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Efficiency of Electricity Distribution: A Micro Level Data Envelopment Analysis in Odisha

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Abstract

This paper measures the relative efficiency of 72 electricity distribution divisions (DDs) in Odisha by using a non-parametric approach to frontier analysis. Input oriented data envelopment analysis (DEA) is applied to evaluate the efficiency of these DDs during 2018-19. The results show that there is existence of overall inefficiency in the majority of electricity divisions. The inefficiencies are mainly due to their technical inefficiency rather than scale inefficiency. The paper has identified 'most inefficient' DDs, which require special attention by the regulators and management in order to increase efficiency by benchmarking them against the most efficient electricity divisions in the state. The paper has also worked out the returns to scale and estimated most productive scale size of the inefficient distribution divisions. This would help the management to take steps for enhancing efficiency of the inefficient distribution divisions and optimise the electricity use in the state.

Key words: Efficiency, electricity distribution division, benchmarking, data envelopment analysis, most productive scale size, Odisha

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NB: The views expressed in the paper are those of the authors and not the institutions they belong.

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1. Introduction

Electricity is one of the major inputs for economic development of a country. It is the convenient, efficient, versatile forms of commercial energy and is therefore considered as the backbone of industrial and agricultural growth. In terms of production India is the third largest producer of electricity. In the recent times India has catapulted to be the fourth largest electricity consuming country. The demand for electricity in the country is driven by sustained economic growth and the thrust to provide continuous power to all. The thrust of the government for electric vehicle transportation to reduce fossil fuel dependence will contribute significantly to the growth of electricity demand. The increased economic activities requires robust manufacturing sector and through Government of India flagship programmes such as 'Make in India' will also significantly spike the demand for electricity. India's current generation capacity is about 350 GW and an additional 225 GW of renewable energy is expected to be integrated into the grid in another four to five years.

In the context of rapidly growing demand for electricity therefore the electricity utilities are required to operate and manage their industries in an efficient way in order to utilize optimum use of existing resources. In spite of reform of the sector, India at present is facing huge aggregate transmission and distribution (AT&C) loss (21.86%), which is much higher than the other emerging countries like China, South Africa, Russia and Brazil. The transmission and distribution losses (T&D) averagely also exceed 22% of total power generated in India which is almost 2.5 times of the world average. The AT&C losses can be attributed to several reasons such as geographical constraint to reach large rural consumers, predominantly low voltage consumers, inadequate investment in distribution system, unmetered and improper billing, collection inefficiency and high pilferage.

The factors such as geographical constraint and predominance of low voltage consumers cannot be controlled but through proper investment and efficient functioning in metering, billing and collection the distribution companies can significantly reduce losses and enhance revenue. The efficiency of electricity distribution utilities depends on the efficiency of distribution at micro level (i.e. division level). Therefore, there is a need to examine the efficiency of distribution divisions to improve the efficiency of distribution utilities.

This paper makes an attempt to examine the efficiency of electricity utility at the division level in Odisha, which is the pioneering state in India to enter into electricity reform in 1995. Until 1995, all the functional segments of the electricity, generation, transmission and distribution were managed by the erstwhile monolithic Odisha State Electricity Board (OSEB). However, over the years OSEB could not live up to the expectations of consumers on growing needs of electricity, maintaining minimum service requirements and a competitive tariff. It dismally failed in operational and financial performance and was dependent on the state government subvention to compensate for mounting losses. There was high transmission and distribution (T&D) loss. In order to overcome these problems, Odisha embarked upon the process of electricity reforms in 1995 with the enactment of Odisha Electricity Reforms Act (Meher and Sahu 2013). As a part of Reform, the OSEB was unbundled and different corporatized entities were created on functional line. To manage hydro generation Orissa Hydro Power Generation Corporation (OHPC) was created, Grid Corporation of Orissa (GRIDCO) and Orissa Power Transmission Company (OPTCL) were created to manage transmission business. In the distribution segment four distribution companies (DISCOMs) were created on geographical lines, viz. Central Electricity Supply Utility (CESU), Northern Electricity Supply Company (NESCO), Southern Electricity Supply Company (SOUTHCO) and Western Electricity Supply Company (WESCO). These four distribution companies were privatised in 1999 through sale of 51% of equity of the companies to the private players to manage the distribution business.

Despite the reform, the T&D loss still remains at an unsustainable level after two decades of reform. Even though Odisha has the experience of two decades of privatisation of electricity distribution utilities, the utilities are found to be relatively inefficient among the distribution utilities of 17 unbundled states in India (Meher and Sahu 2016). There is still high level of distribution loss in Odisha with higher loss at low tension (LT) level compared with the high tension (HT) level. The loss at LT level varies significantly among the distribution divisions, i.e. from 1.35 per cent to 60 per cent, during 2018-19 (OERC, 2019). The high distribution loss at LT level and its large variation not only shows the poor performance of the distribution utilities but also is a serious concern for the electricity sector in Odisha.

The lack of proper benchmarking method for electricity distribution utilities in Odisha is a major handicap for their top management. The electricity distribution companies lack methodology to identify such divisions which need proper attention for improvements. There has to be a continuous mechanism to observe progress and to make an intra-division comparison for proper assessment of the underlying problem. Benchmarking can help them to compare a low performing division with the best performing division in order to develop right strategies for improvement and to achieve desired targets. Therefore, there is a need to examine the efficiency of distribution divisions in Odisha in order to suggest for sustainable development of electricity sector.

The efficiency of electricity distribution utilities is examined by a number of studies. Some of the earlier studies examining efficiency of electricity distribution utilities include Hjalmarsson and Veiderpass (1992) in Sweden, Miliotis (1992) in Greek, Bagdadioglu et al. (1996) in Turkey, Lo et al. (2001) in Taiwan, Pahwa et al. (2002) in USA, Meenakumari and Kamaraj (2008) and Meher and Sahu (2016) in India. However, these studies mostly examine the relative efficiencies of distribution utilities at macro level. Very few studies have examined the distribution efficiencies at micro level. The only micro level study in India the authors have come across is that of Yadav et al. (2010). They have examined the efficiency of electricity distribution divisions at intra-state level in Uttarakhand. They found scope for the improvement of overall efficiency in many divisions and identified particular areas to be improved for overall efficiency enhancement.

Based on the above background, this paper provides a comparative assessment of efficiency of electricity distribution divisions at LT level in Odisha using data envelopment analysis (DEA). The paper is organised as follows. After a brief introduction in section one, section two presents an overview and challenges of electricity distribution in Odisha. Section three presents the methodological aspects and data used in the present study, while section four presents the results and discussion. Section five gives the concluding remarks and policy implications.

2. Overview and Challenges of Electricity Distribution in Odisha

The electricity distribution in Odisha carried out by four distribution utilities spreads over four different geographical zones of the state. The coverage of LT customers of these distribution utilities (DUs) varies from 17.16 lakhs in NESCO to 25.32 lakhs in CESU during 2018-19. These DUs cumulatively purchased 14753 MU of electricity and sold 10152 MU to LT consumers during 2018-19, with a distribution loss of 29.18 per cent. The LT distribution loss was highest in the case of CESU (32.95%), followed by SOUTHCO (30.85%), NESCO

(27.08%) and WESCO (24.86%). In all the DISCOMs, about 50 per cent LT divisions have distribution loss above 30.22 per cent, with 65 per cent in CESU, 37.50 per cent in NESCO, 47.37 per cent in SOUTHCO and 41.18 per cent in WESCO (Table 1).

The high distribution loss is a great concern as the bulk of the electricity generated in the state is through thermal power using coal, which emits carbon dioxide leading to the environmental pollution and climate change. Reducing distribution loss will not only help to save the electricity, but also enhance revenue for the system, better consumer services and reduce tariff. Therefore, the challenge of the electricity distribution utilities in Odisha is to reduce the loss of electricity and supply the same quantity of electricity to the consumers without affecting welfare. In order to do this, it is required to locate the inefficient divisions and benchmark them against the relatively efficient electricity divisions. This paper has made an attempt in this direction.

3. Methodology and Data

3.1. Methodology

The efficiency of electricity distribution utilities is mostly examined by using data envelopment analysis (DEA) technique. Among the different techniques for performance efficiency evaluation, it has got much attention in recent times (Zhou et al., 2008). It is accepted worldwide as one of the major frontier techniques for benchmarking energy sector, more particularly electricity sector (Abbott, 2005; Jamasb & Pollitt, 2001). A commonly used DEA technique developed by Charnes et al. (1978), called the CCR model, has been used extensively to estimate measures of efficiency in a range of industries (Cooper et al. 2000). Moreover, European countries have been increasingly adopting this approach for benchmarking and performance improvement since 1997 (Bogetoft & Otto, 2011).

The present study has followed input-orientation CRS model, which considers the output to be fixed so that the input could be adjusted in order to maximize efficiency. For every inefficient decision making units (DMU), DEA identifies a set of corresponding efficient units that can be utilized as benchmarks for improvements. The benchmarks can be obtained from the dual problem using the model developed by Charnes et al. (1978) as follows.

$$\min_{\lambda_j,\theta} \theta$$

Subject to

$$\sum_{j=1}^{n} \lambda_j x_{ij} \le \theta x_{io} \qquad i = 1,2,\ldots,m \tag{1}$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \ge y_{ro} \qquad r = 1,2,\ldots,s$$

$$\lambda_j \ge 0, \quad j = 1,2,\ldots,n$$

where x_{ij} and y_{rj} represent the observed values for the i= 1,....,m inputs and r= 1,.....,s outputs for each of the j= 1,......, n DMUs. λ_j is the weight of jth unit in the reference point for the assessed unit o, and θ is the efficiency rating for the assessed unit.

The above efficiency evaluation however ignores the presence of non-zero slacks and can be referred to as weak efficiency. We have therefore used two stage DEA process to calculate the efficiency score and slack value. In the first stage, maximal reduction of inputs is achieved via the optimal θ; and in the second stage, movement onto the efficient frontier is achieved via optimizing the slack variables. The two-stage DEA process involved in the following model is used here.

$$\min \theta_0 - \varepsilon\left(\sum_{i=1}^{m} s_{i0}^{-} + \sum_{r=1}^{s} s_{r0}^{+}\right) \tag{2}$$

Subject to

$$\sum_{j=1}^{n} \lambda_j x_{ij} + s_{i0}^{-} = \theta_0 x_{io}, \qquad i = 1,2,\ldots,m$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} - s_{r0}^{+} = y_{ro} \qquad r = 1,2,\ldots,s$$

$$\lambda_j, s_{i0}^{-}, s_{r0}^{+}, \theta_0 \ge 0,$$

where s_{i0}^{-} and s_{r0}^{+} are slack vectors that indicate, respectively, the input excess and the output shortfall.

To determine the pure technical efficiency scores, VRS model presented by Banker et al. (1984), called BCC model, has been used which assumes a further convexity constraint, i.e., $\sum_{j=1}^{n} \lambda_j = 1$. Here the reference unit is expected to exhibit constant returns to scale. The variable introduced into the convexity constraint also brings out the value of increasing or decreasing returns to scale. The reference unit is expected to exhibit increasing returns to scale if $\sum_{j=1}^{n} \lambda_j < 1$, and decreasing returns to scale if $\sum_{j=1}^{n} \lambda_j > 1$.

The scale efficiency score is calculated by taking the ratio of overall efficiency score to pure technical efficiency score. If the scale efficiency score for jth unit is equal to one, then the unit is operating at most productive scale size (MPSS), i.e. optimal scale or constant returns to scale (Banker 1984). On the other hand, if the scale efficiency for jth unit is not equal to one, then the unit is either operating below optimal size or operating above optimal size. When it is operating below optimal size it is experiencing increasing returns to scale (IRS), and when it is operating above optimal size it is experiencing decreasing returns to scale (DRS). In order to determine whether a particular unit is experiencing increasing or decreasing returns to scale, DEA is repeated with non-increasing returns to scale (NIRS) and efficiency scores compared. If the score for a particular unit under VRS equals the NIRS score, then the unit must be operating under DRS. On the other hand, if the score under VRS is not equal to NIRS score then the unit is operating under IRS (Coelli et al. 1998).

The DEA model determines efficiency of one decision making unit (DMU) at a time (Coelli et al. 1998; Jamasb and Pollitt 2003). In the present study, it compares each distribution division with all other distribution divisions, and identifies those divisions that are operating inefficiently compared with other divisions' actual operating results. By this it locates the best practice or relatively efficient divisions. It also measures the magnitude of inefficiency of the inefficient divisions compared to the best practice divisions. The best practice divisions are relatively efficient and are identified by a DEA efficiency rating equal to 1 and the inefficient divisions are identified by an efficiency rating less than 1. If the efficiency rating of the division being evaluated is less than 1, then there is potential for that division to produce the same level of outputs with fewer inputs. DEA is most valuable in complex situations where there are multiple outputs and inputs, which cannot be readily analysed with other techniques and where the number of divisions being evaluated is so numerous that management cannot afford to evaluate each division in depth.

The Most Productive Scale Size (MPSS) of an inefficient unit is identified with the help of the efficiency score found out using equation 2. The following relationship developed by Banker (1984) is used here to obtain the production possibility:

$$\left[\frac{\theta_0^* X_0 - S_0^{-*}}{\sum_{j=1}^{n} \lambda_j^*}, \frac{Y_o + S_0^{+*}}{\sum_{j=1}^{n} \lambda_j^*} \right] \qquad (3)$$

which represent MPSS for a given DMU and lies on the efficient production surface, where S_0^- and S_0^+ represent the vectors of input and output slacks, respectively.

3.2. Choice of variables and data

In the literature, a number of specifications are employed depending on what exactly is being investigated and which variables are being used as inputs and outputs (Meenakumari and Kamaraj 2008). The choice of variables for input and output needs to be taken into account the international experience with electricity distribution benchmarking, which is however constrained by data availability (Hirschhausen et al. 2006). In selecting the inputs and outputs for evaluating the efficiency of distribution divisions, great care is to be taken as the success of evaluation depends on the data availability and quality. However, no universally applicable rational template is available for the selection of variables. In general, the inputs must reflect the resources used and the output must reflect the service levels of the distribution units (DMU) and the degree to which the DMU is meeting its objective of supplying electricity to consumers (Meher and Sahu, 2016).

The most common outputs of electricity distribution units in literature are the quantity of distributed energy, the number of consumers, the peak demand and the service area (Korhonen and Syrjanen 2003). Due to constraint in availability of data for peak demand and service area for all the distribution divisions, the present study has used distributed energy (MU) and number of consumers for fair assessment of output. As the ultimate aim of distribution divisions is to distribute the required quantity of energy to the consumers, these two outputs would indicate how efficiently the distribution division has performed given a set of input variables. These output variables also capture the level of electricity demand as well as demographic constraints under the service area. We have used physical inputs such as quantity of energy used (MU), length of distribution line (circuit KM), DTR capacity (MVA) and AT&C loss (%) as the measure of electricity distribution. As the present study uses input orientation model, the outputs are considered as fixed and inputs are adjusted to maximise efficiency.

The present study uses data for the year 2018-19. The data used in this study include information on 72 electricity distribution divisions from four distribution companies (DISCOMs) of Odisha. The data are collected from the office of Odisha Electricity Regulatory Commission (OERC).

4. Results and Discussion

An overview of the key characteristics of data for 72 electricity distribution divisions (DDs) spread over four distribution companies in Odisha is presented in Table 2. It is revealed from the table that there is variation of input use and output generation among the sample units, with highest variation in the length of distributed line and lowest variation in the number of consumers.

The study has verified isotonicity of the selected input and output variables. It is observed that all the variables are isotonically related (Table 3).

The DEA analysis shows that 15 DMUs or distribution divisions (DDs) are CRS efficient, with overall efficiency score equal to 1 (Table 4). These efficient DDs are from all four distribution companies, with highest number from SOUTHCO (8 DDs) and lowest from NESCO (1 DD). These DDs use the least amount of input to produce their output level. They comprise the best practice set or best practice frontier and, thus, form the reference set or benchmarking for inefficient DDs. These peer DDs set example of good operating practices for inefficient DDs to emulate. The remaining 57 DDs, having overall scores less than 1, are clearly operating less efficiently than the efficient DDs. The inefficiency of these DDs implies that there are few distribution divisions among the peers who could produce the same level of outputs with lesser utilisation of inputs. The reference group presented in Table 4 includes the group of peers against which each inefficient division is found to be most directly inefficient.

It is observed that there is significant correlation of the efficiency score of the DDs with their input variables, except in the case of DTR capacity (Table 5). The correlations are found to be negative, which suggests that these inputs can be reduced to improve efficiency of the inefficient DDs.

The inefficiency of electricity divisions shows the potential for those units to produce the same level of outputs with fewer inputs. Hence, these DDs need to reduce the use of inputs as per their inefficiency percentage to become efficient DDs. However, these DDs will be treated as weak efficient if there is slack in inputs, i.e. idle resources. In order to remain on the frontier line, there is a need to deduct the slack value. The targeted/projected inputs of the CRS inefficient divisions against the actual value after deducting slack values are presented in Table 6. To become efficient, the inefficient unit should reduce the inputs to the target level. It can produce the same output even by reducing the level of inputs used. For example, Angul electricity division has used 278 MU energy input, 3798 circuit KM length of distribution line, 182 MVA DTR capacity and 51.01 per cent AT&C loss. This DD can produce the same level of output by reducing the inputs used to the projection of 158 MU energy input, 1594 circuit KM length of distribution line, 104 MVA of DTR capacity and 20.79 per cent AT&C loss. Similarly, the inputs of the other inefficient electricity distribution divisions can be reduced to the projection level in order to become efficient divisions.

The extent of robustness of an efficient DD is determined by its frequency in appearing in the reference sets of inefficient DDs (Chen 1997, Chen and Yeh 1998, Kumar and Gulati 2008). The efficient division with higher number of referring inefficient divisions is more important in benchmarking. It is found that Rayagada has the first rank in benchmarking, appearing in the reference sets of 39 inefficient DDs (Table 7). On the basis of such high frequency counts, this DD can be appropriately considered as leader in the Odisha electricity distribution. The other important efficient divisions following Rayagada are Berhampur-I (with 34 reference sets), Berhampur-III and Rajgangpur (with 23 reference sets), Paralakhemundi (with 12 reference sets), Kalahandi-East (with 11 reference sets). The other efficient divisions have either fewer referring inefficient divisions or are self-evaluator. The efficient divisions like Malkangiri, Bhubaneswar City-I, Cuttack City-I along with Berhampur City-II and Aska-I, and Bhubaneswar City-II along with Nayagarh respectively are referred by 6, 4, 3, and 1 divisions, while Keonjhar and Purusottampur divisions have no reference sets and may be termed as self-evaluator.

The average efficiency score of all the electricity divisions under four distribution utilities in Odisha is 0.8297, revealing that the DDs are utilising on an average 82.97 per cent of the resources (Table 8). The average performance of DDs in SOUTHCO is best with utilisation of 94.11 per cent of the resources, while the average performance of DDs in CESU is worst with utilisation of 74.17 per cent resources. The variation in efficiency score of DDs is found to be highest in CESU and lowest in SOUTHCO.

The average utilization of resources of inefficient DDs is 78.48 per cent. These DDs can therefore potentially reduce current input levels on an average by 21.52 per cent while providing the same level of output. The inefficient electricity divisions are segregated into four categories, viz. most inefficient, below average, above average and marginally inefficient for policy intervention (Table 9). Among these, the electricity divisions belonging to 'most inefficient' and 'marginally inefficient' categories require special attention.

The most inefficient category includes those electricity divisions which have attained the score below the value of first quartile. Around 62.50 per cent of distribution divisions under CESU are assessed under this category. This is followed by the distribution divisions under NESCO and WESCO with 26.67 per cent. However, there is no distribution division of SOUTHCO under this category. These electricity divisions are worst performers and may be considered as 'target divisions' to take immediate steps by the DISCOMs for efficiency improvement.

The electricity distribution divisions that have attained overall efficiency score above the third quartile value but less than unity are included in 'marginally inefficient' category. The distribution divisions under this category are found only in SOUTHCO (18.18%) and WESCO (6.67%). It is worth mentioning here that these electricity divisions are operating at a high level of efficiency even though they are not fully efficient. In fact these divisions are marginally inefficient and operating close to the efficient frontier. Further, these divisions can attain the status of efficient electricity divisions by bringing little improvement in the resource utilisation process. Therefore, the DISCOMs must pay special attention to enhance the efficiency of these divisions.

It is interesting to investigate the sources of inefficiency of the inefficient distribution divisions. It may be caused either by the inefficient operation of the distribution division or by the disadvantageous conditions under which the division is operating or by both. For this purpose comparison of CRS efficiency and VRS efficiency needs to be done. If a distribution division is fully efficient in both CRS and VRS scores, it is operating in the most productive scale. If the division has full VRS efficiency but low CRS score, then it is operating efficiently locally but not globally due to the small size of the distribution division. The decomposition of overall efficiency (CRS efficiency) depicts the sources of inefficiency, i.e. whether it is caused by inefficient operation displayed by technical efficiency (VRS efficiency) or by the disadvantageous conditions displayed by the scale efficiency (SE) or by both.

Using the VRS specification of the model we found that the efficiency score of all distribution divisions rises and the number of efficient divisions increases (Table 10). While the average score of all distribution divisions increases to 88.11 per cent, with 5.14 percentage points higher than the results under CRS assumption, the number of efficient division increases to 27 from 15. In VRS model, 12 electricity divisions have become efficient, which are inefficient in CRS model, indicating that the inefficiency of these DDs is not caused by poor input utilisation (i.e., managerial inefficiency) rather caused by the operations of the DDs with inappropriate scale size. However, managerial inefficiency exists in the remaining 45 electricity distribution divisions, though with different magnitude. In these DDs overall inefficiencies result from both technical inefficiency and scale inefficiency. Out of this, 41 divisions have technical efficiency score less than scale efficiency score. This indicates that inefficiency in resource utilisation in these DDs is primarily attributed to the managerial inefficiency rather than due to the scale inefficiency.

One basic objective of firms is to operate at most productive scale size, i.e. with constant returns to scale. In the short run, firms may operate increasing returns to scale or decreasing returns to scale. However, in the long run they will move towards constant returns to scale by becoming larger or smaller. The process might involve changes of a firm's operating strategy in terms of scaling up or scaling down of size. The distribution utilities may use this information to determine whether the size of representative firm in the particular industry is appropriate or not (Kumar and Gulati 2008). Table 11 shows that 20.83 per cent DDs are operating at most productive scale size and experiencing constant returns to scale. However, 47.22 per cent DDs are operating at decreasing returns to scale and, thus downsizing seems to be an appropriate strategic option in their pursuit to reduce unit costs. The remaining 31.94 per cent DDs are operating below their optimal scale size, and thus experiencing increasing returns to scale. The policy implication for these DDs is to increase their size in order to enhance efficiency. On the whole, decreasing returns to scale is observed to be the prominent form of scale inefficiency in the Odisha electricity distribution sector.

In order to find how far the upsizing or downsizing of inefficient divisions should go, we have calculated the most productive scale size (MPSS) of the inefficient divisions. It helps to identify their right scale of operation with respect to individual inputs and outputs. The MPSS of inefficient divisions is presented in Table 12. It is calculated taking into consideration the efficiency score and total weights assigned for calculation of efficiency score of inefficient divisions. For example, Angul division is facing decreasing returns to scale. Here MPSS is obtained with reduced inputs and outputs considering its efficiency level and the weights assigned to this division. On the other hand, due to increasing returns of scale, the MPSS of Balugaon division is obtained with reduced inputs and increased outputs. The calculation of MPSS for other inefficient divisions is done accordingly. The MPSS results can be utilised by the management to improve the efficiency of the inefficient LT divisions.

5. Conclusions and Policy Implications

An effort has been made in this study to measure the relative efficiency of 72 electricity distribution divisions in Odisha using a Frontier tool, viz. Data Envelopment Analysis. The model with constant returns to scale (CRS) is applied to evaluate the relative efficiency of different sample electricity distribution divisions. Using input-orientation measure to calculate efficiency score of 72 divisions during 2018-19, it is observed that there is existence of inefficiency in 57 divisions. The level of overall efficiency of inefficient DDs is found to be 78.48 per cent, showing the magnitude of inefficiency to the tune of 22 per cent. 15 distribution divisions scored overall score of unity and, thus, defined as the efficient frontier. On the basis of frequency count in the reference set of inefficient divisions, Rayagada is figured out to be the leader in the Odisha electricity LT distribution division. The study has identified worst performer divisions, which are considered as target divisions requiring most attention to become efficient. On the other hand, the identified marginally inefficient divisions operating at a high level of efficiency close to the efficient frontier can attain the status of efficient divisions by bringing little improvement in the resource utilisation process. Therefore, the DISCOMs must pay special attention to enhance the efficiency of these divisions.

As a majority of the electricity distribution divisions does not seem to operate on the optimum level of operation, there is potential for those units to produce the same level of outputs with fewer inputs. Therefore, they can increase their efficiency by reducing the use of inputs without affecting the supply of output. This can be done by benchmarking them against the most efficient divisions. The reduction of inputs can save the most valuable energy, which can otherwise be utilised for development of the state.

The observed overall inefficiency in the Odisha electricity distribution divisions is due to both poor input utilization (i.e., managerial inefficiency) and failure to operate at most productive scale size (i.e., scale inefficiency). However, in most of the inefficient divisions, the overall inefficiency is mainly attributed to technical inefficiency rather than scale inefficiency. Thus, the LT divisions are more successful in choosing optimal levels of output than adopting best practice technology. The study shows that 47.22 per cent of DDs operate at decreasing returns to scale and, thus, need downsizing in their operations to observe efficiency gains. At the same time 31.94 per cent of DDs are operating at increasing returns to scale and can enhance overall efficiency by increasing their size. The MPSS of the inefficient divisions is calculated based on their returns to scale, which is helpful for the management to identify their right scale of operation and enhance efficiency.

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Table 1: Distribution of LT Divisions of different DISCOMs in Odisha on the basis of their Distribution Loss (2018-19)

Utilities	Distribution loss wise no. of LT divisions (Nos.)				
	Q1 Up to15.48	**Q2 (15.48-30.22)**	**Q3 (30.22-40.98)**	**Q4 Above 40.98**	**All**
CESU	4 (20.00)	3 (15.00)	6 (30.00)	7 (35.00)	20 (100.00)
NESCO	3 (18.75)	7 (43.75)	4 (25.00)	2 (12.50)	16 (100.00)
SOUTHCO	5 (26.32)	5 (26.32)	3 (15.79)	6 (31.58)	19 (100.00)
WESCO	6 (35.29)	4 (23.53)	4 (23.53)	3 (17.65)	17 (100.00)
All	18	19	17	18	72

Note: i) Figures in parentheses indicate percentages
ii) Q indicates quartile
Source: Tariff Order - 2019-20, OERC

Table 2: Summary Statistics of Sample Electricity Distribution Divisions (2018-19)

	Energy Used (MU)	Line Length (Circuit KM)	DTR Capacity (MVA)	AT&C loss (%)	Distributed Energy (MU)	No. of Consumers
Mean	205	2448	150	41.34	141	112095
Std. Deviation	98	1446	82	19.40	69	38442
Minimum	64	343	44	4.07	50	48076
Maximum	446	9029	507	79.24	428	226144

Source: Computed by the authors

Table 3: Input/Output Correlations

	Energy Used	Line Length	DTR Capacity	AT&C loss	Distributed Energy	No. of Consumers
Energy Used	1					
Line Length	0.170	1				
DTR Capacity	0.754**	0.146	1			
AT&C loss	0.223	0.231	-0.155	1		
Distributed Energy	0.852**	0.061	0.885**	-0.206	1	
No. of Consumers	0.525**	0.602**	0.446**	0.298*	0.403**	1

Note: **Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)
Source: Computed by the authors

Table 4: CRS Efficiency of LT Distribution Divisions in Odisha

Sl. No.	DISCOM	Electricity Divisions	Efficiency Score	Benchmark	Peer/ Reference Groups	Input slacks			
						Energy Used (MU)	Line Length (Circuit KM)	DTR Capacity (MVA)	AT&C Loss (%)
1	CESU	Angul	0.570413	1.054512	39,41,55	0	572	0	8
2	CESU	Athgarh	0.523276	1.276422	41,52,55	0	0	0	13
3	CESU	Balugaon	0.767659	0.793991	39,52,62,65	0	0	0	1
4	CESU	Bhubaneswar	0.945874	1.658125	5,6,8,39	0	0	107	0
5	CESU	Bhubaneswar City-I	1	1	-	0	0	0	0
6	CESU	Bhubaneswar City-II	1	1	-	0	0	0	0
7	CESU	Cuttack	0.54179	1.230574	39,55,62,65	0	0	0	5
8	CESU	Cuttack City-I	1	1	-	0	0	0	0
9	CESU	Cuttack City-II	0.854691	1.383213	8,39	1	125	0	0
10	CESU	Dhenkanal	0.643225	2.385271	39,41,52	42	565	0	0
11	CESU	Jagatsinghpur	0.702591	0.817636	39,55,65	0	963	0	9
12	CESU	Kendrapara -I	0.751265	1.126447	15,39,55,65	0	0	0	0
13	CESU	Kendrapara -II	0.764253	0.635749	50,52	0	179	10	17
14	CESU	Khurda	0.71076	1.70965	39,55,62,65	0	0	7	0
15	CESU	Nayagarh	1	1	-	0	0	0	0
16	CESU	Nimapara	0.518427	1.642936	39,41,55	0	0	3	6
17	CESU	Paradeep	0.699104	0.958446	39,41,55	0	116	0	18
18	CESU	Puri	0.704177	1.876729	39,55,65	0	302	0	8
19	CESU	Salepur	0.636632	1.120368	39,41,55	0	558	0	24
20	CESU	Talcher	0.500815	1.082261	39,41,55	0	0	8	11
21	NESCO	Anandapur	0.835117	1.024198	41,52,55	0	654	0	3
22	NESCO	Balasore	0.868367	0.763383	5,39,65	0	0	5	8
23	NESCO	Balasore (Central)	0.625306	0.678679	55,62,65	0	0	9	7
24	NESCO	Baripada	0.864501	1.645076	39,52,55	11	1463	0	0
25	NESCO	Basta	0.744294	0.567789	39,55,65	0	923	0	20
26	NESCO	Bhadrak (North)	0.787551	1.429106	39,55,62,65	0	0	27	0
27	NESCO	Bhadrak (South)	0.760746	0.674929	55,62,65	0	0	11	10
28	NESCO	Jajpur Road	0.685724	1.048194	5,39,65	0	0	14	14

29	NESCO	Jajpur Town	0.666607	1.029157	39,41,55	0	1353	0	14
30	NESCO	Jaleswar	0.754055	0.744876	39,55,65	0	722	0	11
31	NESCO	Joda	0.943841	0.760753	39,55,65	0	216	0	2
32	NESCO	Keonjhar	1	1	-	0	0	0	0
33	NESCO	Kuakhia	0.639184	0.851194	39,55,65	0	401	0	16
34	NESCO	Rairangpur	0.835864	1.23206	41,52,55	0	4960	0	11
35	NESCO	Soro	0.893744	0.894763	39,55,62,65	0	0	9	0
36	NESCO	Udala	0.96131	0.651705	50,52,55	0	1208	0	13
37	SOUTHCO	Aska-I	1	1	-	0	0	0	0
38	SOUTHCO	Aska-II	0.922669	0.898731	37,41	8	0	0	30
39	SOUTHCO	Berhampur-I	1	1	-	0	0	0	0
40	SOUTHCO	Berhampur-II	1	1	-	0	0	0	0
41	SOUTHCO	Berhampur-III	1	1	-	0	0	0	0
42	SOUTHCO	Bhanjanagar	0.875003	1.431564	41,55	0	0	3	16
43	SOUTHCO	Boudh	0.86209	0.771434	50,52,55	0	0	46	27
44	SOUTHCO	Chatrapur	0.796043	1.389414	41,55	0	0	16	15
45	SOUTHCO	Digapahandi	0.992525	1.025552	41,55	0	0	22	15
46	SOUTHCO	Gunupur	0.982257	0.568013	50,52,55	0	115	1	0
47	SOUTHCO	Hinjili	0.959669	1.266493	37,41	2	0	0	1
48	SOUTHCO	Jeypore	0.832156	0.912806	55,62,65	0	0	9	10
49	SOUTHCO	Koraput	0.891021	1.359227	41,55	0	0	8	34
50	SOUTHCO	Malkangiri	1	1	-	0	0	0	0
51	SOUTHCO	Nowrangpur	0.93017	1.543966	52,55	0	0	54	25
52	SOUTHCO	Paralakhemundi	1	1	-	0	0	0	0
53	SOUTHCO	Phulbani	0.837429	1.06284	52	0	1140	24	18
54	SOUTHCO	Purusottampur	1	1	-	0	0	0	0
55	SOUTHCO	Rayagada	1	1	-	0	0	0	0
56	WESCO	Bargarh	0.645579	1.858443	39	7	117	0	31
57	WESCO	Bargarh (West)	0.84283	2.041261	39,41	108	1508	0	44
58	WESCO	Bolangir	0.727456	1.86483	37,40,41	5	0	0	0
59	WESCO	Brajrajnagar	0.93508	0.588048	39,41,55	0	373	0	23
60	WESCO	Deogarh	0.956696	0.413507	50,55,65	0	0	11	30
61	WESCO	Jharsuguda	0.860042	1.129819	39,62,65	0	0	20	10
62	WESCO	Kalahandi (East)	1	1	-	0	0	0	0

63	WESCO	Kalahandi (West)	0.770673	0.7696	50,55,65	0	0	17	19
64	WESCO	Nuapada	0.599785	1.262655	41,52,55	0	81	0	17
65	WESCO	Rajgangpur	1	1	-	0	0	0	0
66	WESCO	Rourkela	0.94739	0.90098	5,39,65	0	0	23	12
67	WESCO	Rourkela-Sadar	0.96383	0.952297	39,62,65	0	0	10	4
68	WESCO	Sambalpur	0.783181	1.07935	8,39,40	0	0	0	28
69	WESCO	Sambalpur (East)	0.67221	1.462321	39,40,41	0	0	2	22
70	WESCO	Sonepur	0.891436	1.693418	39,41	16	2874	0	36
71	WESCO	Sundargarh	0.873789	0.787921	55,62,65	0	0	72	12
72	WESCO	Titilagarh	0.684673	1.447232	39,41,55	0	780	0	16

Source: Computed by the authors.

Table 5: Correlation of efficiency score with inputs & outputs

	Correlation with efficiency
Energy Used	-0.470**
Line Length	-0.297*
DTR Capacity	-0.159
AT&C loss	-0.550**
Distributed Energy	-0.076
No. of Consumers	-0.226

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 6: Actual and Project Inputs of CRS Inefficient Distribution Divisions to become efficient

Sl. No.	Electricity Distribution Divisions	Energy input (MU)		Line Length (Circuit KM)		DTR (MVA)		AT&C Loss (%)	
		Actual	Projected	Actual	Projected	Actual	Projected	Actual	Projected
1	Angul	278	158	3798	1594	182	104	51.01	20.79
2	Athgarh	248	130	2604	1363	142	74	70.84	23.74
3	Balugaon	170	131	2635	2022	143	109	33.16	24.18
4	Bhubaneswar	409	387	1078	1019	482	351	9.25	8.75
5	Cuttack	369	200	3516	1905	258	140	64.05	29.81
6	Cuttack City-II	254	217	1078	773	140	119	12.45	10.64
7	Dhenkanal	438	239	3366	1600	188	121	54.93	35.33
8	Jagatsinghpur	179	126	4160	1960	137	96	39.07	18.94
9	Kendrapara -I	258	194	3168	2380	207	143	35.80	26.89
10	Kendrapara -II	96	74	2229	1525	81	52	42.61	15.87
11	Khurda	366	260	3360	2388	243	166	33.66	23.93
12	Nimapara	367	190	3224	1671	221	111	66.51	28.75
13	Paradeep	179	125	1822	1158	110	77	50.15	17.43
14	Puri	401	282	3644	2264	243	171	39.90	20.30
15	Salepur	198	126	2709	1166	116	74	69.68	20.35
16	Talcher	326	163	2877	1441	221	103	59.23	18.85
17	Anandapur	141	118	2304	1270	88	73	28.42	20.75
18	Balasore	145	126	720	625	111	91	16.14	5.68
19	Balasore (Central)	187	117	2062	1289	159	91	49.54	24.46
20	Baripada	279	230	5006	2865	174	151	38.20	33.03
21	Basta	114	85	3527	1702	96	72	42.61	12.07
22	Bhadrak (North)	280	220	4163	3279	250	170	35.51	27.97
23	Bhadrak (South)	143	109	2381	1811	134	92	39.22	19.73
24	Jajpur Road	226	155	3255	2232	189	115	36.54	10.69
25	Jajpur Town	183	122	3570	1027	106	71	46.96	17.46
26	Jaleswar	153	116	2582	1225	103	78	34.74	15.20
27	Joda	120	113	1796	1480	84	79	12.52	9.69

28	Kuakhia	204	130	3268	1688	145	93	50.53	16.77
29	Rairangpur	187	156	9029	2587	132	110	49.78	30.21
30	Soro	152	136	2885	2578	136	113	23.14	20.68
31	Udala	86	83	3247	1913	76	73	41.12	26.79
32	Aska-II	104	88	600	554	45	42	60.70	25.65
33	Bhanjanagar	160	140	1398	1223	91	77	46.37	25.06
34	Boudh	106	91	2241	1932	132	68	56.91	21.70
35	Chatrapur	166	132	1371	1091	108	70	48.00	23.63
36	Digapahandi	110	109	1067	1059	86	64	34.68	19.28
37	Gunupur	71	70	1764	1618	62	60	22.04	21.65
38	Hinjili	145	136	755	725	64	61	55.60	52.63
39	Jeypore	176	146	2539	2113	147	114	43.81	26.09
40	Koraput	160	142	1524	1358	101	82	66.20	25.22
41	Nowrangpur	229	213	3787	3523	225	155	69.93	40.20
42	Phulbani	147	123	4400	2544	133	87	52.51	26.39
43	Bargarh	446	281	1779	1031	227	147	70.21	14.46
44	Bargarh (West)	431	255	3239	1222	156	131	79.24	23.02
45	Bolangir	305	217	1297	944	145	106	63.24	46.00
46	Brajrajnagar	95	89	850	422	52	49	30.55	5.75
47	Deogarh	64	62	1369	1310	67	54	41.98	10.29
48	Jharsuguda	209	180	2079	1788	170	126	38.22	22.78
49	Kalahandi (West)	152	117	2556	1970	144	95	56.31	24.81
50	Nuapada	197	118	1912	1066	104	62	63.85	21.61
51	Rourkela	146	138	931	882	114	86	20.22	7.44
52	Rourkela-Sadar	153	148	2131	2054	127	112	22.58	17.74
53	Sambalpur	252	197	721	565	175	137	46.46	8.36
54	Sambalpur (East)	264	177	1304	876	138	91	59.22	17.38
55	Sonepur	235	194	4394	1043	111	99	64.59	21.48
56	Sundargarh	144	126	2955	2582	215	116	38.75	22.00
57	Titilagarh	311	213	4070	2006	199	136	63.17	26.79

Source: Computed by the authors.

Table 7: Frequency of efficient divisions referred by inefficient divisions

Efficient Divisions	**Frequency of use as peer/reference group by inefficient divisions**	**Rank in benchmarking**
Rayagada	39	1
Berhampur City-I	34	2
Berhampur City-III, Rajgangpur	23	3
Paralakhemundi	12	4
Kalahandi (East)	11	5
Malkangiri	6	6
Bhubaneswar City-I	4	7
Cuttack City-I, Berhampur City-II, Aska-I	3	8
Bhubaneswar City-II, Nayagarh	1	9
Keonjhar, Purusottampur	0	10

Source: Computed by the authors

Table 8: Average efficiency and their variation

Distribution utilities	No. of Distribution divisions	No. of efficient distribution divisions	No. of inefficient distribution divisions	Mean efficiency score	Standard Deviation	CV (%)
CESU	20	4(20.00)	16 (80.00)	0.7417	0.1737	23.42
NESCO	16	1 (6.25)	15 (93.75)	0.8041	0.1157	14.39
SOUTHCO	19	8 (42.11)	11 (57.89)	0.9411	0.0706	7.50
WESCO	17	2 (11.76)	15 (88.24)	0.8326	0.1305	15.67
All	72	15 (20.83)	57 (79.17)	0.8297	0.1472	17.74

Note: Figures in parentheses are percentages of total distribution divisions
Source: Computed by the authors.

Table 9: Distribution of Inefficient LT Divisions on the basis of their Efficiency Score

Distribution Utilities	No. of Inefficient Divisions	Most Inefficient (up to 0.7058)	Below Average (0. 7058 - 0.8574)	Above Average (0. 8574 - 0.9632)	Marginally Inefficient (Above 0.9632)
CESU	16	Angul, Athgarh, Cuttack, Dhenkanal, Jagatsinghpur, Nimapara, Paradeep, Puri Salepur, Talcher (62.50)	Balugaon, Cuttack City-II, Kendrapara –I, Kendrapara-II, Khurda, (31.25)	Bhubaneswar (6.25)	-
NESCO	15	Balasore (Central), Jajpur Road, Jajpur Town, Kuakhia (26.67)	Anandapur, Basta, Bhadrak (North), Bhadrak (South), Jaleswar, Rairangpur (40.00)	Balasore, Baripada, Joda, Soro, Udala (33.33)	-
SOUTHCO	11	-	Chhatrapur, Jeypore, Phulbani (27.27)	Aska-II, Bhanjanagar, Boudh, Hinjili, Koraput, Nowrangpur, (54.55)	Digapahandi, Gunupur, (18.18)
WESCO	15	Bargarh, Nuapada, Sambalpur (East), Titilagarh (26.67)	Bolangir, Bargarh (West), Kalahandi (West), Sambalpur (26.67)	Brajarajnagar, Deogarh, Jharsuguda, Rourkela, Sonepur, Sundargarh (40.00)	Rourkela-Sadar, (6.67)

Note: Figures in parentheses indicate percentage share of inefficient divisions
Source: Computed by the authors

Table 10: Efficiency Score Analysis of Distribution Divisions in Odisha

Sl. No.	Electricity Distribution Divisions	CRS Efficiency (%)	VRS Efficiency (%)	Scale Efficiency	Returns to Scale
1	Angul	0.570413	0.57843	0.98614	DRS
2	Athgarh	0.523276	0.553154	0.94599	DRS
3	Balugaon	0.767659	0.772555	0.99366	IRS
4	Bhubaneswar	0.945874	1	0.94558	DRS
5	Bhubaneswar City-I	1	1	1	CRS
6	Bhubaneswar City-II	1	1	1	CRS
7	Cuttack	0.54179	0.610592	0.88732	DRS
8	Cuttack City-I	1	1	1	CRS
9	Cuttack City-II	0.854691	1	0.85268	DRS
10	Dhenkanal	0.643225	0.975406	0.65944	DRS
11	Jagatsinghpur	0.702591	0.709833	0.9898	IRS
12	Kendrapara -I	0.751265	0.845152	0.88786	DRS
13	Kendrapara -II	0.764253	0.808572	0.94519	IRS
14	Khurda	0.71076	0.965898	0.735854	DRS
15	Nayagarh	1	1	1	CRS
16	Nimapara	0.518427	0.657354	0.78866	DRS
17	Paradeep	0.699104	0.700797	0.99758	IRS
18	Puri	0.704177	1	0.70418	DRS
19	Salepur	0.636632	0.657678	0.968	DRS
20	Talcher	0.500815	0.513916	0.97451	DRS
21	Anandapur	0.835117	0.841589	0.99231	DRS
22	Balasore	0.868367	0.898268	0.96671	IRS
23	Balasore (Central)	0.625306	0.636002	0.98318	IRS
24	Baripada	0.864501	1	0.8645	DRS
25	Basta	0.744294	0.771077	0.96527	IRS
26	Bhadrak (North)	0.787551	0.817682	0.96315	DRS
27	Bhadrak (South)	0.760746	0.771081	0.9866	IRS
28	Jajpur Road	0.685724	0.685741	0.99998	DRS
29	Jajpur Town	0.666607	0.672186	0.9917	DRS
30	Jaleswar	0.754055	0.766095	0.98428	IRS
31	Joda	0.943841	0.967566	0.97548	IRS
32	Keonjhar	1	1	1	CRS
33	Kuakhia	0.639184	0.64441	0.99189	IRS
34	Rairangpur	0.835864	0.914583	0.91393	DRS
35	Soro	0.893744	0.903315	0.9894	IRS
36	Udala	0.96131	0.973477	0.9875	IRS
37	Aska-I	1	1	1	CRS
38	Aska-II	0.922669	1	0.92267	IRS
39	Berhampur-I	1	1	1	CRS
40	Berhampur-II	1	1	1	CRS
41	Berhampur-III	1	1	1	CRS
42	Bhanjanagar	0.875003	0.931248	0.9396	DRS
43	Boudh	0.86209	0.886767	0.97217	IRS
44	Chatrapur	0.796043	0.847276	0.93953	DRS
45	Digapahandi	0.992525	0.99563	0.99688	DRS

46	Gunupur	0.982257	1	0.98226	IRS
47	Hinjilicut	0.959669	0.962705	0.99685	DRS
48	Jeypore	0.832156	0.834206	0.99754	IRS
49	Koraput	0.891021	0.921334	0.9671	DRS
50	Malkangiri	1	1	1	CRS
51	Nowrangpur	0.93017	1	0.93017	DRS
52	Paralakhemundi	1	1	1	CRS
53	Phulbani	0.837429	0.852337	0.98251	DRS
54	Purusottampur	1	1	1	CRS
55	Rayagada	1	1	1	CRS
56	Bargarh	0.645579	1	0.64558	DRS
57	Bargarh(West)	0.84283	1	0.84283	DRS
58	Bolangir	0.727456	0.991386	0.73378	DRS
59	Brajrajnagar	0.93508	1	0.93508	IRS
60	Deogarh	0.956696	1	0.9567	IRS
61	Jharsuguda	0.860042	0.860131	0.9999	DRS
62	Kalahandi (East)	1	1	1	CRS
63	Kalahandi (West)	0.770673	0.778278	0.99023	IRS
64	Nuapada	0.599785	0.660607	0.90793	DRS
65	Rajgangpur	1	1	1	CRS
66	Rourkela	0.94739	0.953216	0.99389	IRS
67	Rourkela-Sadar	0.96383	0.964644	0.99916	IRS
68	Sambalpur	0.783181	0.817739	0.95774	DRS
69	Sambalpur (East)	0.67221	0.861173	0.78057	DRS
70	Sonepur	0.891436	1	0.89144	DRS
71	Sundargarh	0.873789	0.879727	0.99325	IRS
72	Titilagarh	0.684673	0.825968	0.82893	DRS

Source: Computed by the authors.

Table 11: Returns to Scale of Electricity Distribution Divisions in Odisha during 2013-14 (Nos.)

	CESU	NESCO	SOUTHCO	WESCO	All
Distribution Divisions	20 (100.00)	16 (100.00)	19 (100.00)	17 (100.00)	72 (100.00)
Constant Returns to Scale (CRS)	4 (20.00)	1 (6.25)	8 (42.11)	2 (11.76)	15 (20.83)
Decreasing Returns to Scale (DRS)	12 (60.00)	6 (37.50)	7 (36.84)	9 (52.94)	34 (47.22)
Increasing Returns to Scale (IRS)	4 (20.00)	9 (56.25)	4 (21.05)	6 (35.29)	23 (31.94)

Note: Figures in the parentheses are percentages
Source: Computed by the authors.

Table 12: MPSS for the scale inefficient divisions

Sl. No.	Electricity Distribution Divisions	RTS	Energy Used (MU)	Line Length (Circuit KM)	DTR Capacity (MVA)	AT&C loss (%)	Energy Distributed (MU)	Consumer (Nos.)
1	Angul	DRS	150	2056	99	19.71	77	71212
2	Athgarh	DRS	102	1069	58	18.60	47	47034
3	Balugaon	IRS	164	2550	138	30.45	118	99024
4	Bhubaneswar	DRS	235	621	213	5.27	207	67746
5	Cuttack	DRS	162	1550	114	24.22	82	63305
6	Cuttack City-II	DRS	155	662	86	7.67	127	65535
7	Dhenkanal	DRS	100	908	51	14.81	57	46351
8	Jagatsinghpur	IRS	154	3577	118	23.16	97	101272
9	Kendrapara -I	DRS	159	1957	117	23.85	107	108915
10	Kendrapara -II	IRS	116	2683	82	24.96	71	98887
11	Khurda	DRS	152	1398	97	14.00	102	70725
12	Nimapara	DRS	116	1019	68	17.50	53	48512
13	Paradeep	IRS	131	1331	80	18.18	82	73979
14	Puri	DRS	150	1368	91	10.82	101	61408
15	Salepur	DRS	113	1541	66	18.16	62	60127
16	Talcher	DRS	151	1333	95	17.42	69	57640
17	Anandapur	DRS	115	1881	71	20.26	82	87747
18	Balasore	IRS	165	822	119	7.44	140	62641
19	Balasore (Central)	IRS	172	1903	134	36.04	98	90750
20	Baripada	DRS	140	2632	92	20.08	106	104789
21	Basta	IRS	150	4627	126	21.26	102	101178
22	Bhadrak (North)	DRS	154	2296	119	19.57	115	86480
23	Bhadrak (South)	IRS	161	2686	136	29.23	113	103891
24	Jajpur Road	DRS	148	2131	110	10.20	99	58357
25	Jajpur Town	DRS	118	2315	69	16.96	70	61881
26	Jaleswar	IRS	155	2616	104	20.41	106	98849
27	Joda	IRS	149	2231	104	12.74	134	91036
28	Kuakhia	IRS	153	2457	109	19.70	89	81898
29	Rairangpur	DRS	127	6127	89	24.52	89	111422
30	Soro	IRS	152	2884	126	23.12	123	128174
31	Udala	IRS	127	4792	112	41.10	104	129594
32	Aska-II	IRS	98	618	46	28.54	65	63064
33	Bhanjanagar	DRS	98	856	53	17.51	75	72141
34	Boudh	IRS	118	2507	88	28.12	82	112431
35	Chatrapur	DRS	95	787	50	17.01	65	62331
36	Digapahandi	DRS	106	1035	62	18.80	90	92456
37	Gunupur	IRS	123	3054	106	38.12	102	130258
38	Hinjilicut	DRS	108	574	48	41.55	61	63298
39	Jeypore	IRS	160	2317	125	28.58	119	126874
40	Koraput	DRS	105	1001	60	18.56	83	81202

41	Nowrangpur	DRS	138	2283	100	26.03	110	136242
42	Phulbani	DRS	116	3469	82	24.83	79	108343
43	Bargarh	DRS	151	619	79	7.78	94	52059
44	Bargarh(West)	DRS	125	1338	64	11.28	98	60656
45	Bolangir	DRS	116	507	57	24.67	65	46441
46	Brajrajnagar	IRS	151	1355	82	9.77	135	76448
47	Deogarh	IRS	149	3172	130	24.88	130	134345
48	Jharsuguda	DRS	159	1584	112	20.16	131	83482
49	Kalahandi (West)	IRS	152	2562	123	32.24	103	118993
50	Nuapada	DRS	93	910	49	17.11	47	46839
51	Rourkela	IRS	154	981	95	8.26	141	71595
52	Rourkela-Sadar	IRS	155	2159	118	18.63	143	94469
53	Sambalpur	DRS	183	525	127	7.75	133	58658
54	Sambalpur (East)	DRS	121	601	62	11.88	75	48031
55	Sonepur	DRS	115	2314	58	12.68	93	63808
56	Sundargarh	IRS	159	3280	148	27.92	133	103285
57	Titilagarh	DRS	147	1927	94	18.51	91	80537

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