

## **1) ROAD RESEARCH AND BEST PRACTICE INITIATIVES**

### **1.1 Introduction**

The Ethiopian Roads Authority is making every effort towards the successful implementation of the RSDP. Both the paved and unpaved road networks continue to expand and such expansion requires a cost effective road network management and maintenance approach backed up with sound engineering best practices.

Lessons from past road planning, construction and maintenance practices, experience and research need to be used to inform the sector and to introduce new, innovative and more cost-effective technologies and improvements into the industry. Such experiences and best practices need to be documented and put into practice through periodic updating of the existing manuals and specifications that guide the road construction, maintenance and rehabilitation interventions.

Ethiopia has benefited to some extent from international research and application and significant progress in road planning, construction and maintenance has been achieved since the commencement of the RSDP. However, progress is often stifled by challenges presented due to the complexities of Ethiopia's high altitude terrain, its steep gradients and the variety of geology and geomorphological conditions. The diversity and unpredictability of its local climate adds to the challenge along with ground instability problems, which cause frequent landslides in many areas of the country. Materials meeting the current specifications for construction and maintenance of roads are becoming increasingly scarce, drainage networks can become overstretched and traffic growth can outstrip the expectations of design. The application of currently accepted and often imported technologies can give sub-optimal road performance and the provision of adequate road safety remains a serious challenge.

A better understanding of road performance in Ethiopia, its management and maintenance can only be achieved through a long-term engagement in collecting and properly analyzing local data, undertaking specialized and locally focused research and testing and bringing innovation and appropriate standards into practice. To maximize the benefits accruing from significant investments in research and data collection, efficiency improvements are also needed that cannot be realized in the absence of suitable national institutional arrangements for research.

In line with these requirements, and with the assistance of its development partners ERA is expanding its research effort.

### **1.2 Institutional Arrangements**

#### **1.2.1 Research Unit to Directorate Level**

The present Engineering Research Branch was set up under the responsibility of the Network Management Division of the Ethiopian Roads Authority at the time of the restructuring ERA in 2003. The branch has continued promoting collaborative research with support from

international development partners, such as DFID. However, the ability of the branch to initiate and progress its own quality research activities remains constrained by limitations in the current institutional and organizational set-up; the limitations imposed by lack of suitable facilities and equipment, and the impact of poor access to research based training and quality management approaches. In such circumstances the branches ability to support and meet the broader research challenges posed by the RSDP can be limited.

In line with the, Research and Development Policy Statement and Procedures and the ERA Strategic Plan, coordination of research will be incorporated into the ERA restructuring and will be accorded a Divisional status.

### **1.2.2 Road Research Centre**

In response to the growing research needs of the sector and to build the required highway research capacity across the industry, ERA envisages the establishment of a dedicated Road Research Centre (RRC).

Such a centre, at directorate level, will provide quality research services to the industry and will act to support the future demands of road design, construction, maintenance, management and safe road operation. The RRC will:

- Establish, upgrade and maintain norms and standards for road transport engineering in all aspects of planning, design, construction and maintenance;
- Conduct research into road transport technologies, applied technologies and into the promotion of specialized technology appropriate for delivery of the RSDP;
- Operate a data collection and information service that disseminates data, knowledge and developments to the industry at large; and
- Assist organizations in Ethiopia with aspects of technology development, technology transfer and application to support the future road design, construction, maintenance, planning management and capability.

ERA, has received a grant from the World Bank to finance ERA Modernization and Sector Capacity Building as one of the components of the Road Sector Development Stage-IV (APL-4). A proportion of this loan will be used to provide services for a preparatory study toward the establishment of the RRC. Accordingly, the Terms of Reference for the preparatory study have been already developed.

### **1.2.3 Research Steering Committee**

With an expanding programme of current research activities supporting the sector, a Research Steering Committee has been established. This committee provides technical and logistical oversight on all planned and ongoing research programmes that are carried out under the auspices of the Ethiopian Roads Authority and furthermore provides an important platform for sharing experiences with others.

The core membership of the steering committee comprises representatives from the following institutions and organizations:

- Ethiopian Roads Authority
- All Regional and Rural Roads Authorities
- Addis Ababa City Roads Authority
- Road Fund Administration Office
- Addis Ababa University,
- Contractors Association
- Consultants Association

Specifically, core members of the steering committee act in partnership to:

1. Provide comment for approval of planned research activities and to provide guidance on identifying needs, scope and approaches
2. Ensure the full cooperation of collaborating agencies engaged on the research projects
3. Provide access to any previous research, data or information related to the research programmes
4. Monitor progress of on-going research activities in terms of major activities; milestones and deliverables
5. Provide timely technical and other comments on draft outputs, documents, inception and progress reports submitted by the projects including strategic decisions on the language, style, format and content
6. Endorse final outputs from the research projects and programmes and agree any next steps
7. Keep the local industry aware of the research activities and promote a wide dissemination of project results
8. Promote collaborative working arrangements with like-minded organizations in the Africa Region and elsewhere

## **1.3 Research Activities**

### **1.3.1 Design Technologies for Universal Rural Road Access**

The government has a set vision to make public, economic and social services physically more accessible to the rural population. There remains a critical need to provide the rural communities with transportation infrastructure and services that ensures permanent accessibility to social and government services, economic and business services, and better opportunities for employment and income generation.

In response to this need, the government is planning a Universal Rural Road Access Programme (URRAP) that sets out to connect all kebele by roads of standard that provide all-weather, year round access, meets the need of the rural communities, are affordable and maintainable.

Prior to implementation of the program, it is necessary to develop robust working guidelines and manuals. Gravel and all weather earth roads will be the principle road types under URRAP. In providing technical support to the Ministry of Works and Urban Development, ERA has identified a number of areas where additional verification and proving work is needed with regards the proposed design and construction approaches. In this regard ERA, in collaboration with the RRA has embarked on a number of research activities to verify the selected technologies in relation to the expected methods of construction and the likely equipment to be used. This includes fine tuning of the design approaches from the geometric, pavement and drainage design perspective.

Specific research projects in support of this programme include:

1. Use of locally available marginal gravel wearing course materials as pavement surfacing
2. Determination of the maximum aggregate size in relation to the selected compaction technology.
3. Passability criteria on expansive soil subgrades
4. Demonstration of all-weather earth road pavements
5. Modeling of labour base low volume roads maintenance
6. Evaluating the performance and cost effectiveness of different pavement options on hilly sections

### 1.3.2 African Community Access Programme

The Africa Community Access Programme (AFCAP) is a research programme funded by the UK government's Department for International Development (DFID), which is promoting safe and sustainable rural access in Africa. AFCAP supports knowledge sharing between participating countries in order to enhance the uptake of low cost, proven solutions for rural access that maximize the use of local resources.

ERA acts in the capacity of programme coordinator for all AFCAP activities in Ethiopia and ERA is now managing a sizable portfolio of research activities under the AFCAP umbrella. Much of this research complements the objectives of the RSDP and URRAP, addresses urgent problems facing the sector, paves the way for better sector interventions in the future and provides lesson learning and technology transfer opportunities.

The current project portfolio of on-going projects includes:

**“Preparation of Manuals and Standard Bidding Documents for Low Volume Roads in Ethiopia”** with an immediate objective of preparing a design manual and accompanying specifications and standard bidding documents for low volume roads in Ethiopia. The purpose of these documents is to promote rational, appropriate and affordable implementation of projects

providing low volume roads that makes appropriate use of local resources, is cost-effective and sustainable.

**“Development of Pavement Design Standards & Specifications For Low Volume Roads in Ethiopia”** where the objective is to develop and demonstrate revised pavement design and surfacing standards for low volume roads and disseminate the application of these standards to stakeholders in the federal and regional governments, the private sector and academic institutions. The project involves the construction and monitoring of demonstration and trial sections of low volume road throughout the county.

**“A review of Surface Dressing Practice in Ethiopia”** where the objective is to investigate the causes of premature failures of surface treatment work in Ethiopia. In recent years the skills and ability to construct these surfacings seems to have been lost. This project seeks to remedy the situation and promote surface treatments as a suitable, affordable and sustainable surfacing technology for the country.

AFCAP is also supporting some of the logistical costs of the **Research Steering Committee** and the preparation of a new research newsletter.

AFCAP has also supported a series of **technical visits** for senior staff from ERA, RRA, Road Fund, Addis Ababa University and Ministry of Education to a number of key international road institutions including - the Council for Scientific and Industrial Research and the South African National Roads Agency in South Africa; the Department of Roads and Ministry of Works and Communications in Botswana; the Australian Road Research Board and the Queensland Department of Main Roads in Australia; the National Rural Roads Development Agency, Ministry of Rural Development, the Centre for Scientific and Industrial Research and the Indian Road Congress in India). A visit was also made to the sister South East Asia Community Access Programme (SEACAP) in Laos by ERA.

Pipeline AFCAP projects include the development of a **“Transport Technology Transfer Centre in Ethiopia”** with a short term objective to establish a technology transfer centre with an initial focus on the roads sector and a longer term objective of expanding and mainstreaming the activities of the technology transfer centre across the whole transport sector in Ethiopia.

### 1.3.3 Other On-going Research

**Monitoring of Contractors/Consultants Performance- and Establishment of Project Costs and Unit Rates Estimation & Monitoring System:** The Ethiopian Roads Authority signed a contract with WSP International management Consulting (WSPimc) in August 2009 to provide services for the “Monitoring of Contract/ Consultants Performance – and Establishment of Project Costs and Unit Rate Estimation and Monitoring System”. The objective of this assignment is to provide ERA with the tools to monitor the performance of contractors and consultants and to develop a construction costs monitoring and unit rates estimation system. Such systems will allow ERA to maintain, in-house, any necessary and independently measured and surveyed cost data, as a basis for evaluation of consultant engineers’ cost estimates, individual unit rates and, ultimately, bid prices. Such systems will also provide important information for estimation of life-cycle costs.

### 1.3.4 Recently Completed Research Programs

**Performance Criteria and Life-Cycle Costing for Low-Volume and Labour-Based Unpaved Roads:** This project, attempted to quantify the effects of parameters such as material properties, traffic, geometry and environment on the rates of deterioration on labour-based unpaved roads in order to give guidance on standards and the impact on total costs. The study was carried out on 24 sections of road throughout Ethiopia. This increased the range of the measured parameters and enabled a life-cycle approach and methodology to be developed. Traffic levels, rates of gravel loss and changes in road roughness and were monitored as the key factors dominating road performance.

The study reported that:

- The average rate of gravel loss for all sites was 37 mm/yr at existing traffic levels and 43 mm/yr for a standard performance at an equivalent of 100 vehicles per day (vpd).
- Performance based specifications were developed for wearing course materials
- High road maintenance costs and very high vehicle operating costs are attributed to use of gravels which are too coarse
- The average rate of gravel loss predicted using HDM-4 (16 mm/yr) was 43% of the observed rate of gravel loss (37 mm/yr)

A life cycle costing methodology and an Excel based life-cycle cost calculator was also developed which enables the frequency of maintenance interventions to be estimated.

## 1.4 Future Research

**Slope Management and Protection:** ERA has prepared a project proposal to develop a National Slope Management System. The main objective of the project is to enable road authorities, facing costly slope stability problems, to effectively estimate the probability of slope instability occurrence, its likely severity and to provide prompt (on time) and appropriate mitigation or response measures that take into consideration economy, safety and environmental friendliness.

**Construction Material Database:** ERA has prepared a project proposal to develop a Road Construction Materials Data Base, the main objective of which is to improve methods of resource location and management using a database integrated with a GIS system. Such systems would produce construction material and environmental management maps.

**Using Remote Sensing Data for Road Project Planning, Preliminary Engineering and Environmental Assessment:** ERA has prepared a project proposal that will enable ERA to plan routes judiciously and taking into consideration economical and environmental benefits. At present, a considerable area of the country is not covered by aerial photographs. In addition, there is little availability of topographic maps to a scale than can be usefully employed for detailed engineering design. As a result, optimal route location is missed, often with severe

environmental and financial implications. This project intends to produce planning tools, based on remote sensing, that can be utilized to:

- Automatically determine the best route to optimize the performance metrics:
  - Environmental
  - Economic
  - Construction Cost
- Designate desired road Start-Point and End-Point (or Line)
- Select the cost values of the Road Construction Cost Matrix (for each slope and terrain cover type combination)