

# Technology Initiatives under PMGSY

## 1. Context

1.1 Rural roads are a key component of rural development since they provide access to economic and social infrastructure and services thereby generating increased agricultural income and productive employment opportunity in rural areas. In order to accelerate rural connectivity, the Central Government launched Pradhan Mantri Gram Sadak Yojana (PMGSY) in December, 2000. Rural roads under the PMGSY are required to be constructed to proper engineering standards and stress is laid on quality and durability of assets being created. While in the initial years of the PMGSY programme, annual investments were about Rs.2,500 crore to Rs.3,000 crore, currently the investments are of the order of Rs.20,000 crore per year.

1.2 In order to promote cost-effective and fast construction technologies in the construction of rural roads, it has become imperative to mainstream the technologies already developed through R&D in the past as also to undertake further research and technology initiatives duly taking into account the environment, geographic and other constraints. Immediate focus should be on promoting use of locally available marginal materials, industrial wastes, new materials and environment friendly cold mix technologies.

## 2. Mainstreaming of existing technologies

2.1 There are several technologies which are already part of IRC codes, standards and specifications but are not being utilised in the field due to several factors such as difficulty in execution by contractors, lack of awareness, unfounded fear of failure or non-availability of suitable additives or even incorporation in the project estimates, etc. The proven technologies considered useful for rural roads are as under:

- (i) Soil stabilization (improving properties of locally available marginal materials and soft aggregates)
  - Lime stabilization
  - Cement stabilization
  - Mechanical stabilization
- (ii) Use of Fly Ash/Pond Ash including lime fly ash stabilized and lime fly ash macadam in embankments and subbases/bases of pavements
- (iii) Use of fly ash in cement for concrete structures (culverts, bridges)
- (iv) Use of blast furnace slag
- (v) Roller compacted concrete pavement
- (vi) Interlocking concrete block pavement
- (vii) Cold mix technology using bitumen emulsions for bituminous wearing coat (premix carpet, surface dressing)
- (viii) Use of geo-textiles in road pavements and associated works

2.2 Due to the quantum jump in road development programmes in the country, availability of quality aggregates is becoming an area of concern. For construction of low volume rural roads, it is possible to use locally available marginal materials and soft aggregates by suitably treating them with addition of lime or cement or even through mechanical stabilization depending upon their strength characteristics and other chemical properties (water absorption, etc.). Our immediate focus may,

therefore, be to promote and encourage mainstreaming of the above technologies so as to maximize the use of locally available marginal materials and soft aggregates. This would help not only in cost reduction but also in protecting the environment reducing carbon footprint in the process and time of construction.

2.3 In regions, where fly ash is available, the government guidelines already provide utilization of fly ash within 100 km of the thermal power stations. It is a good stabilizer for black cotton soils and waterlogged areas. There are also opportunities for use of fly ash in cement and concrete structures (culverts and bridges).

2.4 Cold mix technology using cationic emulsions has also much promise particularly in areas of long spells of rainy season and cold climates. Several agencies are manufacturing emulsions with and without foreign collaborations. This is an environment friendly technology and is not equipment intensive. For rural roads, it would prove not only cost-effective but also enable achievement of larger lengths due to availability of longer working season particularly in north-east region and hill states. The use of this technology may also be explored in LWE/IAP districts where there may be lack of contractors with high end equipment.

2.5 We may also take steps to promote the use of geo-textiles in road pavements in areas where drainage is an issue.

2.6 In forest areas, consideration may be given to construction of gravel roads with or without thin bituminous sealing.

2.7 Measures proposed: The NRRDA may undertake the following measures for mainstreaming of the existing technologies.

2.7.1 For working out the requirements of lime/cement/mechanical stabilization of locally available materials, it is necessary to prepare a complete mapping of their strength characteristics and other relevant properties on GIS platform. Such a mapping may be done at district level. IRC:- 42 provides guidance on the tests to be conducted. Such tests can be got conducted through the NITs and other engineering colleges to be identified by NRRDA/SRRDAs and anchored through the CRRI. The CRRI may be requested to formulate the proposal on an urgent basis. For steering progress in this effort, a core P&I Group of two-three persons may be constituted by the NRRDA.

2.7.2 While exercise indicated in para 2.7.1 may continue, it is also necessary to simultaneously proceed with incorporating the use of such materials in the project estimates of every state. It is proposed that in the first year, we may target a length of 15 percent of the annual proposals from each State. For this, PTAs/STAs concerned need to be mandated to identify locations of the local materials for the project stretches and evaluate their strength characteristics. Thereafter, the stabilization technique and the specifications to be adopted should be proposed by the STA and vetted by the PTA/CRRI. The regional reviews being carried out by the NRRDA may include progress on this front also as one of the key performance indicators of SRRDAs. The goal should be that in due course these technologies become a common practice in construction of rural roads all across the country.

2.7.3 The NRRDA has separately entrusted the task of revising the specifications for Rural Roads and Standard Data Book for analysis of rates to IRC. All the technologies indicated in para 2.1 above should be covered in the review of these documents. The Standard Data Book could then be utilized by the PTAs/STAs in supporting the PIUs in preparing analysis of rates and incorporation of the BOQ items in the project estimates.

2.7.4 The PTAs/STAs would also be required to support the PIUs initially in supervision of the works being executed with such technologies and ensuring quality control. This, in itself, will require capacity building of the STAs besides that of the PIUs. The CRRI can be entrusted with the task of capacity building of the PIUs and STAs. In fact, under the sponsorship of NRRDA, the CRRI can be a key partner to provide overall technical support in mainstreaming of the current technologies in execution of PMGSY. Needless to add that the CRRI would need to associate a few external domain experts including PTAs in this exercise.

2.7.5 For execution of works utilizing these technologies, it would be necessary to go in for appropriate and special equipments, particularly for stabilization. It is suggested that a separate Group comprising some domain specialists and representatives of two to three equipment manufacturers may deliberate over the requirements for such specialized equipments and identify the steps needed to facilitate execution of works by the contractors. The TOR for such a group may also include consideration for providing opportunities for low cost and light equipments in construction of rural roads without compromise on quality. This will provide the much-needed support to small local contractors who may hesitate or are otherwise not in a financial position to invest heavily in purchase of equipment.

2.7.6 The procurement procedures for execution of works would also need review to identify any additional requirements of special equipment and specialized technical personnel. Since these technologies are not in normal practice with the contractors, it would be necessary to make arrangements for training their personnel (site engineers, construction workers and equipment operators). For this, dialogue with the contractors may be arranged in different regions of the country. For some of these technologies, for instance cold mix technology, emulsions would be supplied by different manufacturers for which specific instructions of these manufacturers for their use would need to be adhered to. Initially, the support of these manufacturers may be required to alert the PIUs and STAs and to provide technology management support including training.

2.7.7 During execution of works, it will be advisable to undertake documentation of procedures observed, quality control tests conducted and operation of equipment, etc. through videography of various activities so as to help in dissemination at other sites and to serve as training material.

### **3. Promoting use of innovative materials and technologies**

3.1 In order to encourage innovation in development of materials and construction technologies, the IRC have adopted the practice of accreditation of materials and technologies. List of such accredited materials and technologies is available on websites of both IRC and NRRDA. These may be divided into two groups. One group

will be where trials have been completed and results are found to be satisfactory. For such materials and technologies as also relevant for rural roads, it would be advisable that performance of such demonstration projects are evaluated, analyzed and specifications developed, before these materials can be recommended for use on large scale. A report on performance of such materials/technology should be obtained from the road agency under whose jurisdiction the demonstration has been carried out. The work of performance analysis of demonstration projects can be carried out through research institutions like CRRI/PTAs/IITs/NITs/State Engineering Research Institutions and other well established engineering institutions. These institutions will also play an important role of creating awareness among the field engineers through trainings/ workshops and helping in the dissemination of technology. As the development of IRC specification may take some more time, Ministry of Rural Development / NRRDA may consider issuing the following guidelines for use of such materials:

- 3.1.1 For the first year, a target of 5 per cent length of the annual proposals from each state may be considered by the NRRDA. This can be gradually increased as we gain more experience in handling these materials/technologies.
- 3.1.2 For such materials/technologies, it is necessary to obtain warranty of performance and stability in price regime for the product from the technology provider/industry even though performance analysis has shown satisfactory results.
- 3.1.3 With the help of technology provider/industry, the STA concerned (where demonstration has proved successful) should prepare the draft of specification and methodology of construction. This should, thereafter, be got vetted by the NRRDA from the PTA/CRRI.
- 3.1.4 The PTA/STA may guide the PIU in preparation of analysis of rates so that it becomes a standard BOQ item for incorporation into the project estimates.
- 3.1.5 Measures proposed in paras 2.7.4 to 2.7.7 would apply to such materials/technologies also.

3.2 The second group covers such materials and technologies as have been accredited by IRC or even if they are not so far accredited by the IRC but are industry backed and found or claimed to be in use in other countries with similar geographic/climatic situations and considered promising from the point of view of enhancing performance and durability and cost-effectiveness. The technology provider should feel free to file an application with the NRRDA expressing his interest in demonstration of his product in the field. Such application should accompany the value for money analysis of the product/technology. For such materials/technologies, the NRRDA may consider their use first as demonstration projects with suitable safeguards/warranties from the industry. It is in the nation's interest to take up such demonstration projects on a fast track basis. A suitable fund could be set apart from the PMGSY budget for such demonstration projects. Locations and sample size of demonstration projects should be decided by the NRRDA in consultation with the SRRDAs. It may be advisable to undertake trials at least three locations spread across different states. This will help capture the

repeatability of the technology in the milieu of different road agencies, state technical agencies and contractors.

3.3 For such demonstration projects, the industry has to act as a strong partner of NRRDA as an enabler of technology development. It should, therefore, provide technical backstopping to the concerned PIU and STA. Since there could be risk of failure of such technologies, some mechanism needs to be evolved for protection of the personnel belonging to PIUs and STAs and even contractors for their bonafide actions. The government would need to adopt a liberal approach during the trial stage, of course with pre-specified checks and balances. This would also help in reducing/eliminating their resistance to take up such demonstration projects on ground. The NRRDA may undertake a comprehensive dialogue with some of these industry entrepreneurs to identify the role and responsibility of each of the stakeholders (PIUs/STAs/PTAs/industry, contractor) in such demonstration projects. Box 1 gives an indicative matrix of roles of various stakeholders.

**Box 1: Technology Demonstration Projects**  
(Roles and Responsibility Matrix)

- A. NRRDA**
- (i) Bear full cost of construction of the trial section.
  - (ii) Identify locations for demonstration of technology in consultation with the SRRDA.
  - (iii) Obtain and negotiate warranty from the industry/technology provider.
- B. Industry/Technology Provider**
- (i) Provide value for money analysis of the product and warranty of performance to the NRRDA.
  - (ii) Technical Backstopping of PIU and STA.
  - (iii) Training to be imparted to site engineers, equipment operators and construction workers of the contractors. Also provide stipend to workers and equipment operators for the period they are off site during training.
  - (iv) Support the STAs in supervision of the work being executed by the contractors.
  - (v) Assist the SRRDA in installation of performance monitoring instruments/equipments required, if any, at the time of execution of the work.
  - (vi) Join the STA and PIU in periodic monitoring of performance, say every three month, after the road is open to traffic. Performance would be watched for a period of two years.
- C. SRRDA and PIU**
- (i) Assist the NRRDA in finalizing the location of the demonstration project.
  - (ii) Enter into agreement with the STA in preparation of project estimate, supervision during execution and periodic monitoring of performance for a period of two years after the road is open to traffic.
  - (iii) Oversight on the performance of the STA and the contractors.
  - (iv) Ensure installation of performance monitoring instruments during execution of demonstration projects.
  - (v) Join the team of technology provider and STA in periodic monitoring of performance.
- D. STA**
- (i) Enter into agreement with the SRRDA as a turn key partner in technology development process including preparation of project estimate, supervision and quality control during construction, and periodic monitoring of performance for a period of two years post construction.
  - (ii) Expose its personnel to training by the industry/technology provider.
  - (iii) Support the industry/technology provider in training of contractors' personnel (site engineers, equipment operators and construction workers).
  - (iv) Documentation of the procedures observed, methodology of construction, quality control tests conducted, operation of equipment and performance monitoring post construction.
  - (v) Preparation of handouts/booklets for wider use of the technology and dissemination.

3.4 For the projects to be taken as demonstration projects, specific arrangements should be identified in advance for any instrumentation needs and evaluation of performance. For such projects, performance should be monitored on regular basis for a period of at least two years after opening of road to traffic. Advantage should also be taken of the APTF available with the CRRI for getting quick results.

3.5 Another strategy that must be considered by the NRRDA for such demonstration projects is to create a control section with conventional materials side by side. This will help in assessment of the cost-effectiveness of the technology being demonstrated.

3.6 Once the demonstration projects prove successful, the technologies and materials tested under such projects should be dealt with as per the strategy proposed in paras 3.1 and 2.7.

3.7 NRRDA may insist with IRC to review their procedure for such technologies to be mainstreamed. For this, the specifications should be finalized on a fast track and time-bound basis.

#### **4. Technology Development**

4.1 The Highway Research Board of the IRC undertook an exercise sometime back to identify major thrust areas in the highway sector covering road pavements, bridges, traffic and safety related schemes and geotechnical areas. Huge investments are being made for rural roads under the PMGSY and state plans. Some of the thrust areas considered useful and relevant for rural roads are as under:

- (i) Evolving low cost water crossing structure designs
- (ii) Evolving bio-engineering measures for improving slope stability in hill areas.
- (iii) Promoting recycling of pavements for upgradation/rehabilitation projects – evolving guidelines and warrants for recycling.
- (iv) Evolving simple models for Asset Management System of rural roads and predicting rate of deterioration of pavements with time, traffic and weather.
- (v) Evolving low cost erosion control and drainage measures.
- (vi) Bridge construction technologies to achieve faster construction – precasting technologies, steel superstructures. Also evolve standard designs for bridges on rural roads.

4.2 There are quite a number of academic institutions and research agencies in the country who can be approached in this effort. It is suggested that NRRDA may earmark certain budget for such R&D work so that such schemes as are of immediate relevance for the sector can be taken up on a regular basis.

4.3 For giving push to such research, a core P&I group of two-three experts can be constituted from within the standing Advisory Committee of the NRRDA.

#### **5. Preparation of Manuals/Handouts and Dissemination**

5.1 It is suggested that the CRRI proposed to serve as key partner for NRRDA in this entire effort may be charged with the task of preparation of Manuals and Handouts on the current technologies and accredited materials that have proved to be successful. The CRRI could be asked to associate external experts including PTAs where considered necessary.

5.2 The draft of these Manuals and Handouts should be discussed at regional workshops with PIUs and STAs. Based on feedback, the drafts can then be finalized and printed. These documents can also be hosted on the PMGSY website for wider

dissemination. The gist of these handouts can also be published in IRC journals and NRRDA journals – grameen sampark.

5.3 These documents would be useful for dissemination among the various stakeholders – road agencies, contractors, consultants, state technical agencies, etc. For this, regular half a day workshop could be held at the time of regional reviews of PMGSY programmes by the NRRDA and SRRDAs.

## **6. Training and Awareness**

6.1 As discussed earlier, it is absolutely necessary to build the capacity of various stakeholders in mainstreaming of the existing technologies which are not currently being practiced and promoting new materials and technologies being developed by the industry.

6.2 The CRRI may be the nodal agency for this purpose and we should utilize the existing training centres and academic institutions including the PTAs/STAs in this task.

6.3 A directory of guest faculty may also be prepared by the CRRI for enlisting outside support in preparation and delivery of training material.

6.4 Visits of PIUs/SRRDAs/PTAs/STAs should be arranged to good practice projects both within India and outside to create awareness and raising their benchmark.

6.5 We may also seek the support of contractors' organisations to arrange regular colloquium with them in various regions of the country.

## **7. Awards**

7.1 A system of awards may be instituted to recognize the contribution of:

- NRRDA
- SRRDAs
- PIUs
- STAs
- Contractors

in mainstreaming and upscaling the innovative technologies in construction and maintenance of rural roads.