Infrastructure Advisory

CRISIL
An S&P Global Company

Evaluation study of Capital Investment in Gaothan Feeder Separation Scheme and Infrastructure Plan-I implemented by Energy Department, GoM

Final Evaluation Report

November 2017

Acknowledgement

CRISIL Risk & Infrastructure Solutions Ltd. (CRIS) has completed the 'Evaluation study of Capital Investment in Gaothan Feeder Separation Scheme and Infrastructure Plan-I implemented by Energy Department, GoM' through a state wide extensive field survey and stakeholder interactions at various government, utility and customer level. CRIS has also submitted intermittent study reports and presented findings to concerned officials for study findings and feedback. This 'Final Evaluation Report' presents the approach & methodology, key findings, conclusions and recommendations of the study. CRIS received invaluable support, direction and guidance from key officials in conducting the study and preparing this report. In this regard, CRIS would like to whole heartedly acknowledge the following officials:

1) The Planning Department, Government of Maharashtra
2) Shri. Milind Chopade, Officer on Special Duty, Energy Department, Government of Maharashtra
3) Shri. R.R Shinge, Director, Directorate of Economics and Statistics, Planning Department, Government of Maharashtra
4) Shri. Vijay Aher, Additional Director, Directorate of Economics and Statistics, Planning Department, Government of Maharashtra

Further, the study required co-ordination with a number of officers of MSEDCL and collection of a large amount of administrative data of MSEDCL. CRIS would like to sincerely acknowledge the support and guidance of following officers in this regard:

1) Shri. Dnyaneshwar Gawnar, Superintending Engineer, MSEDCL
2) Shri. Chandramani Mishra, Executive Engineer, MSEDCL
3) Officers from zonal, circle and other field offices of MSEDCL

For the task of primary data collection through field survey and face to face interviews with respondents, with the objective of assessing impact of the schemes on village and semi-urban consumers, CRIS has associated with M/s Bureau of Research on Industry & Economic Fundamentals Pvt. Ltd. (BRIEF). BRIEF satisfactorily completed the primary survey in a timely manner and met the quality requirements. CRIS acknowledges contribution of BRIEF in this regard.

Finally, CRIS also duly acknowledges the support provided by the administrative staff of the Directorate of Economics and Statistics, Planning Department, Government of Maharashtra.

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Abbreviations

Acronym	Definition
AE	Assistant Engineer
CE	Chief Engineer
CFL	Compact Fluorescent Light
CRIS	CRISIL Risk & Infrastructure Solutions Ltd.
DES	Directorate of Economics and Statistics
DSPC	Distribution Special Project Cell
DTC	Distribution Transformer Centre
EE	Executive Engineer
ERP	Enterprise Resource Planning
GFSS	Gaothan Feeder Separation Scheme
GoM	Government of Maharashtra
HO	Head Office
INR	Indian National Rupee
KPI	Key Performance Indicator
LED	Light Emitting Diode
MIS	Management Information System
MSEDCL	Maharashtra State Electricity Distribution Company Ltd
OPD	Out Patient Department
PMC	Project Management Consultant
PFC	Power Finance Corporation
PPP	Public Private Partnership
REC	Rural Electrification Corporation
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SDO	Sub Divisional Office
SE	Superintending Engineer
UPS	Uninterruptible Power Supply

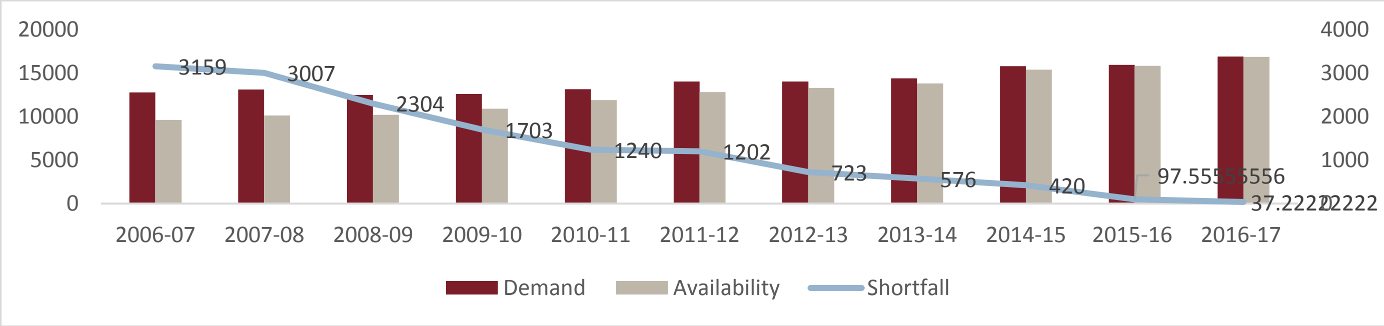
1. Executive summary

1.1 Scheme performance against objectives

The following tables summarize the performance of the two schemes against their objectives.

Table 1-1: Evaluation of schemes' performance against their objectives

<table>
<tr><th>No.</th><th>Schemes' objective</th><th>Performance of the schemes</th></tr>
<tr><td>1</td><td>Reduction in load shedding to rural/ semi-urban consumers (GFSS)</td><td>
There has been significant reduction in load shedding duration across all MSEDCL consumers in rural/ semi-urban areas due to implementation of the scheme. The following chart depicts the power demand, supply and resulting shortfall trend for entire Maharashtra over the period during which the schemes were implemented. It is relevant to note that supply shortfall as compared to demand is the primary reason for load shedding.



All figures are in MW.

The above findings are also corroborated by primary survey respondents who opined that load shedding has significantly reduced. The responses are captured below.
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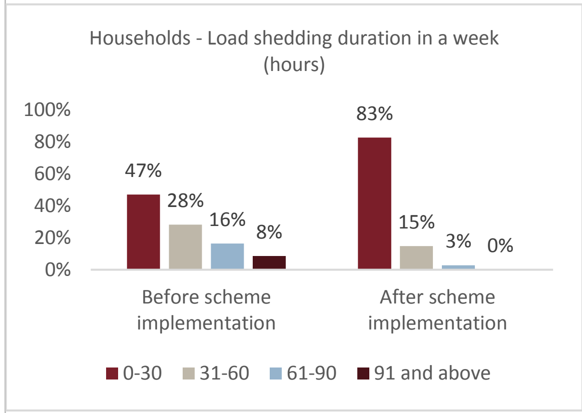
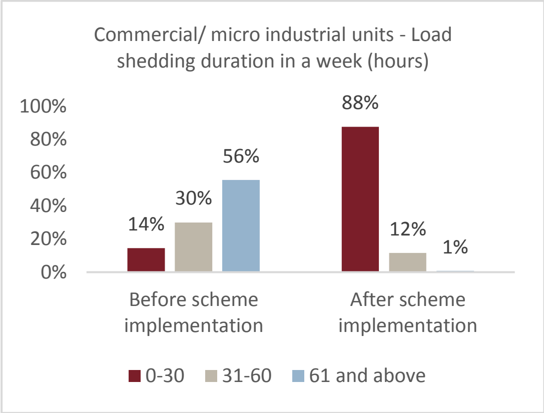
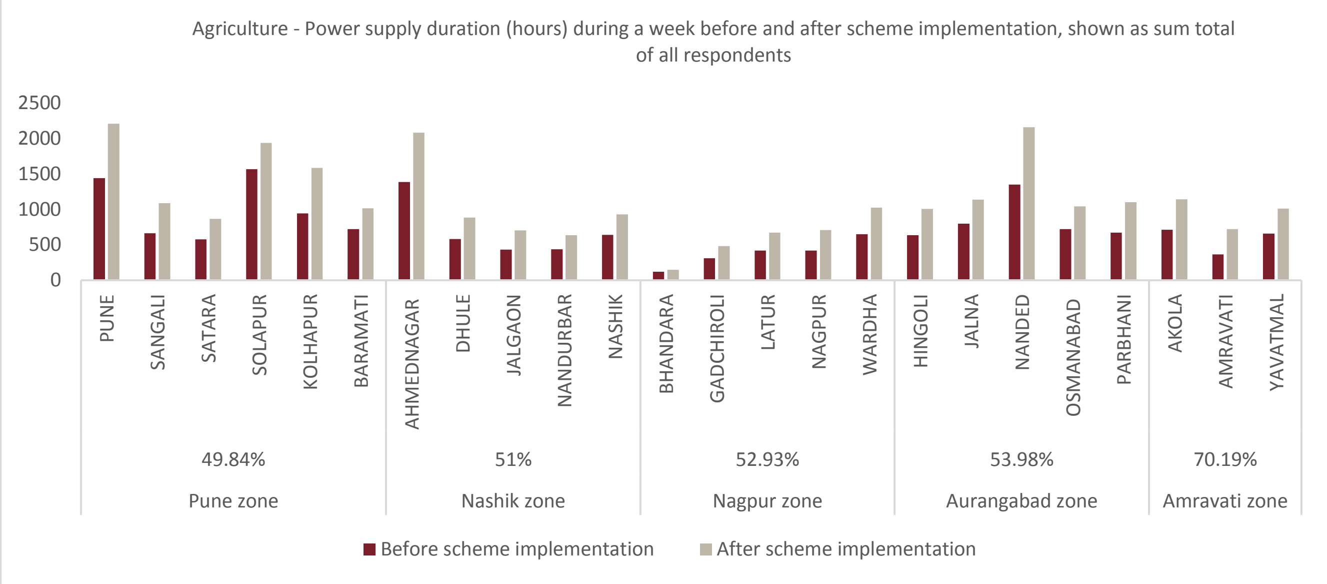
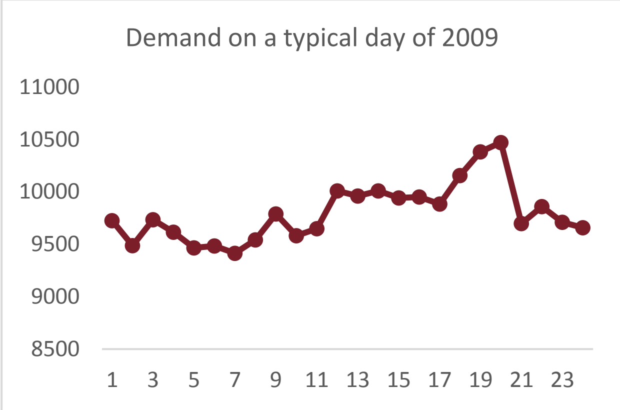
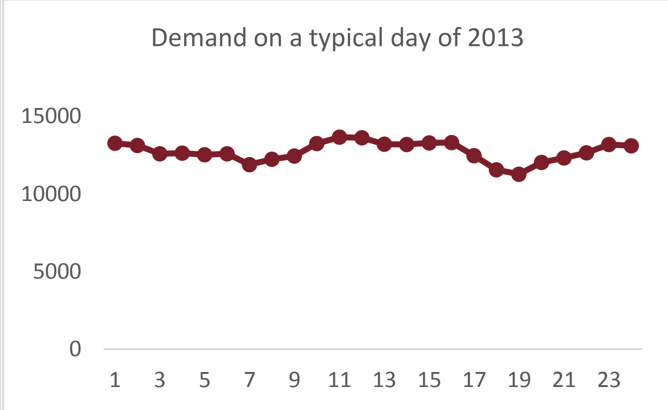
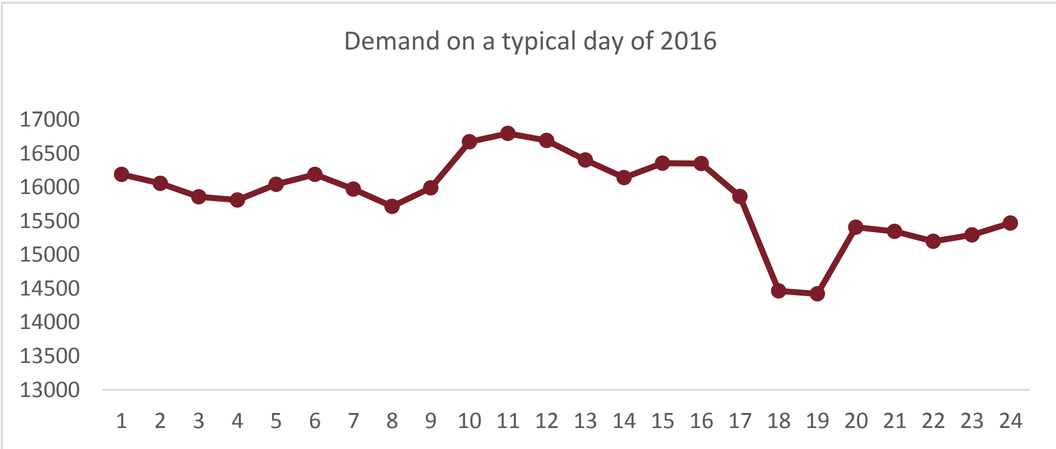
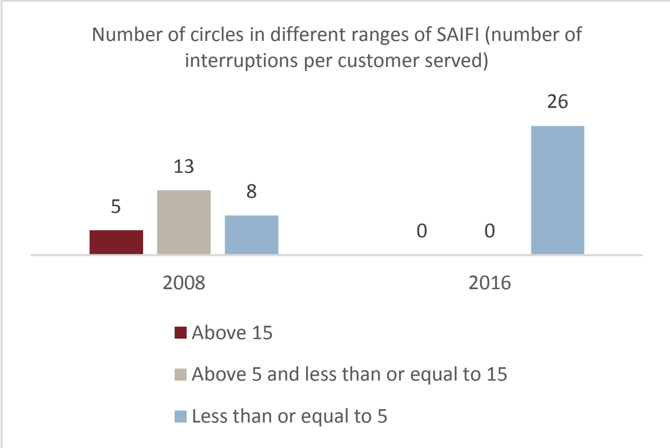
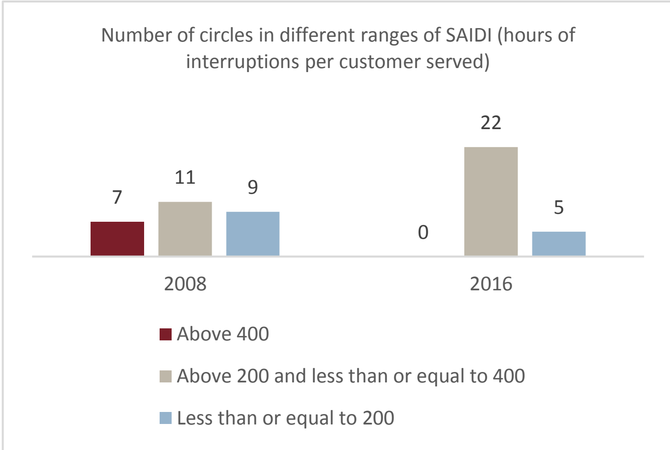
</table>

No.	Schemes' objective	Performance of the schemes
		  37% of the household respondents and 74% of commercial/ micro industrial unit owners who were facing load shedding of greater than 30 hours per week before scheme implementation are now facing load shedding lesser than 30 hours per week. Across all the administrative divisions of Maharashtra, the duration of load shedding reported has reduced by 60-70%. Further, the hours of supply to farmers have increased by 50-70% across all divisions of Maharashtra. On an average, farmers have reported that they now receive a daily supply lasting for 9.62 hours (day plus night) approximately which is a significant increase over pre-scheme implementation era.

No.	Schemes' objective	Performance of the schemes
		
2	Flattening of load curve	Flattening of load curve is an important measure of load management and was one of the primary objective of GFSS and Infrastructure Plan-I schemes. The load curves of a typical day, for overall Maharashtra state, before scheme implementation, immediately after scheme implementation and after completion of a few years post scheme implementation are shown below. It can be observed that the load curve significantly flattened immediately after scheme implementation (2013) however as the years passed by and the schemes' benefits began to wear off, the load curve again started losing its flat properties (2016).

No.	Schemes' objective	Performance of the schemes
		  *All the above values are in MUs.*
3	Improvement in system reliability *(Infrastructure Plan-I)*	SAIFI and SAIDI, which are key indicators to measure system reliability, both improved significantly after the scheme implementation due to strengthening and augmentation of key system components such as cables, feeders, transformers, substations, etc. This resulted in reduced impact of interruptions at customer end, measured through SAIFI and SAIDI. The number of circles with poor values of SAIFI and SAIDI greatly reduced after scheme implementation.

<table>
<tr><th>No.</th><th>Schemes' objective</th><th>Performance of the schemes</th></tr>
<tr><td></td><td></td><td>




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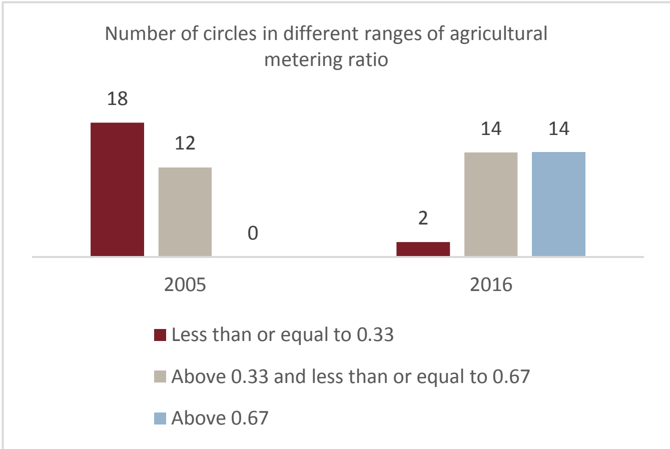
<tr><td>4</td><td>Better energy accounting for agriculture consumption (GFSS)</td><td>
The extent of metering of agricultural consumers has increased during the period of GFSS implementation. On an average, across circles, the share of metered consumption in total agricultural consumption has increased at least 3 times. A significant number of circles have moved from having less than 1/3rd of metered consumption to more than 2/3rd.

The role of GFSS scheme is important here since the scheme involved segregation of agriculture feeders and consequently encouraged growth in metered connections.



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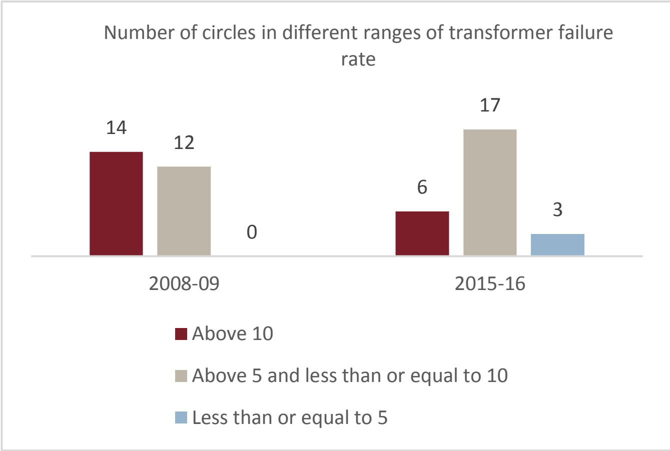
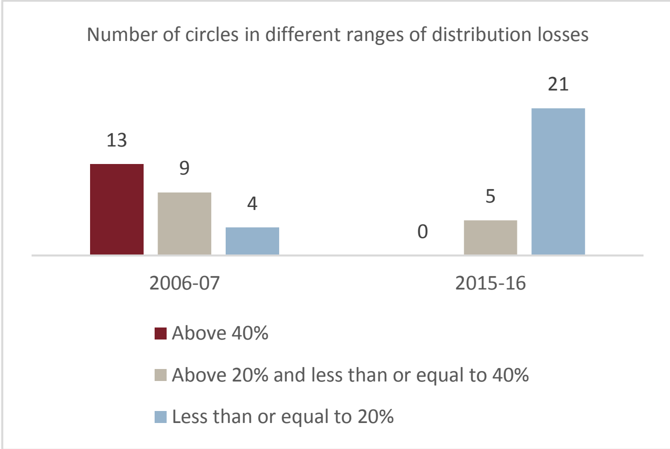
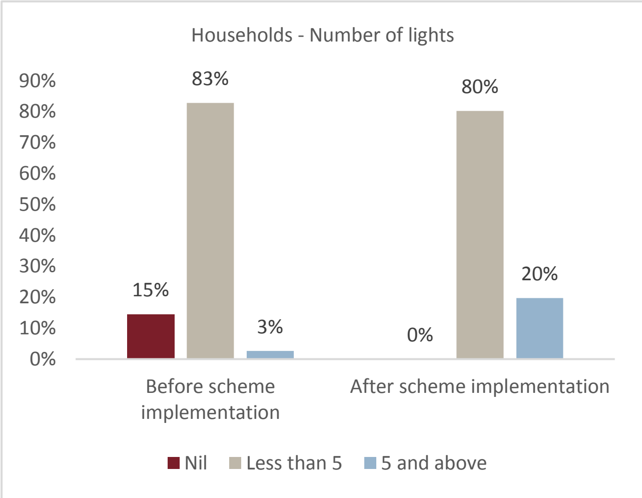
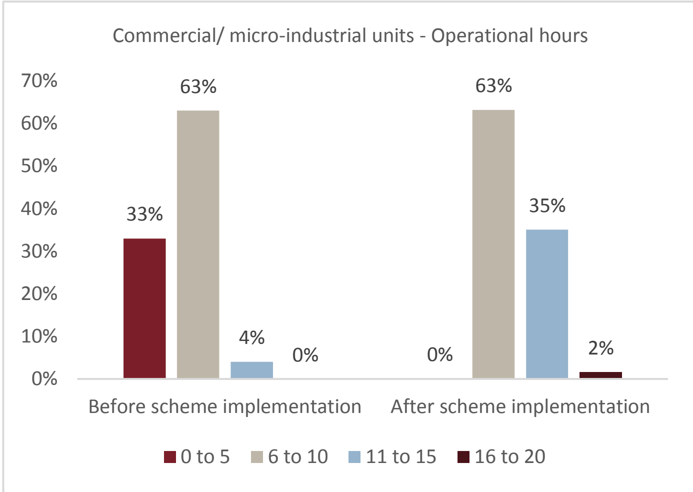
</table>

No.	Schemes' objective	Performance of the schemes
5	Reduction in equipment failure *(Infrastructure Plan-I)*	The Infrastructure Plan-I scheme involved stregthening of transformation capacity of the system through replacement of old transformers along with installation of additional new transformers. This helped greatly reduce the transformer failure rate. Most of MSEDCL's circles were sufering from a transformer failure rate of above 10 failures (per 100 transformers) which reduced to below 10 after scheme implementation. 
6	Reduction in distribution losses *(Both schemes)*	Role of the scheme in reducing distribution losses is highly significant. Reduction in distribution losses was minimal during the period before the scheme implementation i.e. upto 2007. The reduction in distribution losses was much sharper once the implementation of scheme began and eventually flattened out after end of the scheme implementation i.e. 2012 onwards. Most of MSEDCL's circles with distribution losses greater than 20% and 40% have moved to less than 20% after scheme implementation. 

<table>
<tr><th>No.</th><th>Schemes' objective</th><th>Performance of the schemes</th></tr>
<tr><td>7</td><td>Improvement in reliability and quality of power supply to end consumers (Both schemes)</td><td>
All respondent types (households, commercial/ micro industrial units, farmers, schools, hospitals, gram panchayats) have reported that the number and usage of electrical appliances has increased, operating hours for businesses and institutions have increased and electricity has become a greater enabler in taking critical decisions. Farmers have also reported that the number and capacities of pumps installed and the duration of pump operations have increased indicating that the quality and reliability of electricity supply has indeed improved.





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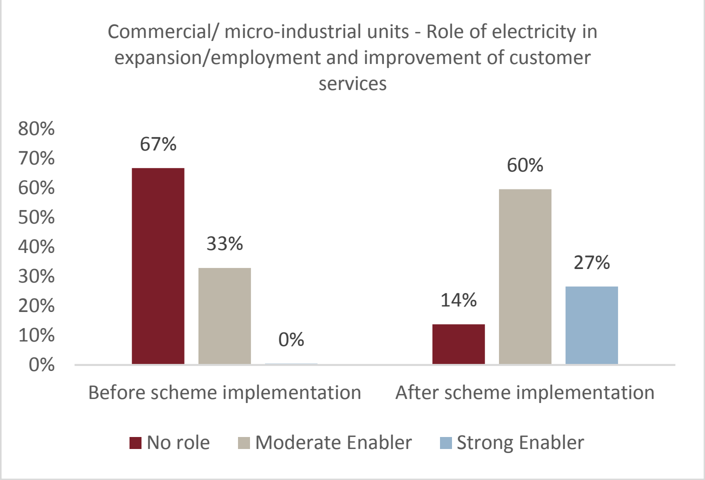
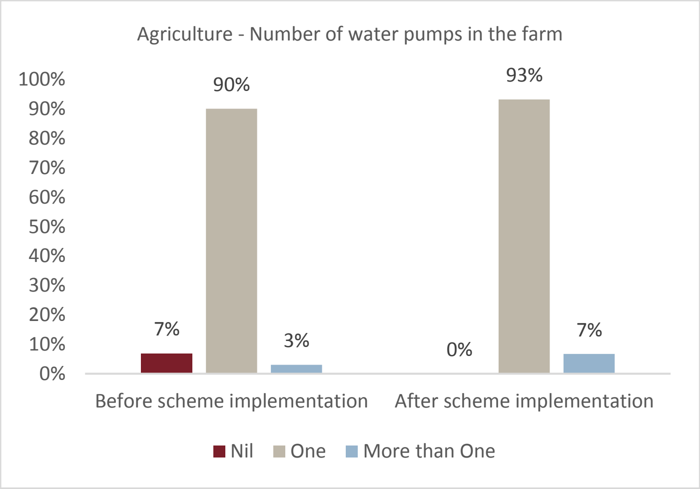
No.	Schemes' objective	Performance of the schemes
		 

1.2 Other salient findings about the schemes

1. Schemes' benefit incidence did not suffer from any bias/ discrimination

It was observed that the schemes' benefits (e.g.: reduction in load shedding duration) were perceived almost uniformly by respondents across various income categories. No particular correlation of scheme benefit and income level was observed. Also perception about the schemes' benefits was not affected by people's awareness levels about the schemes. Most importantly, the magnitude of benefits did not vary significantly between the administrative divisions of Maharashtra. Hence it can be inferred that the scheme was implemented without any bias/ discrimination based on income levels, socio-political preferences, etc.

2. Despite large and complex nature, the schemes could be implemented upto satisfactory standards and in a timely manner

Despite the large work sizes and extensive geographical reach, both the schemes were successful in terms of completion of work to satisfactory standards and meeting of timelines. Factors that were responsible for this include:

- A rigorous and comprehensive monitoring framework involving offices at all levels along with clear segregation of roles and responsibilities between field offices and circle, zonal and head offices.
- Political will at all levels right from gram panchayats, district administrations and upto state government which helped resolve key bottlenecks and issues.

3. Vendor management could have been done better

During initial phases of the implementation, the contractual terms with vendors involved the responsibility of materials procurement lying with MSEDCL. On account of co-ordination issues between MSEDCL and vendors, there were delays in material procurement which delayed completion timelines for initial phases of the projects (this was later corrected and the impact was mitigated which allowed the schemes to achieve their overall timelines).

Another issue during the initial implementation phase was that the terms of payment were heavily in favor of vendors as against MSEDCL – it was observed that the payment terms involved an advance of 70% to the vendors which was much higher than the practice of sound commercial management.

1.3 Recommendations

1. Design of capital investment schemes in power sector should be based on sound and rigorous data and should incorporate flexibility to adapt to changing circumstances

Section 4.1 of this report shows that MSEDCL's performance on parameters which were important markers of the schemes' benefits (distribution losses, SAIFI, SAIDI ,equipment failure rate and load curve trend) began to degrade within 2-3 years after scheme implementation – this was possibly because during scheme implementation the rate of increase in capex investments was much higher than increase in load growth but this trend reversed after scheme implementation with no further significant capital investment. Thus marginal utility of the schemes' started to reduce which ultimately led to degradation in performance.

Capital investment schemes in power sector involve long gestation periods and significant capital outlay. Also considering the asset heavy nature of the business, the improvement in a distribution utility's performance parameters and the quality of supply experienced by consumers is directly proportional to the adequacy of capital investments made in the distribution infrastructure vis-à-vis load growth. Hence the capital investment schemes need to be designed using most accurate and rigorous data concerning load growth. Load forecast should be based on detailed historical data sets going into consumption profiles of each consumer category and each time slot of the day, day of the week, season of the year, etc. Further, all external factors affecting load growth such as real estate development, energy efficiency initiatives, technology changes, etc. need to be taken into consideration. More importantly, load forecasting should not be a one-time "once in 10-years" exercise – the forecast should be updated each year based on actual load growth during the past year – for example, forecast done in 2017 for a 10 year period 2018-2028 should be updated in 2021 using actual data upto the year 2020 to develop revised forecast for remaining years of the period i.e. 2021-2028.

Nevertheless, no matter how rigorous the forecast is, the actual load growth can still significantly vary with respect to the forecast. Hence the scheme design should also incorporate some extent of flexibility in order to adjust to changing parameters – one way to do this could be that the extent of capital investment and load growth should be monitored on yearly basis and in case the actual load growth is much higher than forecasted load growth, the capex investments should be further increased or vice versa. This will allow the capex investments to be adjusted to ensure that the schemes' intended benefits continue to be sustained.

2. Scheme design ignored other non-capex based measures to achieve objectives

The primary survey has revealed that amongst all the farmers surveyed, only 4.87% farmers used energy efficient pumps. Had the design of these schemes also involved increasing awareness about such pumps amongst farmers and provision of financial support to replace existing pumps, the objective of improved load management and flattening of load curve could have been further achieved. Incorporating such financially non-intensive measures could have also enhanced cost effectiveness of the schemes.

3. Scheme could have been implemented earlier

Section 4.1.7 of this report has compared implementation experience of Maharashtra with other states across India where similar rural load separation schemes had been implemented. It was observed that other states started implementing such schemes around 5-6 years before Maharashtra. These states enjoyed greater benefit from the schemes – the extent of distribution loss reduction over scheme implementation period was much higher in other states as compared to Maharashtra – this was possibly because the other states were at much higher levels of distribution losses before scheme implementation than Maharashtra. Further, the reduction in distribution losses post scheme implementation was also sustained for much longer period in other states.

4. Threats arising from implementation of the scheme also needs to be take into consideration

With increase in availability and reliability of power, there is a risk of wastage of natural resources like excessive water being pumped for irrigation purpose and consequent depletion of water table. Such and similar other cross impacts need to be take into consideration while designing schemes similar to the GFSS and Infrastructure Plan-I. Necessary measures need to be built into the scheme design – for example, promoting the use of special pumps with auto cut off feature where a threshold for the volume of water being pumped in a single continuous use can be configured. Another measure that could be explored is to provide metered water connections to farmers so that they get the right price signals in order to curb wastage.

5. Sound vendor management practices

Section 6.1 of this report describes the various issues faced during ground implementation of the scheme which includes poor vendor management practices related to materials procurements and lop-sided payment terms. It is important that sound vendor management practices are used when dealing with vendors. The responsibility sharing between utility and vendors should be properly thought through. Further, payment terms should be in proportion to the extent of work carried out and should include retention payments to ensure guarantee of agreed outputs for a specific period after commissioning. Also, the contract should include adequate incentives and penalties to ensure quality of work is maintained and timelines are met.

6. Capacity building and devolution of responsibilities

The officers from the section and sub-division offices are instrumental for success of such schemes since they actually work at the ground level. These officers should be well empowered in terms of resources and be given due responsibilities. Further, they should be periodically trained in technical and commercial areas including project management, vendor management, contracts, etc.

7. Regular monitoring of load shedding/ outage pattern

In all circles, MSEDCL must conduct a yearly survey regarding load shedding / outage duration and voltage quality issues. The survey may be conducted on a sample set of respondents. This would enable the local office to better understand the issues facing consumers and would ultimately lead to better design of capex schemes.

8. Strengthen data management practices

Data on performance parameters is a critical part of planning and monitoring long term capex investments in power distribution utilities – hence high quality data is of utmost importance. While conducting personal interviews with MSEDCL officers from field offices, it was observed that, outage data is being recorded physically in the log books by officers who are in charge of distribution substations and then punched into MS Excel sheets in computers. This introduces chances for human errors at two stages – **data capture** as well as **data transcription**. The substation outage data is the raw data used in creating the required data sets for computing key reliability indices – SAIFI and SAIDI – and hence is highly critical. In addition, a number of discrepancies and inconsistencies were observed in the 10-year circle-wise data on distribution losses, SAIFI, SAIDI – number of values were missing and trends were observed to be out of line. Further, inconsistencies were also observed in data from circle offices and head office on the same KPI. All of this also points out to issues in **data aggregation** within the entire value chain of data reporting: section office → sub-division office → division office → circle office → zone office → head office.

Technology is an integral part of addressing the above problems. Efforts should be made to reduce manual intervention and introduce automation to the extent possible. Use of data logging tools and equipment, performance reporting systems should be introduced. These need to be introduced at all levels of the data reporting value chain - section office → sub-division office → division office → circle office → zone office → head office.

Capacity development of staff is also important since it helps reduce errors, improve the quality of reported data and improve the quality of decisions made. MSEDCL's staff involved in the data reporting process should be trained in the concepts of monitoring and evaluation – this training should be customized according to the seniority and span of responsibilities – for example, field staff require training in statistical techniques, data estimations, etc. while middle management would require training in computing performance parameters and creating performance reports; senior management would require training in benchmarking and decision making.

2. Introduction

2.1 Background

In the period leading upto the year 2008, several issues were plaguing the power sector in Maharashtra. While there was a significant increase in power demand, the power generation was not able to keep up pace. In order to address the deficit between generation and demand, the state's main power distribution utility i.e. the Maharashtra State Electricity Distribution Company Ltd. (MSEDCL) had to undertake significant extent of load shedding. The problem was compounded by the high energy losses in MSEDCL's network which resulted in financial losses – these financial losses had to be ultimately borne by consumers through increase in power tariffs. In order to reduce the burden of load shedding on consumers and mitigate the impact on power tariffs, the Government of Maharashtra (GoM), through a resolution issued in September 2008, decided to support the MSEDCL in implementing two capital investment schemes, namely: i) **Gaothan Feeder Separation Scheme (GFSS)**, and ii) **Infrastructure Plan-I**.

GFSS is a long term load management scheme whose objective is to achieve reduction in load shedding. It involves segregation of agricultural load and other category load respectively on separate feeders, in which existing feeder is treated as agriculture feeder and separate new feeder is erected from substation to gaothan/ village. Areas particularly identified for GFSS are agriculturally dominated wherein the agricultural loads are concentrated. The existing agricultural feeder will get supply during off-peak period only, whereas new gaothan feeder will get supply as per load shedding protocol. By separating the feeders, the load shedding can be managed more effectively.

Infrastructure Plan-I scheme is designed to upgrade MSEDCL's existing system, undertake capacity addition, replace the deteriorated structures and adopt latest technologies. This is expected to inter alia, reduce transmission & distribution (T&D) losses and reduce equipment failure rate.

The combined impact of these two schemes is thus expected to help GoM address the aforesaid issues affecting the power sector. Having recently completed implementation of both the schemes, the GoM desired to evaluate the design and implementation of the schemes in order to assess whether the intended objectives were met and identify useful learning for future programmes. Towards this, the Directorate of Economics & Statistics (DES), Planning Department, Government of Maharashtra appointed CRISIL Risk & Infrastructure Solutions Ltd. (CRIS) in March 2017 to conduct the evaluation study.

2.2 Objectives and scope of work

The objectives of the evaluation study are:

- To evaluate physical and financial achievement of the scheme since inception.
- To identify problems faced in the ground implementation of the scheme.
- To study programme effectiveness and adequacy with respect to the objectives.
- To evaluate the extent of impact of scheme on village and semi-urban consumers.

The scope of work for CRIS includes:

1. To formulate evaluation study implementation procedure
2. To design schedules for conducting evaluation study
3. To determine coverage in terms of geography, population frame, etc. for canvassing schedules and sampling procedure
4. To conduct pilot study for schedule testing
5. Rectification of schedules on the basis of pilot survey
6. To prepare instruction manual for conducting field work

7. To impart training for conducting field work
8. To conduct field work
9. To monitor field work and take corrective measures
10. To capture data (collection, validation, data entry and compilation in electronic format)
11. To validate captured data
12. To tabulate validated data
13. To analyse tabulated data (tabulation plan to be mutually decided by DES with CRIS)
14. To submit report covering results and recommendations in Marathi language. However, summary and recommendations will have to be submitted in both Marathi and English language.
15. To submit raw data, final data (in electronic format) and schedules to DES. The schedules which would be canvassed by successful bidder should be submitted to DES, if canvassed physically.
16. Secondary data needs to be analysed for all districts (secondary data generated through MIS/ administrative operative system).

2.3 Detailed overview of the schemes under evaluation

2.3.1 GFSS

The scheme was designed to provide the following benefits:

1. Reduction in load shedding particularly to rural/ semi-urban consumers and thereby reducing the feeling of discrimination and discontent among rural consumers
2. Flattening of load curve
3. Better energy accounting for agriculture consumption
4. System strengthening by improving the infrastructure
5. Improvement in reliability and quality of power supply
6. Better load management
7. Reduction in over drawl and power purchase
8. Reduction in T&D losses

The GFSS has been implemented by MSEDCL in four phases followed by implementation in Shrirampur division, Ahmednagar district. Works under this scheme were carried out during the period 2006 to 2011. The scheme covered 29 out of 36 administrative districts of Maharashtra and 13 out of 16 MSEDCL zones, thus covering a significant area of the state. The scheme had ambitious implementation targets – around 3,500 feeders, 50,000 kms of high tension (HT) lines, 12,000 kms of low tension (LT) lines, 27,000 distribution transformer centers (DTC), 17,000 villages, 5,000 wadies and 3,500 MW worth of load under management. Most of these targets were achieved to a fair extent.

2.3.2 Infrastructure Plan-I

The scheme was designed to provide the following benefits:

1. Reduction in T&D losses
2. Reduction in distribution transformer (DT) failure rate
3. Reduction in peak demand
4. Increase in reliability of supply
5. Forced load shedding reduced
6. Increase in availability of supply
7. Reduction in overloading of equipment

8. Strengthening of existing infrastructure
9. Development of new infrastructure to meet load growth
10. Improvement in HT: LT ratio
11. Improvement in standards of performance
12. Reduction in interruptions
13. Reduce loading of DTs to 80% of original level
14. Improvement in power factor
15. Improvement in voltage profile.

Works under this scheme were carried out during the period 2008 to 2013. It achieved implementation of around 600 new substations, 44,000 kms HT lines, 12,000 kms LT lines, 500 new power transformers (PT), augmentation of 400 existing PTs, 73,000 new DTs and augmentation of 9,300 existing DTs.

While GFSS's primary objective was to optimize load management, the Infrastructure Plan-I was a system strengthening scheme intended to upgrade the ageing infrastructure of MSEDCL.

2.3.3 Work undertaken in the schemes and outputs achieved

The implementation of Infrastructure Plan-I work started since 2008. The following table summarizes the year wise equity deployed for Infrastructure Plan-I.

Table 2-1: Year wise equity deployed for Infrastructure Plan-I (Rs Crore)

Year	Infrastructure Plan-I	Year wise equity deployed
2008-09	76.03	4%
2009-10	169.48	8%
2010-11	827.23	38%
2011-12	529.2	25%
2012-13	181.69	8%
2013-14	290.51	13%
2014-15	83.49	4%
Total	**2157.63**	

It is observed that maximum deployment of equity was made during the years 2010 and 2011, during which significant progress was achieved.

The following table summarizes the year wise equity deployed for GFSS.

Table 2-2 : Year wise equity received for GFSS (Rs Crore)

Year	GFSS	Year wise equity received
2008-09	131.77	21%
2009-10	106.95	17%
2010-11	100.83	16%
2011-12	62.4	10%
2012-13	103.4	17%

Year	GFSS	Year wise equity received
2013-14	37.11	6%
2014-15	75	12%
Total	**617.46**	

It is observed the deployment of equity was largely uniform during the entire span of implementation of GFSS. It also shows that the focus in GFSS was higher than in Infrastructure Plan-I during the initial years.

The following table summarizes the original sanctioned budget of GFSS and Infrastructure Plan-I and also the additional expenditure made to successfully implement the schemes.

Table 2-3 : Cost overrun for Infrastructure Plan-I and GFSS schemes (Rs Crore)

Particular	Infrastructure Plan-I	GFSS
Original sanctioned	8918.15	2572.31
Additional Expenditure	1869.00	515.00
Additional Expenditure(as % of original cost)	*21%*	*20%*
Total	**10787.15**	**3087.31**
20% equity (original)	1783.63	514.46
20% equity (additional expenditure)	374.00	103.00

It can be observed that around 20% additional expenditure has been incurred for both GFSS and Infrastructure Plan-I schemes.

The following table summarizes the zone wise progress report of GFSS.

Table 2-4 : Zone wise progress report of GFSS in terms of feeders, HT & LT lines

	Zone	Target	Achievement	% of target achieved	Target	Achieve ment	% of target achieved	Target	Achiev ement	% of target achieved
	Parameters ->	**Feeder number**			**HT line (Km)**			**LT Line (Km)**		
1	Kolhapur Zone	595	595	100.00%	6594.66	6410.98	97.21%	2054.3	2038.9	99.25%
2	Baramati Zone	773	770	99.61%	10982.1	10982.56	100.00%	3992.8	3985.8	99.82%
3	Pune Zone	39	36	92.31%	882.56	799	90.53%	393.92	346.57	87.98%
4	Nashik Zone	586	586	100.00%	5770.58	5624.36	97.47%	1485.1	1475.7	99.37%
5	Jalgaon Zone	342	342	100.00%	5202.47	4943.97	95.03%	739.36	685.06	92.66%
6	Nanded Zone	199	199	100.00%	3383.27	3392.31	100.27%	424.9	433.62	102.05%
7	Latur Zone	249	249	100.00%	3396.07	3396.07	100.00%	552.36	552.36	100.00%

	Zone	Target	Achievement	% of target achieved	Target	Achievement	% of target achieved	Target	Achievement	% of target achieved
8	Chandrapur Zone	12	8	66.67%	380	269	70.79%	53.79	22.79	42.37%
9	Gondia Zone	56	53	94.64%	1585.5	1361.5	85.87%	303	250	82.51%
10	Nagpur Zone	70	59	84.29%	1780.25	1469.3	82.53%	247	158.6	64.21%
11	Aurangabad Zone	245	245	100.00%	2853.86	2714.31	95.11%	425.85	408.73	95.98%
12	Akola Zone	235	232	98.72%	5340.37	5077.64	95.08%	640.21	535.02	83.57%
13	Amravati Zone	200	190	95.00%	4008.74	4018.19	100.24%	758.4	682.88	90.04%
	Total	**3602**	**3564**		**52018**	**50442**		**12050**	**11572**	

It is observed that around 99% of the targeted feeder installation was achieved. While 96% target of HT line addition could be achieved.

Table 2-5 : Zone wise progress report of GFSS in terms of number of villages

	Zone	Target	Achievement	% of target achieved	Target	Achievement	% of target achieved	Target	Achievement	% of target achieved
	Parameters ->	**DTC number**			**Village Benefitted (number)**			**Wadis benefitted (number)**		
1	Kolhapur Zone	4470	4286	96%	2244	2237	100%	1138	1038	91%
2	Baramati Zone	6307	6279	100%	3298	3298	100%	2298	2521	110%
3	Pune Zone	718	647	90%	418	474	113%	268	180	67%
4	Nashik Zone	3043	2975	98%	1613	1611	100%	529	453	86%
5	Jalgaon Zone	2500	2377	95%	1792	1741	97%	173	162	94%
6	Nanded Zone	1556	1579	101%	1274	1274	100%	28	28	100%
7	Latur Zone	1655	1655	100%	1151	1151	100%	145	145	100%
8	Chandrapur Zone	178	115	65%	139	93	67%	0	0	
9	Gondia Zone	800	732	92%	559	537	96%	40	34	85%
10	Nagpur Zone	878	650	74%	584	494	85%	0	0	

	Zone	Target	Achievement	% of target achieved	Target	Achievement	% of target achieved	Target	Achievement	% of target achieved
11	Aurangabad Zone	1396	1411	101%	1205	1167	97%	131	105	80%
12	Akola Zone	2291	2210	96%	1796	1764	98%	20	0	0%
13	Amravati Zone	2190	1887	86%	1841	1526	83%	79	0	0%
	Total	**3602**	**3564**		**52018**	**50442**		**12050**	**11572**	

It can be observed from table that overall around 98% of the target has been achieved in terms of DTC addition. Regarding number of villages benefitted, around 96% of the target has been met for whole of Maharashtra.

2.4 About this report

CRIS has completed evaluation of the two schemes and now presents its findings and recommendations. This report is the **Final Evaluation Report** and covers:

1. The approach and methodology adopted in order to address the aforementioned scope of work
2. Key findings and detailed analysis
3. Conclusions and recommendations

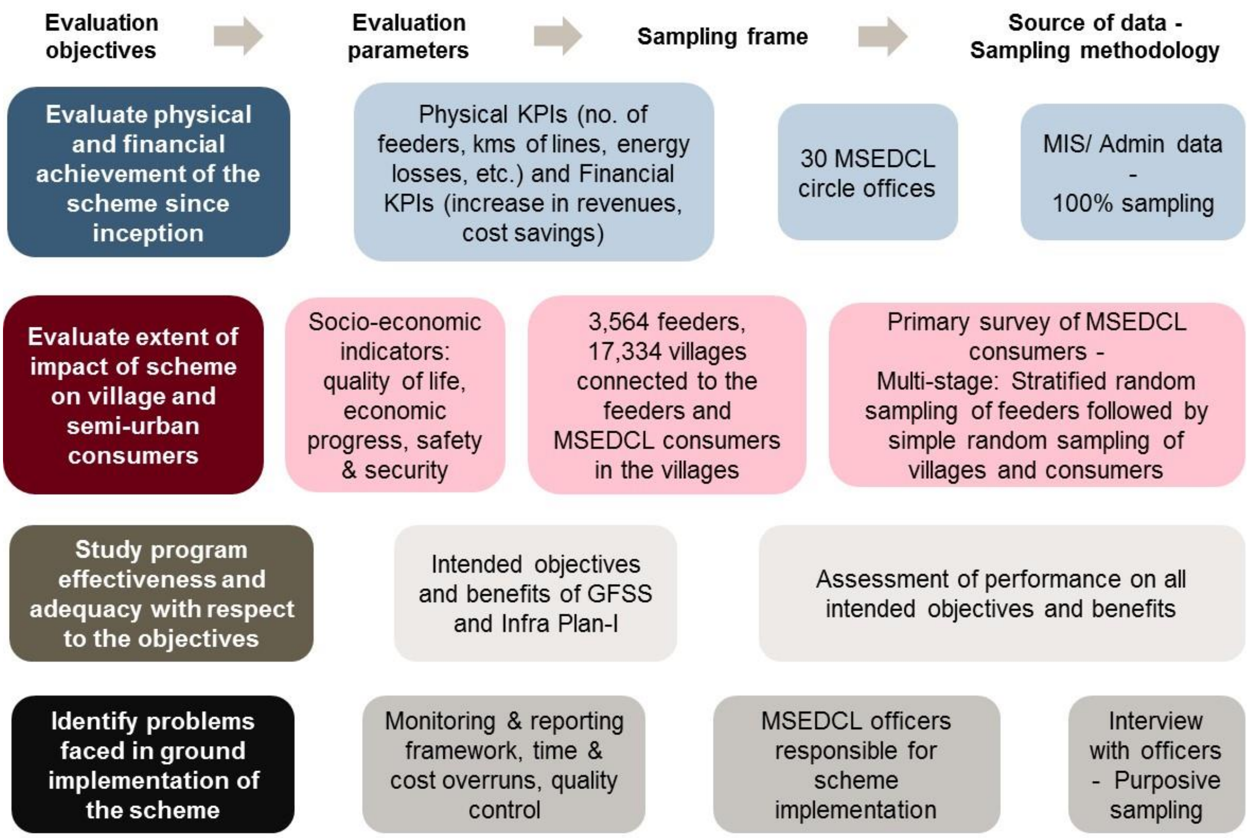
3. Approach and methodology

3.1 Approach

CRIS employed a **multi-pronged evaluation design** in order to address the evaluation objectives. The evaluation design consists of two sequential components: **data collection approach** and **evaluation approach**.

The **data collection approach** is driven by the evaluation objective to be achieved, evaluation parameter, nature and size of data available and required confidence levels as depicted in the figure below:

Figure 3-1: Data collection approach



The **evaluation approach** is similarly guided by the evaluation objectives to be achieved and nature of data collected as depicted in the figure below:

Figure 3-2: Evaluation approach

Scheme's achievement and impact	• Pre-facto and post-facto analysis of KPIs data and data on soci-economic indicators
Program effectiveness and adequacy with respect to the objectives	• Assessing achievement v/s target on each of the intended objectives
Problems faced in ground implementation of the scheme	• Structured listing of key issues • Identifying successes and failures

The detailed methodology is explained in the following sections.

3.2 Methodology

3.2.1 Physical and financial achievements of the schemes

3.2.1.1 Structure of data collection

MSEDCL is structurally divided into various offices with the following reporting structure:

Section office → Sub-division office → Division office → Circle office → Zone office → Head office

Circle office typically corresponds to a Government of Maharashtra designated administrative district. In districts where the district head-quarters are high population urban areas (eg: Nashik, Nagpur, Aurangabad), the districts have been split into two circles offices – rural and urban. Multiple circle offices usually report into a zone office – thus a zone office covers a geographical region comprising of multiple administrative districts.

While MSEDCL comprises of 46 circle offices, the schemes were implemented in 30 circle offices only[1]. The circles in which the schemes were implemented along with the corresponding GoM administrative divisions are described below:

Table 3-1: MSEDCL circle offices where schemes were implemented and corresponding GoM administrative divisions

Sr. No	MSEDCL circle name	GoM administrative division
1	Pune	Pune
2	Solapur	
3	Satara	
4	Kolhapur	

[1] *The circles comprising Konkan administrative division along with Thane, Kalyan and Bhiwandi were excluded because of insignificant numbers of agriculture consumers*

Sr. No	MSEDCL circle name	GoM administrative division
5	Sangli	
6	Baramati	
7	Nashik	Nashik
8	Ahmednagar	
9	Jalgaon	
10	Dhule	
11	Nandurbar	
12	Aurangabad	Aurangabad
13	Jalna	
14	Latur	
15	Beed	
16	Osmanabad	
17	Nanded	
18	Hingoli	
19	Parbhani	
20	Nagpur	Nagpur
21	Wardha	
22	Bhandara	
23	Gondia	
24	Chandrapur	
25	Gadchiroli	
26	Amravati	Amravati
27	Yavatmal	
28	Akola	
29	Buldhaana	
30	Washim	

The evaluation of physical and financial achievements of the schemes involved collection of administrative/ MIS data of MSEDCL on various key performance indicators (KPIs) pertinent to implementation of the schemes. The selection of KPIs and their design was proposed by CRIS, discussed with DES, Energy department (GoM) and MSEDCL officials and accordingly finalized. **The data on KPIs was collected circle-wise**. While CRIS attempted to collect data on all KPIs and for all circles, there were some which could not be covered either due to lack of availability of data or poor quality data. The coverage achieved by CRIS in terms of physical KPIs is described below:

Table 3-2: Physical KPIs – details of coverage achieved in terms of data collection

No.	Intended KPI	Circles sampled	Remarks
1	Extent of metered sales in agriculture	All 30 circles	--
2	SAIFI[2]	26 of 30 circles	Data received for all circles but not considered for Solapur, Pune, Osmanabad and Aurangabad circles because of poor data quality for some of the years (significantly out of trend)
3	SAIDI	27 of 30 circles	Data received for all circles but not considered for Parbhani, Hingoli and Aurangabad circles because of poor data quality for some of the years (significantly out of trend)
4	Distribution losses	26 of 30 circles	Data received for all circles but not considered for Baramati, Nandurbar, Hingoli and Washim circles because of missing data for some of the years
5	Rate of equipment failure	26 of 30 circles	Data received for all circles but not considered for Washim, Baramati, Dhule and Nandurbar circles because of missing data for some of the years
6	Extent of load shedding	All circles	Data is available for overall MSEDCL
7	Load curve shape	All circles	Data is available for overall MSEDCL

In terms of financial KPIs, CRIS managed to achieve the following coverage:

Table 3-3: Financial KPIs – details of coverage achieved in terms of data collection

No.	Intended KPI	Circles sampled	Remarks
1	Savings achieved in power purchase cost (due to reduction in distribution losses)	26 of 30 circles	Data received for all circles but not considered for Baramati, Nandurbar, Hingoli and Washim circles because of missing data for some of the years

3.2.1.2 Data collection and quality control

The data required to compute the above KPIs was obtained from MIS reports/ administrative data maintained at MSEDCL's circle offices and head office. The formats were duly explained to the officials in order to ensure that the data requirements were well understood.

[2] *1. SAIFI or System Average Interruption Frequency Index is an indicator of distribution system reliability and denotes the number of times that the power supply is interrupted to an average customer during the reporting period*

2. SAIDI or System Average Interruption Duration Index is an indicator of distribution system reliability and denotes the duration for which the power supply is interrupted to an average customer during the reporting period

After the filled-in formats were provided, CRIS undertook a rigorous quality control check by investigating for missing data, inconsistency in computations, unexplainable trends, etc.

3.2.1.3 Timeline of data collection

The data was collected during the period starting from 22nd June, 2017 and ending on 31st July, 2017.

3.2.1.4 Evaluation methodology

Physical KPIs: At the time of schemes' design, no targets were specified for these KPIs except for the fact that performance on these KPIs needs to be improved. Accordingly, CRIS analyzed the historical 8-10 years' trend in these KPIs to compare the pre-facto and post-facto situations with respect to the schemes' implementation. CRIS then attempted to quantify attribution of any change in performance to the schemes' implementation based on views of senior officers of MSEDCL.

Financial KPIs: The cost saving for each year of the implementation period was quantified as the amount of power purchase cost avoided due to reduction in T&D losses and computed as shown below. The reduction in T&D losses was considered to the extent that was attributable to the schemes and the extent of attribution was identified based on views of senior officers of MSEDCL.

$$\begin{aligned}\textbf{Annual cost saving} \\ &= \text{Reduction in T\&D losses attributable to the schemes (kWh)} \\ &\times \text{Average power purchase cost of MSEDCL (Rs/ kWh)}\end{aligned}$$

3.2.2 Impact of schemes on village and semi-urban consumers

3.2.2.1 Feeders, villages and respondents covered

CRIS used primary surveys for collecting data and evaluating the schemes' impact on village and semi-urban consumers. The feeders installed under the GFSS were considered as a major characteristic of the schemes. A total number of 3,564 feeders had been installed under the schemes across Maharashtra. The sampling frame was considered to be all of these feeders. The size of the sample to be considered was computed using an online tool known as Raosoft[3], based on the following parameters:

- Acceptable margin of error - 5%
- Confidence level - 90%
- Total number of feeders – 3,564
- Response distribution - 40%

Accordingly, a number of 242 feeders to be sampled was arrived at out of a total 3,564 feeders.

A multi-stage sampling methodology was followed to arrive at the final sample set. The following tables describe the feeder and village selection methodology and the resultant sample set of villages.

[3] http://www.raosoft.com/samplesize.html

Table 3-4: Feeder and village selection methodology

<table>
<tr><th>No.</th><th>Particulars</th><th>Sample size intended</th><th>Sample size achieved</th><th>Remarks</th></tr>
<tr><td>1</td><td>Total feeders</td><td>242</td><td>280</td><td rowspan="2">CRIS approached each circle office to provide data on names of feeders covered under the scheme and villages benefitting from each such feeder. CRIS received complete data on feeders and villages for only 24 out of 30 circles. Data for Aurangabad, Beed, Chandrapur circles was not received while for Buldhana, Gondia, Washim circles the data was incomplete which could not be used.

From the data received for each circle, 8-10 feeders were randomly selected. Wherever data for particular circle was not available, additional feeders were selected from other circles in order to maintain the required feeder count.

From each selected feeder, 2-3 villages were randomly selected. While CRIS intended to uniformly cover villages which were both near and far from the substation, the required data on the distance of each village from substation was not received in order for such purposive sampling to be done.</td></tr>
<tr><td>2</td><td>Total villages</td><td>484</td><td>504</td></tr>
</table>

Of the total 504 villages surveyed, 403 were GFSS related while 101 were Infrastructure Plan-I related. The circle-wise breakup of the number of villages surveyed for each of the schemes is shown in the table below. While the initial target was to cover around 17 villages per circle considering a total count of 30 circles, in final implementation CRIS covered greater than 17 villages in some of the circles in order to compensate for the absence of data from 6 circles (names of the prominent circles where a greater number of villages were covered have been marked with '*').

Table 3-5: Number of villages surveyed for GFSS and Infrastructure Plan-I

No.	Circles	GFSS	Infrastructure Plan- I	Grand Total
1	Ahmednagar *	38	--	38
2	Akola	18	--	18
3	Amravati	14	2	16
4	Baramati	--	18	18
5	Bhandara	18	--	18
6	Dhule	18	--	18
7	Gadchiroli	12	7	19
8	Hingoli	18	--	18
9	Jalgaon	18	--	18
10	Jalna *	11	10	21

No.	Circles	GFSS	Infrastructure Plan- I	Grand Total
11	Kolhapur *	32	5	37
12	Latur	18	--	18
13	Nagpur	17	--	17
14	Nanded *	16	17	33
15	Nandurbar	11	--	11
16	Nasik	17	--	17
17	Osmanabad	18	--	18
18	Parbhani *	25	--	25
19	Pune *	29	7	36
20	Sangli	18	--	18
21	Satara	1	17	18
22	Solapur	18	--	18
23	Wardha	--	18	18
24	Yavatmal	18	--	18
	Grand total	**403**	**101**	**504**

In terms of respondents, different categories of MSEDCL's consumers were surveyed since it was postulated that the schemes' impact would be varied for each consumer category. The categories surveyed included:

1. Households
2. Commercial units/ micro industrial units
3. Farmers
4. Schools
5. Health centers
6. Gram Panchayat office

The sample size covered against each respondent type is described in the table below.

Table 3-6 : Sample size covered against each respondent type

No.	Particulars	Sample size intended	Sample size achieved	Remarks
1	Total households	1,452	1,496	3 respondents selected randomly per village.
2	Total commercial/ micro industrial units	968	976	2 respondents selected randomly per village.
3	Total farmers	484	494	1 respondent selected randomly per village.

No.	Particulars	Sample size intended	Sample size achieved	Remarks
4	Total schools, hospitals & Gram panchayats	100	133	Since these respondents were not present in every village, selection was conducted based on availability and best effort basis
	Grand total	**3,004**	**3,099**	

3.2.2.2 Questionnaire structure

The questionnaires were structured to capture various socio-economic indicators which were hypothesized to be variables affected by the schemes' implementation. The questionnaires covered the following aspects.

1. Characterizing the respondent

This covered factual details about the respondent (name, contact details, age, employment type, income level) and the electricity connection (age of connection, size of load, number of appliances, monthly bill).

2. Awareness about the schemes

Respondent was asked about his/ her awareness of each of the two schemes under evaluation.

3. Load shedding faced presently

This involved enquiring about the nature of load shedding being presently encountered (day of the week, time of the day) and the issues/ complaints/ suggestions regarding load shedding.

4. Assessing the change in quality of electricity supply, social and economic aspects before and after the schemes

Respondent was queried on status of socio-economic parameters for the two periods: before and after scheme implementation. This involved objective questions related to possession of electrical appliances, load shedding duration, way of life, children's education, safety & security.

5. Discrimination faced in scheme implementation

This involved asking the respondent whether he/ she had faced any discrimination in implementation of these schemes within the village with certain consumers/ areas getting more benefit than others. In case discrimination was faced, the respondent was asked to describe the same.

6. Social messaging

The linkage between load shedding and MSEDCL's commercial losses was explained and the respondent was advised that timely payment of bills and reduction of electricity thefts can help to reduce load shedding. Further Gram Panchayat officials were also queried about the efforts that they had undertaken to sensitize villagers about these issues.

The questionnaires were customized according to the nature of individual consumer category - for example - the households' questionnaires were equally oriented towards social, economic and safety aspects while those for commercial/ micro-industrial units were more oriented towards economic aspects. Further, questions were designed with close ended response options so that the scope for subjectivity and ambiguity was reduced to the extent possible.

All the questionnaires employed for the survey are provided in the appendix to this report.

3.2.2.3 Process for finalizing questionnaire design and data collection strategy

Towards initial phase of the project, CRIS conducted a pilot survey whose results were used to update and improve the final questionnaire design and data collection strategy. The survey was conducted in the district of Nashik, involved eight villages and covered 57 respondents. The sample covered both the schemes (GFSS and Infrastructure Plan-I) and all consumer categories except schools and health centers, and thus was an appropriate microcosm of the entire population. The outcomes of the pilot survey were discussed in a meeting between CRIS, DES, Energy department (GoM) and MSEDCL officials and accordingly the questionnaire design and data collection strategy was finalized.

The questionnaires were further reviewed by M/s Bureau of Research on Industry & Economic Fundamentals Pvt. Ltd. (BRIEF), the agency with whom CRIS associated to conduct the data collection for assessing schemes' impact on village and semi-urban consumers. BRIEF further processed each of the questions and the associated response options in order to make the questionnaires amenable to field level data collection.

3.2.2.4 Primary research approach

For the task of primary data collection through field survey and face to face interviews with respondents, with the objective of assessing impact of the schemes on village and semi-urban consumers, CRIS has associated with M/s Bureau of Research on Industry & Economic Fundamentals Pvt. Ltd. (BRIEF). BRIEF has significant experience in the field of conducting similar sized primary surveys for a number of clients. A core team was formed comprising of Team leader, Project manager and Field in-charge. In order to ensure and maintain quality, experienced researchers were selected with over 10 years of field experience.

Around 20 team members were deployed to cover the entire sample area. BRIEF deployed 5 teams, each consisting of 3 to 5 team members across Maharashtra. Each team consisted of enumerators and supervisors. The team was provided adequate training and a survey manual to ensure consistency. The manual included detailed instructions and guidelines on conducting the actual survey with a respondent.

Stringent quality control measures were put in place to ensure data quality. The supervisors conducted monitoring and checks on daily basis. After completion of the survey, the data was cleaned and sanity checks were conducted for missing data, out of trend data, etc.

The data validation was independently carried out by CRIS. Survey respondents were randomly contacted in order to cross check contribution of respondent to the survey and to verify some of the responses. The following table details the validations conducted.

Table 3-7: Data validation for primary survey

Sr. No	Respondent type	Respondent name	Village	District	Date of survey
1	Commercial/ Micro industrial	Indrajeet arun	Daarawadi	Pune	24.07.17
2	Commercial/ Micro industrial	Jadhav	Vitai	Dhule	12.07.17
3	Commercial/ Micro industrial	Dhupindra	Vitai	Dhule	12.07.17
4	Commercial/ Micro industrial	Sanita	Kirawade	Dhule	12.07.17
5	Commercial/ Micro industrial	Babaji Natha Shilke	Dhangadwadi	Pune	24.07.17

Sr. No	Respondent type	Respondent name	Village	District	Date of survey
6	Agriculture	Sayam Singh rajput	Ghodade	Dhule	09.07.17
7	Agriculture	Chandrakant Vishram	Dhangadwadi	Pune	24.07.17
8	Agriculture	Lala Rajput	Vitai	Dhule	12.07.17
9	Agriculture	Kachar Baburao Barave	Chas	Pune	28.07.17
10	Agriculture	Thorat Gitabhai Bankar	Kalamb	Pune	28.07.17
11	Household	Mandar Bhiwaji Kewat	Khamba	Bhandara	08.07.17
12	Household	Narayan Bavne	Khamba	Bhandara	08.07.17
13	Household	Niranjan Wankade	Mahegam	Bhandara	12.07.17
14	Household	Mithish Yadav	Sanaswadi	Baramati	30.07.17
15	Gram Panchayat	Dilip Lanjewar (Sarpanch)	Mahegam	Bhandara	12.07.17
16	Gram Panchayat	Yahswant Meshram	Malutola	Bhandara	09.07.17

3.2.2.5 Timeline of data collection

The interviews with respondents were conducted during the period starting from last week of June, 207 and ending in last week of August, 2017. The teams of BRIEF's enumerators and supervisors conducted the interviews in multiple phases covering each relevant administrative division of Maharashtra.

3.2.3 Ground implementation of the schemes

3.2.3.1 Data collection approach

CRIS used the method of personal interviews with officers of MSEDCL who were responsible for scheme implementation. The individual circle offices of MSEDCL were the basic unit for scheme implementation while the MSEDCL Head Office was responsible for fund disbursement and overall scheme monitoring. The interviews covered officers from both the set of offices.

The questionnaires covered the following aspects:

- Organization structure at each of the offices relevant to scheme implementation
- Implementation methodology
- Quality control
- Challenges faced during implementation
- Progress reporting: persons responsible, frequency of reporting, KPIs being reported

The format of questionnaire was discussed and finalized in a meeting between CRIS, DES, Energy department (GoM) and MSEDCL officials

The personal interview questionnaire used has been provided as appendix to this report.

3.2.3.2 Data collection

The names of officers to be interviewed were provided by the officials from Infrastructure Plan department at MSEDCL Head Office. Accordingly CRIS scheduled interviews, shared the detailed agenda beforehand and conducted face to face interviews with relevant officers. The interviews planned to be conducted and actually conducted are described as follows.

Table 3-8: Interviews to assess ground implementation of the schemes: planned vs actual done

Intended	Implemented
• SE Infra, Akola (Shri. Doey) • SE O&M, Gondia (Shri..Borikar) • SE O&M, Kolhapur (Shri. Sonawne)	• SE Infra, Akola (Shri. Doey) • SE O&M, Gondia (Shri..Borikar) • SE O&M, Kolhapur (Shri. Sonawne) along with Dy. Infra, Kolhapur (Shri. Sameer Akhtar) and AE Infra, Kolhapur, (Shri. S.N Patange)

3.2.3.3 Timeline of data collection

The interviews were conducted during the period starting from 1st August 2017 and ending on 18th August 2017.

4. Key findings: Physical and financial achievements of the schemes

4.1 Physical KPIs

4.1.1 Distribution losses

The 10-year distribution losses for relevant circles are shown in the table below.

Table 4-1 : 10-year distribution losses for relevant circles

Circle	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Akola	43%	39%	35%	35%	27%	25%	25%	24%	25%	26%
Buldhana	36%	23%	23%	22%	20%	16%	13%	13%	14%	13%
Amrawati	40%	28%	27%	23%	21%	19%	18%	16%	15%	16%
Yavatmal	49%	41%	29%	26%	24%	18%	16%	14%	12%	14%
Aurangabad	41%	40%	31%	30%	23%	20%	17%	17%	15%	15%
Jalna	33%	39%	29%	29%	22%	20%	16%	16%	16%	14%
Satara	22%	28%	25%	22%	19%	16%	14%	14%	13%	13%
Solapur	46%	28%	25%	24%	20%	19%	16%	15%	15%	15%
Chandrapur	11%	9%	9%	9%	7%	7%	8%	7%	9%	9%
Gadchiroli	32%	30%	23%	27%	22%	22%	17%	18%	20%	19%
Bhandara	27%	19%	18%	13%	11%	10%	10%	11%	13%	13%
Gondia	49%	41%	35%	33%	31%	24%	22%	22%	23%	23%
Dhule	48%	32%	34%	22%	22%	20%	17%	17%	17%	17%
Jalgaon	45%	27%	29%	28%	24%	19%	20%	17%	19%	22%
Kolhapur	17%	14%	15%	13%	12%	11%	11%	10%	9%	10%
Sangli	24%	31%	29%	29%	26%	21%	19%	18%	17%	16%
Beed	60%	66%	54%	43%	37%	26%	26%	24%	22%	22%
Latur	56%	50%	40%	34%	29%	22%	19%	18%	23%	18%
Osmanabad	55%	56%	51%	45%	34%	29%	21%	18%	16%	15%
Nagpur	19%	15%	12%	11%	9%	9%	9%	10%	11%	11%
Wardha	10%	9%	8%	8%	7%	8%	8%	8%	8%	7%
Nanded	53%	40%	30%	31%	25%	23%	23%	21%	21%	23%
Parbhani	61%	46%	36%	40%	35%	22%	22%	21%	22%	20%
Ahmednagar	48%	30%	31%	25%	15%	19%	18%	20%	18%	17%
Nashik	40%	23%	30%	31%	21%	18%	16%	17%	17%	19%

Circle	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Pune	23%	24%	24%	21%	15%	13%	13%	12%	11%	11%

Trends in the distribution losses for few select circles has been analyzed in the graphs shown below. The circles represent each GoM designated administrative division.

Figure 4-1: Trend in distribution losses for Yavatmal (Amravati division)

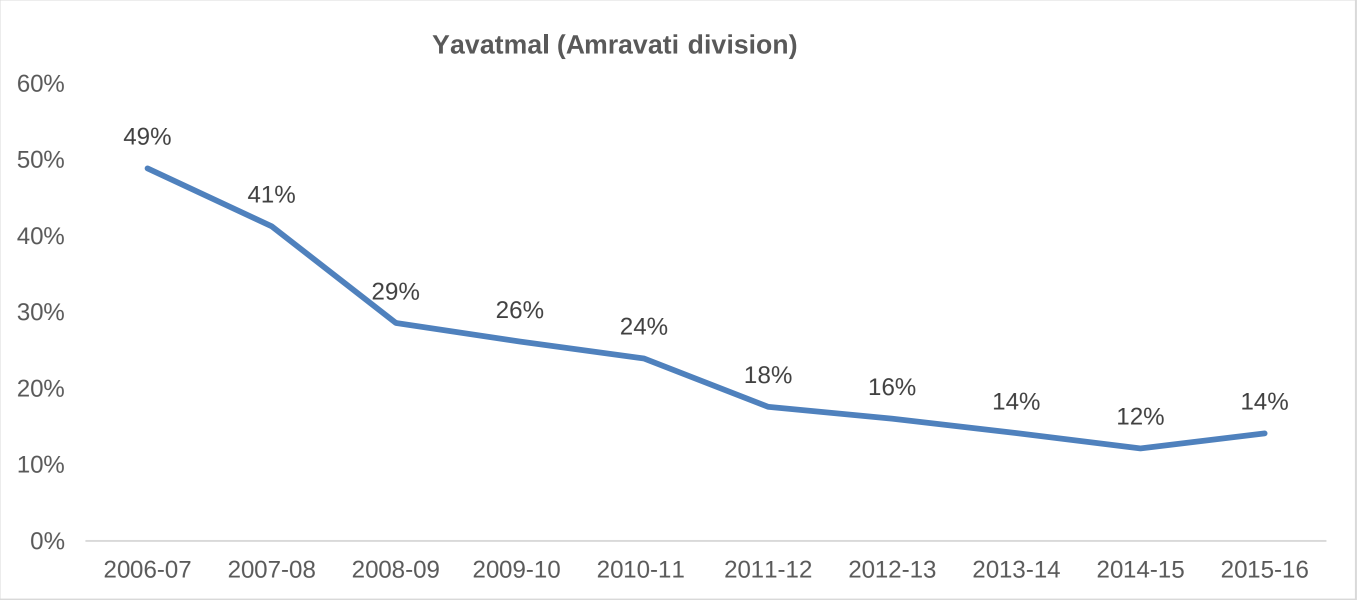


Figure 4-2: Trend in distribution losses for Satara (Pune division)

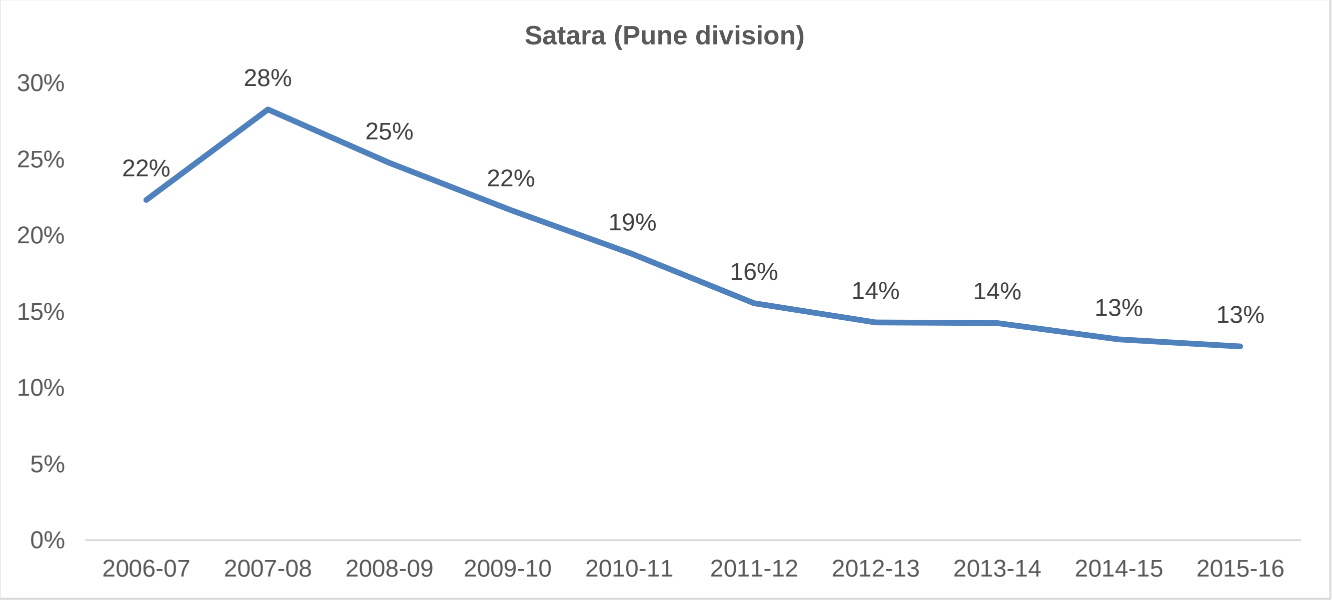


Figure 4-3: Trend in distribution losses for Gondia (Nagpur division)

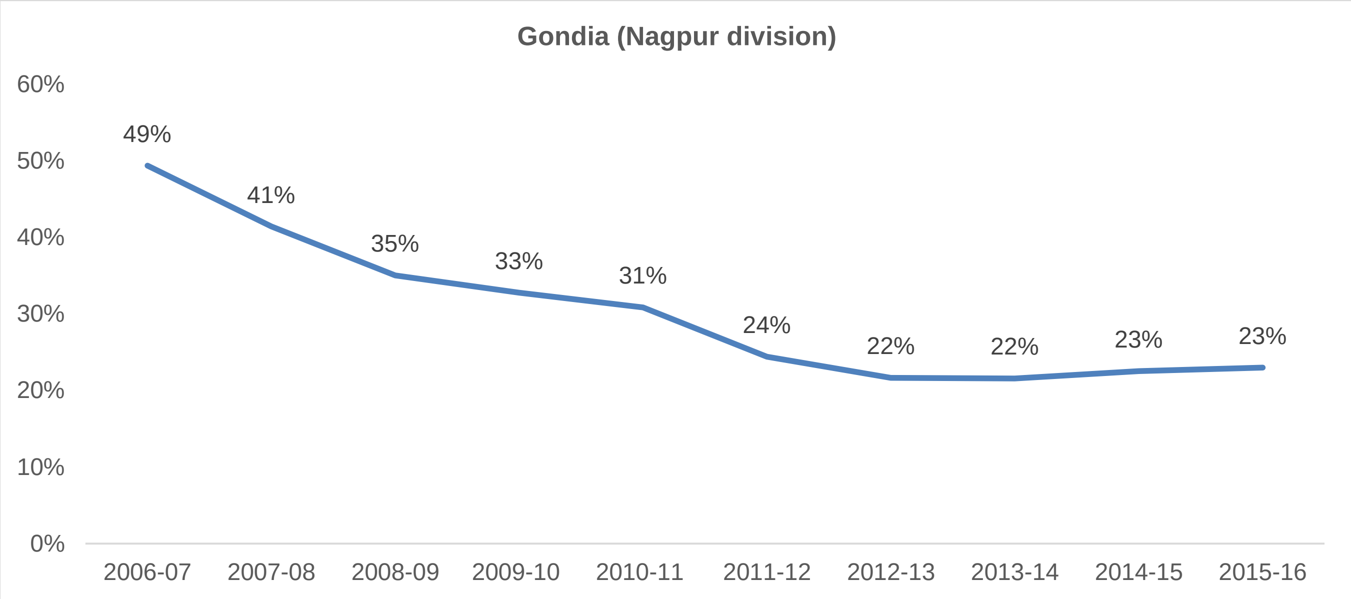


Figure 4-4: Trend in distribution losses for Dhule (Nashik division)

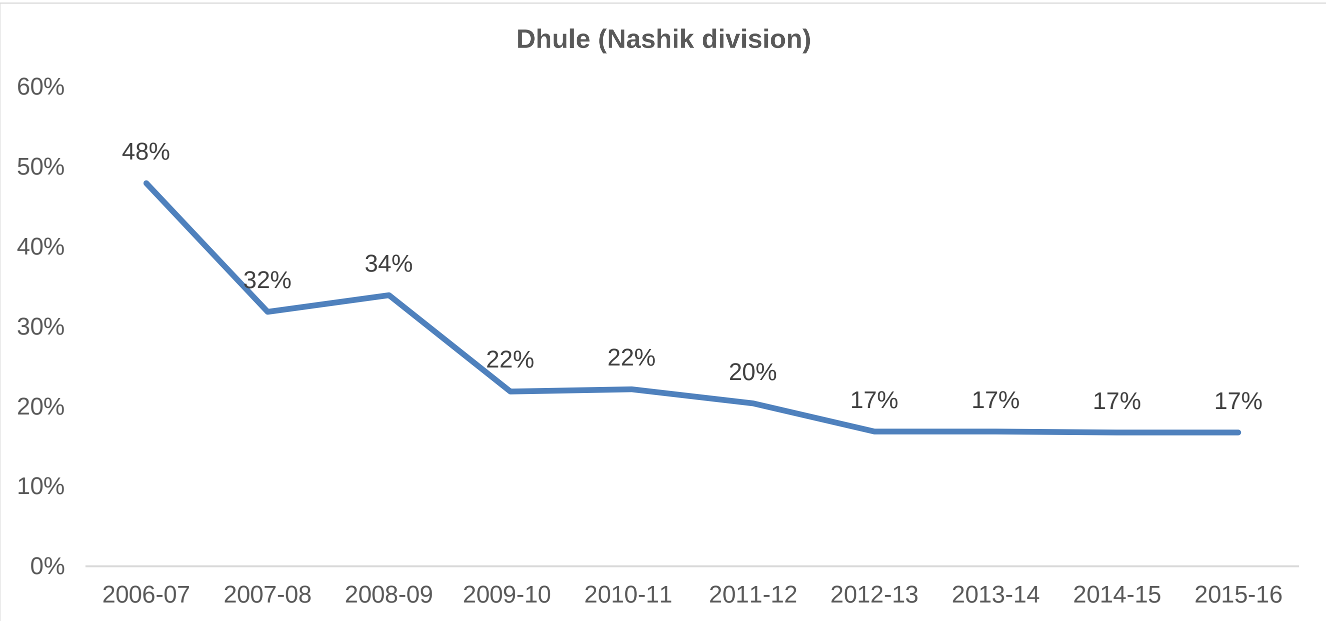
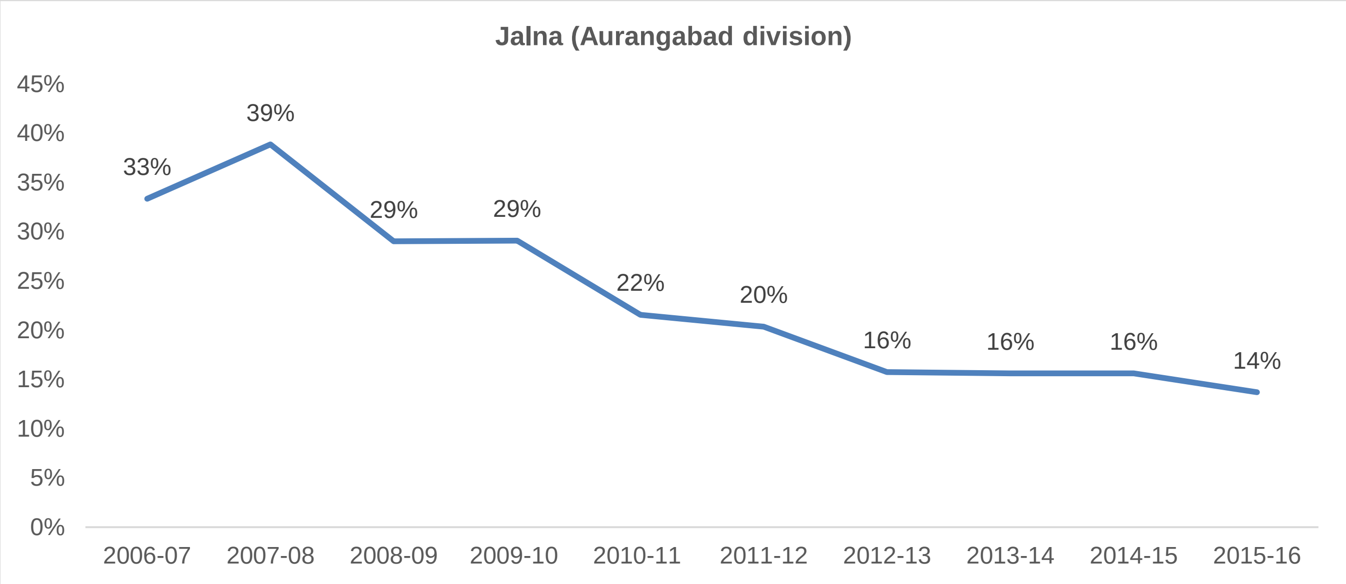


Figure 4-5: Trend in distribution losses for Jalna (Aurangabad division)



The above trends indicate that the reduction in distribution losses was minimal during the period before the scheme implementation i.e. upto 2007. The reduction in distribution losses was much sharper[4] once the implementation of scheme began and eventually flattened out after end of the scheme implementation i.e. 2012 onwards. Similar trends have been observed for all the other circles in each division.

In terms of attribution of the sharp reduction in distribution losses to the schemes, according to circle officers of MSEDCL who were responsible for implementation of the scheme, these schemes were the only schemes successfully implemented during the period when reduction in distribution losses were maximum. Hence, ***the role of these schemes in reducing distribution losses is highly significant.***

4.1.2 Reliability indices (SAIFI and SAIDI)

The **System Average Interruption Frequency Index (SAIFI)** is commonly used as a reliability indicator by electric power utilities. SAIFI is the average number of interruptions that a customer would experience, and is calculated as follows.

SAIFI = Total number of customer interruptions / total number of customers served

SAIFI is measured in units of number of interruptions per customer served.

The **System Average Interruption Duration Index** (**SAIDI**) is commonly used as a reliability indicator by electric power utilities. SAIDI is the average outage duration for each customer served, and is calculated as follows:

SAIDI = Sum of all interruption durations / Total number of customers served

SAIDI is measured in units of time, often minutes or hours of interruptions per customer served. In this chapter, the unit refers to “hours”.

[4] *The extent of reduction for Satara circle may look small as compared to other two circles but that is because the starting level of distribution losses were much lower for Satara circle. The percentage reduction is still substantial*

4.1.2.1 SAIFI

The 9-year data on SAIFI for the relevant circles has been shown in the table below.

Table 4-2: 9-year data on SAIFI for the relevant circles (number of interruptions per customer served)

Circle	2008	2009	2010	2011	2012	2013	2014	2015	2016
Akola	5.07	6.06	10.69	4.22	2.44	1.49	1.08	0.99	2.95
Amravati	1.79	2.38	3.18	6.85	2.10	1.86	1.48	0.67	2.39
Buldhana	2.34	1.77	2.14	3.07	0.88	0.72	0.80	0.59	2.06
Washim	4.81	4.48	4.65	3.35	3.34	3.16	1.15	0.48	2.18
Yavatmal	10.42	8.25	6.48	3.45	1.33	2.42	2.92	1.42	2.62
Jalna	8.17	6.66	14.87	4.26	16.21	4.67	0.91	0.10	2.26
Baramati	20.06	21.83	23.12	11.65	5.13	7.37	1.64	1.08	4.32
Satara	11.11	12.30	17.85	13.47	10.33	3.02	1.77	2.02	3.64
Jalgaon	15.40	17.79	17.81	7.66	3.70	2.75	1.08	1.17	3.92
Dhule	14.13	14.41	14.07	15.04	11.81	29.71	15.88	1.24	2.78
Nandurbar	32.18	37.92	27.39	37.23	10.48	24.33	3.89	2.38	2.92
Kolhapur	8.92	9.25	8.34	14.93	12.02	13.79	6.73	2.70	3.97
Sangli	6.14	5.49	5.70	9.93	6.98	2.34	1.61	1.27	2.76
Beed	15.40	9.16	13.15	6.52	1.22	8.35	2.35	0.40	1.39
Latur	6.51	7.85	5.56	8.30	10.25	5.09	1.09	0.71	3.16
Bhandara	1.40	1.86	3.29	5.26	2.35	1.46	1.07	1.27	2.76
Chandrapur	1.28	1.25	1.26	14.60	7.85	4.44	3.32	2.32	3.64
Gadchiroli	16.03	14.61	22.72	13.00	12.20	4.56	1.01	1.01	2.81
Wardha	9.11	8.74	10.36	4.54	2.65	1.35	0.86	1.53	2.81
Gondia	2.20	3.51	13.90	12.02	8.30	7.52	1.82	1.94	4.05
Hingoli	1.40	0.29	0.00	0.80	0.36	0.57	0.54	0.48	2.87
Nanded	6.72	12.08	13.70	5.79	2.49	1.88	0.42	0.24	2.45
Parbhani	12.08	11.17	0.00	0.47	0.74	1.41	0.45	0.34	3.00
Ahmednagar	12.99	13.36	10.76	17.54	16.89	5.46	1.43	0.14	2.15
Nashik	4.62	5.31	3.33	2.88	2.09	1.32	0.80	0.34	2.97
Nagpur	13.25	12.97	14.82	17.73	14.92	13.63	2.24	0.89	3.56

Trends in the SAIFI for few select circles has been analyzed in the graphs shown below. The circles represent each GoM designated administrative division.

Figure 4-6: Trend in SAIFI for Wardha (Nagpur division) (number of interruptions per customer served)

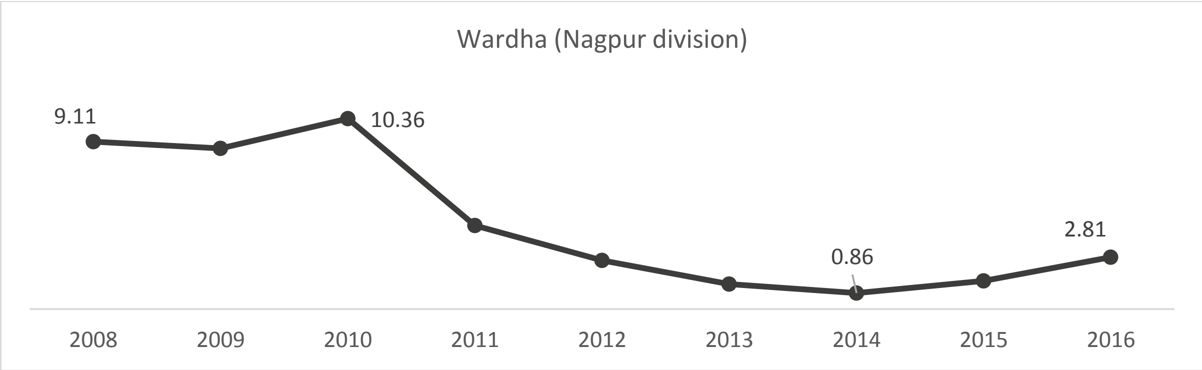


Figure 4-7: Trend in SAIFI for Yavatmal (Amravati division) (number of interruptions per customer served)

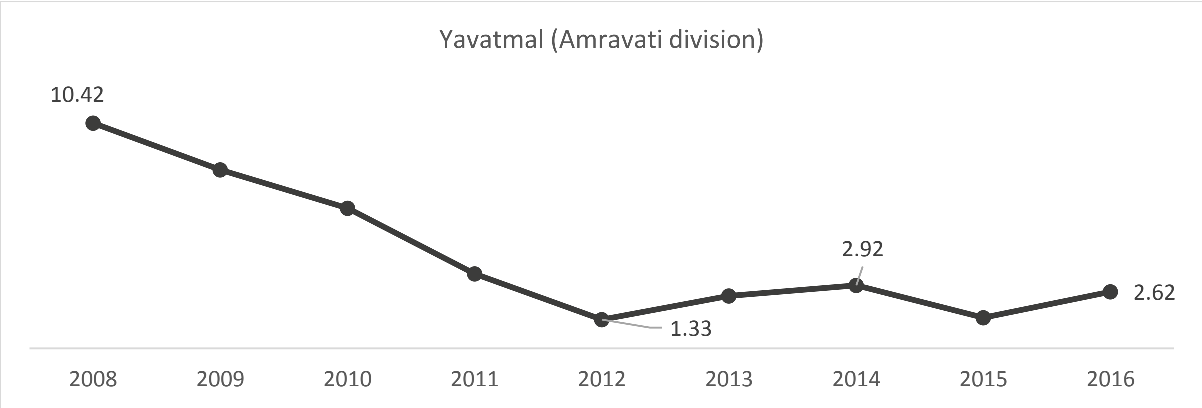


Figure 4-8: Trend in SAIFI for Nanded (Aurangabad division) (number of interruptions per customer served)

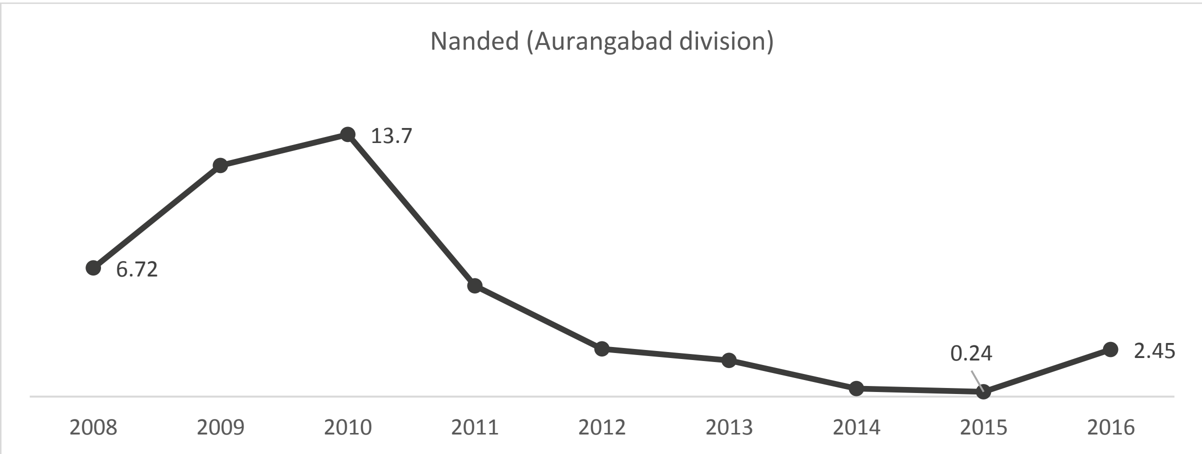


Figure 4-9: Trend in SAIFI for Satara (Pune division) (number of interruptions per customer served)

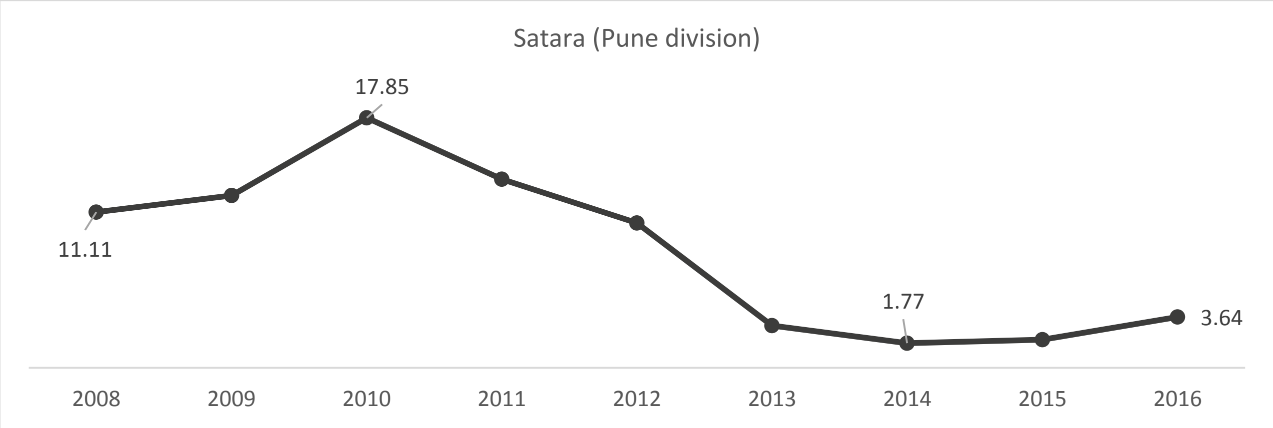
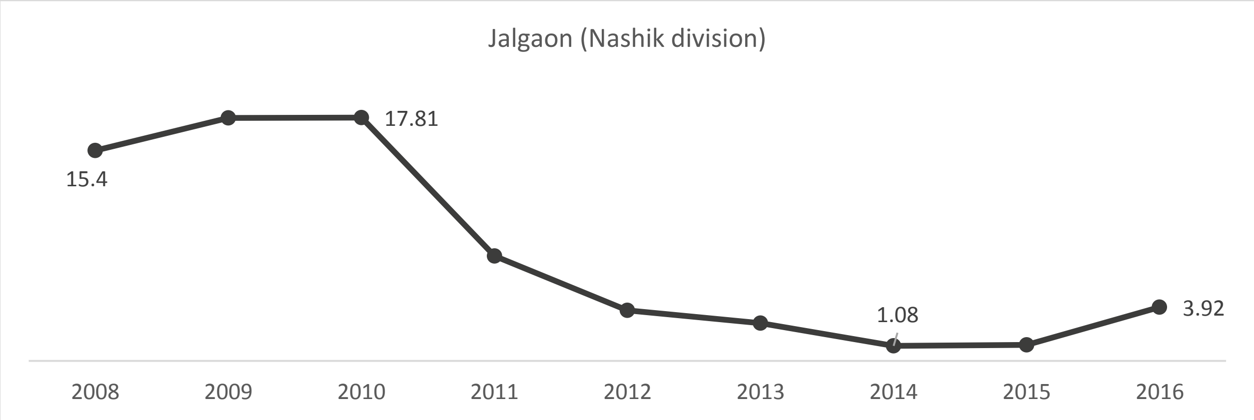


Figure 4-10: Trend in SAIFI for Jalgaon (Nashik division) (number of interruptions per customer served)



The above table and graphs indicate that ***average number of interruptions faced by a typical customer (SAIFI) has significantly reduced during the time the schemes were being implemented. The increasing trend seen in last 2-3 years could, in CRIS view, be on account of the number of interruptions increasing at a faster rate than the additions in number of customers, possibly due to higher load growth.*** The spike in some intermediate years could be on account of natural events/ calamities like thunderstorms, cyclones, heavy rains, etc.[5]

4.1.2.2 SAIDI

The 9-year data on SAIDI for the relevant circles has been shown in the table below.

Table 4-3: 9-year data on SAIDI for the relevant circles (hours of interruption per customer served)

Circle	2008	2009	2010	2011	2012	2013	2014	2015	2016
Ahmednagar	417.72	416.6	234.99	88.11	140.06	137.13	68.74	23.81	209.81
Akola	114.5	222.67	177.87	120.29	156.73	92.87	121.71	117.63	265.25
Amravati	135.08	160.83	132.26	78.08	107.96	96.68	103.93	78.03	191.74
Baramati	388.17	392.49	283.84	131.87	105.5	54.72	88.58	65.57	230.82

[5] *The possible reasons mentioned herein are CRIS view. CRIS has queried about the trends to MSEDCL and its reply is still awaited*

Circle	2008	2009	2010	2011	2012	2013	2014	2015	2016
Beed	410.18	406.1	251.67	124.01	34.74	99.98	111.57	85.14	267.4
Bhandara	177.84	221.97	201.34	126.98	106.08	78.89	113.54	163.14	263.55
Buldhana	219.85	324.68	218.07	97.55	74.96	40.09	74.25	69.93	215.26
Chandrapur	161.86	213.99	149.71	123.82	155.9	107.07	171.35	188.93	240.56
Dhule	363.99	428.79	252.55	87.04	53.58	98.72	69.74	114.95	216.4
Gadchiroli	213.5	395.22	110.58	58.9	46.62	58.65	136.09	205.93	331.52
Gondia	234.99	283.75	51.87	66.43	81.18	103.16	119.7	188.29	309.39
Jalgaon	401.73	442.22	355.85	131.71	36.46	83.16	115.59	111.67	262.22
Jalna	229.88	289.16	130.31	104.28	152.04	132.69	58.98	45.53	204.87
Kolhapur	181.3	185.68	106.97	72.52	64.79	65.88	99.88	114.71	195.11
Latur	435.8	362.23	180.16	138.9	185.16	120.1	51.58	90.53	223.45
Nagpur	266.54	253.81	266.54	79.62	82.74	110.19	89.81	107.28	218.62
Nanded	279.56	281.91	172.75	173.89	163.5	93.58	54.2	44.56	272.94
Nandurbar	671.44	681.05	451.59	114.5	151.13	154.57	137.59	200.32	247.07
Nashik	244.11	394.78	225.38	112.39	122.75	70.17	77.31	68.14	237.27
Osmanabad	520.67	621.82	495.91	226.87	215.25	176.72	72.55	39.46	201.65
Pune	391.29	368.58	252.11	66.54	83.11	111.11	199.19	212.49	272.55
Sangli	82.43	62.74	67.23	42.79	55.57	46.96	44.87	64.85	166.92
Satara	197.08	190.28	170.88	51.2	42.33	58.99	56.35	101.77	184.27
Solapur	130.89	129.29	134.35	98.95	90.03	90.58	82.16	124.94	201.16
Wardha	358.01	365.01	169.2225	86.7	92.11	70.1	95.17	138.5	213.59
Washim	537.51	378.51	297.84	128.4	126.18	94.68	100.46	63.63	200.94
Yavatmal	185.42	159.2	119.29	88.23	81.77	63.98	91.82	90.03	196.46

Trends in the SAIDI for few select circles has been analyzed in the graphs shown below. The circles represent each GoM designated administrative division.

Figure 4-11: Trend in SAIDI for Nagpur (Nagpur division) (hours of interruption per customer served)

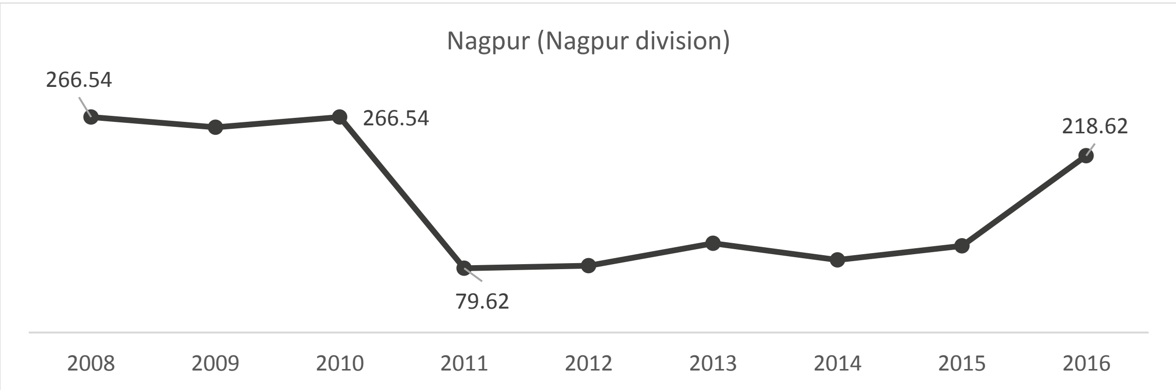


Figure 4-12: Trend in SAIDI for Buldhana (Amravati division) (hours of interruption per customer served)

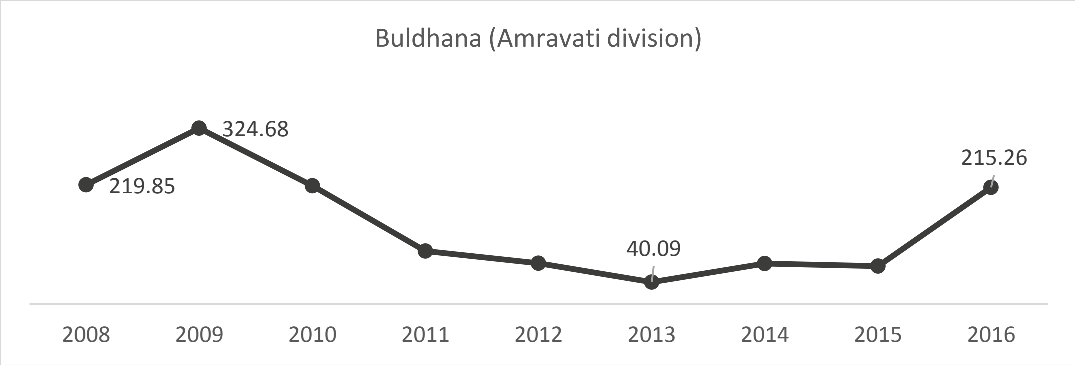


Figure 4-13: Trend in SAIDI for Latur (Aurangabad division) (hours of interruption per customer served)

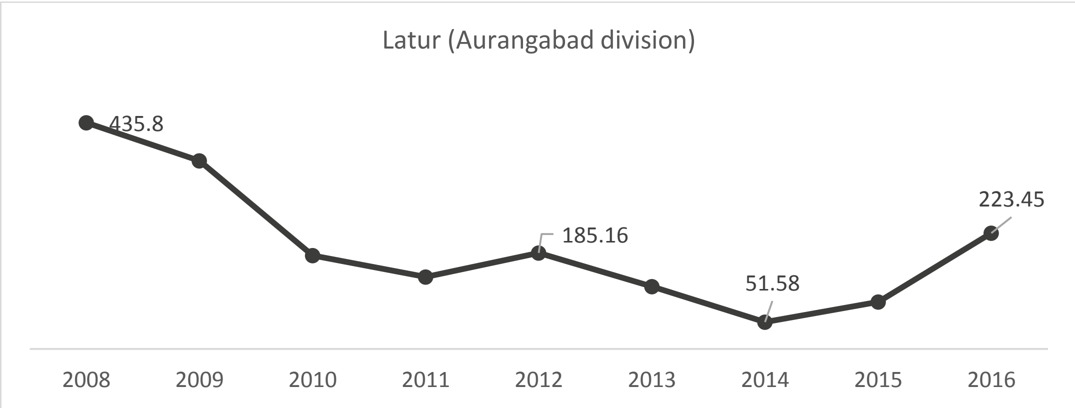


Figure 4-14: Trend in SAIDI for Satara (Pune division) (hours of interruption per customer served)

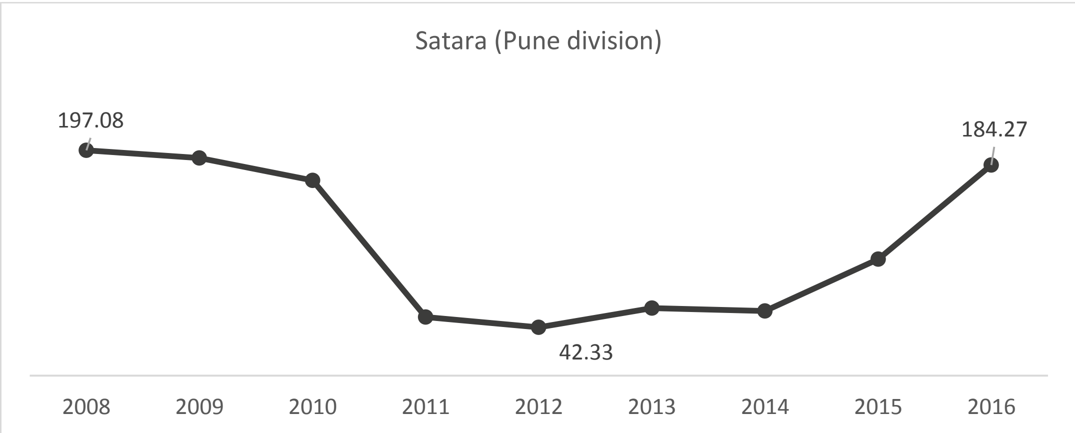
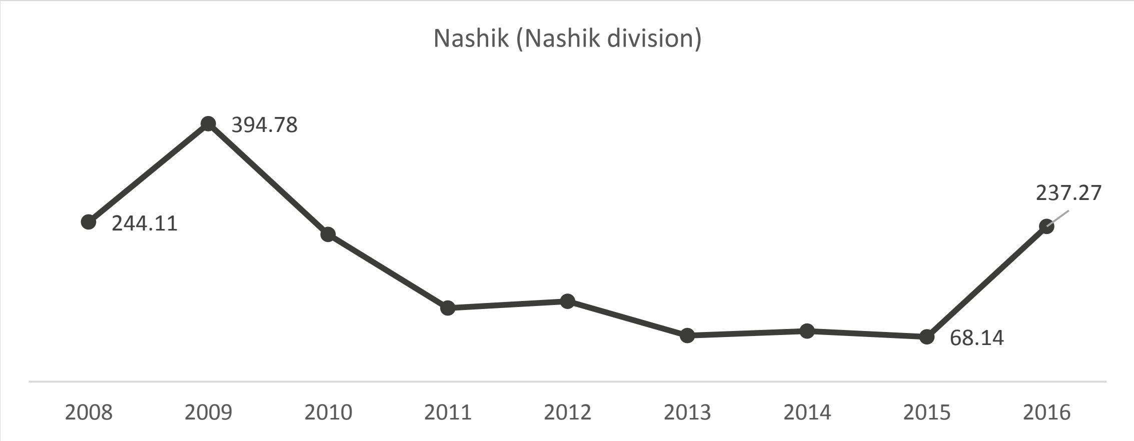


Figure 4-15: Trend in SAIDI for Nashik (Nashik division) (hours of interruption per customer served)



The above table and graphs indicate that ***average duration of interruptions faced by a typical customer (SAIDI) has significantly reduced during the time the schemes were being implemented. The increasing trend seen in last 2-3 years could, in CRIS view, be on account of the duration of interruptions increasing at a faster rate than the additions in number of customers, possibly due to higher load growth. The spike in some intermediate years could be on account of natural events/ calamities like thunderstorms, cyclones, heavy rains, etc.***[6]

On an overall basis, both the number and duration of interruptions has seen improvement during the period of scheme implementation. It can also be seen that the actual period in which improvement is observed in SAIFI, SAIDI is shifted by 1-2 years ahead as compared to distribution losses. This can be attributed to the fact that the Infrastructure Plan-I scheme had a greater role to play in reduction of SAIFI, SAIDI owing to its design as a system strengthening scheme. It is to be noted that implementation of Infrastructure Plan-I scheme followed implementation of GFSS.

4.1.3 Extent of metering in agricultural consumption

One of the direct benefits of agricultural load segregation carried out under the GFSS is increase in the number of agriculture consumers being metered. Owing to more certainty in the availability of power supply, agriculture consumers are willing to get themselves metered. Consequently this results in an increase in metered electricity consumption along with decrease in unmetered electricity consumption. Metering of agriculture consumers provides right signals to such consumers to manage their individual loads and reduce energy wastage, thus in turn helping the utility manage the overall system load properly.

The 12 year data of share of metered to total electricity consumption for agriculture consumers of relevant circles is shown below.

Table 4-4: Share of metered to total electricity consumption for agriculture consumers of relevant circles

Circle	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Akola	0.42	0.52	0.58	0.58	0.61	0.64	0.68	0.75	0.77	0.77	0.80	0.82
Buldhana	0.41	0.46	0.50	0.53	0.56	0.57	0.60	0.60	0.62	0.63	0.66	0.68

[6] *The possible reasons mentioned herein are CRIS view. CRIS has queried about the trends to MSEDCL and its reply is still awaited*

Circle	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Washim	0.64	0.59	0.58	0.62	0.63	0.65	0.68	0.71	0.74	0.75	0.74	0.74
Amaravati	0.43	0.47	0.48	0.48	0.51	0.54	0.58	0.62	0.62	0.64	0.66	0.68
Yavatmal	0.19	0.32	0.38	0.45	0.46	0.48	0.53	0.57	0.58	0.60	0.61	0.61
Baramati	0.16	0.31	0.31	0.36	0.35	0.40	0.48	0.51	0.53	0.58	0.62	0.65
Satara	0.38	0.51	0.59	0.66	0.67	0.73	0.78	0.82	0.83	0.87	0.89	0.89
Solapur	0.24	0.30	0.31	0.34	0.38	0.42	0.45	0.46	0.47	0.46	0.47	0.47
Chandrapur	0.44	0.54	0.71	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Gadchiroli	0.30	0.48	0.82	0.90	0.96	0.98	0.98	1.00	1.00	1.00	1.00	1.00
Bhandara	0.38	0.52	0.78	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Gondia	0.50	0.63	0.87	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Dhule	0.16	0.24	0.27	0.32	0.32	0.34	0.36	0.39	0.41	0.42	0.43	0.44
Jalgaon	0.25	0.34	0.30	0.34	0.34	0.36	0.39	0.44	0.42	0.44	0.48	0.46
Nandurbar	0.18	0.22	0.24	0.26	0.27	0.30	0.34	0.37	0.37	0.41	0.42	0.44
Kolhapur	0.57	0.64	0.69	0.71	0.73	0.77	0.81	0.87	0.89	0.90	0.92	0.93
Sangli	0.46	0.56	0.62	0.72	0.74	0.79	0.79	0.83	0.84	0.85	0.87	0.86
Beed	0.04	0.16	0.24	0.22	0.25	0.29	0.28	0.30	0.31	0.33	0.34	0.33
Latur	0.13	0.22	0.37	0.45	0.50	0.54	0.51	0.51	0.52	0.52	0.53	0.56
Osmanbad	0.11	0.15	0.26	0.29	0.32	0.34	0.29	0.29	0.28	0.30	0.31	0.32
Nagpur	0.58	0.57	0.67	0.77	0.86	0.89	0.90	0.91	0.92	0.92	0.93	0.93
Wardha	0.64	0.72	0.82	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hingoli	0.16	0.17	0.25	0.26	0.29	0.34	0.40	0.42	0.44	0.46	0.50	0.53
Nanded	0.14	0.17	0.20	0.24	0.26	0.33	0.37	0.39	0.40	0.44	0.47	0.49
Parbhani	0.17	0.21	0.23	0.26	0.29	0.34	0.40	0.43	0.46	0.47	0.49	0.52
Ahmednagar	0.13	0.42	0.38	0.45	0.41	0.42	0.38	0.39	0.40	0.43	0.45	0.47
Nashik	0.12	0.44	0.51	0.53	0.52	0.54	0.60	0.61	0.63	0.66	0.66	0.63
Pune	0.19	0.38	0.40	0.44	0.42	0.47	0.54	0.58	0.60	0.64	0.66	0.71
Aurangabad	0.17	0.41	0.37	0.39	0.40	0.42	0.40	0.37	0.36	0.36	0.36	0.34
Jalna	0.02	0.06	0.09	0.10	0.11	0.20	0.24	0.32	0.30	0.33	0.34	0.35

It is observed for most circles metered agricultural consumption has increased which has led to increase in share of metered agricultural consumption to total agricultural consumption. The trend in share of metered agricultural energy consumption for few circles is shown below.

Figure 4-16: Share of metered agricultural energy consumption for Wardha (Nagpur division)

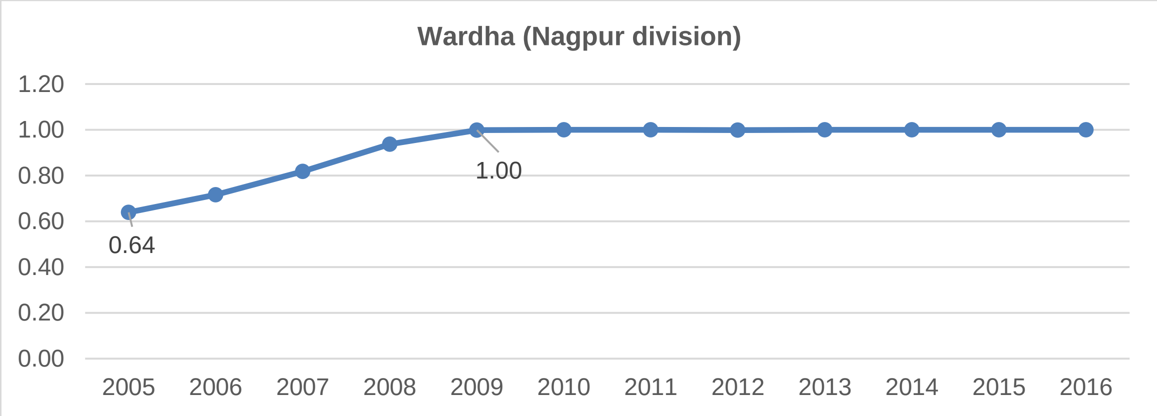


Figure 4-17: Share of metered agricultural energy consumption for Amravati (Amravati division)

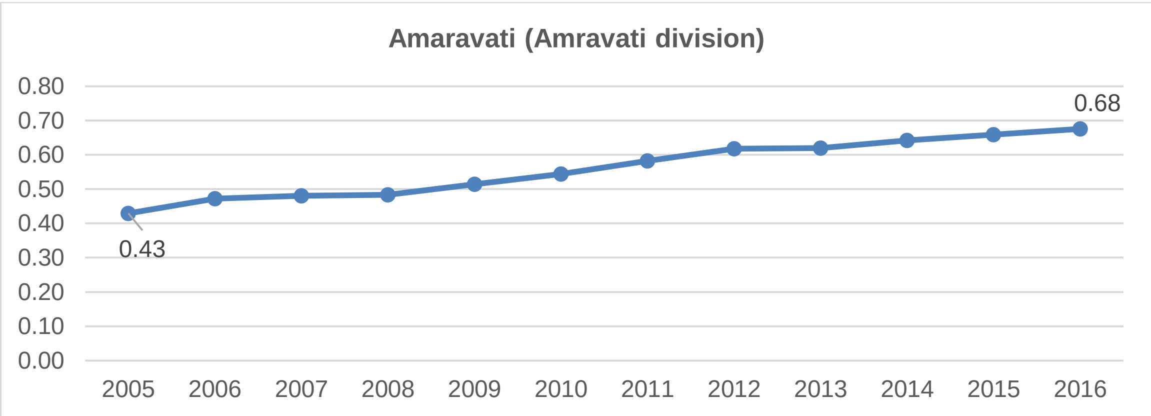


Figure 4-18: Share of metered agricultural energy consumption for Hingoli (Aurangabad division)

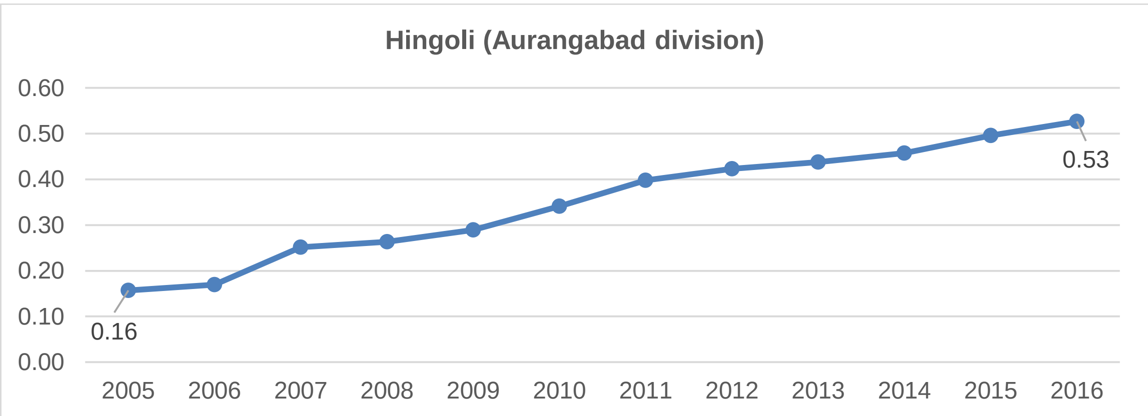


Figure 4-19: Share of metered agricultural energy consumption for Solapur (Pune division)

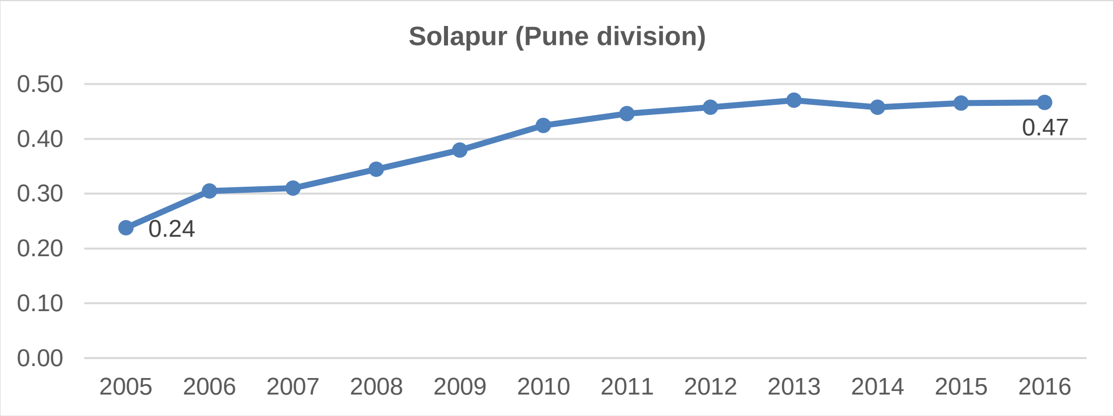
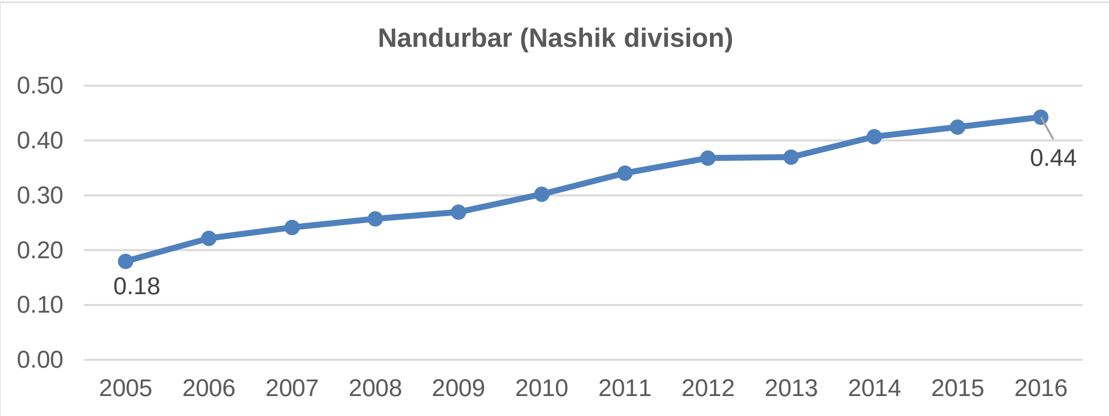


Figure 4-20: Share of metered agricultural energy consumption for Nandurbar (Nashik division)



It is evident that the extent of metering of agricultural consumers has increased during the period of schemes' implementation. The role of GFSS scheme is important here since the scheme involved segregation of agriculture feeders and consequently encouraged growth in metered connections.

4.1.4 Rate of equipment (Transformer) failure

Distribution transformer is a critical equipment in the electricity supply chain and its failure affects the power supply to all customers who are connected to the transformer. One of the major objectives of implementation of Infrastructure Plan-I scheme was to reduce equipment failure rate. Under this scheme, transformers facing issues of age, inadequate capacity, etc. were replaced with new transformers having better specifications.

The following table depicts the transformer failure rate percentages across thirty districts of Maharashtra.

Table 4-5: Transformer failure rate overall the years in Maharashtra

Circle	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Akola	9.55	8.21	6.74	8.34	6.91	6.38	12.10	10.88	10.04
Amravati	10.89	8.39	11.68	5.76	6.33	4.32	6.78	5.54	6.40

Circle	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Buldhana	18.28	18.03	18.92	18.88	10.83	6.47	13.37	8.81	8.72
Yavatmal	7.86	8.18	9.05	11.76	10.36	7.92	9.75	6.26	8.12
Auranagabad	12.55	22.54	13.57	13.33	13.48	6.27	11.91	11.47	13.52
Jalna	16.27	18.42	16.35	14.14	10.41	6.48	15.07	10.79	12.81
Satara	7.36	7.11	7.13	5.74	3.63	3.12	4.37	4.71	5.13
Solapur	17.45	18.40	25.60	14.74	11.14	9.52	9.78	9.80	6.91
Jalgaon	22.04	22.85	25.41	15.37	12.43	10.01	15.14	15.28	13.11
Kolhapur	6.16	7.18	6.68	5.18	3.82	2.96	2.35	2.81	3.20
Sangli	8.14	8.16	8.46	8.93	7.35	5.47	5.98	6.43	6.88
Beed	17.34	17.78	16.13	17.73	16.43	7.75	16.98	13.99	8.86
Osmanabad	21.75	23.39	25.45	17.59	14.94	6.74	12.26	11.52	7.21
Latur	13.11	10.50	9.66	12.63	13.39	9.45	11.99	12.01	6.63
Nagpur	6.89	5.78	5.65	5.37	3.83	3.56	5.03	4.79	4.78
Bhandara	6.43	6.59	6.09	5.82	4.95	3.83	5.36	7.17	8.58
Chandrapur	9.46	8.39	7.62	6.55	6.25	6.06	3.83	6.64	6.60
Gadchiroli	9.75	6.90	6.81	8.28	7.65	7.13	8.23	6.07	4.96
Wardha	7.87	5.99	5.92	4.34	3.48	3.56	4.83	5.96	5.93
Gondia	N.A.	8.37	9.62	7.01	7.39	5.85	7.47	7.69	9.17
Hingoli	N.A.	16.07	16.16	19.90	8.84	8.84	11.87	11.71	14.77
Nanded	13.62	10.62	9.33	9.97	7.07	6.64	11.02	8.96	7.29
Parbhani	15.44	16.07	16.21	18.35	13.36	8.23	15.35	11.69	8.17
Nashik	13.94	17.15	14.58	10.76	7.95	5.82	6.56	8.07	6.68
Ahmednagar	15.27	28.56	15.85	16.27	14.57	9.62	11.82	12.49	11.58
Pune	11.78	11.39	8.07	7.12	6.39	5.66	5.86	6.40	6.48

Overall, it can be observed in most circles, there is a gradual decreasing trend of transformer failure rate over the years.

The following graphs depict the trend in transformer failure rate for one circle representing each zone of Maharashtra.

Figure 4-21: Transformer failure rate of Kolhapur (Pune division)

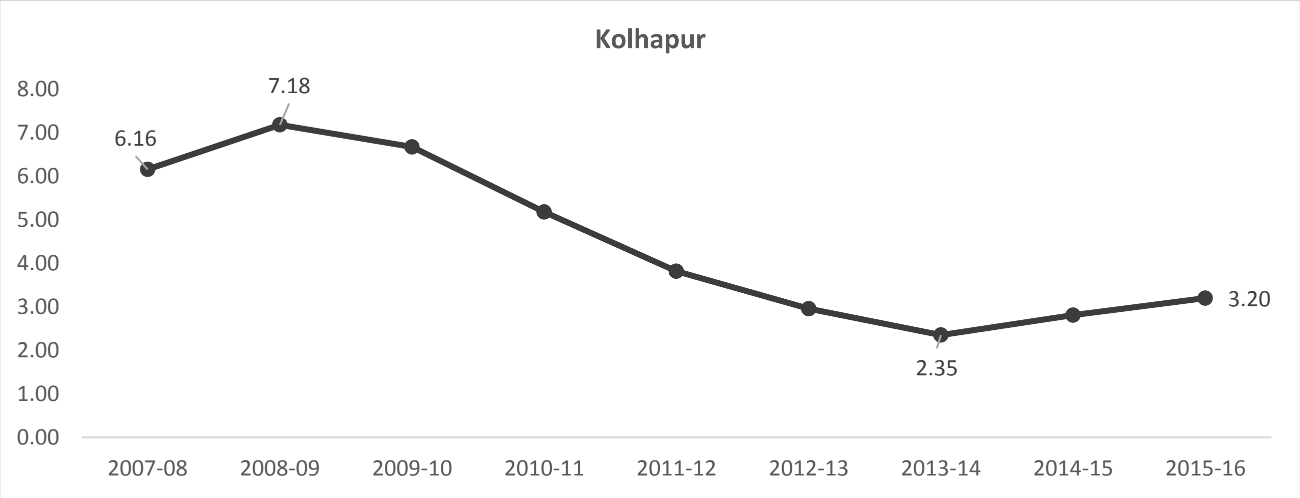


Figure 4-22: Transformer failure rate of Jalgaon (Nashik division)

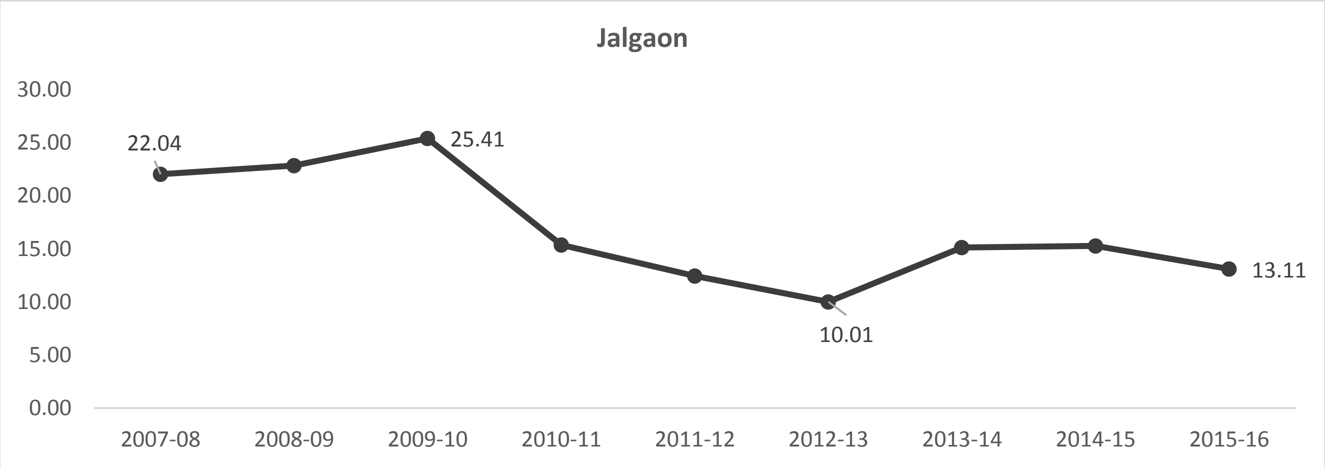


Figure 4-23: Transformer failure rate of Wardha (Nagpur division)

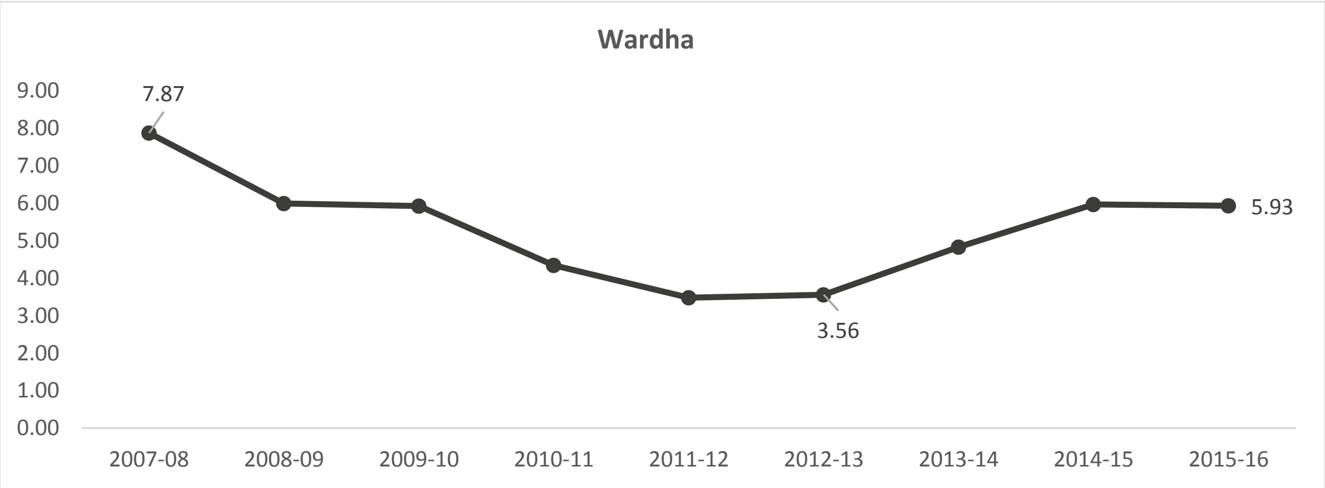


Figure 4-24: Transformer failure rate of Osmanabad (Aurangabad division)

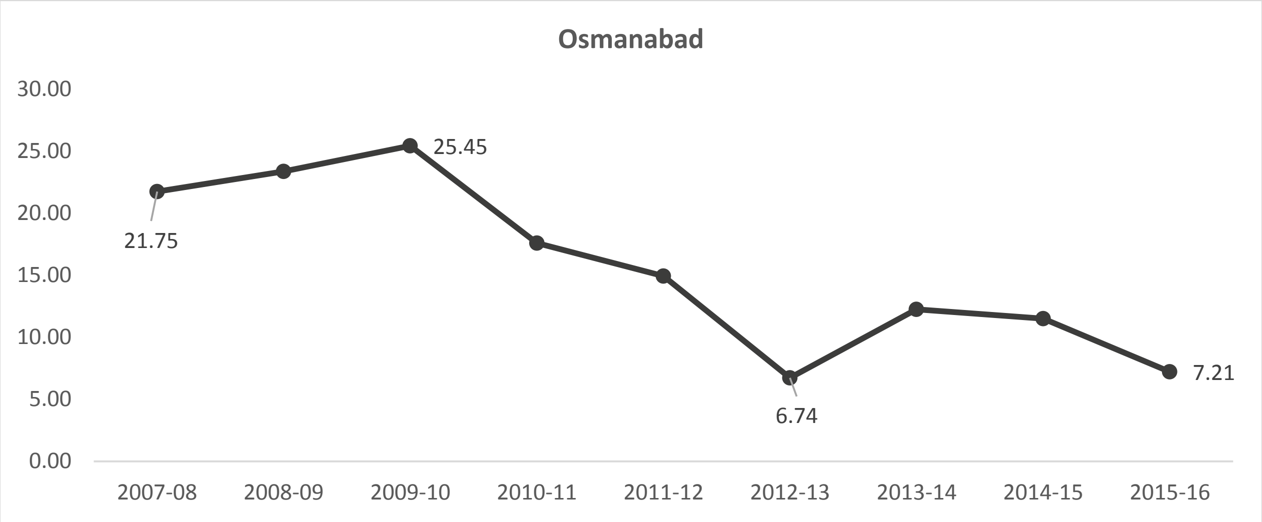
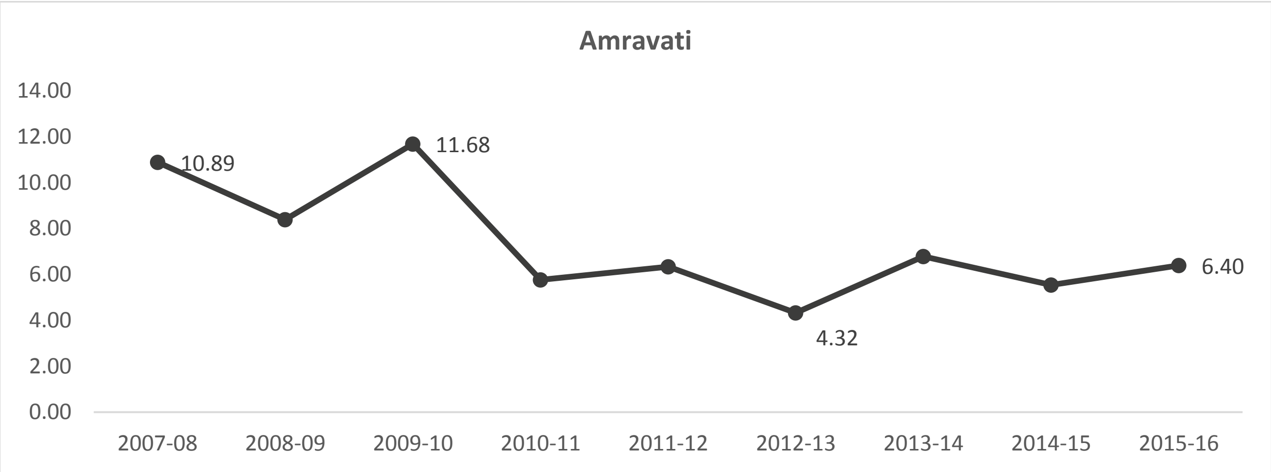


Figure 4-25: Transformer failure rate of Amravati (Amravati division)



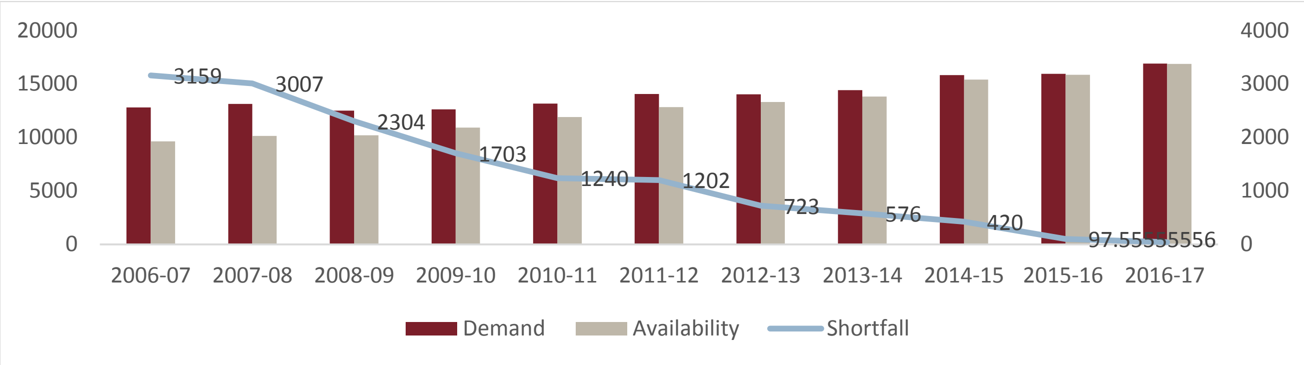
It can be observed there has been a decreasing trend in transformer failure rate till FY 2012-13 after which it has increased for most circles. It can be attributed to the fact that the Infrastructure Plan-I scheme completed around that time, i.e. during 2012-13 in several circles. Eventually, as consumer base continued to increase and with no fresh augmentation of infrastructure, the performance parameters again started to deteriorate.

4.1.5 Reduction in load shedding

MSEDCL has been pioneering several long term load management schemes to reduce load shedding in the state. Feeder separation (GFSS) is one such scheme where the agricultural feeders are carved out, thereby facilitating the load management and also strengthening overall system infrastructure. One of the most important expected benefit for consumers is the reduction in demand-supply shortfall and consequent reduction in planned load shedding.

The following chart depicts the demand, supply and shortfall quantum since the implementation of GFSS and Infrastructure Plan-I schemes began in 2006.

Figure 4-26: Trend of demand, supply and shortfall of power since 2006 (in MW)



The above chart depicts a decreasing trend in the shortfall of power availability. It resulted in gradual reduction of planned load shedding during the period. It can be observed since 2007, the load shedding requirement has been reducing.

The reduction in load shedding quantum which is evident from the analysis above is also corroborated by opinion of rural consumers of MSEDCL across Maharashtra, which has come out clearly during the primary survey conducted by CRIS. The primary survey responses are detailed in Chapter 5 of this report.

4.1.6 Shift in load curve

One of the major objective of GFSS was better load management by MSEDCL. MSEDCL has ensured fixed duration power supply to farmers in whole of Maharashtra. During the primary survey, it was also observed that in many villages, farmers are supplied power during the night time, which actually facilitates to flatten the load curve of the day.

Load curves of three typical days of 2009, 2013 and 2016 have been analyzed to assess the impact of GFSS on load management as shown below.

Figure 4-27 : Hour wise MSEDCL demand on 20.05.09

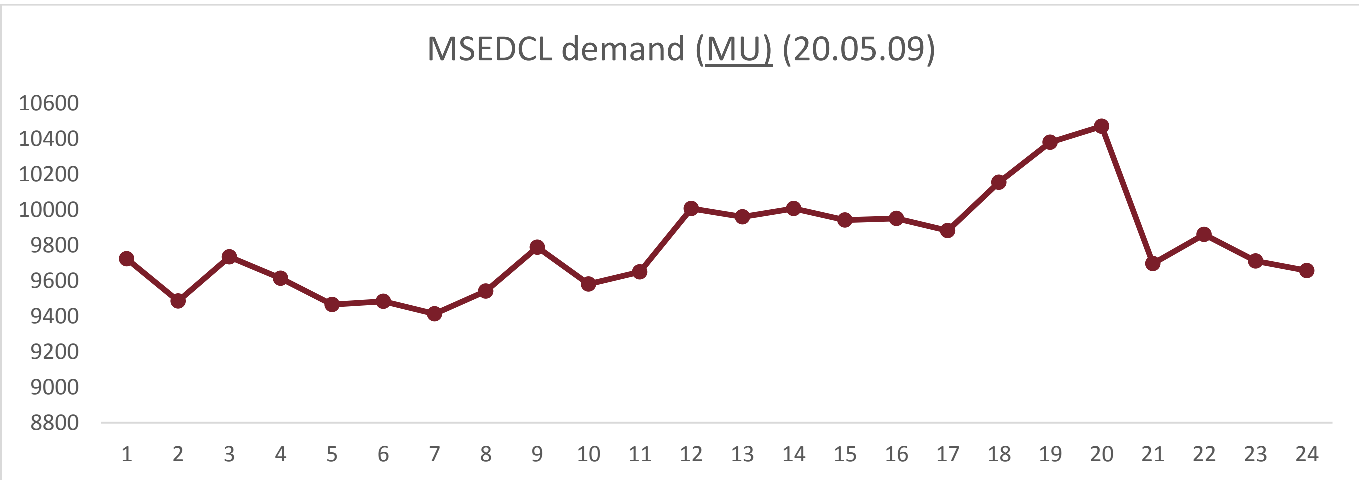


Figure 4-28 : Hour wise MSEDCL demand on 15.05.13

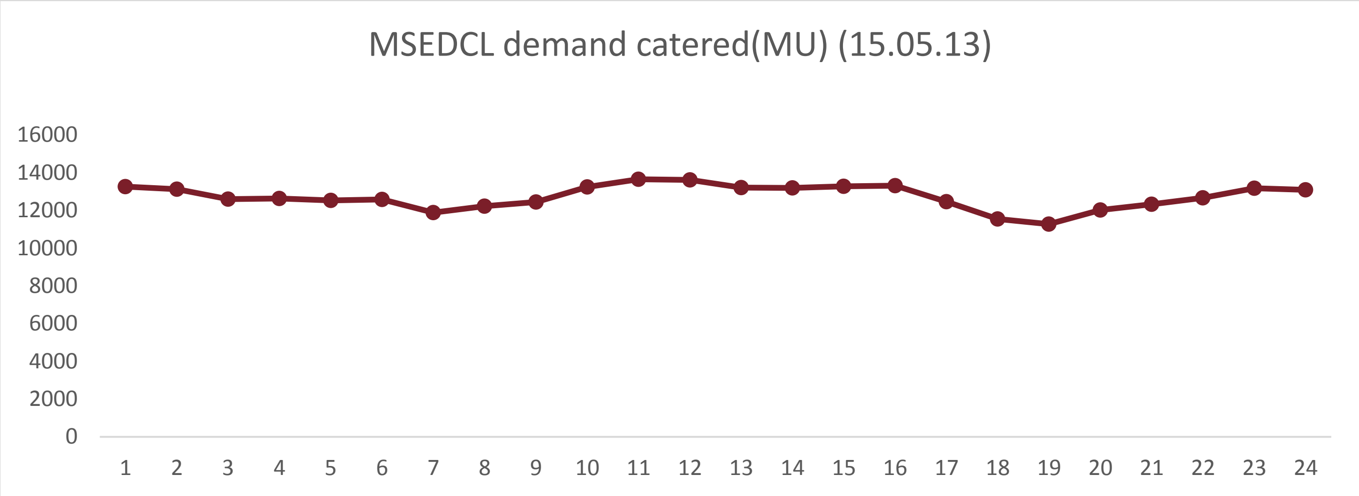
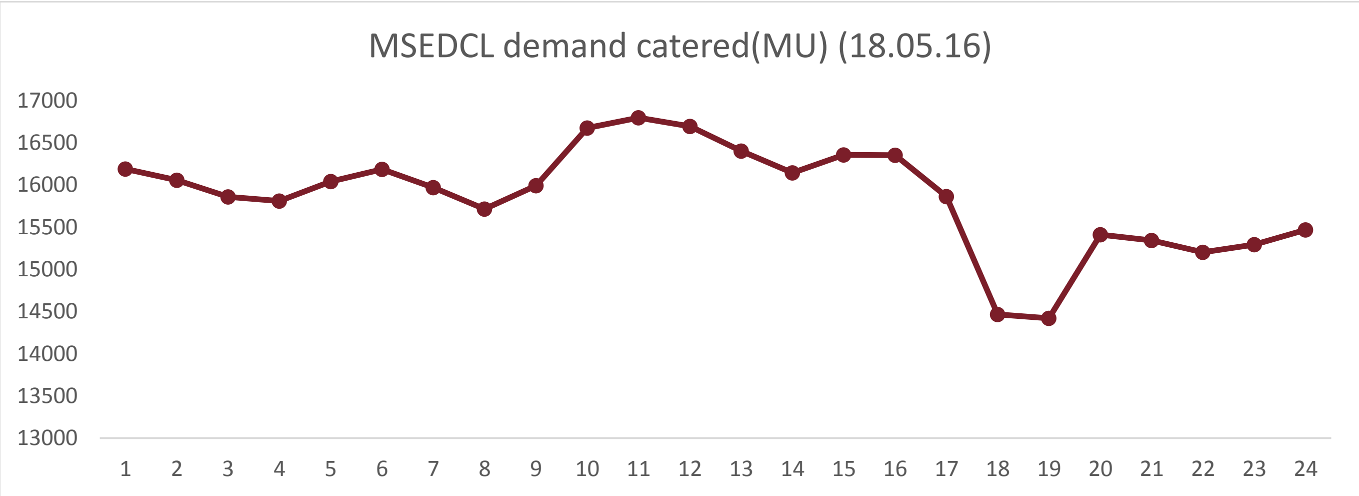


Figure 4-29 : Hour wise MSEDCL demand on 18.05.16



The above three load curves depict the demand catered by MSEDCL on the specified days of 2009, 2013 and 2016 respectively. It is important to note that all these days are typical days of summer when maximum demand is experienced by MSEDCL.

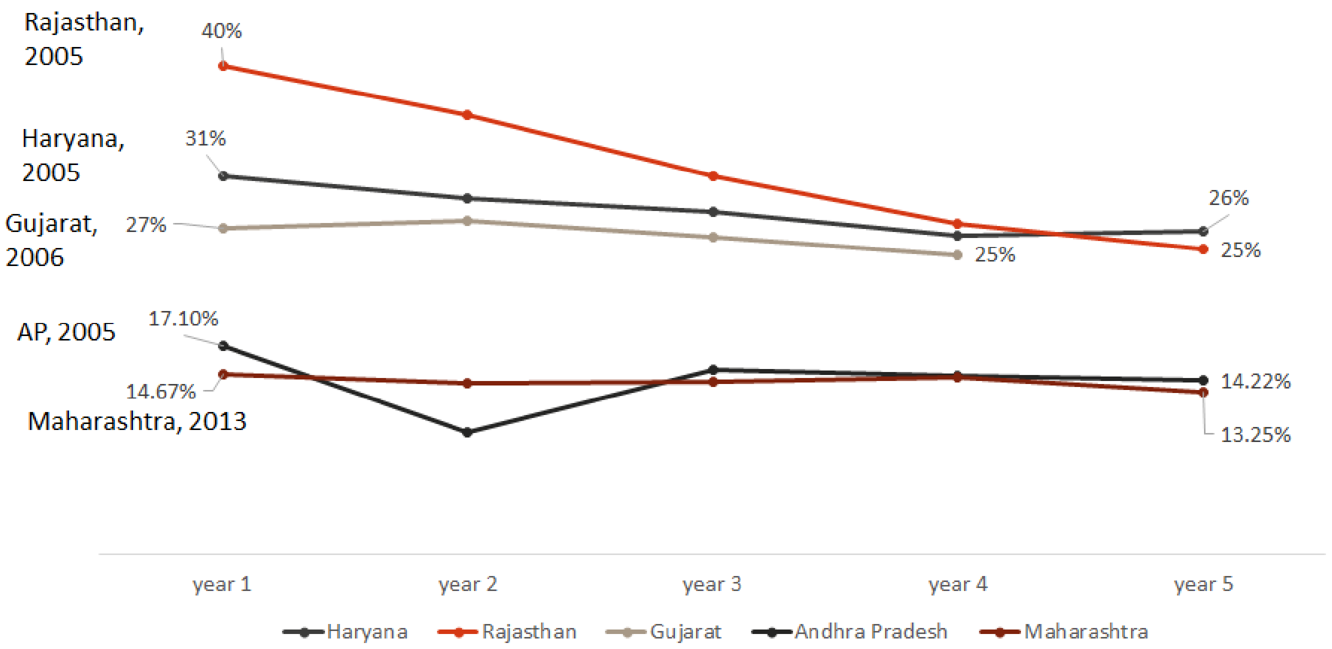
An observation of the above graphs indicates that there were quite significant fluctuations in load pattern during typical day of 2009. During 2013, i.e. immediately following implementation of GFSS, the load pattern was much flatter. However, the load curve of 2016 is observed to consist of fluctuations indicating gradual degradation of the positive impact of GFSS after 2013.

4.1.7 Comparison of Maharashtra with other states where feeder separation schemes have been implemented

Apart from Maharashtra, several other states have implemented rural feeder separation schemes. The post implementation experience of four such states (Haryana, Rajasthan, Gujarat and Andhra Pradesh) has been compared with Maharashtra. Distribution losses reduction is an important benefit arising out of such schemes – accordingly the trend in distribution losses for 5 years post scheme implementation has been plotted for each state.

It is to be noted that since scheme implementation timelines for each state are different, the graphs are not comparable in terms of time.

Figure 4-30: Post scheme implementation trend in distribution losses of various states



Source: Lighting Rural India: Load Segregation Experience in Selected States, report by World Bank, February 2014

Note:

Year 1 post completion of major part of scheme implementation for each state is as depicted below:

Haryana – 2005

Rajasthan – 2005

Gujarat – 2006

Andhra Pradesh – 2005

Maharashtra – 2013

It can be observed across all states that feeder separation schemes have resulted in reduction of distribution losses. It is also pertinent to note that schemes in other states were implemented much earlier than Maharashtra. The loss levels being higher in other states, the extent of reduction has also been greater. Typically, for a large geographical area state like Maharashtra, it is difficult to reduce loss levels below 12-13%. Since Maharashtra had already achieved loss level of 14.67% on completion of scheme, further loss reduction was much more gradual than other states.

An important corollary of the above findings is that had Maharashtra implemented the scheme couple of years earlier, the loss level of 13% could have been achieved much earlier.

4.2 Financial impact

A significant financial impact of the schemes under evaluation on MSEDCL was the cost savings on account of reduction in distribution losses[7]. The reduction in distribution losses led to lower requirement of energy to be purchased and consequently lower power purchase cost – it is noteworthy that power purchase cost constitutes 70-80% of the entire regulated cost of running any distribution business. Thus, any saving in power purchase cost has a significant financial impact on distribution utility business.

CRIS computed the financial impact on account of the schemes using detailed methodology which involved the following steps:

i) Assessment of extent of distribution loss reduction for each circle
ii) Attributing the reduction in losses to the schemes under evaluation
iii) Computing the extent of energy procurement saved (avoided) on account of reduction in distribution losses
iv) Computing product of energy procurement saved and the average per unit power purchase cost of MSEDCL in order to compute the reduction in power purchase cost

The quantum of energy procurement saved and the respective cost savings has been depicted for the sampled circles below.

Table 4-6: Circle wise cost savings

Sr. No	Circle name	Average annual input energy into the circle (million units)	Average annual distribution loss reduction (%)	Average annual energy requirement saved (million units)	Average annual power purchase cost saved (Rs. Crore)
1	Akola	941.51	2.70%	25.38	6.63
2	Buldhana	1017.41	1.41%	14.30	3.74
3	Amravati	1265.89	1.83%	23.22	6.07
4	Yavatmal	1023.80	4.74%	48.49	12.67
5	Aurangabad	1769.81	3.93%	69.62	18.19
6	Jalna	1738.90	3.70%	64.37	16.82
7	satara	1485.07	2.54%	37.78	9.87
8	Solapur	3625.42	1.84%	66.85	17.47
9	Chandrapur	1416.19	0.41%	5.75	1.50
10	Gadchiroli	325.92	1.62%	5.29	1.38
11	Bhandara	607.96	1.77%	10.79	2.82
12	Gondia	430.67	3.40%	14.64	3.83
13	Dhule	1497.82	2.29%	34.33	8.97
14	Jalgaon	3328.80	1.57%	52.13	13.62
15	Kolhapur	3267.03	0.57%	18.62	4.87
16	Sangli	1930.45	2.09%	40.31	10.53
17	Beed	1596.99	7.89%	126.00	32.92
18	Latur	1276.62	5.54%	70.70	18.47

[7] *CRIS also attempted to quantify the increase in revenue on account of increase in energy sales because of the reduction in load shedding due to the schemes. However, the data on extent of load shedding could not be obtained at the time of writing this report*

Sr. No	Circle name	Average annual input energy into the circle (million units)	Average annual distribution loss reduction (%)	Average annual energy requirement saved (million units)	Average annual power purchase cost saved (Rs. Crore)
19	Osmanabad	1070.39	5.38%	57.54	15.04
20	Nagpur	2215.50	1.15%	25.43	6.65
21	Wardha	1167.39	0.15%	1.80	0.47
22	Nanded	1361.53	3.43%	46.70	12.20
23	Parbhani	1104.92	4.73%	52.22	13.64
24	Ahmednagar	3330.21	2.24%	74.60	19.49
25	Nashik	5254.74	0.99%	52.13	13.62
26	Pune	3652.41	2.38%	87.07	22.75
	Grand total	**47703.35**		**1126.06**	**294.24**

Hence, the total cost savings for 26 circles works out to Rs 294.24 crore. This value, prorated for 30 circles comes out to Rs. 339.51 crore.

Hence, the total savings in power purchase cost estimated for all 30 circles is Rs. 339.51 crore which can be largely attributed to the schemes under evaluation.

4.3 Assessment of financial impact of the schemes

Background

The financial impact on MSEDCL is determined on accounts of avoided purchase cost due to reduction in distribution loss of circles in Maharashtra. During CRIS's meetings with various MSEDCL officers who were in charge in various circles for GFSS implementation, it was unanimously stated by all circle officers that GFSS scheme is the only one of its kind which can be attributed for reduction in distribution loss in all circles. Hence, for the analysis below, it has been assumed that the reduction in distribution loss as observed in all circles between 2007-08 and 2011-12 was solely due to GFSS scheme. The duration of 2007-08 to 2011-12 is considered for analysis because GFSS Phase 1 started to get completed in 2007 in some circles, while the last phase, GFSS IV was completed for all circles in 2011. Therefore, all the distribution loss reduction that took place during that period is attributed to GFSS scheme.

After 2011-12, the distribution loss was more stable. Further reduction in distribution loss was circle specific and can be attributed to MSEDCL internal capital investments for system strengthening schemes.

Computation mechanism

The mechanism followed to determine the commercial benefits accrued to MSEDCL due to GFSS scheme is briefed below.

I. The weighted average cost of power purchase is determined from true up year FY 2007-08 to FY 2011-12. (A)

II. The distribution loss reduction percentage for each circle between 2007 and 2011 (including these two years) is computed. (If for Akola circle x% is distribution loss in 2007 and y% is loss in 2011, therefore, net reduction in distribution loss has been x-y)

III. The net reduction in distribution loss (x-y) is then averaged out for five years. (From 2007-08 to 2011-12) (B)

IV. Average input energy for all circles during 2007-08 to 2011-12 is computed.(C)

Therefore, the quantum of energy (MUs) saved (not procured) as a result of reduction in distribution loss is determined. D = B x C

V. Finally, this quantum (avoided procurement) is multiplied with weighted average cost of power to determine the net savings achieved per year.

The average power purchase cost of MSEDCL for the said duration is based on the following data.

Year	Power purchase cost (Rs. Crore)	Quantum (Million units)	Cost/ unit (Rs/kWh)
2007-08	15518	78734	1.97
2008-09	18054	79870	2.26
2009-10	21528	85865	2.51
2010-11	25882	90341	2.86
2011-12	32702	100261	3.26

5. Key findings: Impact of schemes on village and semi-urban consumers

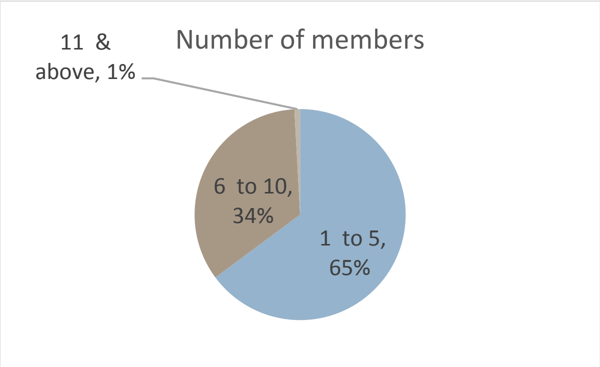
5.1 Household consumers

The survey has been carried out on a total sample size of 1,496 households spread across 487 villages in 24 circles of Maharashtra.

5.1.1 Profiling of respondents

It is important to capture the economic profile and count of the household members of the respondents in order to relate the responses with their living status. The following charts depict the number of members in the family, gross annual earnings and key profession of respondents to have an overall idea of the socio-economic status of the respondents.

Figure 5-1: Number of members in family and annual incomes of families



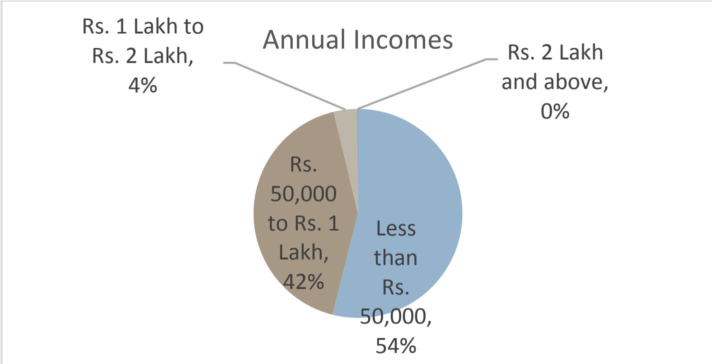


Figure 5-2 : Sources of income

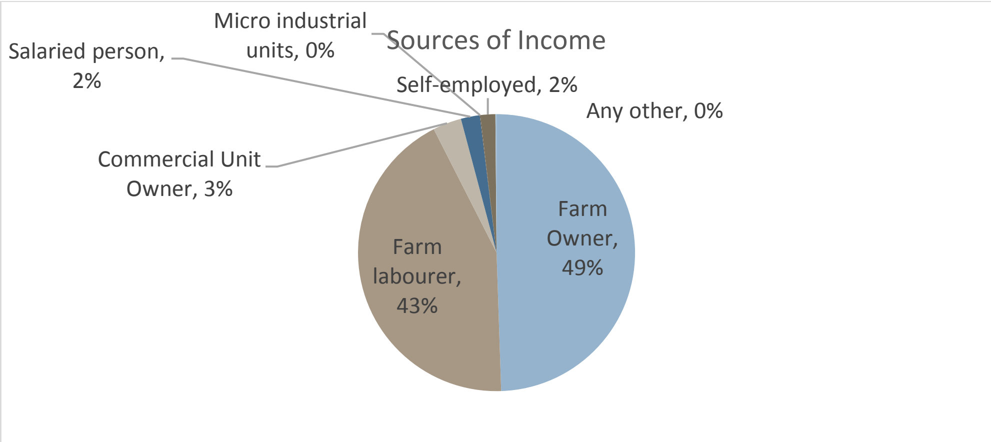
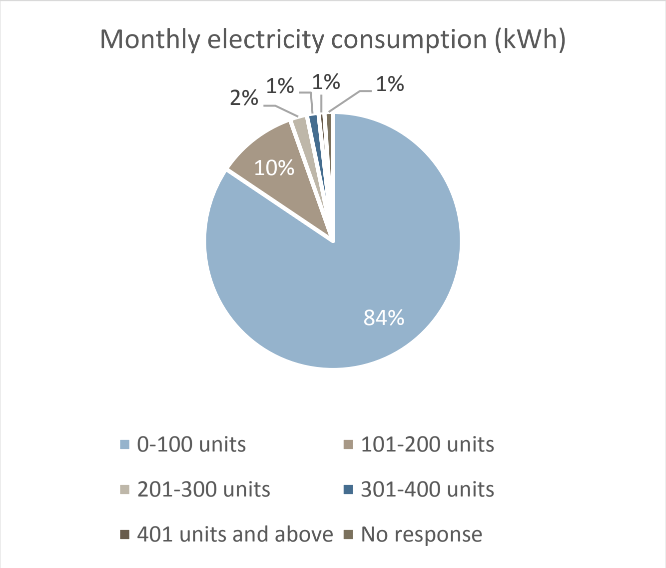
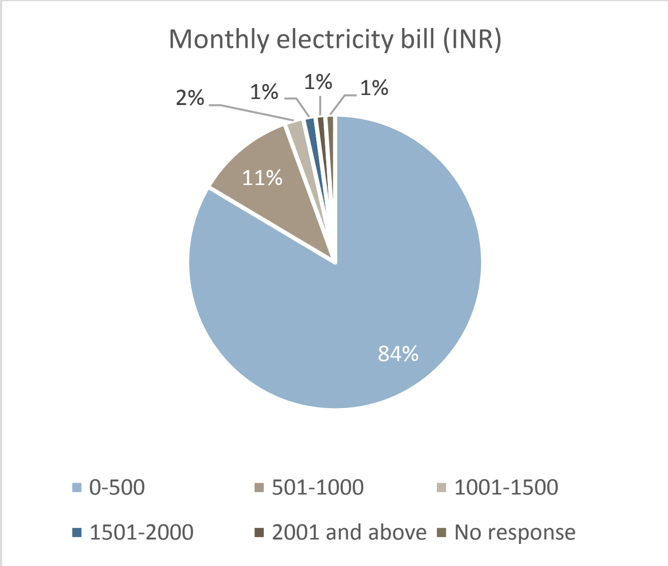


Figure 5-3 : Monthly electricity consumption in kWh & electricity bill in INR





Thus, most of the respondent households surveyed cover low and middle income households and the sources of incomes are closely linked to agricultural activities. The respondents mostly belonged to monthly electricity consumptions of upto 100 and upto 200 units and monthly bills of upto Rs. 500 and upto Rs. 1000. Charts of the respondents detailing other lifestyle habits are shown in appendix to this report.

The split of respondents circle-wise and annual income wise is shown below.

Table 5-1: Split of household respondents circle-wise and annual income

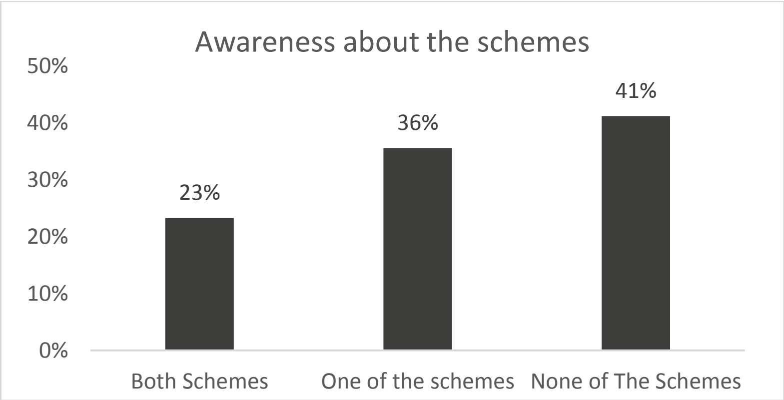
Circle Name	Less than Rs 50,000	Rs 50,000 to Rs 1,00,000	Rs 1,00,000 to Rs 2,00,000	More than Rs 2,00,000	Grand Total
Ahmednagar	108				108
Akola	54	3			57
Amravati	44	1			45
Baramati	37	12	5		54
Bhandara	33	17	5		55
Dhule	2	52			54
Gadchiroli	31	2	2		35
Hingoli	1	53			54
Jalgaon	45	7	2		54
Jalna	42	16	2		60
Kolhapur	63	45			108
Latur	33	21			54
Nagpur	30	15	8		53
Nanded		117			117
Nandurbar	33				33
Nasik	13	21	13	1	48

Circle Name	Less than Rs 50,000	Rs 50,000 to Rs 1,00,000	Rs 1,00,000 to Rs 2,00,000	More than Rs 2,00,000	Grand Total
Osmanabad	7	42	5		54
Parbhani	1	74			75
Pune	43	56	9		108
Sangli	38	16			54
Satara	12	38	4		54
Solapur	33	21			54
Wardha	52	2			54
Yavatmal	52	2			54
Grand Total	**807**	**633**	**55**	**1**	**1,496**

5.1.2 Impact of the schemes on consumers

5.1.2.1 Awareness about the schemes

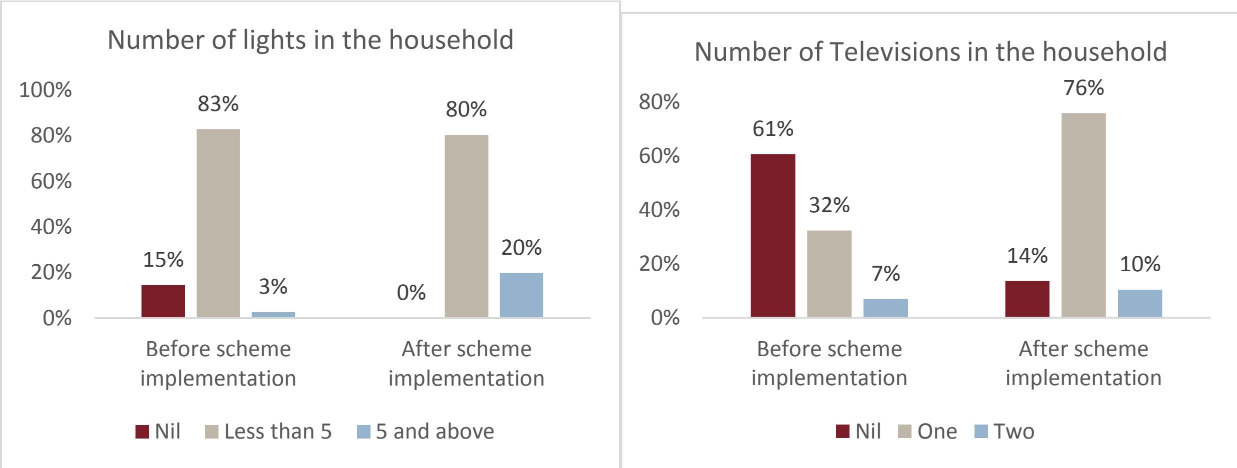
Figure 5-4 : Awareness about the schemes



The above depicts that there is significant scope to increase awareness about the scheme amongst household consumers.

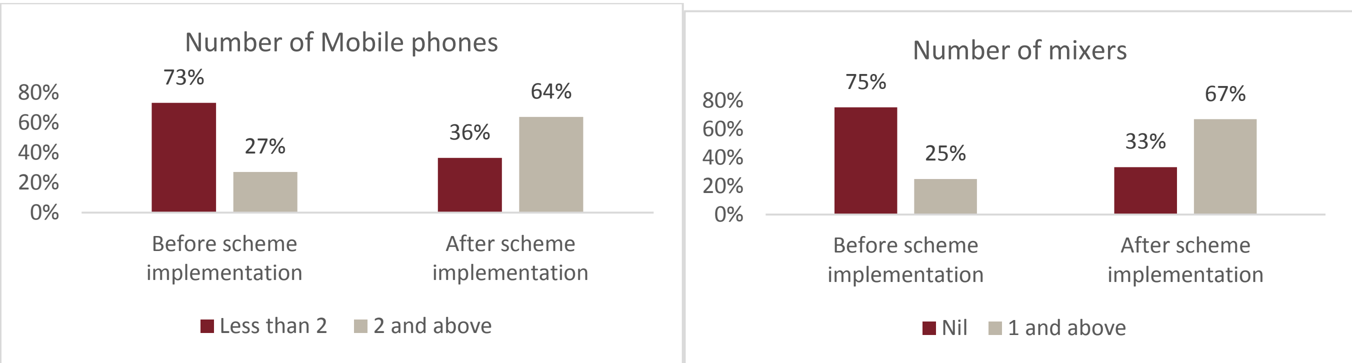
5.1.2.2 Living standards

Figure 5-5 : Number of lights and televisions before and after scheme implementation



It is observed the usage of electrical appliances like light and fan substantially increased after scheme implementation, which is assumed to the year of GFSS implementation.

Figure 5-6 : Number of mobile phones and kitchen mixers before and after scheme implementation

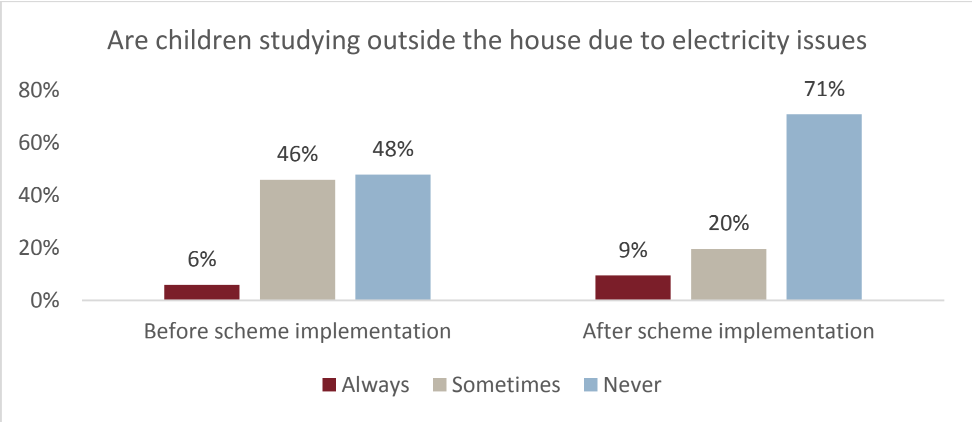


Considering the trend seen in number of lights in the household, it is evident that at least 15% of the respondents surveyed have been electrified[8] after the schemes were implemented. Further there seems to have been improvement in all parameters defining lifestyle comforts after the schemes were implemented – the schemes seem to have direct influence since all these comforts operate on electricity. This also shows that the quality of electricity supply must have improved in order to influence decisions on above aspects.

Statistics on other parameters which define living standards are provided below.

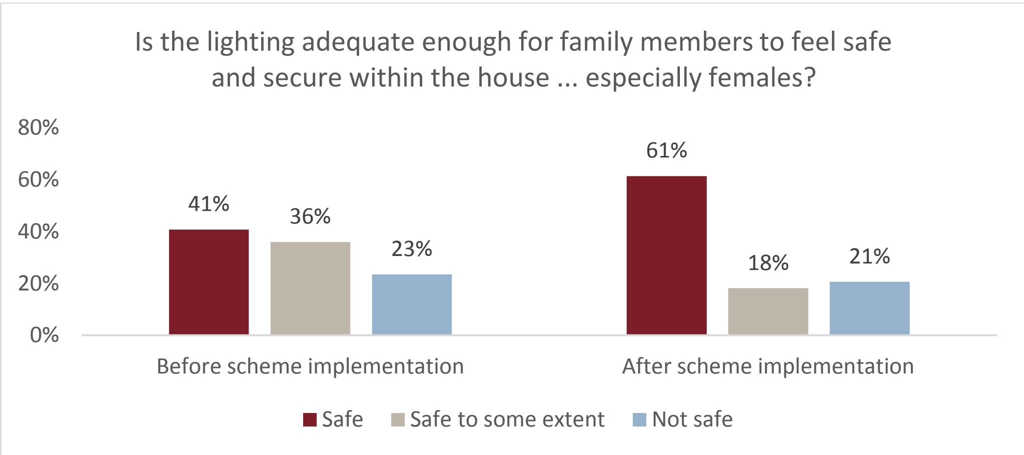
[8] *When a household becomes electrified, the first appliance that usually gets installed is a light*

Figure 5-7: Are children studying outside the house due to electricity issues?



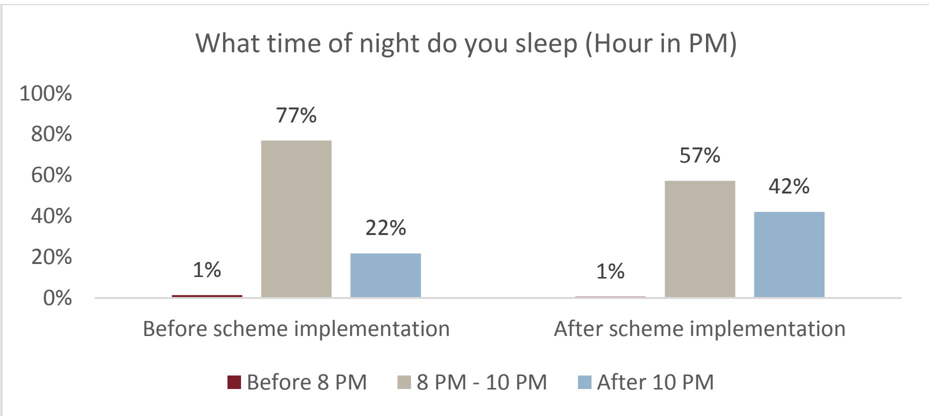
It is observed that children mostly could stay indoors for productive purposes after improvement in power supply and reduction in load shedding.

Figure 5-8: Safety and security of family members



Large number of people started feeling safe after implementation of GFSS and Infrastructure Plan due to better lighting conditions.

Figure 5-9: Time of sleeping at night

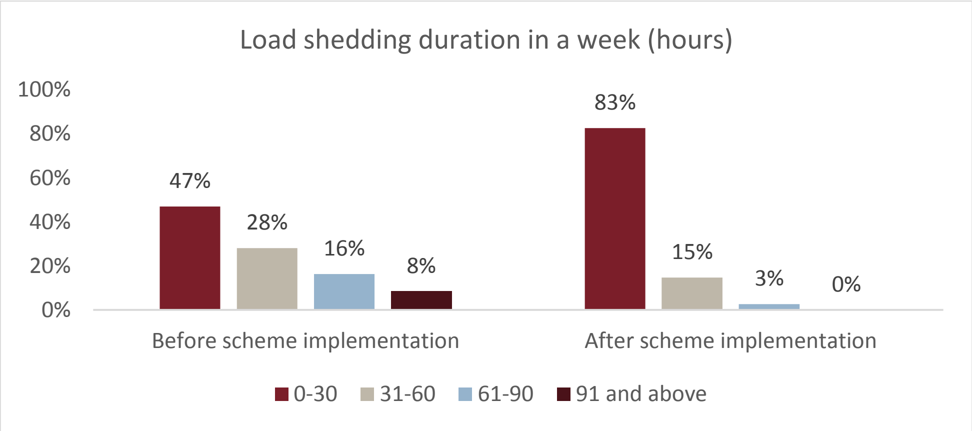


The above statistics indicate that the quality of supply has improved due to positive improvement in children's education, improved perception of safety and security and larger proportion of people staying up late at night.

5.1.2.3 Load shedding

One of the most import important factor which determines the success of GFSS and Infrastructure Plan-I schemes is decrease in load shedding duration. The following chart depicts the responses regarding the same.

Figure 5-10: Duration of load shedding hours before and after scheme implementation



The above indicates that ***there has been significant improvement in load shedding duration after implementation of GFSS and Infrastructure Plan-I schemes. A large proportion of customers who were facing load shedding of higher than 30 hours per week before scheme implementation seem to have now moved to the 0-30 hours slot thus indicating that there has been a significant change in the load shedding policy by MSEDCL.***

The load shedding duration has also been analyzed circle-wise and GoM administrative division-wise as shown in the table below.

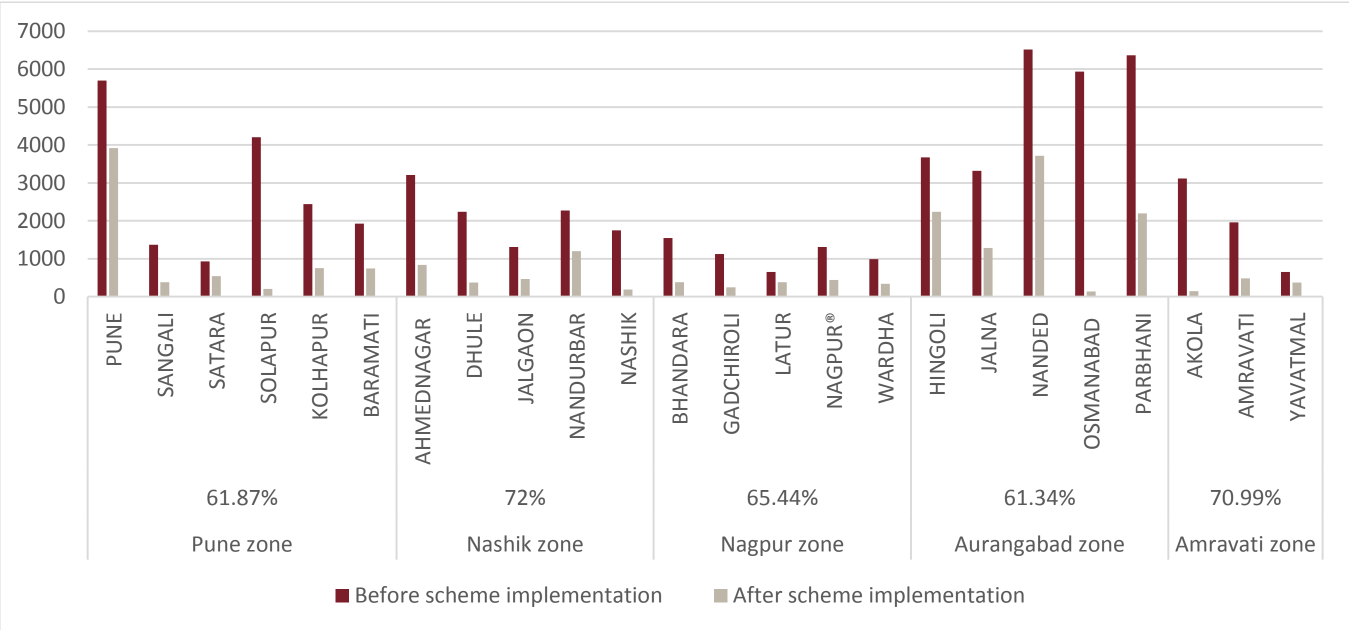
Table 5-2 : Load shedding duration analyzed circle and division wise

Division Name	Division % reduction	Circle Name	Before scheme implementation	After scheme implementation	% reduction
Pune zone	61.87%	Pune	5704	3916	31%
		Sangli	1367	378	72%
		Satara	934	542	42%
		Solapur	4209	206	95%
		Kolhapur	2443	756	69%
		Baramati	1926	744	61%
Nashik zone	72%	Ahmednagar	3208	835	74%
		Dhule	2242	375	83%
		Jalgaon	1306	462	65%
		Nandurbar	2270	1199	47%
		Nashik	1752	186	89%

Division Name	Division % reduction	Circle Name	Before scheme implementation	After scheme implementation	% reduction
Nagpur zone	65.44%	Bhandara	1542	382	75%
		Gadchiroli	1122	245	78%
		Latur	648	378	42%
		Nagpur	1312	437	67%
		Wardha	990	342	65%
Aurangabad zone	61.34%	Hingoli	3677	2239	39%
		Jalna	3317	1287	61%
		Nanded	6520	3712	43%
		Osmanabad	5940	132	98%
		Parbhani	6366	2194	66%
Amravati zone	70.99%	Akola	3115	145	95%
		Amravati	1960	480	76%
		Yavatmal	648	375	42%

The above figures have also been represented in the graph below.

Figure 5-11: Load shedding duration analyzed circle and division wise



As can be observed from the above chart, the benefits accrued due to implementation of GFSS has been substantial across all divisions of Maharashtra.

The following table analyzes the load shedding improvement in terms of villages benefitted by GFSS and Infrastructure Plan-I schemes.

Table 5-3: Load shedding improvement in terms of villages benefitted by GFSS and Infrastructure Plan-I schemes

Particulars	Total load shedding duration in a week	Load shedding duration (GFSS)	Load shedding duration (Infrastructure Plan-I)
Before scheme implementation	64518	52593	11925
After scheme implementation	21947	16552	5395
Reduction (hours/week)	42571	36041	6530
Reduction (in %)	66%	69%	55%

Extent of reduction is higher in GFSS villages since the objective of GFSS is to reduce load shedding while that of Infrastructure Plan-I is system strengthening.

The reduction in load shedding duration has been further analyzed as per income category of respondents to understand whether the schemes were implemented irrespective of the economic status of consumers and therefore whether the implementation has remained unbiased. The observation is tabulated below.

Table 5-4: Income category wise load shedding duration reduction impact

Annual income category	Load shedding duration in a week before scheme implementation (hours)	Load shedding duration in a week after scheme implementation (hours)	Percentage reduction
Less than Rs 50,000	28791	8504	70%
Rs 50,000 to Rs 1 lakh	33288	12709	62%
Rs 1 lakh to Rs 2 lakh	2369	731	69%
More than Rs 2 lakh	70	3	96%
Grand Total	**64518**	**21947**	

No particular correlation of scheme impact and income level is observed. Hence it can be inferred that the scheme was implemented without any bias and irrespective of income status of the consumers.

The reduction in load shedding is also analyzed in terms of awareness about the schemes. Awareness about the scheme can subconsciously influence respondent to answer positively about the scheme. This test tries to analyze the perceived scheme benefit analyzed by awareness about the schemes. The results are tabulated below.

Table 5-5: Perceived scheme benefit analyzed by awareness about the schemes

Awareness level	Before scheme implementation	After scheme implementation	Percentage reduction
Aware of both schemes	17265	5613	67%
Aware of one scheme	22265	8126	64%
Aware of none of the schemes	24988	8208	67%
Grand Total	**64518**	**21947**	

Thus, the schemes' benefits as depicted by survey responses are genuine and not influenced by awareness about the scheme.

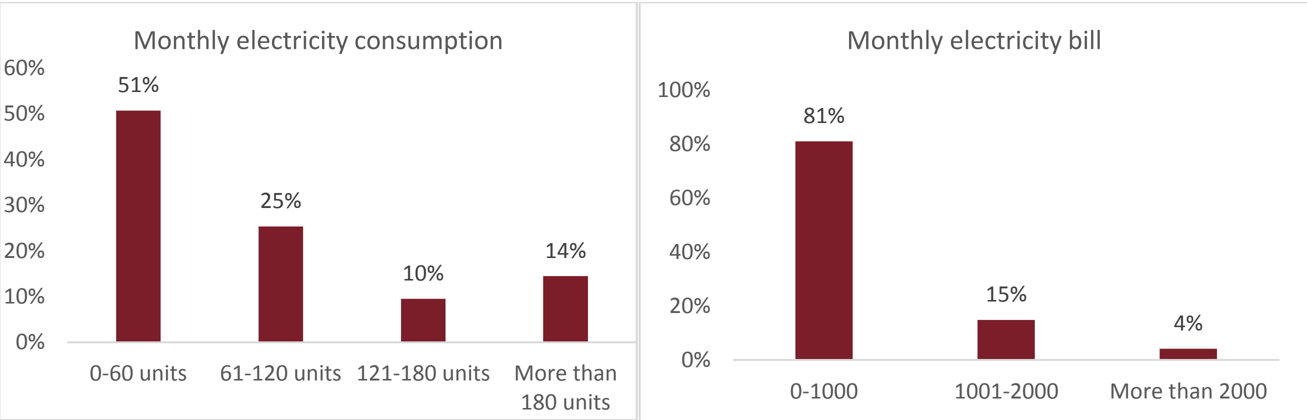
5.2 Commercial/ micro industrial units

The survey has been carried out on a total sample size of 976 commercial spread across 465 villages in 24 circles of Maharashtra.

5.2.1 Profile of respondents

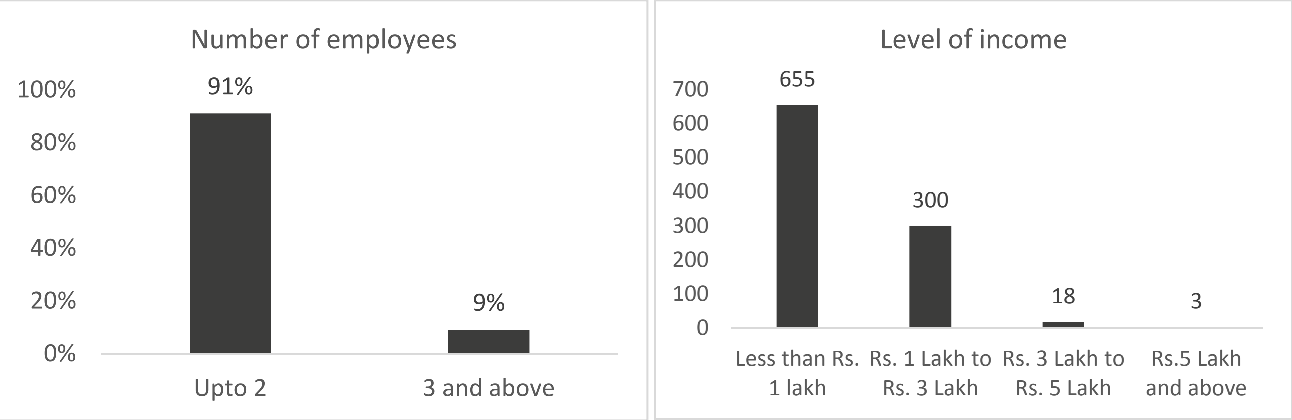
Majority of the sample respondents from the commercial/ micro industrial units belonged primarily in the small to medium size category.

Figure 5-12: Monthly electricity consumption and electricity bill (Commercial/ micro industrial units)



The respondents were mostly small scale shop owners as can be observed from their monthly electricity consumption pattern.

Figure 5-13: Employee count and Annual income from the unit (Commercial/ micro industrial units)



The circle-wise split of respondents from this category, analyzed annual income-wise, is depicted below.

Table 5-6: Circle-wise split of respondents, analyzed annual income-wise (Commercial/ micro industrial units)

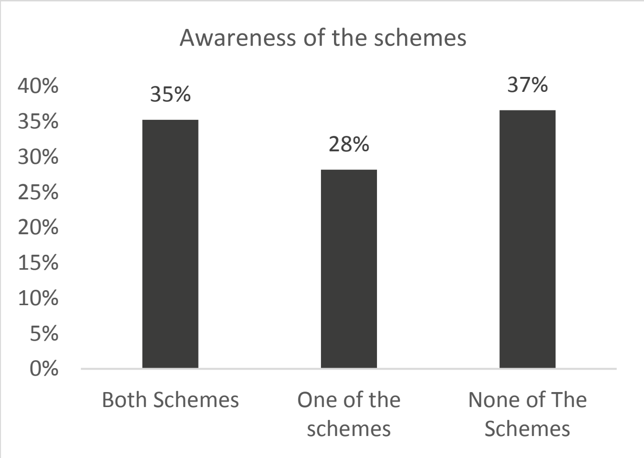
Circles	Less than Rs. 1,00, 000	Rs. 1,00,000 to Rs. 3,00,000	Rs. 3,00,000 to Rs. 5,00,000	Rs.5,00,000 and above	Grand Total
Ahmednagar	61	10	1		**72**
Akola	28	8			**36**
Amaravati	20				**20**
Baramati	19	15	2		**36**
Bhandara	22	13	1		**36**
Dhule	20	14	2		**36**
Gadchiroli	15	4	1		**20**
Hingoli	32	4			**36**
Jalgaon	29	4			**33**
Jalna	31	8			**39**
Kolhapur	46	25			**71**
Latur	34	2			**36**
Nagpur	29	8			**37**
Nanded	50	36	2		**88**
Nandurbar	21	1			**22**
Nashik	10	20			**30**
Osmanabad	19	17			**36**
Parbhani	39	11			**50**
Pune	26	36	7	3	**72**
Sangali	19	17			**36**
Satara	15	22	2		**39**
Solapur	31	5			**36**

Circles	Less than Rs. 1,00, 000	Rs. 1,00,000 to Rs. 3,00,000	Rs. 3,00,000 to Rs. 5,00,000	Rs.5,00,000 and above	Grand Total
Wardha	20	3			**23**
Yavatmal	19	17			**36**
Grand Total	**655**	**300**	**18**	**3**	**976**

5.2.2 Impact of the schemes under evaluation on the consumers

5.2.2.1 Awareness about schemes

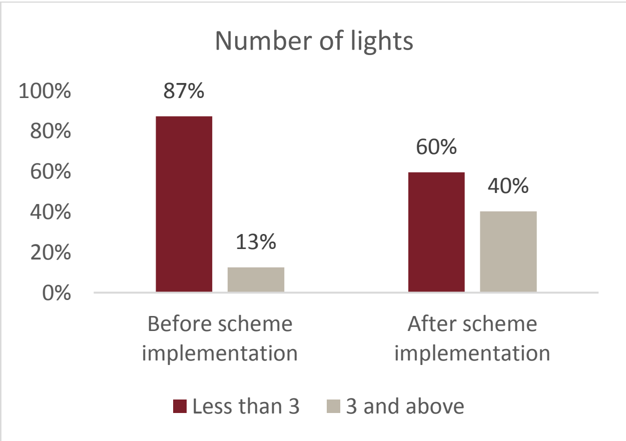
Figure 5-14 : Awareness about schemes (Commercial/ micro industrial units)

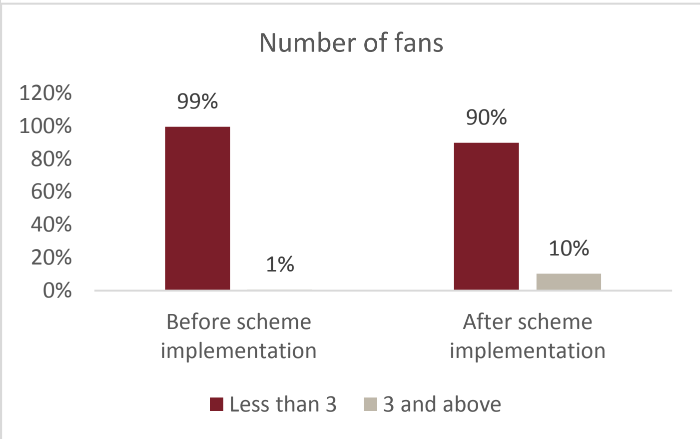


Thus there exists significant potential for increasing awareness about the schemes.

5.2.2.2 Working standards and key business decisions

Figure 5-15 : Number of lights and fans (Commercial/ micro industrial units)





It can be observed there was an increase of 27% respondents who put to use three or more lights in their shops as compared to before scheme implementation.

Figure 5-16 : Number of motors and pumps (Commercial/ micro industrial units)

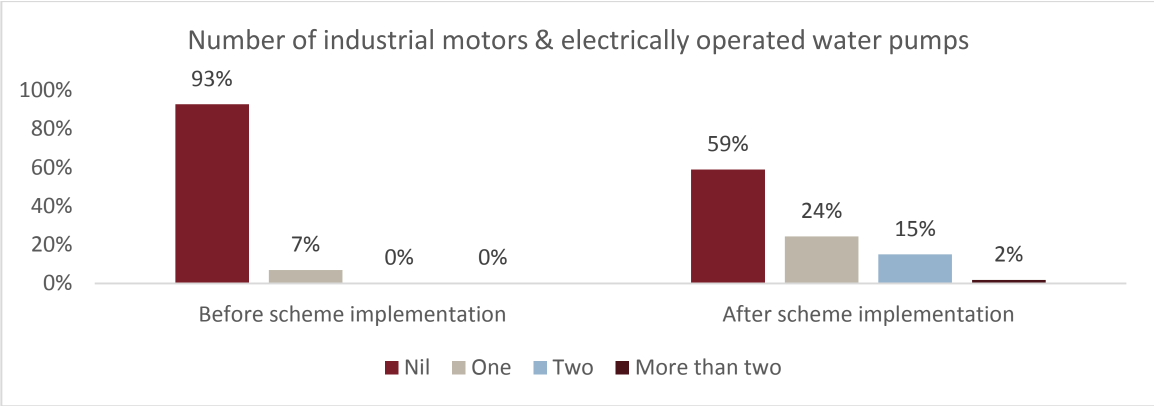


Figure 5-17: Operating hours (Commercial/ micro industrial units)

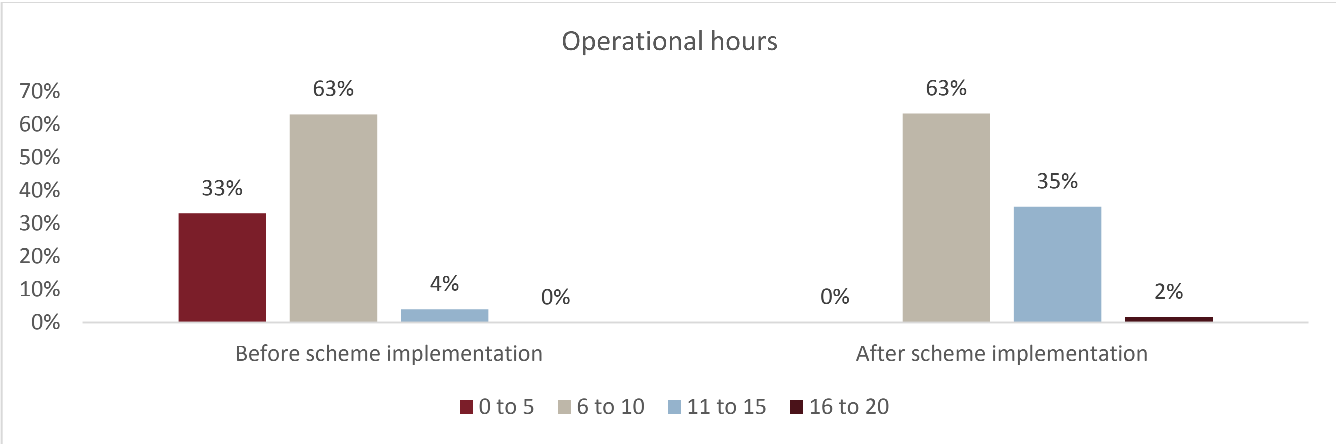
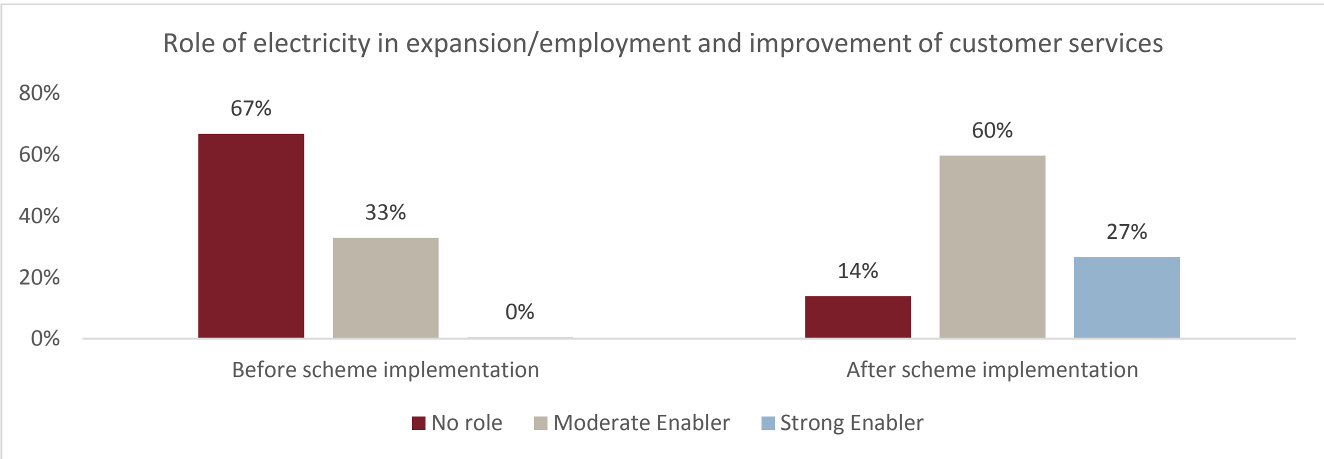


Figure 5-18: Role of electricity in business expansion (Commercial/ micro industrial units)



Role of electricity in business expansion decision has been analyzed circle-wise in the table below.

Table 5-7: Role of electricity in business expansion, analyzed circle wise (Commercial/ micro industrial units)

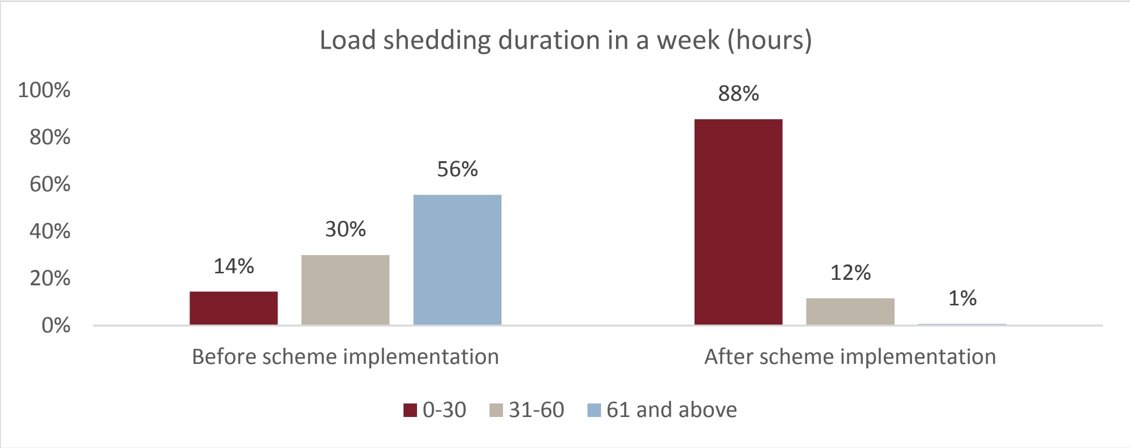
Division	% increase in respondents who think electricity is moderate & strong enabler in business decision	Circle	Before scheme implementation			After scheme implementation		
			Moderate Enabler	No Role	Strong Enabler	Moderate Enabler	No Role	Strong Enabler
Pune	143%	Pune	4	68		23	22	27
		Sangli	36			36		
		Satara	39			34	1	4
		Solapur		36			5	31
		Kolhapur	12	55	4	71		
		Baramati	8	28		12	12	12
Nashik	83%	Ahmednagar	2	70		54	7	11
		Dhule	34	2		36		
		Jalgaon	28	5		33		
		Nandurbar	20	2		9	5	8
		Nashik	10	20		9	9	12
Nagpur	913%	Bhandara		36		36		
		Gadchiroli	8	12		20		
		Latur		36		36		
		Nagpur		37		5		32
		Wardha	7	16		19		4
Aurangabad	99%	Hingoli	5	31		17	11	8
		Jalna	18	21		11	12	16
		Nanded	6	82	4	50	21	17
		Osmanabad	21	15		10	17	9
		Parbhani	39	11		42	3	5
Amravati	242%	Akola	24	12		8	10	18
		Amravati		20		5		15
		Yavatmal		36		6		30

Few conclusions that can be inferred from above statistics:

- Quality of electricity supply has improved after scheme implementation which has resulted in increase in the number of appliances and equipment
- Extent of operating hours has significantly improved
- Electricity has become a greater enabler to take business decisions

5.2.2.3 Load shedding

Figure 5-19: Duration of load shedding hours (Commercial/ micro industrial units)



The above indicates that ***there has been significant improvement in load shedding duration after implementation of GFSS and Infrastructure Plan-I schemes. A large proportion of customers who were facing load shedding of higher than 30 hours per week before scheme implementation seem to have now moved to the 0-30 hours slot thus indicating that there has been a significant change in the load shedding policy by MSEDCL.***

The reduction in load shedding duration has also been analyzed circle wise which is tabulated below.

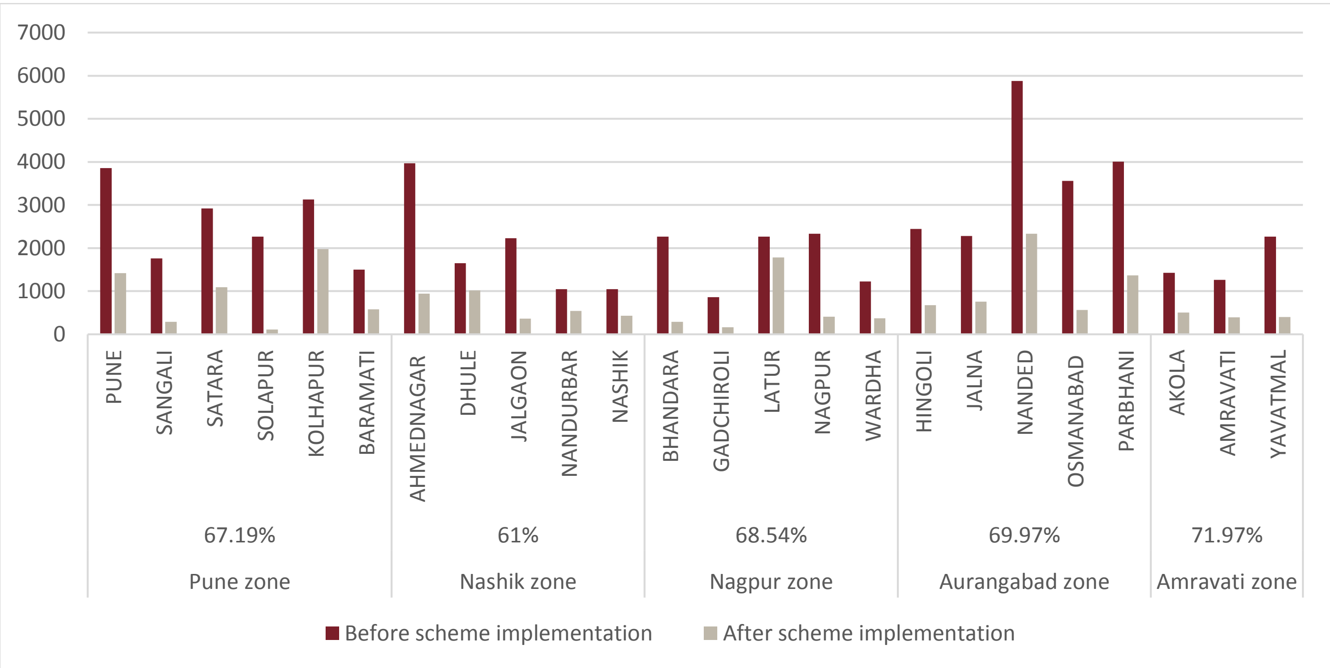
Table 5-8: Reduction in load shedding duration for each circle (Commercial/ micro industrial units)

Division Name	Division % reduction	Circle Name	Before scheme implementation	After scheme implementation	% reduction
Pune	67.19%	Pune	3854	1421	63%
		Sangali	1760	288	84%
		Satara	2920	1092	63%
		Solapur	2268	108	95%
		Kolhapur	3126	1972	37%
		Baramati	1496	574	62%
Nashik	61%	Ahmednagar	3969	942	76%
		Dhule	1646	1015	38%
		Jalgaon	2231	364	84%
		Nandurbar	1042	539	48%
		Nashik	1046	427	59%
Nagpur	68.54%	Bhandara	2268	288	87%
		Gadchiroli	863	160	81%
		Latur	2268	1778	22%
		Nagpur	2331	404	83%

Division Name	Division % reduction	Circle Name	Before scheme implementation	After scheme implementation	% reduction
		Wardha	1226	372	70%
Aurangabad	69.97%	Hingoli	2442	672	72%
		Jalna	2283	756	67%
		Nanded	5880	2331	60%
		Osmanabad	3562	560	84%
		Parbhani	4004	1368	66%
Amravati	71.97%	Akola	1424	504	65%
		Amravati	1258	392	69%
		Yavatmal	2268	398	82%

The above statistics have been also depicted in the graph below.

Figure 5-20 : Reduction in load shedding duration for each circle (Commercial/ micro industrial units)



It is observed that load shedding duration has reduced almost uniformly across all divisions of Maharashtra. Therefore, it can be said that the primary purpose of the schemes i.e. load shedding reduction could be achieved uniformly across Maharashtra.

The reduction in load shedding duration has also been analyzed as per income category of the respondents to understand whether the schemes were implemented irrespective of the economic status of the respondents and therefore whether the implementation has remained unbiased. The observation is tabulated below.

Table 5-9 : Load shedding duration analyzed income-wise (Commercial/ micro industrial units)

Annual income category	Load shedding duration in a week before scheme implementation (Hours)	Load shedding duration in a week after scheme implementation (Hours)	% reduction
Less than Rs 1 lakh	39046	12871	67%
Rs 1 lakh to Rs 3 lakh	17304	5380	69%
Rs 3 lakh to Rs 5 lakh	877	341	61%
More than Rs 5 lakh	208	133	36%

The table above shows that there is a somewhat negative correlation of feeling that load shedding has reduced as compared to income levels. Thus, the perception of load shedding reduction is higher amongst low income categories.

We have also analyzed whether awareness about the schemes has affected the respondents' perception about the benefits – the hypothesis is that awareness about schemes may cause respondents to have a stronger impression about benefits. This hypothesis has been tested using the benefit parameter of load shedding duration, which is the most direct outcome of the schemes. The table below shows the change in perception about load shedding after scheme implementation for 3 categories of respondents based on their awareness levels.

Table 5-10: Awareness of people and load shedding duration (hours) during a week

Awareness level	Load shedding duration before scheme implementation (hours)	Load shedding duration after scheme implementation (hours)	Percentage reduction in load shedding hours after scheme implementation
Respondents who were aware of both schemes	21283	7617	64%
Respondents who were aware of one scheme	15615	4671	70%
Respondents who were aware of none of the schemes	20537	6437	69%
Grand Total	**57435**	**18725**	

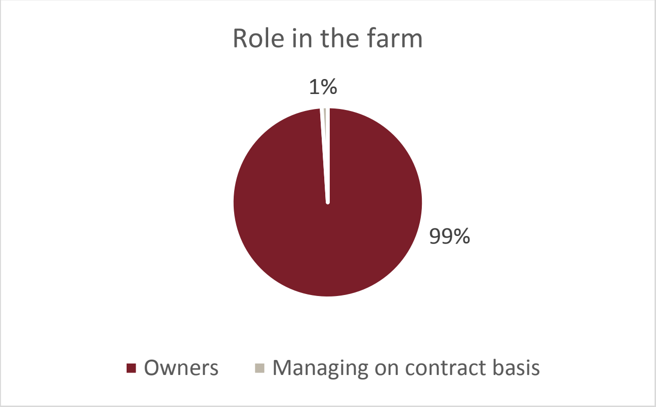
It is observed that irrespective of the awareness level of respondents about the schemes, the perception about benefit (load shedding duration reduction) has largely remained uniform. ***Thus, awareness about the schemes has not affected the perception of respondents about benefits.***

5.3 Agricultural

The survey has been carried out over a total sample size of 494 farmers spread across 24 circles of Maharashtra.

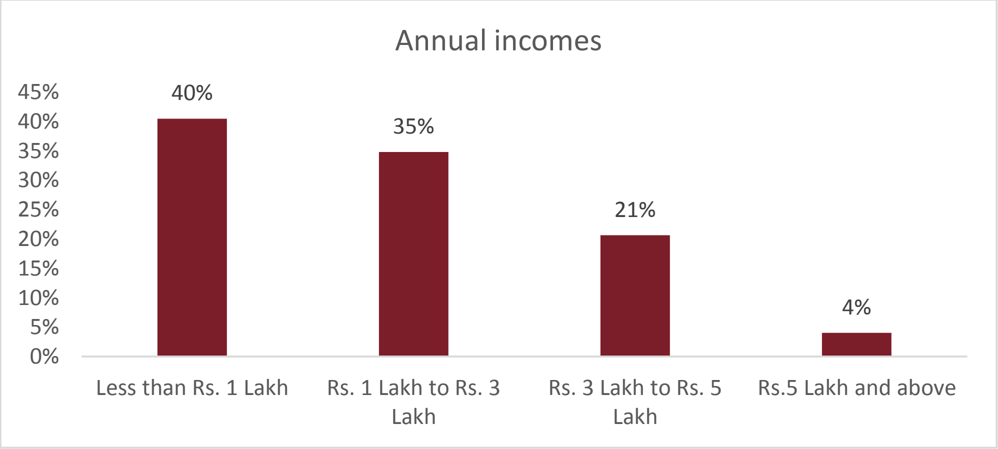
5.3.1 Respondents' profile

Figure 5-21: Ownership of the unit (agriculture consumers)



Almost all respondents were farm owners.

Figure 5-22: Annual incomes (agricultural consumers)



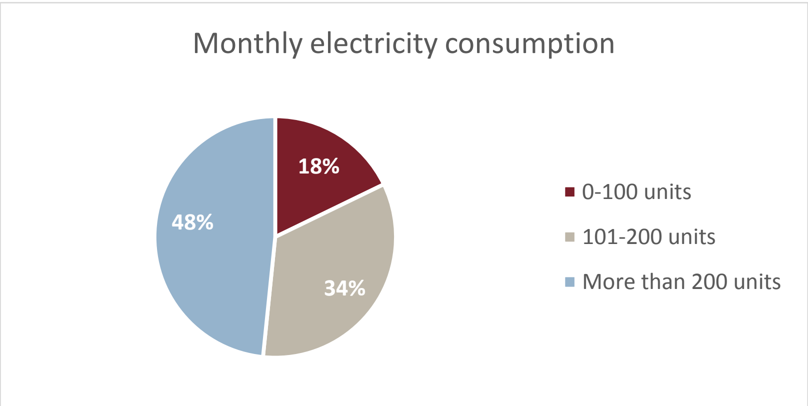
The circle-wise split of respondents, analyzed annual income wise is shown below.

Table 5-11 : Circle-wise split of respondents, analyzed annual income wise (agriculture)

Circle	Less than Rs 1 Lakh	Rs 1 Lakh- Rs 3 lakh	Rs 3 Lakh-Rs 5 Lakh	More than Rs 5 Lakh	Grand Total
Ahmednagar	36				36
Akola	12	5	1		18
Amaravati	8	2			10

Circle	Less than Rs 1 Lakh	Rs 1 Lakh- Rs 3 lakh	Rs 3 Lakh-Rs 5 Lakh	More than Rs 5 Lakh	Grand Total
Baramati	9	7	2		18
Bhandara	15	3			18
Gadchiroli	10	2			12
Dhule	2	8	7	1	18
Hingoli	4	10	2	2	18
Jalgaon	6	11			17
Jalna	8	11	1		20
Kolhapur	1	9	19	7	36
Latur	2	3	9	4	18
Nagpur	9	8	1		18
Nanded	3	19	18	1	41
Nandurbar	9		2		11
Nashik	3	9	4		16
Osmanabad	7	10	1		18
Parbhani	1	5	14	5	25
Pune	16	15	5		36
Sangali	1	1	16		18
Satara	17	1			18
Solapur	6	12			18
Wardha	11	7			18
Yavatmal	4	14			18
Grand Total	**200**	**172**	**102**	**20**	**494**

Figure 5-23: Monthly electricity consumption in kWh (Agriculture)



Most of the respondents owned small scale farms for which their electricity consumption are below 200 units per months.

Figure 5-24: Monthly electricity bill in INR (Agriculture)

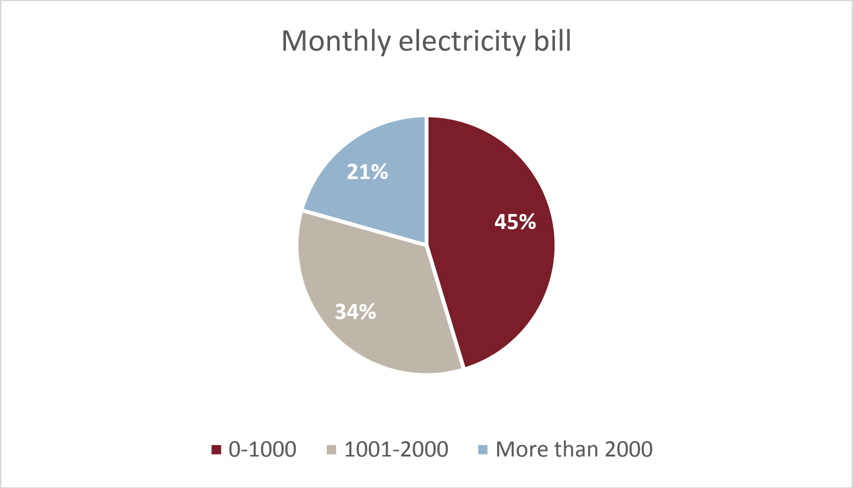


Figure 5-25: Types of connections (agriculture consumers)

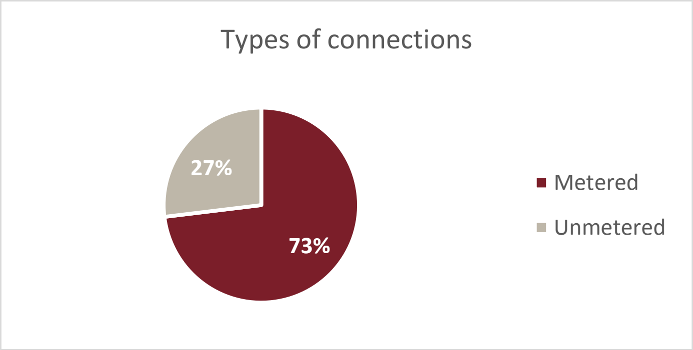
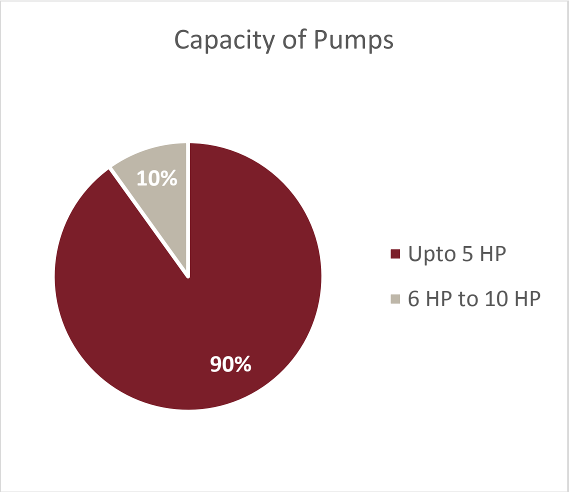
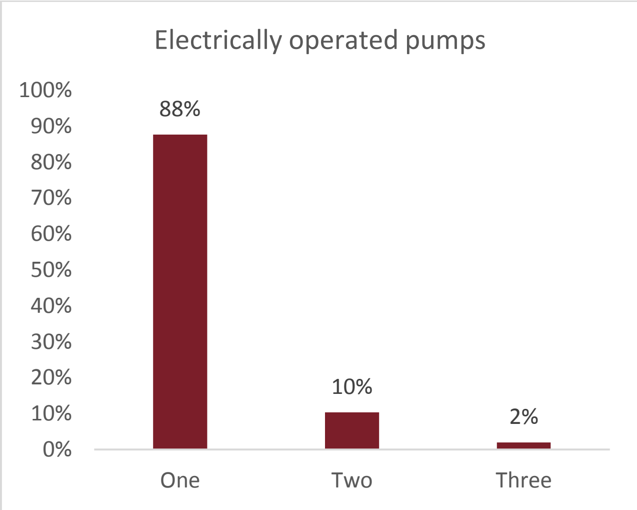


Figure 5-26: Capacity of pumps (agriculture consumers)



As stated earlier since most respondents own small scale units, the ownership of pumps also correspond accordingly.

Figure 5-27: Number of electrically operated pumps (agriculture consumers)



Quite evidently, most pumps are electrically operated.

In terms of agricultural consumers, CRIS has largely surveyed owners of farms. Most of farmers surveyed are from low and middle income categories. Almost 3/4th of them have metered connections which corroborates the analysis on share of metered to total agricultural electricity consumption described in preceding chapter of this report. All of the farmers surveyed had at least one electrically operated water pump.

The average duration of power supply during day time as well as during night time are depicted for all circles as shown in the table below.

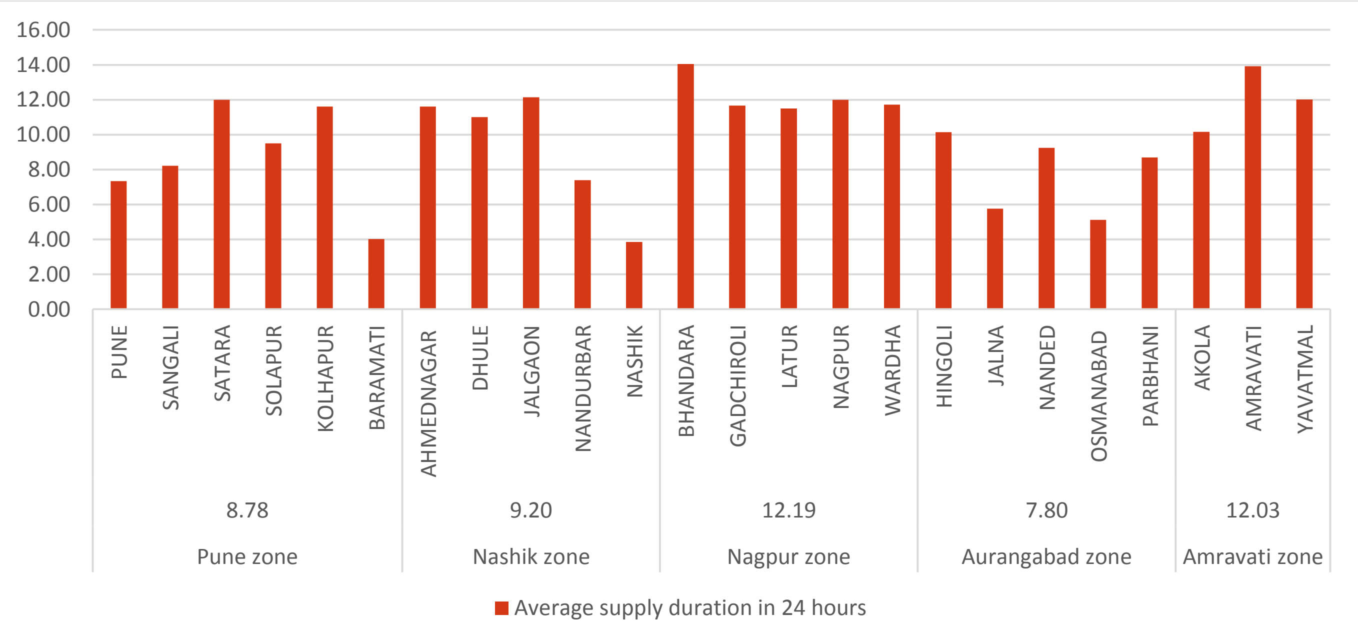
Table 5-12: Average duration of power supply during day and night times – circle wise (Agriculture)

Division Name	Division average supply duration during 24 hours (hours)	Circle Name	Average supply duration-Day Time (hours)	Average supply duration -Night Time (hours)	Average supply duration in 24 hours, day+night (hours)
Pune	8.78	Pune	2.72	4.61	7.33
		Sangli	8.22	0.00	8.22
		Satara	12.00	0.00	12.00
		Solapur	9.50	0.00	9.50
		Kolhapur	8.72	2.90	11.62
		Baramati	3.03	1.00	4.03
Nashik	9.20	Ahmednagar	11.47	0.14	11.61
		Dhule	5.00	6.00	11.00
		Jalgaon	12.14	0.00	12.14
		Nandurbar	3.30	4.09	7.39

Division Name	Division average supply duration during 24 hours (hours)	Circle Name	Average supply duration-Day Time (hours)	Average supply duration -Night Time (hours)	Average supply duration in 24 hours, day+night (hours)
		Nashik	1.86	2.00	3.86
Nagpur	12.19	Bhandara	6.50	7.56	14.06
		Gadchiroli	11.67	0.00	11.67
		Latur	5.67	5.83	11.50
		Nagpur	12.00	0.00	12.00
		Wardha	8.31	3.41	11.72
Aurangabad	7.80	Hingoli	8.50	1.65	10.15
		Jalna	3.22	2.55	5.77
		Nanded	7.05	2.20	9.24
		Osmanabad	3.12	2.00	5.12
		Parbhani	8.70	0.00	8.70
Amravati	12.03	Akola	6.00	4.17	10.17
		Amravati	6.67	7.25	13.92
		Yavatmal	7.61	4.41	12.02
Average for all circles			**7.21**	**2.57**	**9.78**

The average durations are shown in the graph below.

Figure 5-28: Average supply duration during 24 hours for circles and divisions (hour) (Agriculture)

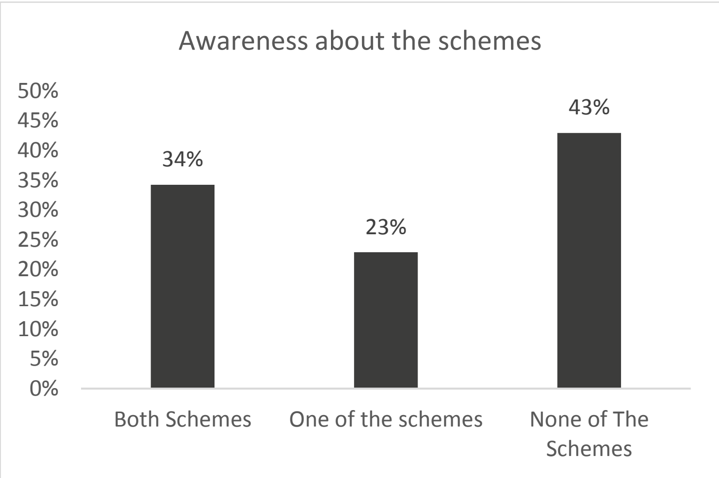


It is observed that most of the circles receive an average daily supply duration of 8 to 12 hours approximately. The supply hours during day time are almost 3 times of that during night time.

5.3.2 Impact on consumers

5.3.2.1 Awareness about the schemes

Figure 5-29: Awareness about the schemes



The above statistics show that there is significant potential to increase awareness about the schemes amongst agricultural consumers.

5.3.2.2 Impact of the schemes on economic aspects

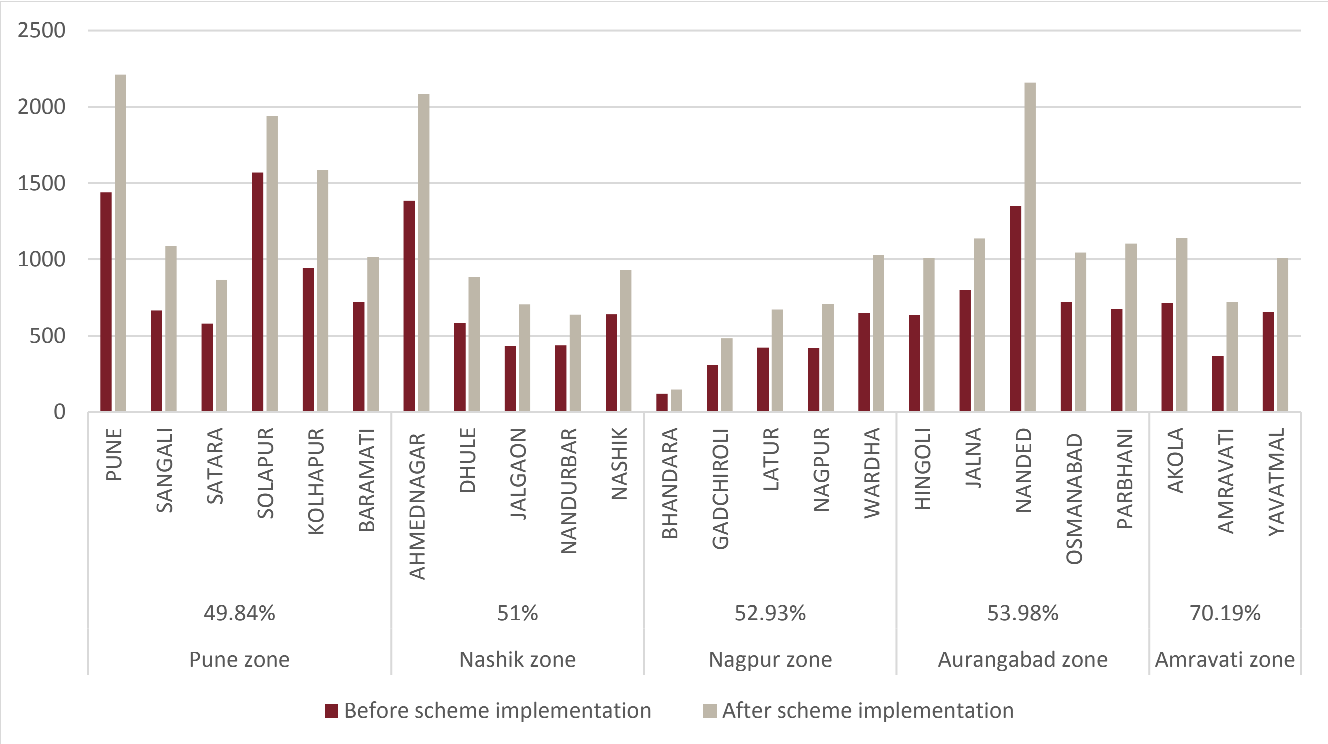
The impact of the schemes on power supply duration in a week, analyzed circle and division-wise is depicted below.

Table 5-13 : Power supply duration during a week before and after scheme implementation: circle and division wise analysis (Agriculture)

Division Name	Division % increase	Circle Name	Before scheme implementation (hours)	After scheme implementation (hours)	% increase
Pune	49.84%	Pune	1440	2211	54%
		Sangli	665	1086	63%
		Satara	579	866	50%
		Solapur	1569	1939	24%
		Kolhapur	943	1585	68%
		Baramati	720	1015	41%
Nashik	51%	Ahmednagar	1385	2084	50%

Division Name	Division % increase	Circle Name	Before scheme implementation (hours)	After scheme implementation (hours)	% increase
		Dhule	584	884	51%
		Jalgaon	433	704	63%
		Nandurbar	436	637	46%
		Nashik	640	931	45%
Nagpur	59.66%	Bhandara	699	1093	56%
		Gadchiroli	309	482	56%
		Latur	421	671	59%
		Nagpur	420	707	68%
		Wardha	649	1027	58%
Aurangabad	53.98%	Hingoli	635	1009	59%
		Jalna	800	1137	42%
		Nanded	1350	2158	60%
		Osmanabad	720	1045	45%
		Parbhani	673	1103	64%
Amravati	70.19%	Akola	715	1141	60%
		Amravati	365	720	97%
		Yavatmal	657	1010	54%

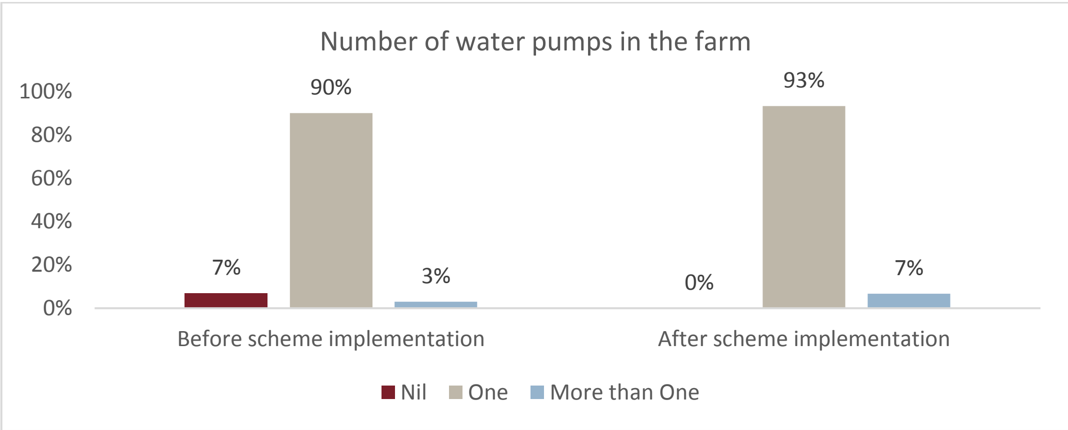
Figure 5-30: Power supply duration during a week before and after scheme implementation: circle and division wise analysis (Agriculture)



It can be observed for all divisions, there was an average increase in supply duration in the range of 50% to 70%.

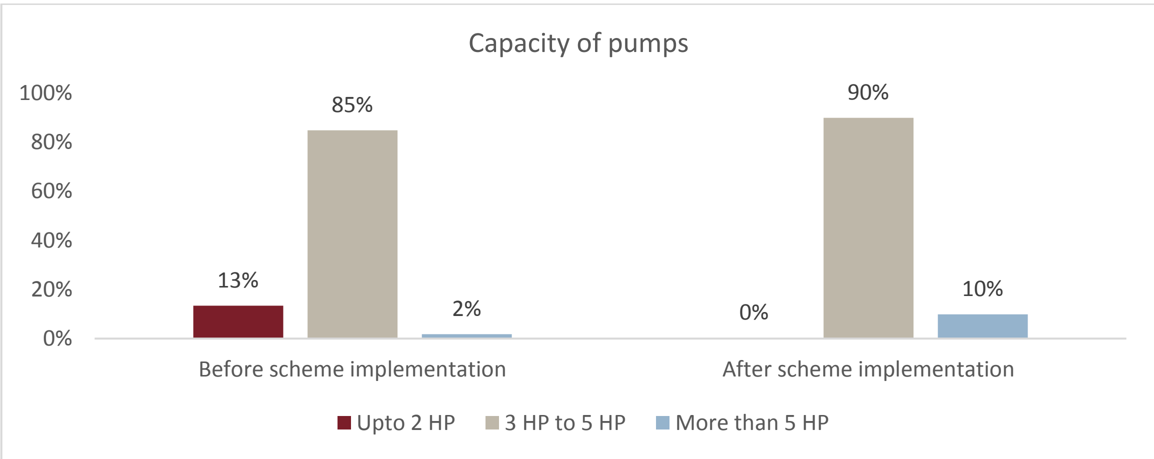
Some of the other impacts are shown below.

Figure 5-31: Number of water pumps in the farm



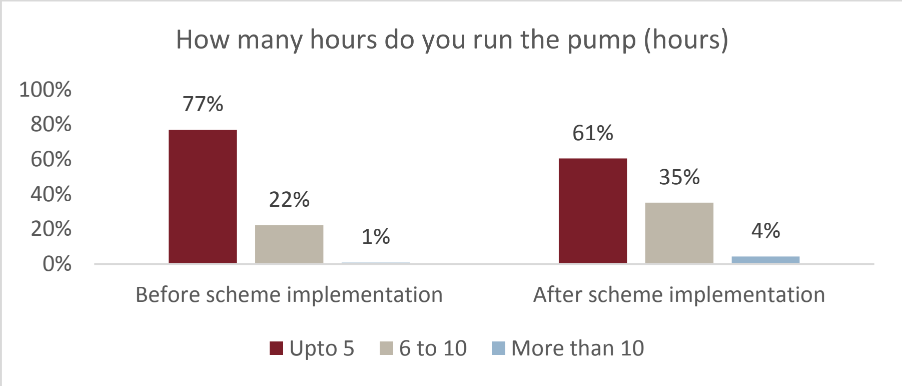
The number of farmers owning at least one water pump increased after scheme implementation.

Figure 5-32: Capacities of pumps



Farmers have now started using higher capacity water pumps.

Figure 5-33: Duration of running of pump in hours



Quite evidently, duration for which power is being supplied to the agricultural units has gone up.

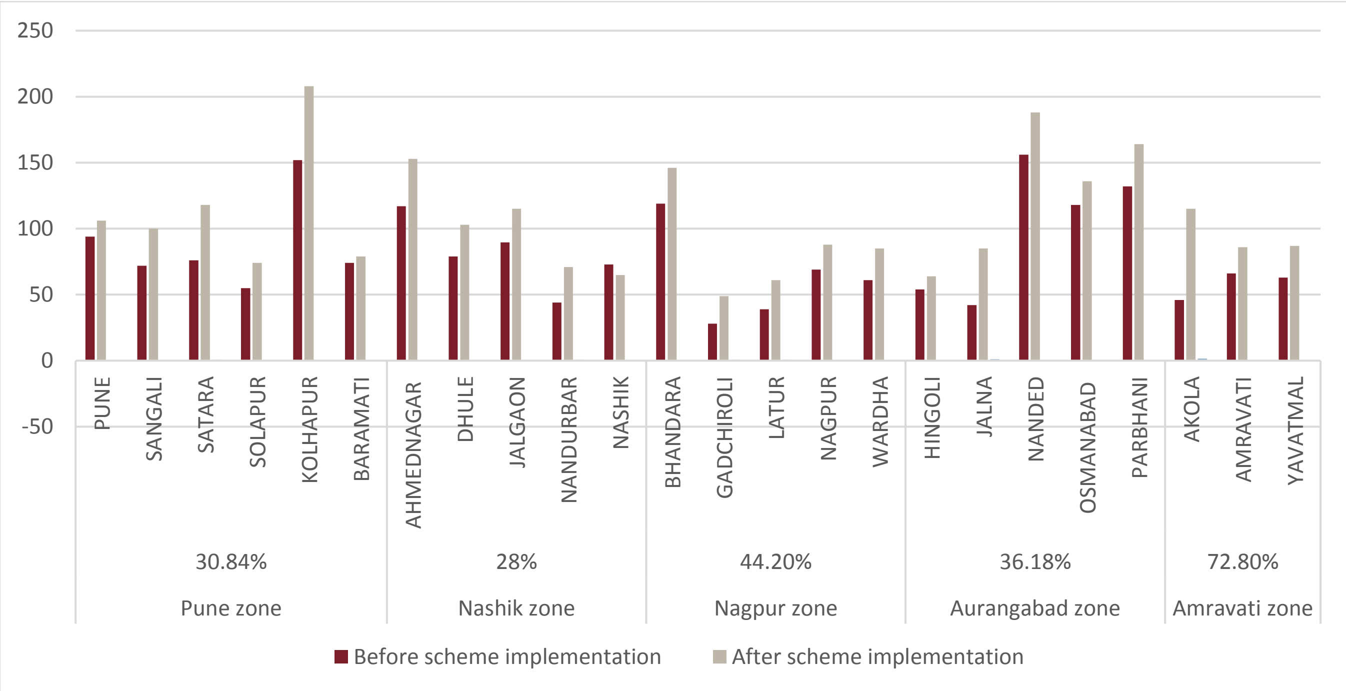
The duration of running of water pumps has been analyzed for all the circles and divisions:

Table 5-14 : Duration of running of water pumps before and after scheme implementation, analyzed circle and division-wise (hours) (Agriculture)

Division Name	Division % reduction	Circle Name	Before scheme implementation (hours)	After scheme implementation (hours)	% increase
Pune	30.84%	Pune	94	106	13%
		Sangli	72	100	39%
		Satara	76	118	55%
		Solapur	55	74	35%
		Kolhapur	152	208	37%
		Baramati	74	79	7%
Nashik	28%	Ahmednagar	117	153	31%
		Dhule	79	103	30%
		Jalgaon	89.5	115	28%
		Nandurbar	44	71	61%
		Nashik	73	65	-11%
Nagpur	44.20%	Bhandara	119	146	23%
		Gadchiroli	28	49	75%
		Latur	39	61	56%
		Nagpur	69	88	28%
		Wardha	61	85	39%
Aurangabad	36.18%	Hingoli	54	64	19%
		Jalna	42	85	102%
		Nanded	156	188	21%
		Osmanabad	118	136	15%
		Parbhani	132	164	24%

Division Name	Division % reduction	Circle Name	Before scheme implementation (hours)	After scheme implementation (hours)	% increase
Amravati	72.80%	Akola	46	115	150%
		Amravati	66	86	30%
		Yavatmal	63	87	38%
Grand total			**1919**	**2546**	**33%**

Figure 5-34: Duration of running of water pumps before and after scheme implementation, analyzed circle and division-wise (hours) (Agriculture)



The duration of running of pumps has also been analyzed in terms of income of farmers, which is shown below.

Table 5-15 : Duration of running of water pumps before and after scheme implementation, analyzed income-wise (hours) (Agriculture)

Income level	Before scheme implementation (hours)	After scheme implementation (hours)	% increase
Less than Rs 1,00,000	740	1055	43%
Rs 1,00,000 to Rs 3,00,000	669	838	25%
Rs 3,00,000 to Rs 5,00,000	429	546	27%
More than Rs 5,00,000	81	107	32%
Grand Total	**1919**	**2546**	**33%**

The above shows that overall the duration of running of pumps has significantly increased after scheme implementation. Moreover, there is no particular correlation between increase in duration of running of pumps and income levels. The highest increase in duration of running of pumps has been shown by the lowest income category. Further, the number of pumps and capacity of pump being used has also increased. All of this indicates that both the quality and availability of power supply has been improved after scheme implementation.

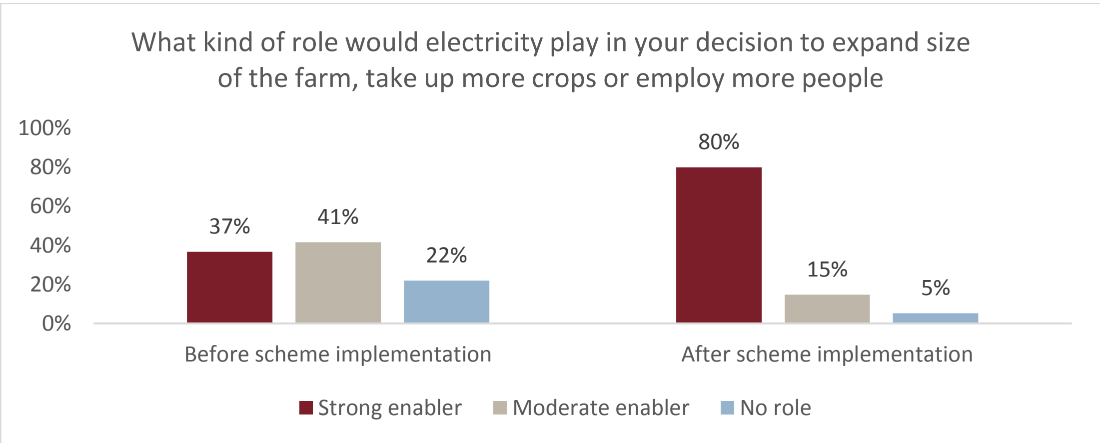
Post scheme implementation, it can be inferred that the amount of water being pumped has significantly increased. Most of the farmers are now receiving an average daily supply duration of 8 to 12 hours – across the circles surveyed, the increase in supply duration has been in the range of 50-70% as compared to before scheme implementation. 16% of the farmers have now significantly increased their pump operating hours from upto 5 hours to running them for greater than 6 hours and 10 hours. 13% of the farmers have increased their pump capacities at least 1.5 to 2 times. The number of pumps owned by each farmer has also shown an increase in some cases.

The fact that greater quantities of water are now being pumped along with the way pumps are now being used by farmers can potentially lead to depletion of water tables. Generally famers switch on their pumps remotely (through their mobile phones) and may not necessarily switch the pumps off, which can result in water wastage.

Such cross impacts need to be taken into consideration in future when designing schemes for increasing supply of power. Specific measures must be incorporated to address such issues. For example, the use of special pumps with auto cut off feature can be promoted – these pumps will have a configurable threshold for the volume of water pumped in a single continuous use. Another measure that could be explored is to provide metered water connections to farmers so that they get the right price signals in order to curb wastage.

5.3.2.3 Role of electricity in economic decisions

Figure 5-35: Role of electricity in expansion decisions (agricultural consumer)



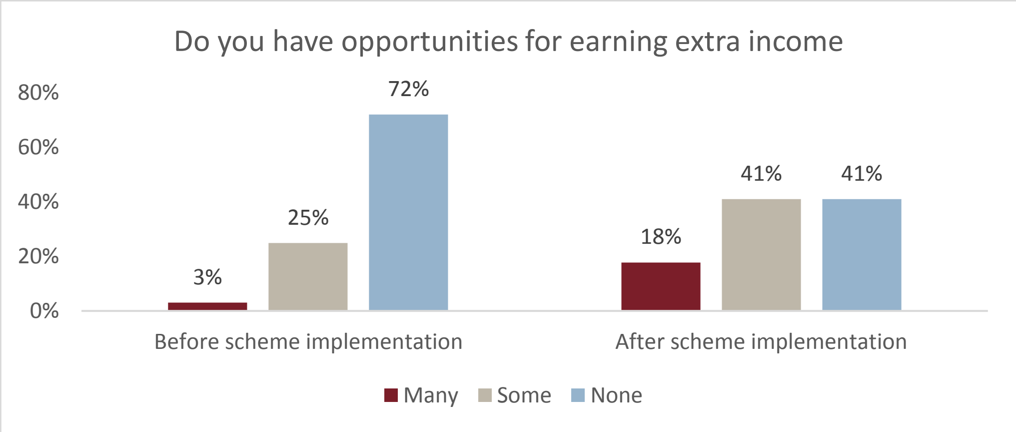
The circle wise breakup of above figures has been provided in the table below.

Figure 5-36: Role of electricity in expansion decisions circle wise (agricultural consumer)

Division Name	% increase in respondents who feel electricity has been a strong/moderate enabler in business expansion	Circle Name	Before scheme implementation			After scheme implementation		
			Moderate Enabler	No Role	Strong Enabler	Moderate Enabler	No Role	Strong Enabler
Pune zone	18.21%	Pune	1	1	34	1	2	33
		Sangali	17	1	0	1		17
		Satara	7	10	1	11	1	6
		Solapur	2		16			18
		Kolhapur	36		0			36
		Baramati	2	2	14	1	3	14
Nashik zone	55%	Ahmednagar	15	4	17	4		32
		Dhule	10	8				18
		Jalgaon	5	11	1	11		6
		Nandurbar	3	5	3	3	5	3
		Nashik	5	1	10	5	1	10
Nagpur zone	91.50%	Bhandara		10	8			18
		Gadchiroli	6	6				12
		Latur	16	2		2		16
		Nagpur		12	6	1		17
		Wardha	14	3	1	4		14
Aurangabad zone	6.75%	Hingoli	4		14	1		17
		Jalna	3	4	13	3	3	14
		Nanded	19	1	21			41
		Osmanabad	8	2	8	4	2	12
		Parbhani	15	5	5	6		19
Amravati zone	141.67%	Akola	4	10	4	5	9	4
		Amravati	2	8		8		2
		Yavatmal	11	2	5	2		16

It can be observed for all administrative zones, there has been significant improvement in people's mindset which has led to substantial rise in respondents who think electricity has to play a major role in any decision for business expansion.

Figure 5-37: Role of electricity in providing economic opportunities (agricultural consumer)



The circle wise breakup of above figures has been provided in the table below.

Figure 5-38: Role of electricity in rise in employment opportunity across circles

Division Name	% increase in respondents who feel there has been rise in employment opportunities	Circle Name	Before scheme implementation			After scheme implementation		
			Many	Some	None	Many	Some	None
Pune zone	21.11%	Pune		1	35	0	2	34
		Sangali			18	0	18	0
		Satara		10	8	10	6	2
		Solapur			18	2	0	16
		Kolhapur			36	0	36	0
		Baramati		9	9	1	5	12
Nashik zone	17%	Ahmednagar	4	11	21	10	21	5
		Dhule		4	14	4	0	14
		Jalgaon			17	0	5	12
		Nandurbar		2	9	0	2	9
		Nashik	2	7	7	3	4	9
Nagpur zone	7.69%	Bhandara		3	15	3	0	15
		Gadchiroli		11	1	11	0	1
		Latur			18	0	18	0
		Nagpur			18	0	18	0
		Wardha		13	5	12	6	0
Aurangabad zone	26.10%	Hingoli	3	11	4	11	4	3
		Jalna	2	4	14	2	5	13
		Nanded	2	18	21	10	18	13

Division Name	% increase in respondents who feel there has been rise in employment opportunities	Circle Name	Before scheme implementation			After scheme implementation		
			Many	Some	None	Many	Some	None
		Osmanabad	1	6	11	6	8	4
		Parbhani		6	19	0	4	21
Amravati zone	28.57%	Akola	1	6	11	2	4	12
		Amaravati		1	9	1	1	8
		Yavatmal			18	0	18	0

It is observed that almost for all zones, there has been some increase in respondents who feel there has been more employment opportunities for them after implementation of schemes and better electricity supply.

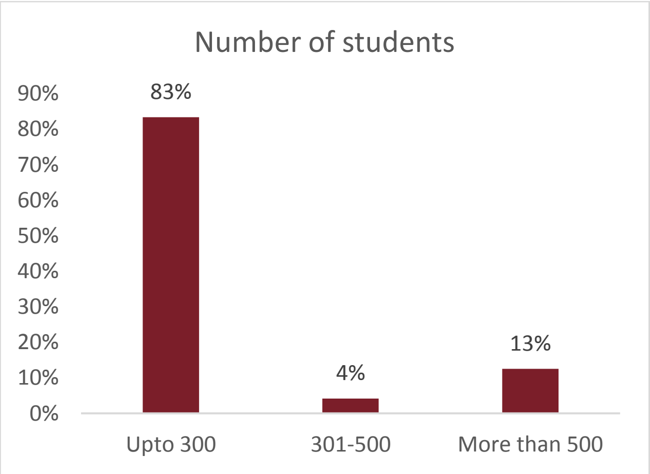
It is evident that with improvement in supply of electricity, electricity has become a much stronger enabler for key business decisions related to expansion. Further, opportunities for earning extra income have also increased for farmers because of electricity.

5.4 Schools and hospitals

The survey has been carried out on a total sample size of 48 schools and 23 hospitals across 24 circles of MSEDCL.

5.4.1 Profile of respondents

Figure 5-39: Number of students - schools



The respondents were mostly small to medium sized schools housing upto 300 students at a time.

Figure 5-40: Monthly electricity consumption (kWh) – Schools

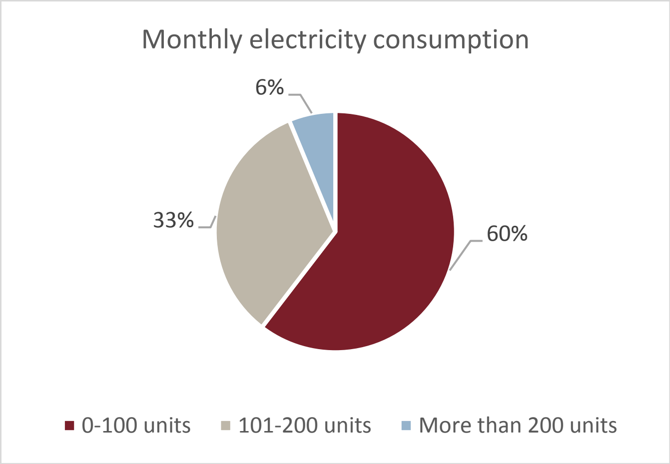
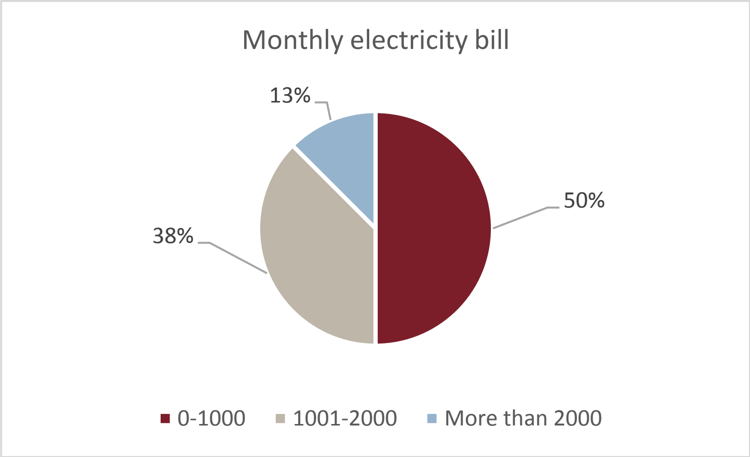


Figure 5-41: Monthly electricity bill (INR) - Schools

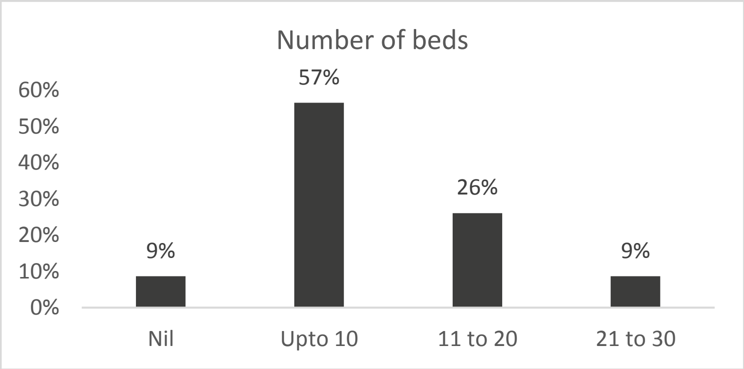


Close to 88% schools paid electricity bills of less than Rs 2000 per month.

The following charts depicts the profile of the health centers which were surveyed under this study.

Most of the hospitals surveyed were small scale facilities half of which had a capacity to admit upto ten patients at a time. While around 26% of those surveyed had the capacity of admitting upto a maximum of 20 patients.

Figure 5-42: Number of beds - hospital



For a significant majority, the annual revenue of the hospital are less than Rs 3 lakh per annum.

Figure 5-43: Annual revenue - hospital

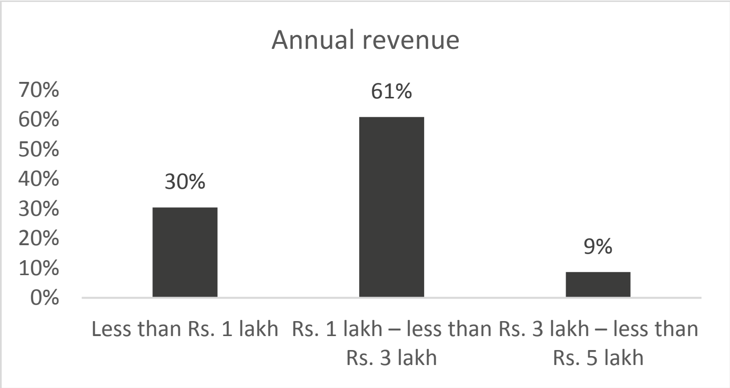
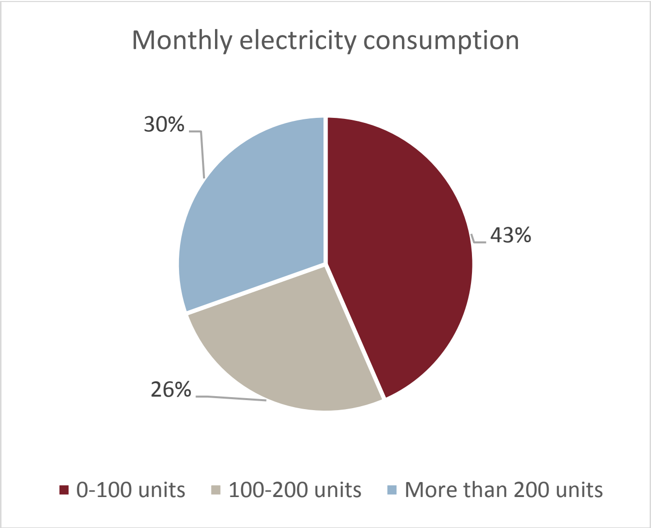
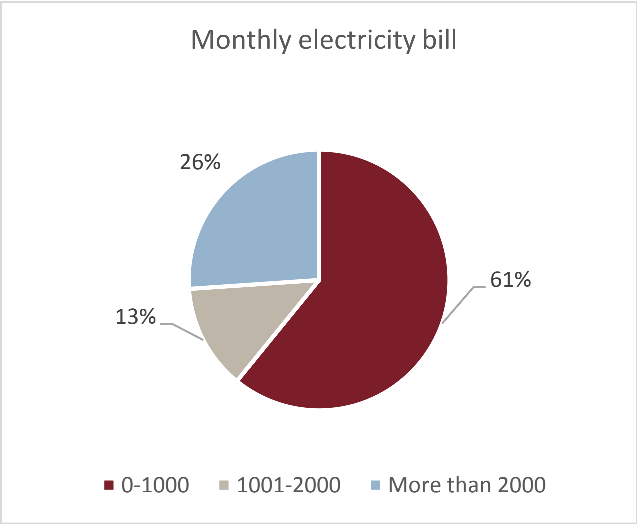


Figure 5-44: Monthly electricity consumption in kWh - hospital Figure 5-45: Monthly electricity bill in INR – hospital





Thus, in terms of profile of respondents, the majority are from small and medium sized schools and hospitals.

Figure 5-46: Number of computers - school

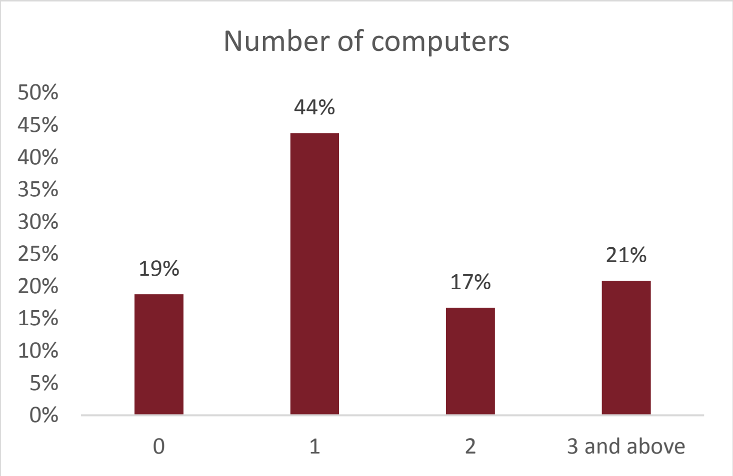
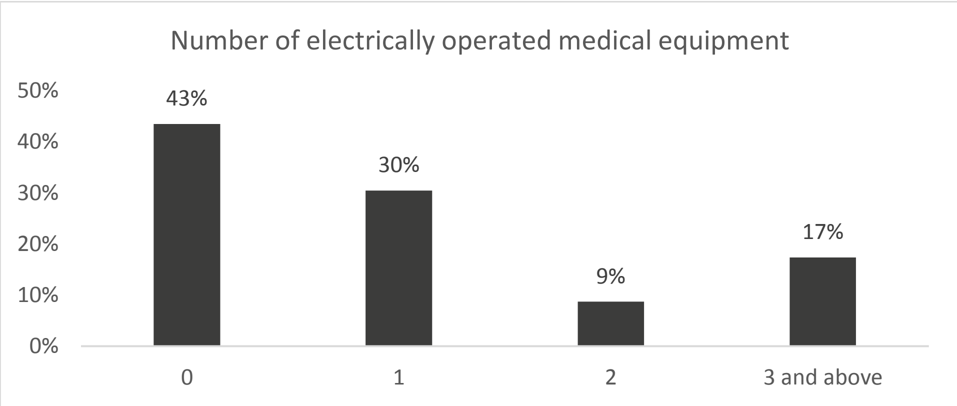


Figure 5-47: Number of electrically operated medical equipment - hospital



Looking at above statistics of electrically operated equipment, more than half of the schools and hospitals surveyed had at least one form of such equipment present.

5.4.2 Impact of schemes on consumers

5.4.2.1 Awareness about schemes

Figure 5-48: Awareness about schemes - schools

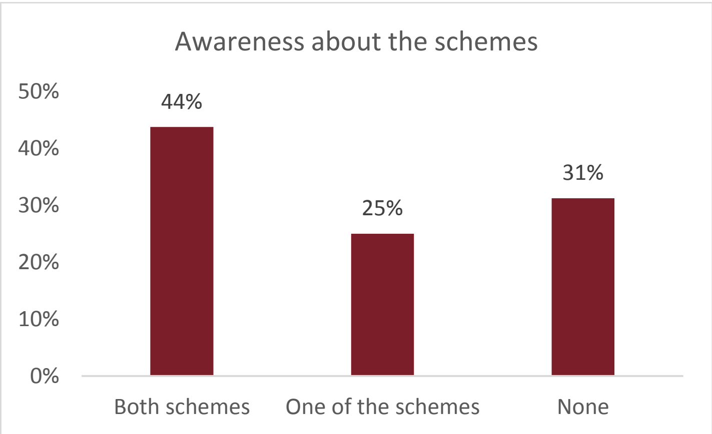
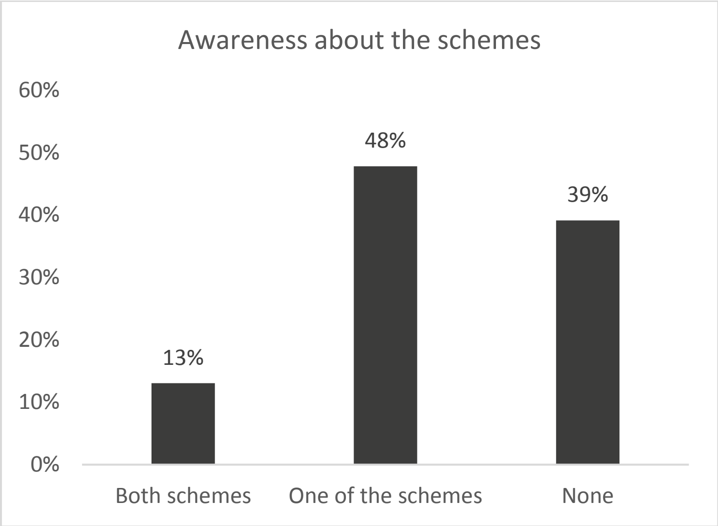


Figure 5-49: Awareness about schemes - hospitals

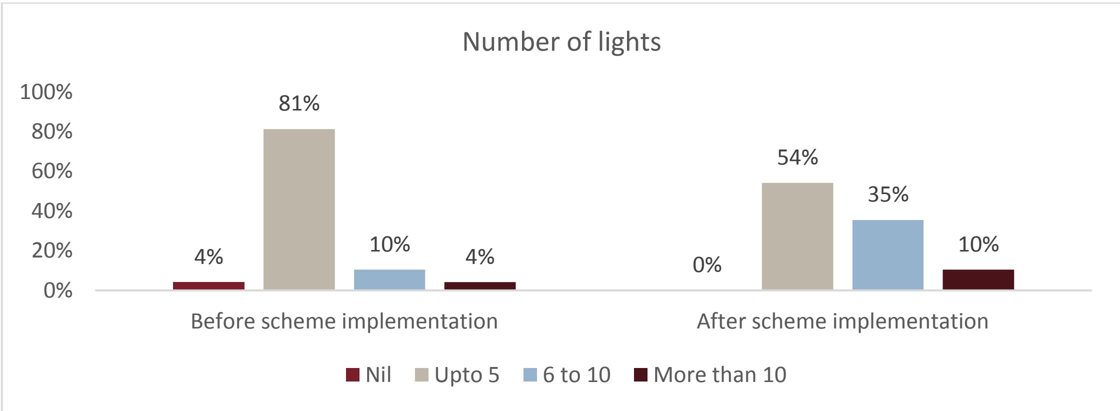


Thus, there remains significant potential to increase awareness about the schemes in schools as well as hospitals.

5.4.2.2 Impact on functioning of schools and hospitals

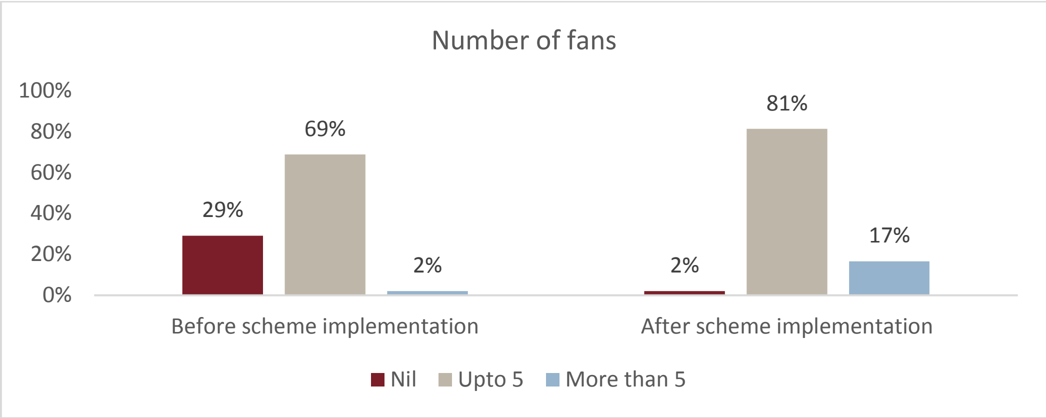
The lighting infrastructure in schools has improved after scheme implementation as can be observed below.

Figure 5-50: Number of lights - schools



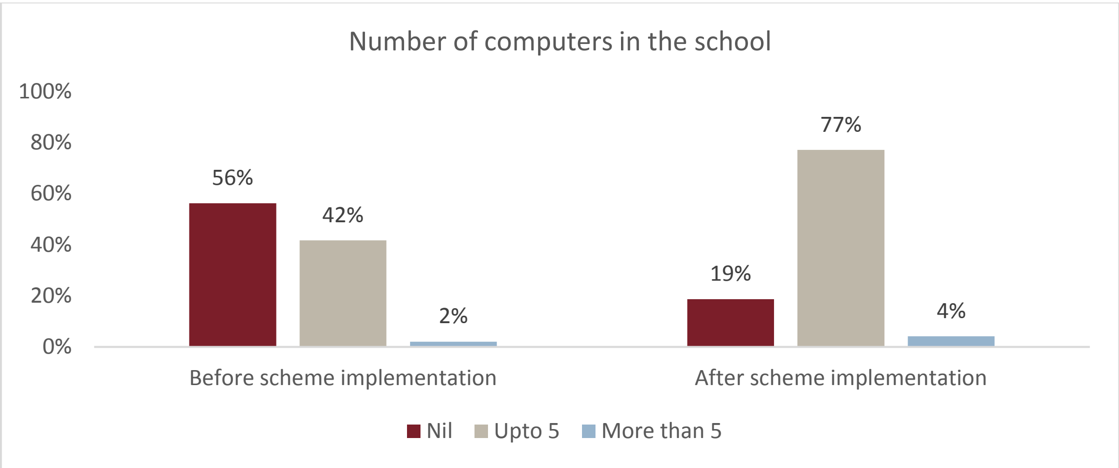
As can be observed the total number of lights in school significantly went up. There are 45% respondents using more than 6 lights after scheme implementation as compared to 14% schools who used more than 6 lights before scheme implementation.

Figure 5-51: Number of fans - schools



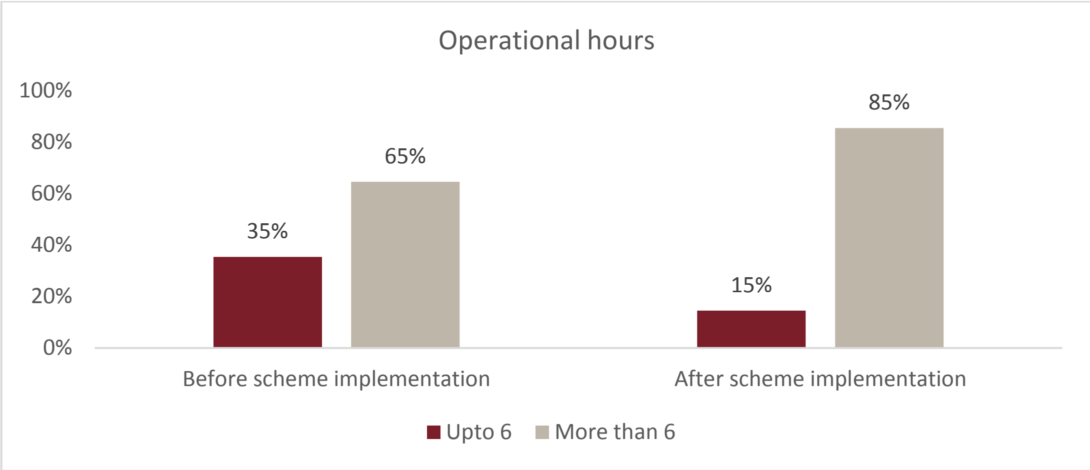
The student comfort also increased as can be observed by the increase in number of fans.

Figure 5-52: Number of computers - schools



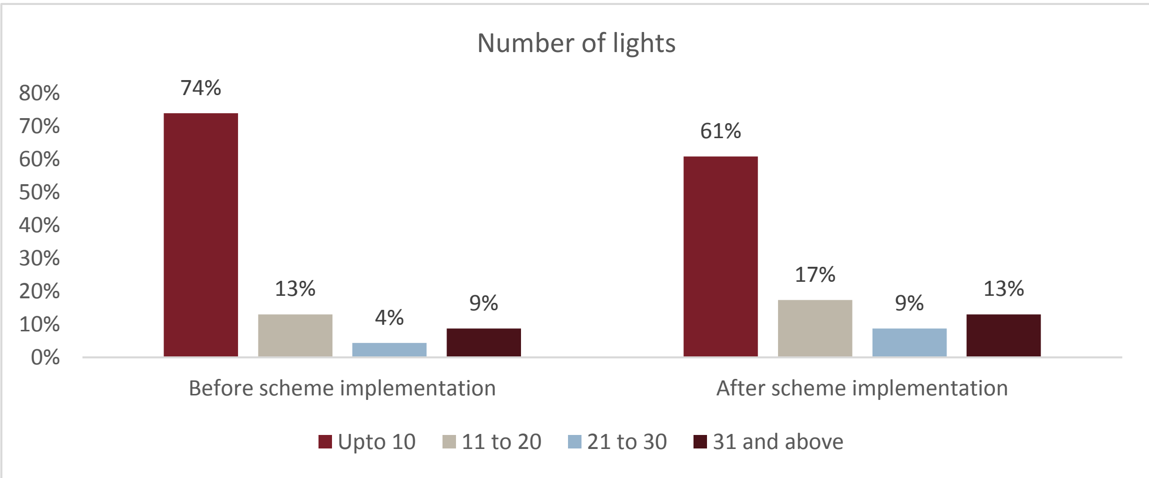
Number of computers put to use substantially increased after implementation of the schemes.

Figure 5-53: Operational hours - schools



As an important observations, the schools started working for longer hours after scheme implementation.

Figure 5-54: Number of lights - hospitals



More number of lights were installed after scheme implementation.

Figure 5-55: Number of fans - hospitals

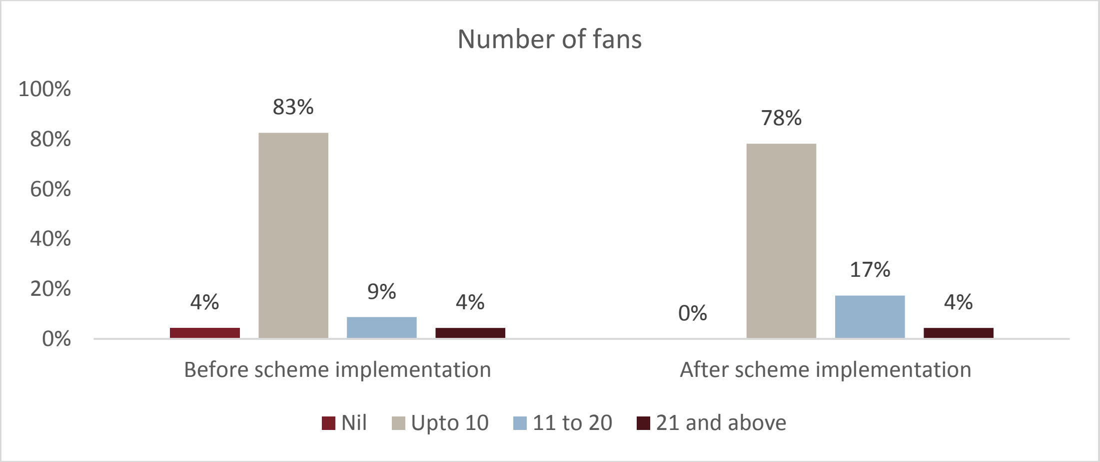
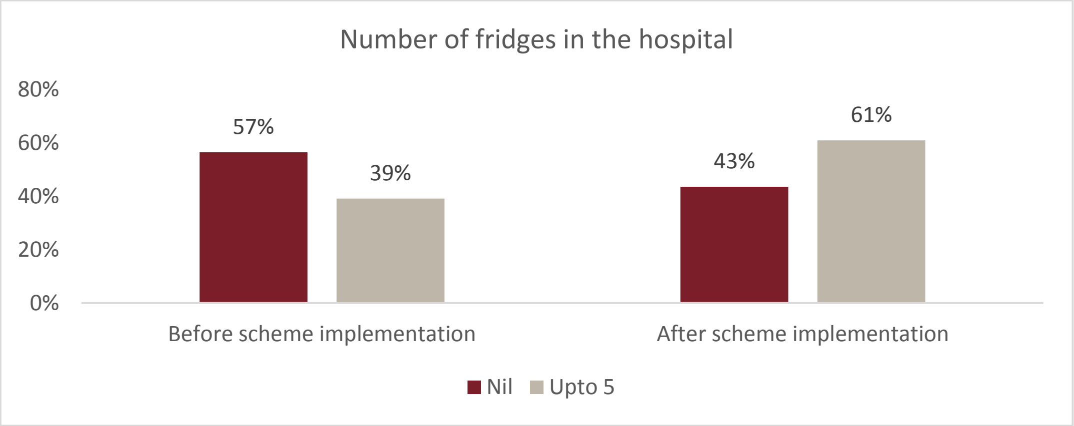
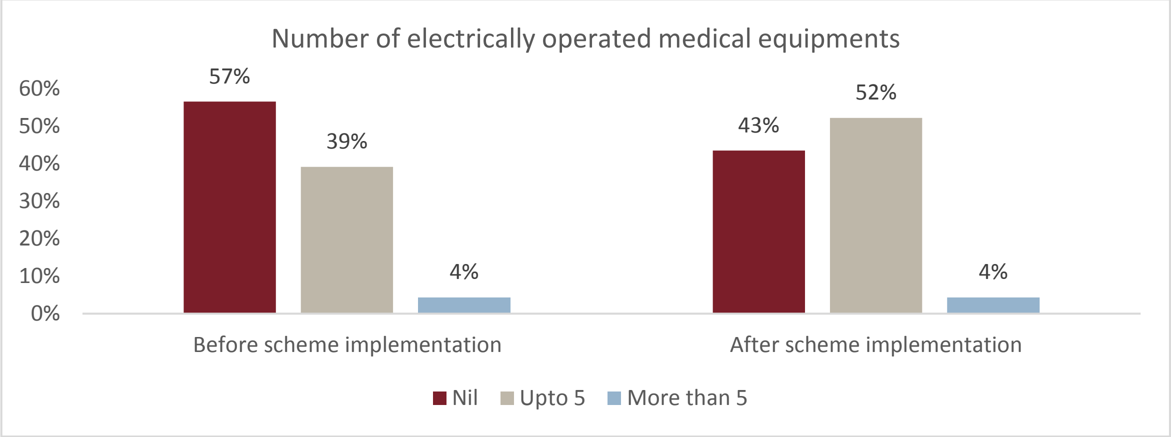


Figure 5-56: Number of fridges – hospitals



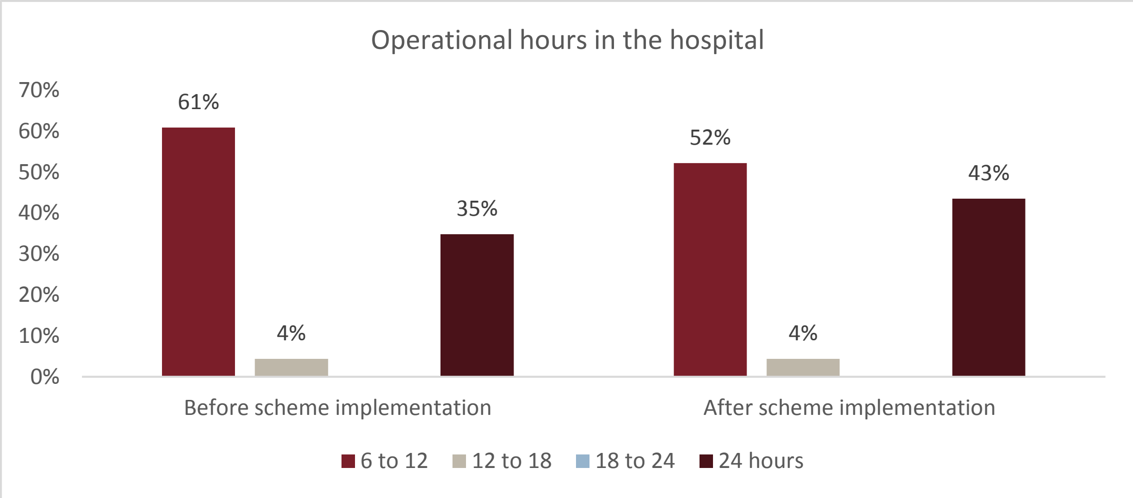
Storage of medicine and other important drugs was improved since the number of fridges put to use gone up substantially, all due to better power supply conditions.

Figure 5-57: Number of electrical equipment – hospitals



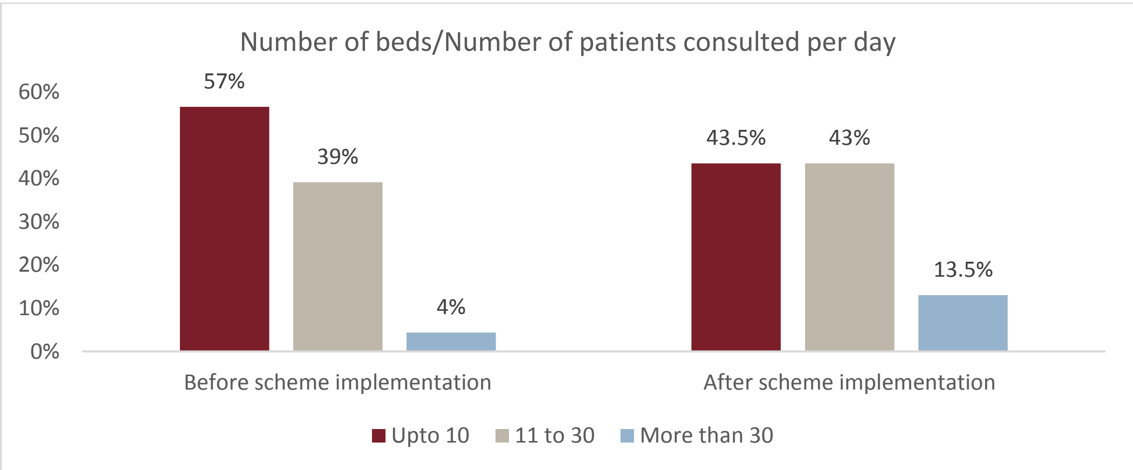
The number of electrically operated medical equipment has increased after scheme implementation.

Figure 5-58: Operational hours – hospitals



Operational hours of the hospitals have increased.

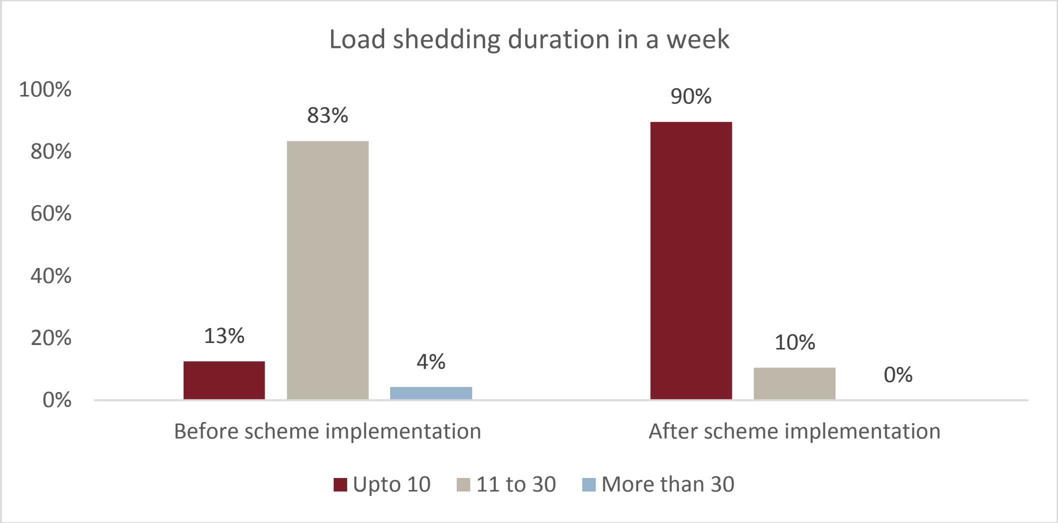
Figure 5-59: Number of patients consulted per day – hospitals



Thus, across most of the parameters, for schools as well as hospitals, there has been an improvement which indicates an overall improvement in the quality and reliability of power supply.

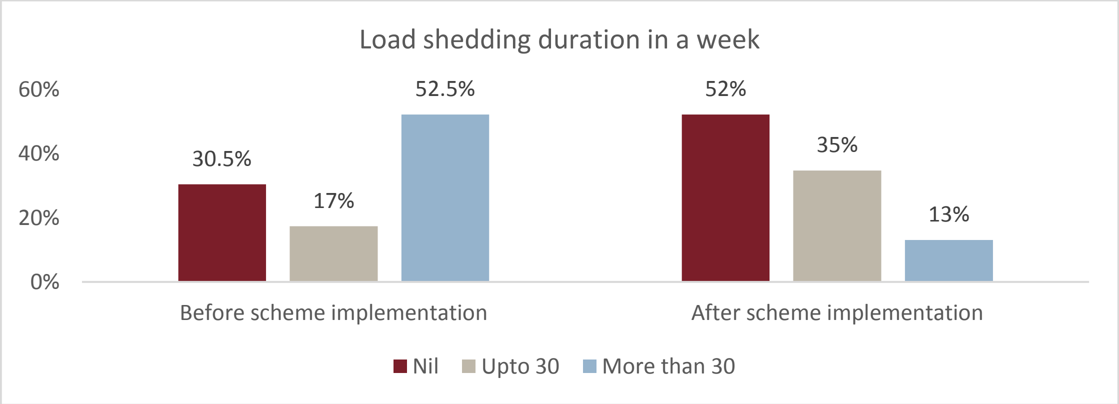
5.4.2.3 Load shedding

Figure 5-60: Weekly load shedding duration (in hours) – schools



Load shedding duration was reduced after segregation of feeders. 87% load shedding used to be more than 11 hours per week before scheme implementation, which reduced to a mere 10% after scheme implementation.

Figure 5-61: Weekly load shedding duration (in hours) - hospitals



Thus, it is evident that the extent of load shedding has significantly reduced after scheme implementation.

5.5 Gram Panchayats

The survey has been carried out on a total sample size of 62 gram panchayats spread across 27 circles of Maharashtra.

5.5.1 Profile of respondents

Figure 5-62: Number of connections – gram panchayat

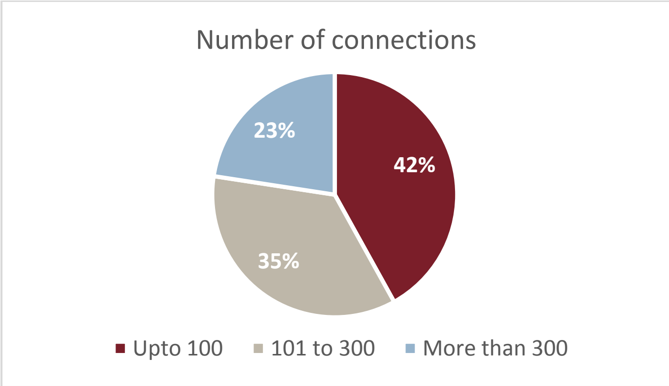
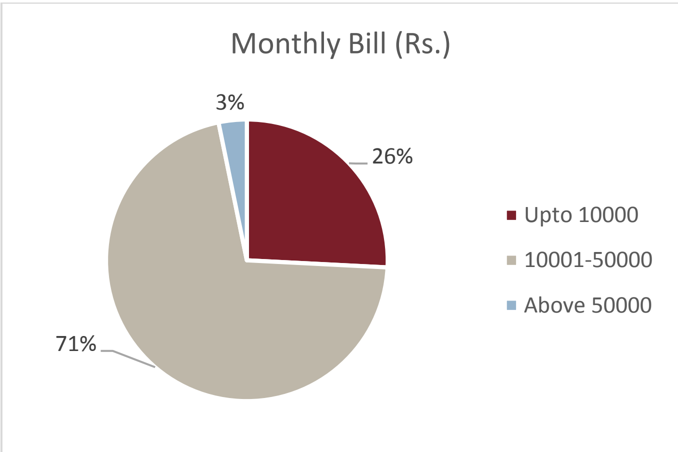


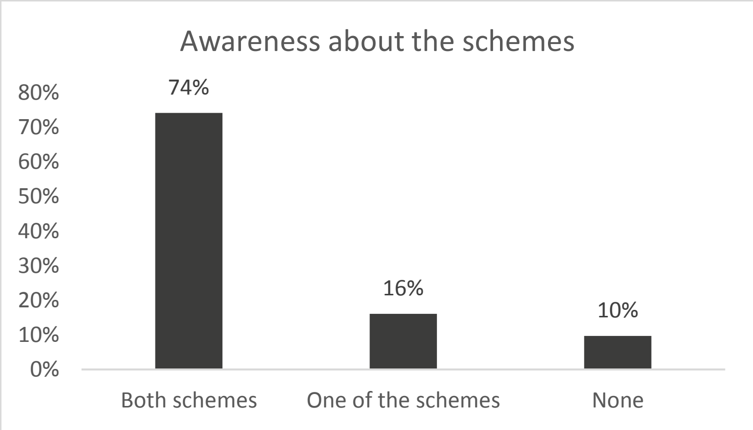
Figure 5-63: Monthly electricity bill in INR – gram panchayats



5.5.2 Impact of schemes on villages

5.5.2.1 Awareness about the schemes

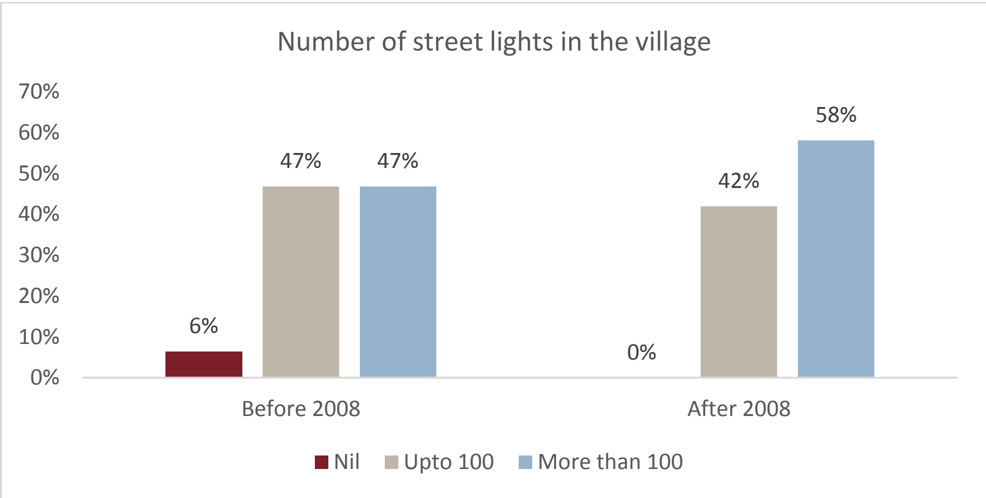
Figure 5-64: Awareness about the schemes – gram panchayats



It is noteworthy that gram panchayats have much higher level of awareness than other consumer categories. However the reason for this is that MSEDCL maintains close coordination with gram panchayats while implementing such schemes.

5.5.2.2 Impact on civic parameters of the village

Figure 5-65: Number of street lights in the villages



The total number of street lights before and after scheme implementation for each of the Gram Panchayat surveyed has been shown below.

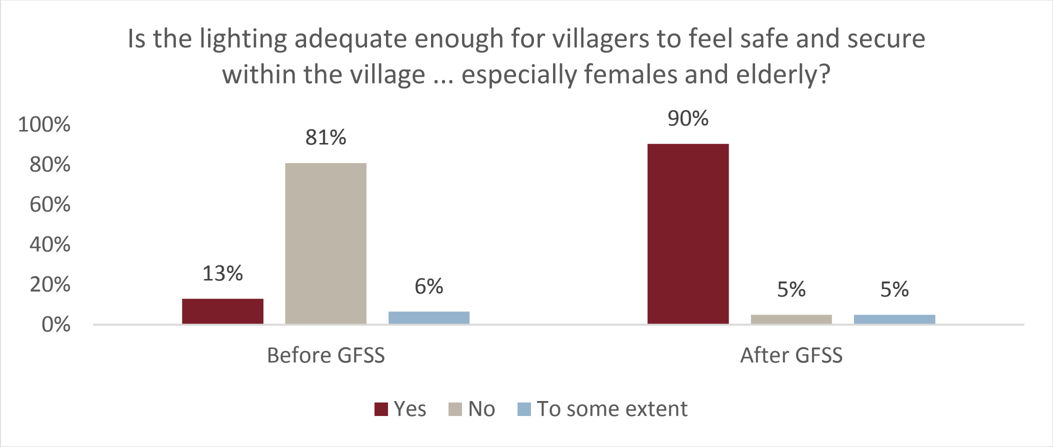
Table 5-16 : Total number of streetlights before and after scheme implementation – Gram panchayat wise

Circle and Panchayat name	Number of Panchayat surveyed	Before scheme implementation	After scheme implementation
Ahmednagar	**3**	**24**	**40**
Gindegaon	1	10	20
Lakhamapuri	1	4	10
Sultanpur	1	10	10
Akola	**2**	**110**	**205**
Akola	1	30	55

Circle and Panchayat name	Number of Panchayat surveyed	Before scheme implementation	After scheme implementation
Chandur	1	80	150
Amravati	**1**	**8**	**20**
Chandrabazar	1	8	20
Bhandara	**2**	**35**	**85**
Malutola	1	0	50
Mohgaon	1	35	35
Gadchiroli	**1**	**0**	**102**
Brahmapuri	1	0	102
Jalgaon	**3**	**50**	**70**
Javkheda	1	21	26
Lonwadi Kh	1	4	19
Wadali	1	25	25
Kolhapur	**1**	**10**	**22**
Bachani	1	10	22
Nagpur	**1**	**15**	**30**
Bidgaon	1	15	30
Nashik	**2**	**25**	**45**
Thangaon	1	20	40
Vadner Bhairav	1	5	5
Osmanabad	**1**	**25**	**55**
Bavi	1	25	55
Satara	**17**	**3590**	**5315**
Anewadi	1	200	300
Anpatwadi	1	250	350
Baudhan	1	300	325
Bnhuinj	1	130	170
Darwadi	1	300	400
Dhom	1	190	270
Jamb	1	230	410
Kavathe	1	150	300
Kenjal	1	230	400
Kikali	1	170	270
Kunnur	1	170	230
Mhatekarwadi	1	300	400
Nagewadi	1	270	360
Pachgani	1	130	250
Pirachiwadi	1	200	300

Circle and Panchayat name	Number of Panchayat surveyed	Before scheme implementation	After scheme implementation
Shabag	1	170	280
Waghjaiwadi	1	200	300
Solapur	**2**	**70**	**180**
Uplai (Bk)	1	30	80
Uplai (Kh)	1	40	100
Wardha	**1**	**45**	**45**
Dhanoli	1	45	45
Yavatmal	**1**	**0**	**50**
Bhari	1	0	50
Grand Total	**38**	**4007**	**6264**

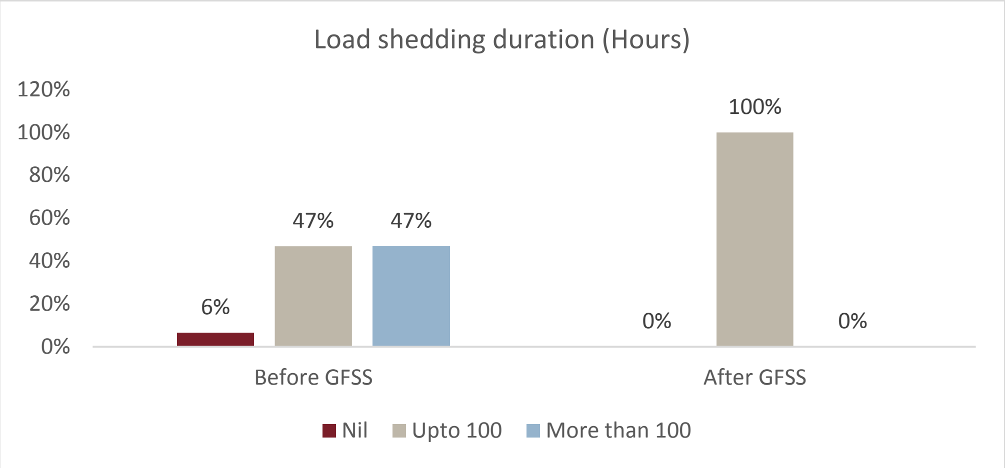
Figure 5-66: Adequacy of lighting for safety and security – gram panchayats



The above statistics reveal that electrification of villages has rapidly increased and the levels of lighting have especially improved.

5.5.2.3 Load shedding

Figure 5-67: Weekly load shedding duration (in hours) – gram panchayats



The weekly load shedding duration before and after scheme implementation has been compiled below.

Table 5-17 : Weekly load shedding duration before and after scheme implementation (hours) (Gram Panchayats)

Circle & Panchayat	Before scheme implementation (hours)	After scheme implementation (hours)
Ahmednagar	**128**	**58**
Gindegaon	40	10
Akola	18	10
Chandur	12	10
Amravati	**65**	**21**
Chandrabazar	65	21
Bhandara	**124**	**44**
Malutola	40	24
Mohgaon	84	20
Gadchiroli	**48**	**28**
Brahmapuri	48	28
Jalgaon	**119**	**40**
Javkheda	25	4
Lonwadi Kh	24	8
Wadali	70	28
Kolhapur	**10**	**12**
Bachani	10	12
Nagpur	**21**	**14**
Bidgaon	21	14
Nashik	**75**	**38**
Thangaon	50	28
Vadner Bhairav	25	10
Osmanabad	**80**	**42**
Bavi	80	42

Circle & Panchayat	Before scheme implementation (hours)	After scheme implementation (hours)
Satara	**337**	**155**
Anewadi	21	7
Anpatwadi	18	8
Baudhan	28	28
Bnhuinj	18	5
Darwadi	19	8
Dhom	20	9
Jamb	19	8
Kavathe	19	9
Kenjal	18	8
Kikali	19	9
Kunnur	19	8
Mhatekarwadi	24	9
Nagewadi	17	8
Pachgani	29	6
Pirachiwadi	19	5
Shabag	15	11
Waghjaiwadi	15	9
Solapur	**126**	**64**
Uplai (Bk)	70	50
Uplai (Kh)	56	14
Wardha	**20**	**12**
Dhanoli	20	12
Yavatmal	**40**	**24**
Bhari	40	24
Grand Total	**1223**	**572**

Thus, there has been significant improvement in load shedding after implementation of the schemes.

5.5.3 Awareness programs conducted by gram panchayats

Following charts depict the various awareness programs conducted by gram panchayats during the last one year.

Figure 5-68: Programs on reduction of losses

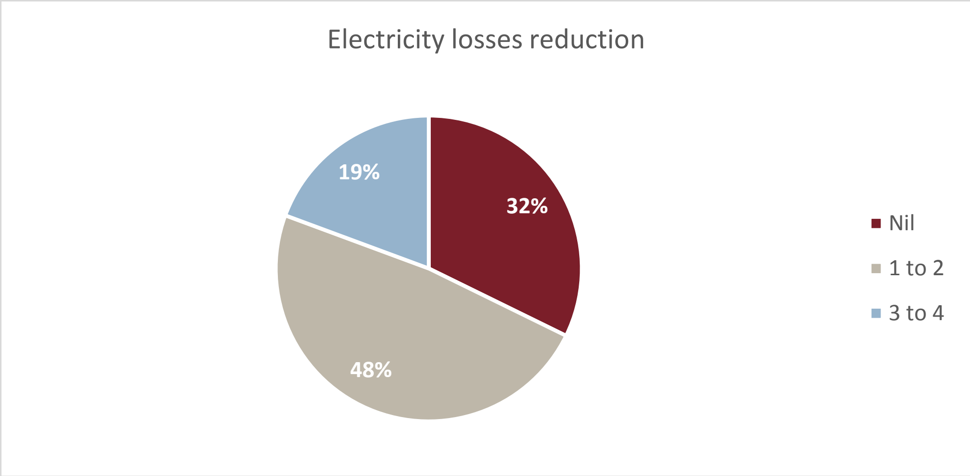


Figure 5-69: Programs on timely bill payment

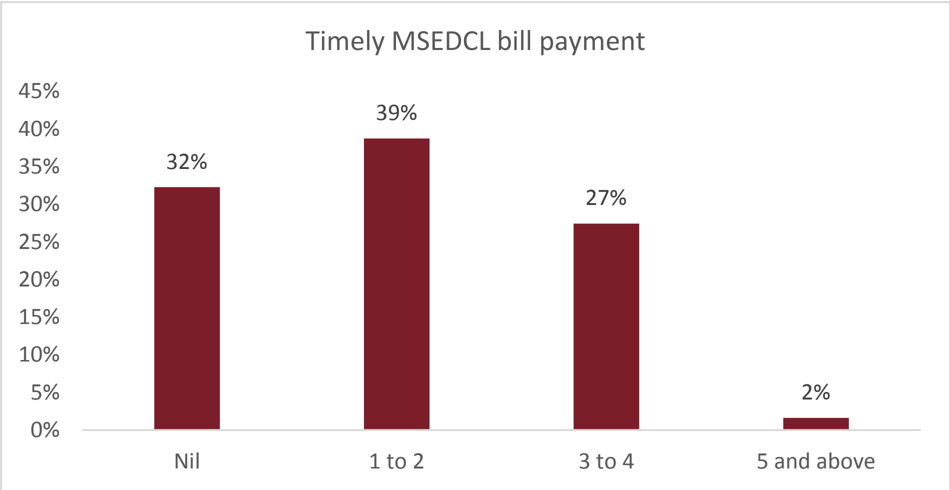
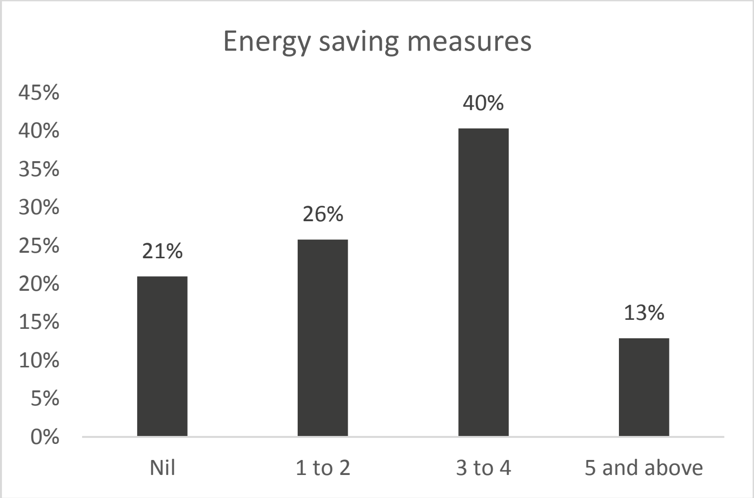


Figure 5-70: Programs on energy saving measures



Thus, most of the villages have conducted at least one program in each of the above three areas. This strongly complements MSEDCL's efforts on reduction of technical, commercial losses and better load management.

6. Key findings: Ground implementation of the schemes

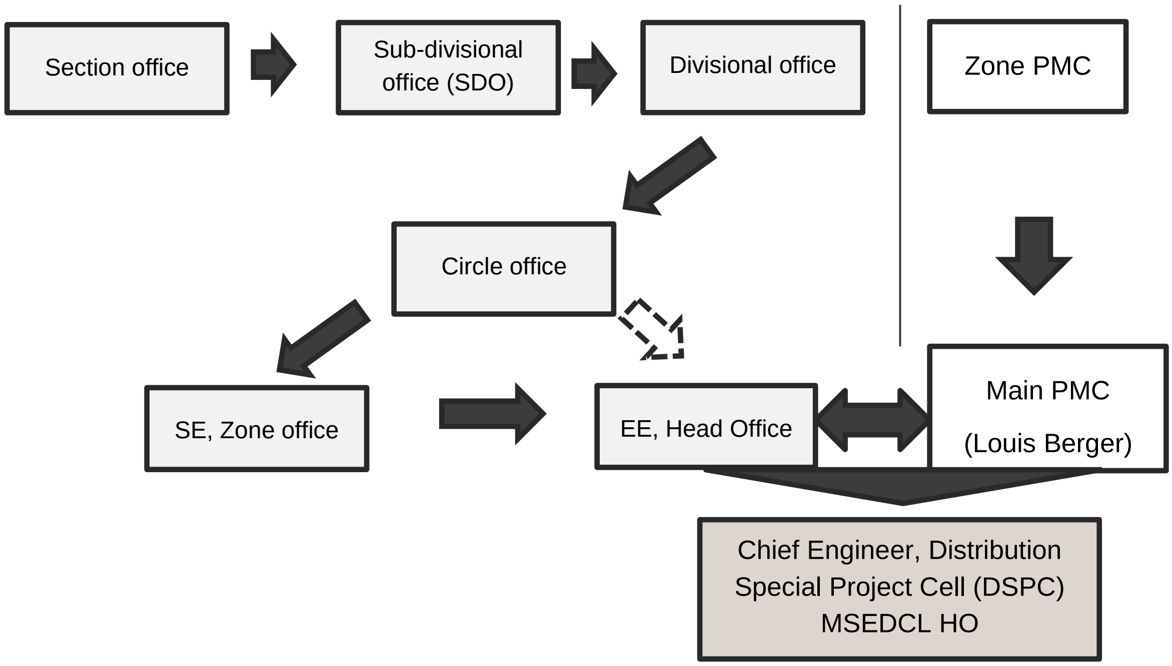
6.1 Description of various implementation aspects

The findings in this section are compiled after detailed interactions with MSEDCL officials who were involved in the implementation of the GFSS and Infrastructure Plan-I schemes. The findings described in this section cover reporting structure, roles and responsibilities, implementation issues, quality control and contractor payments.

6.1.1 Reporting structure

The reporting hierarchy has been shown in a pictorial representation below.

Figure 6-1: Reporting structure for the schemes



The reporting structure involved personnel at all levels of MSEDCL offices alongside a project management consultant (PMC). The section office was involved in ground implementation of the scheme at local level from where reporting began. The reporting ended at the office of the Chief Engineer (CE), District Project Cell office (DSPC) at the MSEDCL Head Office. Apart from the MSEDCL reporting hierarchy, the zonal PMCs reported to the main PMC which was M/s Loius Berger. The Executive Engineer (EE), MSEDCL Head Office and Louis Berger coordinated the progress reports and ultimately reported to CE, DSPC.

The schemes were also closely monitored at the state government level. Monthly meetings were conducted by the Energy Minister, GoM and the Principal Secretary with key MSEDCL officials. This shows that there was involvement from the highest level of state government on monitoring the progress of the schemes.

6.1.2 Roles and responsibilities

The major roles and responsibilities of each MSEDCL offices in the entire reporting structure has been described below.

Figure 6-2: Roles and responsibilities of MSEDCL offices

Section office	Sub-divisional office (SDO)	Divisional office (DO)	Circle office	Zonal office	Head Office
▪ Survey ▪ Quality maintenance ▪ Work completion monitoring before commissioning ▪ All ground work	▪ Major work monitoring like substations or transformers ▪ Preparation of progress reports in coordination with section office ▪ Discrepancy reporting to contractor	▪ Common meeting call for all SDOs and contractors ▪ Resolution of issues ▪ Consolidate progress reports of several SDOs	▪ Keeping track of actual field work done against fund disbursed ▪ Consolidate all DO progress reports and send to zonal office	▪ District level monitoring ▪ Major meetings often convened by CE, Zone ▪ Reporting to Head Office (HO) ▪ Attending HO meetings when required	▪ Convene monthly meetings involving officers from circle and zonal offices and contractors

The implementation of the schemes was mainly driven by officers in section offices, SDOs and DOs while the officers from circle, zonal and head offices largely monitored the scheme and were involved in high level reporting to the state government officials. The SDOs played an instrumental role in interacting with contractor on day-to-day basis and resolution of small scale issues which helped filtering out only the larger issues to be resolved by the DOs.

Certification of work completion was given after joint monitoring by Additional Engineer-Infra, SDO and contractor together. Post this, the asset was commissioned under certification from the Electrical Inspector. After commissioning, the assets were handed over to SDOs.

6.1.3 Implementation issues

The implementation of GFSS and Infrastructure Plan-I schemes did face ground level issues. These were related to land acquisition/ right of way, approvals/ permits, time and cost overruns, resources, quality of work, staff issues, administration, etc. However, most of the issues arose at the local level and were largely resolved through discussions between consumers, local contractors and section/ SDO officers. Support from the local gram panchayat offices and MLAs was also sought. Major issues like approvals and permits were resolved through coordination with the Collector’s office.

Time overrun was one of the major issues faced. Timelines were often delayed due to local issues as well as on account of issues arising at contractor and MSEDCL. GFSS Phase I being on the basis of partial turnkey, some of the critical materials were supplied by MSEDCL which resulted in lack of coordination between MSEDCL and contractor and resultant time delays. Learning from this mistake, the MSEDCL implemented the balance phases of GFSS (II, III and IV) on 100% turnkey basis which helped reduce the time overruns.

6.1.4 Quality control

MSEDCL appointed Rural Electrification Corporation (REC) as an independent quality monitoring agency for both the schemes while Power Finance Corporation (PFC) was appointed specifically for Infrastructure Plan-I. The agencies monitored the schemes during all phases of projects from initiation upto commissioning. 25% of all major works were sampled and inspected for quality issues. For example. If 12 transformers were installed, upto 3 transformers were inspected.

The quality monitoring agencies reported directly to the SE, Infrastructure at MSEDCL Head Office. This ensured independence to a large extent since the scheme implementers i.e. section, SDO and DOs were not involved.

In case of any small to medium level quality issues, letter for poor work was issued to the contractor by section office or SDOs with a copy to higher office. However, for major issues related to quality, the contracts were terminated by the Head Office.

6.1.5 Payments to contractors

During initial phases of GFSS, 70% of the contract value was paid as advance to contractors on procurement of materials. This was later changed to 70% payment be made against completion of work. Finally, during the further phases of GFSS, the payment structure was modified to 70% payment to be made after useful completion of the work i.e. putting all assets to work. The modification in payment structure ensured that the contractor was obliged to maintain quality and timelines of the work.

7. Appendix

7.1 Questionnaires for assessing impact on village and semi-urban consumers

7.1.1 Household

Project title: Evaluation study of Capital Investment in Gaothan Feeder Separation Scheme and Infrastructure Plan-I implemented by Energy Department, GoM

Project reference no.: Tender Notification No. EVL/1117/GFSS/58

Client: Directorate of Economics and Statistics, Planning Department, Government of Maharashtra

Name of the consultant: CRISIL Risk & Infrastructure Solutions Ltd.

*Note: Questions marked with * are compulsory to be answered*

Basic details

1. District*: ____________
2. MSEDCL Circle office*: ____________
3. Block/Taluka*: ____________
4. Panchayat*.________
5. Village*: ____________
6. Date of survey*: ____________
7. Name of respondent*: ____________
8. Age (in years)*: ________
9. Address: ____________
10. Contact details*: ____________
11. Your role in the household*:
    I. Earning member of family
    II. Housewife (who can also be an earning member)^
    III. Dependents
    IV. Others

    ^ Note: Housewife who is an earning member must be shown in option II
12. You are staying in the present accommodation since (mention the year): _________
13. Your household has electricity since (mention the year)*: _____________
14. Details about MSEDCL electricity connection (if there are multiple connections and the others are for other purposes i.e. farming/ shop/ office/ micro industrial unit, their details need to be captured as additional survey in the respective category and not in this survey):
    a. Sanctioned load: ____________kW
    b. Monthly electricity consumption (average): ____________ units (or kWh)
    c. Monthly electricity bill (average), please ask for the latest bill*: ____________ Rs.

d. Outstanding bill arrears (validate from the bill)*: ___________ Rs.

e. Electrical appliances*:

   i. Number of tube lights/ light bulbs: _____
   ii. Of the above, how many are CFL or LED: _____
   iii. Number of fans: ______
   iv. Do you have a TV (Yes/ No): ______
   v. Since when do you have a TV (mention the year): ______
   vi. Do you have a Fridge (Yes/ No): ______
   vii. Number of mobile phones in the household: _______
   viii. Since when does your household have a mobile phone (mention the year): ______
   ix. Do you have a Mixer (Yes/ No): ______
   x. Do you have a household chakki (ghar ghanti) (Yes/ No): ______
   xi. In case you have any solar powered equipment, please provide total capacity of all equipment (kW): ________

15. Number of members in family: ___________

16. Annual income from all sources:

a. Less than Rs. 50,000	b. Rs. 50,000 – less than Rs. 1,00,000
c. Rs. 1,00,000 – less than Rs. 2,00,000	d. Rs. 2,00,000 and above

17. Principle sources of income (if income is from multiple sources, capture the details as additional survey for the respective category (farmer, commercial/ micro-industrial unit owner, etc.)):

   I. Owning a farm
   II. Working as farm labourer
   III. Commercial Unit Owner (Can be a shop/property rentals/bank/coaching center, etc.)
   IV. Salaried person (may be in organized sector or in shops)
   V. Micro industrial units (chakki, food processing (papd, pickles), etc.)
   VI. Self employed
   VII. Any other

Socio-economic impact

1. Do you know about each of the two schemes (i) Swatantra Gaothan Vaahini Yojana/ Gaothan Feeder Separation Scheme and (ii) Payabhoot Suvidha Vikas/ Infrastructure Plan mentioned above*

a. Both schemes	b. One of the schemes
c. None of the schemes	--

2. Are you being subjected to load shedding (Yes/ No)*: _____

3. If the answer to previous question is Yes, what is the present load shedding pattern*:

i. Days of the week: ___________

ii. Start time of the day (24 hour format): ________ hours

iii. End time of the day (24 hour format): ________ hours

4. What are your issues/ complaints/ suggestions regarding load shedding

____

5. This is not a question but an awareness message which needs to be conveyed to the respondent*: Please note that load shedding is linked to consumers paying their bills on time and incidences of theft of electricity remaining under check. By paying your bills on time and ensuring that there is no theft of electricity, you can contribute to reducing load shedding in your village.

6. We are trying to assess impact of the above mentioned schemes on quality of electricity supply and social and economic aspects of your life. These schemes were implemented starting from the year 'x' (please get data on 'x' from CRISIL. If 'x' is not available, use a value of **2008**)*

No.	Parameter	Before 'x'	Present day
i	Number of lights in the household		
ii	Number of Televisions in the household		
iii	Number of Mobile phones in the household		
iv	Number of mixer in the household		
v	Number of ghar ghanti in the household		
vi	Load shedding duration in a week (hours)		
vii	What time of night do you sleep (PM)		
viii	Are children studying outside the house due to electricity issues (Always/ Sometimes/ Never)?		
ix	Do you have opportunities for earning income due to electricity in the house (Many/ Some/ None)		
x	Is the lighting adequate enough for family members to feel safe and secure within the house ... especially females? (Yes/ To some extent/ No)?		

7. Do you think there was any discrimination in implementation of these schemes within the village with certain consumers/ areas getting more benefit than others? Please ignore aspects like accessibility issues, theft prone areas, etc. Please describe in detail:

____

8. Please list top 3 challenges that you face related to electricity:

a. ____

b. ____

c. ____

9. Please list top 3 suggestions for MSEDCL/ Govt. of Maharashtra that can help improve your experience with electricity:

a. ____

b. ____

c. ____

10. Signature of respondent or thumb impression*: __________

7.1.2 Commercial/ micro industrial units

*Note: Questions marked with * are compulsory to be answered*

Basic details

1. District*: ___________
2. MSEDCL Circle office*: ___________
3. Block/Taluka*: ___________
4. Panchayat*._______
5. Village*: ___________
6. Date of survey*: ___________
7. Name of respondent*: ___________
8. Age (in years)*: _______
9. Address of the unit: ___________
10. Contact details*: ___________
11. Name of the unit: ________
12. Type of the unit* (eg: kirana store, restaurant, barber shop, flour mill, etc.): _________
13. Your role in the shop: Owner/ Employee *:
14. This unit is operational since (mention the year): ________
15. Your unit has electricity since (mention the year)*: ____________
16. Details about MSEDCL electricity connection:
    a. Sanctioned load: ___________kW
    b. Monthly electricity consumption (average): ___________ units (or kWh)
    c. Monthly electricity bill (average), please ask for the latest bill*: ___________ Rs.
    d. Outstanding bill arrears (validate from the bill)*: ___________ Rs.
    e. Electrical appliances*:

i. Number of tube lights/ light bulbs: _____
ii. Of the above, how many are CFL or LED: _____
iii. Number of fans: ______
iv. Number of industrial motors: _____
v. Total capacity of industrial motors (HP) : _____
vi. Number of electrically operated water pumps: _____
vii. Total capacity of electrically operated water pumps (HP) : _____
viii. Do you have a TV (Yes/ No): ______
ix. Since when do you have a TV (mention the year): ______
x. In case you have any solar powered equipment, please provide total capacity of all equipment (kW): ________

17. Number of employees in the unit: ___________
18. Annual income:

a. Less than Rs. 1,00,000	b. Rs. 1,00,000 – less than Rs. 3,00,000
c. Rs. 3,00,000 – less than Rs. 5,00,000	d. Rs. 5,00,000 and above

Economic impact

1. Do you know about each of the two schemes (i) Swatantra Gaothan Vaahini Yojana/ Gaothan Feeder Separation Scheme and (ii) Payabhoot Suvidha Vikas/ Infrastructure Plan mentioned above*

a. Both schemes	b. One of the schemes
c. None of the schemes	--

2. Are you being subjected to load shedding (Yes/ No)*: _____

3. If the answer to previous question is Yes, what is the present load shedding pattern*:
   i. Days of the week: ___________
   ii. Start time of the day (24 hour format): ________ hours
   iii. End time of the day (24 hour format): ________ hours

4. What are your issues/ complaints/ suggestions regarding load shedding

   ____

5. This is not a question but an awareness message which needs to be conveyed to the respondent*: Please note that load shedding is linked to consumers paying their bills on time and incidences of theft of electricity remaining under check. By paying your bills on time and ensuring that there is no theft of electricity, you can contribute to reducing load shedding in your village.

6. We are trying to assess impact of the above mentioned schemes on quality of electricity supply and economic aspects of your business. These schemes were implemented starting from the year ‘x’ (please get data on ‘x’ from CRISIL. If ‘x’ is not available, use a value of **2008**)*

No.	Parameter	Before ‘x’	Present day
i	Number of lights in the unit		
ii	Number of fans in the unit		
iii	Number of industrial motors & electrically operated water pumps in the unit		
iv	Load shedding duration in a week (hours)		
v	Number of hours that the unit is operational		
vi	What kind of role would electricity play in your decision to expand size/ capacity of the unit, employ more people or offer more services to your customers (Strong enabler/ Moderate enabler/ No role/ Moderate hindrance/ Strong hindrance)?		
vii	If the answer to above question is hindrance, please describe further		
viii	Is the lighting adequate enough to ensure security within the unit (Yes/ To some extent/ No)?		

7. Do you think there was any discrimination in implementation of these schemes within the village with certain consumers/ areas getting more benefit than others? Please ignore aspects like accessibility issues, theft prone areas, etc. Please describe in detail:

   ____

8. Please list top 3 challenges that you face related to electricity:
   a. ____
   b. ____
   c. ____

9. Please list top 3 suggestions for MSEDCL/ Govt. of Maharashtra that can help improve your experience with electricity:
   a. ____
   b. ____
   c. ____

Signature of respondent or thumb impression*: __________

7.1.3 Farmers

*Note: Questions marked with * are compulsory to be answered*

Basic details

1. District*: ___________
2. MSEDCL Circle office*: ___________
3. Block/Taluka*: ___________
4. Panchayat*._______
5. Village*: ___________
6. Date of survey*: ___________
7. Name of respondent*: ___________
8. Age (in years)*: _______
9. Address of the farm: ___________
10. Size of the farm (acres): ________
11. Contact details*: ___________
12. Your role in the farm: Owner/ Managing on contract basis/ Employee *:
13. This farm is operational since (mention the year): ________
14. Your farm has electricity since (mention the year)*: ____________
15. Which crop/crops are cultivated?*: _________
16. Details about MSEDCL electricity connection:
    a. Sanctioned load: ___________kW
    b. Type of connection (metered/ unmetered): __________
    c. Monthly electricity consumption (average): ___________ units (or kWh)
    d. Monthly electricity bill (average), please ask for the latest bill*: ___________ Rs.
    e. Outstanding bill arrears (validate from the bill)*: ___________ Rs.
    f. Electrical appliances*:
        i. Number of electrically operated water pumps: _____
        ii. Total capacity of electrically operated water pumps (HP) : _____
        iii. Of the above pumps, how many are solar ones: _____
        iv. Of the above pumps, amongst non-solar ones, how many are energy efficient ones: _____
        v. In case the farmer does not have any energy efficient pump or solar pump, please ask the following two questions:
            1. Are you aware of energy efficient pump? (Yes/ No): _______ Have officials from MSEDCL approached you about such a pump? (Yes/ No): ________
            2. Will you be willing to use a subsidized solar pump instead of the present electricity based pump (Yes/ No)? ________How much would you be willing to pay to buy such a pump? Note that running cost of such a pump will be very less as compared to existing pump. Rs. ________
        vi. When did you purchase the first electrically operated pump (mention the year): ______
        vii. Have you refurbished the pump yet? (Yes/ No): _______ If yes, what was the original pump size in HP? : _________HP

viii. Other equipment working on electricity (please name each equipment): _______

17. Number of employees in the farm: ___________

18. Annual income:

a. Less than Rs. 1,00,000	b. Rs. 1,00,000 – less than Rs. 3,00,000
c. Rs. 3,00,000 – less than Rs. 5,00,000	d. Rs. 5,00,000 and above

Economic impact

1. Do you know about each of the two schemes (i) Swatantra Gaothan Vaahini Yojana/ Gaothan Feeder Separation Scheme and (ii) Payabhoot Suvidha Vikas/ Infrastructure Plan mentioned above*

a. Both schemes	b. One of the schemes
c. None of the schemes	--

2. When is electricity supplied to you*:
   i. Days of the week: ___________
   ii. Start time of the day (24 hour format): ________ hours
   iii. End time of the day (24 hour format): ________ hours

3. What are your issues/ complaints/ suggestions regarding the way electricity is supplied to you:

   ____

4. This is not a question but an awareness message which needs to be conveyed to the respondent*: Please note that load shedding is linked to consumers paying their bills on time and incidences of theft of electricity remaining under check. By paying your bills on time and ensuring that there is no theft of electricity, you can contribute to reducing load shedding in your village.

5. We are trying to assess impact of the above mentioned schemes on quality of electricity supply and economic aspects of your business. These schemes were implemented starting from the year 'x' (please get data on 'x' from CRISIL. If 'x' is not available, use a value of **2008**)*

No.	Parameter	Before 'x'	Present day
i	Number of water pumps in the farm		
ii	Total capacity of pumps in the farm (HP)		
iii	Number of other electricity run equipment in the farm		
iv	Power supply duration in a week (hours)		
v	How many hours do you run the pump (hours)		
vi	Types of crops grown		
vii	What kind of role would electricity play in your decision to expand size of the farm, take up more		

No.	Parameter	Before 'x'	Present day
	crops or employ more people (Strong enabler/ Moderate enabler/ No role/ Moderate hindrance/ Strong hindrance)?		
viii	If the answer to above question is hindrance, please describe further		
ix	Do you have opportunities for earning extra income (eg: livestock rearing, dairy, etc.) due to electricity in the farm (Many/ Some/ None)		

6. Do you think there was any discrimination in implementation of these schemes within the village with certain consumers/ areas getting more benefit than others? Please ignore aspects like accessibility issues, theft prone areas, etc. Please describe in detail:

    ____

7. Please list top 3 challenges that you face related to electricity:
    a. ____
    b. ____
    c. ____

8. Please list top 3 suggestions for MSEDCL/ Govt. of Maharashtra that can help improve your experience with electricity:
    a. ____
    b. ____
    c. ____

9. Signature of respondent or thumb impression*: __________

7.1.4 Schools

*Note: Questions marked with * are compulsory to be answered*

Basic details

1. District*: ___________
2. MSEDCL Circle office*: ___________
3. Block/Taluka*: ___________
4. Panchayat*._______
5. Village*: ___________
6. Date of survey*: ___________

7. Name of respondent*: ___________
8. Age (in years)*: _______
9. Address of school: ___________
10. Contact details*: ___________
11. Your role in the school* (Owner/ Principal/ Administrator/ Teacher): ________
12. This school has been established since (mention the year): ________
13. This school has electricity since (mention the year)*: ____________
14. Ownership of school (Government/ Private/ Others): ______
15. Nature of government support (Fully aided/ Semi-aided/ Fully autonomous): ________
16. Details about MSEDCL electricity connection:
    a. Sanctioned load: ___________kW
    b. Monthly electricity consumption (average): ___________ units (or kWh)
    c. Monthly electricity bill (average), please ask for the latest bill*: ___________ Rs.
    d. Outstanding bill arrears (validate from the bill)*: ___________ Rs.
    e. Electrical appliances*:
        i. Number of tube lights/ light bulbs: _____
        ii. Of the above, how many are CFL or LED: _____
        iii. Number of fans: ______
        iv. Number of Computers: ______
        v. Since when do you have a Computer (mention the year): ______
        vi. In case you have any solar powered equipment, please provide total capacity of all equipment (kW): ________
17. Number of students presently enrolled in the school*: ___________
18. Number of classrooms*: __________

Socio-economic impact

1. Do you know about each of the two schemes (i) Swatantra Gaothan Vaahini Yojana/ Gaothan Feeder Separation Scheme and (ii) Payabhoot Suvidha Vikas/ Infrastructure Plan mentioned above*

a. Both schemes	b. One of the schemes
c. None of the schemes	--

2. Are you being subjected to load shedding (Yes/ No)*: _____

3. If the answer to previous question is Yes, what is the present load shedding pattern*:
    i. Days of the week: ___________
    ii. Start time of the day (24 hour format): ________ hours
    iii. End time of the day (24 hour format): ________ hours

4. What are your issues/ complaints/ suggestions regarding load shedding

____

5. This is not a question but an awareness message which needs to be conveyed to the respondent*: Please note that load shedding is linked to consumers paying their bills on time and incidences of theft of electricity remaining under check. By paying your bills on time and ensuring that there is no theft of electricity, you can contribute to reducing load shedding in your village.

6. We are trying to assess impact of the above mentioned schemes on quality of electricity supply and social and economic outcomes. These schemes were implemented starting from the year 'x' (please get data on 'x' from CRISIL. If 'x' is not available, use a value of **2008**)*

No.	Parameter	Before 'x'	Present day
i	Number of lights in the school		
ii	Number of fans in the school		
iii	Number of computers in the school		
iv	Load shedding duration in a week (hours)		
v	Number of hours that the school operates daily (hours)		
vi	Number of students enrolled		
vii	Student attendance percentage		
viii	What kind of role would electricity play in your decision to expand size of the school, take up more students or employ more teachers (Strong enabler/ Moderate enabler/ No role/ Moderate hindrance/ Strong hindrance)?		
ix	If the answer to above question is hindrance, please describe further		

7. Do you think there was any discrimination in implementation of these schemes within the village with certain consumers/ areas getting more benefit than others? Please ignore aspects like accessibility issues, theft prone areas, etc. Please describe in detail:

____

8. Please list top 3 challenges that you face related to electricity:

   a. ____

   b. ____

   c. ____

9. Please list top 3 suggestions for MSEDCL/ Govt. of Maharashtra that can help improve your experience with electricity:

    a. ____

    b. ____

    c. ____

Signature of respondent or thumb impression*: __________

7.1.5 Hospitals

*Note: Questions marked with * are compulsory to be answered*

Basic details

1. District*: ___________
2. MSEDCL Circle office*: ___________
3. Block/Taluka*: ___________
4. Panchayat*._______
5. Village*: ___________
6. Date of survey*: ___________
7. Name of respondent*: ___________
8. Age (in years)*: _______
9. Address of hospital: ___________
10. Contact details*: ___________
11. Your role in the hospital* (Owner/ Administrator/ Doctor): ________
12. This hospital has been established since (mention the year): ________
13. This hospital has electricity since (mention the year)*: ____________
14. Ownership of hospital (Government/ Private/ Others): ______
15. Details about MSEDCL electricity connection:
    a. Sanctioned load: ___________kW
    b. Monthly electricity consumption (average): ___________ units (or kWh)
    c. Monthly electricity bill (average), please ask for the latest bill*: ___________ Rs.
    d. Outstanding bill arrears (validate from the bill)*: ___________ Rs.
    e. Electrical appliances*:
        i. Number of tube lights/ light bulbs: _____
        ii. Of the above, how many are CFL or LED: _____
        iii. Number of fans: ______
        iv. Number of fridge: ______
        v. Number of UPS/ inverters: _______

vi. Total capacity of UPS/ inverters (kVA): _______

vii. Number of electrically operated medical equipment: ______

viii. Since when do you have electrically operated medical equipment (mention the year): ______

ix. In case you have any solar powered equipment, please provide total capacity of all equipment (kW): ________

16. Number of beds in the hospital (average)*: ___________
17. If there are no beds, then number of patients consulted per day (average)*: ______
18. What is the charge for first consulting in the OPD (Rs.): _______
19. Annual income:

a. Less than Rs. 1,00,000	b. Rs. 1,00,000 – less than Rs. 3,00,000
c. Rs. 3,00,000 – less than Rs. 5,00,000	d. Rs. 5,00,000 and above

Socio-economic impact

1. Do you know about each of the two schemes (i) Swatantra Gaothan Vaahini Yojana/ Gaothan Feeder Separation Scheme and (ii) Payabhoot Suvidha Vikas/ Infrastructure Plan mentioned above*

a. Both schemes	b. One of the schemes
c. None of the schemes	--

2. Are you being subjected to load shedding (Yes/ No)*: _____

3. If the answer to previous question is Yes, what is the present load shedding pattern*:

   i. Days of the week: ___________

   ii. Start time of the day (24 hour format): ________ hours

   iii. End time of the day (24 hour format): ________ hours

4. What are your issues/ complaints/ suggestions regarding load shedding

   ____

5. This is not a question but an awareness message which needs to be conveyed to the respondent*: Please note that load shedding is linked to consumers paying their bills on time and incidences of theft of electricity remaining under check. By paying your bills on time and ensuring that there is no theft of electricity, you can contribute to reducing load shedding in your village.

6. We are trying to assess impact of the above mentioned schemes on quality of electricity supply and social and economic outcomes. These schemes were implemented starting from the year ‘x’ (please get data on ‘x’ from CRISIL. If ‘x’ is not available, use a value of **2008**)*

No.	Parameter	Before 'x'	Present day
i	Number of lights in the hospital		
ii	Number of fans in the hospital		
iii	Number of fridge in the hospital		
iv	Number of electrically operated medical equipment in the school		
v	Load shedding duration in a week (hours)		
vi	Number of hours that the hospital operates daily (hours)		
vii	Number of beds or Number of patients consulted per day		
viii	What kind of role would electricity play in your decision to expand size of the hospital, increase treatment services or employ more staff (Strong enabler/ Moderate enabler/ No role/ Moderate hindrance/ Strong hindrance)?		
ix	If the answer to above question is hindrance, please describe further		
x	Is the lighting adequate enough for staff and patients to feel safe and secure within the hospital... especially females and elderly? (Yes/ To some extent/ No)?		

7. Do you think there was any discrimination in implementation of these schemes within the village with certain consumers/ areas getting more benefit than others? Please ignore aspects like accessibility issues, theft prone areas, etc. Please describe in detail:

____

8. Please list top 3 challenges that you face related to electricity:

   a. ____

   b. ____

   c. ____

9. Please list top 3 suggestions for MSEDCL/ Govt. of Maharashtra that can help improve your experience with electricity:

   a. ____

   b. ____

c. ____

10. Signature of respondent or thumb impression*: __________

7.1.6 Gram Panchayats

*Note: Questions marked with * are compulsory to be answered*

Basic details

*There are **two** key persons in each Gram panchayat and we should try to interview both of them. One is a Member who is mostly a Sarpanch and the other is Gram Sewak who is an employee of the Government of Maharashtra. Also when approaching each village, try to interview the Gram Panchayat first – this will facilitate interviews with other respondents in the village.*

1. District*: ___________
2. MSEDCL Circle office*: ___________
3. Block/Taluka*: ___________
4. Panchayat*._______
5. Village*: ___________
6. Date of survey*: ___________
7. Name of respondents*: ___________
8. Designations (please try to interview the Member and Gram Sewak together) *: ________
9. Age (in years)*: _______
10. Address of panchayat office: ___________
11. Contact details*: ___________
12. Since when have you been associated with the Panchayat (mention the year)*: ________
13. Details about MSEDCL connection*:
    a. Number of connections: ____
    b. List all the connections (street lighting, water pumping, gram panchayat office building): ________
    c. For each of the above connections, provide the arrears amount from latest bill (ask respondent to share the bill and validate):
        i. Street lighting: Rs. _______
        ii. Water pumping: Rs. _______
        iii. Gram panchayat office building: Rs. _______
        iv. Any other connection: Rs. _______
    d. Please describe the mode of payment of bills … how much is shared between Gram Panchayat office and Government of Maharashtra? What are the timelines in which the Government releases its share? _____________________

Socio-economic impact

1. Do you know about each of the two schemes (i) Swatantra Gaothan Vaahini Yojana/ Gaothan Feeder Separation Scheme and (ii) Payabhoot Suvidha Vikas/ Infrastructure Plan mentioned above*

a. Both schemes	b. One of the schemes

c. None of the schemes	--

2. Are you aware about the concept of electricity losses? This is the difference of electricity supplied to the village by MSEDCL and electricity consumed by all consumers (Yes/ No): _______

3. If answer to above question is yes, what are the present level of electricity losses in the village as a percentage of the electricity supplied by MSEDCL (%): ______

4. What is the present load shedding pattern in the village*:
   i. Agriculture feeder ("Vaahini"):
      a. Days of the week: ___________
      b. Start time of the day (24 hour format): ________ hours
      c. End time of the day (24 hour format): ________ hours
   ii. Non-agriculture feeder ("Vaahini"):
      a. Days of the week: ___________
      b. Start time of the day (24 hour format): ________ hours
      c. End time of the day (24 hour format): ________ hours

5. What are your issues/ complaints/ suggestions regarding load shedding across the village:

   ____

6. This is not a question but an awareness message which needs to be conveyed to the respondent*: Please note that load shedding is linked to consumers paying their bills on time and incidences of theft of electricity remaining under check. By paying your bills on time and ensuring that there is no theft of electricity, you can contribute to reducing load shedding in your village.

7. We are trying to assess impact of the above mentioned schemes on quality of electricity supply and social and economic outcomes. These schemes were implemented starting from the year 'x' (please get data on 'x' from CRISIL. If 'x' is not available, use a value of **2008**)*

No.	Parameter	Before 'x'	Present day
i	Number of street lights in the village		
ii	Load shedding duration in a week (hours)		
iii	Is the lighting adequate enough for villagers to feel safe and secure within the village ... especially females and elderly? (Yes/ To some extent/ No)?		

8. How many communication programs have you carried out during the last 1 year in following areas:

a. Electricity losses reduction: _____

b. Timely MSEDCL bill payment: ______

c. Energy saving measures: ______

9. Do you think there was any discrimination in implementation of these schemes within the village with certain consumers/ areas getting more benefit than others? Please ignore aspects like accessibility issues, theft prone areas, etc. Please describe in detail:

____

10. Please list top 3 challenges that you face related to electricity:

a. ____

b. ____

c. ____

11. Please list top 3 suggestions for MSEDCL/ Govt. of Maharashtra that can help improve your experience with electricity:

a. ____

b. ____

c. ____

12. Signature of respondent or thumb impression*: __________

7.2 Questionnaire for assessing issues faced during ground implementation of the schemes

- Circle Name:____________
- Respondent Name:___________
- Designation:____________
- Office Address:______________
- Respondent's role in GFSS & Infrastructure Plan:______________
- Respondent's role in which circle:______________

Questions to be asked

1. What was the overall organization structure to implement the scheme at circle level (GFSS and Infrastructure Plan-I)? Who were heading the schemes? Who were reporting to him? What were the major responsibilities of the key persons?
2. Do you think the above organization structure facilitated implementation of the scheme or proved to be hindrance in implementation? How?
3. Was there any specific instruction set/ manual from HQ to implement these projects?
4. How the progress of the scheme was reported to HQ?
   - Who were responsible?
   - What was the frequency of reporting?
   - What was the format in which progress was reported? Which KPIs were covered?
5. What were the major challenges faced during implementation?
   - Land acquisition/ right of way,
   - approvals & permits,
   - project cost and time overruns,
   - resources issues,
   - quality of work,
   - people issues,
   - admin aspects, etc.
   - safety
6. Were all the timelines met? If not, wat were the reasons?
7. What kind of support you got from HQ? If you did not get expected support, what were your expectations?
8. Was there any consultant/third party to supervise the quality?
9. Was the project handed over to MSEDCL immediately after implementation?

Data Requirements

- If possible, please share few copies of the progress report.

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