

ce

Library
IRC International Water
and Sanitation Centre
Tel.: +31 70 30 689 80
Fax: +31 70 35 899 84

Two Tier Maintenance System
for Hand Pumps
in the Danida assisted
Orissa Rural Drinking Water Supply Project

Raj Kumar Daw
Danida Project Directorate
Bhubaneswar, Orissa

May, 1992

A paper for a Workshop on Community based Hand pump
Maintenance System convened by State Govt. of
Karnataka on 20th May 1992 at Bangalore.

{ 822-14762

LIBRARY IRC
PO Box 93190, 2509 AD THE HAGUE
Tel.: +31 70 30 689 80
Fax: +31 70 35 899 64
BARCODE: 14 76 2
LO:

822 11VOR92

1. Background

The Danida Project Directorate (DPD) was specially created under PHED (and later under RWSS of Rural Development Dept.) of GOO, for implementation of the Orissa Drinking Water Project assisted by Danida.

DPD is headed by a Project Director (PD) of the rank of a Superintending Engineer. The Chief Adviser (CA) is one of the representatives of Danida to the project and is counterpart to the PD. There are other divisional executives of the rank of Executive Engineers, some of whom also have Danida appointed Adviser counterparts.

Within the project, the Executive Engineer of the Maintenance Division (EE-MD or ME) and his counterpart, the Maintenance Adviser (MA), are directly responsible for establishment, operation and management of the Two Tier hand pump maintenance system.

Socio Economic Division (SED) initially choose the well sites considering distance, cultural factors of users and resolve practical site selection problems. This improves social acceptance of hand pumps by involving users in the initial site selection. The Socio Economic Executive is responsible for SED and operates through a number of Socio-Economists (SEs, later called Field Officers) placed in each block.

So far, the project has been implemented in two main stages called Phase I and Phase II A. Phase I was implemented from August 1985 and approximately 1600 hand pumps were installed in three blocks of Chandbali (Balasore dist.), Delang (Puri) and Rajkanika (Cuttack). Phase II A of the project, from December 1987, installed an additional 2400 hand pumps in five blocks of Aul, Rajnagar (Cuttack), Brahmagiri, Kanas and Puri Sadar (Puri).

Installation of new pumps was done by Field Divisions (FD) of the project, which were then handed over to MD for maintenance.

Approximately 3600 hand pumps (out of 4000 constructed by the project) are being rendered maintenance services by the Maintenance Division under the Two Tier Maintenance System.

MD operates a computerised database for monitoring of the maintenance system. This monitoring method continuously compiles data of various aspects of maintenance activities.

2. Strategy:

Since its inception in 1985-86, the implementation strategy of the Two Tier Maintenance System, was based on:

- Identifying, training and equipping village based artisans in hand pump maintenance as the first tier of a decentralised village based hand pump maintenance system.
- Promoting this first tier with infrastructural support

through a second tier of a block based Junior Engineer and a pump maintenance crew.

- Instituting preventive maintenance of hand pumps through monthly visits to all pumps by the first tier, the Self Employed Mechanic- SEM.
- Establishing this system initially as a research activity and then gradually transferring it to a regular project activity for adoption in PHED (now RWSS).
- Attempting to make hand pump maintenance into an accepted rural trade by paying fees to SEMs for rendering preventive maintenance and repair service to hand pumps.

3. Implementation of the Maintenance System :

The Two Tier Maintenance System was started in Phase I of the project, from 1985, as a Research & Development activity under direct funding through the Chief Adviser's Office (CAO) in three blocks of Chandbali, Delang and Rajkanika.

During Phase II A (from December 1987) the Two Tier Maintenance System was extended to the next five blocks of the project, Aul, Rajnagar, Brahmagiri, Kanas and Puri Sadar. In this extension, the maintenance system in these five blocks was funded under the reimbursement funding system.

Since 1990, the entire funding of the maintenance system for all eight blocks was placed under reimbursement funding and ceased to be considered as an R & D activity.

The two tiers of the maintenance system are its two major functionaries, the village based Self Employed Mechanic (SEM) as the first tier and the block based Junior Engineer-Maintenance (JE-M) with his maintenance crew as the second tier.

SEMs were the local village craftsmen, generally blacksmiths or cycle mechanics, identified and selected by SED. The main considerations for selection of SEMs were their back-ground and social standing in their own communities, their existing work loads (seasonal and otherwise), their willingness to undertake hand pump maintenance as a subsidiary economic activity and their physical fitness.

Selected SEMs were given training in maintenance of hand Pumps in 2 stages.

Upon successful completion of training with a probation period between the two phases of training, each SEM is "commissioned" by the Project through a contract, specifying the list of pumps under his care, a bicycle, all necessary tools and some spare parts.

The payment of contract fees to SEMs has been done on a monthly basis upon approval of the JE-M with the payment being credited directly to individual bank accounts of SEMs through their respective banks. The amount of the contract fee is Rs. 1000/- per month.

payment was being done from direct funding from the CAO and later from reimbursement funding from the FDs.

Upon commissioning, an SEM attends to the maintenance needs of 20 to 25 pumps in 4 to 5 villages in the vicinity of his own village. His duties include regular preventive maintenance visits to every pump once a month and attending to additional repairs requests made by villagers through an existing informal system of communication in practice in the rural areas by word of mouth by which artisans attend to service request of their clients in their primary trades.

The SEMs get an annual contract fee of Rs.120 per pump handed over to his care. The list of duties and responsibilities of SEM, as stated in his commissioning contract.

Breakdowns, poor performance and malfunction of pumps reports are supposed to be communicated informally and directly to SEM by villagers. All Above Ground (AG) repairs should be attended by the SEM with the essential spares he should have in stock, or which he can obtain from the block JE. In case of only Below Ground (BG) repairs, the SEM takes help of other nearby SEMs on reciprocal basis. By this method, an SEM should be able to attend to the maintenance needs of all pumps under his care with the skills and equipment provided at his disposal by the project.

The JE in a block covers about 500 to 700 pumps through 25 to 30 SEMs in the block. The JE-M has the exclusive task of hand pump maintenance in his block. They conduct monthly meetings of SEMs, arrange for supply of spare parts from the main stores of MD-HQ to the SEMs, provide technical help to SEMs in cases of complicated repairs that SEMs might be unable to rectify. The JE is provided with a motor cycle by the project and has a separate maintenance crew attached to him to assist him with his responsibilities. JEs report to MD (previously TMD) every month in a meeting, where their work is reviewed, reports are submitted, spares parts collected and work planning completed.

A central stores attached to MD processes the indents for spare parts received from JEs, provides and monitors spare parts required by maintenance organisation.

By concept, the MD was evolved as a special cell for maintenance but does not have the full status of a Division and therefore does not have any financial expenditure authority.

4. Present Status:

By March 1992, the status of the Two Tier Maintenance System in the project was:

- Blocks (Phase I & II A) 2 Blocks
- Hand Pumps in the Maintenance System 2000 Pumps
- Assistant Engineer at HQ 1
- Junior Engineers at Blocks 2
- Field Assistants (with Block SEM) 2

- Helpers (with block JEs) 25
- Self Employed Mechanics 163

The detailed status of SEMs and pumps under the maintenance system in each block is given in the following table.

Table 1 : Status of pumps with SEMs by March 1992

| Sl. No. | Block | Number of | | |
|---------|------------|-------------------|-----------------------|----------------------|
| | | SEMs in the block | Hand pumps under SEMs | Total pumps in block |
| 1. | Aul | 23 | 625 | 648 |
| 2. | Brahmagiri | 16 | 300 | 316 |
| 3. | Chandbali | 23 | 652 | 675 |
| 4. | Delang | 21 | 456 | 477 |
| 5. | Ennas | 14 | 277 | 291 |
| 6. | Pari Sadar | 12 | 220 | 232 |
| 7. | Rajkanika | 22 | 433 | 455 |
| 8. | Rajnagar | 27 | 575 | 592 |
| | Total | 163 | 3508 | 3671 |

5. Evaluation:

In order to examine the operation of the project's Two Tier Maintenance System and compare it with the Three Tier Maintenance Systems in rest of the state, Danida commissioned an external evaluation of the two maintenance systems. This evaluation was to critically examine the performance of both the systems so to serve as a basis for decision making to institutionalise a maintenance system in Orissa. The evaluation was conceived in two stages namely, Preliminary Studies and the Main Evaluation. The Preliminary Studies were conducted by Progressive Research Aids, Pune during Dec. 91 - April 92. The results of Preliminary Studies are discussed below.

5.1 Objectives :

The main objective of the preliminary study was to assess quantitative and qualitative functioning and costs of both the systems and to determine the level of maintenance service rendered by the two systems. Specifically, the objectives were:

5.2 Methodology of the Studies :

1. Sample surveys were conducted in Puri and Cuttack districts, covering 126 villages from 8 blocks, with 1278 user households using 426 hand pumps from both the systems. Two separate questionnaires were used for assessing hand pump performance and for assessing perception of user households.
2. An organisational study was conducted in which all levels of functionaries from the two maintenance systems were interviewed to understand qualitative aspects of the systems. Quantitative data and records were also studied including detailed maintenance histories of 50 hand pumps in the Two Tier System.
3. The detailed data for the past three years consisting of main cost centres and cost components, covering both direct and indirect costs were collected and analysed for Two and Three Tier Systems separately.
4. In order to develop a basis for analysis of data and comparison between the two systems, three pump performance indices and five user's perception indices were developed to evolve a quantitative basis for comparison of data.

5.3 Coverage of the Preliminary Studies :

Table 2 shows the coverage of the sample survey in Two and Three Tier Maintenance Systems.

Table 2 : Sample coverage in Two & Three Tier System areas

| Block | Numbers of | | | | |
|--------------------------|----------------------------|-----------|---------------|---------------|-----------------|
| | SEMs/ Fitter Mistrys | GPs | Vill- ages | Hand Pumps | House- holds |
| Two Tier System | | | | | |
| 1. Delang | 7 | 8 | 16 | 54 | 162 |
| 2. Rajkanika | 7 | 9 | 17 | 54 | 162 |
| 3. Rajnagar | 7 | 7 | 16 | 56 | 168 |
| 4. Kanas | 5 | 5 | 12 | 46 | 138 |
| Sub Total | 26 | 29 | 61 | 210 | 630 |
| Three Tier System | | | | | |
| 5. Banapur | 2 | 7 | 17 | 56 | 168 |
| 6. Daspalla | 2 | 7 | 21 | 56 | 168 |
| 7. Garadpur | 3 | 7 | 14 | 53 | 159 |
| 8. Korei | 2 | 6 | 13 | 51 | 153 |
| Sub Total | 9 | 27 | 65 | 216 | 648 |
| Total | 35 | 56 | 126 | 426 | 1278 |

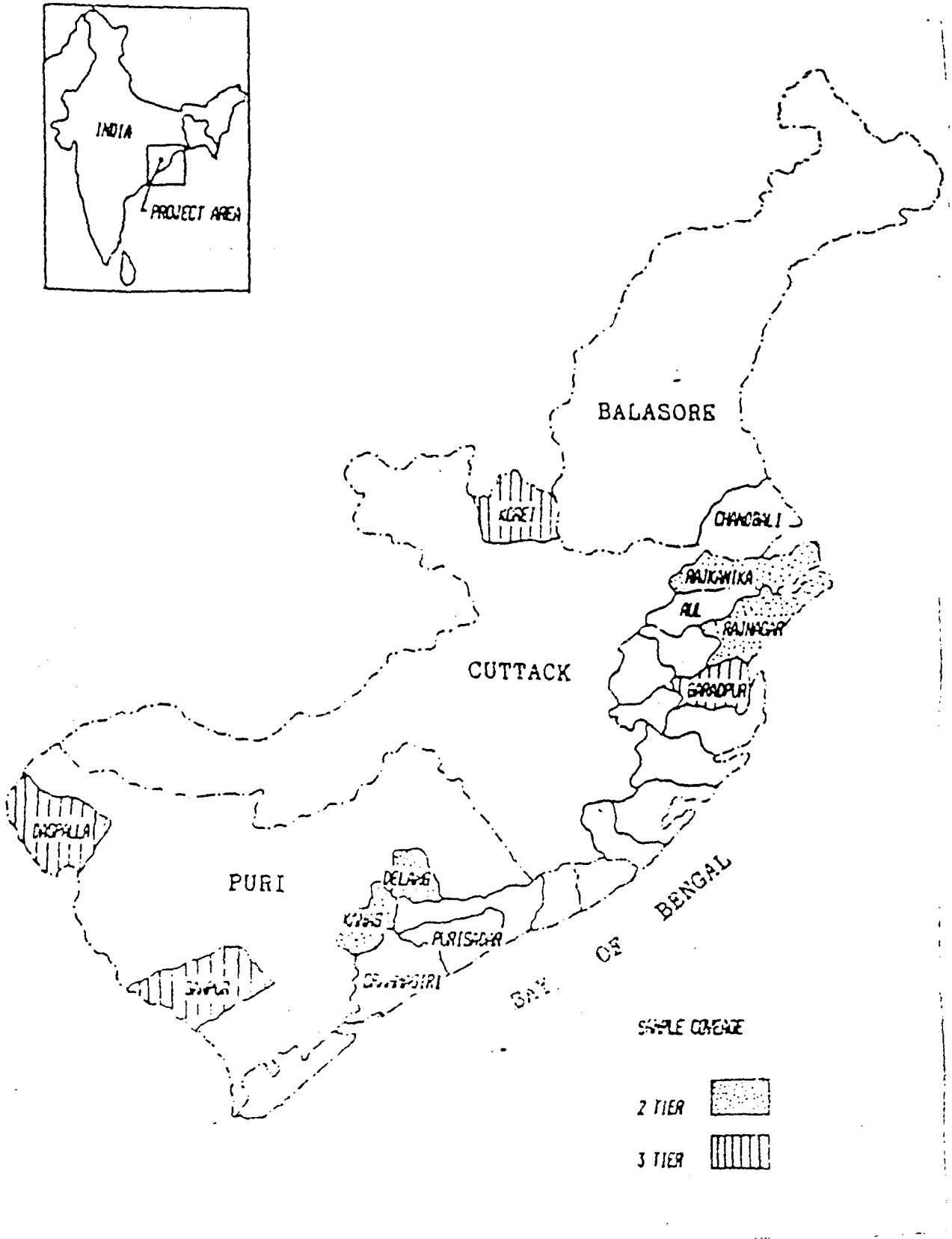


Fig. 1 : Sample blocks chosen for Preliminary Studies

5.4 Findings on Hand Pumps :

Table 3 : Comparative Assessment of Pump Performance

| Numbers of Pumps Surveyed | 210 (100%) | 216 (100%) |
|---|---------------|---------------|
| Parameters Assessed | Two Tier | Three Tier |
| 1. Types of Pumps surveyed : | | |
| 1.1 IM 2 | 75% | 64% |
| 1.2 Others (Suction, Direct Action, etc.) | 25% | 36% |
| 2. Platform in good condition | 70% | 33% |
| 3. Drain in good condition | 62% | 31% |
| 4. Pump installed at proper height | 90% | 63% |
| 5. Pedestal firm in platform | 90% | 40% |
| 6. Rusting of Pump evident | 62% | 50% |
| 7. Pump Performance Indices | | |
| 7.1 Pump maintenance Index | 73% | 54% |
| 7.2 Pump condition Index | 90% | 66% |
| 7.3 Site condition Index | 66% | 44% |
| 7.4 Combined Pump Performance Index | 80% | 57% |

5.5 Findings on Users' Perception Assessment :

Table 4 : Comparative Assessment of User Perception

| Numbers of Households Surveyed | 630 (100%) | 648 (100%) |
|------------------------------------|---------------|---------------|
| Parameters Assessed | Two Tier | Three Tier |
| 1. Pump site was clean | 63% | 58% |
| 2. Waste water drained properly | 75% | 34% |
| 3. Pump was easy to operate | 82% | 54% |
| 4. Pump was: | | |
| 4.1 Usually working | 82% | 58% |
| 4.2 Working intermittently | 15% | 23% |
| 4.3 Not working | 3% | 20% |
| 5. SEM/FM visits regularly | 85% | 11% |
| 6.1 Willing to pay for Maintenance | 40% | 33% |
| 6.2 Average : Rs/HH/month | Rs.2.50 | Rs.1.25 |
| 7. User Perception Indices | | |
| 7.1 User Index | 76% | 71% |
| 7.2 Site condition Index | 79% | 52% |
| 7.3 User Involvement Index | 49% | 50% |
| 7.4 Maintenance Awareness Index | 79% | 79% |
| 7.5 SEM/FM Performance Index | 83% | 29% |
| 7.6 Combined User Index | 75% | 56% |

5.6 Findings of the Cost Study :

Table 5 : Comparative Assessment of Costs (1990 data)

| Cost | Cost in Rs./pump/year | |
|---|-----------------------|-------------|
| | Two Tier | Three Tier |
| Fixed Costs | | |
| Head Office establishment | 299 | 155 |
| Salaries & Allowances | 157 | 37 |
| Depreciation/Interest | 751 | 736 |
| Sub Total | 1207 | 913 |
| Variable Costs | | |
| JE & Crew | 174 | 415 |
| SEM salary, travel etc. | 178 | 43 |
| Spare parts | 115 | 177 |
| Sub Total | 468 | 640 |
| Maintenance Cost per Pump for 1990 | 1675 | 1553 |

6. Conclusions

6.1 The Two Tier System of maintenance had achieved the service delivery level of 80% mainly because of the following factors:

1. Establishment of a decentralised maintenance system based on preventive maintenance available at village level.
2. Establishment of trained part time SEMs supported by full time exclusive and mobile Junior Engineers at the block level.
3. High level of infrastructural support to control and monitor the system regularly.
4. Except User Involvement Index all other indices including User Combined Index was observed to be 75% or more, clearly pointing towards fairly good level of service rendered in the Two Tier System of Maintenance.

6.2 Other conclusions from the study of the Two Tier System were:

1. Nearly 90% of the SEMs were satisfied about hand pump maintenance work and kept the pump record properly.
2. The per pump number of repairs and the cost of spares as observed from pump maintenance histories closely matched with the data collected at the macro level cost study.
3. A three per cent increase in number of pumps was observed in

4. 28% pumps required 62% of the repairs during the period of 5 years studied. These represented problem pumps.

6.3 The Three Tier System of Maintenance has not achieved even 60% service delivery level due to the following reasons:

1. Lack of preventive maintenance of hand pumps.
2. Non-availability of spare parts coupled with lack of control on activities of Fitter Mistry partly due to non-exclusive maintenance work assigned to Junior Engineer.
3. Non-availability and unreliable basic data on pump installations and low priority for maintenance monitoring.
4. The Combined User Index of 56% suggests that there was ample scope for improving the level of service rendered in the Three Tier Maintenance System.

6.4 The analysis of repair complaints data in the Three Tier System showed an increasing trend regarding number of villages reporting pump breakdowns. About one third of villages lodged 3 complaints every year.

6.5 The total maintenance cost per pump per year for the Two Tier system was Rs. 1675 as compared to Rs. 1558 for the Three Tier system. Thus the Two Tier System was costlier by Rs. 117 (i.e. 7%). As far as the fixed costs were concerned the Two Tier system was higher by Rs. 233 (i.e. 23%). This was attributable to the higher management and Socio economic inputs fro HQ in the Two Tier System. But due to the preventive and decentralised maintenance system the Two Tier was able reduce variable costs by Rs. 172 when compared to the Three Tier System.

Responsibilities of the Junior Engineer

The functions of JEs are as follows:

1. Visits to pump sites and to supervise the operations SEMs
2. Conduct monthly meetings of SEMs
3. Compilation of Monthly reports for MD-HQ
4. Organise spare parts supply to SEMs
5. Provide technical guidance and support to SEMs
6. Organises deployment of vehicles when required to attend to repairs of problematic pumps
7. Maintenance of necessary registers and records of the operations of the maintenance system

Duties and Responsibilities of SEMs.

1. The Self Employed Mechanic's (SEM) primary responsibility is to keep all hand pumps under his care in good working condition.
2. The SEM should carry out visit on a regular schedule to each hand pump at least once in every month.
3. During the monthly visits to a hand pump, preventive maintenance and minor repairs shall be carried out as detailed separately. If the necessity of major repairs are seen at this time, they shall be undertaken at the earliest opportunity.
4. Over and above routine monthly visits, the SEM must attend to all requests for repairs to hand pumps, whenever necessary. All such repair requests must be attended to within two days from receiving such requests.
5. All major repairs of below-ground components of hand pumps should be undertaken with the help of at least one preferably two other SEMs. This has been detailed separately.
6. The SEM should help other SEMs near his area of operation in undertaking major repair in their areas, when he receives such a request for assistance.
7. In case the SEM is not able to repair a hand pump for any reason, he should inform the Junior Engineer (JE) as soon as possible, and not wait till the regular monthly meeting. In such cases, the SEM should carry out repairs to pumps as suggested by the JE.
8. When the JE or his crew visits a pump in connection with inspection or repair work, the SEM shall be present at the site.
9. When any problem about any pump is reported to the SEM by the users, the SEM shall personally verify the nature and extent of the problem and report accordingly to the Junior Engineer.

10. The SEM shall give an estimate of the need for spare parts for at least the coming month during the monthly meeting.
11. The SEM shall maintain an adequate stock of spare parts to be able to attend to his repair needs. In case of need, he shall obtain additional spare parts from the JE, without waiting for the regular monthly meeting.
12. Upon completion of his preventive maintenance, minor or major repairs of a hand pump the SEM shall obtain the signature of an user of the pump in his work record, to certify completion of the work.
13. The SEM has to maintain all the records pertaining to routine visits, repair and maintenance work undertaken, consumption of spare parts and the changes (if any) in the water quality.
14. Once in every month the SEM shall attend the monthly meeting on the prearranged date and venue for reporting and completing other functions that have been detailed separately.
15. The SEM is responsible for maintaining his bi-cycle and for using his tools and spare parts carefully.
16. The SEM shall attend future training programmes as and when those are arranged.