

Sub-Saharan Africa Transport Policy Program

RMF Report No 02/06/Mali



Knowledge Sharing and Promotion of Appropriate  
Pavements and Surfacing Technologies for Low-Volume  
Roads in Mali, Senegal and Burkina Faso

Workshop Report

Bamako – Mali

January 14-19, 2006





# **Workshop Report**

## ***Knowledge Sharing and Promotion of Appropriate Pavements and Surfacing Technologies for Low-volume Roads in Mali, Senegal and Burkina Faso***

**Bamako, Mali  
14<sup>th</sup> – 19<sup>th</sup> January, 2006**

**February 2006**

**Prepared for:**

The SSATP  
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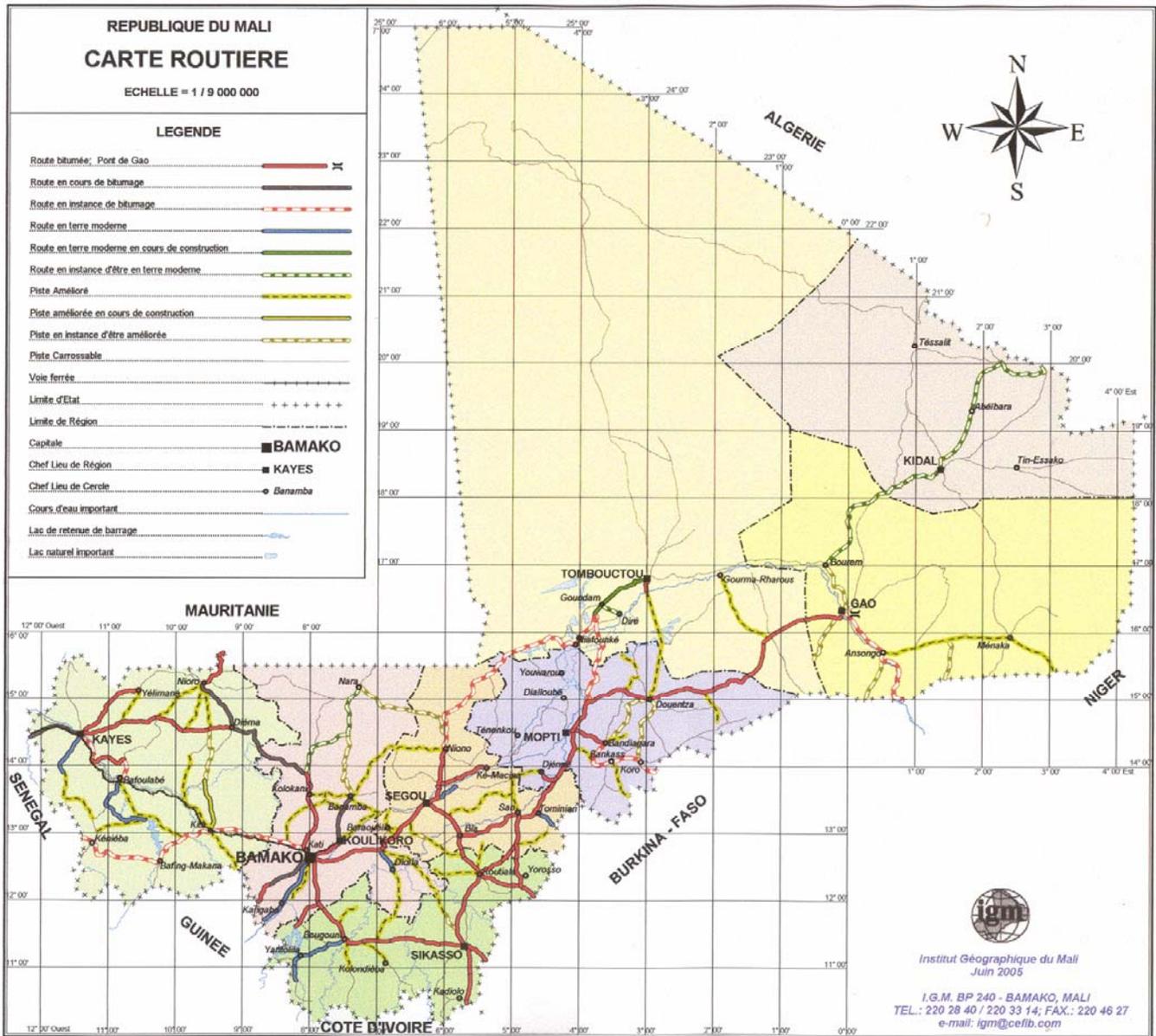
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## LIST OF ABBREVIATIONS

|        |   |
|--------|---|
| AASHTO | American Association of State Highway and Transport Officials |
| CBR    | California Bearing Ratio                                      |
| DBST   | Double Bituminous Surface Treatments                          |
| ESA    | Equivalent Standard Axles                                     |
| LAA    | Los Angeles Abrasion  |
| LTDP   | Long Term Development Plan                                    |
| LVSr   | Low-volume Sealed Roads                                       |
| MDGs   | Millennium Development Goals                                  |
| PCDA   | Agricultural Competitiveness and Diversification Project      |
| QA     | Quality Assurance   |
| RMF    | Road Management and Financing                                 |
| SADC   | Southern Africa Development Community                         |
| SSA    | Sub-Saharan Africa  |
| SSATP  | Sub-Saharan Transport Policy Program                          |
| USA    | United States of America                                      |
| WP     | Work Program  |

## Republic of Mali – Road Map



### Road Classification

| Road Class | Length (km)   | %            |
|------------|---------------|--------------|
| National   | 14,102        | 15.8         |
| Regional   | 7,052         | 8.0          |
| Local      | 28,929        | 32.5         |
| Community  | 38,941        | 43.7         |
| <b>All</b> | <b>89,024</b> | <b>100.0</b> |

Source: Rapport Final: Etude Pour La Determination Des Caracteristiques Geometriques Et Techniques Des Routes Et Des Psites Ameliorees En Republique Du Mali, Dec. 2005

### National Roads by Type

| Type          | Length (km)   | %            |
|---------------|---------------|--------------|
| Bitumen       | 2440.0        | 24.4         |
| Gravel        | 1283.3        | 9.1          |
| Earth/Sand    | 6402.3        | 45.4         |
| Natural Earth | 2975.5        | 21.1         |
| <b>All</b>    | <b>14,102</b> | <b>100.0</b> |

Source: Ministere De L'equiptment Et Des Transports

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## EXECUTIVE SUMMARY

### Background

As part of its support in the thematic area of Road Management and Financing, and on the basis of a specific recommendation arising from the last Annual meeting held in Bamako in November 2005, SSATP is promoting and disseminating aspects of the SADC Guideline on Low-Volume Sealed Roads.

In support of the above, a workshop and related field visits were undertaken in Bamako, Mali by a World Bank/SSATP team from 14<sup>th</sup> – 19<sup>th</sup> January 2006. The objective of the workshop was to disseminate knowledge and promote the use of appropriate technologies in the construction of pavements and bituminous surfacings for low-volume roads. The workshop was attended by a total of 34 delegates from the host country as well as from the neighbouring countries of Senegal and Burkino Faso – three each from the latter countries.

### The Workshop

The 2-day workshop was opened by the General Secretary to the Minister of Equipment and Transport in Mali. The workshop was designed to be interactive in order to maximise the involvement of delegates in discussing burning issues related to pavement and surfacing technologies in their respective countries.

The workshop program included scene-setting presentations by the SSATP/World Bank consultants and break-away working group deliberations on the presentations to discuss the challenges of implementing these new technologies. The scene-setting presentations included:

- Sustainable provision of Low-volume Sealed Roads – General Introduction
- Alternative Surfacing Technologies for Low-volume Sealed Roads + Case Studies
- Alternative Materials and Pavement Design Technologies for Low-Volume Sealed Roads + case Studies.

### Feedback from Workshop

The main issues arising from the workshop deliberations were:

- (a) Barriers to implementing alternative technologies:
  - resistance to change from planners and decision-makers
  - lack of technical specifications and expertise to undertake the new technologies
  - reluctance of donors to accept new technologies

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(b) Means of overcoming barriers

- obtain and disseminate documentation on new technologies (in French)
- conduct lobbying with local decision-makers including awareness workshops, demonstration projects, visits to countries where technologies exist, etc.

(c) Way forward

- obtain urgently relevant documentation on new technologies
- undertake internal review and advocacy initiatives aimed at obtaining agreement for implementing pilot projects on new technologies, including field visits to countries where technologies had been implemented
- consider PCDA project as a vehicle for implementing pilot projects on a selective, spot-improvement basis
- obtain assistance from SSATP in undertaking the pilot projects

### **Outcome of Workshop**

The participants expressed their appreciation of the initiative taken by the SSATP/World Bank in holding the workshop. They stated that they had benefited very much from the presentations of the consultants and were of the view that the workshop had achieved its objectives.

### **Recommendations**

(1) Relevant documentation on the Otta and Sand seals should be translated into French and provided to the relevant authorities in Mali as soon as possible.

(2) The PCDA project should be used as a vehicle to undertake a number of demonstration projects on a selective, spot-improvement, basis, including:

- Otta seal surfacing (single Otta + Sand seal, double Otta, etc)
- Screened laterite/decomposed granite surfacing
- Higher compaction levels in pavement layers

(3) Assistance should be provided to the relevant authorities in Mali to undertake the demonstration projects including the design,, contract documentation, contractor training and construction supervision of the projects.

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## 1. INTRODUCTION

### Background

1.1 The 2006 Work Program (WP) of the Sub-Saharan Africa Transport Policy Program (SSATP) is contained within a framework of priority thematic areas: (a) Road Management and Financing; (b) Appropriate Transport Services; and (c) Regional Integration and Transport. Overarching initiatives comprise transport strategy development based on the outcomes of ongoing poverty/transport analytical work (ensuring transport fully responsive to poverty reduction strategies) and the establishment of appropriate transport sector performance indicators linked to the Millennium Development Goals (MDGs). The work program is the second of four annual programs which will incrementally achieve the objectives of the SSATP Long Term Development Plan (LTDP) which runs to 2007.

1.2 The Road Management and Financing (RMF) Thematic area includes a number of initiatives namely: road network management (institutional and financial arrangements), road fund enhancement, road agency improvements, and capacity building and training. Many countries have embarked on reform agendas, but adherence to sound policy principles and emulation of established good practice is, in a number of cases, problematical. The SSATP is addressing demands for support in these areas in a number of ways, including the implementation of activities arising from specific recommendations made by the last SSATP Annual Meeting held in Bamako, Mali, in November 2005.

1.3 One such activity is the promotion and dissemination of the SADC Guideline on Low-volume Sealed Roads (LVSR), and support to the collection of corresponding experiences from SSA. Whilst the approach and the philosophy of the Guideline have been practiced in some countries over a number of years, the Guideline is now enabling a more comprehensive and coherent approach to be adopted in the utilization of technologies and methods that focus on the utilization of locally available materials. The major impacts of adopting such approaches include a reduction of life-cycle costs. Another important factor is a reduction in the continuous exploitation of non-renewable gravel sources, more so when "good" gravel is used in an inappropriate manner.

### Objectives

1.4 The main objectives of the workshop were to disseminate knowledge and promote the use of appropriate technologies in the construction of pavements and bituminous surface treatments for low-volume roads in SSATP partner countries, in this case, Mali, Senegal and Burkina Faso.

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## Scope of Work

1.5 In order to achieve the above objective, the following scope of work was undertaken by the SSATP/World Bank consultants, under the guidance of the RMF thematic leader.

- (1) Undertaking field visits to assess the prevailing environment in terms of the availability of materials and road construction plant.
- (2) Undertaking an interactive workshop in Mali to outline the concept and philosophy behind the SADC LVSR Guideline, including case studies, as a basis for knowledge sharing and possible application in the mentioned countries.
- (3) Briefing the workshop participants on the way forward with regard to the potential for utilizing more appropriate technologies in the provision of low-volume sealed road applications.

## Terms of Reference

1.6 The Terms of Reference for the SSATP/World Bank consultants are attached as Annex A to this report.

## Program

1.7 The programme for fulfilling the full scope of the Terms of Reference is summarised below:

|                                  |   |
|----------------------------------|---|
| <b>Day 1</b><br>Sunday 14 Jan.   | - 12.15 hrs: Consultants arrive in Mali<br>- 16.00 – 19.30 hrs: Field trip  |
| <b>Day 2</b><br>Monday 15 Jan.   | - 08.00 -11.30 hrs: Courtesy calls on the General Secretary to the Minister of Equipment and Transport; the Director General, Ministry of Equipment and Transport and the National Deputy Manager of Roads.<br>- 11.30 – 12.30 hrs: Finalisation of workshop programme and logistics<br>- 15.30 – 19.00 hrs: Field trip |
| <b>Day 3</b><br>Tuesday 16 Jan.  | - 08.00 – 19.00 hrs: Field trip   |
| <b>Day 4</b><br>Wednesday 17 Jan | - 08.00 – 17.00 hrs: Workshop   |
| <b>Day 5</b><br>Thursday 18 Jan. | - 08.00 – 16.00 hrs: Workshop   |
| <b>Day 6</b><br>Friday 19 Jan.   | - 09.00 – 11.00 hrs: Visit to National Centre for Research and Experiments<br>- 14.00 – 16.00 hrs: Internal wrap-up meeting<br>- 19.00 hrs: Departure from Mali   |

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## 2. FIELD TRIPS

### Introduction

2.1 Field trips were undertaken by the SSATP/World Bank team and the workshop participants from Mali, Senegal and Burkino Faso to a cross-section of road types, including those in the World Bank supported Agricultural Competitiveness and Diversification Project (PCDA). The main objective of these trips was for participants to familiarise themselves with various aspects of road technology in Mali including road standards and performance, availability and utilisation of road construction materials and construction plant and challenges faced in managing unpaved roads.

### Itinerary

2.2 Prior to the workshop, field trips were undertaken by the SSATP/World Bank team to the following roads:

- (1) Sunday 17<sup>th</sup> (16.30 – 19.00 hrs): Bamako-Koulikoro (57 km): National, bitumen surfaced road.
- (2) Monday 18<sup>th</sup> January (15.30-19.00 hrs): Bamako-Dioliba (40 km): Regional, unsurfaced road.

2.3 An all-day trip was also undertaken on Tuesday 19<sup>th</sup> January involving participants from the three participating countries as well as representatives of the PCDA project. This trip focused on the roads included in the PCDA project which is located in a cotton growing area south of Bamako. The PCDA project is being funded by the World Bank and consideration is being given to the use of innovative pavement and surfacing technologies that have been developed in Southern Africa which could have potential application on a spot-improvement basis. The PCDA project area is shown in Figure 1.

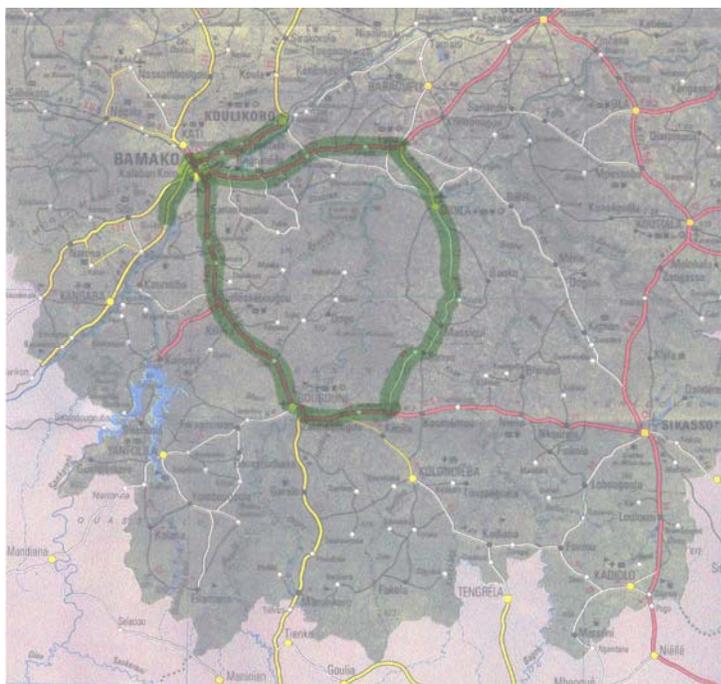


Fig. 1–Roads visited during field trip

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2.4 The roads inspected during the field trip to the PCDA project included the following:

- (1) Bamako-Fana (125 km): National road, bitumen surfaced
- (2) Fana-Dioila (40 km): Regional road, unsurfaced
- (3) Dioila-Massigui (77 km): Regional road, unpaved
- (4) Massigui-Sanso-Intersection with Bougouni-Sikasso road (65 km): unsurfaced
- (5) Intersection with Bougouni-Sikasso road-Bougouni (56 km: National road, bitumen surfaced
- (6) Bougouni-Ouelessebougou (77 km): National road, bitumen surfaced
- (7) Ouelessebougou-Bamako (86 km): National road, bitumen surfaced

### Observations

2.5 **General:** The site visits allowed a representative cross-section of roads to be inspected ranging from bitumen surfaced National Roads, through engineered gravel Regional Roads to un-engineered earth/gravel Local Roads. These typical road types are illustrated below:



Typical bitumen surfaced National road between Bamako and Ouelessebougou (N7)



Typical bitumen surfaced National road between Bamako and Koulikoro



Typical engineered gravel Regional road between Fana and Dioila (R18)



Typical un-engineered, gravel roads in cotton growing area south of Bamako

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2.6 **Materials availability and utilization:** A wide range of natural gravels are available for road construction in Mali. These include:

- (a) gravel from the Niger River which provides a valuable source of road building material as well as significant employment. The river gravel is used for a variety of purposes, including bituminous surfacing, as illustrated below:



Extraction of gravel from the River Niger – a tedious, time-consuming activity yielding typically about 2 – 3 cubic metres per day



Off-loading and washing of gravel to remove fines prior to stock piling on the river bank



Sieving and stock piling of gravel into various sizes – all ready for sale



Double bituminous surfacing using river gravel; constructed in 1997, still performing very well.

- (b) Lateritic gravels - the product of intensive weathering of the parent rock and continued leaching of the initial weathering products to produce a variable, concretionary (hardened) deposit of laterite – occur extensively in southern Mali. These gravels are used both as a wearing course for unpaved roads and as basecourse for paved roads. In addition, where the nodules are hard enough, they have been screened to an appropriate size and, quite innovatively, used as a surfacing aggregate. Decomposed granite and quartzitic gravels also occur extensively in southern Mali and are also used for road construction.



Stock piled, as-dug wearing course material from laterite borrow pit



Nodular laterite used as basecourse on national road between Bamako and Koulikoro



Laterite nodules, when hard enough, can be screened to produce a satisfactory aggregate for a bituminous surfacing



In high rainfall areas (> 1000 mm /year), such as in the cotton growing region of Mali, gravel loss is very high and regraveling is required every two to three years.



Typical laterite gravel road. Generation of dust is a constant hazard to inhabitants living nearby and their crops as well as posing a serious road safety problem to overtaking motorists



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## Discussion

2.7 The following are some of the key issues arising from discussions amongst the participants who undertook the field trip.

- (1) River gravel surfacing was not used extensively in Mali. However, where it had been used (e.g. on the Bamako-Koulikouro road) it had performed very well with an expected service in excess of 10 years. The typical surfacing design was as follows:
  - (a) Prime: 0.8 l/m<sup>2</sup> of MC 30 pen. Grade bitumen
  - (b) 1<sup>st</sup> layer surfacing: Aggregate grading 16-10 mm; binder 1.3 – 1.5 l/m<sup>2</sup> of 400 – 600 pen. Grade bitumen (viscosity equivalent to MC 3000 – 150/200 pen. grade bitumen)
  - (c) 2<sup>nd</sup> layer surfacing: Aggregate grading 8 – 4 mm; binder 2.0 – 2.2 l/m<sup>2</sup>
- (2) Screened laterite gravel had been used successfully on a national road in Mali over a length of 75 km. There was potential for using screened gravel in both Senegal and Burkino Faso.
- (3) Maintaining laterite gravel roads in the PCDA area was a major problem. Due to a combination of high rainfall and the characteristics of the lateritic gravels, it was necessary to have to re-gravel every 2 – 3 years. This was considered a costly waste of finite resources and some form of low cost seal was considered necessary. Dust in villages was also a major problem in the dry season.

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### 3. THE WORKSHOP

#### Objectives

3.1 The main objective of the workshop was to outline the concept and philosophy behind the SADC LVSR Guideline, including case studies, as a basis for knowledge sharing and promotion of appropriate technologies in the construction of pavements and bituminous surface treatments for possible application in the Mali, Senegal and Burkino Faso.

#### Program

3.2 The workshop took place in the conference room of the Ministry of Equipment and Transport. The programme for the workshop is attached as Annex B.

#### Attendance

3.3 The workshop was attended by some thirty four delegates including three each from Senegal, and Burkino Faso. The attendance list is attached as Annex C.



**Participants attending workshop on *Appropriate Pavements and Surfacing Technologies for Low-volume Roads* that was held in Bamako, Mali, 15 – 16 February, 2006**

#### Preliminaries

3.4 **Opening Remarks:** The Opening Remarks were made by Mr. Olav Ellevset, Senior Transport Specialist, SSATP/World Bank Program. During his presentation, Mr. Ellevset focused on the following aspects of the SSATP/World Bank Program:

- 
- Objectives
  - Key thematic areas
  - Achievements of the Road Management and Financing (RMF) area
  - 2006 work program highlights

3.5 **Welcome Remarks:** The Welcome Remarks were made by the General Secretary to the Minister of Equipment and Transport in Mali, Honourable Makan Fily Dabo. Mr. Dabo's remarks may be summarised as follows:

- Mali was appreciative of the support that it has received from the SSATP and the World Bank which has contributed to the development of the country;
- The workshop was very important to the country's road sector and all the related departments would be involved as well as representatives from the neighbouring countries of Senegal and Burkino Faso;
- Roads are the key to the development of any developing country; without roads there would be very little development;
- The life blood of Mali's economy was mining and eco-tourism. Lack of road infrastructure, especially access roads, was hampering the development of these and other sectors of the economy as well;
- The Ministry of Equipment and Transport was fully committed to the development of road infrastructure as a means of improving the economic and social development needs of the country and, by so doing, reducing poverty;
- The SSATP/World Bank team as well as many participants of the workshop would have gone on field trips where they would have seen the many challenges faced by the Ministry of Equipment and Infrastructure in maintaining roads, especially gravel roads, which posed a major challenge.
- The Government's motto is to fight poverty; this entails the provision of road infrastructure initiatives that rely on providing good permanent access for many people in rural areas on a cost effective and sustainable basis.

3.6 In concluding his Welcome Remarks, Mr. Dabo thanked the SSATP and the World Bank again for undertaking the workshop in Mali and wished the participants well in their deliberations which he hoped would lead to improved ways of providing road infrastructure in Mali.

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## Introductory Remarks

3.7 Introductory remarks on the workshop were made by Mr. Olav Ellevset. He firstly expressed the gratitude of the SSATP Program and the World Bank to the Government of Mali for hosting the workshop. He also expressed his thanks to the participants, including those from Senegal and Burkino Faso, for participating in the workshop.

3.8 Some of the key points made by Mr. Ellevset in his Introductory Remarks are as follows:

- The workshop was meant to serve as a forum for sensitization and exchange of experiences based on practical applications in several countries. The workshop will use Mali's Agricultural Competitiveness and Diversification Project as example roads.
- In Mali, delegates might have seen gravel or earth roads that have been repaired and improved with a lot of effort and money, and which have served their purpose for some time. However, too often harsh weather conditions, sometimes combined with poor materials, have made these efforts and investments last for a short period only. In these circumstances, the investments involved in providing traditional bituminous surfacings may not be justifiable due to lack of good quality materials within reasonable haul distance and high costs in relation to the number of vehicles using the road.
- The workshop will deal with alternative surfacing technologies that may be viable even for relatively low traffic roads and could offer life-cycle cost savings of about 30 – 50 per cent, compared to traditional surfacing technologies.
- Overload control remains a threat to Mali's roads and effective control of overloading is of paramount importance to preserve the investments made in providing roads.
- When manpower is available, the use of labour-based technology can provide significant employment opportunities, thereby reducing poverty – an overarching goal of the SSATO Program.

3.9 Mr. Ellevset concluded his remarks by expressing the hope that the participants will find the outcome of the workshop interesting enough to engage in further steps for identifying the viability of customized applications within the framework of on-going and future projects in their respective countries.

## Presentations

3.10 **Presentation No. 1:** The first presentation was made by Mr. Mike Pinard, a SSATP/World Bank consultant, on "*Sustainable Provision of Low-Volume Sealed Roads*". Mr. Pinard's presentation is included as Annex D.

- 
- Background to the SADC Guideline on Low-Volume Sealed Roads
  - Why low-volume sealed roads
  - New approaches and challenges

3.11 **Presentation No. 2:** The second presentation was made by Mr. Charles Overby, a SSATP/World Bank Consultant, on *“Surfacing Technologies for low-Volume Sealed Roads”*. Mr. Overby's presentation, which is included in Annex D, dealt with the following main topics:

- Bituminous surfacings for low volume sealed roads
- The Otta Seal Surfacing
- Example of the use of Otta Seals in Ghana

3.12 **Presentation No. 3:** The third presentation was made by Mr. Mike Pinard on *“Materials and Pavement Design Technologies for Low-volume Sealed Roads”* Mr. Pinard's presentation, which is included as Annex F, dealt with the following main topics:

- General introduction
- Materials issues
- Pavement issues
- Other issues
- Examples

### General discussions

3.13 In the discussion period following the consultant's presentation a number of comments were made by participants focusing initially on observations arising from the field and then on the consultant's presentations. These comments may be summarized as follows:

#### ***Participants observations on field trip***

- *The approach to dealing with the roads in the PCDA project would be to attend to critical sections on a spot-improvement basis to provide all-year accessibility. If the introduction of the alternative technologies could help to improve the poor sections at relatively low cost on a more permanent basis then that help Mali to remove the accessibility bottlenecks that are currently a major problem.*
- *The laterite gravel roads seen during the field trip in the cotton growing areas of Mali perform satisfactorily for a short time after they are constructed. However, even with relatively low traffic levels, the gravel roads tend to degrade quite rapidly due to the high rainfall. As a result, these roads need to be regravelled typically within 2 – 3 years. Also,*

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*gravel roads are dusty for 10 months of the year which is a problem in villages. A more cost effective and sustainable solution is required.*

- *The state of gravel roads in Burkina Faso is similar to that of Mali – they deteriorate relatively quickly after construction. There is a need for alternative solutions. The door is open to trying the alternative pavement and surfacing technologies presented at the workshop.*
- *Research on local materials is required to allow countries such as Mali, Senegal and Burkina Faso to use their local materials more extensively. The existing standards and specifications preclude the use of some local materials that are known to perform successfully.*

#### ***Participants comments on presentations***

- *(1) If Mali were to decide to try out these alternative pavement and surfacing technologies would SSATP be able to assist?*
- *(2) The alternative technologies presented by the consultants entail the adoption of non-standard materials. Are there published standards and specifications that apply to these technologies?*
- *(3) Where the new technologies have been used, have there been any failures?*
- *(4) If sealed pavement strength requirements are reduced from a CBR of 80% to 60% as proposed, will the pavement materials not break down and the pavements perform poorly?*

#### ***Response to participants' comments***

- *(1) Reply by World Bank: Yes, to some extent, SSATP would be able to assist by providing the necessary technical assistance to work with the local counterparts to incorporate these new technologies on a spot-improvement basis on the PCDA project. More comprehensive technical assistance must be financed by the specific transport projects in the respective countries.*
- *(2) Reply by consultants: Yes, there are published standards for both the pavement and surfacing technologies presented. These are based on research work that has been carried out in the Southern African region by research organisations over the past 20, including the use of local materials such as laterites which also occur extensively in Mali, Senegal and Burkino Faso.*

*(3) Yes, where the new technologies have been introduced, there have been failures for a variety of reasons that may not directly be attributed to the technology itself. Such failures are almost inevitable with the introduction of any new technology. However, where the technology has been properly applied, they have performed successfully.*

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- (4) Research evidence in Southern Africa has revealed that, in certain circumstances, the minimum soaked CBR of 80% for natural gravel roadbases is inappropriately high for many low-volume (< 0.5 million ESAs) sealed roads. By adopting an “environmentally optimized” design approach, including (1) sealing of shoulders (at least 1 metre wide), (ii) maintaining a crown height of at least 0.75 metres and (iii) increasing the density of the pavement layers above traditional limits, and (iv) paying strict attention to drainage, there is little risk of not obtaining good performance from such designed pavements.

### Working Group Deliberations

3.14 As a means of assessing the way forward with regard to the introduction of the alternative pavement and surfacing technologies to Mali, Senegal and Burkino Faso, two working groups were tasked with considering a number of key issues as follows:

3.15 *Issues considered by Working Group No. (Mali delegates).*

Issue No. 1: Consider and list any constraints that may, in general, occur with regard to adopting the alternative technologies presented.

3.16 *Feedback from Working Group No. 1 (Issue No.1):*

*The constraints that are likely to occur with the adoption of the alternative technologies are as follows:*

Political constraints

- Acceptance of the new technology by decision-makers

Social constraints

- Scepticism from users

Institutional constraints

- None

Technical constraints

- Lack of technical specifications adapted for the implementation of the new technology (standards, technical specifications, implementation standards);
- Lack of local expertise (training, administration, consultancy firms, contractors).

Economic constraints

- Economic profitability

Financial constraints

- Resource mobilisation constraints
- Lack of adequate resources

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Environmental constraints

- None

3.17 ***Issue No. 2:*** Consider the alternative technologies presented yesterday and list those that are viable for introduction in Mali.

3.18 ***Feedback from Working Group No. 1 (Issue No.2):***

The following aspects of the new technologies are viable for introduction in Mali:

- Sealing of shoulders
- Demonstration of the Otta Seal surfacing
- Increasing the compaction of the pavement layers

3.19 ***Issues considered by Working Group No. 2 (Senegal and Burkino Faso delegates)***

- (i) ***Issue No. 1:*** List any issues that can be regarded as constraints in adopting the new technologies in terms of the “seven dimensions of sustainability” (political, social, institutional, technical, economic, financial and environmental issues).

3.20 ***Feedback from Working Group No.2 - Issue No.1 :***

*The constraints that are likely to occur with the adoption of the alternative technologies are as follows:*

Political constraints

- Lack of political commitment – need to convince politicians of merits of new technologies

Social constraints

- Reluctance to accept what might be perceived as a “cheap” solution in contrast to what is traditionally accepted as a “good” solution (e.g. asphaltic concrete surfacing on a crushed stone base).

Institutional constraints

- Reluctance from planners to go along with new technologies
- Basis for selecting/prioritising sections of road for use with new technologies where there is a multiplicity of stakeholders
- Capacity constraints in local communities to implement new technologies (responsibilities for local/access roads decentralised to local communities)

Technical constraints

- Challenges of introducing new technologies vis-à-vis better known, traditional technologies
- Lack of appropriate specifications
- Lack of training for introduction of new technologies

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*Economic constraints*

- Difficulty to abide by economic criteria
- Owners of borrow pits will have their livelihoods threatened as less material will be required with low cost seals

*Financial constraints*

- Reluctance from donors to accept new technologies
- There will be life-cycle savings from new technologies but a commensurate need for an increase in the initial investment

*Environmental constraints*

- Multiplicity of borrow pit activities
- Risk of exposure to dust in gravel screening process and inadequate protection for workers
- Depletion of local materials

3.21 **Issue No. 2:** If regarded feasible in your country, what would be required to implement the alternative technologies?

*Feedback from Working Group No.2 - Issue No.2 :*

- Conduct lobbying with local decision makers
- Organise national dissemination workshops for creating awareness of new technologies
- Undertake capacity building through seminars, workshops, etc.
- Structure set up to promote new technologies
- Obtain and disseminate documentation on new technologies
- Undertake demonstration projects
- Evaluation of already completed projects to highlight results
- Development of case studies to convince donors of the benefits of the new technologies

*General discussion of feedback from Working Groups*

3.22 The feedback from both Working Groups was similar in many respects except for Institutional and Environmental constraints for which Working Group 1 felt that there were no such constraints. However, upon further discussion, it was concluded that:

- (1) With the introduction of any new technology, the institutional environment would normally need to re-orientate its operations accordingly.
- (2) There would be environmental impacts caused by the introduction of the new technologies. Importantly, there would be reduced borrow pit activities, as well as reduced depletion of local resources. The risk of exposure to the screening of gravel could be mitigated by the provision of masks.

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## Way forward

3.23 The following issues were raised by participants as regards the way forward:

- (1) The priority need was to obtain the relevant documentation on the new technologies, including technical papers, manuals, specifications, etc., in French.
- (2) The roads agencies would need to review the literature themselves, to undertake field trips to countries where the new technology had been applied and to hold internal discussions and, on this basis, to agree the way forward.
- (3) The PCDA project in Mali offers the potential to try out the new technologies on a "spot improvement" basis.
- (4) SSATP assistance would be required to assist with the implementation of the new technologies.

## Workshop Closure

### *Closing remarks by participant from Burkino Faso*

3.24 On behalf of all the delegates to the workshop, Mrs. Maria Ouedraogo expressed their thanks to the Government of Mali for hosting the workshop and to the SSATP and the World Bank for arranging the workshop. In her closing remarks, she stated that:

- All the participants were very pleased and satisfied at the outcome of the workshop and had benefited very much from the presentations of the consultants.
- The workshop had achieved its objective of sharing experiences with all participants on alternative pavement and surfacing technologies that are potentially applicable to Mali, Senegal and Burkino Faso.

### *Closing remarks by the Director General, Ministry of Equipment and Transport*

3.25 On behalf of the Minister of Equipment and Transport, the Director General of that Ministry, Mr. Gabouné thanked all those who, in some way or another, were involved in the workshop, including:

- The SSATP and the World Bank for holding the workshop which came at an opportune time to Mali in terms of offering alternative technologies for assisting to overcome the problem of managing unpaved roads more cost effectively.
- The consultants for their enlightening presentations and sharing of their experiences of the new technologies

- 
- The National Deputy manager of Roads for managing all the local arrangements
  - The representatives of the PCDA for participating in the field trips and for providing the excellent lunches during the workshop
  - The interpreters for doing an excellent job during the workshop

3.26 In concluding his remarks, the Director General expressed the hope that the relevant documentation on the new technologies would be provided in French so that the respective countries would be in a better position to disseminate the information and, eventually, implement the new technologies.

*Closing remarks by the SSATP/World Bank Senior Transport Specialist*

3.27 On behalf of the SSATP/World Bank, Mr. Olav Ellevset firstly thanked both the participant from Burkina Faso and the Director General for their kind remarks. The remainder of his concluding remarks are summarized below:

- With the excellent presentations and very knowledgeable and interested participants from Mali, Senegal and Burkina Faso, the objective of the workshop, which was to share and disseminate knowledge related to appropriate technologies in the construction of pavements and bituminous surface treatments for low-volume roads, had been achieved.
- From the feedback from the workshop, some practical measures will be called for in terms of the way forward. They include: translating the documentation into French for further dissemination of these new technologies, undertaking advocacy with decision makers and organizing study tours. .

3.28 In concluding his remarks, Mr. Ellevset thanked the Malian Government including, particularly, the authorities of the Ministry of Transport and Equipment for the hospitality and the warmth of the welcome extended to the SSATP/World Bank team since their arrival in Mali. Finally, he thanked all participants for the valuable contributions to the workshop deliberations and assured them that the SSATP will always be on your side in exploring new ways of doing things.

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## 4. VISIT TO NATIONAL RESEARCH AND EXPERIMENT CENTRE

### Introduction

4.1 The SSATP/World Bank consultants visited the National Research and Experiment Centre for Buildings and Public Roads on Friday 20<sup>th</sup> January 2006 where a meeting was held with the Director General and some of his staff. The objective of this meeting was to ascertain the role and function of the research centre and the nature of its on-going activities which are described below

### Establishment and Role of Centre

4.2 Prior to 1990, the Central Materials Laboratory existed as part of the Ministry of Equipment and Transport. However, during the riots of 1990/91, the laboratory was largely destroyed and had to be re-established. It was subsequently re-named the National Research and Experiment Centre for Buildings and Public Roads.

4.3 The current Centre for Research is a public establishment headed by a director and a Deputy Director. It employs a total 66 persons of which 5 are engineers and 10 are technicians. The Centre consists of four sections, namely:

- Soil mechanics and foundation
- Road studies
- Research section and
- Administration

4.4 The Centre operates with a Government subsidy. However, it also undertakes work from the private sector on a commercial basis. The Centre focuses mainly on road related projects but also undertakes work in the building construction sector, including research into local materials, building foundations and dams.

4.5 The staff of the Centre confirmed that they could do most common material testing with regard to soil mechanics and asphalt. They also had equipment for geotechnical site investigations and for QA follow-up for road works.

### Standards and Specifications

4.6 The soils and materials testing procedures follow mainly French standards which, in general, are based on the AASHTO standards. The specifications followed for road works are based on French specifications. However, the engineers felt that many of the traditional French specifications are not appropriate for conditions prevailing such as the CBR requirements of 80% which they felt was too restrictive as experience in the country has shown that CBR values as low as 50 – 60% have performed well.

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4.7 The engineers confirmed information given earlier during the visit, viz:

- (1) for surfacing aggregate a Los Angeles Abrasion (LAA) requirement of 25-26 is normally used.
- (2) about 90% of the surfaced road network had a crushed stone base while the remaining 10% consisted of laterite or decomposed granite.
- (3) surfacing aggregate produced from screened decomposed granite had been used on a 75 km long section of road and had performed well;
- (4) Most of the road network was surfaced with a bituminous Chip seal using crushed dolerite. Only a small quantity of river gravel has been used for surfacing purposes.
- (5) When asphalt concrete is produced they always use crushed dolerite.

4.8 It was observed during the visit that laboratory testing activity was not very high.

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## 5. OBSERVATIONS, CONCLUSIONS AND RECOMMENDATIONS

### Observations

5.1 In Mali, local materials for surfacing are used in a number of interesting combinations, viz:

- gravel extracted from the Niger River - a huge industry providing significant livelihood opportunities for many persons in Bamako (see photos).
- river gravel is used for a variety of purposes including a small amount of surface treatment as well as for making cement and asphalt concrete.
- sand seals are not used although sand asphalt is. There is scope for using the former as a surfacing on low traffic roads.
- screened laterite, when the aggregate is hard enough, is also used successfully with traditional penetration grade binders.

5.2 Problems are experienced with maintaining gravel roads. The laterite surfaces become very dusty in the dry weather and slippery in the wet weather. Moreover, the high rainfall levels, generally in excess of 1000 mm in the south of the country, exacerbate the normal institutional and technical problems faced in such circumstances, requiring costly re-gravelling every 2 – 3 years.

5.3 Mali is anxious to seal as many of their unpaved roads as possible with "low cost seals". However, the biggest problem seems to be convincing donors that, in principle, attempting to maintain gravel roads in the traditional manner is simply beyond the institutional, financial and technical capacity of the roads agency, especially when regravelling is required every 2 - 3 years.

5.4 Mali's standards and specifications are admitted to be inappropriate in many respects and limit the use of natural gravels. Typically, crushed stone is required for base course on donor funded projects although local experience shows quite clearly that in many situations laterite bases are a viable option. However, the standards and specifications are currently being revised.

5.5 Sealing of shoulders does not appear to be common practice. This measure would certainly offer immediate and significant advantages in terms of a saving on shoulder regravelling and improved pavement performance.

5.6 Mali's on-going revision of its materials specifications is commendable but does not appear to take account of developments in materials technology based on research work undertaken in Southern Africa and elsewhere during the past 20 years.

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## Conclusions

5.7 The Niger river contains abundant gravel which can be used in a number of surface treatments, such as an Otta seal, Sand seal and also as a more graded Chip seal or other combination seals.

5.8 There is scope for extending the existing surfacing options including the use of sand seals, especially through villages, for dust suppression purposes, as well as screened decomposed granite/laterite, where the aggregate is hard enough, in Otta seals with the use of a softer bitumen or as a Chip seal.

5.9 There are no reasons why the compaction requirements could not be increased in the subgrade and pavement layers in order to make a stiffer, less moisture sensitive pavement structure and, ultimately, a longer lasting pavement for a given traffic loading.

## Recommendations

5.10 Relevant documentation on the Otta and Sand seals should be translated into French and provided to the relevant authorities in Mali as soon as possible.

5.11 The PCDA project should be used as a vehicle to undertake a number of demonstration projects on a selective, spot-improvement, basis, including:

- Otta seal surfacing (single Otta + Sand seal, double Otta, etc)
- Screened laterite/decomposed granite surfacing
- Higher compaction levels in pavement layers

5.12 Assistance should be provided to the relevant authorities in Mali to undertake the demonstration projects indicated in 5.8 above, including the design, contract documentation, contractor training and construction supervision of the projects.

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## **Annexes**

## **SUB-SAHARAN TRANSPORT POLICY PROGRAM**

**Short Term Consultancy Services for Facilitating a Workshop on Knowledge Sharing and Promotion of Appropriate Pavements and Bituminous Surface Treatment Technologies for Low-volume Roads in Mali, Senegal and Burkina Faso.**

### **Terms of Reference**

#### **Background**

The 2006 Work Program (WP) of the Sub-Saharan Africa Transport Policy Program (SSATP) is contained within a framework of priority thematic areas: (a) Road Management and Financing; (b) Appropriate Transport Services; and (c) Regional Integration and Transport. Overarching initiatives comprise transport strategy development based on the outcomes of ongoing poverty/transport analytical work (ensuring transport fully responsive to poverty reduction strategies) and the establishment of appropriate transport sector performance indicators linked to the Millennium Development Goals (MDGs). The work program is the second of four annual programs which will incrementally achieve the objectives of the SSATP Long Term Development Plan (LTDP) which runs to 2007.

The Road Management and Financing (RMF) Thematic area includes a number of initiatives namely: road network management (institutional and financial arrangements), road fund enhancement, road agency improvements, and capacity building and training. Many countries have embarked on reform agendas, but adherence to sound policy principles and emulation of established good practice is, in a number of cases, problematical. The SSATP is addressing demands for support in these areas in a number of ways, including the implementation of activities arising from specific recommendations made by the last SSATP Annual Meeting held in Bamako, Mali, in November 2005.

One such activity for which the current terms of reference are written is the promotion and dissemination of the SADC Guideline on Low volume sealed roads (LVSR), and support to the collection of corresponding experiences from SSA. Whilst the approach and the philosophy of the Guideline have been practiced in some countries over a number of years, the Guideline is now enabling a more comprehensive and coherent approach to be adopted in the utilization of technologies and methods that focus on the utilization of locally available materials. The major impacts of adopting such approaches include a reduction of life-cycle costs. Another important factor is a reduction in the continuous exploitation of non-renewable gravel sources, more so when when "good" gravel is used in an inappropriate manner.

#### **Objectives**

The objective of the consultancy services is to disseminate knowledge and promote the use of appropriate technologies in the construction of pavements and bituminous surface treatments for low-volume roads in SSATP partner countries, this time particularly for Mali, Senegal and Burkina Faso.

## **Scope of Work**

Under the guidance of the RMF thematic leader, the consultants will carry out the following:

1. To undertake field visits to assess the prevailing environment in terms of the availability of materials and road construction plant. Also, to brief the workshop participants on the way forward with regard to the potential for utilizing more appropriate technologies in the provision of low-volume sealed road applications.
2. To undertake an interactive workshop in Mali to outline the concept and philosophy behind the SADC LVSR Guideline, including case studies, as a basis for knowledge sharing and possible application in the mentioned countries.

Presentations and materials can be provided in English, and the SSATP will provide for English interpretation and translation of documents.

## **Resources**

The consultants, Mr. Mike I. Pinard and Mr. Charles Overby, are the two of the core team of authors of the SADC Guideline for Low Volume Sealed Roads presently available. Due to the in-depth knowledge behind the Guideline, they have been selected sole source to undertake the consultancy.

Total time input for both consultants will be:

|                                      |     |       |
|--------------------------------------|-----|-------|
| (a) Preparation of workshop program: | 0.5 | days  |
| (b) Preparation of PP presentation:  | 2   | days  |
| (c) Visit to Mali:                   | 16  | days  |
| (d) Preparation of report:           | 2.5 | days  |
| Total:                               | 21  | days. |

## **Timeframe and Reporting**

The Consultants will arrive in Mali on or about Sunday 15 January, and will depart on or about Saturday 21 January, 2005.

The deliverables are:

- (a) Preparation of workshop program
- (b) Preparation of PP Presentations for workshop
- (c) Preparation of a report summarising the outcome of the workshop and the field visit

Programme - Day 1

|                      |   |
|----------------------|---|
| <b>08.30 – 09.00</b> | <b>REGISTRATION OF DELEGATES</b>  |
| <b>09.00 – 13.00</b> | <b>MORNING SESSION</b>  |
| 09.00 – 09.10        | Opening Remarks<br><i>Olav Ellevset, SSATP/World Bank</i>   |
| 09.10 – 09.20        | Welcome Address<br><i>Secretary General, MET</i>  |
| 09.20 – 09.30        | Break   |
| 09.30 – 09.40        | Introductory Remarks<br><i>Olav Ellevset, SSATP/World Bank</i>  |
| 09.30 – 10.15        | New Approaches to Sustainable Provision of Low-volume Sealed Roads<br><i>Mike Pinard</i>                                |
| 10.15 – 11.00        | Alternative Surfacing Technologies for Low-volume Sealed Roads + Case Studies<br><i>Charles Overby</i>                  |
| <b>11.00 – 11.30</b> | <b>Coffee/Tea Break</b>   |
| 11.30 – 11.45        | Discussion<br><i>All Participants</i>   |
| 11.45 – 12.30        | Alternative Materials and Pavement Design Technologies for Low-volume Sealed Roads + Case Studies<br><i>Mike Pinard</i> |
| 12.30 – 13.00        | Discussion<br><i>All Participants</i>   |
| <b>13.00 – 14.00</b> | <b>Lunch</b>  |
| <b>14.00 – 17.00</b> | <b>AFTERNOON SESSION</b>  |
| 14.00 - 14.30        | Observations and challenges from field trip<br><i>All Participants</i>  |
| 14.30 – 14.40        | Instructions for Working Group Deliberations<br><i>Consultants</i>  |
| 14.40 - 15.00        | Working Groups deliberations<br>Theme: <i>Challenges of implementing new approaches</i>                                 |
| <b>15.00 – 15.30</b> | <b>Tea/Coffee Break</b>   |
| 15.30 – 17.00        | Continuation of Working Group deliberations   |
| 17.00                | <b>Day 1 Closure</b>  |

## Programme - Day 2

|                      |  |
|----------------------|--|
| <b>09.00 – 13.00</b> | <b>MORNING SESSION</b>   |
| 09.00 – 09.45        | Working Group 1 – Feedback   |
| 09.45 - 10.30        | Working Group 2 – Feedback   |
| 10.30 – 11.00        | Discussion   |
| <b>11.00 – 11.30</b> | <b>Tea/Coffee Break</b>  |
| 11.30 – 12.00        | Discussion (Cont'd)  |
| 12.00 – 13.00        | Summary of workshop proceedings<br>Consultants   |
| <b>13.00 – 14.00</b> | <b>Lunch</b>   |
| <b>14.00 – 16.30</b> | <b>AFTERNOON SESSION</b>   |
| 14.00 – 15.00        | Way forward  |
| 15.00 – 15.30        | Concluding discussions   |
| 15.30 – 16.00        | Closing Remarks<br><i>Workshop delegate</i><br><i>Director General, Ministry of Equipment and Transport – Mr. Gabouné Keita</i><br><i>SSATP/World Bank – Mr. Olav Ellevset</i> |
| <b>16.00 – 16.30</b> | <b>Tea/Coffee Break</b>  |
| <b>16.30</b>         | <b>Day 2 Closure – End of Workshop</b>   |

## ATELIER SUR LE BITUMAGE DES ROUTES A FAIBLE VOLUME DE TRAFIC

Bamako, les 16, 17, 18 et 19 Janvier 2006

Liste de Présence

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| 11. | Oumar SY               | AATR/Sénéral               | 869. 07. 51    |
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| 26. | Aly KONE               | Mali/AGETIPE-MALI          | '-             |
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