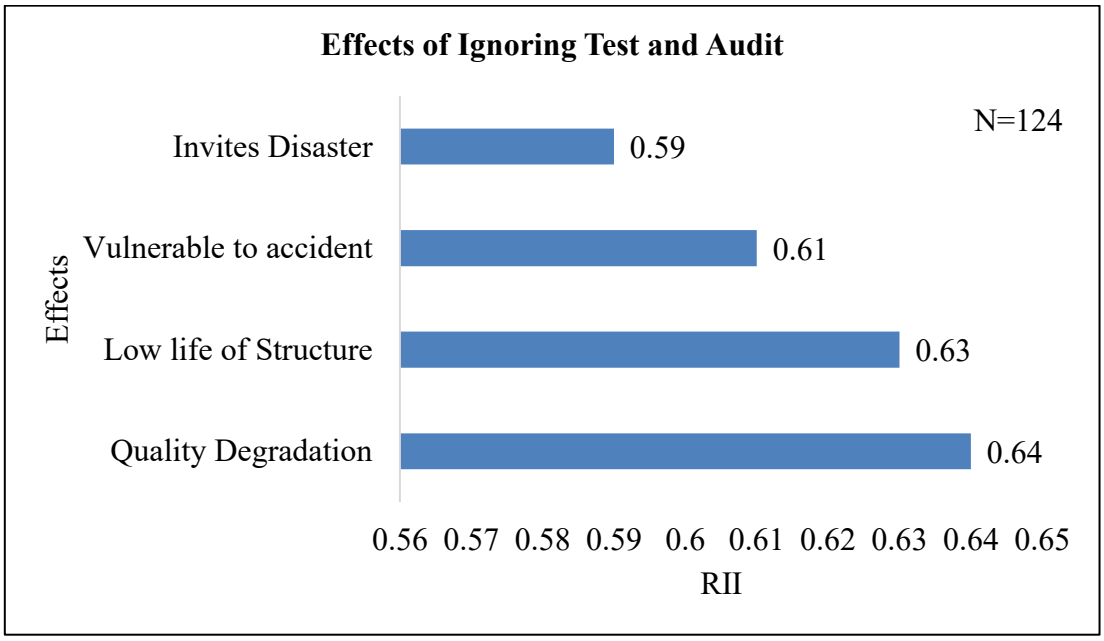

Figure. xv Effects of ignoring test and audit

Respondent analysis on solutions of quality of road structures and their management

Out of 16 Solutions addressed on quality of road structures and their management, Corruption must be controlled and there must be rule of law and good governance achieved the highest RII=0.72 and Culture of inviting subcontractor must be discouraged received RII=0.65 by the data collected from 124 respondents.

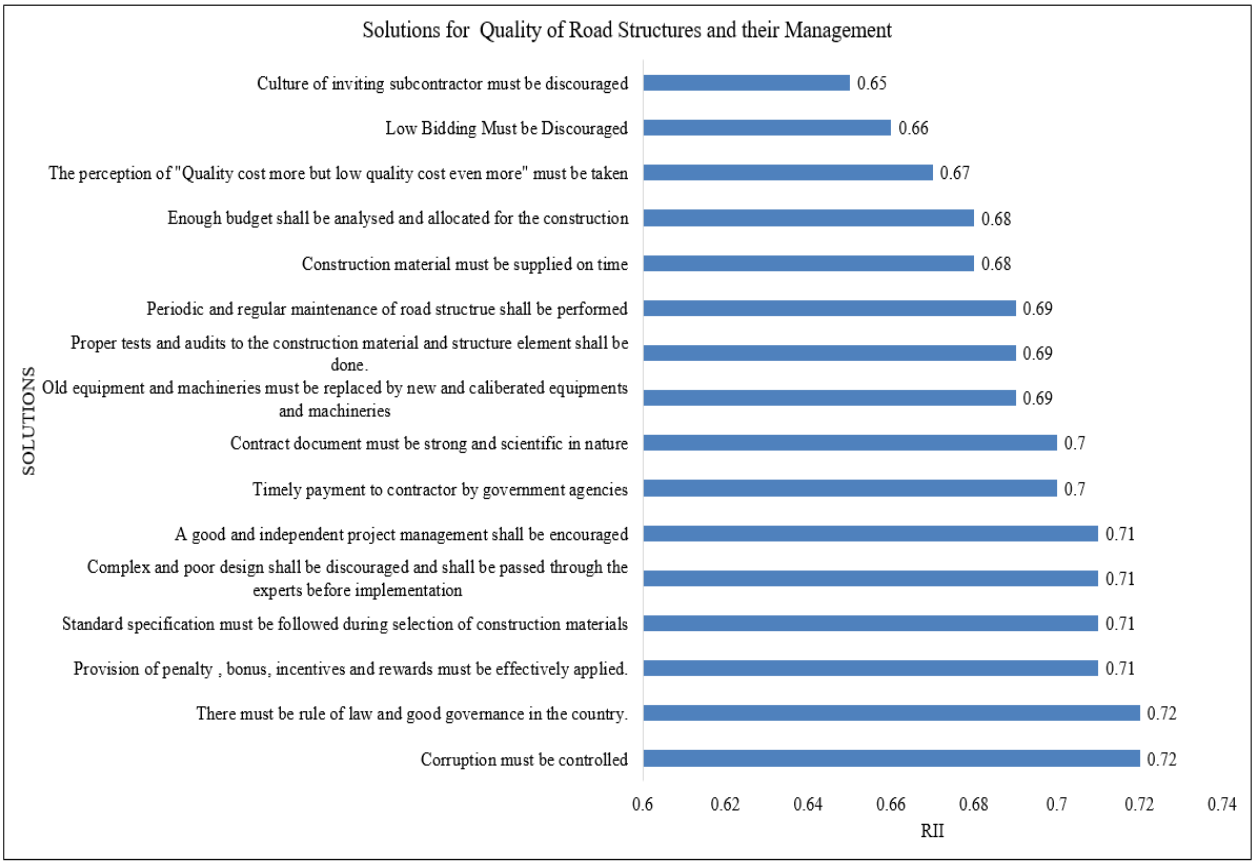

Figure xvi Solutions for quality of road structures and their management

DISCUSSION

Based on in-depth interview, focus group discussion and questionnaire survey data analysis the conclusion has been drawn for quality of road structures and their management. In in-depth interview, discussion on topic was made with two engineers and two

sub engineers of Dhunibesi Municipality. In focus group discussion the stakeholders of the roads in Dhunibesi Municipality, site engineers and ward members were present. In questionnaire survey, 124 respondents responded the questionnaire, among which majority of respondents 54.03% were of age group 20-30 years age group. From the total respondents, 73.39% were male respondents and 26.61% were female respondents, where the majority of 58.87% of responders belong to engineering profession.

Among the seventeen problems addressed on quality of road structures and their management, lack of proper maintenance/untimely maintenance has been the most agreed problem on not achieving the quality of road structures as it has got the highest RII=0.64 among all the problems. Poor project management, contractors mishandling and ignoring test and audits were recorded as the second most agreed problem with RII value 0.62. Less provision of penalties, bonus, incentives and rewards, price escalation and fluctuation, poor quality material were also mostly agreed which received RII=0.6 becoming the third most popularly agreed problems of quality of road structures and their management. Rule of law and good governance in country (RII=0.72), control on corruption (RII=0.72), effective application of provision of penalty, bonus, incentives and rewards (RII=0.71), application of standard specification during selection of construction materials (RII=0.71), encouragement on good and independent project management (RII=0.71) and involvement of experts in design review and adaptation of simple and clear design (RII=0.71) are the most agreed solution for achieving quality of road structure and their management. Insufficient budget becomes the least agreed problems on not achieving the quality of road structure and their management with RII=0.53.

During in-depth interview, it was noticed that the major problems in not obtaining quality in road structures management are due to mishandling and negligence of contractors, insufficient budget, poor construction equipment and machineries, tendency of subcontract, poor design, poor policies and laws, poor project management and price escalation. As a better solution, implementation of total quality management TQM in construction industry was recommended. Costumer focused, total employee involvement, process centered, integrated system, strategic and systematic approach, continual improvement, fact based decision making and communication are basic elements of total quality management. The elimination of disturbing factors in quality achievements shall be recognized and removed from root i.e. proper use of good equipment and machineries, with standard quality materials in construction, good and independent project management and qualified manpower. Focus group discussion suggest problem as low quality work in construction of road, its design, quality management. To achieve the quality proper design, construction and inspection of the road along with their proper management are required.

CONCLUSIONS

Based on in-depth interview, focal group discussion and questionnaire survey data analysis the conclusion has been drawn for quality of road structures and their management. The present scenario of factors affecting quality of road structures management were found to be poor, insufficient budget, tendency of subcontract, contractors mishandling, poor maintenance work and poor plan and policies.

The present condition of quality in road structure management in Dhunibesi Municipality was not good. Due to which the road condition was in miserable condition. Provision of penalty, bonus, incentives and rewards must be effectively applied to achieve quality of road structures management.

Furthermore, proper use of good equipment and machineries, materials in construction could be as defined in standard specification, independent project management, qualified workers, and timely maintenance work of the road structures and finally rule of law and good governance were to be adopted to achieve quality of road structure management. Implementation of total quality management TQM in construction industry i.e. each member (individuals) in the construction needs to get focused on achievement of quality in each sectors. Adaptation of Taguchi method of quality management i.e., the elimination of disturbing factors in quality achievements shall be recognized and removed from root.

RECOMMENDATIONS

- Quality should be kept on top of priority on every phase of construction i.e. Planning, designing, implementation, monitoring and handover.
- Improve in policies and laws such as improved policies on provision of penalties and bonuses based on quality of work, control over the vehicles on the roads as per design, improved bidding process (i.e. more focus on quality assurance than low bidding process) and national periodic and routine maintenance policies of road structures.
- Municipality should hire a quality engineer for managing and implementing quality on construction work of municipal roads.
- Quality management for roads and structures shall comply with other construction industry for better quality achievement, which should be used for further research work.

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