NCAER

The Remote Village Electrification Programme in India

Assessment of Experience in Odisha, Madhya Pradesh and Chhattisgarh

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Contents

List of Text Tables

List of Figures

Executive Summary

In order to fulfil the goal of 'Power for All by 2012' the Ministry of New and Renewable Energy (MNRE) has been implementing a programme, 'Remote Village Electrification Programme' (RVEP), to electrify all unelectrified census villages and remote villages by installing Solar photovoltaic (SPV) home-lighting system. The programme complements the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY).

The SPV home-lighting system has been installed on a cost-sharing basis. In all, 90 per cent of the cost is provided by the central government including CMC and 10 per cent of the cost by the state government. Out of the 10 per cent cost borne by the state government, 5 per cent is expected to come from charges levied on beneficiaries or from other welfare schemes at the state level. In addition to this, MNRE provides a one-time promotional support of Rs 50,000 per village to the implementing agencies. In case of hamlets, a service charge is limited to 10 per cent of the approved CFA for each hamlet subject to a maximum of Rs 50,000 per census village. This criterion is applied uniformly across states. However, in practice, the implementation arrangement differs from state to state.

The present study provides an evaluation of Odisha, Madhya Pradesh and Chhattisgarh.

Objectives of the Study

- Obtaining beneficiary level data on 'Functionality of system'
- Satisfaction levels of beneficiaries
- Effectiveness of implementation arrangements
- Effectiveness of service and maintenance infrastructure
- Level of community participation

Implementation Mechanism of the Programme

The RVEP of the MNRE aims at providing basic lighting/electricity facilities through renewable energy sources. The scheme is being implemented in most of the states through identified state level agencies in India.

At the state level, the responsibility for village electrification is generally vested with the State Electricity Boards (SEBs), while state renewable energy development agencies are responsible for renewable energy programmes. In the absence of clear demarcation of responsibilities, there could be difference in implementation of the scheme in states. In 2005–06, the MNRE, therefore, asked the states to notify implementing agencies in their respective states for implementation of RVEP.

Implementation Process of the RVEP Scheme in Odisha

The Odisha Renewable Energy Development Agency (OREDA), established in the year 1984, under the department of Science and Technology, is the state nodal agency (SNA) for the implementation of the RVEP. The RVEP was initiated in 2006–07 in Odisha. The Odisha State Electricity Board (OSEB) shortlists the name of those remote unelectrified villages and hamlets where the grid connectivity is neither feasible nor cost effective. OREDA collects the list of such identified villages from OSEB and sends it to Ministry of New and Renewable Energy for verification by Rural Electrification Corporation (REC). Once the list of such villages is received by MNRE from REC after verification, the MNRE asks OREDA to prepare a Detailed Project Report (DPR) for such identified villages. Till May 2010, 1629 villages have been identified for RVEP of which 336 villages have been completed.

In order to provide the solar home-lighting system, the OREDA does pre-distribution door-to-door survey themselves with the help of their own staff and prepares detailed project report (DPR) as per guidelines of MNRE.

Tendering Process

After getting the sanction order from MNRE, the OREDA advertises the tender notice in the local and national newspapers inviting sealed bids for supply, installation, commissioning including a five year Comprehensive Maintenance Contract (CMC) of solar home-lighting and street-lighting systems from registered MNRE's suppliers. The tender notice is also put on the OREDA's website. On receipt of the sealed tenders, the technical evaluation of each tender is carried out by OREDA. The technical evaluation involves analysing the tenders with respect to the MNRE's guidelines, experience of the agency, etc. Those tenders that qualify the technical bidding are called by the tender committee for commercial bidding which is conducted by the OREDA/ purchase committee. If the tender is above Rs 5 crore the purchase committee from Department of Science and Technology also attends and monitors the tendering process. The purchase committee opens the qualified tenders in front of all qualified agencies. The work order is awarded to the bidder making the lowest bid. If the bidder making the lowest bid is unable to provide the required number of systems, OREDA/the purchase committee could ask the other parties for their willingness to provide the systems at the lowest bid price. The remaining work is distributed in equal proportion to those bidders who agree to provide the systems at the lowest bid price.

Inspection

The pre-dispatch technical inspection is not done at a recognised/certified test centre by MNRE by OREDA as it is a norm. The supplier supplies and installs the system in the beneficiary

households with the help of his own technicians. The suppliers also arrange in some cases the work of installation to local NGO/technician.

Maintenance of the System

OREDA has a separate Cell of District Renewable Energy in the District Rural Development Authority (DRDA) office in each district. Each cell has a technician for monitoring and evaluating the system at village level when they receive the complaint from the beneficiaries. Total 153 technicians have been appointed under OREDA who also look after the RVEP at village level. They visit the village as a part of their duty regularly. In case they find any non-working system, they inform the suppliers to rectify it. OREDA has specific guidelines for their own technicians. The technician appointed by the suppliers is supposed to visit the villages every quarter for routine maintenance, which includes positioning of the modules, putting distilled water in the battery, checking the direction of the module, etc. In case of breakdown of the system, the technician is supposed to visit the household within a week of the receipt of a complaint.

Rupees 100 is taken from each beneficiary at the time of installation. After installation Rs 20 to 30 is collected from each beneficiary per month. The president and secretary of the VECs are elected by the beneficiaries in the respective village. A separate bank account in the name of the VEC is opened and the President and the Secretary are required to collect a sum of Rs 20 per month per beneficiary and deposit the same into the bank account. The purpose of this fund is to pay for changing of the batteries after five years.

In Odisha, the VEC decides the place of installation of streetlights in their village and it also maintains them.

Implementation Process of the RVEP Scheme in Madhya Pradesh

The MP Urja Vikas Nigam Ltd (MP UVN) is the SNA for the implementation of the RVEP in Madhya Pradesh. This corporation was established by the Government of Madhya Pradesh in 1982 as nodal agency for implementing various programmes and policies of the Government of India as well as the state government for the renewable energy sector. The RVEP was initiated in MP in the year 2006–07. The MP State Electricity Board (MPSEB) shortlists the names of those remote unelectrified villages and hamlets where the grid connectivity is neither feasible nor cost effective. MP UVN collects the list of such identified villages from Energy Department of MPSEB and sends it to Ministry of New and Renewable Energy for verification by REC. Once the list of such villages is received by MNRE from REC after verification, the MNRE asks MP UVN to prepare a DPR for such identified villages. Till March 2010, 994 villages have been identified for RVEP of which, 275 villages have been completed.

The MP UVN conducts pre-distribution door-to-door survey and prepares DPR themselves with the help of their own staff as per the guidelines of MNRE.

Tendering Procedure

After getting the sanction order, the MP UVN advertises a tender notice in the local and national newspapers inviting tenders for supply, installation, commissioning including a five-year Comprehensive Maintenance Contract (CMC) of solar home-lighting and street- lighting systems from registered MNRE's suppliers. In the notice MP UVN asks the bidders to obtain the tender documents from the office of Executive Engineer, SPV and RVEP, and MP UVN against payment of Rs 5,000. On receipt of the sealed tenders, the technical evaluation of each tender is carried out by MP UVN. The technical evaluation involves analysing the tenders with respect to MNRE's guidelines, experience of the agency, etc. Those tenders that qualify the technical bidding are called by MP UVN up to L3. The work is allocated in the ratio of 60 per cent to L1, 25 per cent to L2 and 15 per cent to L3 , respectively. So far, Bharat Electronic Ltd has been the main supplier of solar home-lighting system in MP.

Inspection

As observed in Odisha, in MP also, a pre-dispatch technical inspection is not done at a recognised/ certified test centre by the nodal agency as suggested by MNRE. However, in the tender notice MP UVN requires the bidders to provide information on the test reports for respective items issued by Solar Energy centre/other authorised test centres for their supplies, confirming to the MNRE specification of SPV guidelines. The supplier supplies and installs the system in the beneficiary households with the help of his own technicians. Rs 100 is taken from the BPL beneficiary households and Rs 200 is taken from APL beneficiary households at the time of installation.

A proof of delivery of the system along with the number of households who have received the system is taken by the suppliers from the Panchayat for releasing 90 per cent of the cost.

Maintenance in Madhya Pradesh

Based on the survey, it has been found that in MP, the Panchayat is involved marginally in RVEP programme, and that no third party evaluation has been conducted in MP. No service centre or Operation and Maintenance have been set up in MP for Solar home-lighting system. There is no VEC constituted in the village by the suppliers. Beneficiaries have to come to the Panchayat to report when their systems stop functioning or if they face any other problem. For some villages the distance to the panchayat is about 5 to 10 km.

Discussions with officials of MP UVN revealed that there is no systematic arrangement for maintenance of the systems. Neither the officials knew from where the money would come from or who would take regular responsibility of the maintenance of the system. Lack of community participation as well as social problems and jealousy among the community are the major drawback for smooth functioning of the system cited by some officials in the meeting with MP UVN.

The Process of Implementing the RVEP Scheme in Chhattisgarh

The Chhattisgarh Renewable Energy Development Agency (CREDA) is the SNA for the implementation of RVEP in the state. CREDA was constituted under the Department of Energy, Government of Chhattisgarh in 2001. The Chief Minister of the state is the Chairman of CREDA and the Principal Secretary (Energy) is the Chief Executive Officer (CEO). The RVEP was initiated in 2003–04 in Chhattisgarh. The Chhattisgarh State Electricity Board (CSEB) shortlists the names of those remote unelectrified villages and hamlets where the grid connectivity is neither feasible nor cost effective. CREDA collects the list of such identified villages from CSEB and sends it to Ministry of New and Renewable Energy for verification by Rural Electrification Corporation (REC). Once the list of such villages is received by MNRE from REC after verification, the MNRE asks CREDA to prepare a DPR for CFA for such identified villages. This process is similar to the one observed in Odisha and MP. CREDA has been providing solar home-lighting system through both power plant and individual solar home-lighting system. There are some villages where Power Distribution Network (PDN) becomes costlier to cover all the scattered houses in the village; in such cases the CREDA has been providing individual home-lighting system. Similarly, in some villages if some households are residing at long distances from the centre of the village where the PDN system is costlier to cover those households, in such cases CREDA has been providing individual home-lighting system to those households. In all other cases electricity is supplied through Solar Power Plant.

In Chhattisgarh, the DPRs are prepared by the suppliers describing the power plants in details which they are likely to supply. The suppliers also do pre-distribution door-to-door survey as per guidelines of MNRE as a part of DPR.

The CFA from MNRE is fixed for all the states. CREDA has received grant under RVEP for 440 villages till April 2010. For implementing the RVEP in Chhattisgarh the state government's share is relatively higher as the cost of the power plant is high. (Moreover, state government is providing solar light to 935 villages without any support from MNRE till April 2010. A total 1375 villages have been completed by CREDA, out of which CFA was received from MNRE only for 440 villages.)

Tendering Procedure

After getting the sanction order, the CREDA advertises the tender notice in the local and national newspapers inviting sealed bids for supply and installation of the solar plant for solar home-lighting and street-lighting systems from registered MNRE's suppliers. The tender notice is also put on the CREDA's website. On receipt of the sealed tenders, the technical evaluation of each tender is carried out by CREDA. The technical evaluation involves analysing the tenders with respect to the MNRE's guidelines, experience of the agency, etc. Those tenders that qualify the technical bidding are called by the tender committee for commercial bidding which is conducted by the CREDA. The CREDA opens the qualified tenders in front of all qualified agencies. The work order is awarded to the bidder making the lowest bid. Tata, BP, CEL, BHEL, Sun technique, Agni power and Flotten are the major suppliers of system in Chhattisgarh.

Inspection

A pre-dispatch technical inspection is done at a recognised/certified test centre by MNRE for the systems that are likely to be supplied by the supplier. About 1 per cent of total quantity offered for inspection is randomly inspected by the CREDA.

After inspection, if the system is found satisfactory, the supplier installs the power plant and distributes the light to all the households in the village with the help of their own technicians. Rs 100 is taken from each BPL beneficiary household at the time of installation and Rs 200 is taken from each APL beneficiary household.

Operation and Maintenance System in Chhattisgarh

CREDA sets up one operation and maintenance centre for a cluster of 12 to 16 villages. Each centre has a trained technician and a helper. There is a trained operator in each village under the cluster for providing initial maintenance support in the village. The VEC or any beneficiary may call for his services.

The village operator is fully equipped with spare parts which he keeps at home. All the three service providers have specific instructions to perform their duty. CREDA also provides uniforms to all the three service providers for identification by the villagers.

Cost of O&M CREDA pays Rs 2,000 per month to the technician, Rs 1,000 to the helper and Rs 400 to the operator. Every village has a VEC. The selected beneficiaries are the members of the VEC. If any beneficiary faces any problem he/she immediately informs the operator. The operator responds as soon as possible. The operator collects Rs 5 from each beneficiary for maintenance of the system. For maintenance of the system the state government pays a rate of Rs 25 per beneficiary to CREDA. The CREDA has a separate account for future maintenance of the plant.

CREDA has well defined guidelines for technicians, helpers and operators. The technician is supposed to visit the villages every quarter for routine maintenance, which includes positioning of the modules, putting distilled water in the battery, checking the direction of the module, etc. In case of breakdown of the system, the technician is supposed to visit the households within 10 to 15 days of the receipt of a complaint.

Sample Size and methodology of the Primary Survey

The evaluation survey was carried out in three states—Odisha, Madhya Pradesh and Chhattisgarh. The sample has been drawn from villages where the RVEP was implemented. In all, 186 villages and hamlets were considered for the survey from 21 districts spread over three states.

A list of beneficiary households for selected villages was taken from the implementing agencies. If the village had less than 25 beneficiary households, we considered all of them for interview. If there were 25-100 households, we considered 40 to 50 per cent, whereas if the village had more than 100 beneficiaries, we considered above 25 per cent households. In this way, we covered 5208 beneficiary households for evaluation.

Survey Tools

Two well-structured questionnaires were prepared for the survey. One was canvassed to the selected beneficiary households and the other to the member of the Gram Panchayat or a member of the village energy committee to assess the overall benefits of the solar lighting systems.

The group discussion proved to be extremely useful in eliciting a range of information, which further supports the quantitative survey information. About seven to eight FGDs were organised in each state. In all, 22 FGDs were organised in the three states.

***Village Mapping*:** Mapping was done to capture the number of installation of the street lights and distance between the two streetlights and availability of other infrastructure of the village.

Major Findings of the Survey

Out of 186 sample villages, 70, 43 and 36 villages are located in hilly areas of Odisha, Madhya Pradesh and Chhattisgarh, respectively. About7, 6 and 2 per cent of villages have no proper road connectivity to reach the villages in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

Average village size is about 40, 81 and 59 households in Odisha, Madhya Pradesh and Chhattisgarh, respectively. Average number of households which received the solar home-lighting system is 36, 70 and 52 in Odisha, Madhya Pradesh and Chhattisgarh, respectively. Among the beneficiaries 77 to 83 per cent are from STs.

Status of Streetlights

On an average 3, 6 and 9 streetlights have been installed per village in Odisha, Madhya Pradesh and Chhattisgarh, respectively. Average distances between the two streetlights are 104, 238 and 70 m in Odisha, Madhya Pradesh and Chhattisgarh, respectively. During our visit, about 78.8, 88.0 and 60.3 per cent of the streetlights were working in Odisha, Madhya Pradesh and Chhattisgarh, respectively. About 40 per cent of streetlights were not working in Chhattisgarh.

Status of Solar Power Plant in Chhattisgarh

Out of 50 sample villages, 49 power plants have been installed in 48 villages. Village 'Shobha' in Raipur district has two power plants with capacities of 4 and 5 kW, respectively. The average capacity of the plants is about 3 kW. Forty-eight power plants were working during our visit to Chhattisgarh.

Physical Verification of Streetlights and Homelights

In all three states, total 9397 SPV home-lighting systems have been installed. Out of which 21 systems were missing. Out of 21, 8 were missing in Odisha and 13 systems were missing in Madhya Pradesh. About 14 streetlights were missing of which, 8 were missing in Odisha and 6 were missing in Madhya Pradesh.

Status of Functionality of Home Lighting System

The functionality of the system has been recorded from two sources: (a) reported by the beneficiaries and (b) personal checks by the investigators at the time of visiting the beneficiaries' households. About 68, 78 and 86 per cent of beneficiaries reported that the system has been functional since it was given to them in Odisha, Madhya Pradesh and Chhattisgarh, respectively. However, when the investigators visited the households of beneficiaries and checked the system personally, it is estimated that about 84, 88 and 100 per cent of the systems were in working condition in Odisha, Madhya Pradesh and Chhattisgarh, respectively. The estimated number of days the system is 'not working' is 48, 46 and 14 days in Odisha, Madhya Pradesh and Chhattisgarh, respectively. In other words the actual working condition was better than the responses given by the households.

Reasons for Non-functional Systems

Majority of them thought of 'Technical fault', 'Problems of charge controllers' and 'Luminaires do not work' as the reasons for non-functional system.

Performance of the System by Seasons

On an average, luminaires work for 2.8 to 3.4 hours per day during rainy season. On an average, luminaires work for 3.7 to 4.4 hours per day during winter season and for 4.6 to 4.8 hours per day during summer season.

Pattern of Module Installation

The survey shows that in Odisha, about 55 per cent and 44 per cent of the systems are installed on the roof and a separate pole, respectively.

In Chhattisgarh, only two villages got the individual solar system whereas 48 villages got the system through power plant. In Chhattisgarh about 85.7 per cent have installed the system on the roof as against 14 per cent who have installed the system on a separate pole.

About 94 to 99 per cent of the systems have been installed in a shadow free area in all the three states.

The system should be installed by skilled technician. About 83, 93 and 99 per cent have reported that their systems have been installed by the supplier's technician in Madhya Pradesh, Odisha and Chhattisgarh, respectively.

Cost of the System

The beneficiaries have reported that they paid average Rs 186, Rs 285 and Rs 251 for the system as well as for the installation of the system in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

Contact Person in case of Problems

The beneficiaries call various persons for services when the system does not work. Generally approached personnel are—local technician, member of VEC, gram panchayat officials, supplier's technicians and others. The 'others' consist of skilled relatives and family friends. In case of Odisha, 31, 54, 9 per cent reported that they call 'local mechanics, VEC, supplier's technician, respectively.

In Madhya Pradesh, gram panchayats play significant role in the maintenance of the systems. About 46 per cent of the beneficiaries inform gram panchayat when they face any problems and only about 7 per cent call supplier's technicians.

In case of Chhattisgarh, 88 per cent call local technician/plant operator when there is some problem. VEC and supplier's technician are also involved in the maintenance of the system in Chhattisgarh.

Level of Satisfaction with the Number of Lamps

About 60, 47 and 57 per cent of beneficiaries are not satisfied with the number of light points given to them in Odisha, Madhya Pradesh and Chhattisgarh, respectively. It is because 48, 99 and only 15 per cent have got only one lamp in Odisha, Madhya Pradesh and Chhattisgarh, respectively. About 52 and 84 per cent have got two lamps system in Odisha and Chhattisgarh, respectively.

Contribution by the Beneficiaries

Only about 2 per cent in Madhya Pradesh pay per month, as against 69 and 89 per cent of beneficiaries in Odisha and Chhattisgarh, respectively. In Madhya Pradesh, 98 per cent of beneficiaries do not pay per month. In case of Chhattisgarh, the plant's 'Operator' collects Rs 5 per month. About 72 per cent of beneficiaries reported that 'Operator' comes to collect per month in Chhattisgarh.

Level of Community Participation

The availability of Village Energy Committee (VEC) has been recorded from two sources: (a) reported by the Village Pradhan in the village questionnaire and (b) reported by the beneficiaries in the household's questionnaire.

In Madhya Pradesh, only about 15 per cent of beneficiaries reported of existence of Village Energy Committee in the village, whereas 26 per cent 'do not know' about its existence. The rest about 59 per cent said 'No' VEC in their village in Madhya Pradesh.

About 94 and 85 per cent of beneficiaries reported of presence of VEC in Odisha and Chhattisgarh, respectively.

According to the village questionnaire, in Madhya Pradesh, 43 per cent villages have a VEC and 57 per cent said 'no' VEC in the village.

About 26 per cent of beneficiaries who reported 'do not know 'about existences of VEC may be due to non-functional VEC even though it was formed in Madhya Pradesh. However, 99 and 98 per cent of villages has a VEC in Odisha and Chhattisgarh, respectively.

Organisation of Training

About one-third of the beneficiaries have received some training for self maintenance of the system in Odisha. About 66, 65 and 39 per cent of beneficiaries have reported that they need training for maintenance of the system.

Impact of the Programme

Extent of Kerosene Consumption

The average monthly consumption of kerosene per household is 3.2, 4.9 and 4.7 litres for Odisha, Madhya Pradesh and Chhattisgarh, respectively before SPV home-lighting system.

However, the extent of requirement of kerosene has declined by 41, 30 and 51 per cent in Odisha, Madhya Pradesh and Chhattisgarh, respectively after installation of the SPV home-lighting system.

About 8 and 10 per cent of beneficiaries reported that they 'do not buy kerosene at all now' in Madhya Pradesh and Odisha, respectively.

It is estimated that about 1 per cent each in Odisha and Chhattisgarh sell excess PDS kerosene in the open market as well as to neighbours. Similarly, in Madhya Pradesh about 13.8 per cent sell excess kerosene.

Income Generation Activities

The survey finds that about 22, 10.2 and 2 per cent among the beneficiaries reported that new sources of income generation activities have opened up after getting Solar Lighting System in Odisha, Madhya Pradesh and Chhattisgarh, respectively. The new sources of income earning activities are opening mostly for women in the households in Odisha.

Level of Satisfaction with other Benefits

The RVEP is providing 'better education to children' as reported by 76, 90 and 99 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

'Significant improvement' in case of children education has been reported by 28, 52 and 34 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

'Minor improvement' has been cited by 52, 41 and 64 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

Convenience in Household Work

Only 48, 39 and 35 per cent have reported 'significant' improvement in household work in Odisha, Madhya Pradesh and Chhattisgarh, respectively. Similarly, 'minor improvement in household work' has been reported by 48 per cent each in Odisha and Madhya Pradesh; as against 64 per cent in Chhattisgarh.

Empowerment of Female Members of the Households due to RVEP

Women Feel Independent and Report Improved Standard of Living

About 68, 32 and 22 per cent of beneficiaries reported that women are independent now in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

Similarly, 55, 96 and 57 per cent of beneficiaries reported "improved standard of living" after the RVEP in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

Summary of FGDs

- Before installation of the solar streetlights in the village, wild animals like leopards, bears, etc. were frequently entering into the village and would hunt their cattle and many times also attacked their children. But due to installation of the streetlights now they have stopped coming inside the village and people are freely moving around the village after dark also.
- The crime rate was high at night. The snake and insect bites were common in the village. Now such incidents have reduced.
- Their village could now be identified from a distance even at night as the village looks lively.
- Some of the participants said that they could look after their domestic animals in a better way in the evening due to availability of lights. They collect 8-10 solar home lights for marriage ceremony and other social gatherings.
- They could now organize more social get together at night. A few participants said that mobile charging became easier now.
- Some of the participants in the 'Bijori' village said that their village streetlights were taken to the nearby villages for lighting at occasions like marriages.
- One of the participants is Anganwadi Worker (AWW) in the village 'Maharampura' said that due to the solar light she opens Anganwadi Centre (AWC) everyday.
- All the FGDs participants said that due to availability of light, women find it more comfortable to do household chores.
- A few participants in village 'Bangaura' (Chhattisgarh) said that in their village the children studied up to primary only before getting the solar light after getting solar light some of the children are studying in the middle level.
- The FGD participants in 'Nayapara' village (Chhattisgarh) said that school teacher and forest guard were not staying in the village due to lack of electricity. But now the school teacher and forest guard are staying in the village.
- A few of the participants in the village 'Dheba', 'Kashdol' and 'Diahampara' in Chhattisgarh said that after getting solar light, looking after old and sick people become easier. Social gathering, dancing and singing also takes place in the evening.

- A few of the participants in Chhattisgarh said TV was like a dream for the villager. But now they use TV also for watching the cricket match.
- In Chhattisgarh, the convergences among the households in the village 'Kashdol' has taken place as some participants said that they share their personal problem and try to help each other.
- A few participants said that poor households in their village have totally stopped buying kerosene.
- Some of the participants said that their kerosene consumption has decreased by 60 to 70 per cent after installation of the solar home-lighting system.
- However a few participants said that households are spending some more time on activities such as making bidi and plates out of leaves, rope and weaving in the village.

Status of Maintenance of Solar Lights

- Most of the participants reported that nobody visited their houses after installation of the system and that the beneficiaries themselves removed the charge controller as it was not working.
- Some of the participants said that they bought the CFL from the local market when the original CFL did not work.
- The participants in the FGD organised in Odisha said that supplier's technicians come from DRDA energy cell, after receiving complaints, sometimes they come after 2 to 3 months for services.
- DRDA offices are far away from the village.
- Out of 7 FGDs organised in Odisha, the participants in two FGDs were satisfied with the maintenance of the solar light systems in their villages as local technician and VEC members are taking care of the system.
- The participants expressed their views that, OREDA should also support at the time of replacement of the battery.
- The majority of the participants in all the FGDs said that VEC have been collecting Rs 20 every month.
- In Chhattisgarh, except in one village, all the participants said that they do not find any problems, as the power plant operator looks after the plants.

Insights from the Study

The programme of bringing electricity to remote villages has been undertaken by the MNRE through its "Remote Village Electrification Programme" in partnership with the state governments. Implementation of the scheme has required several stages of assessment, review, planning and activities. In this sense, there is a need for achieving efficiency in implementation

through cooperation of stakeholders and responsiveness to local conditions for successful implementation of this scheme. We note below the benefits as perceived by the villagers and then indicate areas where improvements can lead to greater efficiency and effectiveness of the scheme.

Main Perceived Benefits

The present study, as our previous studies on the programme, has found that bringing electricity to the remote villages can influence life in these villages very significantly for better in many ways. These are (a) reduction in expenditure on kerosene for lighting (b) children spend more time studying (c) women find more convenience in household work (d) some households find it feasible to engage in additional income earning activities; such as making of leaf plates, bidis, weaving/stitching and embroidery and ropes, etc. (e) villagers feel much safer from wild animals at night due to availability of light and the villages look lively.

Areas for Improvement

- Involvement of local people in the identification of beneficiaries, recovery of charges and monitoring the maintenance services can lead to more efficient functioning of the system. *As we have discussed in Chapter 8 there is lack of maintenance and no monthly fee collection especially in Madhya Pradesh.*
- The village panchayats should be given the role of monitoring the implementation of the programme. This will improve transparency in implementation and accountability of the service providers to the village..We find that there is a lot of variation in the way the village panchayats are involved. The VEC have not been formed in many places. *The VEC have not been formed in about 80 per cent of places in Madhya Pradesh. Whereas in Odisha and Chhattisgarh, 94 and 85 per cent, respectively reported the presence of VEC.*
- Community level services such as streetlights or lights in the community facilities should form an integral part of the programme. The scheme envisages installing one streetlight per every 10 households in the village. Contributions for the maintenance of the system should be a commitment from the community as a whole. This will improve community ownership of the scheme in the village and also accountability. As we have noted if the involvement of panchayats is not significant, in the absence of any other mechanism the community level participation will be less than adequate.
- Role of the Village Energy Committee has to be well defined. All the beneficiaries should know about the activities of the VEC. The scheduled activities of the VEC should be strengthened.
- The local people should be given necessary training and information so that they are fully equipped to perform their roles. The awareness campaigns should not be just one time

activity. There is a need for periodic efforts at providing information and better management. Effective awareness campaign should be organized by the nodal agencies/suppliers with the involvement of the people in the selected villages. Posters or advertisements may also help in creating awareness among the villagers.

- Maintenance strategies in case of power plant in Chhattisgarh are better than in case of individual systems prevailing in Odisha and Madhya Pradesh. There is lack of Operation and Maintenance services in Odisha and Madhya Pradesh unlike Chhattisgarh. It is a suggestion that if the village has sizable households and not so much of scattered location it may be ideal to offer a power plant than individual system.
- The programme should also aim to increase the effectiveness of electrification through synergies with the other schemes of the state or central government. This is more likely to happen if there is a greater involvement of panchayati raj institutions at higher levels—blocks and districts.
- The monitoring and evaluation of the scheme is important for effective implementation of the scheme. The corrective measures can be provided if the monitoring inputs are available.
- The evaluation of the projects should be carried out three times during the guarantee period. First, in the year of installation, second, after two and a half years of installation (mid-term evaluation) and third, in the fifth year of installation. The evaluators should visit the same households to assess the functionality of the system during each evaluation at least 50 per cent of the cases both in terms of villages and the households where the SPV systems are installed.
- At least one member of the beneficiary household needs to be trained to look after the system.
- It is expected that MNRE's specific cell coordinates the various electrification schemes. This coordination is important. RVEP is meant for all unelectrified Census villages and hamlets of electrified Census villages where gird connectivity is either not feasible or not cost effective. We point out some instances where we found that grid connection was made available at some point in the selected sample villages.

  - ❖ We found that three villages in Chhattisgarh, viz. 'Jabarsa' in district Dhamtari, 'Sukjhar I' and 'Sukjhar II' in district of Kawardha, were electrified through Solar power plant in 2004 and 2007, respectively. The village 'Jabarsa' is again electrified through grid in 2008. Similarly, the villages 'Sukjhar I' and 'Sukjhar II' are also electrified through grid in 2010. The power plants have been maintained by the operators in the village. However, it is not clear how many lights are given to the households through grid connection.
  - ❖ In Madhya Pradesh, villages 'Antri', Bagwala and Tilawali' in district of Gwalior were connected with grid in 1984, 1985 and 1990, respectively. After few months

the grid connection was discontinued due to certain problems. Solar PV was installed in 2008 and 2009 in these villages. The village 'Vaupur' in Guna district of Madhya Pradesh was electrified through grid in 2006 and the same village was also electrified through solar home-lighting system in 2007.

When the grid electricity reaches the village, the households may lose interest in the solar system and may not maintain these installations. In such cases it is necessary to have the procedures for withdrawing the scheme or at least evaluate the alternatives. If the supply of power through the grid is erratic and deficient, the solar systems may still have a role to play. The remoteness of the villages which limits their access to other forms of infrastructure in a cost effective way may still justify the solar lighting systems if the grid supply of electricity is not satisfactory.

The field work has shown that the selected villages are indeed remote and providing electricity through the solar system is a very significant development/intervention in these villages. If there are further technological improvements that can improve the efficiency or capacity of the systems it would further benefit the households dependent on these systems.

Chapter 1

Rural Remote Village Electrification

1.1 Introduction

Rural electrification is defined as the supply of electricity to small towns and villages, and agro-based industries outside the regional capitals to bring about important social and economic benefits (Kjellstrom et al., 1992; Department of Energy, 2004). Rural electrification supply can be achieved by using the national grid, mini-grid, isolated generator systems or renewable energy systems including solar photovoltaic, wind power plant, small hydropower and bio-fuel engines among others.

Rural electrification was not considered as a basic human need like water and food in the past. Recent studies have emphasised the importance of electrification for meeting basic needs such as health, agriculture, education, information and other infrastructural services. There is a clear correlation between per capita income and human development index (Anderson, 2000; Rehling, 2004). Although rural electrification does not reduce poverty directly, but its relationship to poverty reduction cannot be denied (Department of Energy, 2004). Several research studies have provided analysis of the link between electricity and major global issues such as health, education, water, gender, etc. (Cecelski, 2003; UNDP, 2004). All these studies conclude that though electricity alone cannot initiate development and reduce poverty, but it must be linked to development strategies for education, health, agriculture and infrastructure, and to political and economic improvements. In Ghana and other African countries, increased use of renewable energies such as solar, wind, biomass and biogas have been identified as alternatives to grid-electricity supply in remote rural areas for poverty reduction (World Bank, 2003).

India has a long association with renewable energy sources and Solar Home Lighting system. Though India has been engaged in rural electrification since early 1960s, the consensus that rural electrification needs to be treated as a basic minimum service was reached in the Chief Ministers Conference in 2001. The important resolutions that were adopted in the conference included:

a) Electrification of all villages and households, and rural electrification to be treated as a basic minimum service.

b) Rural electrification to be completed by 2007 and electrification of all households by 2012.

c) States to be given flexibility for using funds under rural development programmes with the consent of village/block Panchayats for undertaking electrification.

d) Electrification of remote villages to be included under a special mode of financing including a grant (Report of the Task Force on Power Sector Investment and Reforms, 2004). Out of 80,000 unelectrified villages, 18,000 villages were supposed to be those which were located in remote and inaccessible areas and could not be electrified through conventional grid extension.

The Ministry of New and Renewable Energy of the Government of India, has been implementing a 'Village Electrification Programme' for electrification of Remote Unelectrified Census Villages and Remote Unelectrified Hamlets of Electrified Census Villages through renewable energy sources since 2001-02. The programme was renamed as 'Remote Village Electrification Programme' (RVEP) in 2003-04[1]. It is now aligned with and made complementary to the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) of the Ministry of Power and aims at covering those villages under autonomous renewable energy system where grid connectivity is neither feasible nor cost effective. The Ministry provides up to 90 per cent of the costs of systems as subsidy to the state implementing agencies. About 97 per cent of the villages have used solar photovoltaic home lighting systems, which provide two lights to each household. Solar Photovoltaic (SPV) technology enables the conversion of direct sunlight into electricity. The basic part of Solar Photovoltaic is known as Solar Cell. Solar Cells are made of semi conducting materials, a thin wafer of Silicon which is exposed to sunlight, to produce DC electric current.

Solar home lighting system helps to meet primarily the need of lighting, although it can also be designed for meeting electricity for Radio, TV, internet and mobile.

A target for coverage of 10,000 villages and hamlets has been set for the Eleventh Plan (Annual Report 2008-09, Ministry of Power). As on 31 March 2009, 9355 remote villages/hamlets have been provided support. The Ministry decided to have it evaluated in various states so that suitable intervention could be made for its better implementation. The present study evaluates the 'Remote Village Electrification Programme' of the Ministry of New and Renewable Energy in three selected states of India. The three states are:

[1] The details of this scheme are elaborated in Appendix A.

Chhattisgarh, Odisha and Madhya Pradesh. A previous study was carried out in Jharkhand, Assam and Meghalaya in 2008.

1.2 Objectives of the Study

This study evaluates the following dimensions of the RVEP programme based on a sample survey:

- ≅ Obtaining beneficiary level data on 'Functionality of system'
- ≅ Satisfaction levels of beneficiaries
- ≅ Effectiveness of implementation arrangements
- ≅ Effectiveness of service and maintenance infrastructure
- ≅ Level of community participation

1.2.1 Following are the specific aspects considered during the survey.

Electrification status: It was checked whether the village is being electrified through grid.

Physical verification: The number of systems in field was verified with those claimed to have been installed. The aim being that number of beneficiaries should coincide[2].

Module capacity: There are two models of the systems installed under the programme. The module capacity for Model-I is minimum 18 W while for Model-II is 36 W.

Module installation: The technical condition of the installation was checked in the survey by the field interviewers based on the training provided. For instance, the photovoltaic frames should be firmly fixed on the roof or on a separate pole. There should be no shadow on it throughout the day. Orientation should be due south. The angle of inclination should be approximately equal to latitude. The modules should have a colour differentiation mark. A deviation from these was recorded. (Suitable training to the interviewers was given for this assessment).

Fixing of luminaires inside the house: The luminaires should be firmly fixed. Their positioning should be such that as large a space as possible is illuminated (positioning in a central place is more desirable than positioning on a wall).

Fixing a cable: Cables should be firmly fixed and not left loosely hanging.

[2]The sample surveys are based on confidentiality of the respondents. Therefore, we will not be able to share the specific identity of the beneficiaries with respect to their responses.

Streetlights: the modules should be shadow free, the light should be positioned so as to illuminate a well used street, the angle of inclination of the fixture of the lamp should be such that it illuminates the road and not the sky, and the pole should be firmly grouted and properly painted.

Functionality of System: The status of functionality was recorded by the field interviewers.

Arrangement for Annual Maintenance Contract, Servicing and Availability of Spares: Proper and easily accessible arrangements for maintenance of the system is the responsibility of the supplier/implementing agency. The detail of the maintenance system was recorded.

Constitution of the Village Energy Committee (VEC) or other Arrangements for Community Participation: The constitution and actual functionality of the VEC has been noted.

Monthly payments of the Beneficiaries: The monthly payments being made by the beneficiaries have been recorded.

Satisfaction Level feedback: reaction of the beneficiaries in this regard has been noted. The feedback with respect to the monthly payments, availability of service and spares, etc. was also recorded.

Technical Issues with SPV Home-lighting System:

- ≅ If the system is not properly installed it would work inefficiently and the output could be reduced.
- ≅ As far as possible, the module should face south and be inclined at an optimum angle. It should be firmly fixed on the ground or on the roof.
- ≅ The lamp should be positioned in a manner that it gives maximum utility of light.
- ≅ The street lighting systems should be positioned in a manner so that the light should focus on the ground.
- ≅ The system is designed for a particular type of lamp. Whenever lamps are replaced, as far as possible same type should be used or else the output may be less.

The field interviewers were trained by the state's implementing agencies in Odisha, Chhattisgarh and Madhya Pradesh, as well as by the trained persons of NCAER to enable them to make the assessment of the above points during the survey.

Chapter 2

Sample Size and Methodology

2.1 Introduction

The evaluation survey was carried out in three states: Madhya Pradesh, Odisha and Chhattisgarh. The village survey work was launched in May 2010. The village sample has been drawn from villages where the 'Village Electrification Programme' has been completed by December 2009. The list of beneficiary households for selected villages was taken from the implementing agencies, viz., Chhattisgarh Renewable Development Agency (CREDA), Odisha Renewable Development Agency (OREDA) Madhya Pradesh Urja Vikas Nigam (MP UVN) at the time of selection of the village. The actual number of districts, the number of villages surveyed and the number of households surveyed are given in Table 2.1.

Table 2.1 Sample Size in Selected States

State	Selected Districts	Number of Villages Surveyed	Number of Households Surveyed
Odisha	Gajapati	10	269
	Keonjhar	14	427
	Sundergarh	14	434
	Kalahandi	20	520
	Nayagarh	14	271
	Mayurbhanj	4	143
	Rayagoda	3	25
	Angul	6	111
Total	8	85	2200
Chhattisgarh	Raipur	14	420
	Dhamtari	8	240
	Rajnandgaon	4	120
	Korba	10	300
	Kawardha	14	420
Total	5	50	1500
Madhya Pradesh	Jhabua	5	151
	Gwalior	10	314
	Betul	11	339
	Sheopur	5	155
	Dindori	5	190
	Satna	7	164
	Guna	4	100
	Hoshangabad	4	95
Total	8	51	1508
Grand Total	21	186	5208

A total of **186** villages have been selected for the survey from **21** districts spread over three states and **5208** households have been surveyed from the selected **186** villages.

2.2 Criteria for Selection of Beneficiary Households

The number of households to be surveyed has been determined in each village after selecting the villages. We have canvassed the questionnaires to all the households if the village/hamlets have less than 25 households in the village. We have left such households only if no one is at home at the time of our visit. If the village had 25 to 100 households, we considered 40 to 50 per cent, whereas if the village had more than 100 beneficiaries, we considered above 25 per cent households. We have covered about 5208 households from 186 villages and hamlets.

2.3 Survey Tools

Two separate questionnaires were prepared for the surveys which were approved by the concerned authority. One has been canvassed to the village leaders and the other questionnaire has been canvassed to the selected sample beneficiary's household. About seven Focus Group Discussions (FGDs) have been organised among the beneficiaries from each selected state. Total 21 FGDs have been organized from these three states.

2.4 Approach

The survey was carried out in the months of May, June andJuly 2010 with the support of NCAER's local networking agencies. Training was given to the field staff by the team of NCAER and state nodal agencies in each state separately.

Selected villages were identified with the help of implementing agencies of the state governments. The physical verification of the list of beneficiary households was carried out with the help of headman of the village/member of VEC in the village. Details are presented in Tables 2.2 to 2.4.

Table 2.2 Sample Districts, Blocks, Villages, SPV installed in Odisha

District	Block	Village	No. of SPV Reported	SPV Missing	Sample Size	Street Light Installed
Gajapati	**Mohana**	Gunduriguda	19	0	19	2
		Malipadar	27	2	25	3
		Luburu	22	0	20	2
		Karanjakua	25	0	22	2
		Hataganda	38	0	37	1
		Jaraganda	48	0	46	4
		Solaguda	21	0	19	2
		Rumesh	48	0	31	6
		Rapet	25	0	20	3
		Paramaguda	40	0	30	3
Total		**10**	**313**	**2**	**269**	**28**
Keonjhar	**Banspal**	Jamudiha	49	0	45	6
		Kansa	74	0	53	12
		Pansuan	56	0	20	6
		Rakam	46	0	25	8
		Talabarada	34	0	24	4
		Emiri	31	0	10	3
		Mundatopa	28	0	10	3
		Sagapalli	88	0	27	10
		Uppar Kansari	52	0	25	5
		Tangarpada	62	0	43	4
		Champajhar	42	0	15	3
		Balibeda	44	0	20	6
		Fulbari	60	0	57	5
		Kapatadiha	57	0	53	6
Total		**14**	**723**	**0**	**427**	**81**
Sunder-garh	**Gurundia**	Madlia	52	2	35	3
		Janda	40	0	26	4
		Sanakantabahal	52	0	48	6
		Jagannath prasad	14	0	14	2
		Sanajodaloi	38	0	18	2
		Dantagothani	59	0	43	6
		Badapada	40	0	38	4
		Sana dahichor	13	0	13	1
	Lahuni-pada	Khajurinali	37	0	32	2
		Arjunjhari	43	2	33	4
		Dhanijam	26	0	24	2
	Bonei	Sandalki	30	0	29	3
		Sindurkela	58	0	46	1
		Khajuribahal	47	0	35	4
Total		**14**	**549**	**4**	**434**	**44**

District	Block	Village	No. of SPV Reported	SPV Missing	Sample Size	Street Light Installed
Kala-handi	**Lanjigarh**	Isnala	23	0	23	2
	M. Rampur	Dedeng	24	0	24	2
	Th. Rampur	Samilpadar	42	0	19	4
		Madanguda	48	0	20	5
		Sialipadar	36	0	20	4
		Bhhataguda	59	0	59	6
		Dalgumma	62	0	62	6
		Melghara	43	0	43	4
		Podapadar	39	0	39	4
		Nigunaguda	21	0	21	2
		Gokulma	54	0	21	5
		Jatangpada	33	0	25	3
		Medkatara	29	0	20	3
		Kurkuti	16	0	16	2
		Goudpadar	17	0	17	2
		Aluaguda	43	0	20	4
		Ghutimaska	39	0	20	4
		Kandhajhapi	65	0	20	6
		Nachimaska	47	0	11	4
		Poiguda	39	0	20	4
Total		**20**	**779**	**0**	**520**	**76**
Naya-garh	**Nuagaon**	Tukuda	24	0	24	2
		Badajhiri	25	0	25	2
	Daspalla	Tapida	12	0	12	1
		Beberi	25	1	24	2
		Nidhikiari	16	1	15	2
		Pehelaju	9	0	9	1
		Kanapaju	45	0	45	3
	Ranpur	Brahmankumbhi	10	0	10	1
		Sirikuti	11	0	11	1
		Bandhamunda	13	0	13	1
		Tikiriapada	17	0	17	2
		Sankhajodi	38	0	38	4
		Betuli	10	0	10	1
		Nelipada	18	0	18	2
Total		**14**	**273**	**2**	**271**	**25**
Mayur-bhanj	**Takhur-munda**	Sudarsanpur	53	0	45	5
	Bahalda	Dumatandi	51	0	51	5
	Bijatola	Amedabeda Hill	30	0	25	3
	Rairang-pur	Kukurjharan	22	0	22	2

District	Block	Village	No. of SPV Reported	SPV Missing	Sample Size	Street Light Installed
Total		**4**	**156**	**0**	**143**	**15**
Raya-gada	**Kasipur**	Silasankuli	13	0	13	1
		Gulasargi	7	0	7	1
		Thakurkama	5	0	5	1
Total		**3**	**25**	**0**	**25**	**3**
Angul	**Angul**	Sikoili	34	0	23	3
		Asanbahal	25	0	16	2
		Bhurkundi	49	0	21	5
	Parlahada	Chakradharpur	13	0	12	1
		Balabhadrapur	37	0	18	4
		Ganeswarpur	44	0	21	4
Total		**6**	**202**	**0**	**111**	**19**
All Total 8		**85**	**3020**	**8**	**2200**	**291**

Table 2.3 Sample Districts, Blocks, Villages, SPV installed in Chhattisgarh

District	Block	Village	No. of SPV Reported	SPV Missing	Sample Size	Street Light Installed
Raipur	**Kashdol**	Ravan	72	0	30	11
		Kaohabahra	46	0	31	7
		Latadadar	45	0	30	8
		Dheba	70	0	30	9
		Mohada	72	0	30	9
		Haradi	103	0	30	9
		Rampur	73	0	30	14
		Mudpar	80	0	30	16
		Dond	67	0	30	8
		Navapara	75	0	30	9
	Mainpur	Shobha	163	0	30	24
		Adgari	119	0	30	8
		Pendra	60	0	22	15
		Temari	78	0	37	15
Total		**14**	**1123**	0	**420**	**162**
Dhamtari	**Dhamtari**	Kandhari	32	0	32	10
		Satiyara	25	0	25	6
	Nagari	Bendrapani	72	0	33	8
		Jabara	84	0	25	17
		Jampani	34	0	34	5
		Keramunda	47	0	30	7
		Lilange	28	0	21	8
		Palgaon	60	0	40	8
Total		**8**	**382**	0	**240**	**69**
Rajnandgaon	**Manpur**	Amakodo	35	0	30	6
		Hureli	56	0	54	10
		Hurve	26	0	23	4
	Molha	Makodi	13	0	13	8
Total		**4**	**130**	0	**120**	**28**
Korba	**Korba**	Dinda Sarai	49	0	30	10
		Hardimahua	66	0	30	10
		Kutuwa-II	71	0	30	8
		Nayapara	49	0	30	7
		Tenduaghat	43	0	30	7
	Palli	Bisemar	76	0	30	6
		Daihanpara	43	0	30	8
		Keramunda	61	0	30	6
		Pahadgaon	64	0	30	6
		Surka	51	0	30	9
Total		**10**	**573**	0	**300**	**77**

District	Block	Village	No. of SPV Reported	SPV Missing	Sample Size	Street Light Installed
Kawardha	**Bodla**	Bangoura	52	0	30	10
		Bhursi Pakari	68	0	30	10
		Chendra Padar	36	0	30	8
		Mukam	33	0	30	12
		Salgi	34	0	30	10
		Sukjhar I	30	0	30	7
		Sukjhar II	30	0	30	5
	Pandriya	Adhchara	30	0	30	4
		Chata	43	0	30	8
		Machgaon	53	0	30	6
		Sarpani I	98	0	30	5
		Sarpani II	94	0	30	7
		Teliapani I	34	0	30	5
		Teliapani II	42	0	30	8
Total		**14**	**677**	0	**420**	**105**
All Total 5		**50**	**2885**	0	**1500**	**441**

Table 2.4 Sample Districts, Blocks, Villages, SPV installed in Madhya Pradesh

District	Block	Village	No. of SPV Reported	SPV Missing	Sample Size	Street Light Installed
Jhabua	**Sondwa**	Bhanchidi	90	0	39	5
		Borewala	114	0	47	6
		Wakner	255	0	37	22
	Katthiwala	Motibar	23	0	12	2
		Kusumba	56	0	16	3
Total		**5**	**538**	**0**	**151**	**38**
Gwalior	**Ghattigaon**	Sikrawali	61	2	42	6
		Maharampura	89	0	35	9
		Kaimari	44	0	27	4
		Ghighali	112	0	40	10
		Berkheda	36	0	22	3
		Tilawali	22	0	20	2
		Antri	34	4	20	4
		Para	51	1	30	5
		Charaidang	40	1	29	5
		Bagwala	109	1	49	11
Total		**10**	**598**	**9**	**314**	**59**
Betul	**Bhimpur**	Chival	59	0	25	6
		Uttari	142	0	55	10
		Bijori	57	0	31	6
		Pali	77	0	36	8
		Rohani	45	0	24	4
		Hardadadu	79	0	37	8
		Virpura	71	0	36	8
	Shahpur	Sawrida	38	0	19	4
		Bod	55	0	27	6
		Path	103	0	24	10
	Chicholi	Panchhi	36	0	25	5
Total		**11**	**762**	**0**	**339**	**75**
Sheopur	**Vijaypur**	Badhwani	47	1	15	5
		Baghcha	104	0	30	10
	Karhal	Dondi Khera	114	0	42	11
		Saran Ahirvani	131	0	43	13
		Dubdee	47	0	25	5
Total		**5**	**443**	**1**	**155**	**44**
Dindori	**Shahpura**	Tikri maheshwari	101	0	38	10
		Duba Raiyat	161	0	42	16
		Duba Mall	137	0	40	12
	Karanjia	Dadar Gaon	134	0	40	13
	Samnapur	Jilong	74	0	30	7
Total		**5**	**607**	**0**	**190**	**58**

District	Block	Village	No. of SPV Reported	SPV Missing	Sample Size	Street Light Installed
Satna	**Majgawan**	Gopal Sagar	10	0	10	2
		Kathwariya	76	0	28	4
		Khadra Tola	27	0	26	2
		Kachura	35	0	32	4
		Tamar	8	0	8	2
	Mahihar	Naugawankap	50	0	30	4
		Dongargaon	54	0	30	4
Total		**7**	**260**	**0**	**164**	**22**
Guna	**Aron**	Bhaiswala	59	3	25	4
	Guna	Pali	26	0	23	2
	Bamhori	Sonda	34	0	31	6
		Bhaupura	26	0	21	1
Total		**4**	**145**	**3**	**100**	**13**
Hoshanga-bad	**Pipariya**	Ghodanar	17	0	16	2
		Rorighat	51	0	28	5
		Khamkhedi	39	0	22	4
		Kajri	32	0	29	4
Total		**4**	**139**	**0**	**95**	**15**
All Total 8		**51**	**3492**	**13**	**1508**	**324**

Chapter 3

Remote Village Electrification Programme: The Process of Implementation

3.1 Background of the Scheme

The Remote Village Electrification Programme of the MNRE aims at providing basic lighting/electricity facilities through renewable energy sources. The scheme is being implemented in most of the states through identified state level agencies in India.

At the state level, the responsibility for village electrification is generally vested with the State Electricity Boards (SEBs), while state renewable energy development agencies are responsible for renewable energy programmes. In the absence of clear demarcation of responsibilities, there could be difference in implementation of the scheme in states. In 2005–06, the MNRE, therefore, asked the states to notify implementing agencies in their respective states for implementation of RVEP. In this section of the report we assess the process of implementing the scheme in Odisha, Madhya Pradesh and Chhattisgarh.

The SPV home lighting system has been installed on a cost-sharing basis. In all, 90% of the cost is provided by the central government including CMC and 10% of the cost by the state government. Out of the 10 percent cost borne by the state government, 5 per cent is expected to come from charges levied on beneficiaries or from other welfare schemes at the state level. In addition to this, MNRE provides a one-time promotional support of Rs 50,000 per village to the implementing agencies. In case of hamlets, a service charge is limited to 10% of the approved CFA for each hamlet subject to a maximum of Rs 50,000 per census village. This criterion is applied uniformly across states. However, in practice, the implementation arrangement differs from state to state.

3.2 Implementation Process of the RVEP Scheme in Odisha

The Odisha Renewable Energy Development Agency (OREDA), established in the year 1984, under the department of Science and Technology, is the state nodal agency (SNA) for the implementation of the Remote Village Electrification Programme (RVEP). The RVEP was initiated in 2006–07 in Odisha. The Odisha State Electricity Board (OSEB) shortlists the name of those remote unelectrified villages and hamlets where the grid connectivity is neither

feasible nor cost effective. OREDA collects the list of such identified villages from OSEB and sends it to Ministry of New and Renewable Energy for verification by Rural Electrification Corporation (REC). Once the list of such villages is received by MNRE from REC after verification, the MNRE asks OREDA to prepare a Detailed Project Report (DPR) for such identified villages.

Table 3.1 Number of Remote Villages Received for RVEP by OREDA as on May 2010

Villages	Total
Received till May 2010	1629
Completed till May 2010	336
Under Progress	371
Balance	922

Before preparing the DPR, a Memorandum of Understanding (MoU) is signed between OREDA and MNRE underscoring the respective roles and responsibilities of OREDA and the MNRE.

3.2.1 Parameters of the survey

In order to provide the solar home-lighting system, the OREDA does pre-distribution door-to-door survey themselves with the help of their own staff as per guidelines of MNRE. The survey includes the following parameters.

i. Constitution of Village Energy Committee.
ii. Preparation of a list of beneficiary households with photograph.
iii. Recording the latitude and longitude of the location of the households in the village through Global Positioning System (GPS).
iv. Preparation of profile of the selected villages.
v. Identification of the means of communication available in the villages.
vi. Organising awareness campaigns in the villages.
vii. Estimating the number of home-lighting and street-lighting systems required in the villages.
viii. Obtaining a certificate from the beneficiary households certifying their willingness to accept the system.

3.2.2 Contents of DPR

On the basis of this verification and door-to-door survey report, the OREDA prepares a Detailed Project Report (DPR) and sends the same to MNRE for obtaining the grant. The following points are covered in the DPR prepared for each selected village.

i. Village Profile
ii. Technical details of the village including various renewable energy resources available and total demand for electricity in the village.
iii. Implementation arrangements including mode of implementation, monitoring arrangements and plan for long-run sustainability of the system, etc.
iv. Number of households proposed to be provided with the system in the village.
v. Number of street lights required.
vi. Cost of installation and revenue generation.
vii. Capacity and details of the proposed systems.
viii. Map of the village.

If the DPR qualifies under the criteria of MNRE, the sanction letter is sent by MNRE to OREDA.

3.2.3 Tendering process

After getting the sanction order from MNRE, the OREDA advertises the tender notice in the local and national newspapers inviting sealed bids for supply, installation, commissioning including a five year Comprehensive Maintenance Contract (CMC) of solar home-lighting and street-lighting systems from registered MNRE's suppliers. The tender notice is also put on the OREDA's website. On receipt of the sealed tenders, the technical evaluation of each tender is carried out by OREDA. The technical evaluation involves analysing the tenders with respect to the MNRE's guidelines, experience of the agency, etc. Those tenders that qualify the technical bidding are called by the tender committee for commercial bidding which is conducted by the OREDA/ purchase committee. If the tender is above Rs 5 crore the purchase committee from Department of Science and Technology also attends and monitors the tendering process. The purchase committee opens the qualified tenders in front of all qualified agencies. The work order is awarded to the bidder making the lowest bid. If the bidder making the lowest bid is unable to provide the required number of systems, OREDA/ the purchase committee could ask the other parties for their willingness to provide the

systems at the lowest bid price. The remaining work is distributed in equal proportion to those bidders who agree to provide the systems at the lowest bid price.

3.2.4 Inspection

The pre-dispatch technical inspection is not done at a recognised/certified test centre by MNRE by OREDA as it is a norm. The supplier supplies and installs the system in the beneficiary households with the help of his own technicians. The suppliers also arrange in some cases the work of installation to local NGO/technician. A sum of Rs 100 is taken from the beneficiary households at the time of installation. The supply, installation, commissioning and comprehensive maintenance contract (CMC) of the system for five years is the responsibility of the supplier. After installation, the supplier also organises training and awareness campaigns for the beneficiaries in some places reported by OREDA officials.

3.2.5 Maintenance of the system

OREDA has a separate Cell of District Renewable Energy in the District Rural Development Authority (DRDA) office in each District. Each cell has a technician for monitoring and evaluating the system at village level when they receive the complaint from the beneficiaries. Total 153 technicians have been appointed under OREDA who also looks after the RVEP at village level. They visit the village as a part of their duty regularly. In case they find any non-working system, they inform the suppliers to rectify it. OREDA has specific guidelines for their own technicians. The technician appointed by the suppliers is supposed to visit the villages every quarter for routine maintenance, which includes positioning of the modules, putting distilled water in the battery, checking the direction of the module, etc. In case of breakdown of the system, the technician is supposed to visit the households within a week of the receipt of a complaint.

3.2.6 Proof of delivery

The supplier is required to provide the following details to OREDA.

i. A list of beneficiary households where the systems have been installed.

ii. A certificate of the receipt of system from the beneficiary along with an agreement that the system is a government property and will be maintained properly, and if found sold or transferred by the beneficiary, legal action could be taken against him.

iii. A photo of the beneficiary along with the model number.

iv. A report of the technical specifications of the system installed.

v. A certificate of the receipt of number of systems in the village by the VEC is also taken as a proof of delivery.

The nodal agency provides 90 per cent of the tender cost to suppliers after verifying the above points. After the submission of acceptance certificate from each beneficiary, OREDA officials visit the villages and inspect the systems on a sample basis.

For receiving final instalment of the CFA, a third party evaluation is mandatory. An advertisement is done in local newspapers for seeking expression of interest for carrying out an evaluation survey of already electrified villages through solar home-lighting system by NGOs. The third party evaluation includes verification of functionality of the system, level of satisfaction of beneficiaries, maintenance of the system, requirement of the additional light, etc. The third party evaluation report is submitted to the MNRE. However, the third party evaluation has not been done in Odisha so far.

3.2.7 Maintenance of systems at village level

Rs 100 is taken from each beneficiary at the time of installation. After installation Rs 20 to 30 is collected from each beneficiary per month.

The president and secretary of the VECs are elected by the beneficiaries in the respective village. A separate bank account in the name of the VEC is opened and the President and the Secretary are required to collect a sum of Rs 20 per month per beneficiary and deposit the same into the bank account. The purpose of this fund is to pay for changing of the batteries after five years.

3.2.8 Installation of streetlights

In Odisha, the VEC decides the place of installation of streetlights in their village and it also maintains them.

3.3 Implementation Process of the RVEP Scheme in Madhya Pradesh

The MP Urja Vikas Nigam Ltd (MP UVN) is the SNA for the implementation of the RVEP in Madhya Pradesh. This corporation was established by the Government of Madhya Pradesh in 1982 as nodal agency for implementing various programmes and policies of the Government of India as well as the state government for the renewable energy sector. The

RVEP was initiated in MP in the year 2006–07. The MP State Electricity Board (MPSEB) shortlists the names of those remote unelectrified villages and hamlets where the grid connectivity is either not feasible or not cost effective. MP UVN collects the list of such identified villages from Energy Department of MPSEB and sends it to Ministry of New and Renewable Energy for verification by REC. Once the list of such villages is received by MNRE from REC after verification, the MNRE asks MP UVN to prepare a DPR for such identified villages.

Table 3.2 Total Remote Villages Received till March 2010 for RVEP in MP

Villages	Total
Remote Villages for RVEP	994
Completed Village	275
Under progress	99
Balance	620

Before preparing the DPR, a Memorandum of Understanding (MoU) is signed between MP UVN and MNRE underscoring the respective roles and responsibilities of MP UVN and the MNRE.

The MP UVN conducts pre-distribution door-to-door survey themselves with the help of their own staff as per the guidelines of MNRE. The survey includes the following parameters.

i. Constitution of Village Energy Committee.
ii. Preparation of a list of beneficiary households with photograph.
iii. Recording the latitude and longitude of the location of the households in the village through GPS.
iv. Preparation of profile of the selected villages.
v. Identification of the means of communication available in the villages.
vi. Organising awareness campaigns in the villages.
vii. Estimating the number of home-lighting and street-lighting systems required in the villages.
viii. Obtaining a certificate from the beneficiary households certifying their willingness to accept the system.

3.3.1 Contents of DPR

On the basis of this verification and door-to-door survey report, the MP UVN prepares a DPR and sends the same to MNRE for obtaining the grant. The following points are covered in the DPR prepared for each selected village.

i. Village project summary including total project cost.
ii. Village profile.
iii. Technical details of the village including various renewable energy resources available and total demand for electricity in the village.
iv. Implementation arrangements including mode of implementation, monitoring arrangements, etc.
v. Name of the selected beneficiaries.
vi. Capacity and details of the proposed systems.
vii. Map of the village.

If the DPR qualifies under the criteria of MNRE, the sanction letter is sent by MNRE to MP UVN.

3.3.2 Tendering procedure

After getting the sanction order, the MP UVN advertises a tender notice in the local and national newspapers inviting tenders for supply, installation, commissioning including a five-year Comprehensive Maintenance Contract (CMC) of solar home-lighting and street- lighting systems from registered MNRE's suppliers. In the notice MP UVN asks the bidders to obtain the tender documents from the office of Executive Engineer, SPV and RVEP, and MP UVN against payment of Rs 5000. On receipt of the sealed tenders, the technical evaluation of each tender is carried out by MP UVN. The technical evaluation involves analysing the tenders with respect to MNRE's guidelines, experience of the agency, etc. Those tenders that qualify the technical bidding are called by MP UVN up to L3. The work is allocated in the ratio of 60 % to L1, 25 % to L2 and 15 % to L3 respectively. So far, Bharat Electronic Ltd has been the main supplier of solar home-lighting system in MP.

3.3.3 Inspection

As observed in Odisha, in MP also, a pre-dispatch technical inspection is not done at a recognised/certified test centre by the nodal agency as suggested by MNRE. However, in the

tender notice MP UVN requires the bidders to provide information on the test reports for respective items issued by Solar Energy centre/other authorised test centres for their supplies, confirming to the MNRE specification of SPV guidelines. The supplier supplies and installs the system in the beneficiary households with the help of his own technicians. Rs 100 is taken from the BPL beneficiary households and Rs 200 is taken from APL beneficiary households at the time of installation. The supply, installation, commissioning, and comprehensive maintenance contract (CMC) of the system for five years is the responsibility of the supplier.

The supplier is required to provide a list of beneficiary households where the systems have been installed. The supplier is also required to submit a certificate of the receipt of system from the beneficiary along with an agreement that the system is a government property and will be maintained properly, and if found sold or transferred by the beneficiary, legal action could be taken against him. A proof of delivery of the system along with the number of households who have received the system is taken by the suppliers from the Panchayat for releasing 90 per cent of the cost.

Based on the survey, it has been found that in MP, the Panchayat is involved marginally in RVEP programme, and that no third party evaluation has been conducted in MP. Further, a prescribed format is available in MP UVN for CMC but the suppliers have not been using it so far, even though the systems are older than three years. No service centre or Operation and Maintenance have been set up in MP for Solar home-lighting system. There is no VEC constituted in the village by the suppliers. Beneficiaries have to come to the Panchayat to report when their systems stop functioning or if they face any other problem. For some villages the distance to the panchayat is about 5 to 10 km.

Discussions with officials of MP UVN revealed that there is no systematic arrangement for maintenance of the systems. Neither the officials knew from the money would come from or who would take regular responsibility of the maintenance of the system. Lack of community participation as well as social problems and jealousness among the community are the major drawback for smooth functioning of the system cited by some officials in the meeting with MP UVN.

3.4 The Process of Implementing the RVEP Scheme in Chhattisgarh

The Chhattisgarh Renewable Energy Development Agency (CREDA) is the SNA for the implementation of RVEP in the state. CREDA was constituted under the Department of

Energy, Government of Chhattisgarh in 2001. The Chief Minister of the state is the Chairman of CREDA and the Principal Secretary (Energy) is the Chief Executive Officer (CEO). The RVEP was initiated in 2003–04 in Chhattisgarh. The Chhattisgarh State Electricity Board (CSEB) shortlists the names of those remote unelectrified villages and hamlets where the grid connectivity is either not feasible or not cost effective. CREDA collects the list of such identified villages from CSEB and sends it to Ministry of New and Renewable Energy for verification by Rural Electrification Corporation (REC). Once the list of such villages is received by MNRE from REC after verification, the MNRE asks CREDA to prepare a DPR for CFA for such identified villages. This process is similar to the one observed in Odisha and MP.

CREDA has been providing solar home-lighting system through both power plant and individual solar home-lighting system. There are some villages where Power Distribution Network (PDN) becomes costlier to cover all the scattered houses in the village, in such cases the CREDA has been providing individual home-lighting system. Similarly, in some villages if some households are residing at long distances from the centre of the village where the PDN system is costlier to cover those households, in such cases CREDA has been providing individual home-lighting system to those households. In all other cases electricity is supplied through Solar Power Plant.

3.4.1 Progress of RVEP in Chhattisgarh

Till April 2010, CREDA has provided solar home-lighting system to 1375 villages and hamlets.

Table 3.3 Total number of Villages for RVEP till May 2010 in Chhattisgarh

Villages	Total
No. of villages provided with power plants	289
No. of villages/hamlets provided with SHLS	151
No. of villages/hamlets provided with power plant/SHLS without CFA of MNRE	935
No. of Villages provided with CFA of MNRE	440
Total No. of Villages provided with Solar light by CREDA	1375

Note: SHLS stands for Solar Home Lighting System

Sources: CREDA.

Table 3.4 Number of Electrified Villages and Masjratola through SPV systems by CREDA till April 2010 by District

S.No.	Districts	Villages	Masjratola	Total
1	Raipur	99	54	153
2	Dhamtari	43	1	44
3	Mahasamund	5	3	8
4	Rajnandgaon	49	3	52
5	Kabirdham	77	6	83
6	Durg	1	0	1
7	Bilaspur	45	48	93
8	Rajgarh	11	2	13
9	Korba	77	138	215
10	Janjgir-Champa	1	0	1
11	Sarguja	15	1	16
12	Koria	108	12	120
13	Jash-pur	52	28	180
14	Bastar	30	10	40
15	Dantewada	12	107	119
16	Narayanpur	4	0	4
17	Bija-pur	119	3	122
18	Kanker	97	14	111
Total	Chhattisgarh	845	530	1375

In Chhattisgarh, the DPRs are prepared by the suppliers describing the power plants in details which they are likely to supply. The suppliers also do pre-distribution door-to-door survey as per guidelines of MNRE as a part of DPR. The survey includes the following parameters.

i. Constitution of Village Energy Committee.

ii. Preparation of a list of beneficiary households with photograph.

iii. Recording the latitude and longitude of the location of the households in the village through GPS.

iv. Preparation of profile of the selected villages.

v. Identification of the means of communication available in the villages.

vi. Organising awareness campaigns in the villages.

vii. Estimating the number of home-lighting and street-lighting systems required in the villages.

viii. Obtaining a certificate from the beneficiary households certifying their willingness to accept the system.

These details are the same as in Odisha and MP.

3.4.2 The contents of DPR

On the basis of this verification and door-to-door survey report, the CREDA prepares a Detailed Project Report (DPR) and sends the same to MNRE for obtaining the grant. The following points are covered in the DPR prepared for each selected village.

i. Village profile.

ii. Technical details of the village including various renewable energy resources available and total demand for electricity in the village.

iii. Implementation arrangements including mode of implementation, monitoring arrangements and plan for long-run sustainability of the system, etc.

iv. Number of households proposed to be provided with the system in the village.

v. Number of streetlight required.

vi. Cost of installation and revenue generation.

vii. Capacity and details of the proposed systems.

viii. Map of the village.

The CFA from MNRE is fixed for all the states. CREDA has received grant under RVEP for 440 villages till April 2010. For implementing the RVEP in Chhattisgarh the state government's share is relatively higher as the cost of the power plant is high.

(Moreover, state government is providing solar light to 935 villages without any support from MNRE till April 2010. A total 1375 villages have been completed by CREDA, out of which CFA was received from MNRE only for 440 villages.)

3.4.3 Tendering procedure

After getting the sanction order, the CREDA advertises the tender notice in the local and national newspapers inviting sealed bids for supply and installation of the solar plant for solar home-lighting and street-lighting systems from registered MNRE's suppliers. The tender notice is also put on the CREDA's website. On receipt of the sealed tenders, the technical evaluation of each tender is carried out by CREDA. The technical evaluation involves

analysing the tenders with respect to the MNRE's guidelines, experience of the agency, etc. Those tenders that qualify the technical bidding are called by the tender committee for commercial bidding which is conducted by the CREDA. The CREDA opens the qualified tenders in front of all qualified agencies. The work order is awarded to the bidder making the lowest bid. Tata, BP, CEL, BHEL, Sun technique, Agni power and Flotten are the major suppliers of system in Chhattisgarh.

3.4.4 Inspection

A pre-dispatch technical inspection is done at a recognised/certified test centre by MNRE for the systems that are likely to be supplied by the supplier. About 1 per cent of total quantity offered for inspection is randomly inspected by the CREDA.

After inspection, if the system is found satisfactory, the supplier installs the power plant and distributes the light to all the households in the village with the help of their own technicians. Rs 100 is taken from each BPL beneficiary household at the time of installation and Rs 200 is taken from each APL beneficiary household. The supply, installation, commissioning and comprehensive maintenance contract (CMC) of the system for five years is the responsibility of the supplier. After installation, the supplier also organises training and awareness campaigns for the beneficiaries. In Chhattisgarh, supplier's job is over after installation of the plant and distribution of the system at households' level. The CMC is not given to the suppliers by CREDA. Rather the system is maintained by the CREDA. The Operation and Maintenance (O & M) of the power plants are also looked after by CREDA.

3.4.5 Operation and maintenance system in Chhattisgarh

CREDA sets up one operation and maintenance centre for a cluster of 12 to 16 villages. Each centre has a trained technician and a helper. There is a trained operator in each village under the cluster for providing initial maintenance support in the village. The VEC or any beneficiary may call for his services.

The village operator is fully equipped with spare parts which he keeps at home. All the three service providers have specific instructions to perform their duty. CREDA also provides uniforms to all the three service providers for identification by the villagers.

Cost of O&M CREDA pays Rs 2000 per month to the technician, Rs 1000 to the helper and Rs 400 to the operator. Every village has a VEC. The selected beneficiaries are the members of the VEC. If any beneficiary faces any problem he/she immediately informs the operator.

The operator responds as soon as possible. The operator collects Rs 5 from each beneficiary for maintenance of the system. For maintenance of the system the state government pays a rate of Rs 25 per beneficiary to CREDA. The CREDA has a separate account for future maintenance of the plant.

CREDA has well defined guidelines for technicians, helpers and operators. The technician is supposed to visit the villages every quarter for routine maintenance, which includes positioning of the modules, putting distil water in the battery, checking the direction of the module, etc. In case of breakdown of the system, the technician is supposed to visit the households within 10 to 15 days of the receipt of a complaint.

3.4.6 Proof of delivery

The supplier is required to provide a list of beneficiary households where the systems have been installed. The supplier is also required to submit a certificate of the receipt of system from the beneficiary along with an agreement that the system is a government property and will be maintained properly and if found sold or transferred by the beneficiary, legal action could be taken against him. A photo of the beneficiary along with the model number, a report of the technical specifications of the system installed and a certificate of the receipt of number of systems in the village by the VEC are also taken as a proof of delivery. CREDA officials themselves go to the village and verify the list of beneficiaries before the payment is released.

For receiving final instalment of the CFA, a third party evaluation is mandatory. An advertisement is done in local newspapers for seeking expression of interest for carrying out an evaluation survey of already electrified villages through solar home-lighting system by NGOs. The third party evaluation report is submitted to the MNRE.

Chapter 4

Importance of Rural Electrification

4.1 Review of Literature

Rural electrification is an important component of Integrated Rural Development. Although rural electrification did receive attention through various programmes, its reach was inadequate as many rural consumers inhabit in remote areas and there has not been much prospect for industrial and commercial growth in these areas. Recently, it has been recognised globally that "rural electrification is intrinsically linked with sustainable development at local, national and regional levels". A number of studies have found that rural electrification has direct role in achieving Millennium Development Goals (MDG). A few studies provide insight into the importance of rural electrification in overall sustainable development. Introduction of modern technologies for production, supply and consumption of energy will bring about more energy efficiency. Substitution of fossil fuel by alternative sources of renewable energy will reduce environmental damage and their harmful effects.

This chapter provides a review of some studies that deal with the following.

i) Importance of energy to achieve Millennium Development Goals (the eight Millennium Development Goals[3] set to be achieved by 2015).
ii) Studies pertaining to rural electrification and social change.
iii) Studies related to environment and climate change.

4.2 Energy and MDG Linkages

Momentum on the energy–MDG agenda was forwarded by the Millennium Project of the UN in 2004 that evolved a vision comprising a set of energy services that could provide a way forward towards meeting the MDGs by 2015. The summary and key conclusions of the same are as given below.

[3] In September 2000, at the United Nations Millennium Summit, 189 countries agreed to a set of time bound and measurable goals and targets. These goals are (i) Combating poverty and hunger, (ii) Achieving universal primary education, (iii) Promoting gender equality and empowering women, (iv) Reducing child mortality, (v) Improving maternal health, (vi) Combating HIV/Aids, malaria and other diseases, (vii) Ensuring environmental sustainability, and (viii) Developing a Global partnership for development. Eight goals, 18 targets and 48 indicators were adopted. The development community now refers to these as the Millennium Development Goals to be met by 2015.

4.2.1 Eradicate extreme poverty and hunger

Central to overcoming poverty is the need to create opportunity for poor to generate income. The most plausible way of ensuring this is to involve them in productive activities at the household level, at the national level, and at the global level. Energy inputs such as electricity and fuel are essential for industrial activities, transportation, commerce, micro enterprises and agriculture that generate jobs which, in turn, have direct impact on poverty reduction. Productive activities linked with low quality or traditional energy hardly results in better production and better standards of living. Employment generation to eradicate extreme poverty and hunger, therefore, calls for use of modern and efficient energy.

4.2.2 Achieve universal primary education

Electricity is needed in schools and at home to achieve universal primary education. Without electricity children have no sufficient light in the classroom and no light to study at home at night. This situation affects their capacity to undertake assignments or review their lessons. Also some teaching learning materials cannot be used without electricity. Further, in poor homes that have no access to electricity, children may have to spend a significant portion of their time collecting fuel to meet family needs. A few hours of electricity to students can result in major improvements in their performance to study (UNDP, 2005). Having electricity in the schools and rural homes is also necessary to attract good teachers from outside the village.

4.2.3 Promote gender equality and empower women

Rural women suffer more than men due to lack of electricity as women are mostly responsible for household work especially cooking and energy related activities in an inefficient way. This takes their time away from other productive activities as well as education and social participation. Access to better kitchen appliances and electricity eases women's domestic burden and allows them to pursue educational, economic and other opportunities. Use of radio, television and other modern communication tools play a major role in empowering women and leading to better governance. Non-availability of electricity is further aggravating the problem of digital divide between different sectors of the economy.

4.2.4 Reduce child mortality

Diseases caused by contaminated and impure water, and respiratory illness caused by the effects of indoor air pollution from use of traditional fuels and stoves, directly contributes to

infant and child disease and mortality. Non-availability of electricity in the village public health centers affects treatment requirements of mothers and children. Thus, rural electrification may help in reducing child mortality significantly.

4.2.5 Improve maternal health

Women are disproportionately affected by indoor air pollution and water and food-related illness. Lack of electricity in health clinics for night time deliveries is an inhibiting factor in providing better services to the mother and child at the most critical time of their lives. The daily drudgery and physical burden of fuel collection and transport contribute to poor maternal health conditions, especially in rural areas.

4.2.6 Combat HIV/AIDS, malaria and other diseases

Use of electricity for communication such as in radio and television can spread important public health information to combat deadly diseases. Health care facilities, doctors and nurses, all require electricity and the services that it provides (illumination, refrigeration, sterilization, etc.) to deliver effective health services.

4.2.7 Ensure environmental sustainability

Energy production, distribution and consumption has many adverse effects on the local, regional and global environment including indoor, local and regional air pollution, local particulates, land degradation, acidification of land and water, and climate change. Cleaner energy systems such as LPG are needed to address all of these effects and to contribute to environmental sustainability.

4.2.8 Develop a global partnership for development

The World Summit for Sustainable Development called for partnerships between public entities, development agencies, civil society and the private sector to support sustainable development, including the delivery of affordable, reliable and environmentally sustainable energy services.

A study by Pepukaye Bardouille (2005) has prepared case studies from seven countries. The countries are Bangladesh, Bolivia, Cambodia, Ghana, Malawi, Tanzania and Uganda. The study highlighted that improved access to energy is a critical input for reducing poverty and achieving the MDGs. Modern energy contributes to improved health by lowering indoor and outdoor air pollution. It reduces the burden on women and young girls, many of whom spend

hours each day collecting and carrying firewood, and leaves them with more time for income generation. Energy is a critical input for providing a host of social services from education and health care to communication. The study recommends that adequate, clean and efficient energy services should be provided by 2015 to all educational and health facilities.

Modi (2005) suggested providing electricity for services such as lighting, for refrigeration, ICT (information and communication technology), water pumping and purification for all schools, clinics, hospital, and community centers. This study highlights importance of energy for achieving MDG.

Another study by Stockholm Environment Institute (SEI) (2005) recommends providing electricity for all schools, clinics, hospitals and community centres which has direct links with MDGs. The study suggests for providing modern fuels for 50 per cent of those who at present use traditional biomass for cooking. The study also suggests providing electricity for all schools, clinics, hospitals and community centres.

4.3 Studies Pertaining to Rural Electrification and Social Change

A number of studies provide insight into how rural electrification helps in changing rural society for betterment in various ways.

Arne (2006) provides an assessment of the social significance of rural electrification with solar energy. Kenya has emerged as one of the global leaders, per capita, in the use of renewable energy technology. This is due largely to a growing market for solar PV systems among the rural households since the mid 1980s. In Kenya only about 4 per cent of rural households were connected with electrical grid in the early 1980s. As of now, solar electricity has emerged as a key alternative to grid-based rural electrification in Kenya. The study highlights that (a) The demand for solar PV systems in the Kenya market is driven by middle class purchasing power; (b) Electric light from solar system plays a minor role in supporting direct income generation activities in rural Kenya. Given the distribution of ownership of solar systems, nearly all of these productivity gains are captured by rural middle class families. (c) Solar PV plays a more substantial role in supporting the use of electric light for key social activities such as evening time studying by children. (d) Solar electricity in Kenya is widely used for households' applications such as television, radio and cellular telephone charging that helps improve communication.

The significance of solar electrification in Kenya, therefore, is closely linked to its role in supporting rural–urban connections for Kenya's rural middle class.

Ahammed and Taufiq (2008) focus on how application of PV light for rural electrification helps in increasing rural income as well as the living standard of the rural poor. The basic applied forms of solar PV in rural Bangladesh are solar home-lighting system installed at households and local market/Bazaar (Haat). The first solar PV microutility was established in Manikganj Bazaar of Dinajpur district, 400 km north of Dhaka in 1999. Lighting needs of the shops were met by Kupi, a small kerosene lamp. The supplier 'Renewable Energy Technology in Asia' explained the concept of solar energy based electrification systems to the shop owners and the Bazaar Management Committee covering the topics of operation, benefits and maintenance. They accepted the idea. A daily tariff of five taka/rupees with no initial deposit was agreed upon and a contract was then signed between suppliers and Bazaar Management Committee and shop owners. Seven solar modules of 50 WP each, divided into two groups, were installed in two suitable locations of the market. The battery banks and controllers accompanying each group were placed close to two respective solar panels. Similar systems were subsequently installed, serving business such as grocery shops, restaurants, barber shops, tea houses and doctor's clinics.

The success of solar PV microutilities is attributable to several factors. These include the acceptability of a daily tariff structure and a rate of five taka, as well as proper marketing that explains the solar energy-based system's capabilities, benefits and constraints in comparison to other available options to potential users. Benefits of the system also accrue because of the use of local institutions. An agreement which was signed with the Bazaar Management Committee includes the terms and conditions of the service, maintenance procedure, payment, and financial details of the users. The training of a technician to take care of the system on behalf of the collective is viewed favorably by users.

Ouwens, (2006) explains the impact of renewable energy on changing the socio-economic status of women. It is not easy to improve the position of women in the society, unless their level of income increases. Poverty alleviation can be realised by the introduction of renewable energy system in a sustainable way. The most important point is the possibility to generate income. This can take place in many ways. The activities may lead to the start of small and medium sized enterprises. One example could be the picking up of seeds from oil

bearing plants. The seeds can be sold in the market. Women can also do the processing and can make and valorize side products like soap.

A study by George, et al. (1991), finds that rural electrification has a critical role on family planning practice in rural Nigeria. Two communities of Bonny and Kula were chosen because of their similarity in population, terrain and climate. Fishing is the major source of livelihood of the people in both these areas. In addition to fishing, small scale farming activity is carried out in both places but on a part time basis. There is neither processing nor manufacturing activity in the two areas.

Bonny has regular electricity whereas Kula community does not have electricity at all. The data reveals that family planning is practiced more in the electrified community than the non-electrified (Kula) one, and there has been a significant decline in fertility**.**

A study by Sadeka (2005) finds the impact of rural electrification on the changing socio-economic status of women in Bangladesh. The study finds that rural electrification has contributed positively towards women's overall development. The rural electrification increased mobility, greater participation in income earning activities and greater involvement in major household and other decision making processes.

4.4 Role of Energy on Environment and Climate Change

There is a growing consensus that anthropogenic activities especially the use of fossil fuels is rapidly transforming the earth's atmosphere dramatically that could drastically alter the global climatic patterns. The poorest countries are generally acknowledged to be among the most vulnerable to the impacts of climate change; everybody is potentially at risk from climate change effects caused by burning fossil fuels as well as poor agricultural practices, deforestation and industrial processes.

A study by 'Energy Action Group' (2009) explores energy and climate issues in Brazil. The paper was prepared by the America's Society/Council of America's Energy Action group. It is designed to provide a background on energy issues and climate change. Three main conclusions are (a) Biofuels must be part of a cleaner energy matrix, but integrating them more fully into the world's energy mix will require the creation of a truly global market, (b) Brazil and the United States are essential to helping the world meet growing energy demand as well as transition to cleaner energy source, and two countries should increase collaboration on energy and climate issues (c) Brazil has an important profile in energy and climate matters

and should play a bigger role in these issues internationally. Maintaining an open investment climate for energy will be essential.

A study by Mitra (2002) finds that rural India suffers an acute energy shortage resulting from deforestation. Various energy sources, needed for production, domestic use, lighting, transport, etc. are discussed. The scarcity of energy is an obstacle to the development of the village and has an adverse impact on the quality of life of the people. The study also explained the extent of corruption in the Public Distribution System (PDS) in kerosene. Poor households have to depend on firewood and dry leaves for cooking and lighting. Therefore, trees are vanishing at an alarming rate and social forestry programme in the area has suffered.

Roger Peters (2005) emphasises that some fossil fuel will need to be left unused in the ground if adequate greenhouse gas (GHG) emission reductions are to be achieved. Stabilization of GHG concentrations also cannot be achieved without the United States transforming itself into a renewable-energy-based economy, and without large economies such as China, India and Brazil leapfrogging a fossil-fuel based economy to one based on renewable energy. Renewable energy and energy efficiency must play a central role in future climate change regimes, achieving a global transition through international co-operation on climate change, development and the alleviation of poverty. GHG reductions cannot be expected without addressing poverty and universal access to energy services at the same time.

Chapter 5

Profile of the Sample Villages, Functionality of Street Lights and Physical Verification of the System

5.1 Introduction

The RVEP provides support for electrification of unelectrified census villages/remote unelectrified hamlets of electrified census villages, where grid connectivity is either not feasible or not cost effective. The initial shortlisting of remote villages/hamlets is carried out by the state governments through their energy/power departments. The state governments shortlist unelectrified villages/hamlets in their states which are not likely to be electrified through grid and send their names to MNRE for verification by Rural Electrification Corporation (REC) to ensure that the same villages are not covered both under RGGVY and the RVEP.

A certificate from the REC to the effect that the villages/hamlets proposed to be covered are 'remote' is a pre-requisite for consideration of proposals under the Ministry's programme. The lists of remote villages identified by state governments, which they propose to take up for electrification through RVEP are referred to REC by Ministry for confirmation on this aspect. Subsequently, after identification of remoteness of villages by REC, states are advised to submit proposals for support to the Ministry as per the provisions of the scheme. Approvals of the state government for submitting the proposals are also required in the prescribed format before sanction. Explicit willingness of villagers that the systems being proposed are acceptable to them is also desirable.

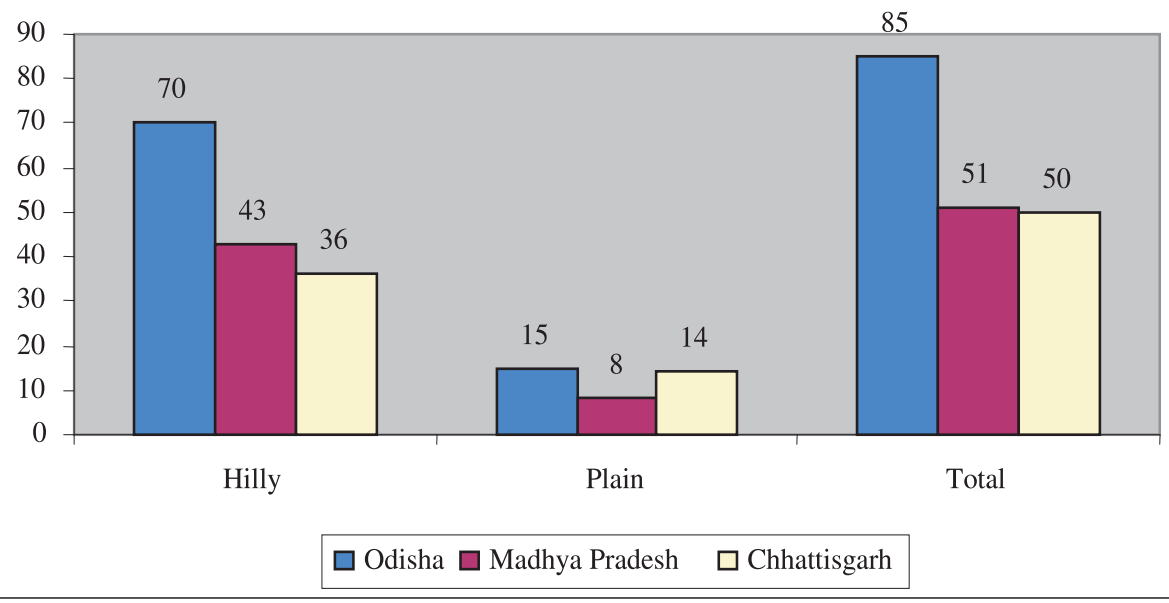
This study is based on a sample of villages where the RVEP has been implemented. This required classification of the villages based on extent of 'remoteness'. The study was carried out in Odisha, MP and Chhattisgarh.

In order to assess remoteness and difficult location pattern of these villages, we considered a few criteria; such as type of area of the villages (Hilly/Plain/Desert), Distance from such village to Block HQ (km), Distance from villages to District HQ (km), Distance to nearest Bus Stand (km), Distance to nearest Railway station (km) and distance to the nearest grid connection, etc.

5.2 Distribution of Selected Villages

Out of 186 sample villages, 85, 51 and 50 were selected from Odisha, MP and Chhattisgarh, respectively (Fig. 5.1). Out of these sample villages, 70, 43 and 36 villages are located in the hilly areas and 15, 8 and 14 are located in the plain areas of Odisha, Madhya Pradesh and Chhattisgarh, respectively.

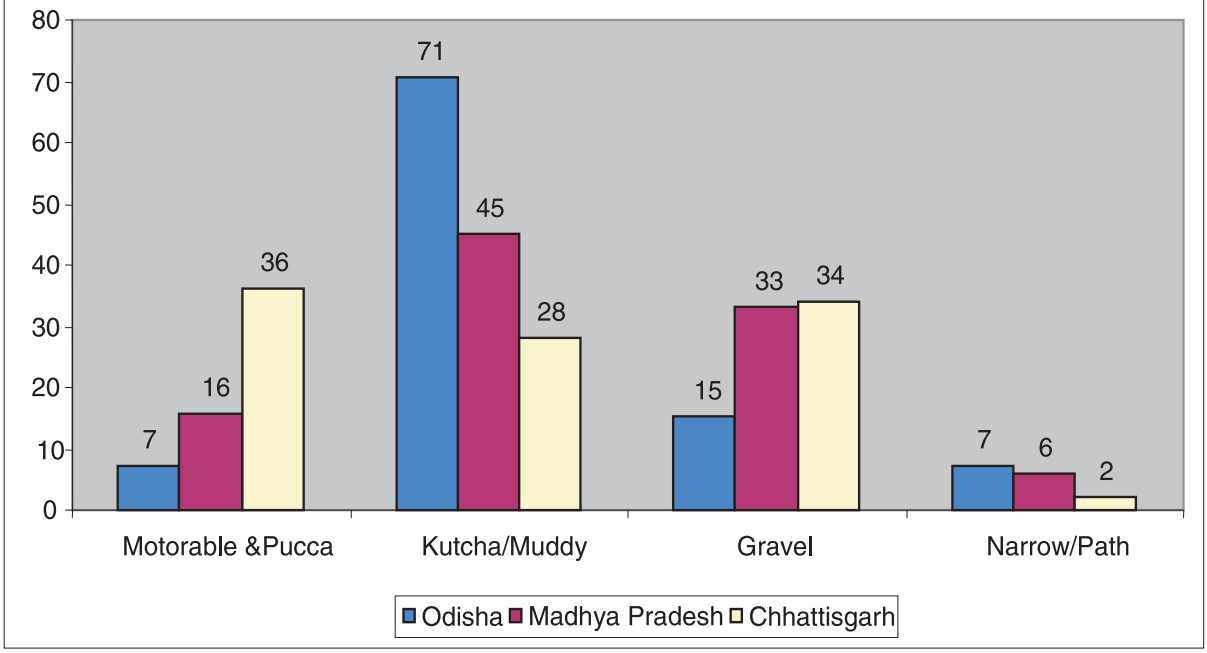
Fig. 5.1 Distribution of Sample Villages by Type



5.3 Approach Road to the Village

By definition, approach to the remote village is difficult. In the sample villages of Odisha, 7 per cent of them have motarable and pucca roads. 15 per cent have gravel roads. 7 per cent have no proper road connectivity and another 71 per cent have only kutcha or mud roads for approach. The situation in Chhattisgarh is slightly better as 36 per cent of sample villages have pucca approach road as compared to 16 per cent in MP. The proportion of kutcha/mud road access to villages is 28 per cent in Chhattisgarh and 45 per cent in MP. Figure 5.2 illustrates the relative position of the road access in these states.

Fig. 5.2 Approach Road to the Sample Village (%)



5.4 Distance to the Remote Villages

Block headquarter is the second nearest institution for the villages after Gram Panchayat. The estimated average distance to block headquarter from the village is about 33, 33 and 45 km in Odisha, MP and Chhattisgarh, respectively. Similarly the average distance from village to district headquarter is 94, 74 and 83 km for Odisha, MP and Chhattisgarh (Table 5.1). These are relatively long distances to an extent that reaching the block headquarters from the village can be easily an hour's time even on motorable road.

Table 5.1 Distribution of Sample Villages by Average Distance from Different Places (km)

State	Block Headquarter	District Headquarter	Nearest Bus Stand	Nearest Railway Station	Nearest Grid Village
Odisha	33	94	11	70	12
Madhya Pradesh	33	74	10	52	5
Chhattisgarh	45.0	83	12	97	12

Buses being a convenient mode of transportation, majority of people in both rural and urban areas, use it for traveling. The average distance from village to the bus stop is estimated as

11, 10 and 12 km for Odisha, Madhya Pradesh and Chhattisgarh, respectively. People have to walk considerable distance first to reach public transport.

Though railway is the cheapest mode of transportation, it is not available for majority of villages at a reasonable distance. The average distance from village to the railway stop is estimated as 70, 52 and 97 km for Odisha, Madhya Pradesh and Chhattisgarh, respectively. It is observed that people in Kawardha district either need to come to Raipur or Bilaspur railway station of Chhattisgarh, due to non availability of local train services. Therefore the estimated distance from village to railway station is relatively longer in Chhattisgarh.

Except a few sample villages in Madhya Pradesh, other sample villages are not electrified through grid system. However, the average distance from remote village to the grid village is about 12, 5 and 12 km in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

5.5 Village Size and Solar PV Installation

The average sample village size is 40, 81 and 59 for Odisha, Madhya Pradesh and Chhattisgarh, respectively (Fig. 5.3). Solar PV has been installed in 36, 70 and 52 households in the villages of Odisha, Madhya Pradesh and Chhattisgarh, respectively. The reasons cited by the respondents who do not have these solar systems installed are separation of the family after installation, not at home during the survey period and not having ration cards.

Fig. 5.3 Average Number of Households in the Sample village and Solar System installed

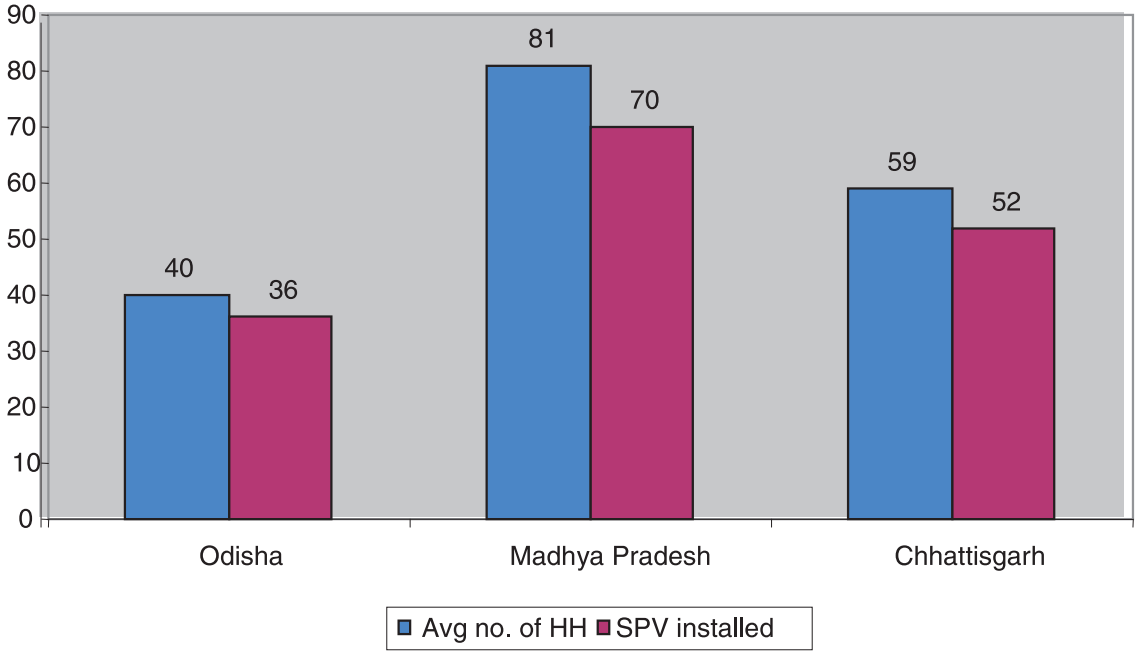


Table 5.2: Distribution of Households in the sample villages

	Average number of HHs by caste in the Village						
States	**SC**	**ST**	**OBC**	**Others**	**Avg. No. of HHs per village**	**Avg. No. of Beneficiary HHs per village**	**% of Population below poverty**
Odisha	3	34	3	0	40	36	88
Madhya Pradesh	1	60	19	1	81	70	56
Chhattisgarh	2	47	10	1	59	52	57

It is observed that all our sample villages/hamlets are predominantly inhabited by Schedule Tribes (Fig.5.4).

5.6 Status of Streetlights

Streetlights have been installed in every village irrespective of the size of the village/hamlet. On an average 3 to 9 streetlights have been installed in the sample villages in Odisha, Madhya Pradesh and Chhattisgarh (Table 5.3). The installation of streetlight is adequate as per norms in Chhattisgarh (norm is one street light per every 10 households). The streetlight is inadequate in Odisha and Madhya Pradesh. We asked our investigators to check whether the streetlights have been installed as reported by the suppliers and check whether the installed streetlights are adequate for whole village? We have also checked the functionality of the streetlights and voltage of the battery during the visit to the village. The results are presented in Tables 5.3, 5.4 and 5.5.

Table 5.3 Availability and Functionality of Streetlights in Sample States

State	No. of Sample Villages	Total Street lights Installed	Average Street lights per village/hamlets	Average Distance between two streetlights in meters
Odisha	85	283	3	104
Madhya Pradesh	51	318	6	238
Chhattisgarh	50	446	9	70
Total	186	1053	6	137

Table 5.4 Adequacy of Streetlights and Average Additional Requirement per Village

State	Streetlights not adequate (% of respondents)	Required no. of additional streetlights	Voltage of Battery of Street light	
			Day time	Night time
Odisha	60	1	12.7	11.2
Madhya Pradesh	75	3	12.9	12.0
Chhattisgarh	94	5	13.3	11.3

About 60, 75 and 94 per cent of respondents said the current number of streetlights installed in the village is not adequate ('No' responses) in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Table 5.4). It is surprising that in Chhattisgarh the distance between two streetlights is only 70 meters; whereas in Odisha and Madhya Pradesh the distance between two streetlights is about 104 and 238 meters, respectively. The suggested number of streetlights may be justified in Odisha and Madhya Pradesh as average number of streetlights is below the norms as well as the distance between the two streetlights is larger. The voltage of the battery of streetlight is about 13 at day time and about 11 at night.

Table 5.5 Functionality and Installation of the Streetlights in the Sample Villages (%)

State	Streetlight working	Installed in shadow free place	Lamp Facing the ground	Cable firmly fixed	Facing south direction	Inclinatio-n equal to latitude
Odisha	78.8	98	93	92	97	84
Madhya Pradesh	88.0	96	93	92	95	95
Chhattisgarh	60.3	-	-	-	-	-

About 79, 88 and 60 per cent of streetlights are working in Odisha, Madhya Pradesh and Chhattisgarh, respectively at the time of our visit to the villages (Table 5.5). About 40 per cent of streetlights installed are not working in Chhattisgarh. However, the installation of streetlights in Odisha and Madhya Pradesh seems to be appropriate as more than 90 per cent of the streetlights have been installed in shadow free place, lamps are facing the ground, cables are firmly fixed, modules are facing south and the inclinations of the modules are equal to latitude in Odisha and Madhya Pradesh. However, in Chhattisgarh except two villages the streetlights have been provided through power plant.

5.7 About Solar Power Plant in Chhattisgarh

In Chhattisgarh, out of 50 sample villages, the solar home-lighting system has been provided through solar power plant in 48 villages. Functioning of a total 49 power plants was verified in five districts of Chhattisgarh. Except one, all the plants were working at the time of our visit. In Raipur, in Shobha village, two plants have been installed with capacity of 4 and 5 kW. The average capacity of the plants is about 3 kW. The total capacity of all 49 power plants is estimated as 323 kW, which has the capacity of providing 3081 SPV model-1 home lights and 739 streetlights. However, the suppliers have provided 2650 home light and 435 streetlights so far (Table 5.6). The uncovered households may be covered under the programme or they can increase the number of lights in some needy households if they demand more number of lights.

Table 5.6 Status of the Solar Power Plant in Chhattisgarh

Districts	Sample Villages	Capacity of the plants (kW)		SPV Capacity of Model-1	SPV installed (Model-1)	Potential of the Plant for Street Light
		Total	Avg. per plant			
Raipur	14	67	4.8	1254	241	241
Dhamtari	8	26	3.3	433	105	105
Rajnand-gaon	4	10	2.5	186	31	31
Korba	10	39	4.0	608	186	186
Kawardha	14 -2*	39	3.3	600	176	176
5	**48 +2=50**	323	3.1	3081	739	739

Note: *SPV home-lighting system has been provided.

5.8 Physical Verification of SPV Household Systems

Lists of all beneficiaries of the selected villages have been taken from the state level nodal agencies for verification. The list of beneficiaries of each village is kept by the headman of some villages. It is very interesting to note that at the time of verification, a few members of the neighboring households came forward for further clarification and identification of the beneficiary households in the village. The number of systems installed in the village is fully coinciding with the names of the beneficiaries in Chhattisgarh. But, in case of Madhya Pradesh and Odisha there are minor variations. In Odisha, 8 households reported that they received the system but the systems were stolen by someone at night. The same has been reported by 13 households in Madhya Pradesh. A few street lights were also missing in Odisha and Madhya Pradesh (Table 5.7).

Table 5.7 Number of Sample villages, Solar PV installation, Number of Streetlights Installed and Number of SPVs missing

States	No. of Sample Village	No. of SPV Reported	SPV Missing	Reported Street Light Installed	No. of Stree Light Missing
Odisha	85	3020	8	291	8
Madhya Pradesh	51	3492	13	324	6
Chhattisgarh	50	2885	0	446	0
Total	186	9397	21	1061	14

5.9 Problems Faced by the Beneficiaries

We requested the respondents of the village questionnaire to provide insights into problems faced by the beneficiaries in the village. About 25 and 28 per cent said that 'battery does not charge during rainy season' in Odisha and Madhya Pradesh respectively. Similarly 22 and 24 per cent reported that 'Technicians do not come to check the system in time' in Odisha and Madhya Pradesh respectively. In Madhya Pradesh, about 31 per cent reported that 'charge controller spoiled very soon' as against 5 per cent in Odisha. 'Spare parts not available in the nearby market' is an important problem faced by the beneficiaries in the village. About 7, 8 and 10 per cent have reported such problems in Odisha, Chhattisgarh and Madhya Pradesh, respectively. 'No problem' is reported by 4, 16 and 72 per cent in Madhya Pradesh, Odisha and Chhattisgarh, respectively.

Lack of awareness for operation and maintenance of the system is one of the major hindrances of the better functionality of the system. About 8 and 18 per cent suggested that programmes be organised for enhancing awareness for operation and maintenance of the system in Chhattisgarh and Odisha, respectively (Table 5.8).

Table 5.8 Problems Faced and Suggestions for Better Performance (% of respondents)

Problems faced by the Households	**% of Respondents**
Odisha	
Battery does not charge properly during rainy season	24.7
Technicians do not come to check the system regularly	22.4
Awareness required for operation & maintenance of the system	17.6
No problem	16.5
Spare parts not available in the nearby market	7.1
Service centre required in nearby the village	7.1
Charge controller spoiled very soon	4.7
Madhya Pradesh	
Battery does not charge properly during rainy season	27.5
Technicians do not come to check the system regularly	23.5
Charge controller spoiled very soon	31.4
Spare parts not available in the nearby market	9.8
No problem	3.9
Capacity of battery should be increased	3.9
Chhattisgarh	
No problem	72.0
Capacity of battery should be increased	12.0
Awareness required for operation & maintenance of the system	8.0
Spare parts not available in the nearby market	8.0

5.10 Major Findings

5.10.1 About distance

i. Out of 186 sample villages, 70, 43 and 36 villages are located in Hilly areas of Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. About 71, 45 and 28 per cent of villages have kutcha and muddy road in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. 7, 6 and 2 per cent of villages have no proper road connectivity to reach the villages in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iv. About 33 to 45 km distance from village to the block headquarter.

v. About 94, 74 and 83 km average distance from village to district headquarter in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

vi. About 10 km from village to the nearest bus stop.

vii. Distance to the railway station is about 70, 52 and 97 km in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

viii. Distance to the village with grid connection is about 5 to 12 km.

5.10.2 Size of the village and installation of SPVs

i. Average village size is about 40, 81 and 59 households in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. Average number of households which received the solar home-lighting system is 36, 70 and 52 in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. Among the beneficiaries 77 to 83 per cent are from STs.

iv. All our sample villages/hamlets are dominated by Scheduled Tribes.

5.10.3 Status of streetlights

i. On an average 3, 6 and 9 streetlights have been installed per village in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. Average distances between the two street lights are 104, 238 and 70 m in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. The majority of the village respondents said that the current number of streetlight installed is not adequate.

iv. On an average 1 and 3 more streetlights are suggested by the investigators in Odisha and Madhya Pradesh, respectively. Whereas five more streetlights has been suggested by the suppliers in Chhattisgarh.

v. The average voltage of the battery is 12.7 to 13.3 during day time; but at night it has average voltage of 11.2 to 12.0 in all the three states.

vi. During our visit, about 78.8, 88.0 and 60.3 per cent of the streetlights were working in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

vii. About 40 per cent of streetlights were not working in Chhattisgarh.

viii. More than 90 per cent of streetlights have been installed in shadow free place, lamps are facing the ground, cables are firmly fixed, modules are facing south and inclination is equal to latitude (about 23 degree in case of Odisha, Madhya Pradesh and Chhattisgarh)

5.10.4 Status of solar power plant in Chhattisgarh

i. Out of 50 sample villages, 49 power plants have been installed in 48 villages.

ii. Village 'Shobha' in Raipur district has two power plants with capacities of 4 and 5 kW respectively.

iii. The average capacity of the plants is about 3 kW.

iv. 48 power plants were working during our visit to Chhattisgarh.

v. The total capacity of all 49 power plants is 323 kW.

vi. It has the capacity of providing 3081 SPV model-1 and 739 Street lights.

vii. Currently they are providing 2650 home lights and 435 street lights

5.10.5 Physical verification of street lights and home lights

i. In all three states, total 9397 SPV home-lighting systems have been installed. Out of which 21 systems were missing. Out of 21, 8 were missing in Odisha and 13 systems were missing in Madhya Pradesh.

ii. In Madhya Pradesh, 220 SPV home-lighting systems were not functional during our visit.

iii. About 14 streetlights were missing of which, 8 were missing in Odisha and 6 were missing in Madhya Pradesh.

5.10.6 Problems faced by the beneficiaries

i. About 25 and 28 per cent said that 'battery does not charge during rainy season' in Odisha and Madhya Pradesh, respectively.

ii. 22 and 24 per cent reported that 'Technicians do not come to check the system in time' in Odisha and Madhya Pradesh, respectively.

iii. In Madhya Pradesh, about 31 per cent reported that 'charge controler spoiled very soon' as against 5 per cent in Odisha.

iv. The problem of spare parts not available in nearby markets is reported by about 7, 8 and 10 per cent in Odisha, Chhattisgarh and Madhya Pradesh, respectively.

v. 'No problem' is reported by 4, 16 and 72 per cent in Madhya Pradesh, Odisha and Chhattisgarh, respectively.

Chapter 6

Profile of the Beneficiaries of Solar Home Lighting Systems

6.1 Introduction

The remote village electrification programme (RVEP) provides mainly SPV home-lighting systems to remote census villages/hamlets. People living in such villages/hamlets are characterized by low level of income, living in kutcha houses, no education/low level of education, mostly SCs/STs and OBC, etc. This section provides general characteristics of beneficiary households of Solar home-lighting system in Odisha, Madhya Pradesh and Chhattisgarh.

The survey covered 5208 beneficiary households in 186 villages in these three states. The surveyed beneficiaries are mostly of Scheduled Tribes and Other Backward Castes. Out of 2200 beneficiary households in Odisha, 83.2, 8.8 and 7.5 per cent belong to STs, OBCs and SCs, respectively. Out of 1508 households in Madhya Pradesh, 71.7, 24.6 and 1.7 per cent belong to STs, OBCs and SCs category. The majority of beneficiaries are in STs in case of Chhattisgarh as well (Table 6.1).

Table 6.1 Distribution of Beneficiary Households by Caste (%)

State	SCs	STs	OBCs	General	Total	Sample size
Odisha	7.5	83.2	8.8	0.6	100	2200
Madhya Pradesh	1.7	71.7	24.6	2.1	100	1508
Chhattishgarh	3.1	78.1	17.8	1.0	100	1500
Total						5208

The household size is relatively high in remote villages than the state average estimated by the Census 2001. The average household sizes of beneficiaries are 5.2, 6.4 and 4.9 in Odisha, Madhya Pradesh and Chhattisgarh respectively (Table 6.2). On an average there are 3 to 4 children below 14 years of age in all these three states. The estimated Census (2001) average household sizes are 4.8, 5.5 and 5.1 for Odisha, Madhya Pradesh and Chhattisgarh, respectively. The overall household size of our sample in fact matches with the all India average of 5.3 of these states.

Table 6.2 Average Household Sizes and Number of Children of the Beneficiary Households

State	No. of Children Below 14 Years		No. of person Above 14 Years		Avergae Household Size	
					RVEP beneficiaries	Census 2001
	Female	Male	Female	Male		
Odisha	3518	3574	2173	2205	5.2	4.8
Madhya Pradesh	2452	3222	1886	2072	6.4	5.5
Chhattisgarh	2385	2498	1212	1249	4.9	5.1

6.2 Type of House owned by the Beneficiaries

A dwelling unit can be one of many types such as 'Pucca', 'Semi-Pucca' and 'Kutcha'. Among the beneficiaries, 79 to 96 per cent live in 'Kutcha' houses. About 6 and 15 per cent live in 'Pucca' and 'Semi-Pucca' houses in Madhya Pradesh (Table 6.3). Only 5 and 3 per cent of beneficiaries live in semi-pucca houses in Odisha and Chhattisgarh respectively.

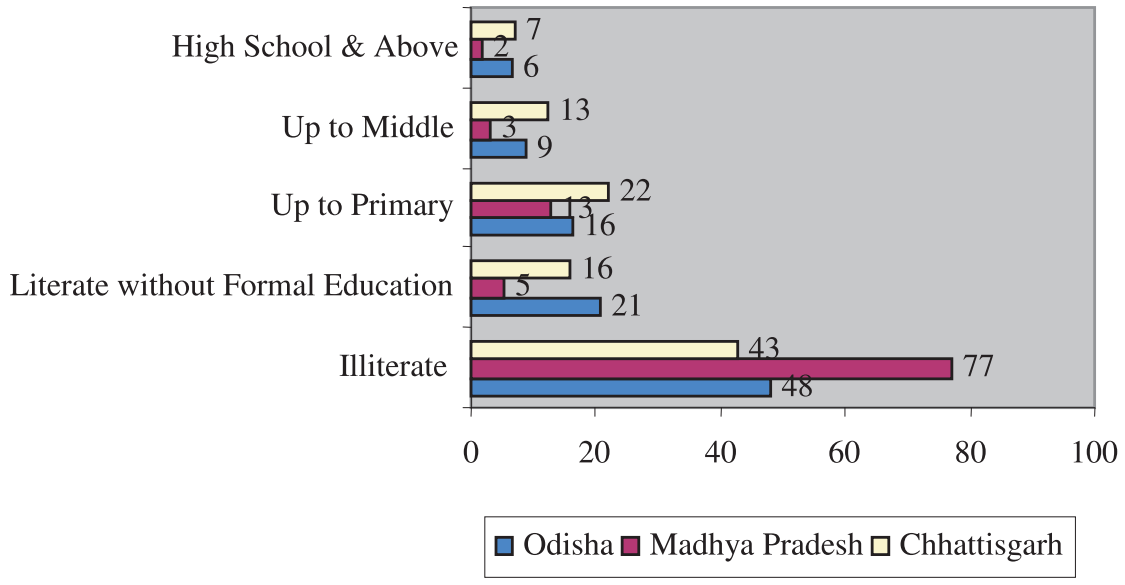
Table 6.3 Type of Houses Owned by the Beneficiaries (%)

State	Pucca	Semi-Pucca	Kutcha	Total
Odisha	0.3	4.6	95.1	100
Madhya Pradesh	5.9	15.1	79.0	100
Chhattisgarh	0.5	3.0	96.3	100

6.3 Level of Education of the Head of Beneficiaries

Level of education of the head of the household provides social status and affects development and involvement of the households in the other activities in the society where they live. Among the surveyed households, 48, 77 and 43 per cent are illiterates and 20.5, 5 and 15.7 are literate without formal education in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Appendix Table 3). In case of Madhya Pradesh, about 18 per cent of beneficiaries are literates with some formal education. About 16, 13 and 22 per cent have education up to primary level in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Fig. 6.1).

Fig. 6.1 Level of Education of the Head of the Beneficiary HH (%)



6.4 Occupation and Level of Annual Income of Beneficiaries

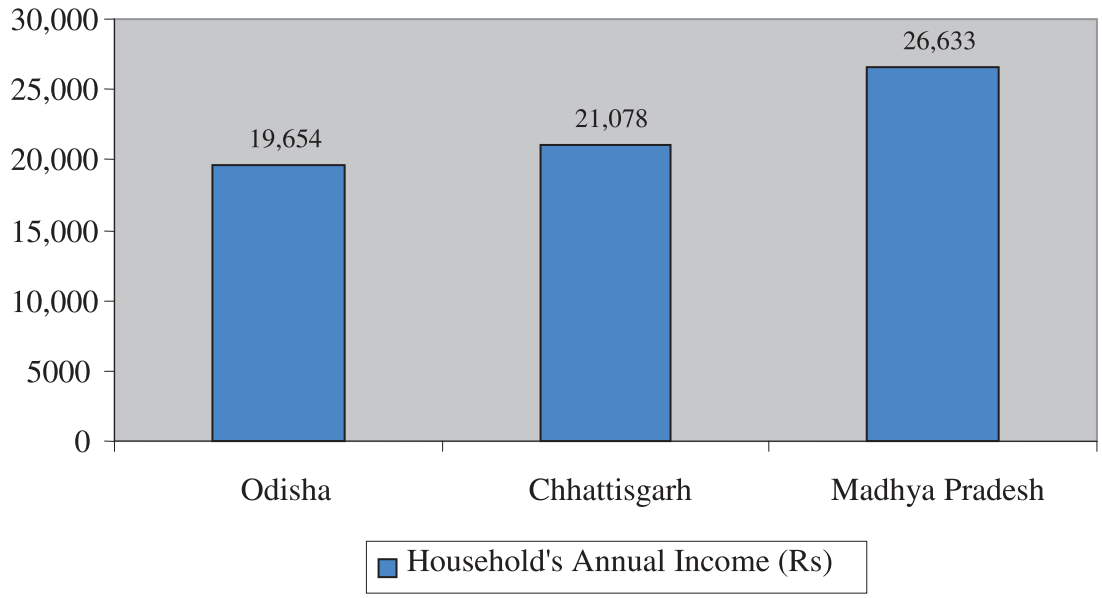
Occupation has close linkage with level of education. High level of illiteracy among the beneficiaries forces them to engage in low income agricultural occupations. Hence, 'Agriculture is the primary occupation' for about 64, 46 and 16 per cent of beneficiary households in Odisha, Madhya Pradesh and Chhattisgarh, respectively. In case of Chhattisgarh, about 77 per cent are wage labour in agricultural and non-agricultural activities (Table 6.4). About 27, 43 and 41 per cent are non-agricultural wage labourers in Odisha, Madhya Pradesh and Chhattisgarh, respectively. Activities in animal husbandry and fishing are not very significant in remote areas.

Table 6.4 Percentage of Households by Primary Occupation

State	Agricul-ture	Animal Husbandry & Fishing	Agricultural Wages	Non-Agricultural Wages	Salary, Business & Others	Total
Odisha	64.3	1.0	2.0	26.9	5.8	100
Madhya Pradesh	45.8	2.1	7.4	42.5	2.1	100
Chhattisgarh	16.3	1.7	36.3	41.1	4.6	100

Occupation and household's income are correlated. The level of annual beneficiary households' income from all sources is Rs 19,654, Rs 26,633 and Rs 21,078 for Odisha, Madhya Pradesh and Chhattisgarh, respectively (Fig. 6.2). The household's annual income reflects the extent of poverty as 88, 56 and 57 per cent of the beneficiaries of remote villages are living below poverty line.

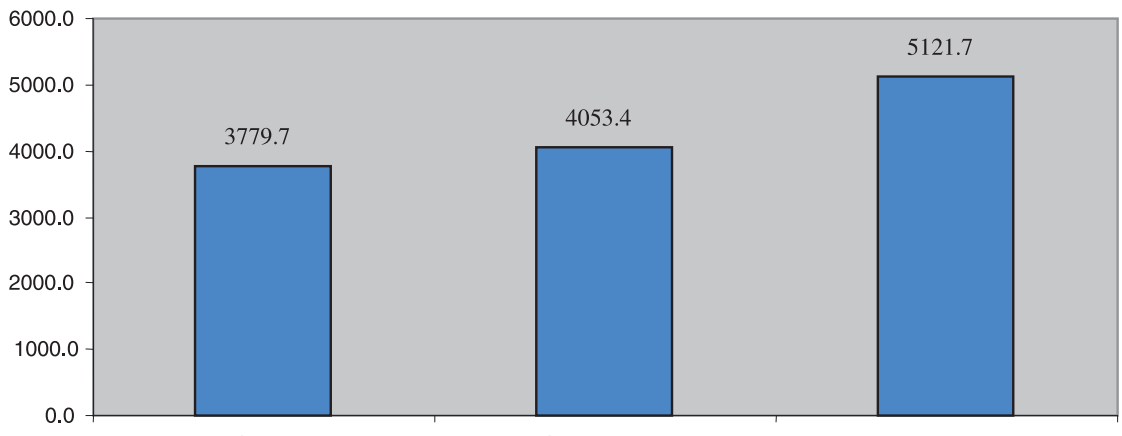
Fig. 6.2 Household's Average Annual Income (Rs)



The annual household income of Madhya Pradesh is slightly higher as compared to Odisha and Chhattisgarh. About 43 per cent of beneficiaries are engaged in non-agricultural activities in Madhya Pradesh.

The estimated per-capita income follows the same pattern as the level of household's total income. The per capita income is as low as Rs 5121, Rs 4053 and Rs 3779.7 for Madhya Pradesh, Chhattisgarh and Odisha, respectively (Fig. 6.3).

Fig. 6.3 Per-capita Income of Beneficiary (Rs)



6. 5 Major Findings of this Section

i. Sample households are dominated by STs and average household size stands at 5.2, 6.4 and 4.9 for Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. Majority of heads of the households are illiterate in all the three states.

iii. Agriculture is the primary occupation of 64, 46 and 16 per cent of beneficiary households in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iv. Average annual households income is Rs 19,654 , Rs 26,633 and Rs 21,078 for Odisha, Madhya Pradesh and Chhattisgarh, respectively.

v. The per capita income is as low as Rs 5121, Rs 4053 and Rs 3780 for Madhya Pradesh, Chhattisgarh and Odisha, respectively.

Chapter 7

Status of Installation of SPV Home Lighting System

7.1 Introduction

Proper functionality of the system is determined by many factors. These are

i. module capacity

ii. module installation

iii. fixing of luminaires inside the house

iv. fixing of cable, etc.

This section presents the status of installation in the sample states.

Solar home-lighting system has been installed through solar power plant and through solar individual home-lighting systems. In Odisha and Madhya Pradesh, the solar home-lighting system has been provided through solar individual home-lighting system, whereas in Chhattisgarh, solar home-lighting system has been provided both through solar power plant as well as solar individual home-lighting system. In Chhattisgarh, only about 6 per cent of our sample households got individual home-lighting system as against 100 per cent in Odisha and Madhya Pradesh (Table 7.1).

Table 7.1 Type of Solar Lighting Systems Installed (% of households by type of SLS)

State	Through Solar Power Plant	Through SPV home-lighting System	Sample Size
Odisha	0	100	2200
Madhya Pradesh	0	100	1508
Chhattisgarh	94.3	5.7	1500

7.2 Distribution of system by Year of Installation

The distribution of sample households by year of installation of the system is presented in Table 7.2 and Appendix Table 6. The scheme was initiated in 2006–07 in Odisha and Madhya Pradesh, whereas in Chhattisgarh it had started much earlier. In Odisha, about 16, 55 and 29 per cent of sample households got the system installed in the year 2007, 2008 and 2009, respectively. Similarly, in Madhya Pradesh, 34, 25, 33 and 9 per cent of sample

households got the system installed in the year 2007, 2008, 2009 and 2010, respectively. However, in Chhattisgarh 41 per cent of sample households got the system in 2007.

Table 7.2 A Distribution of sample households by year of installation of Solar Home Lighting System (%)

State	2003	2004	2006	2007	2008	2009	2010	Total
Odisha	-	-	-	15.5	55.1	29.4	0	100
Madhya Pradesh	-	-	-	33.5	25.0	32.8	8.6	100
Chhattisgarh	20.5	19.2	8.7	41.0	10.5	0	0	100

The system should be installed by skilled technician. About 93, 83 and 99 per cent have reported that their system was installed by the supplier's technicians in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Fig. 7.1).

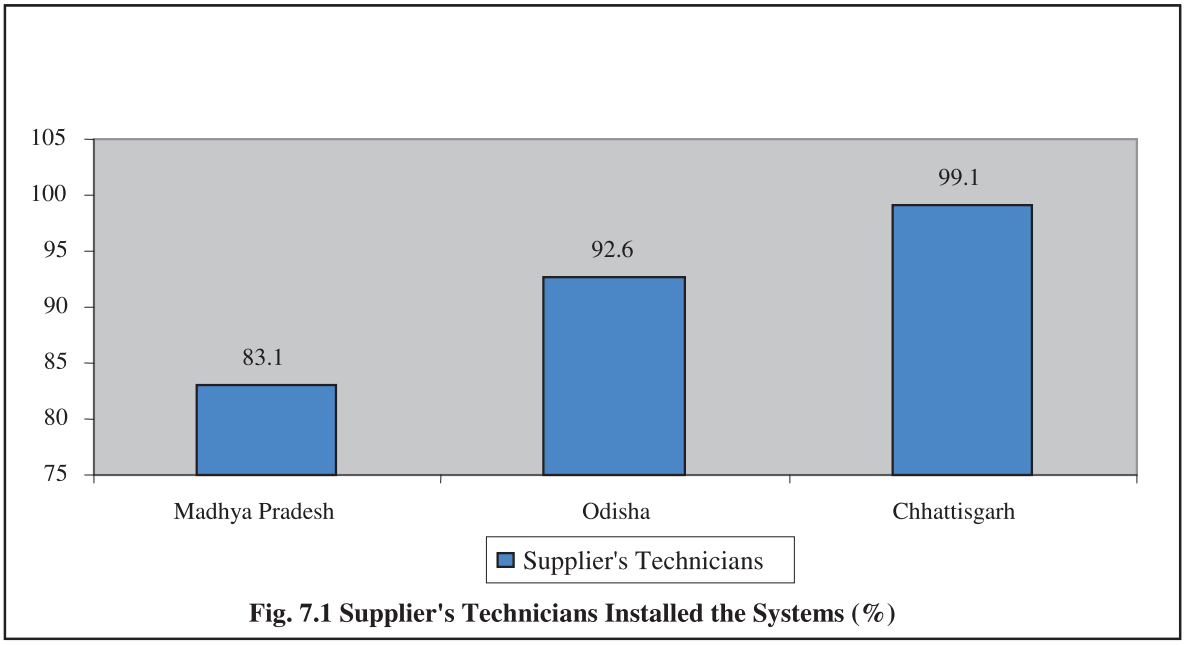


Fig. 7.1 Supplier's Technicians Installed the Systems (%)

In Madhya Pradesh, about 13 per cent have reported that the systems have been installed on their own with the help of relatives and others. About 6 and 4 per cent do not know who installed the system in Odisha and Madhya Pradesh, respectively (Table 7.3).

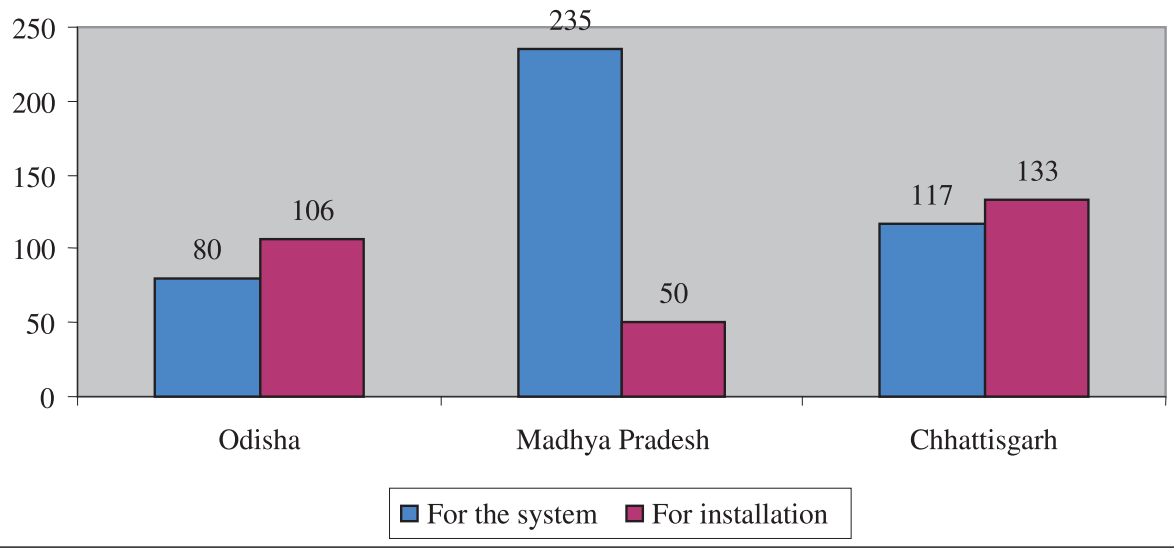
Table 7.3 Who installed the systems? (% of responses)

State	Supplier's Technician	Local village Technician & Member of VEC	Self, Relatives & Others	Do not know	Total
Odisha	92.6	1.8	0.1	5.5	100
Madhya Pradesh	83.1	0.5	12.8	3.6	100
Chhattisgarh	99.1	0.5	0.3	0.1	100

7.3 Cost of the System

The systems were given free of cost in all the three states. However, the beneficiaries have reported that they paid average Rs 186, Rs 285 and Rs 251 for the system as well as for the installation of the system in Odisha, Madhya Pradesh and Chhattisgarh, respectively. On an average Rs 80, Rs 235 and Rs 117 were paid on account of the system in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Fig. 7.2).

Fig. 7.2 Average Payment for the System and for the Installation (Rs)



7.4 Pattern of Module Installation

7.4.1 Place of Installation of the Module

Apart from the weather conditions, other factors are also important for achieving smooth functionality of the system. The module consists of many cells made of semi conducting materials, a thin wafer of Silicon, which is exposed to sunlight to generate electricity. The

module may be installed on the roof of the house or on a separate pole in completely shadow free area. The module orientation should be south facing and angle of inclination should be approximately equal to latitude.

The survey shows that in Odisha, about 55 per cent and 44 per cent of the systems are installed on the roof and a separate pole, respectively. Only about 1.5 per cent keep the system inside during day time in Odisha. In Chhattisgarh, only two villages have got individual solar system whereas 48 villages got the system through power plant. About 85.7 per cent have installed the system on the roof as against 14 per cent who have installed the system on a separate pole. In Madhya Pradesh, 97 per cent installed the system on the roof (Table 7.4).

Table 7.4 Installation of Module (%)

State	On the Roof	Separate Pole	Keep Inside the House	Total
Odisha	54.9	43.5	1.5	100
Madhya Pradesh	97.2	2.5	0.3	100
Chhattisgarh	85.7	14.3	0	100

In principle the module should be installed in a shadow free area. About 94 to 99 per cent of the systems have been indeed installed in a shadow free area in all the three states (Table 7.5). Even though almost all the systems have been installed in the shadow free area, it is not

enough for full utilisation of the system. The module should face south so as to get full sun light. About 67, 80 and 97 per cent have installed the system where the orientation of the modules is due south in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

Table 7.5 Status of Module installation in the households (%)

State	Installation of Module on a Shadow free area (%)		Orientation of the Module due South (%)		Inclination equal to latitude approximately (%)	
	Yes	No	Yes	No	Yes	No
Odisha	93.7	6.3	66.9	33.1	47.3	52.7
Madhya Pradesh	94.4	5.6	79.5	20.5	68.9	31.1
Chhattisgarh	98.7	1.3	97.4	2.6	98.7	1.3

In Odisha, more than one-third of the households installed the system where the orientation of the modules is not due south. Moreover, about 53 per cent of the module's inclination is not approximately equal to latitude in Odisha. In Madhya Pradesh, about one-third of the modules installed are not approximately equal to latitude. But in Chhattisgarh, 99 per cent of the modules are installed in a correct way. Only about 2 per cent of the modules carried some colour differentiation mark in the sample systems in these three states (Table 7.6).

Table 7.6 Does the Module carry colour differentiation mark (%)

State	Module carry colour differentiation mark (%)	
	Yes	No
Odisha	1.7	98.3
Madhya Pradesh	2.5	97.5
Chhattisgarh	1.3	98.7

7.4.2 Fixing of luminaires inside the households

Proper fixing of the luminaires is very important to illuminate the maximum possible darkness of the room. If the CFL is not properly fixed, it may not work at all. As the remote village people are not experienced in fixing the luminaires, an assessment was carried out to check how and where the luminaires are fixed.

Table 7.7 Place of Fixing of Luminaires inside the House (%)

State	Fixing of CFL I			Fixing of CFL II		
	Centre of roof	corner	wall	Centre of roof	corner	wall
Odisha	20	17	63	14	19	67
Madhya Pradesh	34.2	17.8	48	100	0	0
Chhattisgarh	60.8	5.1	34	3.2	4.4	92.3

The fixing up of the luminaires on the centre place of the roof is more desirable than fixing on a wall. Table 7.7 presents that in Odisha, only about 20 per cent of households have fixed lamp 1 on the centre of the roof, as against 34 and 61 per cent of households have fixed on the centre of the roof in Madhya Pradesh and Chhattisgarh, respectively. About 63, 48 and 34 per cent have fixed the luminaires on a wall in Odisha, Madhya Pradesh and Chhattisgarh, respectively. Only about 5 per cent have fixed the lamp1 in the corner in Chhattisgarh, as against 17 per cent each in Odisha and Madhya Pradesh.

In case fixing of CFL II, about 67 and 92 per cent have fixed the CFL II on the wall in Odisha and Chhattisgarh respectively. In Odisha, 14 and 19 per cent have fixed the lamp II in the centre and corner respectively. Whereas, 100 per cent have fixed the lamp II at the centre of the roof in Madhya Pradesh.

7.4.3 Status of fixing of luminaires

Fixing up luminaires has direct relation with getting maximum light in the house. About 71 and 79 per cent of households fixed the luminaires firmly (Lamp I and lamp II) in Odisha. Whereas, about 86 and 50 per cent fixed the lamp I and lamp II firmly inside the households in Madhya Pradesh (Table 7.8). However, the status of fixing of luminaires is relatively better in Chhattisgarh. About 89 and 92 per cent fixed the lamp I and II firmly in Chhattisgarh.

Table 7.8 Households fixed the luminaires firmly inside the house (%)

State	Lamp I		Lamp II	
	Yes%	No%	Yes%	No%
Odisha	70.6	29.4	79.2	20.8
Madhya Pradesh	86.2	13.8	50	50
Chhattisgarh	89.1	10.9	91.9	8.1

A question was asked ‘do the lamp I and lamp II illuminate the maximum possible area of the room?” It is observed that 80 to 91 per cent reported that the lamp I illuminates maximum area of the darkness of the room in all the three states. In case of lamp II, 81 to 100 per cent have reported that the lamp II illuminates maximum area of the darkness of the room (Table 7.9).

Table 7.9 Do the Lamps illuminate the Maximum Possible Area of the room?

State	Lamp I		Lamp II	
	Yes %	No%	Yes %	No %
Odisha	80.2	19.8	81.0	19.0
Madhya Pradesh	82.5	17.5	100	0
Chhattisgarh	91.0	9.0	93.5	6.5

7.4.4 Fixing of cables

Ideally the cables should be firmly fixed at a specific length. The length of the cable between battery and charge controller should be approximately one meter. It has to be smoothly fixed. But in remote villages, since majority of the houses have kuthca wall, there may be variation in the manner of fixing the cable. Given the housing condition in rural areas, an assessment was carried out whether the cables connecting battery to modules, battery to charge controllers and charge controllers to luminaires are fixed firmly or not. For lamp I about half of the cables are not firmly fixed as against one-third in case of lamp II in Odisha. In Madhya Pradesh, in case of lamp I, 68 per cent of cables were firmly fixed as against 100 for lamp II. Above 80 per cent of the cables in lamp I and II are firmly fixed in Chhattisgarh (Table 7.10).

Table 7.10 How are Cables Fixed? (% of Responses)

State	Lamp I (%)		Lamp II (%)	
	Firmly Fixed	Loosely Hanging	Firmly Fixed	Loosely Hanging
Odisha	52.4	47.6	70.8	29.3
Madhya Pradesh	68.4	31.7	100	0
Chhattisgarh	83.1	16.9	85.0	15.0

It is advised that the cable should not have joints while connecting the device to the battery, connecting battery to the charge controller and connecting the charge controller to the luminaires. Table 7.11 presents the status of the cables in all the three states. 82 to 86 per cent of the cables do not have joints while connecting the cables between device to battery, battery to charge controller and charge controller to luminaires in Odisha. Whereas 62 to 72 per cent do not have joints in Madhya Pradesh as against 99 per cent in Chhattisgarh while connecting

the cables between device to battery, battery to charge controller and charge controller to luminaires.

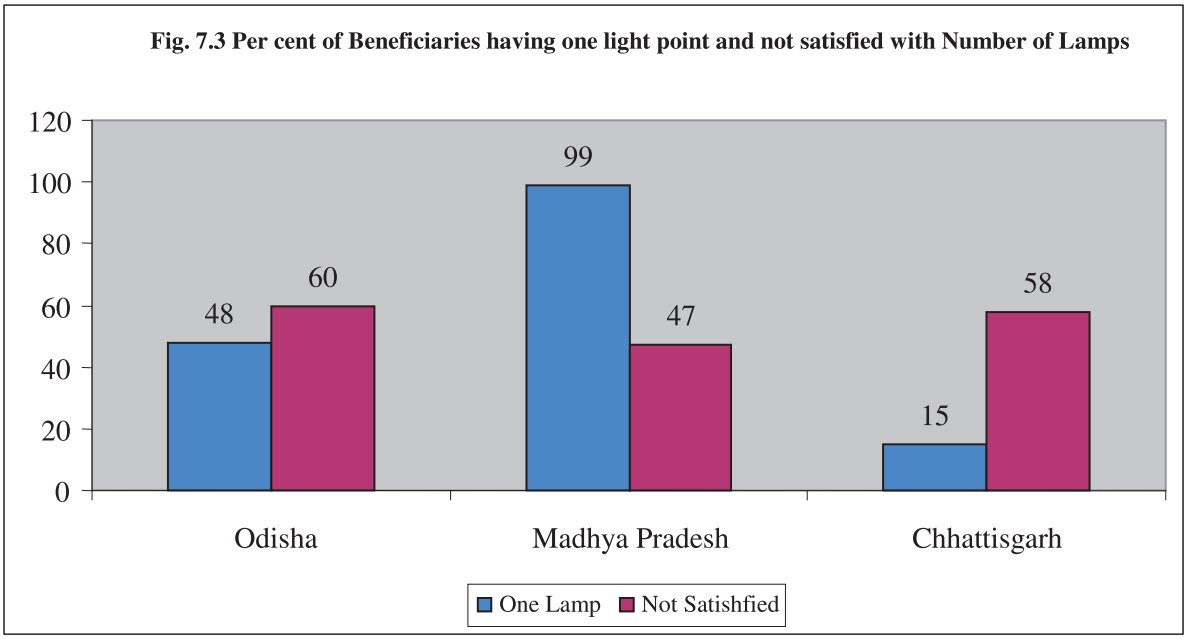
Table 7.11 Is There any Joint in the Cable? (% responses)

State	Device to Battery		Battery to Charge controller		Charge controller to luminaires	
	Yes	No	Yes	No	Yes	No
Odisha	13.7	86.0	15.0	85.0	18.0	82.0
Madhya Pradesh	28.4	71.6	37.3	62.7	37.2	62.8
Chhattisgarh	1.3	98.7	1.3	98.7	1.3	98.7

7.5 Level of Satisfaction with Number of Lamps

About 60, 47 and 57 per cent of beneficiaries are not satisfied with number of lights given to them in Odisha, Madhya Pradesh and Chhattisgarh, respectively. It is because, 48 per cent, 99 per cent and only 15 per cent have got only one lamp in Odisha, Madhya Pradesh and Chhattisgarh, respectively. About 52 and 84 per cent have got two lamps systems in Odisha and Chhattisgarh, respectively (Fig. 7. 3).

Fig. 7.3 Per cent of Beneficiaries having one light point and not satisfied with Number of Lamps



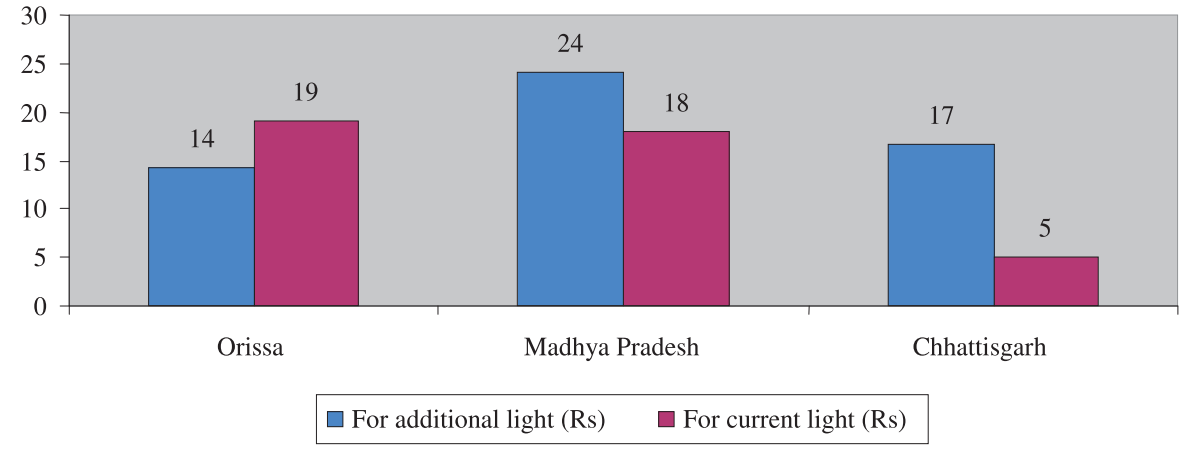
In Madhya Pradesh, about 53 per cent are satisfied with the number of lights given to them as against 40 and 42 per cent in Odisha and Chhattisgarh, respectively (Table 7.12 and Appendix Tables 8, 9).

Table 7.12 No. of Lamps given to the Households (%)

State	One	Two	Three	Sample
Odisha	48	52	0	2,200
Madhya Pradesh	99	1	0	1,508
Chhattisgarh	15	84.1	1	1,500

About 46, 49 and 26 per cent of beneficiaries are willing to pay more for additional light in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Appendix Table 10). On an average Rs 14 to Rs 24 is the amount the beneficiaries are willing to pay for additional light. Majority of beneficiaries are not willing to pay more for additional light in all the three states. Currently, on an average the beneficiaries pay Rs 19, Rs 18 and Rs 5 in Odisha, Madhya Pradesh and Chhattisgarh per month (Fig. 7. 4 and Appendix Table 11).

Fig. 7. 4 On an average a beneficiary willing to pay for additional light and monthly current payment (Rs)



7.6 Contribution by the Beneficiaries

Forming a Village Energy Committee (VEC) among the beneficiaries is an important step of implementation of the programme in the villages. The VEC may have a separate account to deposit the contribution of beneficiaries for future maintenance of the system. Beneficiaries are supposed to pay a minimum fixed amount per month to the VEC. Only about 2 per cent in Madhya Pradesh pay per month, as against 69 and 89 per cent of beneficiaries in Odisha and Chhattisgarh, respectively (Table 7.13). In Madhya Pradesh 98 per cent of beneficiaries do not pay per month. Beneficiaries to the tune of 99 and 91 per cent reported that a member of

VEC comes and collects the user fee every month in Odisha and Madhya Pradesh, respectively. In case of Chhattisgarh, the plant 'Operator' collects Rs 5 per month (Table 7.14).

Table 7.13 Are you paying user fee per Month? (% of responses)

State	Yes	No	Total
Odisha	68.5	31.5	100
Madhya Pradesh	2.3	97.7	100
Chhattisgarh	88.8	11.2	100

Table 7.14 Whom do you pay the user fee? (% of responses)

State	Supplier officials come to collect	Member of VEC comes to collect	Others/operator	Total
Odisha	1	98.6	1	100
Madhya Pradesh	0	91.38	8.62	100
Chhattisgarh	21	6.58	72.41	100

About 21, 7 and 72 per cent of beneficiaries reported that 'supplier's officials', member of VEC and 'Operator' come to collect the user fee per month, respectively in Chhattisgarh.

7.7 Knowledge about the Battery

'Battery' is one of the major components of the solar home-lighting system. It works for a specific duration and it has to be replaced as and when it becomes necessary. About one-third of the beneficiaries said that they are aware of the life period of a battery in Odisha. In Madhya Pradesh and Chhattisgarh, 12 and only 5 per cent of beneficiaries, respectively, are aware of the life period of a battery (Table 7.15). About 95, 88 and 67 per cent do not know about the life period of a battery in Chhattisgarh, Madhya Pradesh and Odisha, respectively.

Tables 7.15Are you Aware of the Life Period of a Battery (% of responses)

State	Yes	No	Total
Odisha	33.3	66.7	100
Madhya Pradesh	12.1	87.9	100
Chhattisgarh	4.6	95.4	100

When asked about the number of years a battery works about 84 per cent of beneficiaries in Odisha said that it works for 5 years. Similarly, 57 per cent in Madhya Pradesh and 67 per cent in Chhattisgarh have reported that the life period of a battery is 3 years and 5 years, respectively (Figs 7.5 to 7.7, Appendix Table 12)

Fig. 7.5 Number of Years of Battery Life in Odisha (% of responses)

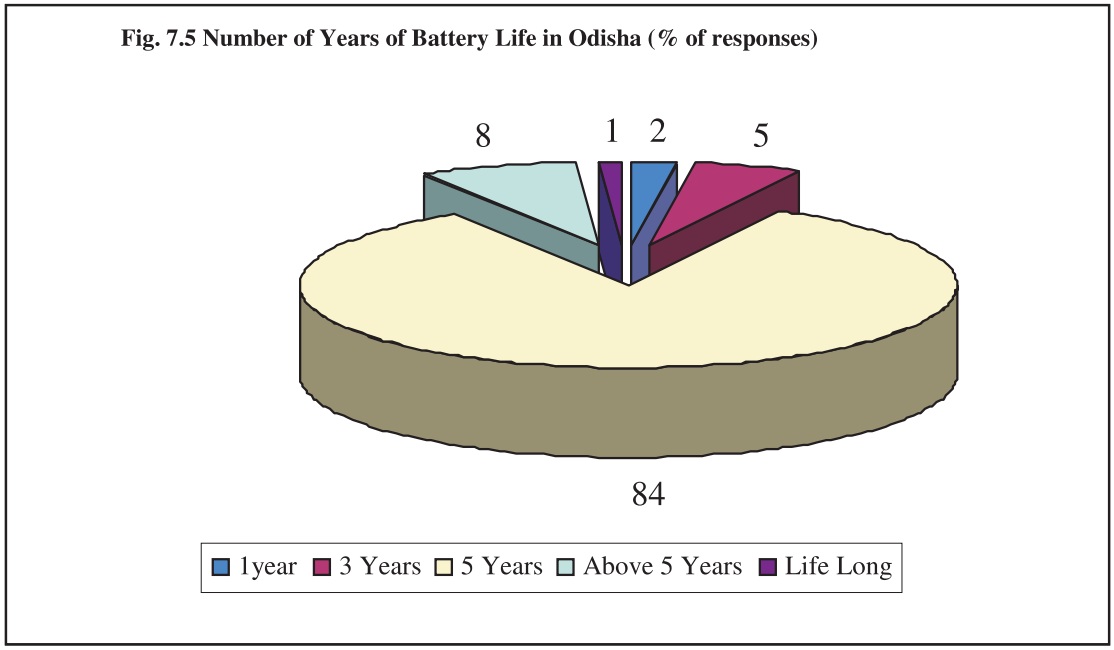


Fig. 7.6 Number of Years of Battery Life in Madhya Pradesh (% of Responses)

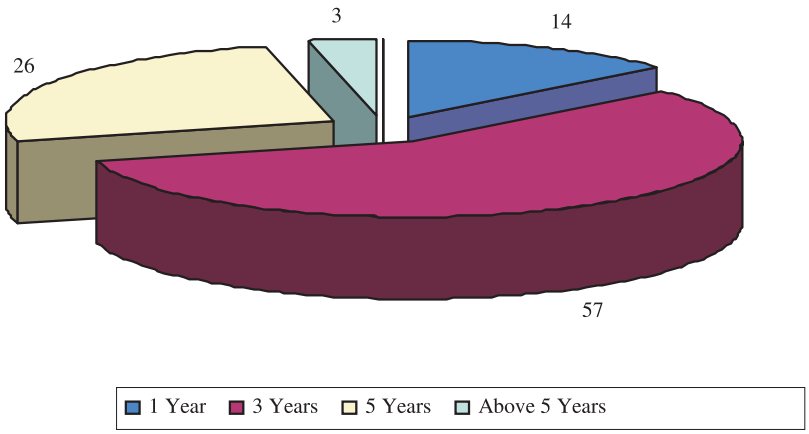
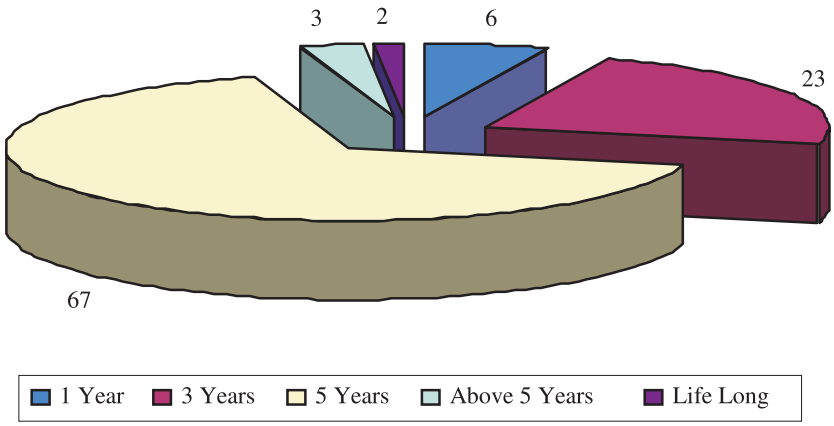


Fig. 7.7 Number of Years of Battery Life in Chhattisgarh (% of Responses)



7.8 Knowledge about the Replacement of the Battery

About one-third of the beneficiaries do not know that the battery has to be replaced in every five years in Odisha. Only about 10 and 3 per cent of beneficiaries know that the battery has to be replaced in every five years in Madhya Pradesh and Chhattisgarh, respectively. This suggests that 90 and 97 per cent of beneficiaries do not know that it has to be replaced in every five years. Knowledge about the price of a battery is also very important. The

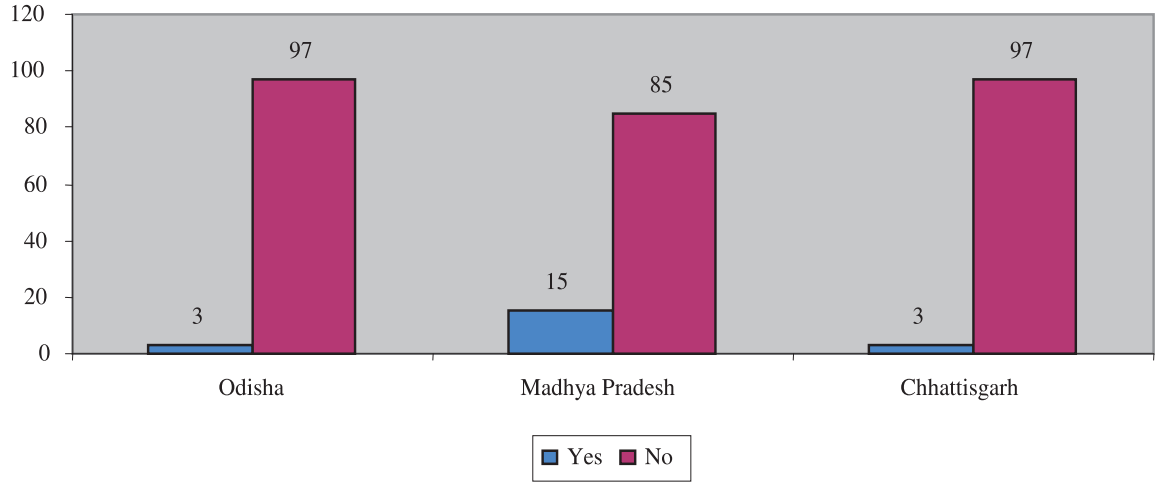
beneficiaries have given varying levels of the estimated cost of a battery. The average estimated cost of a battery is Rs 5609, Rs 3055 and Rs 4242 in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Table 7.16).

Table 7.16 Knowledge of Replacement for the Batteries and Reported Average Cost of the battery (Rs)

State	Do you know? (% of responses)		What is cost of the Battery?
	Yes	No	Average cost of the battery (Rs)
Odisha	30.1	69.9	5609.52
Madhya Pradesh	10.2	89.8	3055.17
Chhattisgarh	3.0	97.0	4242.42

Majority of beneficiaries do not know that banks have a provision of giving loan for replacement of battery. The lack of awareness is because majority of the remote villages do not have linkage with any bank. Only about 15 per cent know that one can borrow from bank for replacement of a battery in Madhya Pradesh as against 3 per cent each in Odisha and Chhattisgarh (Fig. 7.8).

Fig. 7.8 Knowledge that Banks provide loan for buying a Battery (%)



In Chhattisgarh, the replacement of battery is the responsibility of CREDA as solar home-lighting system has been given through power plant in 48 villages out of 50 villages. Hence, 99 per cent of beneficiaries do not have any plan for replacement of battery in Chhattisgarh (Appendix Table 15).

7.9 Future Plan for Replacement of Battery

About 66 to 99 per cent do not have any plan for future replacement of the battery in all the three states (Appendix Table 14). However, the rest of the beneficiaries have shown various sources for financing for replacement of battery. These are (a) savings per month (b) borrowing from relatives; (c) borrow from bank (d) VEC collection per month. Some of them have reported that they cannot replace battery. About 15 per cent reported they are saving per month in Odisha as against 10 per cent in Madhya Pradesh. 5 per cent of each in Odisha and Madhya Pradesh reported that they will borrow from relatives (Figs 7.9 and 7.10)

Fig. 7.9Future Plan for Replacement of a Battery in Odisha, sources of Finances (%)

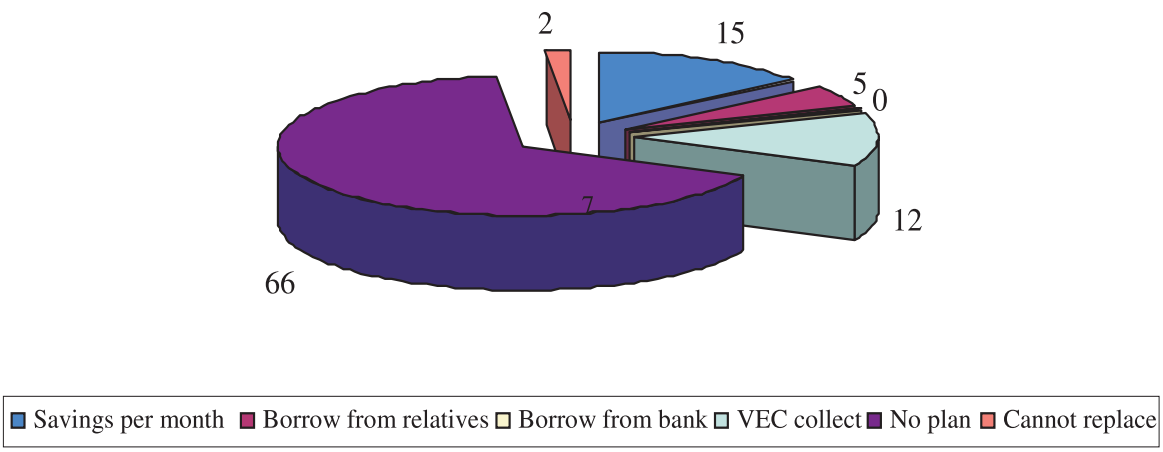
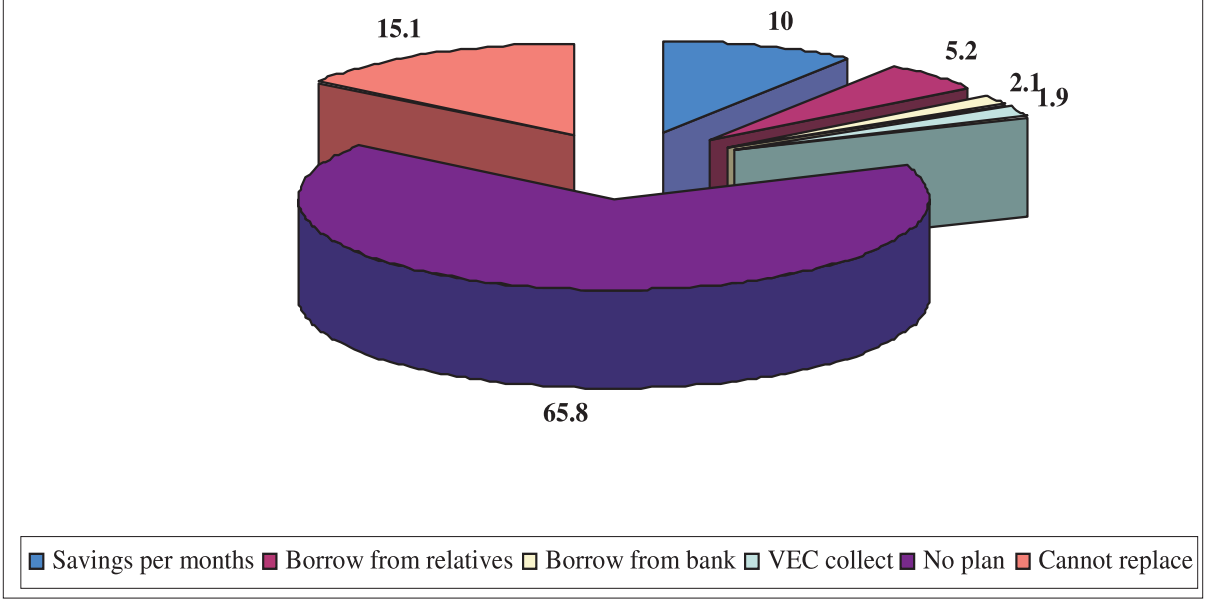


Fig. 7.10 Future Plan for Replacement of a Battery in Madhya Pradesh, Sources of Finance (%)



7.10 Major Findings

7.10.1 Distribution *of system by year of installation*

i. *In Odisha, about 16, 55 and 29 per cent of sample households got the system installed in the year 2007, 2008 and 2009, respectively.*

ii. *In Madhya Pradesh, 34, 25,* 33 and 9 per cent of sample households got the system installed in the year 2007, 2008, 2009 and 2010, respectively.

iii. In Chhattisgarh, 41 per cent of sample households got the system in 2007.

7.10.2 Cost of the system

i. The beneficiaries have reported that they paid Rs 186, Rs 285 and Rs 251 for the system as well as for the installation of the system in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. On an average Rs 80, Rs 235 and Rs 117 were paid on account of the system in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

7.10.3 Pattern of module installation

i. The survey shows that in Odisha, about 55 per cent and 44 per cent of the systems are installed on the roof and a separate pole, respectively.

ii. Only about 1.5 per cent keeps the system inside during day time in Odisha. In Chhattisgarh, only two villages got the individual solar system whereas 48 villages got the system through power plant.

iii. In Chhattisgarh about 85.7 per cent have installed the system on the roof as against 14 per cent who have installed the system on a separate pole.

iv. About 94 to 99 per cent of the systems have been installed in a shadow free area in all the three states.

v. About 67, 80 and 97 per cent have installed the system where the orientation of the modules is due south in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

vi. In Odisha, more than one-third of the households installed the system where the orientation of the modules is not due south.

vii. Moreover, about 53 per cent of the module's inclination is not approximately equal to latitude in Odisha.

viii. In Madhya Pradesh, about one-third of the modules installed are not approximately equal to latitude.

ix. In Chhattisgarh, 99 per cent of the modules are installed in a correct way.

7.10.4 Fixing of luminaires inside the households

i. In Odisha, only about 20 per cent of households have fixed the lamp I on the centre of the roof, as against 34 and 61 per cent of households have fixed on the centre of the roof in Madhya Pradesh and Chhattisgarh, respectively.

ii. About 63, 48 and 34 per cent have fixed the luminaires on the wall in Odisha, Madhya Pradesh and Chhattisgarh, respectively. Only about 5 per cent have fixed the lamp I in the corner in Chhattisgarh, as against 17 per cent each in Odisha and Madhya Pradesh.

iii. In case of fixing of CFL II, about 67 and 92 per cent have fixed the CFL II on the wall in Odisha and Chhattisgarh, respectively.

iv. In Odisha, 14 and 19 per cent have fixed the lamp II in the centre and corner, respectively. Whereas, 100 per cent have fixed the lamp II at the centre of the roof in Madhya Pradesh.

7.10.5 Status of fixing of luminaires

i. About 71 and 79 per cent of households have fixed the luminaires firmly (Lamp I and lamp II) in Odisha.

ii. About 86 and 50 per cent have fixed the lamp I and lamp II firmly inside the households in Madhya Pradesh.

iii. The status of fixing of luminaires is relatively better in Chhattisgarh. About 89 and 92 per cent fixed the luminaires I and II firmly in Chhattisgarh.

iv. It is observed that 80 to 91 per cent reported that the lamp I illuminates maximum area of the darkness of the room in all the three states.

v. In case of lamp II and 81 to 100 per cent have reported that the lamp II illuminates maximum area of the darkness of the room.

7.10.6 Fixing of cables

i. For lamp I about half of the cables are not firmly fixed as against one-third in case of lamp II in Odisha.

ii. In Madhya Pradesh, in case of lamp I, 68 per cent of cables were firmly fixed as against 100 for lamp II. Above 80 per cent of the cables in lamp I and II are firmly fixed in Chhattisgarh.

7.10.7 Level of satisfaction with the number of lamps

i. About 60, 47 and 57 per cent of beneficiaries are not satisfied with the number of light points given to them in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. It is because that 48, 99 and only 15 per cent have got only one lamp in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. About 52 and 84 per cent have got two lamps system in Odisha and Chhattisgarh, respectively.

7.10.8 Contribution by the beneficiaries

- Only about 2 per cent in Madhya Pradesh pay per month, as against 69 and 89 per cent of beneficiaries in Odisha and Chhattisgarh, respectively.
- In Madhya Pradesh, 98 per cent of beneficiaries do not pay per month. 99 and 91 per cent of beneficiaries reported that a member of VEC comes and collects every month in Odisha and Madhya Pradesh, respectively.

- In case of Chhattisgarh, the plant's 'Operator' collects Rs 5 per month.
- About 72 per cent of beneficiaries reported that 'Operator' comes to collect per month in Chhattisgarh.

7.10.9 Knowledge about the battery

i. 'About one-third of the beneficiaries said that they are aware of the life period of the battery in Odisha.

ii. In Madhya Pradesh and Chhattisgarh, 12 and only 5 per cent of beneficiaries, respectively, are aware of the life period of a battery. About 95, 88 and 67 per cent do not know about the life period of a battery in Chhattisgarh, Madhya Pradesh and Odisha, respectively.

iii. About 84 per cent of them said that it works 5 years in Odisha. Similarly 57 per cent and 67 per cent have reported that the life period is 3 years and 5 years in Madhya Pradesh and Chhattisgarh, respectively.

iv. About one-third of the beneficiaries do not know that the battery has to be replaced in every five years in Odisha.

v. Only about 10 and 3 per cent of beneficiaries know that the battery has to be replaced in every five years in Madhya Pradesh and Chhattisgarh, respectively.

vi. In Madhya Pradesh and Chhattisgarh, 90 and 97 per cent of beneficiaries, respectively, do not know that it has to be replaced in every five years.

vii. The average estimated cost of the battery is Rs 5609, Rs 3055 and Rs 4242 in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

viii. Only about 15 per cent know that one can borrow from bank for replacement of battery in Madhya Pradesh as against 3 per cent each in Odisha and Chhattisgarh.

Chapter 8

Status of Functionality, Problems and Maintenance

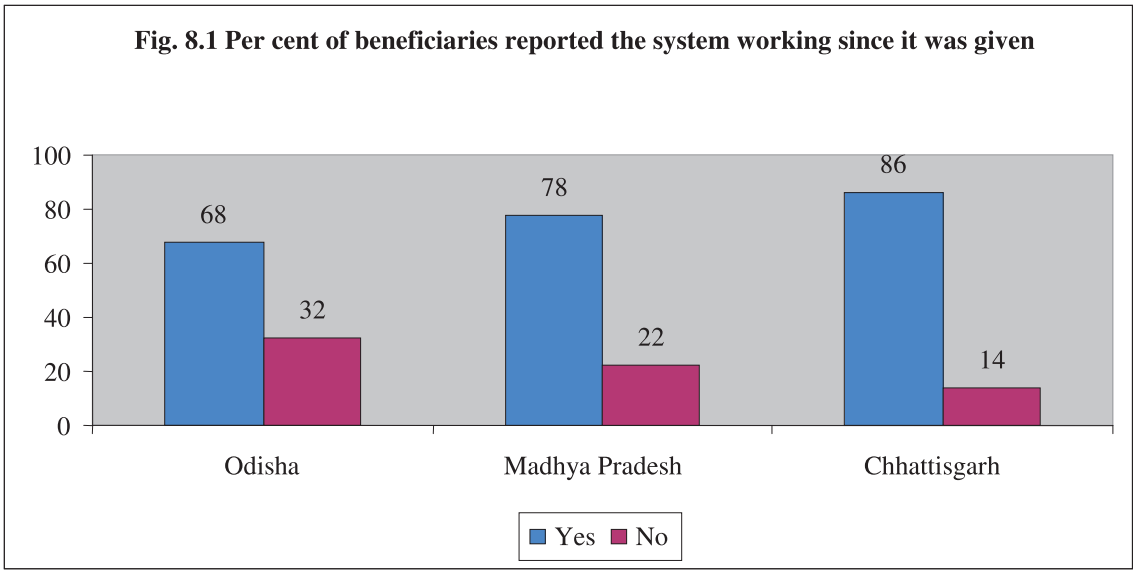
8.1 Introduction

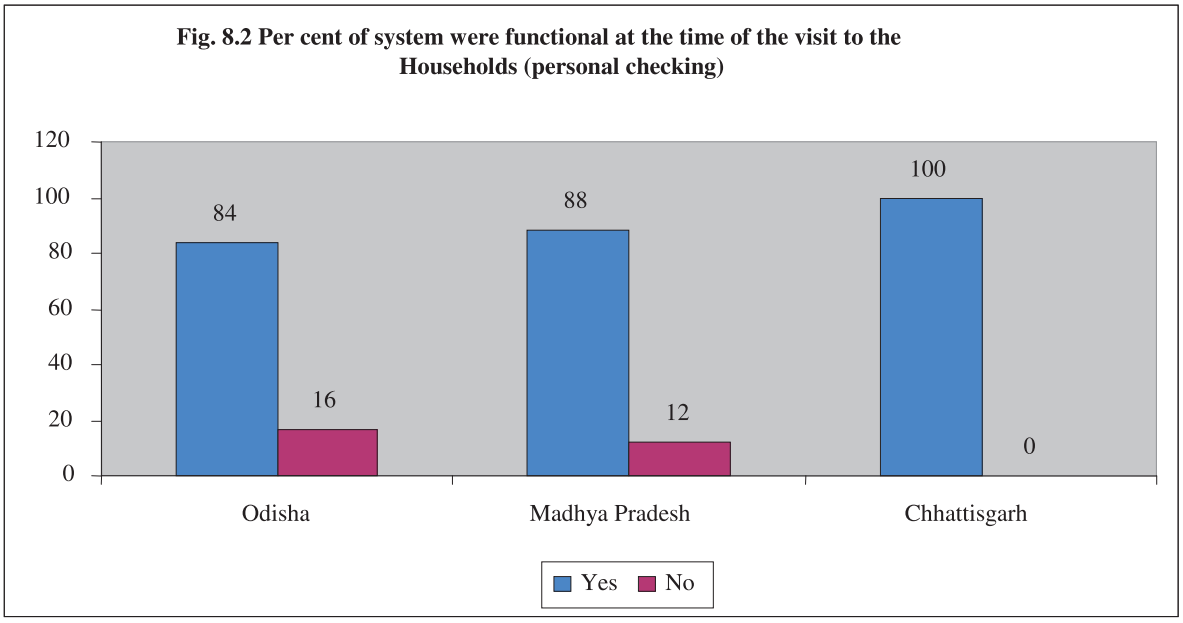
In Chapter 7, we discussed about status of installation of the solar PV systems. In this chapter, we present the survey results on the status of functionality of the systems and problems faced by the beneficiaries in maintenance. The functionality of the system has been recorded from two sources: (a) reported by the beneficiaries and (b) personal checks by the investigators at the time of visiting the household.

8.2 Status of Functionality

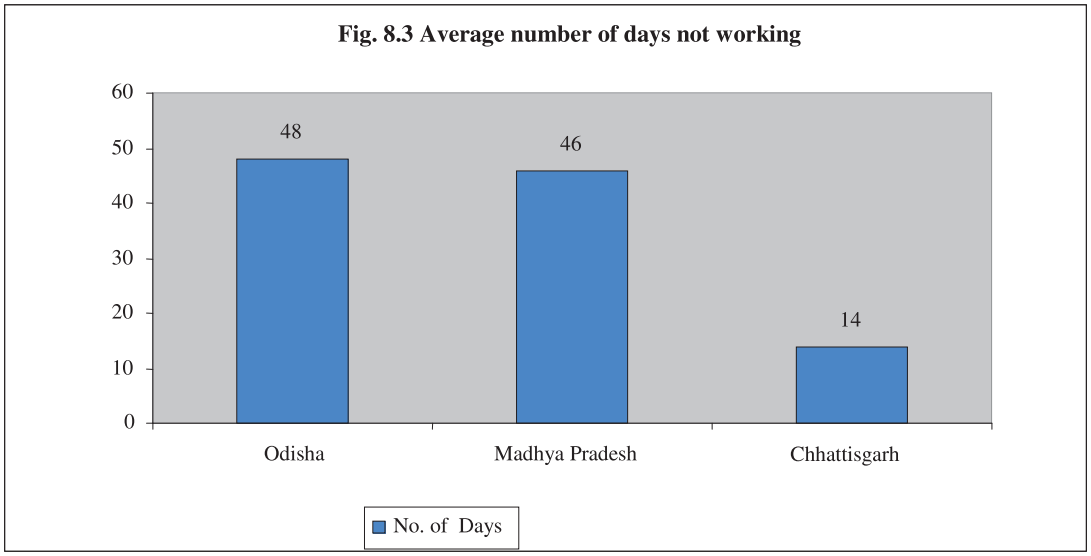
About 68, 78 and 86 per cent of beneficiaries reported that the system has been functional since it was given to them in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Fig. 8.1). However, when the investigators visited the households of beneficiaries and checked the system personally, it is estimated that about 84, 88 and 100 per cent of the systems were in working condition in Odisha, Madhya Pradesh and Chhattisgarh respectively (Fig. 8.2). In other words the actual working condition was better than the responses given by the households..

Fig. 8.1 Per cent of beneficiaries reported the system working since it was given





The estimated number of days the system is 'not working' are 48, 46 and 14 days in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Fig. 8.3).



8.3 Reasons for Non-functional Systems

Surprisingly, when we asked the beneficiaries 'what are the reasons for non functionality of the PV systems, the majority of them were unable to identify any specific reason. Majority of them gave 'Technical fault', 'Problems of charge controllers' and 'Luminaires do not work' as the reasons for non-functional systems (Table 8.1).

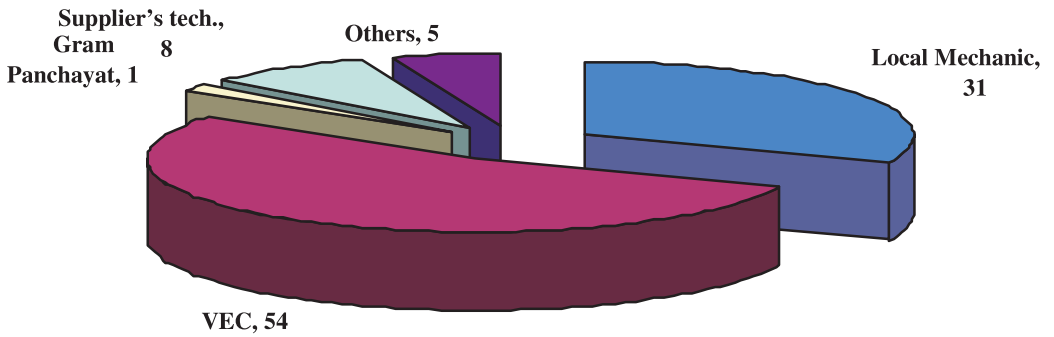
Table 8.1 Reasons for non-functional systems Cited by the Beneficiaries (%)

State	"It was a technical fault".	"Charge controller does not work."	"Luminaires are not functioning"	Total
Odisha	99.0	0.5	0.5	100
Madhya Pradesh	98.8	0.9	0.0	100
Chhattisgarh	94.3	5.7	0.1	100

8.3.1Contact person in case of problems

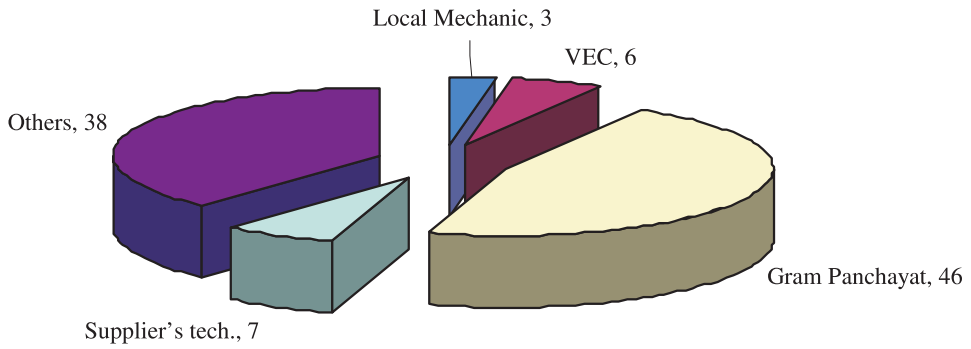
The beneficiaries call various persons for services when the system does not work. Generally approached personnel are—local technician, member of VEC, gram panchayat officials, supplier's technicians and others. The 'others' consist of skilled relatives and family friends. In case of Odisha, 31, 54, 9 per cent reported that they call 'local mechanics, VEC, supplier's technician, respectively (Appendix Table 18). They also call members of gram panchayat and others for help (Fig. 8.4).

Fig. 8. 4 Who is called when system does not work in Odisha (% responses)



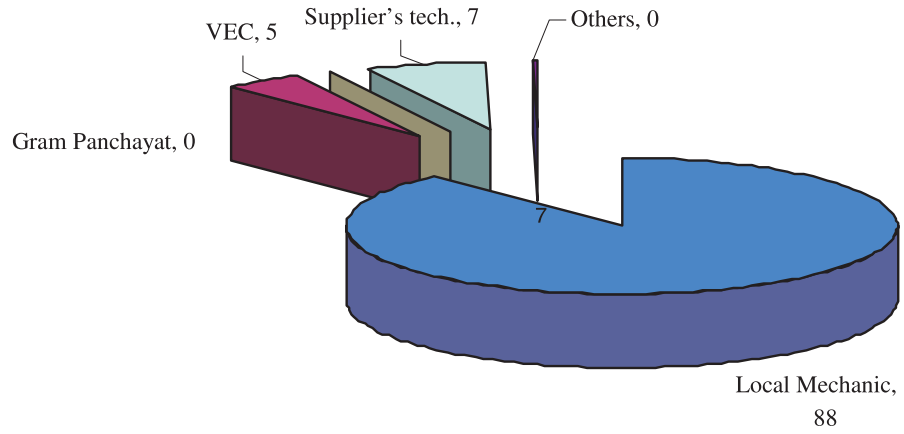
In Madhya Pradesh, gram panchayats play significant role in the maintenance of the systems. About 46 per cent of the beneficiaries inform gram panchayat when they face any problems. Only about 7 per cent call supplier's technicians. As VEC and local technicians are not active in Madhya Pradesh, only 6 and 3 per cent call VEC and local technician respectively, for services (Fig. 8.5).

Fig. 8. 5 Who is called when system does not work in Madhya Pradesh (% responses)



In case of Chhattisgarh, 88 per cent call local technician/plant operator when there is some problem. VEC and supplier's technician are also involved in the maintenance of the system in Chhattisgarh (Fig. 8.6).

Fig. 8. 6 Who is called when system does not work in Chhattisgarh (% responses)



8.3.2 Level of Satisfaction with the Redressal System

In spite of calling various persons to rectify the problem, only about 67, 12 and 88 per cent have reported that somebody came to their house for services in Odisha, Madhya Pradesh and Chhattisgarh, respectively. In case of Madhya Pradesh, 84 per cent said that 'nobody' came for services as against 7 per cent in Chhattisgarh (Table 8.2). As we observed in Madhya Pradesh, due to lack of VEC as well as maintenance facilities, the beneficiaries were asked to inform the Gram Panchayat if the system does not work. The 'Gram Panchayat' informs to the suppliers or the supplier's technician. In some remote villages the Gram Panchayat office itself is located at a distance of 10 to 15 km. It may be possible that the most of the time 'nobody' comes for services when there is a need in Madhya Pradesh.

Table 8.2 Level of satisfaction in Maintenance (%)

State	Did anybody come to check the problems?			Are you satisfied with the redressal system?		
	Yes	No	sometimes	Yes	No	No Comment
Odisha	67.1	30.6	2.4	41.2	38.3	20.5
Madhya Pradesh	12.6	84.4	3.0	3.9	81.3	14.8
Chhattisgarh	88.2	7.0	4.8	84.5	5.8	9.7

Therefore, 81 per cent of beneficiaries reported that they are not satisfied with the grievance redressal system in Madhya Pradesh. About 38 and 6 per cent of beneficiaries are also not satisfied with the grievance redressal system in Chhattisgarh and Odisha, respectively (Table 8.2).

8.4 Reasons for Dissatisfaction

Multiple reasons have been cited by the beneficiaries for not being satisfied with the grievance redressal system. 'No one is available to repair or check the system' was the major reason as cited by 66 and 44 per cent of beneficiaries in Madhya Pradesh and Odisha, respectively. 'Technician does not repair properly' is the second major reason reported by 30 and 16 per cent of beneficiaries in Chhattisgarh and Odisha, respectively. 'VEC' not available is another reason mentioned by 4 to 9 per cent of the beneficiaries in all these three states. Lack of spare parts in the nearby market, or with the technicians, high cost of the repairs were the other reasons cited for dissatisfaction with the system (Appendix Table 19) and (Figs 8.7, 8.8 and 8.9).

Fig. 8.7 Reasons for dissatisfaction with grievance redressal system in Odisha (% responses)

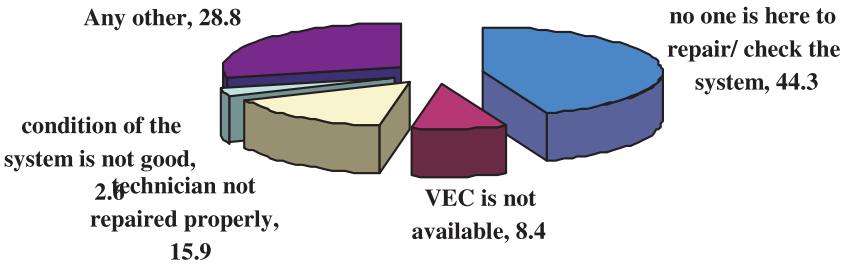


Fig. 8.8 Reasons for dissatisfaction with the grievance redressal system in Madhya Pradesh (% responses)

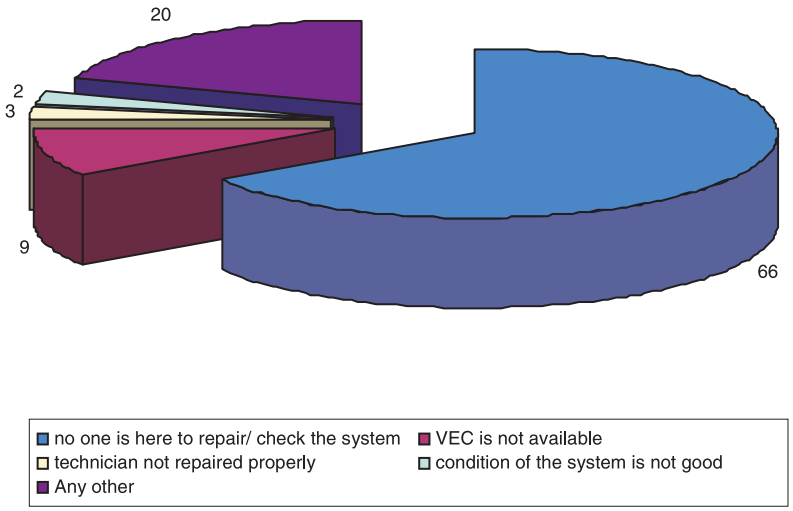
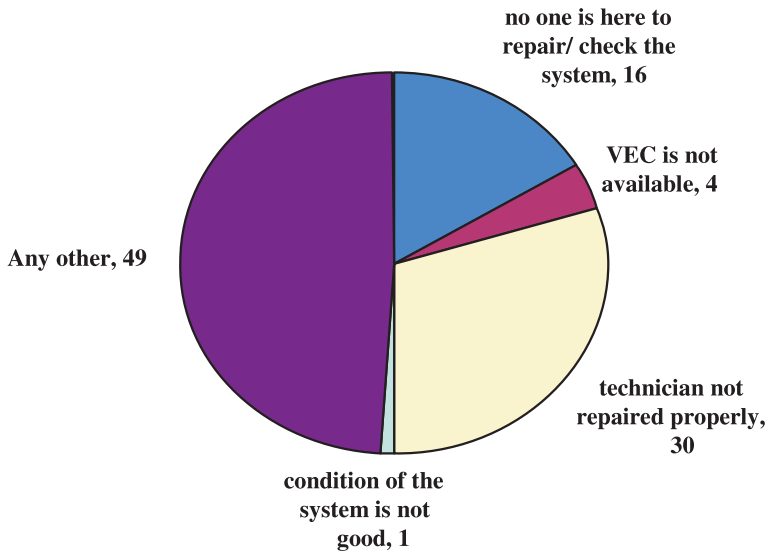


Fig. 8.9 Reasons for dissatisfaction with grievance redressal system in Chhattisgarh (% responses)



8. 5 Performance of the System by Seasons

If the modules are installed properly, fixing of luminaires is proper, fixing of cable from charge controller to the module is also proper then one CFL light can provide light up to 10 hours in normal weather conditions. Two CFL luminaires can provide light up to 4-5 hours a day. One of the major advantages of the Solar Home Lighting System is that the energy can be stored in the battery for two to three days, if the lights are used scarcely. In this study an assessment has been carried out to check the number of hours for which light is received by the beneficiaries during different seasons. On an average the luminaires work for 2.8 hours to 3.4 hours during rainy season. Whereas the performance of the system is better in winter and summer season (Table 8.3).

Table 8.3 Average number of hours the Luminaires work

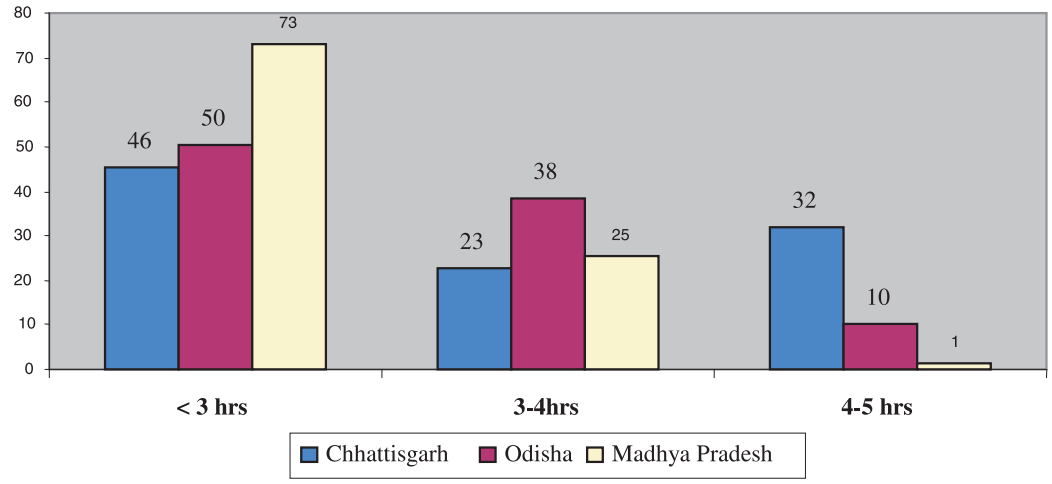
State	Rainy	Winter	Summer
Madhya Pradesh	2.8	3.7	4.8
Odisha	3.1	4.2	4.6
Chhattishgarh	3.4	4.4	4.7

8.5.1 Performance of the system during rainy season

Respondents in Madhya Pradesh reported the weakest performances of the systems in the rainy season. About 46, 50 and 73 per cent reported that light comes for less than 3 hours

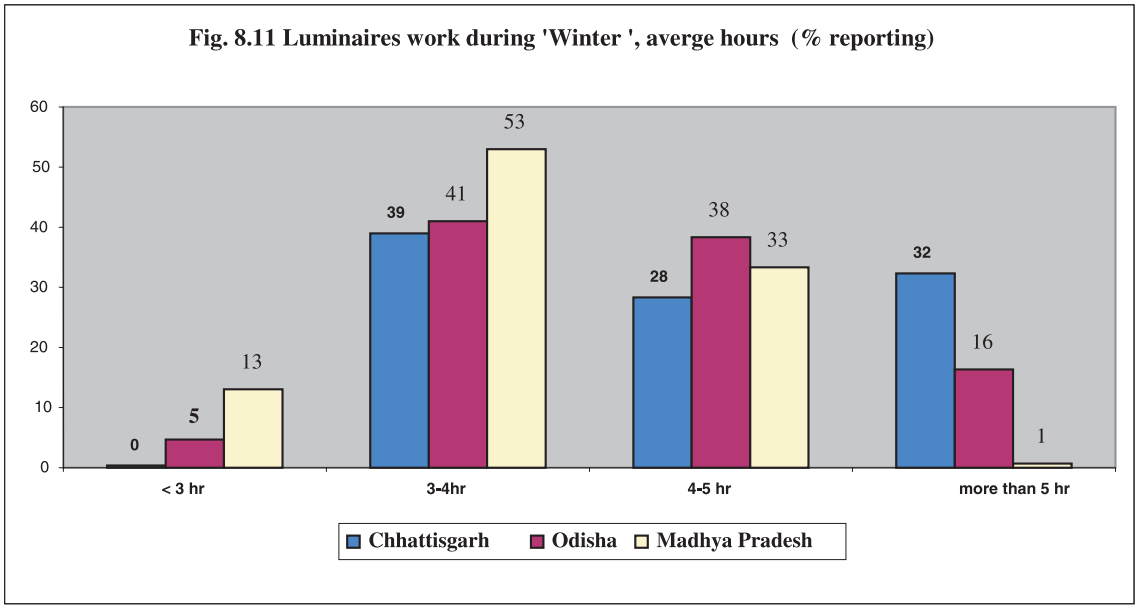
during rainy seasons in Chhattisgarh, Odisha and Madhya Pradesh, respectively. 23 to 38 per cent reported that light comes for 3 to 4 hours in Chhattisgarh, Odisha and Madhya Pradesh, respectively. Only about 1 per cent said luminaires work for 4-5 hours in Madhya Pradesh as against 32 per cent and 10 per cent in Chhattisgarh and Odisha, respectively. The performance of the systems is better in Chhattisgarh as compared to Madhya Pradesh and Odisha (Fig. 8.10).

Fig. 8.10 Luminaires working during 'Rainy season', average hours per day (% reporting)



8.5.2 Performance of the system during winter season

It is expected that the performance of the system may be better in winter as compared to rainy seasons. In Madhya Pradesh, about 13 per cent reported that they get light for less than 3 hours as against 5 per cent in Odisha; whereas no one is reporting that they get light for less than 3 hours in Chhattisgarh during winter season (Fig. 8.11). About 39, 41 and 53 per cent of beneficiaries said that they get light for 3 to 4 hours in Chhattisgarh, Odisha and Madhya Pradesh, respectively. About 61, 54 and 34 per cent reported that they get light for more than 4 hours in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

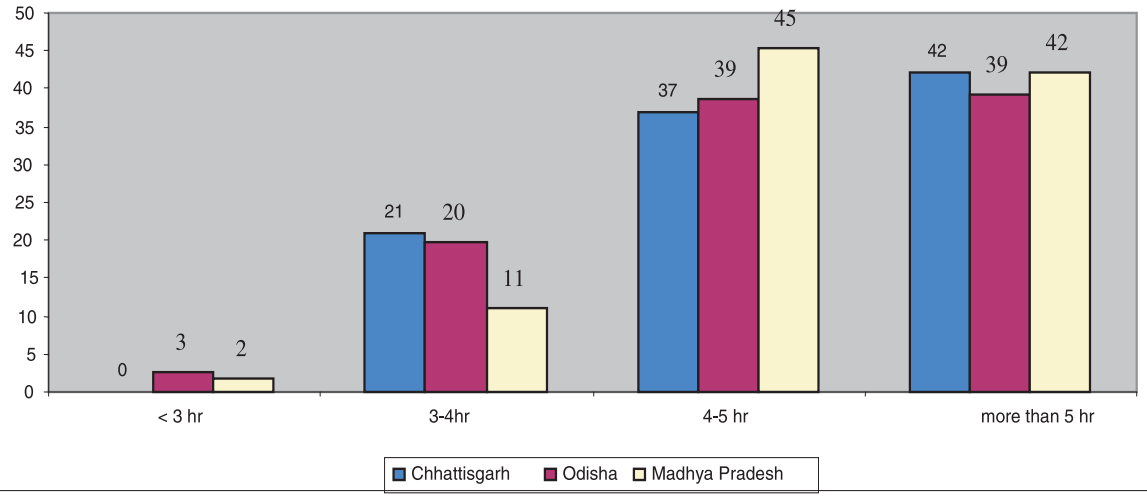


8.5.3 Performance of the system during summer season

The performance of the system should be even better during summer season than winter and rainy seasons. It is expected that the sunshine remains throughout the day and the battery will be fully charged. Hence, majority of the beneficiaries should get longer period of light from their PV system in summer season.

Only about 2 per cent each in Odisha and Madhya Pradesh reported that they get light less than 3 hours from the PV system during summer seasons. 37, 39 and 45 per cent have reported that they get light for 4-5 hours in Chhattisgarh, Odisha and Madhya Pradesh, respectively. Similarly, 42 per cent each in Chhattisgarh and Madhya Pradesh reported that they get light for more than five hours. More than one-third of the beneficiaries reported that they get light for more than five hours in Odisha (Fig. 8.12). Thus, as expected the solar power is available to its maximum during the summer season as compared to winter and rainy seasons.

Fig. 8.12 Luminaires work per day Average hours during 'Summer' (% reporting)



8.5.4 Performance of the system by year of installation

It is a well known fact that once the system gets old and if the system is not maintained properly then the level of performance declines. The survey also finds this to be the case. In Odisha, of those who received the systems in 2007, about 70 per cent reported that they get light for less than 3 hours a day as against 58 per cent of beneficiaries who got the system in 2009 during rainy season (Table 8.4). About 22 per cent of those who received the system in 2007 reported getting light for 3–4 hours as compared to 37.4 per cent of those who got the system in 2009. The pattern of performance is similar in the winter and summer seasons.

Table 8.4 Performances by Year of Installation in Odisha

Year	Rainy Season		Winter Season		Summer Season	
	<3 hr	3–4 hr	3–4 hr	4–5 hr	3–4 hr	4 to 5 hr
2007	69.8	22.0	38.1	43.4	17.6	75.7
2009	57.9	37.4	47.1	44.1	18.7	81.0

The estimated season-wise and year-wise performance of the system in Madhya Pradesh is presented in Table 8.5. It is observed that the performance of the systems during different seasons does not vary much by year of installation of the system. During summer season, of those who got the system in 2007 and 2009, 87 and 88 per cent reported that they get light for

about 4 and 5 hours in a day from their PV system, respectively. During rainy seasons, about 72 to 75 per cent reported that they get less than 3 hours of light. Performance of the system has been reported to be poor for the most recent systems in the rainy season.

Table 8.5 Performance by Year of Installation in Madhya Pradesh (% of responses)

Year	Rainy Season		Winter Season		Summer Season	
	<3 hr	3–4 hr	3–4 hr	4–5 hr	3–4 hr	4 & 5 hr
2007	72.1	27.3	54.7	29.5	10.5	87.3
2009	75.6	21.4	51.7	29.7	11.5	87.7

In Chhattisgarh, the SPV home lighting system has been provided to the households through a solar power plant. Therefore, the duration of the light is fixed in Chhattisgarh, 4 hours in the evening and 2 hours in the morning. CREDA has appointed one operator to look after the plant in each village. He has been maintaining and operating the plant. However, the performance of the system does not differ much in different seasons as compared to Madhya Pradesh and Odisha. During rainy season 75 per cent of those who got the system in 2006 reported getting light for less than 3 hours as against 46 per cent who got the system in 2008. Similarly, during winter, 71 per cent of those who got the system in 2006 reported that they get the light for 3–4 hours as compared to 47.5 per cent of those who got the system in 2008 (Table 8.6 and Appendix Tables 20 to 31).

Table 8.6 Performance by Year of Installation in Chhattisgarh (% of responses)

Year	Rainy Season		Winter Season		Summer Season	
	<3 hr	3-4 hr	3–4 hr	4–5 hr	3–4 hr	4 to5 hr
2006	75.1	18.5	70.8	23.1	38.5	61.5
2008	46.2	18.4	47.5	21.5	34.8	65.2

8.6 Problems Faced by the Beneficiaries

8.6.1 Different types of problems

'Light goes after 2 hours' is one of the problems, cited by 7, 2 and 9 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively. The system 'does not work in rainy season' is cited by 34, 69 and 80 per cent, in Odisha, Madhya Pradesh and Chhattisgarh, respectively. A sizable per cent of beneficiaries are also faced with the problem

of ‘Poor Battery’, and ‘loose wiring’ in Odisha and Madhya Pradesh. Only about 15, 13 and 6 per cent of beneficiaries said that they cannot use TV and other audio entertainment appliances with the system (Appendix Table 32).

The functionality problem mostly occurs during rainy season. About 75 to 97 per cent of beneficiaries reported that problems are more frequent in ‘Rainy season’ (Table 8.7). Only about 10 per cent reported that they faced problem in winter season in Madhya Pradesh. The problems are rare in summer in all the three states.

Table 8.7 When are the Problems More Frequent? (% responses)

State	Rainy season	Winter season	Summer season
Odisha	75.2	1.8	0.2
Madhya Pradesh	80.0	9.5	0.1
Chhattisgarh	97.2	2.6	0.1

8.6.2 Non-availability of VEC

The availability of Village Energy Committee (VEC) has been recorded from two sources.

i) Reported by the Village Pradhan in the village questionnaire.

ii) Reported by the beneficiaries in the household’s questionnaire.

In Madhya Pradesh, only about 15 per cent of beneficiaries reported of existence of VEC in the village, whereas 26 per cent ‘do not know’ about its existence. The rest about 59 per cent said ‘No’ VEC in their village in Madhya Pradesh. About 94 and 85 per cent of beneficiaries reported of presence of VEC in Odisha and Chhattisgarh, respectively (Table 8.8). The respondent of village questionnaires was either a village Pradhan or a member of VEC or an influential person in the village. According to the village questionnaire, in Madhya Pradesh, 43 per cent villages have a VEC and 57 per cent said ‘no’ VEC in the village. About 26 per cent who reported ‘do not know’ about existence of VEC may be due to non-functional VEC even though it was formed in Madhya Pradesh. 99 and 98 per cent of villages has a VEC in Odisha and Chhattisgarh, respectively (Table 8.8).

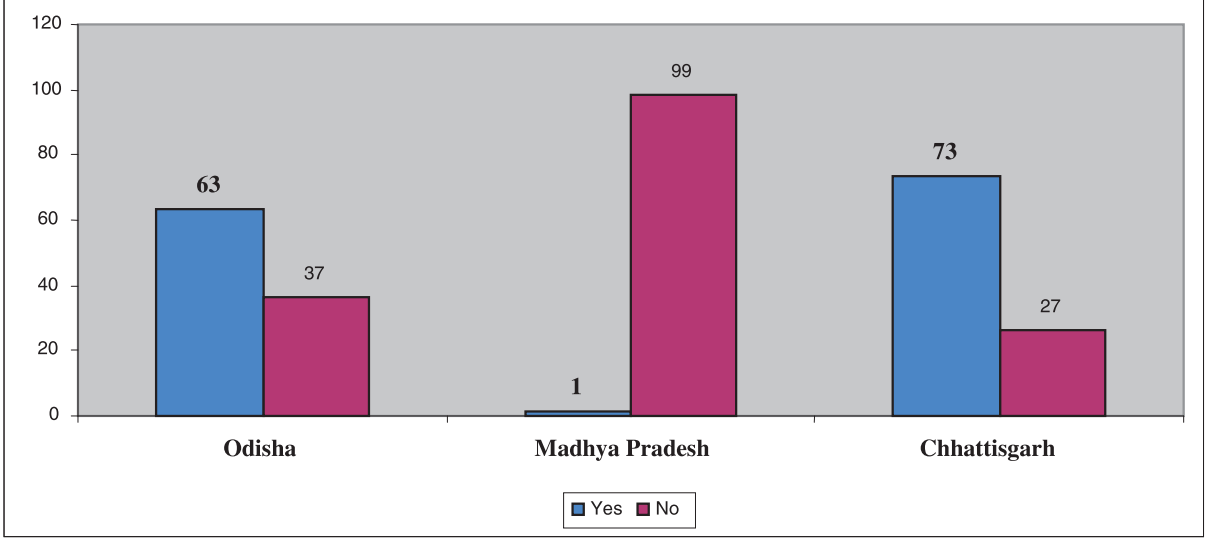
Table 8.8 Is there any Village Energy Committee (VEC) constituted under RVEP? (% of responses)

	From Beneficiaries (%)			From Village Respondents (%)	
State	Yes	No	Do not Know	Yes	No
Odisha	93.6	1.1	5.4	98.82	1.18
Madhya Pradesh	15.5	58.6	26.0	43.14	56.86
Chhattisgarh	84.5	4.3	11.2	98.0	2.0

8.6.3 Organisation of awareness campaign

Organising awareness campaign regarding the functionality of the system and type of maintenance care is one of the major responsibilities of suppliers. In Madhya Pradesh 99 per cent of beneficiaries reported that 'no awareness' campaign was organised by the suppliers. About 63 and 73 per cent of beneficiaries reported organisation of such campaigns in Odisha and Chhattisgarh (Fig. 8.13). A smaller but significant 37 and 27 per cent of beneficiaries reported of not having such campaigns in Odisha and Chhattisgarh, respectively.

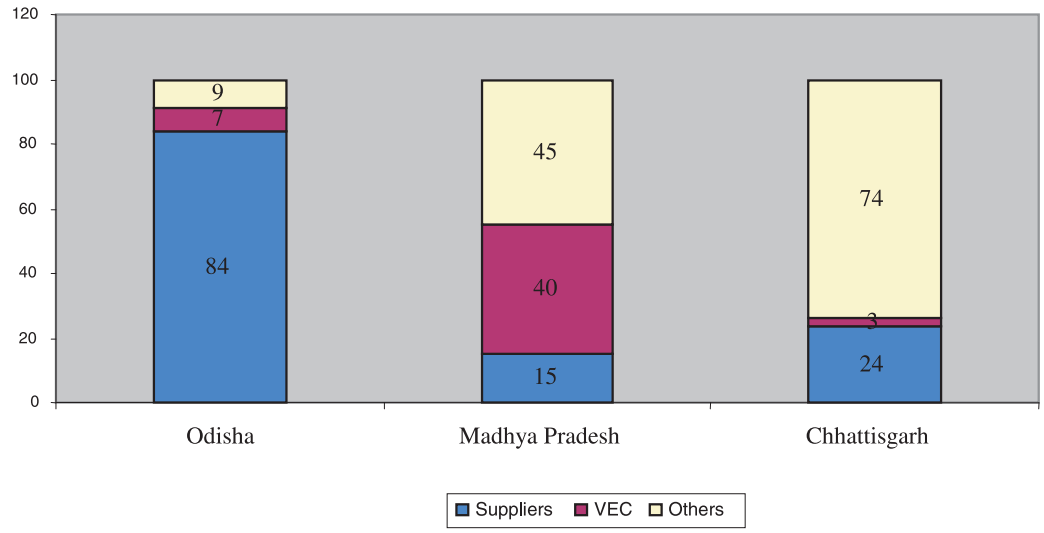
Fig. 8. 13 Awareness Campaign Organised after Installation (% responses)



About 84, 15 and 24 per cent of beneficiaries reported that 'suppliers' had organised awareness campaign in their village. Only 7, 40 and 3 per cent of beneficiaries reported that 'VEC' had organised the training in Odisha, Madhya Pradesh and Chhattisgarh, respectively. The operation and maintenance system is relatively better in Chhattisgarh. The village plant operator and supplier's technician play major role in maintenance system in Chhattisgarh.

About 74 per cent of beneficiaries said that 'others' (consisting of operators and technicians) organised awareness campaign in Chhattisgarh (Fig. 8.14).

Fig. 8.14 Who organised the Awareness Campaign? (% responses))



About 76 to 95 per cent of beneficiaries also reported attending the awareness campaign organised by various parties in these states (Table 8.9).

Table 8.9 Per cent of Beneficiaries attending the Awareness Campaign

State	Yes	No	Total
Odisha	77.5	22.5	100
Madhya Pradesh	95.0	5.0	100
Chhattisgarh	75.8	24.3	100

8.6.4 Organisation of Training programme

Organising training programme for maintenance of the system by the households themselves is also one of the major responsibilities of the suppliers. About one-third of the beneficiaries have received some training for self maintenance of the system in Odisha. Whereas, 99 and 94 per cent of the beneficiaries did not receive any such training in Madhya Pradesh and Chhattisgarh, respectively (Table 8.10).

Table 8.10 Households Receiving Training for Maintenance of the system (%)

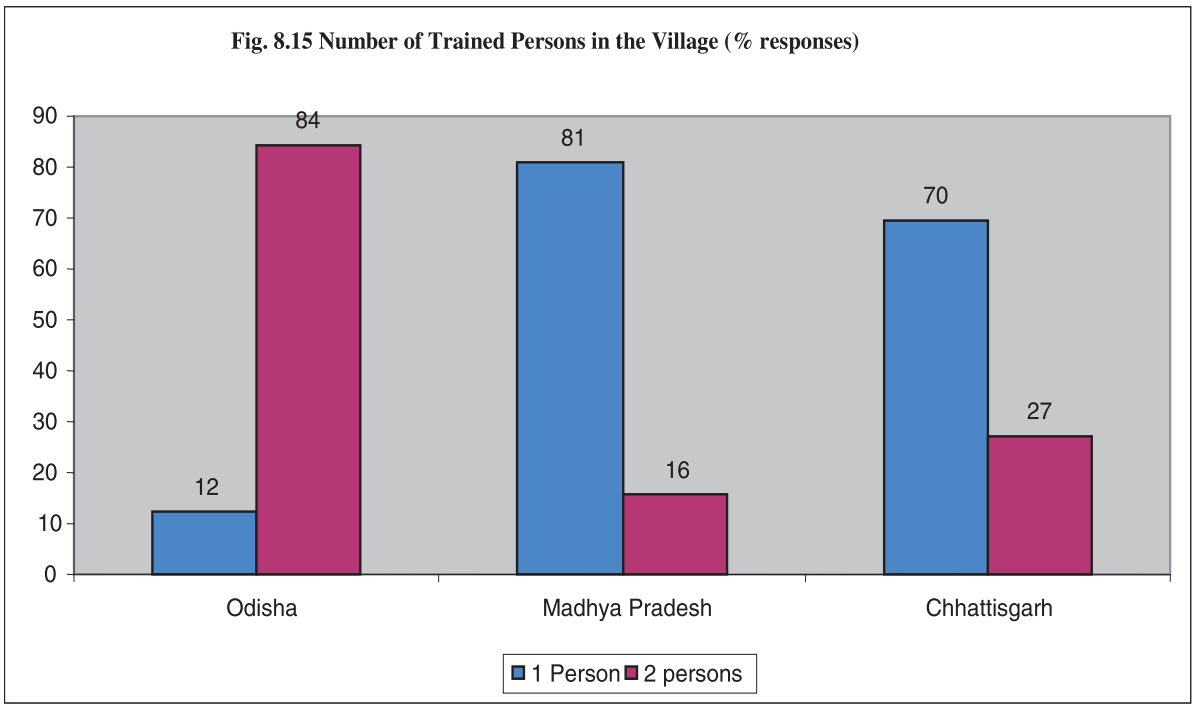
State	Yes	No	Total
Odisha	31.2	68.8	100
Madhya Pradesh	1.3	98.7	100
Chhattisgarh	6.1	93.9	100

About 66, 65 and 39 per cent of beneficiaries have reported that they need training for maintenance of the system (Table 8.10). Whereas 34, 35 and 61 per cent said they do not need such training. About 52, 9 and 95 per cent of beneficiaries said there are trained persons in their villages in Odisha, Madhya Pradesh and Chhattisgarh (Table 8.11).

Table 8.11 Households need Training in maintenance of the system (%)

State	Do you need training for maintenance?		Are there trained person in the village?	
	Yes	No	Yes	No
Odisha	65.8	34.2	51.9	48.1
Madhya Pradesh	64.9	35.1	9.4	90.6
Chhattisgarh	39.1	60.9	95.4	4.6

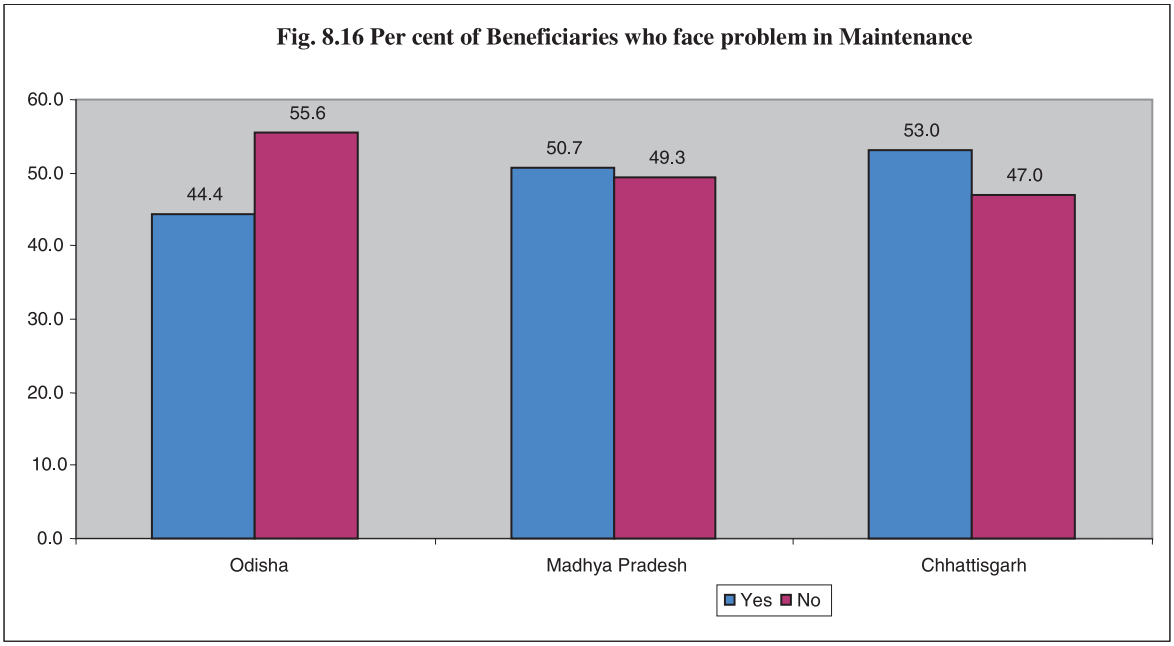
About 84 per cent of beneficiaries reported that ‘two’ trained persons are available in their village in Odisha, as against 81 and 70 per cent reported that there is ‘one’ trained person in Madhya Pradesh and Chhattisgarh, respectively (Fig. 8.15).



About 16 and 27 per cent of beneficiaries reported of having 'two' trained persons in their village in Madhya Pradesh and Chhattisgarh, respectively.

8.7 Maintenance of the System and Level of Satisfaction

We observed that there was no training organised for maintenance of the system for the beneficiaries. The systems require continuous maintenance for smooth functioning in long run. Due to lack of training for self maintenance of the system, the beneficiaries face lots of problems. However, more than half of beneficiaries face such problems in Madhya Pradesh and Chhattisgarh. About 56 per cent of beneficiaries said they do not have any problem in maintenance in Odisha (Fig. 8.16)



About 52 per cent of beneficiaries reported that suppliers have appointed local technicians in Odisha. However, about 8 per cent of beneficiaries do not know about it whereas 39 reported that 'no' local technicians have been appointed by the suppliers in Odisha. About 72 per cent of beneficiaries reported that 'No' local technician has been appointed and 27 per cent 'do not know' about it in Madhya Pradesh. But in Chhattisgarh 96 per cent have reported for appointment of 'local technician' in their village. Only one per cent said that there is a local technician appointed by the suppliers (Table 8.12).

Table 8.12 Is there any Local Technician Appointed by the Supplier? (%)

State	Yes	No	Do not Know	Total
Odisha	52.4	39.3	8.3	100
Madhya Pradesh	0.7	72.1	27.2	100
Chhattisgarh	95.6	1.5	2.9	100

8.7.1 Activities of the local technician

About 84, 15 and 99 per cent reported that the local technician comes for maintenance/ services when they need his help in Odisha, Madhya Pradesh and Chhattisgarh, respectively. Only about two per cent reported that the member of VEC also comes for maintenance of the system. In case of Madhya Pradesh, 81 per cent reported that 'others'—gram panchayat—were involved in the maintenance of the system. The maintenance system is rare in Madhya

Pradesh as there is no 'VEC' and 'No' local technicians appointed by the suppliers. However, the beneficiaries were asked to inform the gram panchayat when the systems stop working in Madhya Pradesh (Table 8.13). In Chhattisgarh, the local technicians, appointed by the supplier as a 'Power Plant Operator' look after the power plant. He has been authorised to collect the monthly contribution from the beneficiaries. Therefore, he has to visit monthly for collection as well as for services when the beneficiaries call him.

Table 8.13 Who comes for Maintenance/servicing of the system (% respones)

State	Local skilled technician	Member of VEC	Others	Total
Odisha	84.2	2.8	13.0	100
Madhya Pradesh	15.2	3.3	81.4	100
Chhattisgarh	98.6	1.0	0.4	100

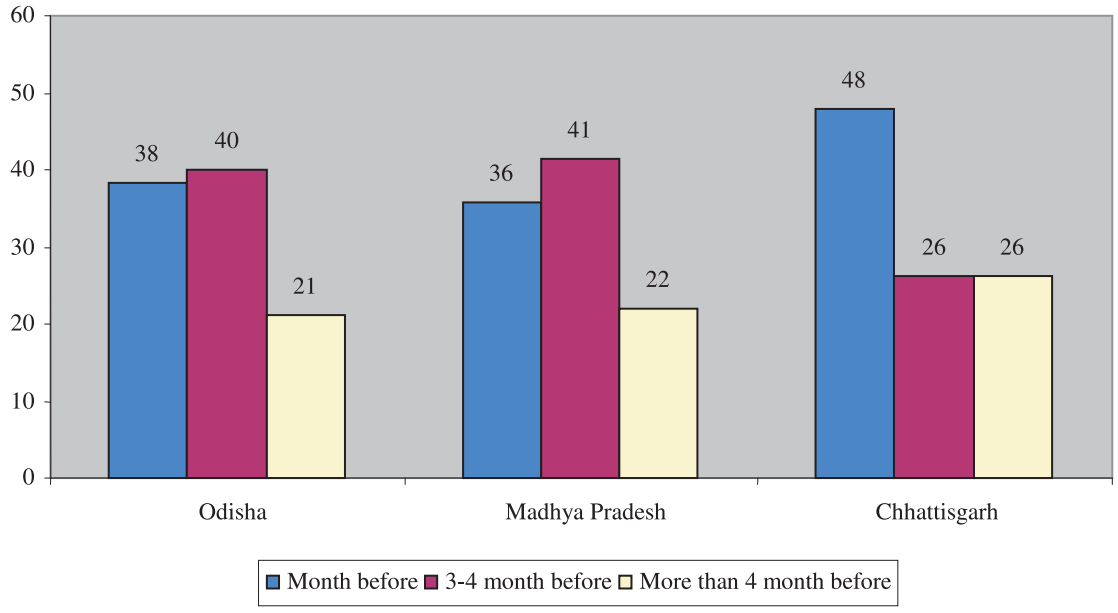
Table 8.14 Frequency of Visit by the Technician (%)

State	Weekly	Monthly	Quarterly	On call
Odisha	0.4	16.8	19.1	63.8
Madhya Pradesh	0.4	17.8	23.6	58.2
Chhattisgarh	0	43.5	4.4	52.2

About 16.8, 17.8 and 44 per cent of beneficiaries reported 'Monthly' visit of technicians in Odisha, Madhya Pradesh and Chhattisgarh respectively. Similarly, 19, 24 and 4 per cent of beneficiaries reported that the technician visit 'quarterly' for maintenance purposes in Odisha, Madhya Pradesh and Chhattisgarh. However, 64, 58 and 52 per cent of beneficiaries reported of visiting the technician 'on call' for services (Table 8.14).

About 38, 36 and 48 per cent of beneficiaries reported the visit of technician in the previous month in Odisha, Madhya Pradesh and Chhattisgarh, respectively. 40, 41 and 26 per cent of beneficiaries reported the visit of technician 4 months ago in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Appendix Table 45). Only about 20 per cent reported the visiting by the technicians more than 4 months ago in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Fig. 8.17)

Fig. 8.17 Last Visit by the Technician before the Survey (% responses)

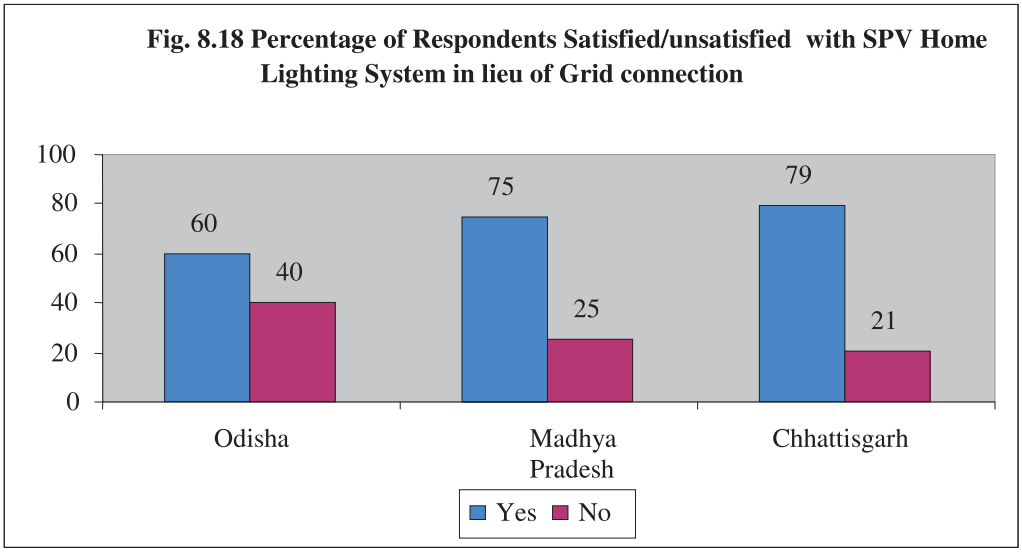


In Chhattisgarh, about 13 per cent of beneficiaries maintained a service card just to record their regular visit of the technician. In Odisha and Madhya Pradesh 99 per cent each reported of not having any maintained any service card (Appendix Table 46). Moreover, 79, 84 and 48 per cent of beneficiaries are not satisfied with the services of technician in Odisha, Madhya Pradesh and Chhattisgarh, respectively. 91 per cent of beneficiaries each in Odisha and Madhya Pradesh reported that the technician does not replace 'spare parts and Luminaires' as against 74 per cent in Chhattisgarh (Table 8.15).

Table 8.15 Level of Satisfaction with the Services of Technicians (%)

State	Is the service of Technician Satisfactory?		Does he replace spare/luminaires?	
	Yes	No	Yes	No
Odisha	20.7	79.3	9.1	90.9
Madhya Pradesh	15.6	84.4	9.1	90.9
Chhattisgarh	52.2	47.8	26.1	73.9

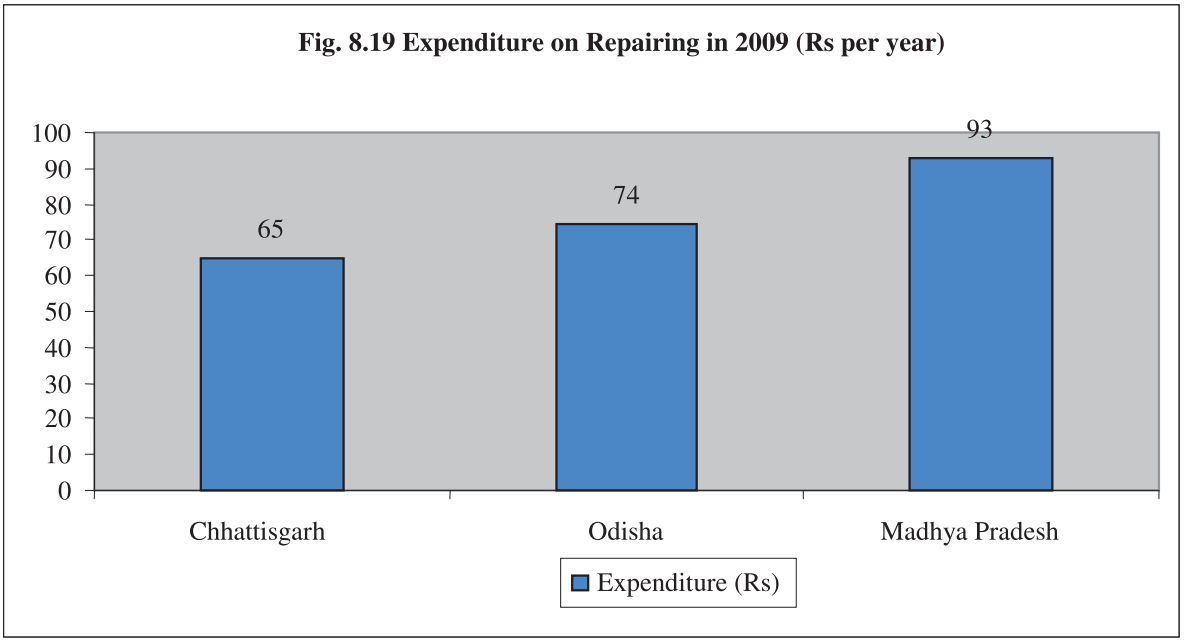
Even though the majority of the beneficiaries are not satisfied with the services of technician; still 60, 75 and 79 per cent of beneficiaries are satisfied with solar home-light system in lieu of grid extension in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Fig. 8.18). Only 21, 25 and 40 per cent are not happy with the SPV home-lighting system in lieu of grid extension in Chhattisgarh, Madhya Pradesh and Odisha (Appendix Table 47).



The various problems with the SPV system have been cited by the beneficiaries. These are spare parts not easily available, battery problem, lack of skilled persons for maintenance, weak agency services, charge controller not working, low voltage, etc. (Appendix Table 44).

8.7.2 Expenditure on repairing

Average expenditure incurred by the beneficiaries for repairs of the system during 2009 is presented in Fig. 8.19. The annual average expenditure for maintenance is Rs 65, Rs 74 and Rs 93 in Chhattisgarh, Odisha and Madhya Pradesh, respectively (Appendix Table 48).



8.8 Major Findings

8.8.1 Status of functionality

i. About 68, 78 and 86 per cent of beneficiaries reported that the system has been functional since it was given to them in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. However, when the investigators visited the households of beneficiaries and checked the system personally, it is estimated that about 84, 88 and 100 per cent of the systems were in working condition in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. In other words the actual working condition was better than the responses given by the households.

iv. The estimated number of days the system is 'not working' is 48, 46 and 14 days in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

8.8.2 Reasons for non-functional systems

Majority of them thought of 'Technical fault', 'Problems of charge controllers' and 'Luminaires do not work' as the reasons for non-functional system.

8.8.3 Contact person in case of problems

i. The beneficiaries call various persons for services when the system does not work. Generally approached personal are—local technician, member of VEC, gram panchayat officials, supplier's technicians and others.

ii. The 'others' consist of skilled relatives and family friends. In case of Odisha, 31, 54, 9 per cent reported that they call 'local mechanics, VEC, supplier's technician, respectively.

iii. They also call members of gram panchayat and others for help.

iv. In Madhya Pradesh, gram panchayats play significant role in the maintenance of the systems.

v. About 46 per cent of the beneficiaries inform gram panchayat when they face any problems. Only about 7 per cent call supplier's technicians.

vi. As VEC and local technicians are not active in Madhya Pradesh. Only 6 and 3 per cent call VEC and local technician for services.

vii. In case of Chhattisgarh, 88 per cent call local technician/plant operator when there is some problem.

viii. VEC and supplier's technician are also involved in the maintenance of the system in Chhattisgarh.

8.8.4 Level of satisfaction with the redressal system

i. Only about 67, 12 and 88 per cent have reported that somebody came to their house for services in Odisha, Madhya Pradesh and Chhattisgarh, respectively.
ii. In case of Madhya Pradesh 84 per cent said that 'nobody' came for services as against 7 per cent in Chhattisgarh.
iii. 81 percent of beneficiaries reported that they are not satisfied with the grievance redressal system in Madhya Pradesh.
iv. About 38 and 6 per cent of beneficiaries are also not satisfied with the grievance redressal system in Chhattisgarh and Odisha, respectively.

8.8.5 Reasons for dissatisfaction

i. 'No one is available to repair or check the system' was the major reason as cited by 66 and 44 per cent of beneficiaries in Madhya Pradesh and Odisha, respectively.
ii. 'Technician does not repair properly' is the second major reason reported by 30 and 16 percent of beneficiaries in Chhattisgarh and Odisha, respectively.
iii. 'VEC' not available is another reason mentioned by 4 to 9 per cent of the beneficiaries in all these three states.
iv. Lack of spare parts in the nearby market, or with the technicians, high cost of the repairs were the other reasons cited for dissatisfaction with the system

8.8.6 Performance of the system by seasons

i. On an average, luminaires work for 2.8 to 3.4 hours per day during rainy season.
ii. On an average, luminaires work for 3.7 to 4.4 hours per day during winter season.
iii. On an average, luminaires work for 4.6 to 4.8 hours per day during summer season.

8.8.7 Performance of the system during rainy season

i. Respondents in Madhya Pradesh reported the weakest performances of the systems in the rainy season.
ii. About 46, 50 and 73 per cent reported that light comes for less than 3 hours during rainy seasons in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

iii. 23 to 38 per cent reported that light comes for 3 to 4 hours in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

iv. Only about 1 per cent said luminaires work for 4–5 hours in Madhya Pradesh as against 32 per cent and 10 per cent in Chhattisgarh and Odisha, respectively.

v. The performance of the systems is better in Chhattisgarh as compared to Madhya Pradesh and Odisha.

8.8.8 Performance of the system during winter season

i. In Madhya Pradesh, about 13 per cent reported that they get light for less than 3 hours as against 5 per cent in Odisha; whereas no one is reporting that they get light for less than 3 hours in Chhattisgarh during winter season.

ii. About 39, 41 and 53 per cent of beneficiaries said that they get light for 3 to 4 hours in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

iii. About 61, 55 and 34 per cent reported that they get light for more than 4 hours in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

8.8.9 Performance of the system during summer season

i. Only about 2 per cent each in Odisha and Madhya Pradesh reported that they get light for less than 3 hours from the PV system during summer seasons.

ii. 37, 39 and 45 per cent have reported that they get light for 4–5 hours in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

iii. Similarly, 42 per cent each in Chhattisgarh and Madhya Pradesh reported that they get light for more than five hours.

iv. More than one-third of the beneficiaries reported that they get light for more than five hours in Odisha.

v. Thus, as expected the solar power is most available during the summer season as compared to winter and rainy seasons.

8.8.10 Performance of the system by year of installation

i. In Odisha, those who received the systems in 2007, about 70 per cent reported that they get light for less than 3 hours a day as against 58 per cent of beneficiaries who got the system in 2009 during rainy season.

ii. About 22 per cent reported getting light for 3-4 hours of those who received the system in 2007 as compared to 37.4 per cent reported that they got the system in 2009.

iii. The pattern of performance is similar in the winter and summer seasons in Odisha.

iv. In Madhya Pradesh, it is observed that the performance of the systems during different seasons does not vary much by year of installation of the system.

v. During summer season, 87 and 88 per cent of them (those who got the system in 2007 and 2009, respectively) reported that they get light for about 4 and 5 hours in a day from their PV system.

vi. During rainy seasons, about 72 to 75 per cent reported that they get less than 3 hours of light. Performance of the system has been reported to be poor for the most recent systems in the rainy season in Madhya Pradesh.

vii. The duration of the light is fixed in Chhattisgarh, 4 hours in the evening and 2 hours in the morning. CREDA has appointed one operator to look after the plant in each village. He has been maintaining and operating the plant.

viii. However, the performance of the system does not differ much in different seasons as compared to Madhya Pradesh and Odisha.

8.8.11 Problems faced by the beneficiaries

i. 'Light goes after 2 hours' is one of the problems, cited by 7, 2 and 9 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. The system 'does not work in rainy season' is cited by 34, 69 and 80 per cent, in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. A sizable per cent of beneficiaries also faced problem due to "Poor Battery, and 'loose wiring' in Odisha and Madhya Pradesh. Only about 15, 13 and 6 per cent of beneficiaries said that they cannot use TV and other audio entertainment appliances with the system.

iv. The functionality problem mostly occurs during rainy season. About 75 to 97 per cent of beneficiaries reported that problems are more frequent in 'Rainy seasons'

8.8.12 Non-availability of VEC

i. The availability of Village Energy Committee (VEC) has been recorded from two sources: (a) reported by the Village Pradhan in the village questionnaire and (b) reported by the beneficiaries in the household's questionnaire.

ii. In Madhya Pradesh, only about 15 per cent of beneficiaries reported of existence of Village Energy Committee in the village, whereas 26 per cent 'do not know' about its existence.

iii. The rest about 59 per cent said 'No' VEC in their village in Madhya Pradesh. About 94 and 85 percent of beneficiaries reported of presence of VEC in Odisha and Chhattisgarh, respectively.

iv. According to the village questionnaire, in Madhya Pradesh, 43 per cent villages have a VEC and 57 per cent said 'no' VEC in the village.

v. About 26 per cent who reported 'do not know 'about existences of VEC may be due to non-functional VEC even though it was formed in Madhya Pradesh.

vi. 99 and 98 per cent of villages has a VEC in Odisha and Chhattisgarh, respectively.

8.8.13 Organisation of awareness campaigns

i. 99 per cent of beneficiaries reported that 'no awareness' campaign was organised by the suppliers in Madhya Pradesh.

ii. About 63 and 73 per cent of beneficiaries reported organising such campaigns in Odisha and Chhattisgarh.

iii. A smaller but significant 37 and 27 per cent of beneficiaries reported not having such campaign in Odisha and Chhattisgarh, respectively.

iv. About 84, 15 and 24 per cent of beneficiaries reported that 'suppliers' had organised awareness campaign in their village.

v. Only 8, 40 and 3 per cent of beneficiaries reported that 'VEC' had organised the training in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

vi. About 74 per cent of beneficiaries said that 'others' (consisting of operators and technicians) organised awareness campaign in Chhattisgarh).

vii. About 76 to 95 per cent of beneficiaries also reported attending the awareness campaign organised by various parties in these states.

8.8.14 Organisation of training programmes

i. About one-third of the beneficiaries have received some training for self maintenance of the system in Odisha.

ii. Whereas, 99 and 94 per cent of the beneficiaries did not receive any such training in Madhya Pradesh and Chhattisgarh, respectively.

iii. About 66, 65 and 39 per cent of beneficiaries have reported that they need training for maintenance of the system.

iv. About 52, 9 and 95 per cent of beneficiaries said there are trained persons in their villages in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

8.8.15 Maintenance of the system and level of satisfaction

i. More than half of beneficiaries face problems in Madhya Pradesh and Chhattisgarh.

ii. About 56 per cent of beneficiaries said they do not have any problem with maintenance in Odisha.

iii. About 52 per cent of beneficiaries reported that suppliers have appointed local technicians in Odisha.

iv. However, about 8 per cent of beneficiaries do not know about it whereas 39 reported that 'no' local technician has been appointed by the suppliers in Odisha.

v. About 72 per cent of beneficiaries reported that 'No' local technician has been appointed and '27' per cent 'do not know' about it in Madhya Pradesh.

8.8.16 Activities of the local technician

i. About 84, 15 and 99 per cent reported that the local technician comes for maintenance/services when they need his help in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. In case of Madhya Pradesh, 81 per cent reported that 'Others' meaning the involvement of 'gram panchayat' in the maintenance of the system.

iii. The maintenance system is rare in Madhya Pradesh as there is no 'VEC' and 'No' local technician appointed by the suppliers. However, the beneficiaries were asked to inform the gram panchayat when the systems stop working in Madhya Pradesh.

iv. In Chhattisgarh, the local technicians, appointed by the supplier as a 'Power Plant Operator' look after the power plant.

v. The technician has been authorised to collect the monthly contribution from the beneficiaries. Therefore, he has to visit monthly for collection as well as for services when the beneficiaries call him.

vi. Even though the majority of the beneficiaries are not satisfied with the services of technician; still 60, 75 and 79 per cent of beneficiaries are satisfied with solar home-lighting system in lieu of grid extension.

vii. Only 21, 25 and 40 per cent are not happy with the SPV home-lighting system in lieu of grid extension.

8.8.17 Expenditure on repairing

The annual average expenditure for maintenance is Rs 65, Rs 74 and Rs 93 in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

Chapter 9

Impact of RVEP on Kerosene Consumption and Other Benefits

9.1 Introduction

Kerosene is a basic household item without which there will be little or no activity that can take place after it gets dark in such areas, where there is no electricity. Almost all rural households use kerosene, especially for lighting. Kerosene is a fuel that is highly subsidised by the government and government distributes it through the Public Distribution System (PDS). About 97 per cent of kerosene using households purchases kerosene from fair price shops (FPS).3 The entitlement of kerosene through PDS is determined by the size of the households. The purchase of kerosene by the household is determined by two factors: (i) availability of kerosene; and (ii) the utility or requirement of kerosene. Moreover, quality of the available kerosene is the same for all households. A higher income household will not necessarily purchase better quality kerosene. However, as these villages are not electrified at all, the consumption of kerosene may be relatively more than in the other villages. Festivals, marriages, and other social or religious activities require lighting and kerosene is the main fuel for lighting during such activities.

9.2 Extent of Kerosene Consumption

The requirement of kerosene was greater before the installation of SPV home-lighting system in all the three states. The average monthly per household consumption of kerosene was 3.2, 4.9 and 4.7 litre for Odisha, Madhya Pradesh and Chhattisgarh, respectively before installation of SPV home-lighting system. On an average, the entitlement of kerosene from PDS is 3.0, 4.5 and 4.0 litre in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Table 9.1). The requirement of kerosene in Chhattisgarh is almost twice the entitlement of kerosene from PDS. However, the extent of requirement of kerosene has declined by 41, 30 and 51 per cent in Odisha, Madhya Pradesh and Chhattisgarh, respectively after installation of the SPV home-lighting system.

Table 9.1 Average Consumption of Kerosene per Month (in litres)

State	Consumption of Kerosene per month (litres)		Entitlement of kerosene from PDS per month (litres)	Decline in consumption of kerosene after SPV(%)
	Before SPV	After SPV		
Odisha	3.2	1.9	3.0	41
Madhya Pradesh	4.9	3.4	4.5	30
Chhattisgarh	4.7	2.3	4.0	51

9.3 Type of Fuel Used for Cooking and Lighting Before and After RVEP

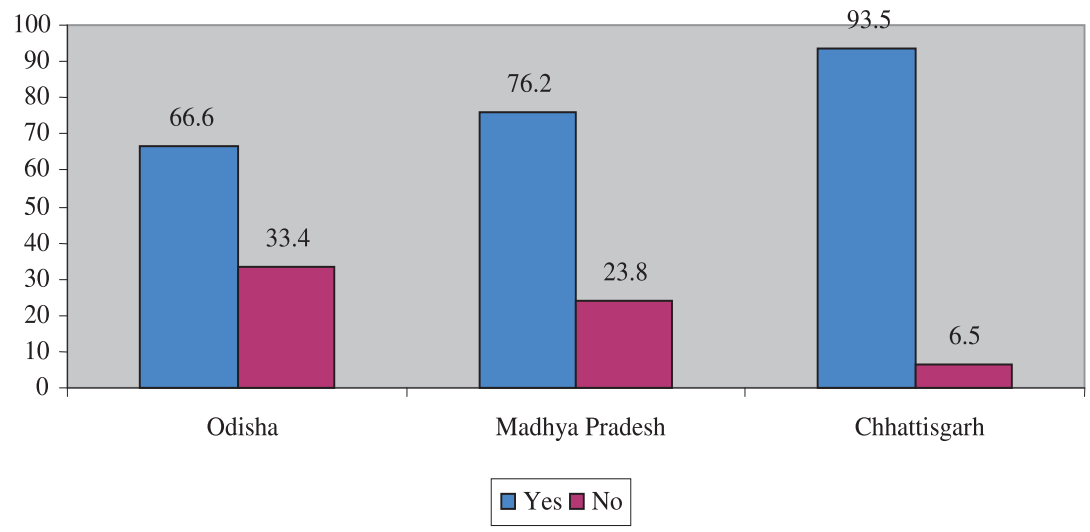
9.3.1 Use of electricity for cooking and lighting

As we have observed our sample households mostly belong to ST and are living in hilly forest areas. 'Firewood' is the major fuel for cooking for them. About 100 per cent of beneficiaries reported 'not using electricity for cooking and lighting before installation of SPV home-lighting system in Odisha, Madhya Pradesh and Chhattisgarh. After installation of SPV home-lighting system about 95 to 98 per cent of beneficiaries started using electricity for lighting in Odisha and each in Madhya Pradesh and Chhattisgarh (Appendix Tables 50 to 52).

Kerosene was the only source for lighting reported by 99 per cent of beneficiaries in all the three states before installation of the system. Kerosene was also used for cooking before installation of SPV system in Odisha. About 37 per cent of beneficiaries reported the use of kerosene for cooking in Odisha before SPV system was installed as against 4 per cent in Chhattisgarh. Almost all remote village households purchase kerosene from the PDS only. No household uses LPG and edible oil for cooking and lighting in the sample households. The price of kerosene per litre does not vary much in sample states. The price of PDS kerosene is Rs 10 to Rs 12 per litre and it has remained the same before and after installation of the system (Appendix Table 54).

About 67 to 94 per cent of beneficiaries said that they get kerosene as per their entitlement (Fig. 9.1). About one-third of beneficiaries in Odisha and Madhya Pradesh reported of not getting kerosene as per entitlement. It may be possible either that the beneficiaries are unable to buy from PDS in time or the distributors have reduced their quota after installation of the SPV system.

Fig. 9.1 Do you get PDS kerosene as per entitlement (% responses)



9.3.2 Major uses of kerosene purchased from PDS

It is a well known fact that kerosene is required mostly for lighting everyday in remote villages where electricity is not available. However, when they organise get-togethers, marriages and other social festivals they need additional kerosene for lighting. Normally, households buy PDS kerosene once a month. Some of the households store it for future use in such activities. About 10 per cent of households reported that they store it for future use in Odisha as against 3 per cent in Chhattisgarh.

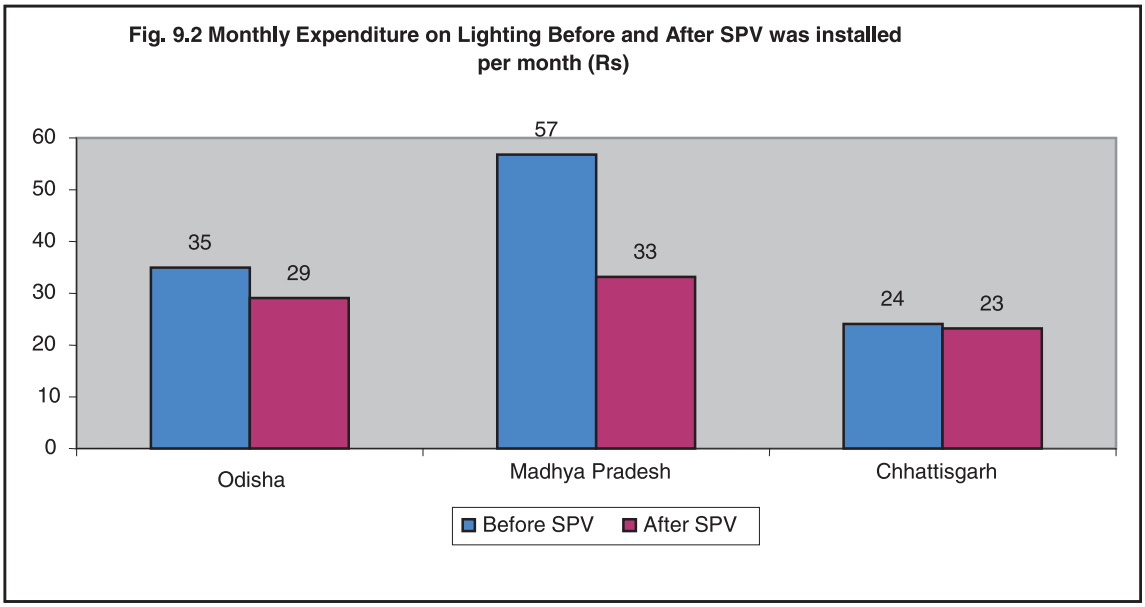
About 83, 95 and 92 per cent reported that the PDS kerosene is used only for lighting in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Appendix Table 57).

9.4 Indirect Advantage of SPV Home Lighting System in Kerosene

It is observed that about 8 and 10 per cent of beneficiaries reported that they 'do not buy kerosene at all now' in Madhya Pradesh and Odisha, respectively. It is estimated that about 1 per cent each in Odisha and Chhattisgarh sell excess PDS kerosene in the open market as well as to neighbours. Similarly, in Madhya Pradesh about 13.8 per cent sell excess kerosene (Appendix Tables 57-59). The open market price of kerosene varies across markets. However, it has remained between Rs 25 to Rs 35 per litre, whereas the PDS price of kerosene per litre is Rs 12 in Odisha and Chhattisgarh. But it is Rs 11 in Madhya Pradesh.

9.5 Expenditure on Lighting Before and After SPV

Expenditure on lighting has been declining in all the sample places. However, the rate of decline is not very significant. The average per month expenditure on lighting was Rs 35, Rs 57 and Rs 24 in Odisha, Madhya Pradesh and Chhattisgarh, respectively before installation of SPV home-lighting system (Fig. 9.2). The expenditure on lighting has declined by 17, 42 and 4 per cent in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Appendix Table 76).



9.6 Uses of other Electrical Appliances

The beneficiaries are deriving other benefits from the SPV home-lighting system. These are electric fan, radio, tape recorder, television and mobile charging. About 4 per cent of beneficiaries reported the using of electric fan in Chhattisgarh. About 6 to 15 per cent of sample households use radio, one to 2 per cent use tape recorder, one to 6 per cent use television and 9 to 29 per cent use SPV home-lighting system for mobile charging (Table 9.2) (Appendix Tables 74 and 75).

Table 9.2 Per cent of Households using SPV Home Lighting System

State	Mobile Charging		Radio		Tape Recorder		Television	
	Yes	No	Yes	No	Yes	No	Yes	No
Odisha	9.7	99.8	15.1	84.9	1.2	98.8	2.0	98.0
Madhya Pradesh	28.6	99.6	6.5	93.5	2.4	97.6	1.0	99.0
Chhattisgarh	9.3	95.7	6.0	94.0	0.5	99.5	5.5	94.5

9.7 Income Generation Activities

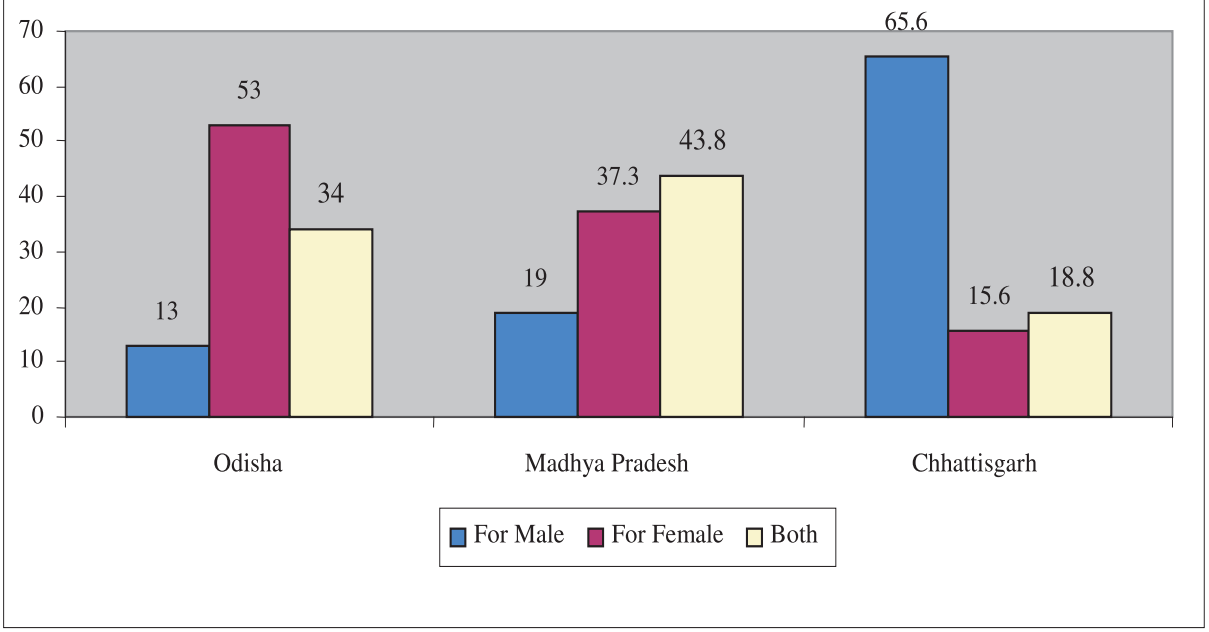
Solar home-lighting system has been considered as a merit good as it carries many external benefits. It can help in creating new source of income in the households. The survey finds that about 22, 10.2 and 2 per cent among the beneficiaries reported that new sources of income generation activities have opened up after getting Solar home-lighting system (Table 9.3).

Table 9.3 Opening up of New Sources of income after Solar home lighting system (% of responses)

State	Yes	No	Total
Odisha	22.4	77.6	100
Madhya Pradesh	10.2	89.9	100
Chhattisgarh	2.1	97.9	100

The new sources of income earning activities are opening mostly for women in the households in Odisha (Fig. 9.3). In Madhya Pradesh about 43 per cent reported that the new sources of income earning activities are opening for both males and females; whereas in Chhattisgarh about 66 per cent have reported that the new sources of income earning activities are opening for only male members of households (Appendix Table 60) (Details are in Appendix Tables 77 to 79).

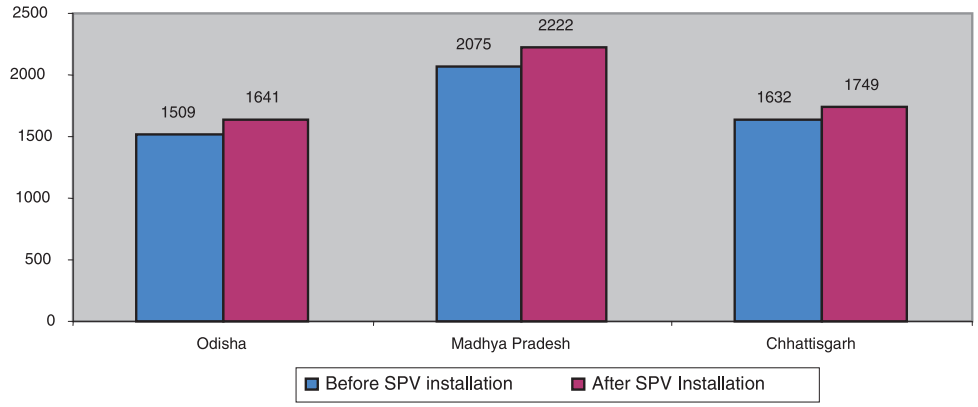
Fig. 9.3 New Sources of Income Generation Activities after installation of SPV (%)



9.8 Impact on Household's Income

There is a potential for multiple income generation activities in the beneficiary households because of electricity. As a consequence, household's income has been increasing although at a slow pace in all the three states. The growth of monthly income has been estimated as 8.75, 7.0 and 7.2 per cent for Odisha, Madhya Pradesh and Chhattisgarh, respectively since the installation of the SPV systems (Appendix Table 61), (Fig. 9.4). Practically, there are hardly any new sources of income generating activities taking place; but the beneficiaries are spending additional time in their daily activities in the evening because of solar light. These activities are making of plates with leaves, weaving/stitching and embroidery and rope making, etc. which they were engaged in earlier also.

Fig. 9.4 Monthly Household Income Before and After SPV installation (Rs per month)



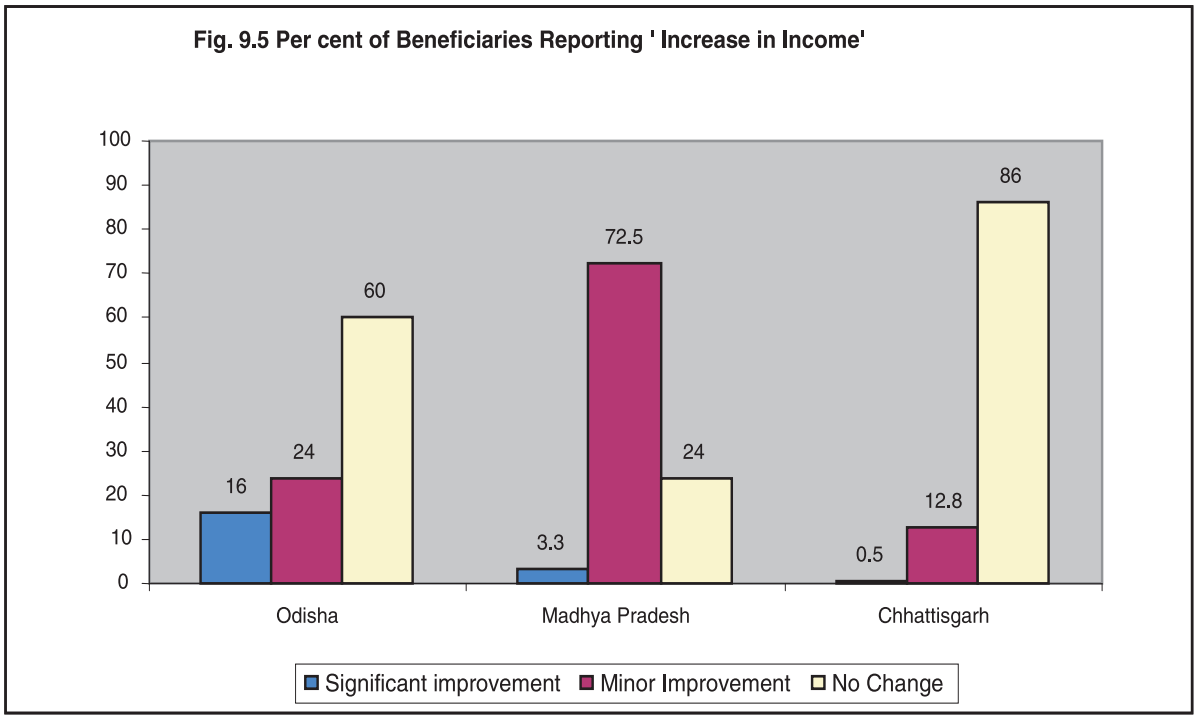
9.9 Level of Satisfaction with Other Benefits

'Satisfaction' is a qualitative concept and a state of mind from certain activities/changes. We have made an attempt to provide an assessment of satisfaction of the households with respect to benefits of SPV systems through few statements in the beneficiaries' questionnaire, (a) increase in income, (b) improved standard of living, (c) better education to the children (d) convenience in household work (e) whether incidence of malaria has reduced.

9.9.1 Increase in income

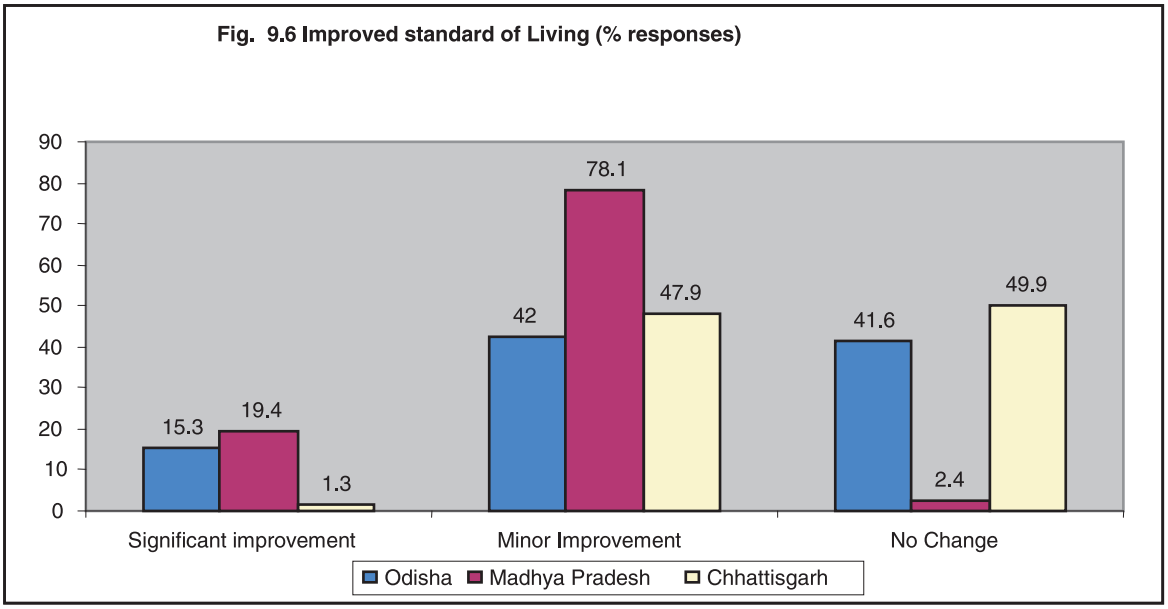
About 16, 24 and 60 per cent have reported of 'Significant improvement' 'Minor improvement' and 'No change', respectively in increase in income due to solar home-lighting system in Odisha (Fig. 9.5). There is 'minor improvement' in income, expressed by 73 and 13 per cent in Madhya Pradesh and Chhattisgarh, respectively. Whereas, 86 per cent

reported ‘no change’ in Chhattisgarh as against 24 per cent in Madhya Pradesh (Appendix Tables 62 to 64).



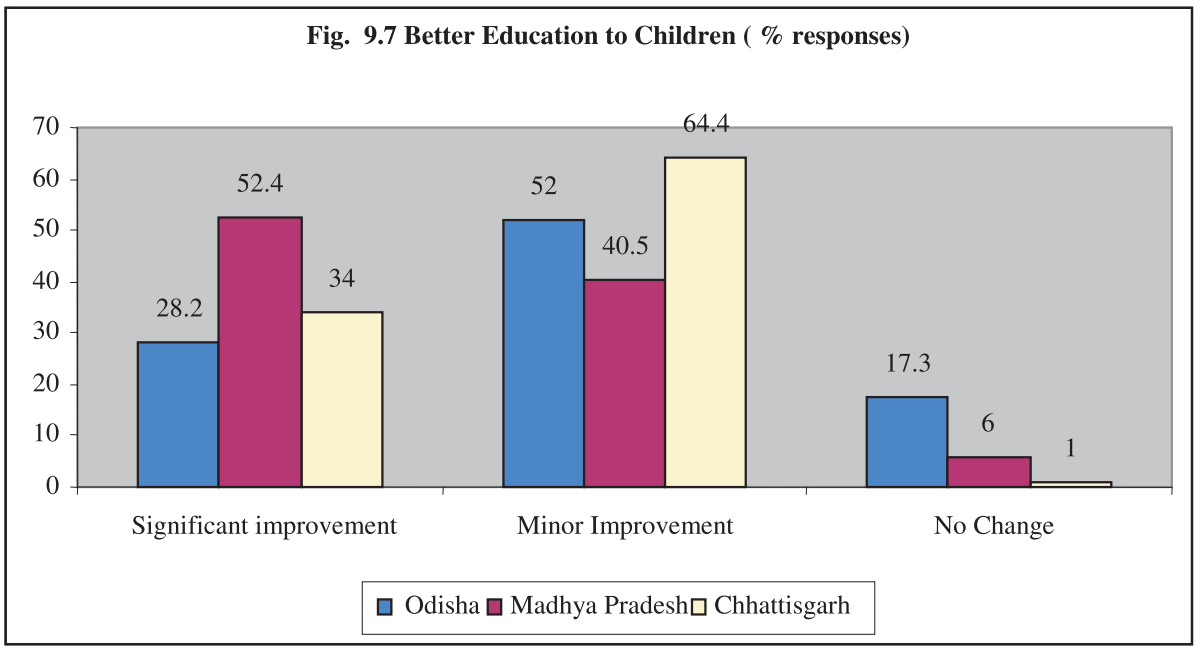
9.9.2 Improved standard of living

Only about 1 per cent of beneficiaries reported “improved standard of living” ‘significantly’ in Chhattisgarh as against 19 and 15 per cent in Madhya Pradesh and Odisha, respectively. ‘Minor improvement’ has been reported by 42, 78 and 48 per cent in Odisha, Madhya Pradesh and Chhattisgarh, respectively. 50, 42 and 2 per cent have reported ‘no changes’ in Chhattisgarh, Odisha and Madhya Pradesh, respectively (Fig. 9.6) (Appendix Tables 62 to 64).



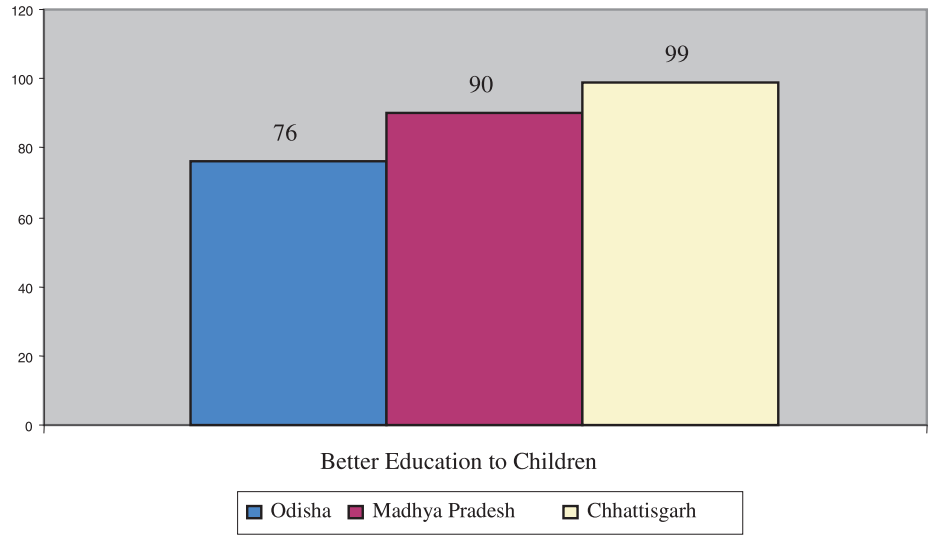
9.9.3 Better education to children

'Significant improvement' in case of education to children has been reported by 28, 52 and 34 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively. 'Minor improvement' has been cited by 52, 41 and 64 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Fig. 9.7). 'No changes' has been cited by 17, 6 and 1 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Appendix Tables 62 to 64).



The beneficiaries are extremely happy as their children are spending more time in studying in the evening after getting solar light. The RVEP is providing 'better education to children' as reported by 76, 90 and 99 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Fig. 9.8) (Appendix Table 72).

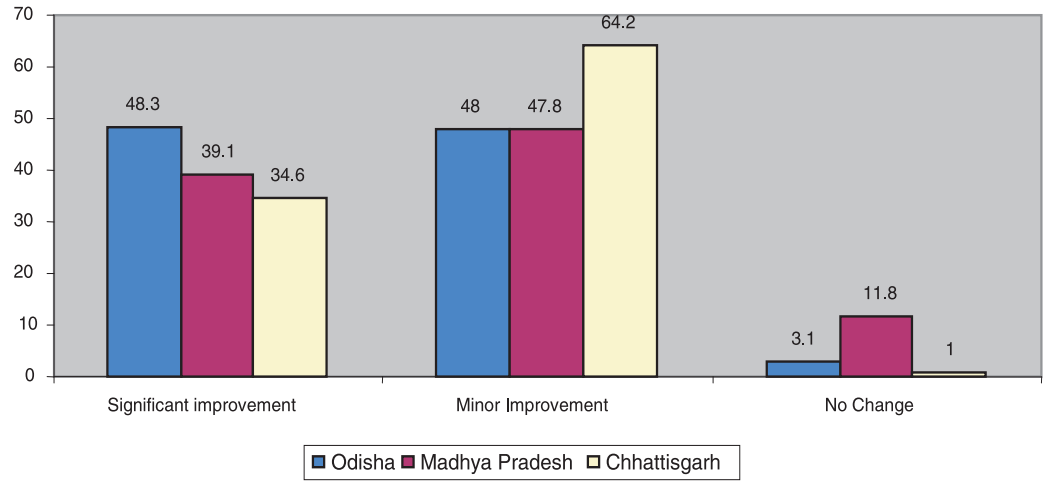
Fig. 9.8 Better Education to Their Children (% responses)



9.9.4 Convenience in household work

Convenience in household work due to application of electricity has been well recognised. However, only 48, 39 and 35 per cent have reported as 'significant' improvement in household work in Odisha, Madhya Pradesh and Chhattisgarh, respectively. Similarly, 'Minor improvement in household work' has been reported by 48 per cent each in Odisha and Madhya Pradesh; as against 64 per cent in Chhattisgarh. About 12 per cent have reported 'no changes' in Madhya Pradesh (Fig. 9.9) (Appendix Tables 62 to 64).

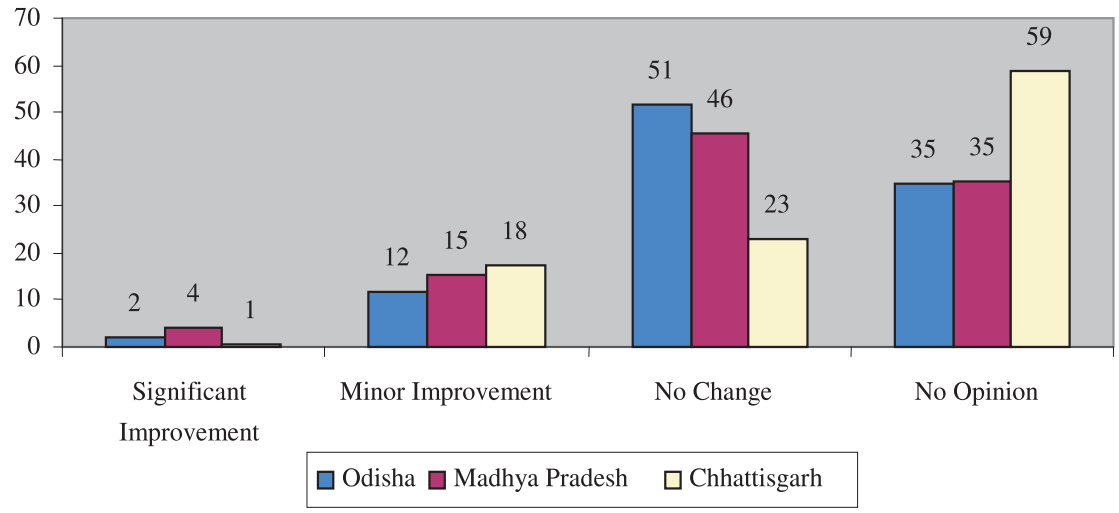
Fig. 9.9 Convenience in Household Work (% responses)



9.9.5 Malaria reduction after Solar PV systems were installed

In case of statement on 'Malaria Reduction', only 2, 4 and 1 per cent have expressed that incidence of malaria has reduced after solar light installation in Odisha, Madhya Pradesh and Chhattisgarh, respectively. Similarly, 12, 15 and 18 per cent have opted for 'minor improvement in malaria reduction' in Odisha, Madhya Pradesh and Chhattisgarh, respectively. About half of beneficiaries reported 'no change' in Odisha and Madhya Pradesh. More than one-third of beneficiaries do not give any opinion in Odisha and Madhya Pradesh. In case of Chhattisgarh, 23 and 59 per cent have said 'no change and 'no opinion, in case of malaria reduction after the coming of solar light (Fig. 9.10) (Appendix Tables 62 to 64).

Fig. 9.10 Malaria Reduced after Solar light (% responses)

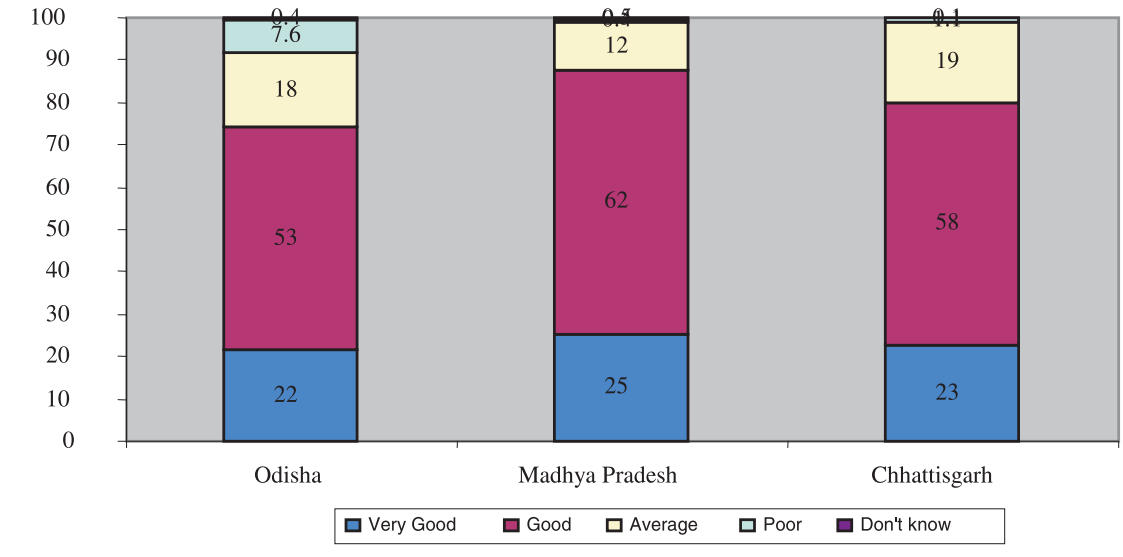


9.10 Level of Satisfaction from Other Aspects of Solar PV System

9.10.1 Availability/duration of light

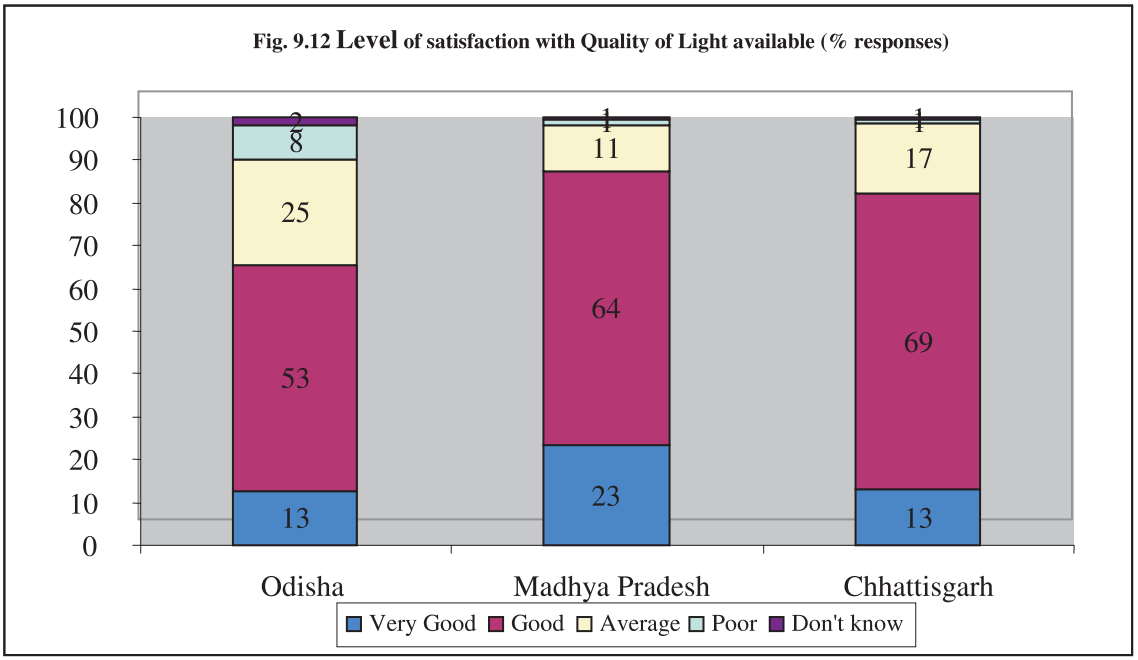
All the beneficiaries have expressed their satisfaction with availability/duration of light by citing as 'very good', 'good', 'average' and 'poor' in all the three states. About 21.5, 53, 17.6 and 8 per cent of the respondents have reported the availability of light to be very good, good, average and poor, respectively in Odisha. These percentages do not vary much in case of Madhya Pradesh and Chhattisgarh (Fig. 9.11) (Appendix Table 65).

Fig. 9.11 Level of satisfaction with Availability/Duration of light (%)



9.10.2 Quality of light

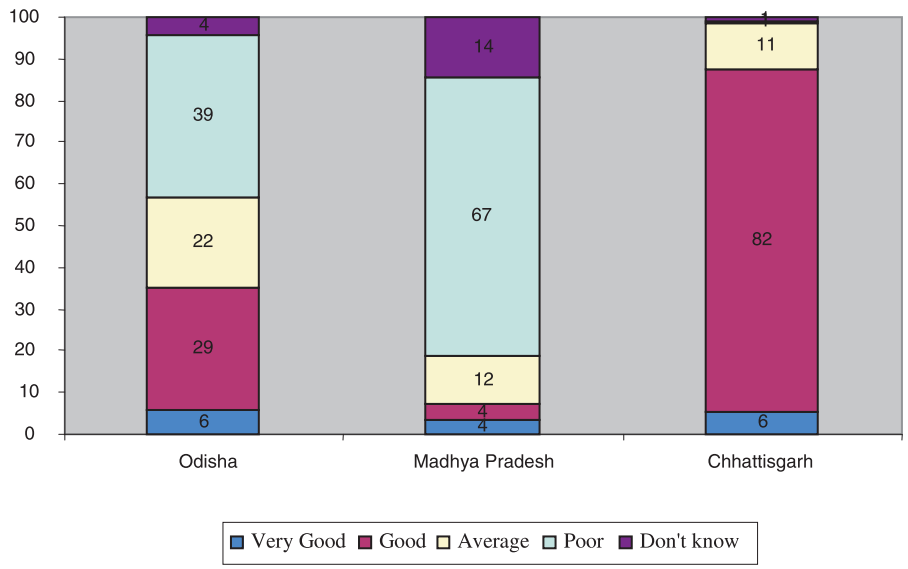
About 13 per cent each in Odisha and Chhattisgarh cited the quality of light to be 'very good' as against 23 in Madhya Pradesh. About 53, 64 and 69 per cent cited the quality of light to be 'good' in Odisha, Madhya Pradesh and Chhattisgarh, respectively. The quality of light is 'average' for 25, 11 and 17 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively. The quality of light is 'poor' for 8 per cent in Odisha as against 1 per cent each in Madhya Pradesh and Chhattisgarh (Fig. 9.12) (Appendix Table 66).



9.10.3 Services of technicians

The service of the technician in the case of SPV system is very important as the system demands continuous maintenance. Only about 6 per cent of beneficiaries expressed their level of satisfaction as 'very good' in Odisha and Chhattisgarh as against 4 per cent in Madhya Pradesh. The service of technician is 'good' for 82, 29 and 3 per cent in Chhattisgarh, Odisha and Madhya Pradesh, respectively. The service is 'average' for 22 per cent in Odisha and 12 and 11 per cent in Madhya Pradesh and Chhattisgarh, respectively. The service of technician is 'poor' for 67 per cent in Madhya Pradesh as against 39 per cent in Odisha. Not even one per cent reported the service as 'poor' in Chhattisgarh (Fig. 9.13) (Appendix Table 67).

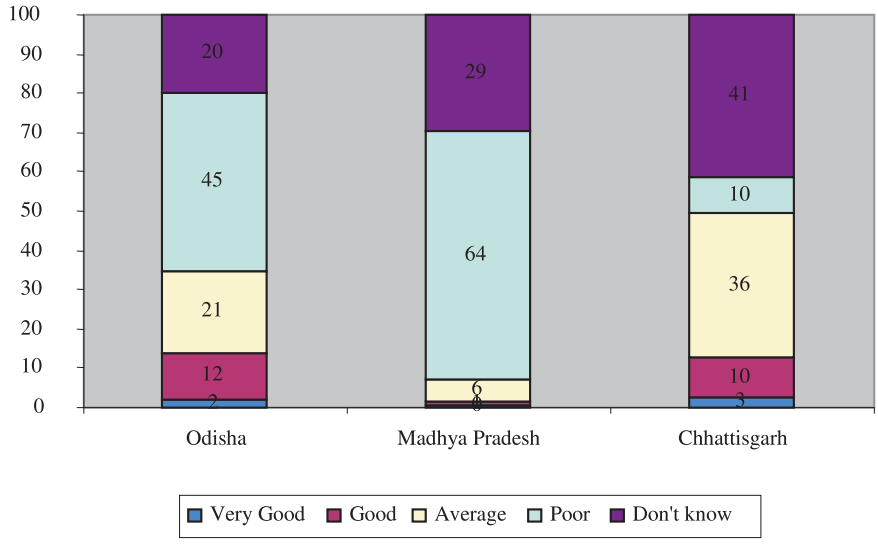
Fig. 9.13 Level of Satisfaction with Service of the Technician (% responses)



9.10.4 Availability of spare parts

Availability of spares reflects the arrangement of maintenance services of the system. Availability of spare parts is 'poor' for 45 and 64 per cent in Odisha and Madhya Pradesh, respectively. Only about 10 per cent quoted as 'poor' in Chhattisgarh. 21, 6 and 36 per cent cited as 'average' in Odisha, Madhya Pradesh and Chhattisgarh, respectively. About 11 per cent cited it as 'good' each in Odisha and Chhattisgarh as against one per cent in Madhya Pradesh (Fig. 9.14) (Appendix Table 68).

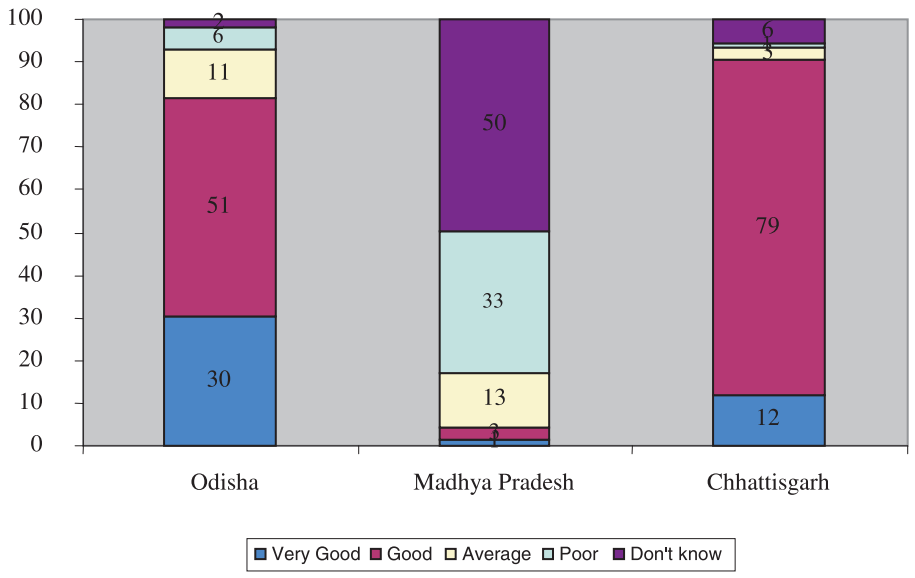
Fig. 9.14 Level of Satisfaction **with Availability of Spare parts (% of respondents)**



9.10.5 Support from VEC

It was expected that every selected village for RVEP should form an active village energy committee (VEC) to support maintenance of home lights and streetlights in the village. One member of the VEC is supposed to be a trained person to help beneficiaries in case of non-availability of technicians. About 30, 1, 12 per cent said that they received 'very good' support from VEC whereas 51, 3 and 79 per cent received 'good' support from VEC in Odisha, Madhya Pradesh and Chhattisgarh, respectively. In Madhya Pradesh, 33 and 50 per cent quoted the support from VEC as 'poor' and 'don't know' about the services of VEC as there is only 15 per cent of respondents who are aware of availability of VEC in Madhya Pradesh (Fig. 9.15) (Appendix Table 69).

Fig. 9.15 Level of satisfaction with support from VEC (%)



9.11 Empowerment of the Female Members of the Households due to RVEP

9.11.1 Employment and new sources of income

Are there new employment opportunities or new source of income which have opened up after installation of SPV in the village? Activities such as a new shop or STD booth, bamboo craft, weaving and stitching/embroidery, making 'Patella' and 'Dona', rope making, etc. may be more feasible after the installation of SPV system in the village. After installation of solar home-lighting system, women feel comfortable to work on such activities for a few hours in the evening to generate additional income. Employment/engagement in such activities among

women beneficiaries is reported to be 8, 5 and 2 per cent in Odisha, Madhya Pradesh and Chhattisgarh, respectively. Similarly, 21,10 and 2 per cent among women feel new source of income opened up after RVEP in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Table 9.4).

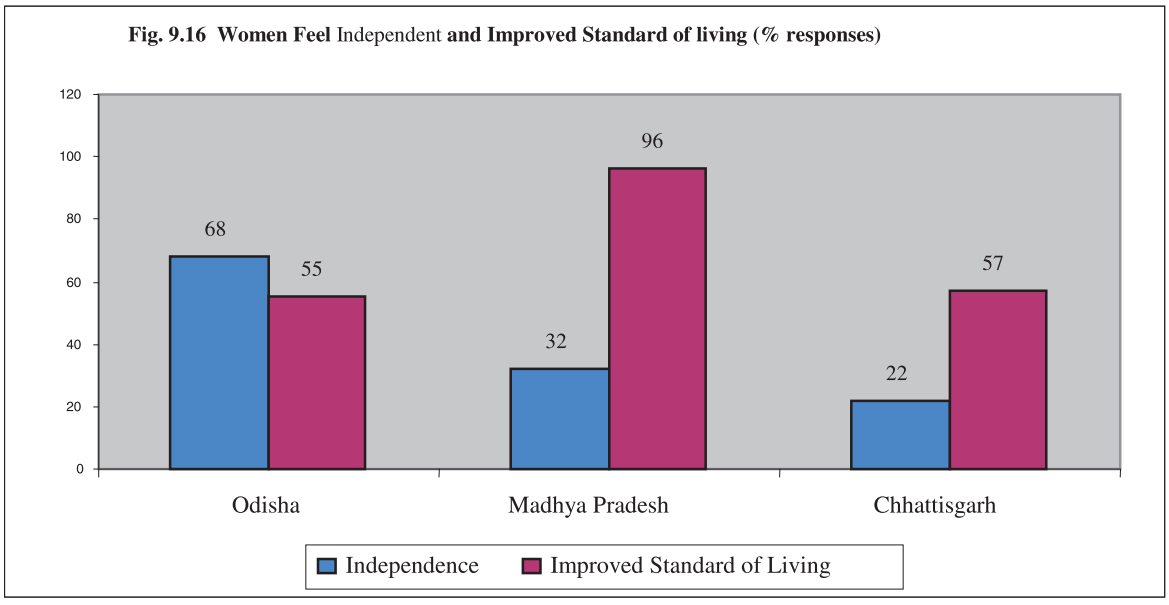
Table 9.4 Status of Employment and New Source of Income among Women (%)

State	New Employment opportunity		New Source of Income	
	Yes	No	Yes	No
Odisha	7.5	92.6	21.0	79.1
Madhya Pradesh	5.3	94.7	9.8	90.3
Chhattisgarh	1.5	98.5	1.9	98.1

9.11.2 Women feel independent and report improved standard of living

After installation of solar home-lighting system women feel more comfortable in household activities as well as feel independent. About 68, 32 and 22 per cent of beneficiaries reported that women are independent now in Odisha, Madhya Pradesh and Chhattisgarh, respectively (Fig. 9.16) (Appendix Tables 70 and 71).

Similarly, 55, 96 and 57 per cent of beneficiaries reported "improved standard of living" after the RVEP in Odisha, Madhya Pradesh and Chhattisgarh respectively (Fig. 9.15).



9.11.3 Availability of streetlight in front of beneficiary's house

Beneficiaries may be happier if the streetlight is installed in front of their house. They can also derive other benefits from the streetlight. About, 21, 22 and 42 per cent of beneficiaries have a streetlight in front of their house (Table 9.5).

Table 9.5 Streetlights in front of Beneficiary's House(%)

State	Yes	No
Odisha	21.4	78.6
Madhya Pradesh	21.6	78.4
Chhattisgarh	41.9	58.1

9.12 Suggestions given by the Beneficiaries for Better Functioning of RVEP

At the end of the household questionnaire, we requested the beneficiaries to provide suggestions for improvement of programme. A number of suggestions were given by the beneficiaries for better performance of the programme. These are the following.

(a) Need of more streetlights.
(b) The capacity of the battery should be increased.
(c) Permanent technician should be appointed.
(d) Power of luminaires should be increased.
(e) More awareness programmes should be organised.
(f) 2 to 3 service centres should be set up in the village.
(g) Those who got one lamp are requesting to give two luminaires (Appendix Table 73).

9.13 Major Findings

9.13.1 Extent of kerosene consumption

i. The average monthly consumption of kerosene per household is 3.2, 4.9 and 4.7 litres for Odisha, Madhya Pradesh and Chhattisgarh, respectively before SPV
   a. home-lighting system.
ii. On an average, the entitlement of kerosene from PDS is 3.0, 4.5 and 4.0 litres in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. However, the extent of requirement of kerosene has declined by 41, 30 and 51 per cent in Odisha, Madhya Pradesh and Chhattisgarh, respectively after installation of the SPV home-lighting system.

9.13.2 Type of fuel used for cooking and lighting before and after RVEP

i. About 100 per cent of beneficiaries reported 'not using electricity for cooking and lighting before installation of SPV home-lighting system in Odisha, Madhya Pradesh and Chhattisgarh.

ii. After installation of SPV home-lighting system about 95 to 98 per cent of beneficiaries use electricity for lighting in Odisha, Madhya Pradesh and Chhattisgarh.

iii. Kerosene was the only source for lighting reported by 99 per cent of beneficiaries in all the three states before installation of the system.

iv. About 37 per cent of beneficiaries reported use of kerosene for cooking in Odisha before SPV system was installed as against 4 per cent in Chhattisgarh. Almost all remote village households buy kerosene from the PDS only.

v. No household uses LPG and edible oil for cooking and lighting in the sample households.

vi. The price of PDS kerosene is Rs 10 to Rs 12 and it has remained the same before and after installation of the system.

vii. About 67 to 94 per cent of beneficiaries said that they get kerosene as per their entitlement.

viii. About one-third of beneficiaries in Odisha and Madhya Pradesh reported of not getting kerosene as per entitlement.

ix. About 10 per cent of households reported that they store it for future use in Odisha as against 3 per cent in Chhattisgarh.

x. About 83, 95 and 92 per cent reported that the PDS kerosene is used only for lighting in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

9.13.3 Indirect advantage of SPV home-lighting system in kerosene

i. About 8 and 10 per cent of beneficiaries reported that they 'do not buy kerosene at all now' in Madhya Pradesh and Odisha, respectively.

ii. It is estimated that about 1 per cent each in Odisha and Chhattisgarh sell excess PDS kerosene in the open market as well as to neighbours.

iii. Similarly, in Madhya Pradesh about 13.8 per cent sell excess kerosene.

9.13.4 Expenditure on lighting before and after SPV

i. The average per month expenditure on lighting was Rs 35, Rs 57 and Rs 24 in Odisha, Madhya Pradesh and Chhattisgarh, respectively before installation of SPV home-lighting system.

ii. The expenditure on lighting has declined by 17, 42 and 4 per cent in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

9.13.5 Uses of other electrical appliances

i. About 4 per cent of beneficiaries reported using electric fan in Chhattisgarh.

ii. About 6 to 15 per cent of sample households use radio, one to 2 per cent use tape recorder, one to 6 per cent use television and 9 to 29 per cent use SPV home-lighting system for mobile charging.

9.13.6 Income generation activities

i. The survey finds that about 22, 10.2 and 2 per cent among the beneficiaries reported that new sources of income generation activities have opened up after getting Solar Lighting System in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. The new sources of income earning activities are opening mostly for women in the households in Odisha.

iii. In Madhya Pradesh about 43 per cent reported that the new sources of income earning activities are opening for both males and females; whereas about 66 per cent have reported that the new sources of income earning activities are opening for only male members of households.

9.13.7 Impact on household's income

i. There is a potential for multiple income generation activities in the beneficiary households because of electricity.

ii. As a consequence, household's income has been increasing although at a slow pace in all the three states.

iii. The growth of monthly income has been estimated as 8.75, 7.0 and 7.2 per cent for Odisha, Madhya Pradesh and Chhattisgarh, respectively since the installation of the SPV systems.

9.13.8 Level of satisfaction with other benefits

i. About 16, 24 and 60 per cent have reported of 'Significant improvement' 'Minor improvement' and 'No change', respectively in increase in income due to solar home lighting system in Odisha.

ii. There is 'minor improvement' in income, expressed by 73 and 13 per cent in Madhya Pradesh and Chhattisgarh, respectively.

iii. Whereas, 86 per cent reported 'no changes' in Chhattisgarh as against 24 per cent in Madhya Pradesh.

9.13.9 Improved standard of living

i. Only about 1 per cent of beneficiaries reported "improved standard of living" 'significantly' in Chhattisgarh as against 19 and 15 per cent in Madhya Pradesh and Odisha, respectively.

ii. 'Minor improvement' has been reported by 42, 78 and 48 per cent in Odisha, Madhya Pradesh and Chhattisgarh, respectively. 50, 42 and 2 per cent have reported 'no changes' in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

9.13.10 Better education to children

i. 'Significant improvement' in case of children education has been reported by 28, 52 and 34 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. 'Minor improvement' has cited by 52, 41 and 64 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. 'No changes' has been cited by 17, 6 and 1 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iv. The beneficiaries are extremely happy as their children are spending more time in studying in the evening after getting solar light.

v. The RVEP is providing 'better education to children' as reported by 76, 90 and 99 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

9.13.11 Convenience in household work

i. Only 48, 39 and 35 per cent have reported as 'significant' improvement in household work in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. Similarly, 'Minor improvement in household work' has been reported by 48 per cent each in Odisha and Madhya Pradesh; as against 64 per cent in Chhattisgarh.

iii. About 13 per cent have reported 'no changes' in Madhya Pradesh.

9.13.12 Malaria reduction after solar PV systems were installed

i. Only 2, 4 and 1 per cent have expressed that incidence of malaria has reduced after solar light installation in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. Similarly, 12, 15 and 18 per cent have said on 'minor improvement in malaria reduction' in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. About half of the beneficiaries reported 'no change' in Odisha and Madhya Pradesh. More than one-third of beneficiaries do not give any opinion in Odisha and Madhya Pradesh.

iv. In case of Chhattisgarh, 23 and 59 per cent have said 'no change and 'no opinion, in case of malaria reduction after the coming of solar light.

9.13.13 Level of satisfaction from other aspects of solar PV system

Availability/duration of light

i. About 21.5, 53, 17.6 and 8 per cent of the respondents have reported the availability of light to be very good, good, average and poor in Odisha.

ii. These percentages do not vary much in case of Madhya Pradesh and Chhattisgarh.

Quality of light

i. About 13 per cent each in Odisha and Chhattisgarh cited the quality of light to be 'very good' as against 23 in Madhya Pradesh.

ii. About 53, 64 and 69 per cent cited the quality of light is 'good' in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. The quality of light is 'average' for 25, 11 and 17 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iv. The quality of light is 'poor' for 8 per cent in Odisha as against 1 per cent each in Madhya Pradesh and Chhattisgarh.

9.13.14 Services of technicians

i. Only about 6 per cent of beneficiaries expressed their level of satisfaction as 'very good' in Odisha and Chhattisgarh as against 4 per cent in Madhya Pradesh.

ii. The services of technician are 'good' for 82, 29 and 3 per cent in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

iii. The service is 'average' for 22 per cent in Odisha and 11 per cent each in Madhya Pradesh and Chhattisgarh.

iv. The service of technician is 'poor' for 67 per cent in Madhya Pradesh as against 39 per cent in Odisha. Not even one per cent reported the service as 'poor' in Chhattisgarh.

9.13.15 Availability of spare parts

i. Availability of spare parts is 'poor' for 45 and 64 per cent in Odisha and Madhya Pradesh, respectively.

ii. Only about 10 per cent quoted it as 'poor' in Chhattisgarh. 21, 6 and 36 per cent cited as 'average' in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. About 11 per cent cited it as 'good' each in Odisha and Chhattisgarh as against one per cent in Madhya Pradesh.

9.13.16 Support from VEC

i. About 30, 1, 12 per cent said that they received 'very good' support from VEC whereas 51, 3 and 79 per cent received 'good' support from VEC in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. In Madhya Pradesh, 33 and 50 per cent quoted the support from VEC as 'poor' and 'don't know' about the services of VEC as there is only 15 per cent of respondents who are aware of the availability of VEC in Madhya Pradesh.

9.13.17 Empowerment of Female Members of the Households due to RVEP

Employment and new sources of income

i. Activities such as a new shop or STD booth, bamboo craft, weaving and stitching/embroidery, making 'Patella' and 'Dona', rope making, etc. may be more feasible after the installation of SPV system in the village.

ii. After installation of solar home-lighting system, women feel comfortable to work on such activities for a few hours in the evening to generate additional income.

Employment/engagement in such activities among women beneficiaries is reported to be 8, 5 and 2 per cent in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. Similarly, 21,10 and 2 per cent among women feel new source of income opened up after RVEP in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

Women feel independent and report improved standard of living

i. About 68, 32 and 22 per cent of beneficiaries reported that women are independent now in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. Similarly, 55, 96 and 57 per cent of beneficiaries reported "improved standard of living" after the RVEP in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

9.13.18 Availability of streetlight in front of beneficiary's house

About, 21, 22 and 42 per cent of beneficiaries have a streetlight in front of their house.

9.13.19 Suggestions given by the beneficiaries for better functioning of RVEP

A number of suggestions were given by the beneficiaries for better performance of the programme. These are the following.

(a) Need of more streetlights.

(b) The capacity of the battery should be increased.

(c) Permanent technician should be appointed.

(d) Power of luminaires should be increased.

(e) More awareness programmes should be organised.

(f) 2 to 3 service centres should be set up in the village.

(g) Those who got one lamp are requesting to give two luminaires.

Chapter 10

Details of Focus Group Discussions in the Sample States

10.1 Introduction

Economic conditions, including household amenities of the beneficiaries, provide a description of the overall status of the beneficiaries. Their understanding and management of other economic and non-economic activities at the household level plays a crucial role in their participation in social activities in the village. Focus group discussions (FGDs) were organised in Chhattisgarh, Madhya Pradesh and Odisha to assess the involvement of the households in the Solar Home Lighting Programme and the type of benefits and satisfaction derived by the households. FGD is a method of qualitative study used for capturing information not covered in the structured questionnaires. In such method, the selected participants are allowed to speak freely on a specific subject in a group. Attempt was made to include representatives of all socio-economic groups in the discussions. It was thought that this process of group discussion would allow the investigators to capture the perception, behaviour, and direct and indirect economic benefits, level of satisfaction, utilisation of Solar Home Lighting System and the role of participants in the maintenance of the system.

The characteristics of the participants were predetermined to the extent that, one group consisted of only females, including one or two non-beneficiaries. One group was only for men, including one or two non-beneficiaries, and the third group consisted of both men and women. About 8 to 10 persons were invited to the discussion in each group. The selection of the participants for the FGDs was made keeping in mind the existing compatibility across the various socio-economic groups. The discussions followed a guideline to discuss four major issues, namely, level of satisfaction from the Solar Home Lighting System, type of benefits being realised, extent of use of kerosene, knowledge of duration of battery use for solar lighting system, participation in awareness campaign if any, training received if any, etc.

The group discussion proved to be extremely useful in eliciting a range of information, which further supports the quantitative survey information. About seven to eight FGDs were organised in each state. In all, 22 FGDs were organised in the three states.

10.2 A profile of FGDs Organised in Madhya Pradesh

Specific details of the FGDs held in Madhya Pradesh are tabulated below (Table 10.1).

Table 10.1 Details of the FGDs held in Madhya Pradesh

District	Block	Village	Caste to which majority of the village population belongs	Number of participants who attended FGDs	Date on which FGD was organized
Betul	Bhimpur	Bijori	ST	8	08.6.10
	Bhimpur	Pali	ST	8	12.6.10
Guna	Aron	Bhaisyala	OBC	8	16.6.10
Gwalior	Ghiagalm	Bagwala (Female)	OBC	7	26.6.10
	Ghattigaon	Maharampura (Female)	OBC	7	22.6.10
Dindori	Shahpura	Duba Raiyat	ST	8	21.6.10
Jhabua	Alirajpur	Wakner	ST	8	12.6.10
Sheopur	Vijaypur	Bodhwani	OBC	6	08.6.10
Total Number of sampled districts = 6	Number of blocks from sampled districts = 8	Number of villages from sampled districts/ blocks = 8		Total Number of participants in FGDs = 60	All FGDs were held between 8 June 2010 and 26 June 2010

Altogether 8 FGDs were held in 6 districts of Madhya Pradesh. The FGDs were held in the month of June between 8 June 2010 and 26 June 2010. Out of 8 FGDs, two were organised among the female members in the villages Bagwala and Maharampura in Gwalior district. The other 6 FGDs were organised among the male members. Two FGDs were organised in villages Bijori and Pali in the Betul District. The other 4 FGDs were organised in the villages Bhaisyala, Duba Rayat, Wakner and Bodhwani in the Districts of Guna, Dindori, Jhabua and Sheopur, respectively.

Four FGDs were organised in the villages dominated by ST population and another 4 FGDs were organised in the villages dominated by OBC population. Detailed profile of the participants who took part in the 8 FGDs held in Madhya Pradesh is tabulated below (Table 10.2).

Table 10.2 Profile of the Participants in the FGDs in Madhya Pradesh

Caste of the participants and Number of FGD organised	Majority are ST(No.) =	4
	Majority are OBC (No.) =	4
Level of Education of the participants	Illiterate	46%
	Primary	5%
	Middle	33%
	10th +	16%
Type of Cards held	BPL	71%
	APL	29%
Occupation of the participants	Agriculture	53%
	Livestock fishing	4%
	Agri wages	5%
	Non-agri wages	39%
Type of Houses in which the participants live	Kutcha	80%
	Semi-pucca	20%
No. of rooms in the houses of the participants	1 room	56%
	2 rooms	39%
	3 rooms	6%

Sixty-three to 86 per cent of the population in the villages Bijori, Pali, Bagwala and Badwani own APL cards; and 53 to 66 per cent of population in the other 4 villages, viz., Duba Raiyat, Bhaisyala, Maharampura and Wakner, own BPL cards. About 16 to 21 per cent of population does not own any card in Bagwala, Maharampura, Duba Raiyat and Pali.

10.2.1 Major findings from FGDs in Madhya Pradesh

All the 7 women participants in the FGD in the village Bagwala said that the village was electrified through grid in 1985. The electric wires and cables had been stolen by unidentified crooks. The village is located near the forest. The crime rate was high at night. The snakes and insects bite was common in the village. Now such incidents have reduced. The villagers got solar light in 2009 and are very happy for that. Compared to earlier darkness, they now felt much safer from wild animals at night due to availability of light. The crime rate has drastically reduced in the village. The village looks lively.

The 6 male FGD participants in the village Badhwani said that their village was electrified through grid about 15 years ago. The power supply was, however, disconnected after a few months. They were happy to have solar lights now. Livestock rearing is the main occupation of the population in the village. Majority of the participants said that they could look after their domestic animals in a better way in the evening due to availability of lights.

Some participants in villages Badhwani and Maharampur said that they collected 8–10 solar home-lights for marriage ceremony and other social gatherings. This has been a great advantage from the introduction of solar lights. They could now organize more social get togethers at night. A few participants said that mobile charging became easier now.

Some of the participants in the 'Bijori' village said that their village streetlights were taken to the nearby village for lighting at the occasion of the marriage. Some of the participants are very upset about this kind of action in the village. They are unable to prevent this kind of activities. One of the participants is Anganwadi Worker (AWW) in the village 'Maharampura' said that due to the solar light she opens Anganwadi Centre (AWC) every day.

All the FGDs participants said that due to availability of light, women find it more comfortable to do household chores. Some participants in Pali, Duba Rayat and Bhasyala villages said that children could now play in the evening and study at night. A few participants said that going to neighbourhood at night became easier now. All the participants in the village Wakner were very proud that their village could now be identified from a distance even at night as the village looks lively.

All the participants said that expenditure on kerosene reduced substantially after the introduction of solar lights. Most of the beneficiaries live either in one or two room sets. The current solar light is enough for them. A few participants in the village Bagwal said that poor households in their village totally stopped buying kerosene. Only some beneficiaries buy kerosene from PDS as per their requirements for lighting and initial ignition of wood for cooking. A few rich beneficiaries buy kerosene from open market also for running water pump for irrigation.

No additional income earning activities have been introduced in the village after installation of solar light. However a few participants in the villages Wakner and Pali said that some households now make bidi and plates out of leaves at night. Some participants in the villages

Pali, Bijori, Bhaisyala and Bagwal said that their children study at night for longer time than before.

10.2.2 Status of maintenance of solar lights

Most of the participants reported that nobody visited their houses after installation of the system and that the beneficiaries themselves removed the charge controller as it was not working. Some of the participants said that they bought the CFL from the local market when the originally CFL did not work. Only a few participants in the village Duba Raiyat said that supplier's technician visited their village a few days back. Participants from village Bagwala reported that, in their village, the solar home-lighting system was installed in two phases. The technician re-visited some households covered in the first phase to solve some problems while they were carrying out installation in other households in the second phase.

From FGDs it appeared that participants were not much aware about the life and maintenance of the battery. A few participants in the villages Maharampura, Bijori and Bhaisyala said that battery works for 3 to 6 years. Others agreed to the statement. In all other FGDs participants said that they did not know about the life of the battery, neither they had any plan for

replacing it. Some participants in the villages Wakner and Mahamrampur said that replacement of the battery was the responsibility of the suppliers.

At the end, all the participants suggested that technicians need to be appointed. A few participants in 'Maharampur' said that proper training should be given to villagers themselves to enable them to rectify their own problems relating to solar lighting systems. The participants in the village Bagwala suggested that the number of streetlights needed to be increased. Participants in the village Wakner suggested that they should be provided with irrigation facilities based on alternative energy sources as is practiced in nearby villages of the Gujarat state.

10.3 A Profile of FGD Organised in Odisha

Specific details of the FGDs held in Odisha are tabulated below (Table 10.3).

Table 10.3 Details of the FGDs held in Odisha

District	Block	Village	Caste to which majority of the village population belong	Number of participants who attended FGDs	Date on which FGD was organized
Kalahandi	Th. Rampur	Poiguda	OBC	12	16.07.2010
	Bhimpur	Bhataguda	ST	14	20.06.2010
Nayagarh	Ranpur	Sankhajodi	ST	12	13.07.2010
Keonjhar	Banspal	Champajhar	ST	10	06.07.2010
	Banspal	Jamdiha	ST	11	10.07.2010
Angul	Angul	Bhurkundi	OBC	12	09.07.2010
Sundergarh	Sankatabahal	Gurundia	ST	12	21.06.2010
Total Number of sampled districts = 5	Number of blocks from sampled districts = 7	Number of villages from sampled districts/ blocks = 7		Total Number of participants in FGDs = 83	All FGDs were held between 20 June 2010 and 16 July 2010

Altogether 7 FGDs were organised in Odisha. The FGDs were held between 20 June 2010 and 16 July 2010. Out of 7 FGDs, 3 were organised among women beneficiaries in the village Bhurkundi, Champajhar and Poiguda in the districts of Angul, Keonjhar and Kalahandi, respectively. The other 4 FGDs were organised in the village Bhataguda, Jandiha, Sankantabahal and Sankhajodi in the districts of Kalahandi, Keonjhar, Sundergarh and

Nayagarh, respectively. FGDs were organised among the people from dominant caste in the village. Five FGDs were organised among the STs, where only a few participants were from SC category. Similarly, 2 FGDs were organised among the OBCs where only a few participants attended the discussion from STs. A few non-beneficiaries also attended the discussion.

Detailed profile of the participants who took part in the 7 FGDs held in Odisha are tabulated below (Table 10.4).

Table 10.4 Profile of the Participants in the FGDs in Odisha

Caste of the participants and Number of FGD organized	Majority are ST(No. of FGD)=	5
	Majority are OBC(No. of FGD)=	2
Level of Education of the participants	Illiterate	46%
	Primary including non-formal education	39%
	Middle	11%
	10th +	4%
Type of Cards held	BPL	90%
	APL & ATD	10%
Occupation of the participants	Agr. & Livestock	54%
	Petty Business	1%
	Agri wages	14%
	Non-agri wages	30%
Type of Houses in which the participants live	Kutcha	93%
	Semi-spucca	7%
No. of rooms in the houses of the participants	1	6%
	2	60.20%
	3+	33%

About 93 per cent of the FGD participants are living in kutcha house, whereas 60 per cent of them have two rooms set. About 54 per cent of them are engaged in agricultural activities, 44 per cent are agricultural and non-agricultural wage laborers. About 90 per cent of the participants own BPL cards. 46 per cent of the participants are illiterate and the others are literate and some of them have the level of education up to 10th standard.

10.3.1 Major findings from FGDs in Odisha

All the participants are very happy to have the solar home-lighting system in their house. All the participants agree to the point that their kerosene consumption for lighting has decreased substantially. Some of the participants said that they purchase kerosene only from PDS quota of about 3 litre but use only 1–2 litre. Their kerosene consumption has decreased by 60 to 70 per cent after installation of the solar home-lighting system. They use kerosene only when the solar lights do not work. During rainy season due to low voltage, the beneficiaries face problem, then they use kerosene light. Some of the participants said that they use kerosene for initial ignition of lighting the *Chula.* Some of the participants said that they store PDS kerosene for future use during festival. Some of the participants in the village Bharkundi said that some of the households in the village use kerosene for water pump machine used for irrigation.

Among the participants, those who have school going children said that their children are studying in the evening for longer time happily. Almost all the participants in the Champajhar village said that their children are getting more time to study in the evening and a few of participants said that their children are getting more marks in the examination after getting solar lighting. Women find it more comfortable in doing household work after getting solar lights. They feel free and independent while doing cooking and other household work at night.

Participants also organise cultural programmes for entertainment and spend some time in the evening after household work in playing cards, ludo, etc. about three-fourth participants said that elephants are not coming inside the village after getting solar street light in the village.

Some of the participants in the FGDs organised in the villages Sankhajodi and Jamdiha said that before introduction of solar light in their villages people used to sleep early. But now some of the households have started making leaf plates and some have started weaving and rope making activities and sleep late at night. Similarly, some of the participants in the village Bhurkadi said that in their village a few persons started Bidi making work at night. A few participants said that, out of 48 beneficiaries in the village Sanakantabahal only 5 or 7 households have started leaf plate making and rope making activities in the evening. This implies that direct economic activities have taken place in the village in some manner as light works only for few hours.

10.3.2 Status of maintenance of solar lights in Odisha

Out of 7 FGDs, the participants in 2 FGDs were satisfied with the maintenance of the solar light system in their villages. The participants in the Sankhajodi village said that, local technician and VEC members are taking care of the system. All the beneficiaries are satisfied with the performance of the local technicians. Besides, two trained persons are available, one of whom is residing in the village. He is available on call for services. But the spare parts are not available in the local market. The technician does not replace the spare parts in time. However, the participants said that during rainy season they do not get enough light.

The majority of the participants in Bhurkundi village said that they are not facing major problem. After installation of the system, the supplier's representative organised a meeting in the village and discussed about the maintenance of the system. They also appointed one technician to look after the system in the village.

The maintenance system is poor in the village Sanakantabahal. The participants said that no trained person is available in the village. The supplier's technician never comes to the village. Neither VEC members are trained for maintenance of the system. During rainy season they face major problems in the system.

The participants in the FGD organised in the village Jamdiha, Poiguda, Champajhar and Bhataguda said that supplier's technicians come from DRDA energy cell. After receiving complaints, sometimes they come after 2 to 3 months for services. The DRDA offices are far away from the villages.

A few participants in the FGDs organised in the village Bhataguda said that local technician comes sometimes for minor problems. Member of VEC is active in the village Jamdiha. They help in minor problems faced by the beneficiaries.

Majority of the participants are aware of the life of the battery in the Sankhajodi village. But they are not sure about the cost of the battery. They also said VEC has been collecting Rs 20 every month for future maintenance of the system and replacement of the battery as well. The participants expressed their views that, OREDA should also support at the time of replacement of the battery. The majority of the participants in all the FGDs said that VEC has been collecting Rs 20 every month. That money may be used for replacement of the battery if required. Only a very few participants are aware of the life of the battery. Majority of the participants said that they do not have any plan for replacement of the battery.

About 70 per cent of the participants who received model 2, requested for increasing the capacity of luminaires. A few of the participants said that capacity of the battery should be increased so that they get sufficient light for longer period. All the participants who received model 1, suggested that number of lamps with more capacity need to be increased. All the participants in the village Jamdiha said that children find it difficult to study because of low capacity luminaires (9 W). During rainy days, the voltage becomes even lower. All the participants agreed to pay Rs 10 or Rs 20 every month for more capacity of light in the village Sanakatabahal. The participants in the village Sanhkajodi requested to increase the capacity so that they can use TV, Tape recorders, etc. All the participants in the village Champajhar said that number of streetlights should be increased. Only three streetlights are functional and that are not enough for a village where 57 households live. They have requested for another 3 streetlights for the village. Similarly the FGD participants in the village Poiguda requested to provide 2 more streetlights. They said currently 4 streetlights are functional which are not enough.

The participants in specific FGDs in Odisha gave some major suggestions listed below.

i. The participants in the FGDs in the villages Bhurkundi, Poiguda, Sankhajodi and Champajhar have suggested that adequate training should be given to all the beneficiaries for self maintenance of the system.
ii. The participants in the FGDs in the villages Sanakantabahal and Jandiha suggested for appointment of local technicians and the need for spare parts for regular maintenance of the systems.
iii. Almost all the participants have suggested organising more awareness campaigns for maintenance of the system.

10.4 A Profile of FGDs Orgainsed in Chhattisgarh

Specific details of the FGDs held in Chhattisgarh are tabulated below (Table 10.5)

Table 10.5 Details of the FGDs held in Chhattisgarh

District	Block	Village	Caste to which majority of the village population belong	Number of participants who attended FGDs	Date on which FGD was organised
Raipur	Kasdol	Dheba	ST	12	22.07.2010
	Bhimpur	Kauhabahara	OBC	9	10.07.2010
		Latadadar	ST	13	24.07.2010
Korba	Mainpur	Shobha	ST	8	13.07.2010
	Korba	Nayapara	OBC	12	19.06.2010
	Pali	Keramuda	ST	13	26.06.2010
		Daihanpara	ST	11	-
Kavardha	Bodla	Bangaura	ST	12	08.07.2010
Dhamtari	Dhamtari	Satiyara	ST	12	12.06.2010
Total Number of sampled districts = 4	Number of blocks from sampled districts = 7	Number of villages from sampled districts/ blocks = 9		Total Number of participants in FGDs = 102	All FGDs were held between 12 June 2010 and 24 July 2010

Nine FGDs were held in Chhattisgarh. The FGDs were held between 12 June 2010 and 24 July 2010. Out of 9 FGDs, 3 were organised among women beneficiaries in the villages Keramuda, Dheba and Satiyara in the districts of Korba, Raipur and Dhamtari, respectively. The other 6 were organised among the males in the villages Kauhabahara, Latadadar, Shobha, Nayapara, Daihanpara and Bangaura in the districts of Raipur, Korba and Kawardha. Out of 9 FGDs, 4 were organised only among the STs. Participants in other 5 FGDs were from SCs, STs and OBCs. A few non-beneficiaries also attended the discussion.

Table 10.6 Profile of the Participants in the FGDs in Chhattisgarh

Caste of the participants and Number of FGD organized	Majority are ST (No. of FGD)=	7
	Majority are OBC (No. of FGD)=	2
Level of Education of the participants	Illiterate	48%
	Primary including non-formal education	32%
	Middle	9%
	10th +	11%
Type of Cards held	BPL	44%
	APL & ATD	40%
Occupation of the participants	Agri. & Livestock	28%
	Petty Business	4%
	Agri wages	24%
	Non-agri wages	44%
Type of Houses in which the participants live	Kutcha	96%
	Semi-pucca	4%
No. of rooms in the houses of the participants	1 room	24%
	2 rooms	59%
	3+ rooms	17%

Altogether 102 participants took part in the 9 FGDs in Chhattisgarh. About 96 per cent of them live in kutcha house and 60 per cent own two rooms set. About 48 per cent of the participants are illiterate, 15 per cent are just literate without formal education. Among others, about 26 and 11 per cent have elementary and secondary level of education respectively. About 68 per cent are wage laborer and the others are cultivators. 44.1 per cent own BPL cards (Table 10.6).

10.4.1 FGD organised in Kauhabahara (on 10 July 2010)

A group of 10 members was invited to a group discussion to know the benefits from the solar lighting system installed in the village. Nine members assembled at the central place of the village. All participants were the beneficiaries of the solar electrification programme. The discussion started with the benefits of the solar lights provided to households and the

streetlights installed in the village. The observations, opinions and suggestions of the participants are as follows.

It is noted that almost all participants were found to be very happy to receive solar light in their home as well as streetlights in the village.

All participants were unanimous in saying that their expenses on lighting after receiving the solar light have reduced by 40 per cent. They also added that before installation of the light their kerosene consumption for lighting was average 5 litre per month and it has come down to 3 litre per month. They also added that now they are buying kerosene only from PDS and it is enough for their supporting lighting in their home and initial ignition for lighting a *chula*.

Majority of the participants told that due to the solar light their children are spending more time in their studies. They also added that now their children are securing more marks in their examinations than before.

One participant was saying that this village is surrounded by thick forest. There are various wild animals in the forest. Before installation of the solar streetlights in the village, wild animals like leopards, bears, etc. were frequently entering into the village and hunt their cattle and many times also attacked their children. But due to installation of the streetlights now they have stopped coming inside the village and people are freely moving around the village after it gets dark too. All participants strongly supported this view.

Majority of participants said that now women are getting sufficient time to do their household work due to availability of light in the evening.

A few of the participants mentioned that some people like tailors, carpenters, etc. have got the facility to work more at night. But no new sources of income activities have opened up in the village.

Regrettably none of them know the length of the life of the battery bank of the plant. They added that the replacement of the battery is the responsibility of CREDA.

Majority of participants were saying that capacity of the plant should be increased, so that they can get light for whole day and they also can use other appliances like TV, fan, radio, water pump for irrigation, etc. But they are not interested to pay more.

One participant was complaining that the cost of the light (luminaire) provided by CREDA is very high (i.e. Rs 120). Hence, it is found that many households bought a normal CFL bulb from the market when they need to replace. The cost of the luminaire should be affordable to poor people of the village and the luminaires should be always available with the operator.

Ultimately all participants unanimously said that they are grateful to CREDA for this solar light.

Village: Shobha (Block Mainpur)

This village is surrounded by thick forest and presently suffering from the Naxalite problem.

In the nearest village named Adgari, naxalite people met two of our investigators and warned them to stop the work in remaining villages of the whole block.

In this village two Solar Plants (one is 4 kW and another is 5 kW) have been installed by CREDA on 3 June 2003. Total 153 households have been electrified through these two plants.

In this village two lamps of 11 W have been provided to each household. The households are getting electricity for 3 hr in the evening (i.e. 6 pm to 9 pm) and 2 hr in the morning (i.e. 4 am to 6 am).

A total of 24 streetlights have been installed in this village through these two plants but villagers reported that almost all streetlights are not working for last 2 months. The plant operator of this village has left the job. Hence presently there is no operator in this village.

Total of 27 households of this village have not been electrified because these households are from the two hamlets of this village which are 1 km from the main village.

There is also a residential girls' school "**Adivasi Kanya Ashram Shala**" in this village. There are 65 girl students studying in this school. CREDA has also installed a 900 W solar power plant in this school. Ten tube lights of 14 W, 6 Tube lights of 28 W and one lamp of 11 W have been provided to the school. The installation cost of this plant has been spent from the state fund by CREDA. The plant is working well.

10.4.2 Focus Group Discussion (on 13 July 2010)

A group of males was requested for the group discussion to know their opinion towards the solar power plants installed in this village. Nine men assembled on the school ground of "Adivasi Kanya Ashram Shala". Out of 9, 1 participant was non-beneficiary of the solar light. Out of 9 Participants five were from the ST category, two from SC category and one from OBC category (One of the participants is the girls' hostel's in charge who joined the discussion later).

The educational level of the 8 participants was below primary. Only 1 participant who was a student has appeared for the higher secondary examination. Two of the ST participants have got pucca houses and others have kutcha houses.

The FGD started with advantages of the solar light and their opinions are as follows.

It is noted that households from the main village were found to be very happy to receive the solar light in their home but the households from the hamlets were very upset because they did not receive the benefit of light and requested for solar light as early as possible.

The participants from the main villages were happily saying that their monthly expense on kerosene has noticeably reduced by about 40 per cent. They added that before using solar lamp they were purchasing 5 litre kerosene from PDS and it was insufficient for their

monthly lighting hence many times they were purchasing some more from open market on the higher rates also. But now they are getting only 3 litre from the PDS and it is enough for their monthly lighting because now they are using this kerosene only for the initial ignition to light a Chula and in emergencies for lighting. The teacher in-charge of the Adivasi girls' hostel also joined this discussion and told that before this solar light they needed 125 litre of kerosene monthly for lighting in their hostel but now due to this light the kerosene consumption has gone down to 25 litre only.

The majority of participants were unanimous in saying that now their children are getting more time to complete their school home work and also found giving more time to their studies.

All participants were saying that now the women are getting sufficient time for their kitchen work due to availability of this light in the evening.

Two participants were saying that due to street lights, now the animals, especially the leopard and bear have stopped coming to the village from the forest. Before the light these animals were coming inside the village and hunt cows and goats of the villagers. Now the villagers also feel safe from the wild animals and they can move around the village without fear.

All participants were unanimous in saying that no new economic activity has started in the household due to this light but they added that some people like tailors, carpenters have benefited as they can work more in the evening.

It is found through the discussion that no body from the participants knows the length of life of battery bank and none of them have any plan to replace the battery bank in future.

Majority of participants were saying that remaining households from the hamlets of this village also should be provided the solar light at the earliest.

They also suggested that the capacity of the solar power plant should be increased so that the villagers can use water pump by this electricity to irrigate their fields and also can use other electrical appliances like fan, radio, and TV, etc.

Recently the operator of this village has left the job (the operator got another job) hence they requested to appoint a new operator in the village. They also requested that all streetlights of this village should be repaired as early as possible.

The FGD participants in 'Nayapara' village said that school teacher and forest guard were not staying in the village due to lack of electricity. But now the school teacher and forest guard are staying in the village. The second major advantage is that expenditure on kerosene reduces significantly. After installation of streetlights, wild animals also stop coming to the village. A few of the participants said TV was dream for the villager. But now they use TV also for watching the cricket match. Women and school going children are very happy to have solar light and this is a common opinion of all the FGDs. Children are studying better and women get some time for preparing meal at night. A few participants in village 'Bangaura' said that in their village the children used to study up to primary only before getting the solar light but after getting solar light some of the children are studying in the middle level. Some of the participants said that some of the households in their village are so poor that they cannot buy even PDS kerosene for lighting. They used to cut forest wood for lighting and cooking. Now they use wood only for cooking.

A few of the participant in the village 'Dheba', 'Kashdol' and 'Diahampara' said that after getting solar light, looking after old and sick people became easier. Looking after domestic animals has also become easier now.

Visiting neighbours and organizing social get-togethers in the evening is easier now. The convergence among the households in the village 'Kashdol' has taken place as a few participants said that they share their personal problem and try to help each other. Social gathering, dancing and singing also take place in the evening. This was reported by some participants in the villages 'Daihanpara' and 'Dheba' After getting solar light children play outside in the evening, said some of the participants.

No new activities have taken place after the light but some of the participants said. However, organizing marriage and other functions has become more comfortable in the village.

10.4.3 Regarding maintenance and suggestion

All the participants said that CREDA has trained one person in the village who is in charge of the plant. He looks after the plants. So far they said that they do not find any problems. Almost all the participants said that duration of the light is only four hours which is less. Some of the participants said that they need to use kerosene lamp after 10 pm if they need to work. They suggested increasing the number of hours & light in the evening.

Almost all the participants suggested increasing the capacity of the plant so that they can use other appliances such as fan, TV and cooler.

Ultimately all participants unanimously said that they are grateful to CREDA for this solar light.

Chapter 11

Major Findings of the Survey

11.1 Major Findings of Chapter 5

i. **11.1.1 About distance**

ii. Out of 186 sample villages, 70, 43 and 36 villages are located in hilly areas of Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. About 71, 45 and 28 per cent of villages have kutcha and muddy roads in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iv. 7, 6 and 2 per cent of villages have no proper road connectivity to reach the villages in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

v. About 33 to 45 km distance from village to the block head quarter.

vi. About 94, 74 and 83 km average distance from village to district head quarter in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

vii. About 10 km from village to the nearest bus stop.

viii. Distance to the railway station is about 70, 52 and 97 km in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ix. Distance to the village with grid connection is about 5 to 12 km.

11.1.2 Size of the village and installation of SPVs

i. Average village size is about 40, 81 and 59 households in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. Average number of households which received the solar home-lighting system is 36, 70 and 52 in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. Among the beneficiaries 77 to 83 per cent are from STs.

iv. All our sample villages/hamlets are dominated by Scheduled Tribes.

11.1.3 Status of streetlights

i. On an average 3, 6 and 9 street lights have been installed per village in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. Average distances between the two street lights are 104, 238 and 70 m in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. The majority of the village respondents said that the current number of streetlight installed is not adequate.

iv. On an average 1 and 3 more streetlights are suggested by the investigators in Odisha and Madhya Pradesh respectively. Whereas 5 more streetlights has been suggested by the suppliers in Chhattisgarh.

v. The average voltage of the battery is 12.7 to 13.3 during day time; but at night it has average voltage of 11.2 to 12.0 in all the three states.

vi. During our visit, about 78.8, 88.0 and 60.3 per cent of the streetlights were working in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

vii. About 40 per cent of street lights were not working in Chhattisgarh.

viii. More than 90 per cent of streetlights have been installed in shadow free place, lamps are facing the ground, cables are firmly fixed modules are facing south and inclination is equal to latitude (about 23 degree in case of Odisha, Madhya Pradesh and Chhattisgarh).

11.1.4 Status of solar power plant in Chhattisgarh

i. Out of 50 sample villages, 49 power plants have been installed in 48 villages.

ii. Village 'Shobha' in Raipur district has two power plants with capacities of 4 and 5 kW respectively.

iii. The average capacity of the plants is about 3 kW.

iv. 48 power plants were working during our visit to Chhattisgarh.

v. The total capacity of all 49 power plants is 323 kW.

vi. It has the capacity of providing 3081 SPV model-1 and 739 Street lights.

vii. Currently they are providing 2650 home lights and 435 street lights.

11.1.5 Physical verification of streetlights and homelights

i. In all three states, total 9397 SPV home-lighting systems have been installed. Out of which 21 systems were missing. Out of 21, 8 were missing in Odisha and 13 systems were missing in Madhya Pradesh.

ii. In Madhya Pradesh, 220 SPV home-lighting systems were not functional during our visit.

iii. About 14 streetlights were missing of which, 8 were missing in Odisha and 6 were missing in Madhya Pradesh.

11.1.6 Problems faced by the beneficiaries

i. About 25 and 28 per cent said that 'battery does not charge during rainy season' in Odisha and Madhya Pradesh, respectively.

ii. 22 and 24 per cent reported that 'Technicians do not come to check the system in time' in Odisha and Madhya Pradesh, respectively.

iii. In Madhya Pradesh, about 31 per cent reported that 'charge controller spoiled very soon' as against 5 per cent in Odisha.

iv. The problem of spare parts not available in nearby markets is reported by about 7, 8 and 10 per cent in Odisha, Chhattisgarh and Madhya Pradesh, respectively.

v. 'No problem' is reported by 4, 16 and 72 per cent in Madhya Pradesh, Odisha and Chhattisgarh, respectively.

11.2 Major Findings of Chapter 6

i. Sample households are dominated by STs and average household size stands at 5.2, 6.4 and 4.9 for Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. Majority of heads of the households are illiterate in all the three states.

iii. Agriculture is the primary occupation of 64, 46 and 16 per cent of beneficiary households in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iv. Average annual households income is Rs 19,654 , Rs 26,633 and Rs 21,078 for Odisha, Madhya Pradesh and Chhattisgarh, respectively.

v. The per capita income is as low as Rs 5121, Rs 4053 and Rs 3780 for Madhya Pradesh, Chhattisgarh and Odisha, respectively.

11.3 Major Findings of Chapter 7

11.3.1 Distribution of system by year of installation

i. In Odisha, about 16, 55 and 29 per cent of sample households got the system installed in the year 2007, 2008 and 2009, respectively.

ii. In Madhya Pradesh, 34, 25, 33 and 9 per cent of sample households got the system installed in the year 2007, 2008, 2009 and 2010, respectively.

iii. In Chhattisgarh, 41 per cent of sample households got the system in 2007.

11.3.2 Cost of the system

i. The beneficiaries have reported that they paid Rs 186, Rs 285 and Rs 251 for the system as well as for the installation of the system in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. On an average Rs 80, Rs 235 and Rs 117 were paid on account of the system in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

11.3.3 Pattern of module installation

i. The survey shows that in Odisha, about 55 per cent and 44 per cent of the systems are installed on the roof and a separate pole, respectively.

ii. Only about 1.5 per cent keeps the system inside during day time in Odisha. In Chhattisgarh, only two villages got the individual solar system whereas 48 villages got the system through power plant.

iii. In Chhattisgarh about 85.7 per cent have installed the system on the roof as against 14 per cent who have installed the system on a separate pole.

iv. About 94 to 99 per cent of the systems have been installed in a shadow free area in all the three states.

v. About 67, 80 and 97 per cent have installed the system where the orientation of the modules is due south in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

vi. In Odisha, more than one-third of the households installed the system where the orientation of the modules is not due south.

vii. Moreover, about 53 per cent of the module's inclination is not approximately equal to latitude in Odisha.

viii. In Madhya Pradesh, about one-third of the modules installed are not approximately equal to latitude.

ix. In Chhattisgarh, 99 per cent of the modules are installed in a correct way.

11.3.4 Fixing of luminaires inside the households

i. In Odisha, only about 20 per cent of households have fixed the lamp I on the centre of the roof, as against 34 and 61 per cent of households have fixed on the centre of the roof in Madhya Pradesh and Chhattisgarh, respectively.

ii. About 63, 48 and 34 per cent have fixed the luminaires on the wall in Odisha, Madhya Pradesh and Chhattisgarh, respectively. Only about 5 per cent have fixed the lamp I in the corner in Chhattisgarh, as against 17 per cent each in Odisha and Madhya Pradesh.

iii. In case of fixing of CFL II, about 67 and 92 per cent have fixed the CFL II on the wall in Odisha and Chhattisgarh, respectively.

iv. In Odisha, 14 and 19 per cent have fixed the lamp II in the centre and corner, respectively. Whereas, 100 per cent have fixed the lamp II at the centre of the roof in Madhya Pradesh.

11.3.5 Status of fixing of luminaires

i. About 71 and 79 per cent of households have fixed the luminaires firmly (Lamp I and lamp II) in Odisha.

ii. About 86 and 50 per cent have fixed the lamp I and lamp II firmly inside the households in Madhya Pradesh.

iii. The status of fixing of luminaires is relatively better in Chhattisgarh. About 89 and 92 per cent fixed the luminaires I and II firmly in Chhattisgarh.

iv. It is observed that 80 to 91 per cent reported that the lamp I illuminates maximum area of the darkness of the room in all the three states.

v. In case of lamp II and 81 to 100 per cent have reported that the lamp II illuminates maximum area of the darkness of the room.

11.3.6 Fixing of cables

i. For lamp I about half of the cables are not firmly fixed as against one-third in case of lamp II in Odisha.

ii. In Madhya Pradesh, in case of lamp I, 68 per cent of cables were firmly fixed as against 100 for lamp II. Above 80 per cent of the cables in lamp I and II are firmly fixed in Chhattisgarh.

11.3.7 Level of satisfaction with number of lamps

i. About 60, 47 and 57 per cent of beneficiaries are not satisfied with the number of light points given to them in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. It is because that 48, 99 and only 15 per cent have got only one lamp in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. About 52 and 84 per cent have got two lamps system in Odisha and Chhattisgarh, respectively.

11.3.8 Contribution by the beneficiaries

- Only about 2 per cent in Madhya Pradesh pay per month, as against 69 and 89 per cent of beneficiaries in Odisha and Chhattisgarh, respectively.
- In Madhya Pradesh, 98 per cent of beneficiaries do not pay per month. 99 and 91 per cent of beneficiaries reported that a member of VEC comes and collects every month in Odisha and Madhya Pradesh, respectively.
- In case of Chhattisgarh, the plant's 'Operator' collects Rs 5 per month.
- About 72 per cent of beneficiaries reported that 'Operator' comes to collect per month in Chhattisgarh.

11.3.9 Knowledge about the battery

i. 'About one-third of the beneficiaries said that they are aware of the life period of the battery in Odisha.

ii. In Madhya Pradesh and Chhattisgarh, 12 and only 5 per cent of beneficiaries, respectively, are aware of the life period of a battery. About 95, 88 and 67 per cent do not know about the life period of a battery in Chhattisgarh, Madhya Pradesh and Odisha, respectively.

iii. About 84 per cent of them said that it works 5 years in Odisha. Similarly 57 per cent and 67 per cent have reported that the life period is 3 years and 5 years in Madhya Pradesh and Chhattisgarh, respectively.

iv. About one-third of the beneficiaries do not know that the battery has to be replaced in every five years in Odisha.

v. Only about 10 and 3 per cent of beneficiaries know that the battery has to be replaced in every five years in Madhya Pradesh and Chhattisgarh, respectively.

vi. In Madhya Pradesh and Chhattisgarh, 90 and 97 per cent of beneficiaries, respectively, do not know that it has to be replaced in every five years.

vii. The average estimated cost of the battery is Rs 5609, Rs 3055 and Rs 4242 in Odisha, Madhya Pradesh and Chhattisgarh, respectively. Only about 15 per cent know that one can borrow from bank for replacement of battery in Madhya Pradesh as against 3 per cent each in Odisha and Chhattisgarh.

11.4 Major Findings of Chapter 8

11.4.1 Status of functionality

i. About 68, 78 and 86 per cent of beneficiaries reported that the system has been functional since it was given to them in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. However, when the investigators visited the households of beneficiaries and checked the system personally, it is estimated that about 84, 88 and 100 per cent of the systems were in working condition in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. In other words the actual working condition was better than the responses given by the households.

   a. The estimated number of days the system is 'not working' is 48, 46 and 14 days in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

11.4.2 Reasons for non-functional systems

Majority of them thought of 'Technical fault', 'Problems of charge controllers' and 'Luminaires do not work' as the reasons for non-functional system.

11.4.3 Contact person in case of problems

i. The beneficiaries call various persons for services when the system does not work. Generally approached personal are—local technician, member of VEC, gram panchayat officials, supplier's technicians and others.

ii. The 'others' consist of skilled relatives and family friends. In case of Odisha, 31, 54, 9 per cent reported that they call 'local mechanics, VEC, supplier's technician, respectively.

iii. They also call members of gram panchayat and others for help.

iv. In Madhya Pradesh, gram panchayats play significant role in the maintenance of the systems.

v. About 46 per cent of the beneficiaries inform gram panchayat when they face any problems. Only about 7 per cent call supplier's technicians.

vi. As VEC and local technicians are not active in Madhya Pradesh. Only 6 and 3 per cent call VEC and local technician for services.

vii. In case of Chhattisgarh, 88 per cent call local technician/plant operator when there is some problem.

viii. VEC and supplier's technician are also involved in the maintenance of the system in Chhattisgarh.

11.4.4 Level of satisfaction with the redressal system

i. Only about 67, 12 and 88 per cent have reported that somebody came to their house for services in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. In case of Madhya Pradesh 84 per cent said that 'nobody' came for services as against 7 per cent in Chhattisgarh.

iii. 81 per cent of beneficiaries reported that they are not satisfied with the grievance redressal system in Madhya Pradesh.

iv. About 38 and 6 per cent of beneficiaries are also not satisfied with the grievance redressal system in Chhattisgarh and Odisha, respectively.

11.4.5 Reasons for dissatisfaction

i. 'No one is available to repair or check the system' was the major reason as cited by 66 and 44 per cent of beneficiaries in Madhya Pradesh and Odisha, respectively.

ii. 'Technician does not repair properly' is the second major reason reported by 30 and 16 percent of beneficiaries in Chhattisgarh and Odisha, respectively.

iii. 'VEC' not available is another reason mentioned by 4 to 9 per cent of the beneficiaries in all these three states.

iv. Lack of spare parts in the nearby market, or with the technicians, high cost of the repairs were the other reasons cited for dissatisfaction with the system

11.4.6 Performance of the system by seasons

i. On an average, luminaires work for 2.8 to 3.4 hours per day during rainy season.

ii. On an average, luminaires work for 3.7 to 4.4 hours per day during winter season.

iii. On an average, luminaires work for 4.6 to 4.8 hours per day during summer season.

11.4.7 Performance of the system during rainy season

i. Respondents in Madhya Pradesh reported the weakest performances of the systems in the rainy season.

ii. About 46, 50 and 73 per cent reported that light comes for less than 3 hours during rainy seasons in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

iii. 23 to 38 per cent reported that light comes for 3 to 4 hours in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

iv. Only about 1 per cent said luminaires work for 4–5 hours in Madhya Pradesh as against 32 per cent and 10 per cent in Chhattisgarh and Odisha, respectively.

v. The performance of the systems is better in Chhattisgarh as compared to Madhya Pradesh and Odisha.

11.4.8 Performance of the system during winter season

i. In Madhya Pradesh, about 13 per cent reported that they get light for less than 3 hours as against 5 per cent in Odisha; whereas no one is reporting that they get light for less than 3 hours in Chhattisgarh during winter season.

ii. About 39, 41 and 53 per cent of beneficiaries said that they get light for 3 to 4 hours in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

iii. About 61, 55 and 34 per cent reported that they get light for more than 4 hours in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

11.4.9 Performance of the system during summer season

i. Only about 2 per cent each in Odisha and Madhya Pradesh reported that they get light for less than 3 hours from the PV system during summer seasons.

ii. 37, 39 and 45 per cent have reported that they get light for 4–5 hours in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

iii. Similarly, 42 per cent each in Chhattisgarh and Madhya Pradesh reported that they get light for more than five hours.

iv. More than one-third of the beneficiaries reported that they get light for more than five hours in Odisha.

v. Thus, as expected the solar power is most available during the summer season as compared to winter and rainy seasons.

11.4.10 Performance of the system by year of installation

i. In Odisha, those who received the systems in 2007, about 70 per cent reported that they get light for less than 3 hours a day as against 58 per cent of beneficiaries who got the system in 2009 during rainy season.

ii. About 22 per cent reported getting light for 3-4 hours of those who received the system in 2007 as compared to 37.4 per cent reported that they got the system in 2009.

iii. The pattern of performance is similar in the winter and summer seasons in Odisha.

iv. In Madhya Pradesh, it is observed that the performance of the systems during different seasons does not vary much by year of installation of the system.

v. During summer season, 87 and 88 per cent of them (those who got the system in 2007 and 2009, respectively) reported that they get light for about 4 and 5 hours in a day from their PV system.

vi. During rainy seasons, about 72 to 75 per cent reported that they get less than 3 hours of light. Performance of the system has been reported to be poor for the most recent systems in the rainy season in Madhya Pradesh.

vii. The duration of the light is fixed in Chhattisgarh, 4 hours in the evening and 2 hours in the morning. CREDA has appointed one operator to look after the plant in each village. He has been maintaining and operating the plant.

viii. However, the performance of the system does not differ much in different seasons as compared to Madhya Pradesh and Odisha.

11.4.11 Problems faced by the beneficiaries

i. ‘‘Light goes after 2 hours’ is one of the problems, cited by 7, 2 and 9 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. The system ‘does not work in rainy season’ is cited by 34, 69 and 80 per cent, in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. A sizable per cent of beneficiaries also faced problem due to “Poor Battery, and ‘loose wiring’ in Odisha and Madhya Pradesh. Only about 15, 13 and 6 per cent of beneficiaries said that they cannot use TV and other audio entertainment appliances with the system.

iv. The functionality problem mostly occurs during rainy season. About 75 to 97 per cent of beneficiaries reported that problems are more frequent in ‘Rainy seasons’.

11.4.12 Non-availability of VEC

i. The availability of Village Energy Committee (VEC) has been recorded from two sources: (a) reported by the Village Pradhan in the village questionnaire and (b) reported by the beneficiaries in the household’s questionnaire.

ii. In Madhya Pradesh, only about 15 per cent of beneficiaries reported of existence of Village Energy Committee in the village, whereas 26 per cent 'do not know' about its existence.

iii. The rest about 59 per cent said 'No' VEC in their village in Madhya Pradesh. About 94 and 85 percent of beneficiaries reported of presence of VEC in Odisha and Chhattisgarh, respectively.

iv. According to the village questionnaire, in Madhya Pradesh, 43 per cent villages have a VEC and 57 per cent said 'no' VEC in the village.

v. About 26 per cent who reported 'do not know 'about existences of VEC may be due to non-functional VEC even though it was formed in Madhya Pradesh.

vi. 99 and 98 per cent of villages has a VEC in Odisha and Chhattisgarh, respectively.

11.4.13 Organisation of awareness campaigns

i. 99 per cent of beneficiaries reported that 'no awareness' campaign was organised by the suppliers in Madhya Pradesh.

ii. About 63 and 73 per cent of beneficiaries reported organising such campaigns in Odisha and Chhattisgarh.

iii. A smaller but significant 37 and 27 per cent of beneficiaries reported not having such campaign in Odisha and Chhattisgarh, respectively.

iv. About 84, 15 and 24 per cent of beneficiaries reported that 'suppliers' had organised awareness campaign in their village.

v. Only 8, 40 and 3 per cent of beneficiaries reported that 'VEC' had organised the training in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

vi. About 74 per cent of beneficiaries said that 'others' (consisting of operators and technicians) organised awareness campaign in Chhattisgarh.

vii. About 76 to 95 per cent of beneficiaries also reported attending the awareness campaign organised by various parties in these states.

11.4.14 Organisation of Training programme

i. About one-third of the beneficiaries have received some training for self maintenance of the system in Odisha.

ii. Whereas, 99 and 94 per cent of the beneficiaries did not receive any such training in Madhya Pradesh and Chhattisgarh, respectively.

iii. About 66, 65 and 39 per cent of beneficiaries have reported that they need training for maintenance of the system.

iv. About 52, 9 and 95 per cent of beneficiaries said there are trained persons in their villages in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

11.4.15 Maintenance of the system and level of satisfaction

i. More than half of beneficiaries face problems in Madhya Pradesh and Chhattisgarh.

ii. About 56 per cent of beneficiaries said they do not have any problem with maintenance in Odisha.

iii. About 52 per cent of beneficiaries reported that suppliers have appointed local technicians in Odisha.

iv. However, about 8 per cent of beneficiaries do not know about it whereas 39 reported that 'no' local technician has been appointed by the suppliers in Odisha.

v. About 72 per cent of beneficiaries reported that 'No' local technician has been appointed and '27' per cent 'do not know' about it in Madhya Pradesh.

11.4.16 Activities of the local Technician

i. About 84, 15 and 99 per cent reported that the local technician comes for maintenance/services when they need his help in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. In case of Madhya Pradesh, 81 per cent reported that 'Others' meaning the involvement of 'gram panchayat' in the maintenance of the system.

iii. The maintenance system is rare in Madhya Pradesh as there is no 'VEC' and 'No' local technician appointed by the suppliers. However, the beneficiaries were asked to inform the gram panchayat when the systems stop working in Madhya Pradesh.

iv. In Chhattisgarh, the local technicians, appointed by the supplier as a 'Power Plant Operator' look after the power plant.

v. The technician has been authorised to collect the monthly contribution from the beneficiaries. Therefore, he has to visit monthly for collection as well as for services when the beneficiaries call him.

vi. Even though the majority of the beneficiaries are not satisfied with the services of technician; still 60, 75 and 79 per cent of beneficiaries are satisfied with solar home-lighting system in lieu of grid extension.

vii. Only 21, 25 and 40 per cent are not happy with the SPV home-lighting system in lieu of grid extension.

11.4.17 Expenditure on repairing

The annual average expenditure for maintenance is Rs 65, Rs74 and Rs 93 in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

11.5 Major Findings of Chapter 9

11.5.1 Extent of kerosene consumption

i. The average monthly consumption of kerosene per household is 3.2, 4.9 and 4.7 litres for Odisha, Madhya Pradesh and Chhattisgarh, respectively before SPV home-lighting system.

ii. On an average, the entitlement of kerosene from PDS is 3.0, 4.5 and 4.0 litres in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. However, the extent of requirement of kerosene has declined by 41, 30 and 51 per cent in Odisha, Madhya Pradesh and Chhattisgarh, respectively after installation of the SPV home-lighting system.

11.5.2 Type of fuel used for cooking and lighting before and after RVEP

i. About 100 per cent of beneficiaries reported 'not using electricity for cooking and lighting before installation of SPV home-lighting system in Odisha, Madhya Pradesh and Chhattisgarh.

ii. After installation of SPV home-lighting system about 95 to 98 per cent of beneficiaries use electricity for lighting in Odisha,Madhya Pradesh and Chhattisgarh.

iii. Kerosene was the only source for lighting reported by 99 per cent of beneficiaries in all the three states before installation of the system.

iv. About 37 per cent of beneficiaries reported use of kerosene for cooking in Odisha before SPV system was installed as against 4 per cent in Chhattisgarh. Almost all remote village households buy kerosene from the PDS only.

v. No household uses LPG and edible oil for cooking and lighting in the sample households.

vi. The price of PDS kerosene is Rs 10 to Rs 12 and it has remained the same before and after installation of the system.

vii. About 67 to 94 per cent of beneficiaries said that they get kerosene as per their entitlement.

viii. About one-third of beneficiaries in Odisha and Madhya Pradesh reported of not getting kerosene as per entitlement.

ix. About 10 per cent of households reported that they store it for future use in Odisha as against 3 per cent in Chhattisgarh.

x. About 83, 95 and 92 per cent reported that the PDS kerosene is used only for lighting in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

11.5.3 Indirect advantage of SPV home lighting system in Kerosene

i. About 8 and 10 per cent of beneficiaries reported that they 'do not buy kerosene at all now' in Madhya Pradesh and Odisha, respectively.

ii. It is estimated that about 1 per cent each in Odisha and Chhattisgarh sell excess PDS kerosene in the open market as well as to neighbours.

iii. Similarly, in Madhya Pradesh about 13.8 per cent sell excess kerosene.

11.5.4 Expenditure on lighting before and after SPV

i. The average per month expenditure on lighting was Rs 35, Rs 57 and Rs 24 in Odisha, Madhya Pradesh and Chhattisgarh, respectively before installation of SPV home-lighting system.

ii. The expenditure on lighting has declined by 17, 42 and 4 per cent in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

11.5.5 Uses of other electrical appliances

i. About 4 per cent of beneficiaries reported using electric fan in Chhattisgarh.

ii. About 6 to 15 per cent of sample households use radio, one to 2 per cent use tape recorder, one to 6 per cent use television and 9 to 29 per cent use SPV home-lighting system for mobile charging.

11.5.6 Income generation activities

i. The survey finds that about 22, 10.2 and 2 per cent among the beneficiaries reported that new sources of income generation activities have opened up after getting Solar Lighting System in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. The new sources of income earning activities are opening mostly for women in the households in Odisha.

iii. In Madhya Pradesh about 43 per cent reported that the new sources of income earning activities are opening for both males and females; whereas about 66 per cent have reported that the new sources of income earning activities are opening for only male members of households.

11.5.7 Impact on household's income

i. There is a potential for multiple income generation activities in the beneficiary households because of electricity.

ii. As a consequence, household's income has been increasing although at a slow pace in all the three states.

iii. The growth of monthly income has been estimated as 8.75, 7.0 and 7.2 per cent for Odisha, Madhya Pradesh and Chhattisgarh, respectively since the installation of the SPV systems.

11.5.8 Level of satisfaction with other benefits

i. About 16, 24 and 60 per cent have reported of 'Significant improvement' 'Minor improvement' and 'No change', respectively in increase in income due to solar home lighting system in Odisha.

ii. There is 'minor improvement' in income, expressed by 73 and 13 per cent in Madhya Pradesh and Chhattisgarh, respectively.

iii. Whereas, 86 per cent reported 'no changes' in Chhattisgarh as against 24 per cent in Madhya Pradesh.

11.5.9 Improved standard of living

i. Only about 1 per cent of beneficiaries reported "improved standard of living" 'significantly' in Chhattisgarh as against 19 and 15 per cent in Madhya Pradesh and Odisha, respectively.

ii. 'Minor improvement' has been reported by 42, 78 and 48 per cent in Odisha, Madhya Pradesh and Chhattisgarh, respectively. 50, 42 and 2 per cent have reported 'no changes' in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

11.5.10 Better education to children

i. 'Significant improvement' in case of children education has been reported by 28, 52 and 34 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. 'Minor improvement' has cited by 52, 41 and 64 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. 'No changes' has been cited by 17, 6 and 1 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iv. The beneficiaries are extremely happy as their children are spending more time in studying in the evening after getting solar light.

v. The RVEP is providing 'better education to children' as reported by 76, 90 and 99 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

11.5.11 Convenience in household work

i. Only 48, 39 and 35 per cent have reported as 'significant' improvement in household work in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. Similarly, 'Minor improvement in household work' has been reported by 48 per cent each in Odisha and Madhya Pradesh; as against 64 per cent in Chhattisgarh.

iii. About 13 per cent have reported 'no changes' in Madhya Pradesh.

11.5.12 Malaria reduction after solar PV systems were installed

i. Only 2, 4 and 1 per cent have expressed that incidence of malaria has reduced after solar light installation in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. Similarly, 12, 15 and 18 per cent have said on 'minor improvement in malaria reduction' in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. About half of the beneficiaries reported 'no change' in Odisha and Madhya Pradesh. More than one-third of beneficiaries do not give any opinion in Odisha and Madhya Pradesh.

iv. In case of Chhattisgarh, 23 and 59 per cent have said 'no change and 'no opinion, in case of malaria reduction after the coming of solar light.

11.5.13 Level of satisfaction from other aspects of solar PV system

Availability/duration of light

i. About 21.5, 53, 17.6 and 8 per cent of the respondents have reported the availability of light to be very good, good, average and poor in Odisha.

ii. These percentages do not vary much in case of Madhya Pradesh and Chhattisgarh.

Quality of light

i. About 13 per cent each in Odisha and Chhattisgarh cited the quality of light to be 'very good' as against 23 in Madhya Pradesh.

ii. About 53, 64 and 69 per cent cited the quality of light is 'good' in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. The quality of light is 'average' for 25, 11 and 17 per cent of beneficiaries in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iv. The quality of light is 'poor' for 8 per cent in Odisha as against 1 per cent each in Madhya Pradesh and Chhattisgarh.

11.5.14 Services of technicians

i. Only about 6 per cent of beneficiaries expressed their level of satisfaction as 'very good' in Odisha and Chhattisgarh as against 4 per cent in Madhya Pradesh.

ii. The services of technician are 'good' for 82, 29 and 3 per cent in Chhattisgarh, Odisha and Madhya Pradesh, respectively.

iii. The service is 'average' for 22 per cent in Odisha and 11 per cent each in Madhya Pradesh and Chhattisgarh.

iv. The service of technician is 'poor' for 67 per cent in Madhya Pradesh as against 39 per cent in Odisha. Not even one per cent reported the service as 'poor' in Chhattisgarh.

11.5.15 Availability of spare parts

i. Availability of spare parts is 'poor' for 45 and 64 per cent in Odisha and Madhya Pradesh, respectively.

ii. Only about 10 per cent quoted it as 'poor' in Chhattisgarh. 21, 6 and 36 per cent cited as 'average' in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. About 11 per cent cited it as 'good' each in Odisha and Chhattisgarh as against one per cent in Madhya Pradesh.

11.5.16 Support from VEC

i. About 30, 1, 12 per cent said that they received 'very good' support from VEC whereas 51, 3 and 79 per cent received 'good' support from VEC in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. In Madhya Pradesh, 33 and 50 per cent quoted the support from VEC as 'poor' and 'don't know' about the services of VEC as there is only 15 per cent of respondents who are aware of the availability of VEC in Madhya Pradesh.

11.5.17 Empowerment of Female Members of the Households due to RVEP

Employment and new sources of income

i. Activities such as a new shop or STD booth, bamboo craft, weaving and stitching/embroidery, making 'Patella' and 'Dona', rope making, etc. may be more feasible after the installation of SPV system in the village.

ii. After installation of solar home-lighting system, women feel comfortable to work on such activities for a few hours in the evening to generate additional income. Employment/engagement in such activities among women beneficiaries is reported to be 8, 5 and 2 per cent in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

iii. Similarly, 21, 10 and 2 per cent among women feel new source of income opened up after RVEP in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

Women feel independent and report improved standard of living

i. About 68, 32 and 22 per cent of beneficiaries reported that women are independent now in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

ii. Similarly, 55, 96 and 57 per cent of beneficiaries reported "improved standard of living" after the RVEP in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

11.5.18 Availability of Streetlight in front of beneficiary's house

i. About, 21, 22 and 42 per cent of beneficiaries have a streetlight in front of their house. The average distance between two streetlights reported by the beneficiaries is estimated as 70, 100 and 62 metres in Odisha, Madhya Pradesh and Chhattisgarh, respectively.

11.5.19 Suggestion given by the beneficiaries for better functioning of RVEP

A number of suggestions were given by the beneficiaries for better performance of the programme. These are the following.

(a) Need of more streetlights.

(b) The capacity of the battery should be increased.

(c) Permanent technician should be appointed.

(d) Power of luminaires should be increased.

(e) More awareness programmes should be organised.

(f) 2 to 3 service centres should be set up in the village.

(g) Those who got one lamp are requesting to give two luminaires.

Chapter 12

Insights from the Study

12.1 Introduction

The programme of bringing electricity to remote villages has been undertaken by the MNRES through its "Remote Village Electrification Programme" in partnership with the state governments. Implementation of the scheme has required several stages of assessment, review, planning and activities. In this sense, there is a need for achieving efficiency in implementation through cooperation of stakeholders and responsiveness to local conditions for successful implementation of this scheme. We note below the benefits as perceived by the villagers and then indicate areas where improvements can lead to greater efficiency and effectiveness of the scheme.

12.2 Main Perceived Benefits

The present study, as our previous studies on the programme, has found that bringing electricity to the remote villages can influence life in these villages very significantly for better in many ways. These are (a) reduction in expenditure on kerosene for lighting (b) Children spend more time studying (c) women find more convenience in households work (d) some households find it feasible to engage in additional income earning activities; such as making of leaf plates, bidis, weaving/stitching and embroidery and ropes, etc. (e) villagers feel much safer from wild animals at night due to availability of light and the villages looks lively.

12.3 Areas for Improvement

- Involvement of local people in the identification of beneficiaries, recovery of charges and monitoring the maintenance services can lead to more efficient functioning of the system. *As we have discussed in Chapter 8 there is lack of maintenance and no monthly fee collection especially in Madhya Pradesh.*
- The village panchayats should be given the role of monitoring the implementation of the programme. This will improve transparency in implementation and accountability of the service providers to the village.. We find that there is a lot of variation in the way the village panchayats are involved. The VEC have not been formed in many places. *The VEC have not been formed in about 80 per cent of places in Madhya*

Pradesh. Whereas in Odisha and Chhattisgarh, 94 and 85 per cent, respectively reported presence of VEC.

- Community level services such as streetlights or lights in the community facilities should form an integral part of the programme. The scheme envisages installing one streetlight per every 10 households in the village. Contributions for the maintenance of the system should be a commitment from the community as a whole. This will improve community ownership of the scheme in the village and also accountability. As we have noted if the involvement of panchayats is not significant, in the absence of any other mechanism the community level participation will be less than adequate.

- Role of the Village Energy Committee has to be well defined. All the beneficiaries should know about the activities of the VEC. The scheduled activities of the VEC should be strengthened.

- The local people should be given necessary training and information so that they are fully equipped to perform their roles. The awareness campaigns should not be just one time activity. There is a need for periodic efforts at providing information and better management. Effective awareness campaign should be organized by the nodal agencies/suppliers with the involvement of the people in the selected villages. Posters or advertisements may also help in creating awareness among the villagers.

- Maintenance strategies in case of power plant in Chhattisgarh are better than in case of individual systems prevailing in Odisha and Madhya Pradesh. There is lack of Operation and Maintenance services in Odisha and Madhya Pradesh unlike Chhattisgarh. It is a suggestion that if the village has a sizable households and not so much of scattered location it may be ideal to offer a power plant than individual system.

- The programme should also aim to increase the effectiveness of electrification through synergies with the other schemes of the state or Central government. This is more likely to happen if there is greater involvement of panchayati raj institutions at higher levels—blocks and districts.

- The monitoring and evaluation of the scheme is important for effective implementation of the scheme. The corrective measures can be provided if the monitoring inputs are available.

- The evaluation of the projects should be carried out three times during the guarantee period. First, in the year of installation, second, after two and a half years of installation (mid-term evaluation) and third, in the fifth year of installation. The evaluators should visit the same households to assess the functionality of the system during each evaluation at least 50 per cent of the cases both in terms of villages and the households where the SPV systems are installed.

- At least one member of the beneficiary household needs to be trained to look after the system.

- It is expected that MNRE's specific cell coordinates the various electrification schemes. This coordination is important. RVEP is meant for all unelectrified Census villages and hamlets of electrified Census villages, where gird connectivity is either not feasible or not cost effective. We point out some instances where we found that grid connection was made available at some point in the selected sample villages.

    - ❖ We found that three villages in Chhattisgarh, viz: 'Jabarsa' in district Dhamtari, 'Sukjhar I and 'Sukjhar II' in district of Kawardha, were electrified through Solar power plant in 2004 and 2007, respectively. The village 'Jabarsa' is again electrified through grid in 2008. Similarly, the villages 'Sukjhar I' and 'Sukjhar II' are also electrified through grid in 2010. The power plants have been maintained by the operators in the village. However, it is not clear how many lights are given to the households through grid connection.

    - ❖ In Madhya Pradesh, village 'Antri', Bagwala and Tilawali' in district of "Gwalior" was connected with grid in 1984, 1985 and 1990, respectively. After few months the grid connection was discontinued due to certain problems. Solar PV was installed in 2008 and 2009 in these villages. The village 'Vaupur' in 'Guna' district of Madhya Pradesh was electrified through grid in 2006 and the same village was also electrified through solar home-lighting system in 2007.

When the grid electricity reaches the village, the households may lose interest in the solar system and may not maintain these installations. In such cases it is necessary to have the procedures for withdrawing the scheme or at least evaluate the alternatives. If the supply of

power through the grid is erratic and deficient, the solar systems may still have a role to play. The remoteness of the villages which limits their access to other forms of infrastructure in a cost effective way may still justify the solar lighting systems if the grid supply of electricity is not satisfactory.

The field work has shown that the selected villages are indeed remote and providing electricity through the solar system is a very significant development/intervention in these villages. If there are further technological improvements that can improve the efficiency or capacity of the systems it would further benefit the households dependent on these systems.

Appendix A

'Remote Village Electrification Programme', Details of the Scheme

1.0 OBJECTIVE

'Remote Village Electrification Programme' is a holistic and ambitious scheme of Ministry of the New and Renewable Energy (MNRE). The objective of the scheme is to electrify all the remote census villages and remote hamlets of electrified census villages through non-conventional energy sources such as solar energy, small hydro power, biomass/biogas, wind energy, hybrid systems, etc. The scheme aims in providing benefits of electricity to the people living in most remote, backward and deprived areas of the country. This welfare scheme has been implemented in such areas which are surrounded by forest, hills, deserts and island where electrification through grid is impossible or not cost effective. Such neglected areas are under this ambitious programme for electrification**.**

2.0 IDENTIFICATION OF REMOTE VILLAGES/HAMLETS AND DEFINITION

The identification of such remote villages/hamlets has been entrusted to the Rural Electrification Corporation. The state governments should shortlist unelectrified village/hamlets in their states which are not likely to be electrified through grid and send their names to MNRE for verification by REC. The plan for electrification of remote villages/hamlets should ideally be an integral part of the plan for complete rural electrification in the state.

3.0 DEFINITION OF ELECTRIFIED VILLAGES

A remote village or remote hamlet will be deemed to be electrified if at least 10% of the households are provided with lighting facility. In addition, energy may also be provided for community facilities, pumping for drinking water supply or irrigation, as well as for economic and income generating activities.

3.1 Scope of the Scheme

The scheme covers all unelectrified remote census villages by 2007. All unelectrified remote hamlets of electrified census villages, by 2012. Coverage of all households in remote census villages and hamlets, by 2012. All unelectrified remote census villages or remote hamlets of

electrified census villages, which will not be electrified through grid by the end of the Eleventh Plan (2012), as certified by the authority, will be covered under this scheme.

4.0 SCHEME DESIGN

The scheme is intended to cover all the households in the village/hamlets, including Dalit bastis of the village, and creation of capacity for availability of electricity as laid down in the National Electricity Policy, 2005, i.e., a minimum of 1 kWh/household/day. However, if the state governments, conclude after due consideration that the norm of 1 kWh/household/day is not achievable in a cost effective manner through various non-conventional energy technologies, due to inadequate availability of the resources, then as a last resort they may decide to provide at least the basic lighting facilities through Solar Photovoltaic homelighting systems for each of the willing households in the village. However, as per the National Rural Electrification policies of the Government, village/hamlets using isolated lighting technologies like solar photovoltaic, may not be designated as 'electrified'.

5.0 IMPLEMENTATION ARRANGEMENT AND MEMORANDUM OF UNDERSTANDING WITH THE STATES

In order to implement the RVEP and to share the roles and responsibility with the state government, it has been decided to enter into a Memorandum of Understanding with each state governments intending to implement the programme. While sanctioning the MNRE support, preference will be given to states who have signed the MoU with MNRE.

6.0 DEFINED ACTIVITIES ELIGIBLE FOR SUPPORT

(i) Installation of power plants based on small hydro power, biomass, wind, biofuels, biogas, etc for electrification of remote village/hamlets. Solar photovoltaic power plants may also be supported if found to be cost effective. Combination of renewable energy systems for domestic and community lighting would be supported where no other non-conventional energy technology is found to be feasible.

(ii) Initial surveys and studies if necessary for firming up of State-wise lists of remote unelectrified census villages and hamlets: assessing the renewable energy resources available in the villages and energy requirement of the community**;** and, identification of appropriate technology options for electrification, preparation of State-wise Master Plans.

(iii) Institution development and capacity building, development of repair and maintenance infrastructure, etc.

(iv) Monitoring and evaluation of individual projects or programme as a whole, including technical, operational and socio-economic aspects, user feedback, impact assessment, etc., development of management information system for proper coordination and monitoring, etc.

(v) Training, orientation and awareness programmes for various target groups, conferences/seminars/workshops for experience sharing among various stakeholders, etc.

(vi) Development of remote village specific electricity generation systems and packages based on different non-conventional energy technologies.

7.0 CENTRAL FINANCIAL ASSISTANCE (CFA)

a. Central Financial Assistance of up to 90 % of the cost of the non-conventional electricity generation systems (including the cost of Annual Maintenance Contract (AMC), if any, for 5 years) will be provided for approved projects for electrification of remote unelectrified census villages and unelectrified hamlets of electrified census villages, subject to the maximum amounts as given in Annexure-I. The technical specifications and norms will be as per the respective MNRE Programme Division's circulars which may be issued from time to time.

b. The balance cost of the projects can be financed through contribution from state plans, beneficiaries, or other sources. However, it will be necessary that at least half of the balance cost is met from state government's funding.

c. CFA equal to 1.11 times the maximum approved subsidy for a Model-I SPV homelighting system will be provided for BPL households in all the villages/hamlets approved for electrification through non-conventional energy sources.

d. The maximum amount of CFA from the Ministry for electrification of a village/hamlet will be limited to an amount worked out at the rate of Rs. 18,000 per household.

e. Up to 100% of the cost of organizing activities listed at ii to vi in Activities Eligible for Support will be provided Central Financial Assistance on case to case basis on merit of the proposal.

8.0 IMPLEMENTATION MECHANISM

Following sequence of activities will be adopted for approval of financial support and implementation of projects:

i) Notification by the state government identifying nodal implementation agency for the Remote Village Electrification Programme, if not already notified.

ii) Preparation of Detailed Project Reports (DPRs) by the nodal implementing agency as per the enclosed format for the village/hamlets to be taken up for electrification under the programme; preparation of the plan for sustained operation of the projects including the revenue model proposed; and organisation of appropriate village level bodies for actual implementation/overseeing of the work.

iii) Approval of the DPRs and the proposals by the state government including the commitment for balance of the funds in the format given at Annexure-II.

iv) Submission of proposals to the Ministry for support along with the required documents.

v) Competitive bidding process after sanction of the MNRE support. For photovoltaic systems, procurement should be done from suppliers having valid test certificate from MNRE authorized test centre. For biomass gasification systems, procurement should be from a MNRE approved manufacture/supplier.

vi) Implementation of the project

vii) Certification by the authorized village/district level officials/bodies as per the requirements of the national Rural Electrification Policies, that the village has been electrified or that the work has been carried out as per the sanction order/DPR (for SPV homelighting systems).

viii) Periodic monitoring by the state implementing agency/independent agency and submission of report to MNRE.

Any other requirement which may be laid by the Central Government from time to time through policies/regulations/enactments for rural electrification will have to be complied with.

9.0 PROJECT PROPOSALS

Project proposals for electrification of remote villages should be accompanied by a detailed project report as per the formats prescribed in the programme guidelines. The proposals should also contain:

a) Complete census code number (2001 census) of the remote village.

b) Complete list of beneficiaries.

c) Approval of the state government in the format given in Section A.2.

d) Confirmation from the competent village authority that non-conventional energy systems are acceptable in lieu of grid power.

e) Confirmation that the village/hamlets have not been covered under any other programme of the Ministry for providing basic lighting facility.

10.0 PATTERN OF RELEASE OF FUNDS

Release of the Central Financial Assistance for approved projects will be made as per the following pattern:

- Initial release along with the sanction order –70% of the CFA
- Final installment after commissioning – 30% of the CFA

The amount of funds released along with the sanction order should be utilized as early as possible for payment to the suppliers. In case for unavoidable reasons, it is not possible to utilize the funds, the same should be kept in an interest bearing separate bank account and the interest accrued will have to be submitted along with the proposal for second and final release.

Audited Statement of Expenditure (SOE) and utilization certificates (UCs) would be provided by the state implementing agency in the format given in Section A.3. The second installment will be released after receipt of U/Cs and SOEs and required certifications as mentioned at points vii & viii under Implementation Mechanism.

11.0 SERVICE CHARGES TO THE IMPLEMENTING AGENCIES

The implementing agencies under the RVEP are required to undertake survey of the remote village for assessment of demand for electricity and availability of renewable energy resources, prepare DPRs, involve beneficiaries including their awareness and training, ensure tie-up of matching funds, implement projects and ensure the short term and long term functionality of the projects through monitoring during installation as well as subsequently including monitoring by independent agencies, technical backup to users, etc. The Ministry will provide to the implementing agencies a one time service charge of Rs. 50,000 per village/hamlet taken up for electrification through non-conventional energy devices. This support would be released along with and in the same proportion as the central financial Assistance.

12.0 MONITORING ARRANGEMENTS

The concerned State Departments/implementing agencies must ensure close monitoring of the implementing of the projects and provide periodic progress reports to the Ministry. For such monitoring of the projects, the state agencies are required to identify one or more independent organisations and entrust them with this responsibility. The names of such organisations may be intimated along with the proposals. The charges for these organisations would be met out of the service charges released by the Ministry. It is suggested that a reasonable amount out of the service charges be kept separate for payment to the independent monitoring agency. After installation also it will be the responsibility of the implementing agencies to ensure functionality of the systems and periodic monitoring may be carried out by them to oversee this. The district/village level agencies should be closely associated in planning, implementation and monitoring of all projects.

The Ministry may also carry out its own monitoring and evaluation of the projects directly or through independent agencies appointed by it. The regional offices of the Ministry will also be authorized to monitor the projects from time to time and required facilities for this purpose should be provided by the state implementing agency.

13.0 MISCELLANEOUS

This scheme will be effective for the Financial Year 2006-07 from the date of issue of the administrative approval. The projects already initiated with MNRE support will continue to

be financed on the support pattern and under the terms and conditions indicated in the respective sanction letters issued by the Ministry.

The State Government Department/Agencies may initiate action to implement the RVEP during the current financial year as per the scheme. Firmed up project proposals may be forwarded along with the Project Report and other documents as stipulated. The **proposal** would be considered on merit and subject to availability of funds. The final decision on support would rest with the Ministry.

General Terms and Conditions of the Scheme

- The support under the programme is subject to the provisions of GFR of the Government of India.
- The level of CFA considered for the application will be the one which is applicable at the time of sanction of the project.
- It will be desirable that all statutory clearances from the State Government and other bodies are tied up before the proposal is submitted for support.
- The application should be forwarded by the notified department/agency of the State Government which has been entrusted with the responsibility for electrification of remote villages.
- Mere submission of application or seeking of additional information by the Ministry would not mean approval of CFA to any particular project.
- The Ministry may through its own officers or through hired experts, get the performance of the approved project appraised, for its operation as per the stated conditions.
- In addition to the above, the Ministry may also designate outside consultants/institutions for monitoring the performance after commissioning. The project authorities will have to undertake as a precondition for the CFA, to provide all necessary assistance and data to the authorized consultants.
- The implementing agency will also be required to provide data on performance of the project on a six monthly basis to the Ministry for compilation for a period of 3 years.

- The Ministry will have a right to ask for operating and design data from the implementing agency for a period up to three years after commissioning and use the same in whatever manner deemed necessary by it for promotion of the programme and in fulfillment of the objectives.

- The Ministry will have a right to publish case studies/success stories/articles/technical papers on the performance of the project, wherein due acknowledgement to the implementing agency will be given.

- The achievements made during the course of the project will be covered photographically and copies of such photographs shall be sent to the Ministry for its records.

- The implementing agency will display a notice board at a prominent place at the project site to the effect the project has been financially supported by the Ministry.

- The CAG or any other agency/officers authorized by the Ministry will have a right of access to the books of accounts of the beneficiary.

- MNRE reserves the right to add/alter/change these conditions in its sole discretion to ensure wider fulfillment of the interest of the programme.

- Award of CFA by the Ministry will not make it a party to any liability which may arise on account of operation of the project such as accidental injury to persons, damage to surroundings, rehabilitation of displaced persons etc.

Appendix A.1

Pattern of Central Financial Assistance (CFA) for 2006-07 Remote Village Electrification Programme

I- Electrification through SPV Systems

Model I and Model II of solar home systems as specified hereunder would only be eligible for support. For proposals involving other models, Central Financial Assistance (CFA) would be restricted to that applicable for Model II. For BPL households, these amounts will be multiplied by a factor of 1.11.

Amount in Rupees

SPV System		General Category States	Special Category States
Homelighting System Model I	18 W Module, 1 light	5895	6165
Homelighting System Model II	37 W Module, 2 lights	11250	11250
Streetlighting System	74 W Module, 11 W lamp	19602	20578
Power Plants		3,15,000 per kW including modules, batteries, electronic systems, internal cabling, structures, all civil works, fencing, etc. An additional CFA worked out on the basis of Rs. 3150 per household will be given towards the cost of distribution lines, service connections, fittings and fixtures inside the houses.	

The above CFA values are based on the costs which include supply of the systems at the site, installation, commissioning and onsite Annual Maintenance Contract (AMC) for five years including warranty for parts and components such as battery, electronics, lamps, etc. For PV modules, the warranty will be for ten years. State implementing agencies must ensure that the required local service setup has been created by the suppliers for fulfillment of AMC liability.

II - Electrification through Small Hydro Projects

Region	Capacity	Maximum CFA/kW (Rupees)
Plains & other regions of all other States	Up to10 kW	98100
	Above 10 kW and up to 100 kW	92700
	Above 100 kW and up to 1000 kW	68400
Notified Hilly regions of all other States & Islands	Up to10 kW	1,07,100
	Above 10 kW and up to 100 kW	1,01,700
	Above 100 kW and up to 1000 kW	77400
N.E. Regions, Sikkim, Uttaranchal, J&K and Himachal Pradesh (Special Category States)	Up to10 kW	1,16,100
	Above 10 kW and up to 100 kW	1,10,700
	Above 100 kW and up to 1000 kW	86400

The above prices are inclusive of all civil works, distribution network within the village, transportation, installation and commissioning charges and Annual Maintenance Contract for 5 years. The cost of transmission lines from the power plant to the village is not included.

III - Electrification through Biomass Gasifier Projects

Maximum Central Financial Assistance/kW, (Rupees)

Type of System	Gasifier rating	Plain	Hilly areas	North-East
100% Producer Gas	Up to 10 kWe	68040	71442	74844
	>10 up to 20 kWe	48528	50954	53380
	>20 up to 50 kWe	49500	51975	54450
	>50 kWe	43726	45912	48099
Dual fuel	Up to 10 kWe	60466 (63,000)	63489 (66150)	66512 (69300)
	>10 up to 20 kWe	40,500	42525	44550
	>20 up to 50 kWe	36000	37800	39600
	>50 kWe	31500	33075	34650

Note: 1. Figures in brackets include increases in cost on account of oil ghani.

2. *Prices are inclusive of 5 year AMC(2years warranty + 3 years), distribution network within the village, all civil works, transportation charges and installation and commissioning charges.*

Appendix A.2

Format for Approval of the State Energy/ Power Department

***Subject:* Proposals for Electrification of Remote Villages/ Hamlets through Non-Conventional Energy Sources**

This is with reference to proposal for electrification of ____ no. of villages/hamlets prepared by ……..(name of the agency) which is notified by the state government as the implementing agency for electrification of remote villages/hamlets. The proposal is being submitted for approval of MNRE financial support under the Remote Village Electrification Programme.

This is to confirm that the proposal has approval of the state government and it is also confirmed that the state government will be responsible for, i) mobilizing balance of the funds required, including the minimum stipulated contribution from the state and, ii) long term sustainability of the systems.

____(name of the agency) will be responsible at the field level for repair and maintenance, upgradation, upkeep, etc. of the systems installed under the project.

Signed

Authorized Signatory
Energy/Power Department

Appendix A.3

Form of Utilisation Certificate

(As per Form GFR 19-A GOI Decision (1) below Rule 150)

Name of Organisation: _____

Financial Year: _____

S. No.	***MNRE sanction for Released amount***		
	Letter No.	**Date**	**Amount** (Rs. in Lakhs)
		TOTAL:	

1. *Certified that out of Rs. _____ of grants-in-aid sanctioned during the year _____ in favour of _____ under Ministry of New and Renewable Energy letter no. given in the margin and Rs. _____ on account of unspent balance of the previous year, a sum of Rs. _____ has been utilised for the purpose of _____ for which it was sanctioned and that the balance of Rs. _____ remaining unutilised at the end of the year has been surrendered to Government(vide No. _____ dated _____)/will be adjusted during towards the grants-in-aid payable during the next year _____ .*

2. *Certified that I have satisfied myself that the conditions on which the grants-in-aid was sanctioned have been duly fulfilled/are being fulfilled and that I have exercised the following checks to see that the money was actually utilised for the purpose for which it was sanctioned.*

Date: _____ ***Signature of P. I.*** _____

Place: _____ ***Designation*** _____

Signature: _____ ***Signature*** _____

Head of Deptt. of Project ***Accounts Officer of Project***

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Appendix Tables

Appendix Table 1: Distribution of Beneficiary Households by Castes (%)

State	SC	ST	OBC	General	Total	Sample Size
Odisha	7.5	83.2	8.8	0.6	100	2200
Madhya Pradesh	1.7	71.7	24.6	2.1	100	1508
Chhattisgarh	3.1	78.1	17.8	1.0	100	1500

Appendix Table 2: Average Family Size and Children of the Beneficiary Households

State	Below 14 Years		Above 14 Years		Average family Size
	Female	Male	Female	Male	
Odisha	3518	3574	2173	2205	5.2
Madhya Pradesh	2452	3222	1886	2072	6.4
Chhattisgarh	2385	2498	1212	1249	4.9

Appendix Table 3: Percentage Level of Education of the Head of the Households

State	Illiterate	Literate without Formal Education	Up to Primary	Up to Middle	High School & Above	Total
Odisha	48.2	20.5	16.3	8.6	6.4	100
Madhya Pradesh	77.0	5.1	12.9	3.2	1.9	100
Chhattisgarh	42.6	15.7	22.2	12.5	6.9	100

Appendix Table 4: Percentage of Households with Primary Occupation

State	Agriculture	Animal Husbandry & Fishing	Agricultural Wages	Non-Agricultural Wages	Salary, Business & Others	Total
Odisha	64.3	1.0	2.0	26.9	5.8	100
Madhya Pradesh	45.8	2.1	7.4	42.5	2.1	100
Chhattisgarh	16.3	1.7	36.3	41.1	4.6	100

Appendix Table 5: Average Annual Households Income from all sources with per capita income (Rs)

State	HH Income (Rs)	Per capita Income
Odisha	19275	3779.7
Madhya Pradesh	26448	4053.4
Chhattisgarh	20731	5121.7

Appendix Table 6: Year of Activation of Solar Light

State	2003	2004	2006	2007	2008	2009	2010	Sample Size
Odisha				341	1212	647		2200
Madhya Pradesh				505	377	496	130	1508
Chhattisgarh	308	288	130	615	159	0	0	1500

Appendix Table 7: On an average how much did they pay for the system and for the Installation? (Rs)

State	Payment for System	Payment for Installation	Total
Odisha	113	107	186.7
Madhya Pradesh	235	155	285.0
Chhattisgarh	118	133	251.0

Appendix Table 8: Number of lamps given to you

State	One	Two	Three	Total
Odisha	1056	1145	0	2200
Madhya Pradesh	1500	7	0	1508
Chhattisgarh	232	1260	7	1500

Appendix Table 9: Are the lamps sufficient to you? (%)

State	Yes	No	Total
Odisha	39.8	60.3	100
Madhya Pradesh	52.8	47.2	100
Chhattisgarh	42.4	57.6	100

Appendix Table 10: Are you willing to pay more for additional light? (%)

State	Yes	No	Total
Odisha	46.0	54.0	100
Madhya Pradesh	49.4	50.6	100
Chhattisgarh	26.4	73.7	100

Appendix Table 11: On an average willing to pay more (Rs) and current monthly payment

State	Rs	Rs
Odisha	14	19
Madhya Pradesh	24	18
Chhattisgarh	17	5

Appendix Table 12: Life period of Battery (%)

State	1year	3 Years	5 Years	Above 5 Years	Life Long	Total
Odisha	2.3	5.3	83.6	7.7	1.1	100
Madhya Pradesh	13.7	56.8	26.2	3.3	0.0	100
Chhattisgarh	5.8	23.2	66.7	2.9	1.5	100

Appendix Table 13: Do you know the battery has to be replaced every five years? (%)

State	Yes	No	Total
Odisha	30.1	69.9	100
Madhya Pradesh	10.2	89.8	100
Chhattisgarh	3.0	97.0	100

Appendix Table 14: Response on plans for future replacement of the battery (%)

State	Savings per month	Borrow from relatives	Borrow from bank	VEC collect	No plan	Can't replace	Total
Odisha	14.8	4.6	0.3	12.3	66.4	1.6	100
Madhya Pradesh	10.0	5.2	2.1	1.9	65.8	15.1	100
Chhattisgarh	0.1	0.2	0.0	0.0	99.7	0.0	100

Appendix Table 15: Do you know that banks provide loan for replacement of battery? (%)

State	Yes	No	Total
Odisha	2.8	97.2	100
Madhya Pradesh	15.5	84.5	100
Chhattisgarh	3.4	96.6	100

Appendix Table 16: Is System working since it was given? (%)

State	Yes	No	Total
Odisha	67.9	32.1	100
Madhya Pradesh	77.6	22.4	100
Chhattisgarh	85.8	14.2	100

Appendix Table 17: Number of days did not work

State	No. of Days
Odisha	48
Madhya Pradesh	46
Chhattisgarh	14

Appendix Table 18: Who do you contact in case of any complaint? (%)

State	Local Mechanic	VEC	Gram Panchayat	Supplier's technician	Others	Total
Odisha	31.2	53.8	1.3	8.5	5.2	100
Madhya Pradesh	2.9	5.5	46.3	6.9	38.4	100
Chhattisgarh	88.2	4.5	0.0	7.0	0.3	100

Appendix Table 19: Reasons for not being satisfied (%)

State	no one is here to repair/ check the system	VEC is not available	Technician not repaired properly	condition of the system is not good	Any other	Total
Odisha	44.3	8.4	15.9	2.6	28.8	100
Madhya Pradesh	65.7	9.2	2.9	2.2	20.0	100
Chhattisgarh	16.3	4.1	29.6	1.0	49.0	100

Appendix Table 20: On an average how many hours per day the Luminaires work? (%)

State	During Rainy Season				
	> 3 hr	3-4hr	4-5 hr	< 5 hr	Total
Odisha	50.4	38.4	10.3	1.0	100
Madhya Pradesh	73.3	25.4	1.4	0.0	100
Chhattisgarh	45.5	22.6	31.8	0.1	100

Appendix Table 21: On an average how many hours per day the Luminaires work? (%)

State	During Winter Season				
	> 3 hr	3-4hr	4-5 hr	< 5 hr	Total
Odisha	4.6	40.9	38.4	16.2	100
Madhya Pradesh	12.9	53.0	33.3	0.8	100
Chhattisgarh	0.4	39.1	28.3	32.2	100

Appendix Table 22: On an average how many hours per day the Luminaires work? (%)

State	During Summer Season				
	> 3 hr	3-4hr	4-5 hr	< 5 hr	Total
Odisha	2.6	19.7	38.6	39.2	100
Madhya Pradesh	1.7	11.0	45.3	42.1	100
Chhattisgarh	0.1	21.0	36.8	42.1	100

Appendix Table 23: On an average how many hours per day the Luminaires work? (%)

State	Rainy Season					
	Year	> 3 hr	3-4hr	4-5 hr	< 5 hr	Total
Odisha	2007	69.8	22.0	6.7	1.5	100
	2008	40.9	43.5	14.2	1.4	100
	2009	57.9	37.4	4.8	0.0	100

Appendix Table 24: On an average how many hours per day the Luminaires work? (%)

State	Winter Season					
	Year	> 3 hr	3-4hr	4-5 hr	< 5 hr	Total
Odisha	2007	9.1	38.1	43.4	9.4	100
	2008	4.2	38.3	33.8	23.7	100
	2009	3.1	47.1	44.1	5.7	100

Appendix Table 25: On an average how many hours per day the Luminaires work? (%)

State	Summer Season					
	Year	> 3 hr	3-4hr	4-5 hr	< 5 hr	Total
Odisha	2007	6.7	17.6	39.6	36.1	100
	2008	2.6	20.8	31.3	45.3	100
	2009	0.3	18.7	51.7	29.3	100

Appendix Table 26: On an average how many hours per day the Luminaires work? (%)

State	Rainy Season				
	Year	> 3 hr	3-4hr	4-5 hr	Total
Madhya Pradesh	2007	72.1	27.3	0.6	100
	2008	69.8	29.7	0.5	100
	2009	75.6	21.4	3.0	100
	2010	79.2	20.0	0.8	100

Appendix Table 27: On an average how many hours per day the Luminaires work? (%)

State	Winter Season					
	Year	> 3 hr	3-4hr	4-5 hr	< 5 hr	Total
Madhya Pradesh	2007	15.5	54.7	29.5	0.4	100
	2008	8.8	61.0	30.0	0.3	100
	2009	16.8	51.7	29.7	1.8	100
	2010	0.0	28.5	71.5	0.0	100

Appendix Table 28: On an average how many hours per day the Luminaires work? (%)

State	Summer Season					
	Year	> 3 hr	3-4hr	4-5 hr	< 5 hr	Total
Madhya Pradesh	2007	2.2	10.5	47.3	40.0	100
	2008	0.8	10.9	49.3	39.0	100
	2009	1.8	11.5	39.8	46.9	100
	2010	1.5	10.8	46.9	40.8	100

Appendix Table 29: On an average how many hours per day the Luminaires work? (%)

State	Rainy Season					
	Year	> 3 hr	3-4hr	4-5 hr	< 5 hr	Total
Chhattisgarh	2003	25	32.8	42.2	0	100
	2004	75.4	14.2	10.4	0.0	100
	2006	75.4	18.5	6.2	0.0	100
	2007	35.3	23.3	41.3	0.2	100
	2008	46.2	18.4	34.8	0.6	100

Appendix Table 30: On an average how many hours per day the Luminaires work? (%)

State	Winter Season					
	Year	> 3 hr	3-4hr	4-5 hr	< 5 hr	Total
Chhattisgarh	2003	0	28.9	29.9	41.2	100
	2004	0.4	55.6	34.7	9.4	100
	2006	0.8	70.8	23.1	5.4	100
	2007	0.7	27.6	27.3	44.4	100
	2008	0.0	47.5	21.5	31.0	100

Appendix Table 31: On an average how many hours per day the Luminaires work? (%)

State	Summer Season					
	Year	> 3 hr	3-4hr	4-5 hr	< 5 hr	Total
Chhattisgarh	2003	0	13.6	29.6	56.8	100
	2004	0	33.0	50.0	17.0	100
	2006	0	38.5	51.5	10.0	100
	2007	0.2	11.9	34.3	53.7	100
	2008	0	34.8	24.7	40.5	100

Appendix Table 32: Type of Problems faced by the Beneficiaries (%)

State	Light goes after 2 hr	Does not work in rainy season	Poor battery	Loose wiring	No TV/music	Others	Total
Odisha	6.9	33.8	4.5	5.9	14.9	34.2	100
Madhya Pradesh	2.4	69.0	3.5	6.6	12.9	5.6	100
Chhattisgarh	8.6	79.9	0.7	1.5	5.6	3.7	100

Appendix Table 33: When are the problems more frequent? (%)

State	Rainy season	Winters	Summers	Others	Total
Odisha	75.2	1.8	0.2	22.9	100
Madhya Pradesh	80.0	9.5	0.1	10.4	100
Chhattisgarh	97.2	2.6	0.1	0.1	100

Appendix Table 34: Did you receive training regarding maintenance of the system? (%)

State	Yes	No	Total
Odisha	31.2	68.8	100
Madhya Pradesh	1.3	98.7	100
Chhattisgarh	6.1	93.9	100

Appendix Table 35: Do you think you need training for self-maintenance of the system? (%)

State	Yes	No	Total
Odisha	65.8	34.2	100
Madhya Pradesh	64.9	35.1	100
Chhattisgarh	39.1	60.9	100

Appendix Table 36: Do you have trained person in the village? (%)

State	Yes	No	Total
Odisha	51.9	48.1	100
Madhya Pradesh	9.4	90.6	100
Chhattisgarh	95.4	4.6	100

Appendix Table 37: Number of trained persons per village (% of response)

State	1 person	2 person	3 person	4 person	5 person	Total
Odisha	12.4	84.3	2.9	0.2	0.2	100
Madhya Pradesh	80.9	15.6	1.4	0.7	1.4	100
Chhattisgarh	69.7	27.2	3.1	0.0	0.0	100

Appendix Table 38: Do you call them for services if required? (%)

State	Yes	No	Total
Odisha	96.8	3.2	100
Madhya Pradesh	78.7	21.3	100
Chhattisgarh	97.3	2.7	100

Appendix Table 39: Was there any awareness campaign organized after installation? (%)

State	Yes	No	Total
Odisha	63.4	36.6	100
Madhya Pradesh	1.3	98.7	100
Chhattisgarh	73.5	26.6	100

Appendix Table 40: Awareness campaign organized by whom? (%)

State	Suppliers	VEC	Others	Total
Odisha	83.7	7.5	8.8	100
Madhya Pradesh	15.0	40.0	45.0	100
Chhattisgarh	23.7	2.7	73.6	100

Appendix Table 41: Percentage of HH which attended the campaign

State	Yes	No	Total
Odisha	77.5	22.5	100
Madhya Pradesh	95.0	5.0	100
Chhattisgarh	75.8	24.3	100

Appendix Table 42: Is there any Village Energy Committee (VEC) constituted under RVEP? (%)

State	Yes	No	Don't Know	Total
Odisha	93.6	1.1	5.4	100
Madhya Pradesh	15.5	58.6	26.0	100
Chhattisgarh	84.5	4.3	11.2	100

Appendix Table 43: Do you face any problem regarding maintenance/servicing/ replacement of spare parts? (%)

State	Yes	No	Total
Odisha	44.4	55.6	100
Madhya Pradesh	50.7	49.3	100
Chhattisgarh	53.0	47.0	100

Appendix Table 44: Reasons for not being satisfied from open ended (%)

State	now there is no one who comes to check the problem	charge control is making problem immediately	no additional cost should be charged for repairing	spare parts are not available	Total
Odisha	4.2	95.4	0.2	0.3	100
Madhya Pradesh	13.3	86.7	0.0	0.0	100
Chhattisgarh	0.3	99.7	0.0	0.0	100

Appendix Table 45: Last visit by the technician (% responses)

State	Week before	Month before	3-4 months before	More than 4 months before	Total
Odisha	0.6	38.4	40.0	21.0	100
Madhya Pradesh	0.7	35.8	41.4	22.1	100
Chhattisgarh	0.0	47.8	26.1	26.1	100

Appendix Table 46: Is there any service card maintained by technician? (%)

State	Yes	No	Total
Odisha	1.3	98.7	100
Madhya Pradesh	0.1	99.9	100
Chhattisgarh	13.0	87.0	100

Appendix Table 47: Are you satisfied with the solar lighting system in lieu of grid extension? (%)

State	Yes	No	Total
Odisha	59.6	40.4	100
Madhya Pradesh	75.0	25.0	100
Chhattisgarh	79.2	20.8	100

Appendix Table 48: How much did you pay for repairing? (Rs)

State	Rs
Odisha	74
Madhya Pradesh	93
Chhattisgarh	65

Appendix Table 49: Beneficiaries rank most important reasons for not being satisfied (%)

State	Spare parts not easily available	Battery problem	Lack of skilled persons for maintenance	Unaffordable	Irregular agency services	Charge controller not working in time	Low Voltage	Others	Total
Odisha	41.9	7.5	13.2	2.8	13.7	3.9	6.1	10.9	100
Madhya Pradesh	35.5	17.0	30.0	0.0	3.7	9.8	0.8	3.2	100
Chhattisgarh	18.3	11.9	2.6	0.6	6.4	1.3	24.7	34.3	100

Appendix Table 50: What Fuels are used for cooking and lighting by the Households? (%)

Odisha

Particulars	Before Solar Light Installation				After Solar Light Installation			
	Cooking		Lighting		Cooking		Lighting	
	Yes	No	Yes	No	Yes	No	Yes	No
Electricity	0.1	99.9	0.4	99.6	0.1	100	94.5	5.5
kerosene	38.6	61.5	99.2	0.8	0.7	99.3	91.4	8.6
LPG	0	100	0.2	99.8	0	100	0	100
Edible Oil	0.1	100	1.9	98.1	0	100	0	100

Appendix Table 51: What Fuels are used for cooking and lighting by the Households? (%)

Madhya Pradesh

Particulars	Before Solar Light Installation				After Solar Light Installation			
	Cooking		Lighting		Cooking		Lighting	
	Yes	No	Yes	No	Yes	No	Yes	No
Electricity	0.1	99.9	0.5	99.5	0.5	99.5	97.88	2.12
kerosene	0.6	99.4	98.5	1.5	36.5	63.5	93.8	6.2
LPG	0	100	0.1	99.9	0	100	0.1	99.9
Edible Oil	0.1	99.9	0.3	99.7	0.1	99.9	0.2	99.8

Appendix Table 52: What Fuels are used for cooking and lighting by the Households? (%)

Chhattisgarh

Particulars	Before Solar Light Installation				After Solar Light Installation			
	Cooking		Lighting		Cooking		Lighting	
	Yes	No	Yes	No	Yes	No	Yes	No
Electricity	0.1	99.9	2.0	98.0	0.1	99.9	98	2
kerosene	3.9	96.1	97.1	2.9	2.7	97.3	99.5	0.5
LPG	0.1	99.9	0.1	99.9	0.3	99.7	1.5	98.5
Edible Oil	0	100	0.1	99.9	0	100	0	100

Appendix Table 53: Total consumption of kerosene from PDS and open market per month (average) (in litres)

State	Total consumption of Kerosene		Entitlement of Kerosene from PDS
	Before	After	
Odisha	3.2	1.9	3.0
Madhya Pradesh	4.9	3.4	4.5
Chhattisgarh	4.7	2.3	2.3

Appendix Table 54: Rupee per litre of kerosene after and before Solar Light Installation

State	Before RVEP	After RVEP
Odisha	12	12
Madhya Pradesh	11	11
Chhattisgarh	10	12

Appendix Table 55: Percentage of beneficiaries getting Kerosene from PDS before and after Solar Light Installation

State	Sample size	Before	After	Before %	After %
Odisha	2201	2195	2088	99.7	94.9
Madhya Pradesh	1507	1456	1343	96.6	89.1
Chhattisgarh	1499	1445	1414	96.4	94.3

Appendix Table 56: Do you get the amount of kerosene as per your entitlement? (%)

State	Yes	No	Total
Odisha	66.6	33.4	100
Madhya Pradesh	76.2	23.8	100
Chhattisgarh	93.5	6.5	100

Appendix Table 57: What are the major uses of kerosene purchased from PDS? (%)

State	For Lighting	Cooking	Selling at the open market	for specific religious festivals	required for marriages	for get together	store it for future use	others	Total
Odisha	82.6	0.2	1.0	4.3	0.3	0.9	10.3	0.5	100
Madhya Pradesh	95.3	0.6	0.1	0.3	0.1	0.0	0.4	3.3	100
Chhattisgarh	92.3	0.3	0.3	1.7	0.0	0.1	2.8	2.6	100

Appendix Table 58: Do you get kerosene as much as you need from open market? (%)

State	Yes	No	Total
Odisha	21.1	78.9	100
Madhya Pradesh	60.2	39.8	100
Chhattisgarh	27.4	72.6	100

Appendix Table 59: What are the major advantages of the solar lighting system in fuel expenditure? (%)

State	Not buying kerosene at all now	Buying kerosene only from PDS quota	Sell the excess kerosene to the neighbour at higher price	Sell the excess kerosene to open market	others	Total
Odisha	9.5	82.6	0.1	0.9	6.9	100
Madhya Pradesh	7.9	33.1	8.6	5.2	45.2	100
Chhattisgarh	0.6	91.8	0.9	0.1	6.7	100

Appendix Table 60: The new Sources of Income opened up for whom (% Responses)

State	For Male	For Female	Both	Total
Odisha	13.0	53.0	34.0	100
Madhya Pradesh	19.0	37.3	43.8	100
Chhattisgarh	65.6	15.6	18.8	100

Appendix Table 61: Income per month (Rs)

State	Before RVEP	After RVEP
Odisha	1509	1641
Madhya Pradesh	2075	2222
Chhattisgarh	1632	1749

Appendix Table 62: Various benefits realized by households (%)

Odisha

Benefits	Significant Improvement	Minor Improvement	No change	No opinion
Increase in Income	16.0	23.7	60.0	0.2
Improved Standard of Living	15.3	42.3	41.6	0.8
Better Education to Children	28.2	51.8	17.3	2.7
Convenience in Household Work	48.3	48.0	3.1	0.5
Malaria reduced after solar lights	2.1	12.0	51.4	34.5

Appendix Table 63: Various benefits realized by households (%)

Madhya Pradesh

Benefits	Significant Improvement	Minor Improvement	No change	No opinion
Increase in Income	3.3	72.5	24.1	0.2
Improved Standard of Living	19.4	78.1	2.4	0.1
Better Education to Children	52.4	40.5	6.0	1.1
Convenience in Household Work	39.1	47.8	11.8	1.3
Malaria reduced after solar lights	3.9	15.3	45.5	35.3

Appendix Table 64: Various benefits realized by households (%)

Chhattisgarh

Benefits	Significant Improvement	Minor Improvement	No change	No opinion
Increase in Income	0.5	12.8	85.7	1.0
Improved Standard of Living	1.3	47.9	49.9	0.9
Better Education to Children	34.0	64.4	0.9	0.7
Convenience in Household Work	34.6	64.2	1.0	0.2
Malaria reduced after solar lights	0.7	17.6	22.8	58.8

Appendix Table 65: What is your overall rating of Solar Home Lighting System under Following Criteria? (%)

State	Availability/ Duration of Light					
	Very Good	Good	Average	Poor	Don't Know	Total
Odisha	21.5	52.9	17.6	7.6	0.4	100
Madhya Pradesh	25.4	62.2	11.5	0.4	0.5	100
Chhattisgarh	22.0	57.8	19.1	1.1	0.1	100

Appendix Table 66: What is your overall rating of Solar Home Lighting System under Following Criteria? (%)

State	Quality of the Light Availability					
	Very Good	Good	Average	Poor	Don't Know	Total
Odisha	12.7	52.8	24.7	7.9	2.0	100
Madhya Pradesh	23.2	64.4	10.5	1.3	0.7	100
Chhattisgarh	12.9	69.2	16.7	0.7	0.5	100

Appendix Table 67: What is your overall rating of Solar Home Lighting System under Following Criteria? (%)

State	Service of the Technician/ Manufacturer					
	Very Good	Good	Average	Poor	Don't Know	Total
Odisha	6.0	29.0	21.7	38.9	4.3	100
Madhya Pradesh	3.6	3.5	11.6	67.2	14.2	100
Chhattisgarh	5.5	81.8	11.1	0.7	0.9	100

Appendix Table 68: What is your overall rating of Solar Home Lighting System under Following Criteria? (%)

State	Availability of Spare Parts					
	Very Good	Good	Average	Poor	Don't Know	Total
Odisha	1.9	11.7	21.1	45.2	20.0	100
Madhya Pradesh	0.3	1.3	5.5	63.6	29.4	100
Chhattisgarh	2.6	10.3	36.4	9.6	41.2	100

Appendix Table 69: What is your overall rating of Solar Home Lighting System under Following Criteria? (%)

State	Support from the VEC					
	Very Good	Good	Average	Poor	Don't Know	Total
Odisha	30.4	51.2	11.2	5.5	1.7	100
Madhya Pradesh	1.4	3.0	12.8	32.9	50.0	100
Chhattisgarh	11.9	78.7	2.9	0.7	5.9	100

Appendix Table 70: The Female member of the household feel RVEP has empowered them (%)

State	Independence		
	Yes	No	Total
Odisha	68.1	31.9	100
Madhya Pradesh	31.5	68.5	100
Chhattisgarh	21.5	78.5	100

Appendix Table 71: The Female member of the household feel RVEP has empowered them (%)

State	Improved Standard of Living of the Family		
	Yes	No	Total
Odisha	55.2	44.8	100
Madhya Pradesh	96.2	3.9	100
Chhattisgarh	56.6	43.4	100

Appendix Table 72: The Female member of the household feel RVEP has empowered them (%)

State	Better Education to Children		
	Yes	No	Total
Odisha	76.0	24.0	100
Madhya Pradesh	89.7	10.4	100
Chhattisgarh	98.7	1.3	100

Appendix Table 73: Most Important suggestions which would improve the electrification through Solar Lighting System

State	Require more street lights	The capacity of the battery should be increased	Permanent technician should be appoint here	Power of luminaire/battery should increase	more awareness should be spread	2-3 service centres needed in the village	they should provide two luminaires	Total
Odisha	1.3	9.1	32.2	12.3	18.9	22.7	3.6	100
Madhya Pradesh	8.9	27.6	25.8	15.6	8.3	7.3	6.6	100
Chhattisgarh	0.5	0.9	8.9	85.9	1.8	1.5	0.5	100

Appendix Table 74: Other than single/double lamps, what other appliances are being used by the households using SPV home lighting system? (%)

State	Electric Fan		Radio		Tap Recorder		Television	
	Yes	No	Yes	No	Yes	No	Yes	No
Odisha	0.2	99.8	15.1	84.9	1.2	98.8	2.0	98.0
Madhya Pradesh	0.4	99.6	6.5	93.5	2.4	97.6	1.0	99.0
Chhattisgarh	4.3	95.7	6.0	94.0	0.5	99.5	5.5	94.5

Appendix Table 75: Other than single/double lamps, what other appliances are being used by the household using SPV home lighting system? (%)

State	Electric Iron		Sewing Machine		Mobile Charging	
	Yes	No	Yes	No	Yes	No
Odisha	0.1	100.0	0.5	99.6	9.7	90.3
Madhya Pradesh	0.1	99.9	0.1	99.9	28.6	71.4
Chhattisgarh	0.2	99.8	0.3	99.7	9.3	90.7

Appendix Table 76: Average monthly expenditure on lighting (Rs)

State	Before Solar	After Solar
Odisha	35	29
Madhya Pradesh	57	33
Chhattisgarh	24	23

Appendix Table 77: What is the New Source of Income in the Household? (%)

Odisha

Sources of Income	Before RVEP		After RVEP	
	Yes	No	Yes	No
Agriculture	90.2	9.8	90.2	9.8
Animal Husbandry	39.9	60.2	40.8	59.2
Fishing	0.3	99.7	0.4	99.6
Agricultural Wages	16.5	83.6	16.5	83.5
Non-Agricultural Wages	55.2	44.8	55.1	44.9
Salary	3.0	97.0	3.0	97.0
Business/Shop	4.0	96.1	4.8	95.2
Weaving	6.1	93.9	0.4	99.6
Stitching/Embroidery	8.2	91.8	15.0	85.0
Tutorials	0.3	99.7	0.6	99.4
Others Specify	10.5	89.5	16.0	84.0

Appendix Table 78: What is the New Source of Income in the Household? (%)
Madhya Pradesh

Sources of Income	Before RVEP		After RVEP	
	Yes	No	Yes	No
Agriculture	86.5	13.5	100	0
Animal Husbandry	69.7	30.3	70.7	29.3
Fishing	1.3	98.7	1.4	98.6
Agricultural Wages	34.8	65.2	34.8	65.2
Non-Agricultural Wages	77.7	22.3	77.7	22.3
Salary	1.1	98.9	1.0	99.0
Business/Shop	1.5	98.5	2.2	97.8
Weaving	0	100	12.0	88.0
Stitching/Embroidery	0.1	99.9	3.3	96.8
Tutorials	0	100	0.5	99.5
Others Specify	1.0	99.0	2.9	97.1

Appendix Table 79: What is the New Source of Income in the Household? (%)
Chhattisgarh

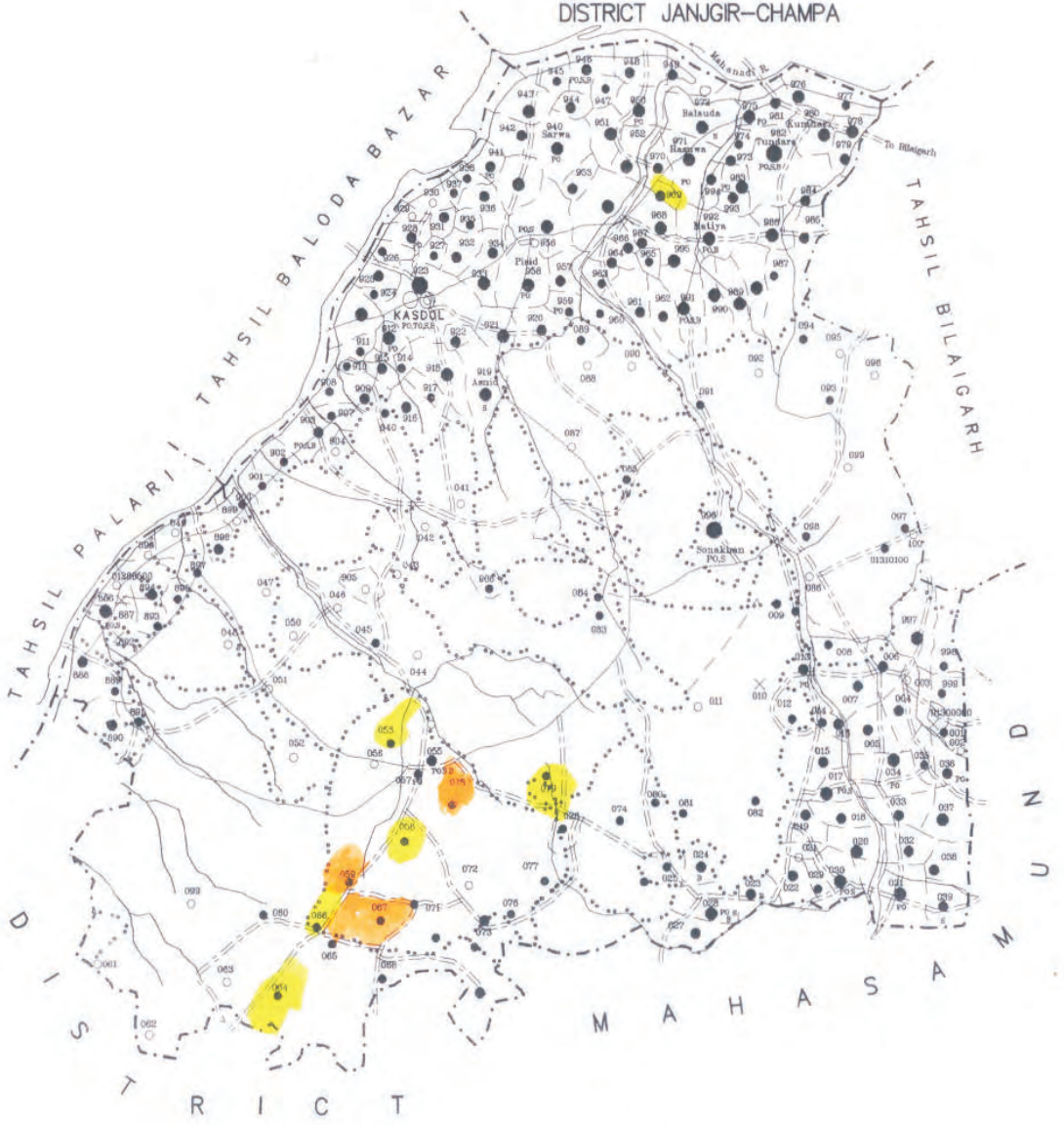
Sources of Income	Before RVEP		After RVEP	
	Yes	No	Yes	No
Agriculture	19.7	80.3	100	0
Animal Husbandry	45.2	54.8	44.7	55.3
Fishing	1.2	98.8	1.9	98.1
Agricultural Wages	74.9	25.1	74.5	25.5
Non-Agricultural Wages	78.2	21.8	77.7	22.3
Salary	3.0	97.0	3.2	96.8
Business/Shop	1.3	98.7	1.3	98.7
Weaving	2.1	97.9	2.1	97.9
Stitching/Embroidery	2.2	97.8	2.5	97.5
Tutorials	0.4	99.6	0.5	99.5
Others Specify	8.3	91.7	8.9	91.1

Appendix Table 80: How often does the household clean the module installed outside the house? (%)

State	Never	Weekly	Fortnightly	Monthly	Quarterly	Total
Odisha	39.1	17.2	5.4	22.9	15.4	100
Madhya Pradesh	4.9	24.1	46.7	17.9	6.4	100
Chhattisgarh	7.8	1.3	87.0	3.9	0	100

Appendix Table 81: How often does the household keep the module outside for the whole day? (%)

State	Yes	No	Total
Odisha	77.3	22.7	100
Madhya Pradesh	89.7	10.3	100
Chhattisgarh	3.9	96.1	100



INDIA
CHHATTISGARH
TAHSIL KASDOL
C.D. BLOCK KASDOL
DISTRICT RAIPUR

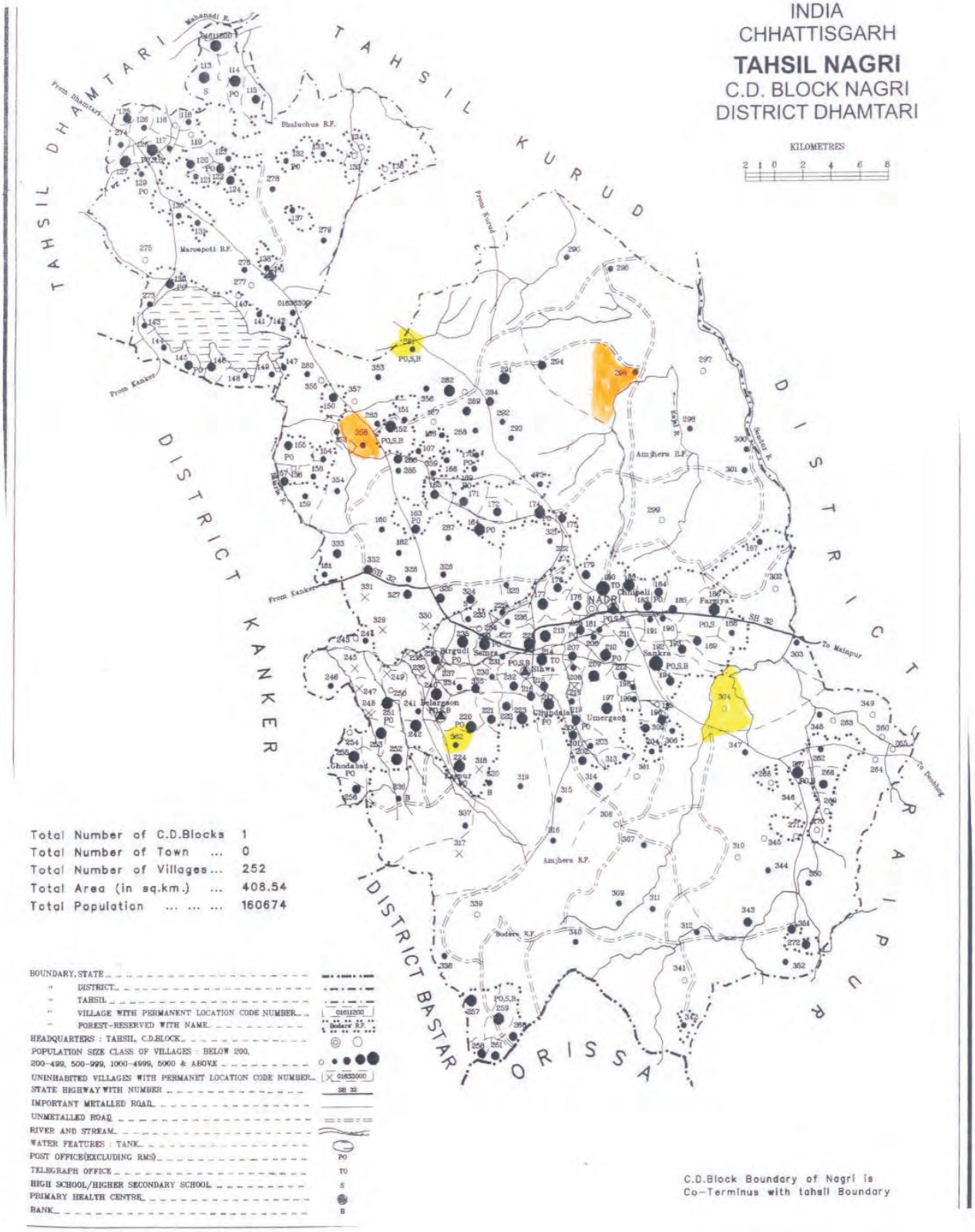
KILOMETRES
12 10 0 2 4 6 8

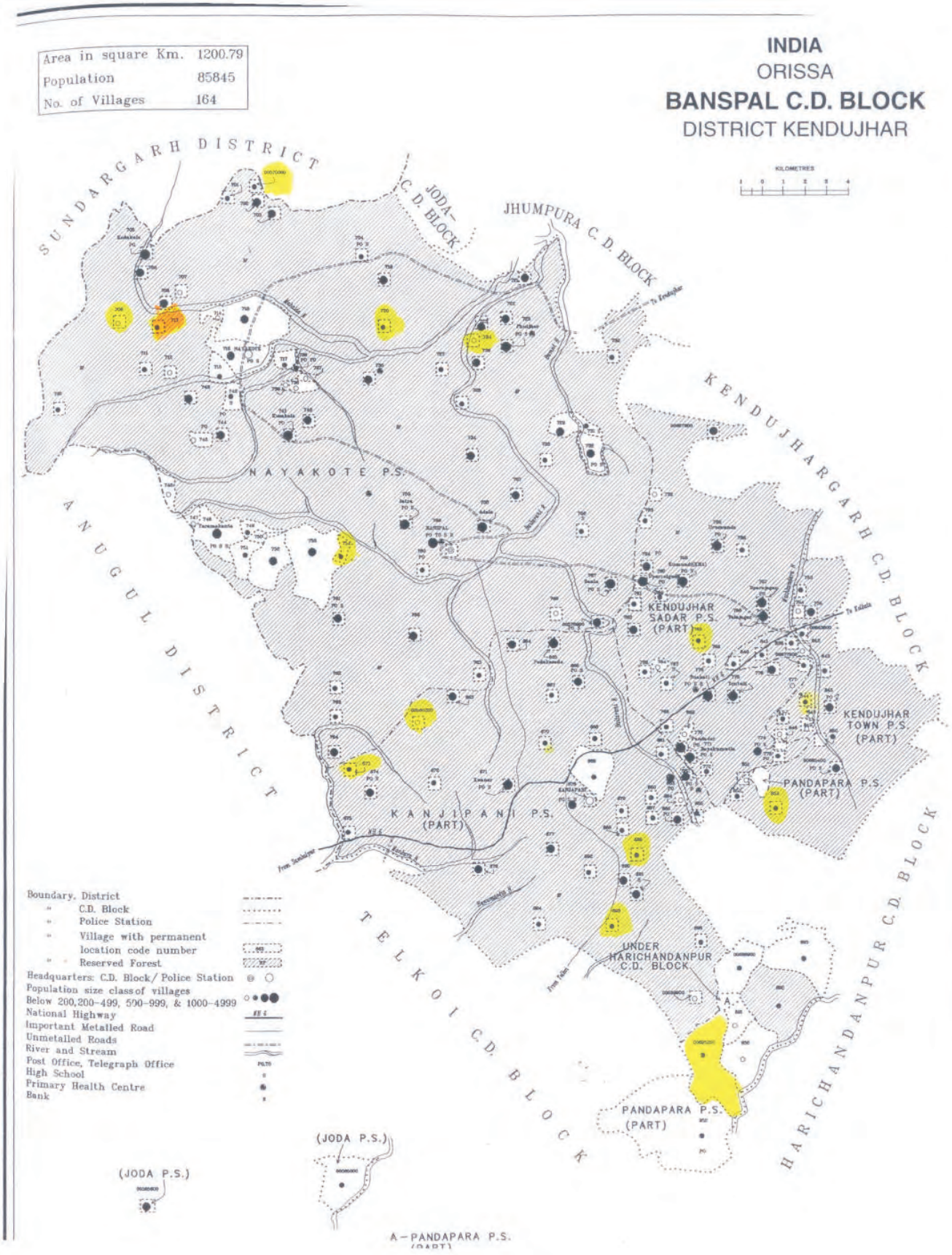
Total number of C.D.Blocks	1
Total number of Town(s)	0
Total number of Villages	217
Total Area (in Sq.Km)	679.88
Total Population	160093

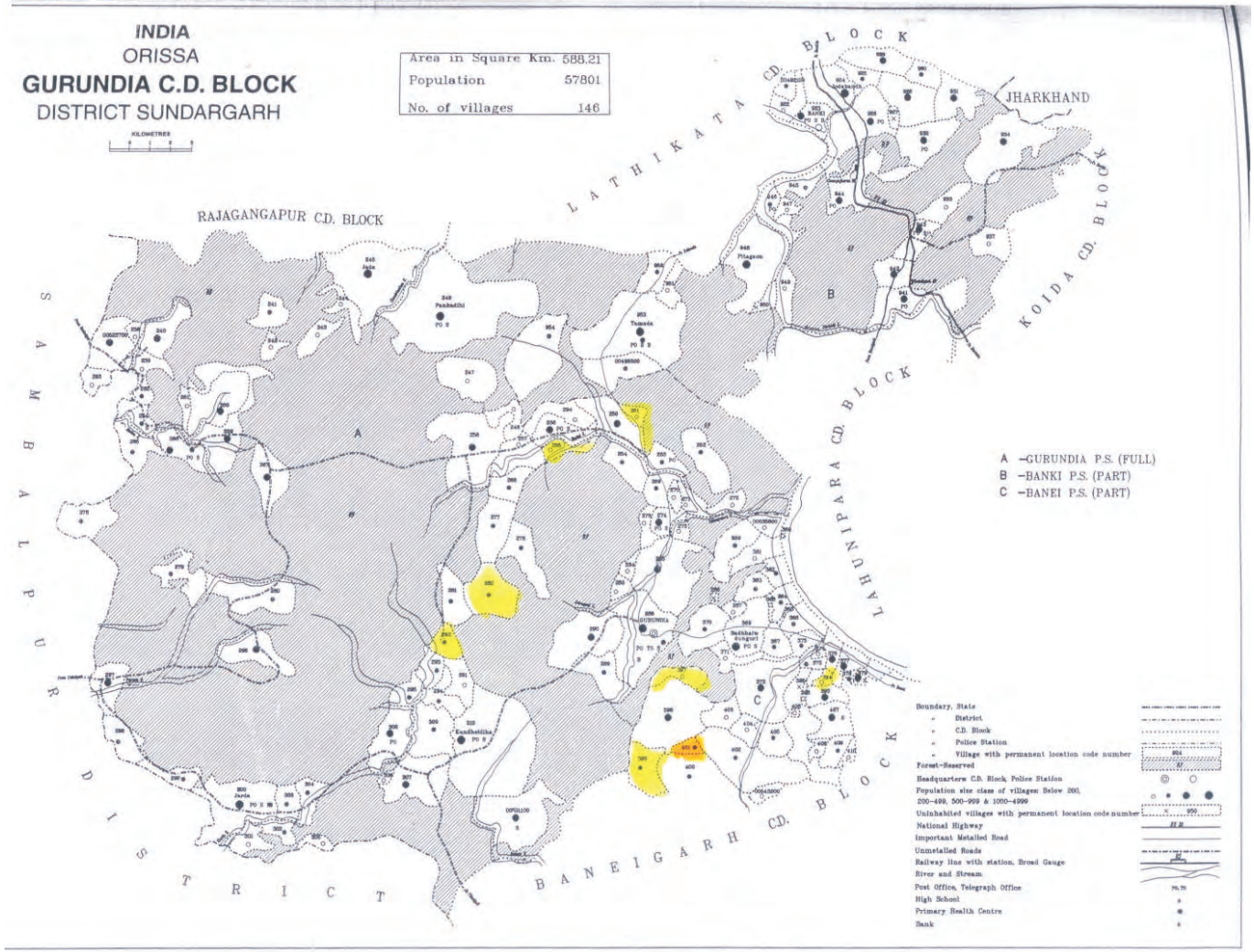
C.D.Block boundary of Kasdol is co-terminus with tahsil boundary.

BOUNDARY: DISTRICT
- TAHSIL
- VILLAGE WITH PERMANENT LOCATION CODE NUMBER
- FOREST-RESERVED WITH NAME

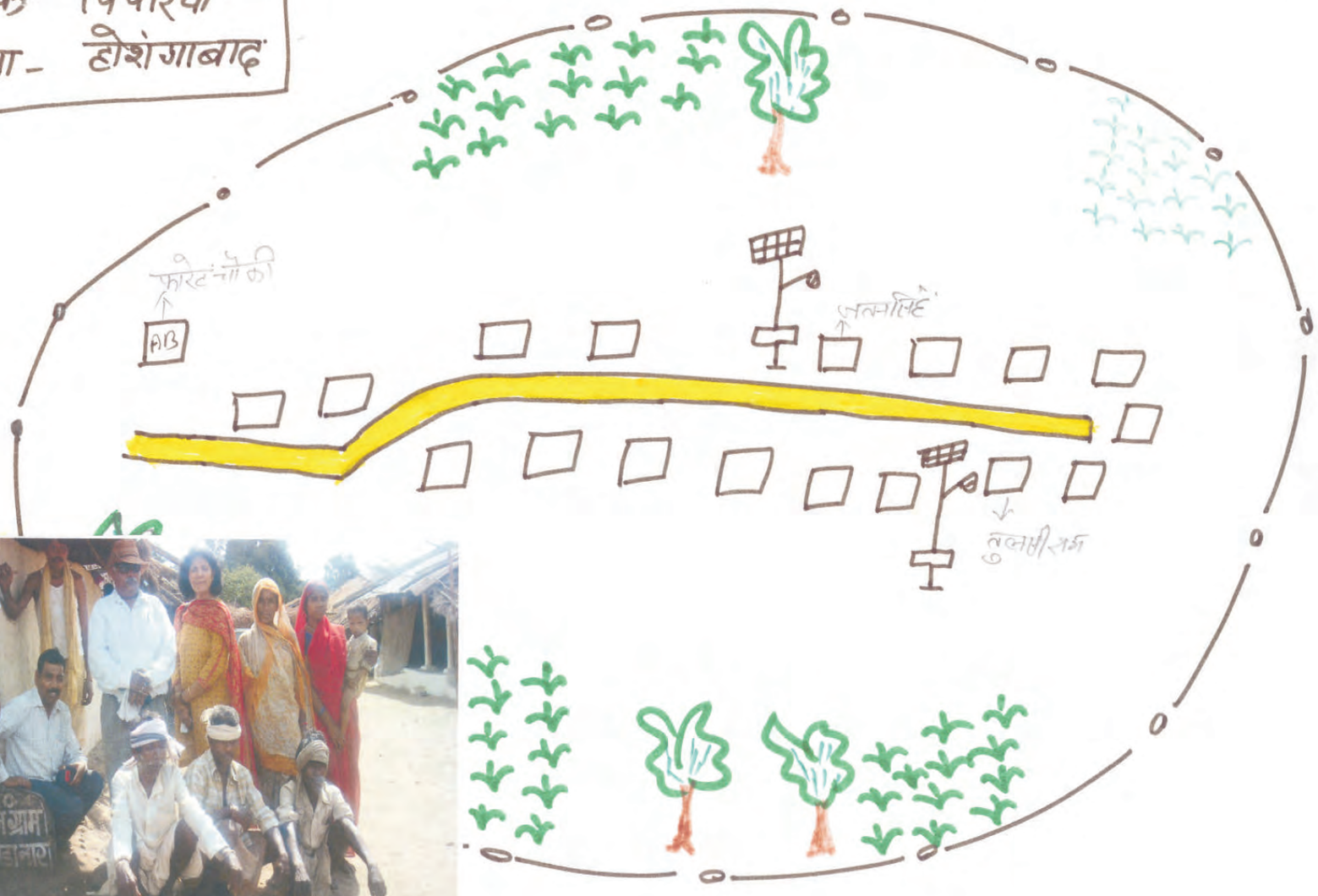
HEADQUARTERS: TAHSIL, C.D. BLOCK
POPULATION SIZE CLASS OF VILLAGES : BELOW 200,200-499, 500-999,1000-4999,5000 AND ABOVE
UNINHABITED VILLAGES WITH PERMANENT LOCATION CODE NUMBER (01300000)
IMPORTANT METALLED ROAD
UNMETALLED ROAD
RIVER AND STREAM
POST OFFICE (EXCLUDING R.M.S) PO
TELEGRAPH OFFICE TO
HIGH SCHOOL / HIGHER SECONDARY SCHOOL S
BANK B


INDIA
CHHATTISGARH
TAHSIL NAGRI
C.D. BLOCK NAGRI
DISTRICT DHAMTARI
KILOMETRES
2 1 0 2 4 6 8
TAHSIL DHAMTARI
TAHSIL KURUD
DISTRICT KANKER
DISTRICT RAIPUR
DISTRICT BASTAR
ORISSA
NAGRI
Bhaluchua R.F.
Marenpoti R.F.
Amjhera R.F.
Bodera R.F.
From Dhamtari
From Kurud
From Kanker
To Malapur
To Dondeka
Total Number of C.D.Blocks 1
Total Number of Town ... 0
Total Number of Villages ... 252
Total Area (in sq.km.) ... 408.54
Total Population 160674
BOUNDARY, STATE
" DISTRICT
" TAHSIL
" VILLAGE WITH PERMANENT LOCATION CODE NUMBER
" FOREST-RESERVED WITH NAME
HEADQUARTERS : TAHSIL, C.D.BLOCK
POPULATION SIZE CLASS OF VILLAGES : BELOW 200, 200-499, 500-999, 1000-4999, 5000 & ABOVE
UNINHABITED VILLAGES WITH PERMANET LOCATION CODE NUMBER
STATE HIGHWAY WITH NUMBER
IMPORTANT METALLED ROAD
UNMETALLED ROAD
RIVER AND STREAM
WATER FEATURES : TANK
POST OFFICE(EXCLUDING RMS)
TELEGRAPH OFFICE
HIGH SCHOOL/HIGHER SECONDARY SCHOOL
PRIMARY HEALTH CENTRE
BANK
C.D.Block Boundary of Nagri is Co-Terminus with tahsil Boundary


INDIA
ORISSA
BANSPAL C.D. BLOCK
DISTRICT KENDUJHAR
Area in square Km. 1200.79
Population 85845
No. of Villages 164
KILOMETRES
SUNDARGARH DISTRICT
JODA C. D. BLOCK
JHUMPURA C. D. BLOCK
KENDUJHARGARH C.D. BLOCK
ANUGUL DISTRICT
TELKOI C.D. BLOCK
HARICHANDANPUR C.D. BLOCK
NAYAKOTE P.S.
KENDUJHAR SADAR P.S. (PART)
KENDUJHAR TOWN P.S. (PART)
PANDAPARA P.S. (PART)
KANJIPANI P.S. (PART)
UNDER HARICHANDANPUR C.D. BLOCK
PANDAPARA P.S. (PART)
(JODA P.S.)
(JODA P.S.)
A – PANDAPARA P.S. (PART)
Boundary, District
" C.D. Block
" Police Station
" Village with permanent location code number
" Reserved Forest
Headquarters: C.D. Block/ Police Station
Population size class of villages
Below 200, 200–499, 500–999, & 1000–4999
National Highway
Important Metalled Road
Unmetalled Roads
River and Stream
Post Office, Telegraph Office
High School
Primary Health Centre
Bank

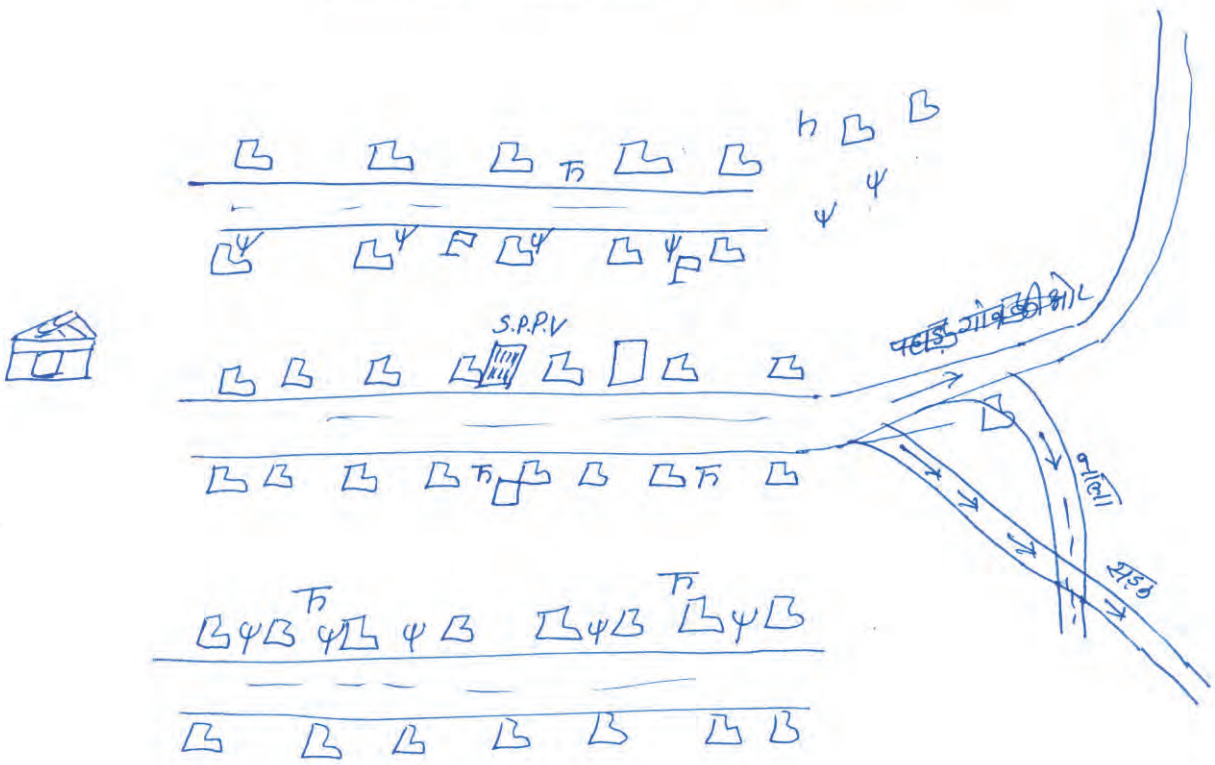

INDIA
ORISSA
GURUNDIA C.D. BLOCK
DISTRICT SUNDARGARH
KILOMETRES
Area in Square Km. 588.21
Population 57801
No. of villages 146
RAJAGANGAPUR C.D. BLOCK
LATHIKATA C.D. BLOCK
JHARKHAND
KOIDA C.D. BLOCK
LAHUNIPARA C.D. BLOCK
BANEIGARH C.D. BLOCK
SAMBALPUR DISTRICT
A –GURUNDIA P.S. (FULL)
B –BANKI P.S. (PART)
C –BANEI P.S. (PART)
Boundary, State
" District
" C.D. Block
" Police Station
" Village with permanent location code number
Forest-Reserved
Headquarters C.D. Block, Police Station
Population size class of villages: Below 200, 200-499, 500-999 & 1000-4999
Uninhabited villages with permanent location code number
National Highway
Important Metalled Road
Unmetalled Roads
Railway line with station, Broad Gauge
River and Stream
Post Office, Telegraph Office
High School
Primary Health Centre
Bank

ग्राम- घोडानार
ब्लाक- पिपरिया
जिला- होशंगाबाद



STATE- CHHATTISGARH
DISTRICT- KORBA
BLOCK- PALI
VILLAGE- KERAMUDA
NAME OF HEAD OF THE VILLAGE PANCHAYAT – PAHADGAON

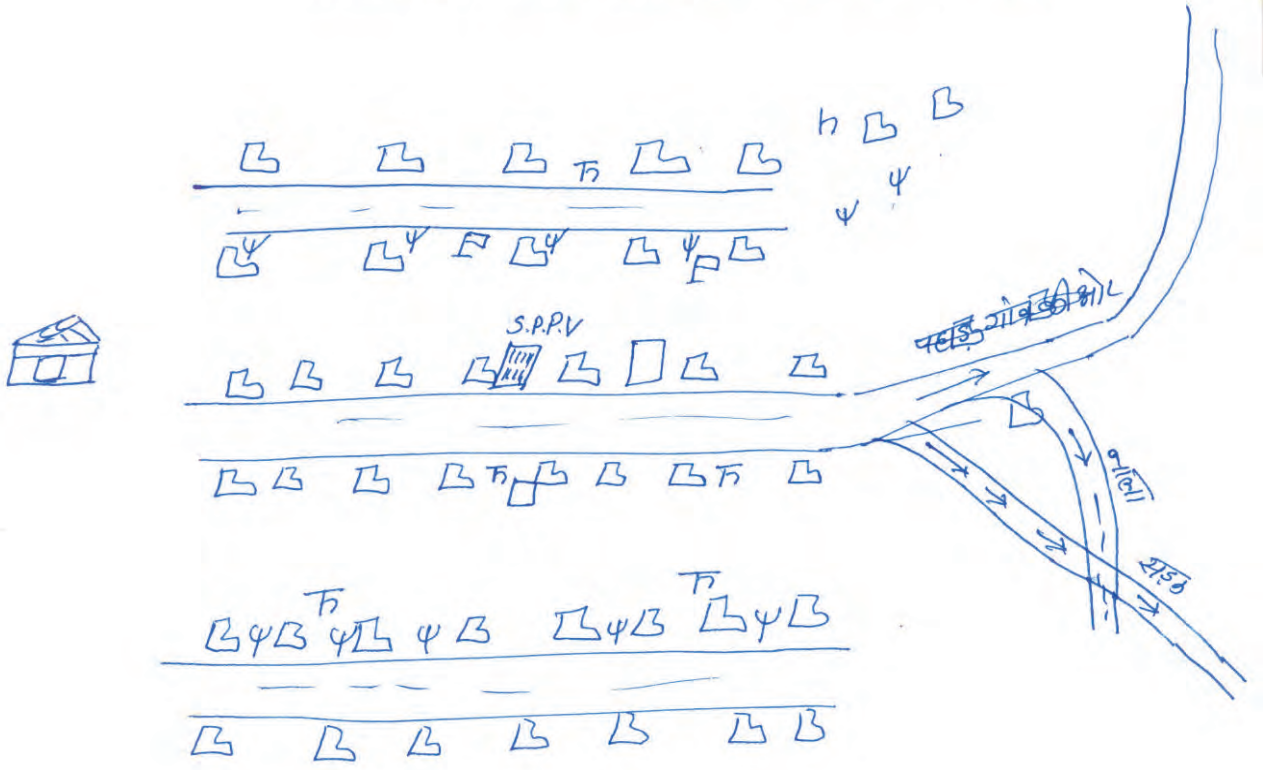
VILLAGE KERAMUDA SOCIAL MAP



संकेत-
- मकान
- सोलर कनेक्शन वाला
- नल
- पावर प्लांट
- विद्यालय
- चबुतरा

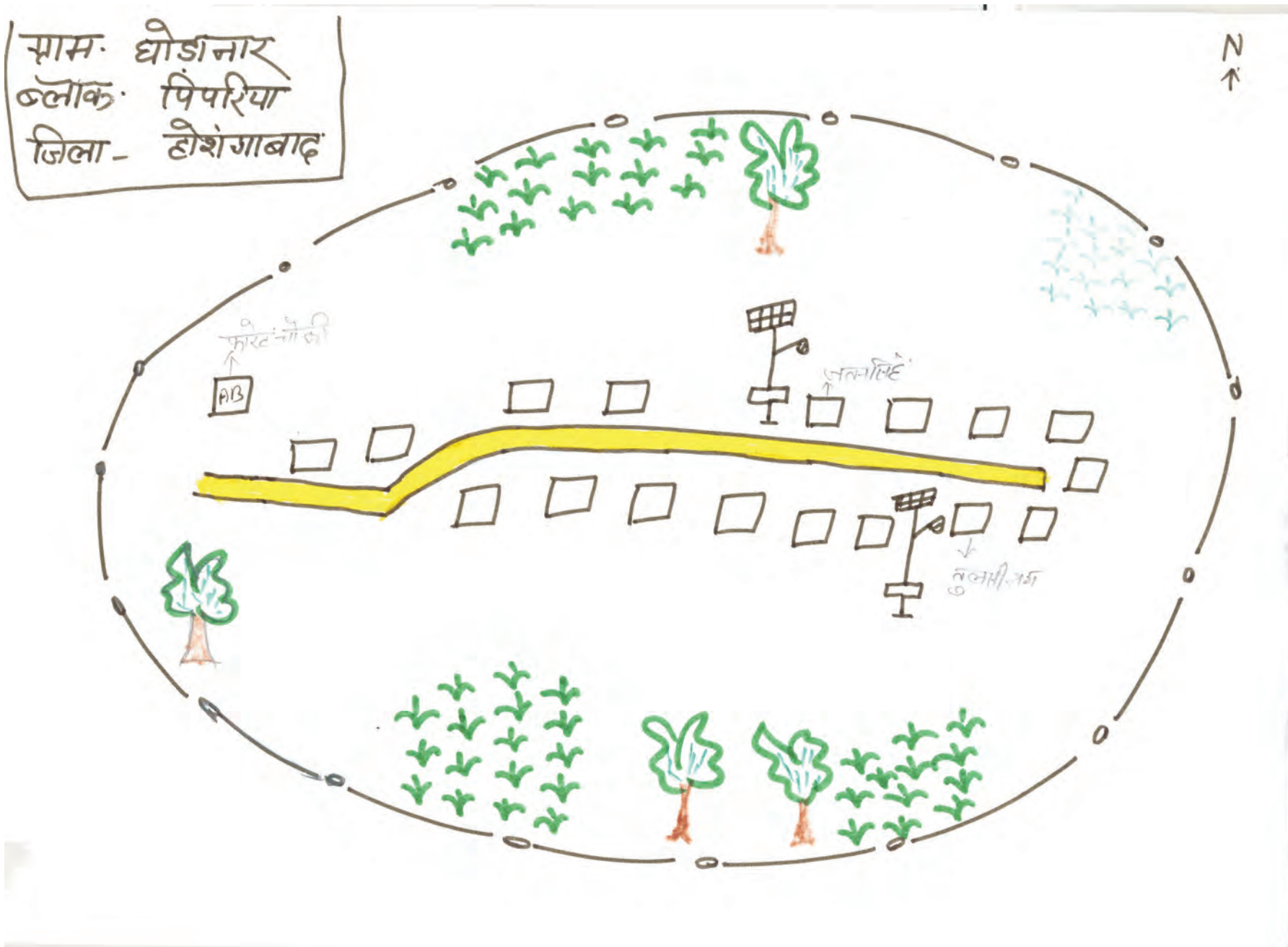
STATE- CHHATTISGARH
DISTRICT- KORBA
BLOCK- PALI
VILLAGE- KERAMUDA
NAME OF HEAD OF THE VILLAGE PANCHAYAT – PAHADGAON

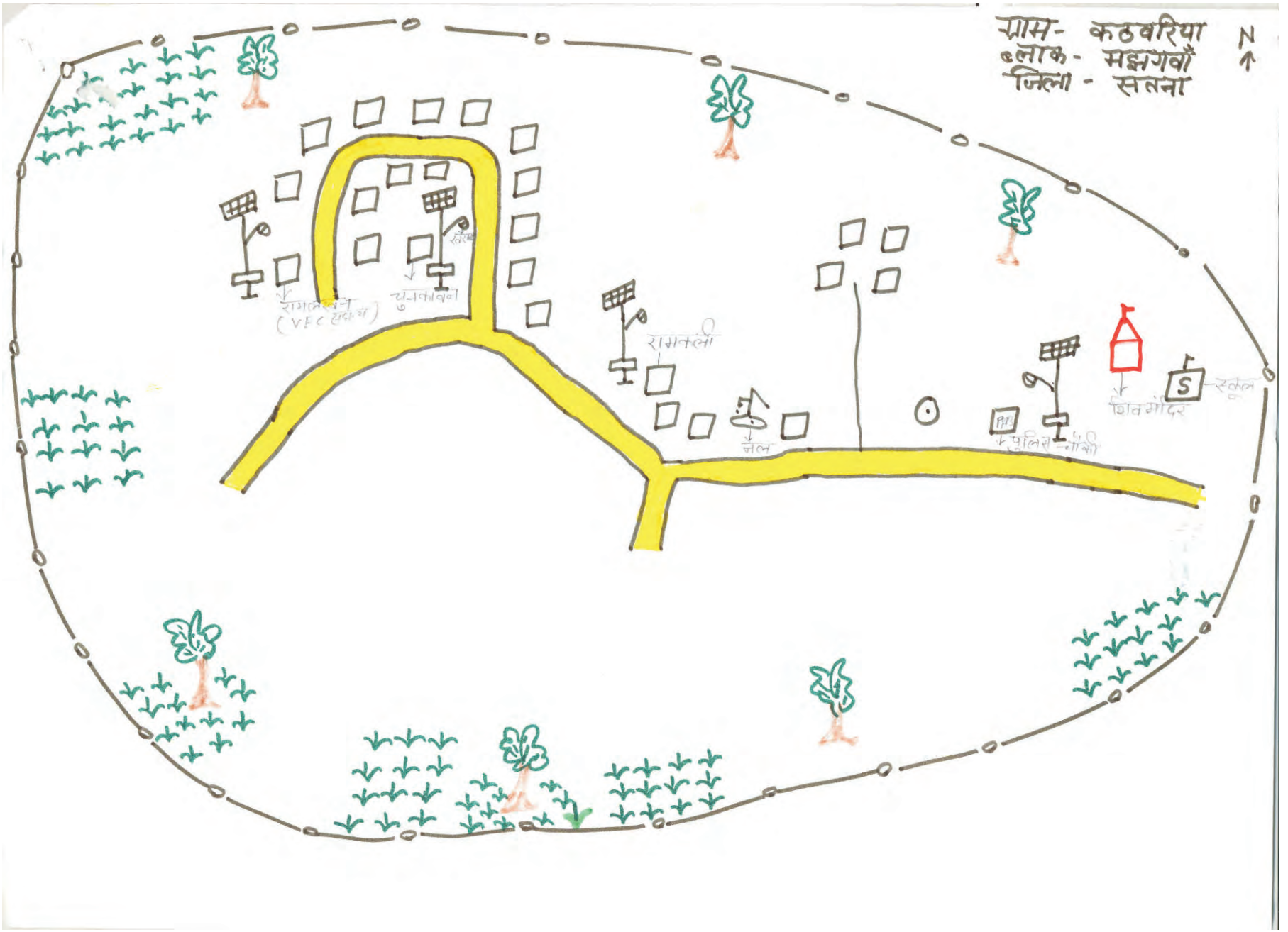
VILLAGE KERAMUDA SOCIAL MAP



संकेत -
- मकान
- सोलर कनेक्शन संख्या
- नल
- पावर प्लांट
- विद्यालय
- चबुतरा

ग्राम- धोडानार
ब्लॉक- पिपरिया
जिला- होशंगाबाद




ग्राम- कठवरिया
ब्लाक- मझगवाँ
जिला - सतना
N
रामलीला
(VFC हॉल)
चबूतरा
रामलीला
नल
पुलिस चौकी
शिवमंदिर
S
स्कूल

ग्राम- नौगवाँ कप
ब्लाक- मैहर
जिला- सतना

ग्राम - कचुरा
ब्लॉक - मझगवाँ
जिला - सतना

N
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ग्राम - पाट
ब्लाक - शहपुर
जिला - बैतूल