A Non-Parametric Approach for Performance Appraisal of Agricultural Market Committees in India

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Abstract: *Efficient performance of Agricultural Market Committees (AMCs) is considered to be the sine quo non for the economic development of an agrarian country like India. Though the number of AMCs has been steadily increasing in India, still the farmers are being exploited by one form or another in transacting the agricultural commodities. In view of this, several apprehensions and concerns were raised fearing about the performance of AMCs in discharging the regulatory provisions for efficient transaction of agricultural commodities. Various enactments have been formulated by Government from time to time to revamp the agricultural marketing system in the country and presently, Model act 2005 (The State Agricultural Produce Marketing (Development and Regulation) Act, 2005) has been under implementation. In this context of exploring the agricultural marketing system with a farmers ended approach, the present paper aims at analyzing the performance appraisal of AMCs in Coastal region of AP in India through Data Envelopment Analysis(DEA) approach. The analytical findings revealed that 53% of selected AMCs are being operated at Scale Efficiency <1. The remaining 47% AMCs are being operated at constant return to scale (CRS) and this directs the Government to continue the existing support even in the future.*
Keywords: *Agricultural Market Committees, Data Envelopment Analysis, Efficiency, Return to Scale.*

I.   Introduction

Efficient performance of agricultural markets is considered as the *sine qua non* of economic development of any country. This is not an exception with reference to India. It is a known fact that, regulated agricultural markets have been established in India with the prime objective of transacting agricultural produce efficiently and thereby, to safeguard the interests of the farming community. Since 1966 and upto the current year, there have been a steady progress in the establishment of regulated agricultural markets in the country. In India, the organized marketing of agricultural commodities has been promoted through a network of regulated markets. Most State Governments and Union Territory(UT) administrations have enacted legislations (Agricultural Produce Marketing (Regulation) Act (APMC Act)) to provide for the regulation of agricultural produce markets. While by the end of 1950, there were 286 regulated markets in the country, their number as on 31st, March 2011 stood at 7566 consists of 2433 principal markets and 5133 sub-yards. Some wholesale markets are outside the purview of the regulation under APMC Acts. Similar trends were noticed in the state of Andhra Pradesh in general and Coastal region of Andhra Pradesh in particular. In Andhra Pradesh, with 23 districts, there are 905 regulated markets which consists of 329 principal markets and 576 sub-yards and in Coastal region of Andhra Pradesh comprising of 9 districts, 127 principal markets and 360 sub-yards are reported as on 31st, March 2011.

So far, so forth, these regulated markets in Coastal region of Andhra Pradesh are serving the farming community in view of the laid out promises at the time of their establishment. The contributions of these regulated markets are clearly manifested through various outcomes in the forms of viz, regulating the marketing practices, systematizing the marketing costs, settlement of disputes between farmers and traders, prompt payment of sales proceeds, checking the malpractices of marketing middlemen etc., with a view to safeguard the interests of the farmers in transacting their produce and inturn, to realize significant producer's share in consumer's rupee. To keep up these promises, the Government from time to time revised the marketing regulations and presently Model Act, 2005 (The State Agricultural Produce Marketing (Development and Regulation) Act, 2005) has been enacted to make the farmers more dynamic and competitive in the context of liberalized trade regime. However, in reality, there exists a wide gap between the promises made and actual performance shown by these regulated markets. The earlier mentioned regulatory provisions offered by these regulated markets are being exploited in one form or other against the interests of the farming community. Thus, it became evident that, these regulated markets in the Coastal region of Andhra Pradesh in India are not able to function efficiently in discharging the regulatory provisions and hence, the farmers could not enjoy the true benefits of market regulation. It is in this context, the researchers made an attempt to analyse the technical efficiency in the functioning of regulated markets in Coastal region of Andhra Pradesh in India. It has seen that

not many attempts were found in India in general and Coastal region in particular to analyse the efficiency of functions of regulated markets. In this background, this study is certainly a contribution in the analysis of efficiency of regulated markets. Thus this study explores the use of Data Envelopment Analysis(DEA), a non-parametric approach which is a powerful Operations Research tool appropriate for the context. This study is conducted with the following specific objectives:

1) To study whether the regulatory provisions contribute to the technical efficiency of the functioning of regulated markets, and if they contribute, how they influence the efficiency.
2) To analyse the trends in the efficiency in the functioning of regulated markets.

II.   Methodology

For analyzing the efficiency of regulated markets in India, Coastal region of Andhra Pradesh state has been purposefully selected, as the investigators hail from this state. Data Envelopment Analysis (DEA) model was used to assess the technical efficiency of regulated markets in Coastal region of Andhra Pradesh in India.

DEA is one of the most popular non-parametric approaches used in the literature to appraise the performance of Decision Making Units (DMUs). It permits the selection of efficient markets with in the Coastal region. DEA was used in prior studies on the efficiency of financial institutions to examine the impact of some specific changes such as financial reforms, the impact of financial practices and the impact of different ownership groups. DEA assesses the efficiency frontier on the basis of all input and output information from the region. (Rogers, 1998). Thus, the relative efficiency of markets operating in the same region can be estimated (Fried et al. 2002). Hence, identification of performance indicators in regulated markets is useful for identifying a benchmark for the whole region. Moreover, the DEA methodology has the capacity to analyse multi-inputs and multi-outputs to assess the efficiency of institutions (Coelli, Rao & Battese 1998).

DEA Model :

Several DEA models have been presented in the literature. The basic DEA model evaluates efficiency based on the productivity ratio which is the ratio of outputs to inputs. This study applied Charnes, Cooper and Rhode's (CCR) (1978) model and Banker, Charnes and Cooper (BCC) (1984) model. The production frontier has constant returns to scale in CCR model. The basic CCR model formulation (dual problem/ envelopment form) is given by :

The basic CCR model formulation (dual problem/ envelopment form) :

$$\text{Min}\,\theta - \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right)$$

Subject to :

$$\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = \theta x_{i0} \quad (i=1, \ldots\ldots, m)$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = y_{r0} \quad (r=1, \ldots\ldots, s)$$

$$\lambda_j \geq 0 \quad (j=1, \ldots\ldots, n)$$

Source :Zhu (2003, p.13)

where, θ denotes the efficiency of DMUj , while y_{rj} is the amount of rth output produced by DMUj using x_{ij} amount of ith input. Both y_{rj} and x_{ij} are exogenous variables and λ_j represents the benchmarks for a specific DMU under evaluation (Zhu 2003). Slack variables are represented by s_i and s_r. According to Cooper, Seiford and Tone (2004) the constraints of this model are :

i. the combination of the input of firm j is less than or equal to the linear combination
    of inputs for the firm on the frontier;
ii. the output of firm j is less than or equal to the linear combination of inputs for the
     firm on the frontier; and
iii. the main decision variable θ_j lies between one and zero.

Further, the model assumes that all DMUs are operating at an optimal scale. However, imperfect competition and constraints to finance may cause DMUs to operate at some level different to the optimal scale (Coelli, Rao & Battese 1998). Hence, the Banker, Charnes and Cooper (1984) BCC model is developed with a production frontier that has variable returns to scale. The BCC model forms a convex combination of DMUs (Coelli, Rao & Battese 1998). Then the constant returns to scale linear programming problem can be modified to one with variable returns to scale by adding the convexity constraint $\Sigma\lambda_j = 1.$ The model given below illustrates the basic BCC formulation (dual problem/envelopment form) :

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$$\text{Min}\theta - \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right)$$

Subject to :

$$\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = \theta x_{i0} \quad (i=1, \ldots\ldots\ldots, m)$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = y_{r0} \quad (r=1, \ldots\ldots\ldots, s)$$

$$\lambda_j \geq 0 \quad (j=1, \ldots\ldots\ldots,n)$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

Source :Zhu (2003, p.13)

This approach forms a convex hull of intersecting planes (Coelli, Rao & Battese 1998). These planes envelop the data points more tightly than the constant returns to scale (CRS) conical hull. As a result, the variable returns to scale (VRS) approach provides technical efficiency (TE) scores that are greater than or equal to scores obtained from the CRS approach (Coelli, Rao & Battese 1998). Moreover, VRS specifications will permit the calculation of TE decomposed into two components: scale efficiency (SE) and pure technical efficiency (PTE). Hence, this study first uses the CCR model to assess TE then applies the BCC model to identify PTE and SE for each DMU. The relationship of these concepts is given below :

Relationship between TE, PTE and SE :

$TE_{CRS} = PTE_{VRS}*SE$

where TE_{CRS} = Technical efficiency of constant return to scale

PTE_{VRS} = Technical efficiency of variable return to scale

SE = Scale efficiency

Source : Coelli, et al., (1998).

The above relationship, which is unique, depicts the sources of inefficiency, i.e., whether it is caused by inefficient operation (PTE) or by disadvantageous conditions displayed by the scale efficiency (SE) or by both. If the scale efficiency is less than 1, the DMU will be operating either at decreasing return to scale (DRS) which implies if a proportional increase of all input levels produces a less-than-proportional increase in output levels or increasing return to scale (IRS) which is the converse case. This can lead to a conclusion that resources may be transferred from DMUs operating at DRS to those operating at IRS to increase average productivity at both sets of DMUs (Boussofiane et al.,1992).

III.   Data And Variables For The Study

Efficiency of a AMC depends on the facilities available with the AMC such as drying platforms, storage units, market functionaries etc., which leads to good amount of arrivals and in turn AMC earns countable market fees creating employment. DEA assumes that, the inputs and outputs have been correctly identified. Usually as the number of inputs and outputs increase, more DMUs tend to get an efficiency rating of 1 as they become too specialized to be evaluated with respect to other units. On the other hand, if there are too few inputs and outputs, more DMUs tend to be comparable. In any study, it is important to focus on correctly specifying inputs and outputs. DEA is commonly used to evaluate the efficiency of a number of AMCs and it is a multi-factor productivity analysis model for measuring the relative efficiency of a homogeneous set of regulated markets (DMUs). For every inefficient AMC, DEA identifies a set of corresponding efficient AMC that can be utilized as benchmarks for improvement of performance and productivity. DEA is developed based on two scale of assumptions viz., Constant Return to Scale (CRS) model and Variable Return to Scale (VRS) model. CRS means that the producers are able to linearly scale the inputs and outputs without increasing or decreasing efficiency. This is a significant assumption. The assumption of CRS may be valid over limited ranges but its use must be justified. As an aside, CRS tends to lower the efficiency scores while VRS tends to raise efficiency scores.

For enabling the study of evaluation of AMC's we have the following resources(inputs) and productivity indicators or outputs :

Inputs : X_1 - Arrivals(in Qtls), X_2 - Amenities & facilities(in MTs.), X_3 - Market functionaries(in Nos.),

X_4 - Notified market area(in Kms)

Outputs : Y_1 - Valuation(Rs. in Lakhs), Y_2 - Market fees(Rs. in Lakhs), Y_3 - Staff position(in Nos.)

The study involves the application of DEA to assess the efficiency of 127 AMCs in Coastal region, with nine districts of Andhra Pradesh State in India during the years 2005-06, 2006-07, 2007-08 and 2008-09. The data used for assessment was obtained from the Annual Reports published by Directorate of Marketing and Inspection(vide ref : www.agmarknet.nic.in) and from the Annul Administrative Reports of the selected AMCs. DEA is applied separately for each year using input-orientation with radial distances to the efficient frontier. By running these programmes with the same data under CRS and VRS assumptions, measures of overall technical efficiency (TE) and 'pure' technical efficiency(PTE) are obtained, along with scale efficiencies. The details were shown in Tables (5) to (7).

IV. Results And Discussions

The main theme of the present study is to assess the performance of AMCs in nine districts viz., East Godavari, Guntur, Krishna, Nellore, Prakasham, Srikakulam, Vijayanagaram, Visakapatnam, West Godavari which are located in Coastal region of Andhra Pradesh state in India. The study intends to assess the efficiency of facilities in AMCs and thereby improving operations of AMCs to provide suitable and improved marketing avenues for farming community.

PERFOMANCE OF Amcs AT REGIONAL LEVEL: The findings of DEA portrayed through Table 1 revealed the following salient information:

➤ Nearly 47 percent i.e. 60 out of 127 total AMCs in Coastal region are operated at Constant Return to Scale(CRS) in the entire period of study, that is 2005-06 to 2008-09. This reveals that these 60 AMCs in Coastal region are operating with stability, balancing the inputs(resources contained in these) to satisfy the outputs i.e. the purpose of AMCs. These are :

Table 1 : AMCs with constant return to scale (CRS) :

S.No.	Name of AMC	RETURN TO SCALE			
		2005-06	2006-07	2007-08	2008-09
1	ALAMURU	crs	crs	crs	crs
2	AMBAJIPETA	crs	crs	crs	crs
3	JAGGAMPETA	crs	crs	crs	crs
4	KAKINADA	crs	crs	crs	crs
5	PEDDAPURAM	crs	crs	crs	crs
6	PITHAPURAM	crs	crs	crs	crs
7	RAJOLE	crs	crs	crs	crs
8	Ramachandrapuram	crs	crs	crs	crs
9	SAMARLAKOTA	crs	crs	crs	crs
10	SAMPARA	crs	crs	crs	crs
11	TALLAREVU	crs	crs	crs	crs
12	DUGGIRALA	crs	crs	crs	crs
13	GUNTUR	crs	crs	crs	crs
14	KUCHINAPUDI	crs	crs	crs	crs
15	PIDIGURALLA	crs	crs	crs	crs
16	ROMPICHERLA	crs	crs	crs	crs
17	TADIKONDA	crs	crs	crs	crs
18	AVANIGADDA	crs	crs	crs	crs
19	GANNAVARAM	crs	crs	crs	crs
20	KAIKALUR	crs	crs	crs	crs
21	KANCHIKACHERLA	crs	crs	crs	crs
22	MALLESWARAM	crs	crs	crs	crs
23	VIJAYAWADA	crs	crs	crs	crs
24	ATMAKUR	crs	crs	crs	crs
25	GUDUR	crs	crs	crs	crs
26	KAVALI	crs	crs	crs	crs
27	KOVVUR	crs	crs	crs	crs
28	NELLORE	crs	crs	crs	crs
29	SULLUR PET	crs	crs	crs	crs
30	VAKADU	crs	crs	crs	crs
31	VENKATAGIRI	crs	crs	crs	crs
32	DARSI	crs	crs	crs	crs
33	GIDDALUR	crs	crs	crs	crs
34	KANDUKUR	crs	crs	crs	crs
35	KANIGIRI	crs	crs	crs	crs
36	MARKAPUR	crs	crs	crs	crs
37	ONGOLE	crs	crs	crs	crs
38	PARCHUR	crs	crs	crs	crs

39	ICHAPURAM	crs	crs	crs	crs
40	KOTABOMMALI	crs	crs	crs	crs
41	SRIKAKULAM	crs	crs	crs	crs
42	TEKKALI	crs	crs	crs	crs
43	BOBILLI	crs	crs	crs	crs
44	GAJAPATHINAGARAM	crs	crs	crs	crs
45	KURUPAM	crs	crs	crs	crs
46	PUSUPATHIREGA	crs	crs	crs	crs
47	VIJAYANAGARAM	crs	crs	crs	crs
48	ANAKAPALLI	crs	crs	crs	crs
49	BHEEMUNEPATNAM	crs	crs	crs	crs
50	CHINTHAPALLI	crs	crs	crs	crs
51	VISAKAPATNAM	crs	crs	crs	crs
52	ACHANTA	crs	crs	crs	crs
53	AKIVIDU	crs	crs	crs	crs
54	BHEMADOLU	crs	crs	crs	crs
55	BHIVARAM	crs	crs	crs	crs
56	DENDLURU	crs	crs	crs	crs
57	ELURU	crs	crs	crs	crs
58	POLAVARAM	crs	crs	crs	crs
59	UNDI	crs	crs	crs	crs
60	UNGUTUR	crs	crs	crs	crs

➢ About 15 percent i.e. 19 out of 127 total AMCs in Coastal region are operating with Increasing Return to Scale(IRS) through out the study period which reveal that these are showing encouraging trend to promote the purpose of AMC subject to additional inputs or resources and support. Infact these AMCs do need encouragement to promote the goal or purpose of AMCs. These are :

Table 2 : AMCs with increasing return to scale (IRS) :

S.No.	Name of AMC	RETURN TO SCALE			
		2005-06	2006-07	2007-08	2008-09
1	MUMMIDIVARAM	**irs**	**irs**	**irs**	**irs**
2	CHILAKALURIPET	**irs**	**irs**	**irs**	**irs**
3	KROSUR	**irs**	**irs**	**irs**	**irs**
4	PONNURU	**irs**	**irs**	**irs**	**irs**
5	REPALLE	**irs**	**irs**	**irs**	**irs**
6	SATTENAPALLI	**irs**	**irs**	**irs**	**irs**
7	VINUKONDA	**irs**	**irs**	**irs**	**irs**
8	JAGGAYAPETA	**irs**	**irs**	**irs**	**irs**
9	MYLAVARAM	**irs**	**irs**	**irs**	**irs**
10	NUZIVUD	**irs**	**irs**	**irs**	**irs**
11	RAPUR	**irs**	**irs**	**irs**	**irs**
12	MARTUR	**irs**	**irs**	**irs**	**irs**
13	PODILI	**irs**	**irs**	**irs**	**irs**
14	KANCHILI	**irs**	**irs**	**irs**	**irs**
15	PALAKONDA	**irs**	**irs**	**irs**	**irs**
16	CHEPURUPALLI	**irs**	**irs**	**irs**	**irs**
17	KOTHAVALASA	**irs**	**irs**	**irs**	**irs**
18	SALURU	**irs**	**irs**	**irs**	**irs**
19	GOPALAPURAM	**irs**	**irs**	**irs**	**irs**

➢ However it is important to note that **none** of the other AMCs in the Coastal region of Andhra Pradesh is operating with Decreasing Return to Scale(DRS) **during** the study period which is a encouraging factor with respect to the efficiency of AMCs.

➢ Only one AMC(Gudivada) is operated with DRS for three years of reference study period.   Further it is observed that some of the AMCs are exhibiting dismal performance regarding operational efficiency of the resources, i.e., they are operated with DRS for one or two years of reference period of study which indicates that the resources of these AMCs can be transferred to AMCs operated with IRS. These AMCs are seen in Table 3.

Table 3 : AMCs with trend of scale during 2005-2009 :

S.No.	Name of AMC	RETURN TO SCALE			
		2005-06	2006-07	2007-08	2008-09
1	ALLAVARAM	crs	**DRS**	crs	crs
2	KOTHAPETA	**irs**	**irs**	**irs**	**DRS**
3	PRATHIPADU	crs	crs	**DRS**	**DRS**
4	RAJAHMUNDRY	**DRS**	crs	**DRS**	**irs**
5	TUNI	**DRS**	crs	**irs**	**DRS**
6	GUDIVADA	**DRS**	**DRS**	**irs**	**DRS**
7	NANDIGAMA	**irs**	**irs**	**irs**	**DRS**
8	VUYYURU	**irs**	**irs**	**irs**	**DRS**
9	ADDANKI	crs	**DRS**	**DRS**	**irs**
10	KANDEPI	**DRS**	crs	**irs**	**DRS**
11	MADDIPADU	**DRS**	crs	**irs**	**irs**
12	NARASANNAPETA	**irs**	**irs**	**DRS**	**DRS**
13	PONDURU	crs	crs	crs	**DRS**
14	RAJAM	crs	crs	crs	**DRS**
15	SOMPETA	**irs**	**irs**	**DRS**	**irs**
16	PARVATHIPURAM	crs	crs	**DRS**	**DRS**
17	ATTILI	crs	crs	**DRS**	crs
18	CHINTALAPUDI	**irs**	**irs**	**irs**	**DRS**
19	KOVVUR	**DRS**	crs	**irs**	**DRS**
20	NARSAPURAM	**DRS**	crs	**irs**	**irs**
21	PENUGONDA	crs	crs	**DRS**	**DRS**
22	TANAKU	crs	**DRS**	crs	crs

> It is also noticed that some of the AMCs have shown a shift in the return to scale pattern i.e either from IRS to CRS or vice-versa implying that, there is increased resource use efficiency with reference to the exploitation of resources usage . Hence, these AMCs have shown an increased pace of return to scale. These AMCs are seen in Table 4.

Table 4 : AMCs with trend of CRS and IRS during 2005-2009 :

S.No.	Name of AMC	RETURN TO SCALE			
		2005-06	2006-07	2007-08	2008-09
1	ANAPARTHY	crs	**irs**	**irs**	**irs**
2	NAGARAM	crs	crs	crs	**irs**
3	BAPATLA	**irs**	**irs**	**irs**	crs
4	IPUR	**irs**	**irs**	**irs**	crs
5	MACHERLA	crs	**irs**	crs	**irs**
6	MANGALAGIRI	crs	**irs**	crs	**irs**
7	NARSARAOPETA	**irs**	**irs**	**irs**	crs
8	TENALI	**irs**	**irs**	crs	crs
9	KALIDINDI	**irs**	crs	crs	crs
10	MACHILIPATNAM	**irs**	crs	crs	crs
11	MOVVA	crs	**irs**	**irs**	**irs**
12	PAMARRU	crs	crs	crs	**irs**
13	TIRUVUR	**irs**	crs	**irs**	**irs**
14	NAIDUPET	**irs**	crs	**irs**	**irs**
15	UDAYAGIRI	crs	crs	crs	**irs**
16	CHERALA	**irs**	**irs**	**irs**	crs
17	KAMBAM	crs	crs	crs	**irs**
18	AMADALAVALASA	**irs**	crs	crs	**irs**
19	HIRAMANDALAM	crs	crs	crs	**irs**
20	PATHAPATNAM	crs	crs	crs	**irs**
21	CHODAVARAM	**irs**	**irs**	**irs**	crs
22	NARSIPATNAM	crs	**irs**	crs	**irs**
23	PADERU	crs	crs	crs	**irs**
24	YELAMANCHELLI	**irs**	**irs**	crs	**irs**
25	PALAKOLLU	crs	**irs**	**irs**	**irs**
26	TADEPALLIGUDEM	crs	crs	crs	**irs**

PERFORMANCE OF Amcs AT DISTRICT LEVEL : Mean technical efficiency of AMCs in Coastal region district-wise was obtained and shown in table-6 and 7. Interestingly some of the following observations are established.

➢ In Coastal region more number of efficient AMCs are identified compared to inefficient AMCs which reveal that the purpose of AMCs are significant in this part of Andhra Pradesh(table-7).
➢ Further it is interesting and encouraging to note that number of efficient AMCs increased from the financial year 2005-06 to 2008-09 which is a positive growth and trend for the promotion of AMCs activity as per the intention of Government scheme in the Coastal region of Andhra Pradesh(table-7).

Among selected districts (table-6), East Godavari district had exhibited highest mean scale efficiency for three years except in the year 2007-08 and Nellore district is having highest mean scale efficiency for one years i.e., 2007-08. The district with least mean scale efficiency throughout the reference study period is Guntur.

The informal discussions held with AMC Officials revealed the following interesting points for this heartening performance:

• Farmers are showing positive attitude for transacting their produce in the AMCs compared to local markets on account of the competitive price being realized in the AMCs.
• Strengthening of infrastructure in the market yards like grading, processing, marketing information network, storage facilities etc.
• More encouragement by the Government in the form of implementing pledge loan scheme, Rythu Bandhu Padhakam etc.
• Regulation of marketing practices and marketing costs.

V.   Conclusions

The analyses reveal that nearly 62 percent of the overall 127 AMC in Coastal region seen to be performing optimally(efficiently fulfilling the purpose) balancing the resources. However still 38 percent of the overall 127 AMCs, the efficiency is behind optimal level. Among this, 23 percent of AMCs are not achieving the best performance due to lack of availability of adequate resources while improvement can be established with augmenting adequate resources(inputs). However, other 15 percent of AMCs do not perform efficiently due to lack of motivation since the resources are under utilized and does not exhibit the fulfillment of optimal performance inspite of adequate resources. Therefore the study identifies that the resources which are unutilized in some of the AMCs can be distributed to those which are lagging behind due to scarcity of resources to promote and strengthen the overall activity of AMC performance in this region. This will promote 90 percent of AMCs to achieve optimal performance within the region and to participate in the wellbeing of farming community as per the intention of the Government support.

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Table 5 : DEA analysis – Calculation of CRS, VRS, Scale efficiency and Return to Scale of selected AMCs in Coastal region of A.P. during 2005-2009 :

S.No.	Name of AMC	2005-06				2006-07				2007-08				2008-09			
		CRS	VRS	Scale	RTS	CRS	VRS	Scale	RTS	CRS	VRS	Scale	RTS	CRS	VRS	Scale	RTS
1	ALAMURU	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
2	ALLAVARAM	1	1	1	crs	0.9974	1	0.9974	DRS	1	1	1	crs	1	1	1	crs
3	AMBAJIPETA	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
4	ANAPARTHY	1	1	1	crs	0.8619	1	0.8619	irs	0.8559	1	0.8559	irs	0.922	1	0.922	irs
5	JAGGAMPETA	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
6	KAKINADA	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
7	KOTHAPETA	0.7999	0.8622	0.9277	irs	0.8656	0.894	0.9683	irs	0.8672	0.8691	0.9978	irs	0.9618	1	0.9618	DRS
8	MUMMIDIVARAM	0.717	1	0.717	irs	0.7908	1	0.7908	irs	0.701	0.9792	0.7159	irs	0.5224	1	0.5224	irs
9	NAGARAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	0.5529	0.699	0.7909	irs
10	PEDDAPURAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
11	PITHAPURAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
12	PRATHIPADU	1	1	1	crs	1	1	1	crs	0.9299	1	0.9299	DRS	0.8833	0.9866	0.8953	DRS
13	RAJAHMUNDRY	0.9078	0.9482	0.9574	DRS	1	1	1	crs	0.7565	0.7674	0.9858	DRS	0.6691	0.7083	0.9446	irs
14	RAJOLE	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
15	Ramachandrapuram	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
16	SAMARLAKOTA	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
17	SAMPARA	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
18	TALLAREVU	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
19	TUNI	0.8322	0.9067	0.9178	DRS	1	1	1	crs	0.7366	0.769	0.9579	irs	0.9842	1	0.9842	DRS
20	BAPATLA	0.9621	1	0.9621	irs	0.8934	1	0.8934	irs	0.9611	1	0.9611	irs	1	1	1	crs
21	CHILAKALURIPET	0.5898	1	0.5898	irs	0.9574	1	0.9574	irs	0.7779	1	0.7779	irs	0.5637	1	0.5637	irs
22	DUGGIRALA	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
23	GUNTUR	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
24	IPUR	0.5863	1	0.5863	irs	0.5949	1	0.5949	irs	0.612	1	0.612	irs	1	1	1	crs
25	KROSUR	0.5354	1	0.5354	irs	0.685	1	0.685	irs	0.8138	1	0.8138	irs	0.6728	1	0.6728	irs
26	KUCHINAPUDI	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
27	MACHERLA	1	1	1	crs	0.9473	1	0.9473	irs	1	1	1	crs	0.8835	1	0.8835	irs
28	MANGALAGIRI	1	1	1	crs	0.6777	1	0.6777	irs	1	1	1	crs	0.5562	1	0.5562	irs
29	NARSARAOPETA	0.4447	1	0.4447	irs	0.6014	1	0.6014	irs	0.7067	1	0.7067	irs	1	1	1	crs
30	PIDIGURALLA	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
31	PONNURU	0.8957	1	0.8957	irs	0.8478	1	0.8478	irs	0.8796	1	0.8796	irs	0.9044	1	0.9044	irs
32	REPALLE	0.5817	1	0.5817	irs	0.667	1	0.667	irs	0.6338	1	0.6338	irs	0.5306	1	0.5306	irs
33	ROMPICHERLA	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
34	SATTENAPALLI	0.5724	1	0.5724	irs	0.889	1	0.889	irs	0.8841	1	0.8841	irs	0.5925	1	0.5925	irs

Table 5 (Cont'd) : DEA analysis – Calculation of CRS, VRS, Scale efficiency and Return to Scale of selected AMCs in Coastal region of A.P. during 2005-2009 :

35	TADIKONDA	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
36	TENALI	0.9718	1	0.9718	irs	0.9717	1	0.9717	irs	1	1	1	crs	1	1	1	crs
37	VINUKONDA	0.4933	1	0.4933	irs	0.5839	1	0.5839	irs	0.6859	1	0.6859	irs	0.587	1	0.587	irs
38	AVANIGADDA	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
39	GANNAVARAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
40	GUDIVADA	0.761	0.7672	0.992	DRS	0.7653	0.7844	0.9756	DRS	0.7502	0.7506	0.9995	irs	0.8399	1	0.8399	DRS
41	JAGGAYAPETA	0.5004	0.7741	0.6465	irs	0.4914	0.7735	0.6352	irs	0.439	0.8376	0.5241	irs	0.5203	0.7495	0.6942	irs
42	KAIKALUR	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
43	KALIDINDI	0.9727	1	0.9727	irs	1	1	1	crs	1	1	1	crs	1	1	1	crs
44	KANCHIKACHERLA	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
45	MACHILIPATNAM	0.9758	1	0.9758	irs	1	1	1	crs	1	1	1	crs	1	1	1	crs
46	MALLESWARAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
47	MOVVA	1	1	1	crs	0.6703	0.9599	0.6983	irs	0.7452	0.9538	0.7813	irs	0.7157	0.8501	0.8419	irs
48	MYLAVARAM	0.7445	0.8264	0.9009	irs	0.7525	0.8443	0.8913	irs	0.6616	0.8624	0.7672	irs	0.7551	0.7694	0.9814	irs
49	NANDIGAMA	0.6968	0.7465	0.9334	irs	0.8815	0.8869	0.9939	irs	0.8195	0.8644	0.948	irs	0.9361	1	0.9361	DRS
50	NUZIVUD	0.5448	0.7982	0.6826	irs	0.4738	0.8143	0.5818	irs	0.4421	0.8104	0.5455	irs	0.4694	0.7242	0.6482	irs
51	PAMARRU	1	1	1	crs	1	1	1	crs	1	1	1	crs	0.7894	1	0.7894	irs
52	TIRUVUR	0.6697	0.7595	0.8817	irs	1	1	1	crs	0.747	0.7977	0.9364	irs	0.8579	0.8811	0.9736	irs
53	VIJAYAWADA	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
54	VUYYURU	0.8876	0.919	0.9659	irs	0.9342	0.9435	0.9901	irs	0.8734	0.9182	0.9513	irs	0.9572	0.9762	0.9805	DRS
55	ATMAKUR	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
56	GUDUR	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
57	KAVALI	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
58	KOVVUR	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
59	NAIDUPET	0.9361	1	0.9361	irs	1	1	1	crs	0.9129	1	0.9129	irs	0.6894	1	0.6894	irs
60	NELLORE	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
61	RAPUR	0.6159	0.8434	0.7303	irs	0.8162	0.9664	0.8445	irs	0.7341	0.9061	0.8102	irs	0.632	0.8085	0.7817	irs
62	SULLUR PET	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
63	UDAYAGIRI	1	1	1	crs	1	1	1	crs	1	1	1	crs	0.8037	0.9053	0.8878	irs
64	VAKADU	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
65	VENKATAGIRI	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
66	ADDANKI	1	1	1	crs	0.9749	0.9775	0.9973	DRS	0.9882	1	0.9882	DRS	0.9537	0.9651	0.9882	irs
67	CHERALA	0.9029	0.9043	0.9984	irs	0.7549	0.7908	0.9546	irs	0.7305	0.7708	0.9477	irs	1	1	1	crs
68	DARSI	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
69	GIDDALUR	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
70	KAMBAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	0.7293	1	0.7293	irs

Table 5 (Cont'd) : DEA analysis – Calculation of CRS, VRS, Scale efficiency and Return to Scale of selected AMCs in Coastal region of A.P. during 2005-2009 :

#	Name	CRS	VRS	Scale	RTS	CRS	VRS	Scale	RTS	CRS	VRS	Scale	RTS	CRS	VRS	Scale	RTS
71	KONDEPI	0.9813	1	0.9813	DRS	1	1	1	crs	0.6225	0.7959	0.7821	irs	0.9302	1	0.9302	DRS
72	KANDUKUR	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
73	KANIGIRI	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
74	MADDIPADU	0.9576	0.9694	0.9879	DRS	1	1	1	crs	0.9507	0.9519	0.9986	irs	0.6756	0.9029	0.7482	irs
75	MARKAPUR	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
76	MARTUR	0.7533	0.8125	0.9271	irs	0.7791	0.8125	0.9589	irs	0.7773	0.8787	0.8846	irs	0.9074	0.9457	0.9596	irs
77	ONGOLE	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
78	PARCHUR	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
79	PODILI	0.5109	1	0.5109	irs	0.4761	1	0.4761	irs	0.4915	1	0.4915	irs	0.373	1	0.373	irs
80	AMADALAVALASA	0.9883	1	0.9883	irs	1	1	1	crs	1	1	1	crs	0.9294	1	0.9294	irs
81	HIRAMANDALAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	0.6283	1	0.6283	irs
82	ICHAPURAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
83	KANCHILI	0.3158	1	0.3158	irs	0.3158	1	0.3158	irs	0.4556	1	0.4556	irs	0.3158	1	0.3158	irs
84	KOTABOMMALI	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
85	NARASANNAPETA	0.6565	0.7089	0.9262	irs	0.6933	0.7029	0.9864	irs	0.7408	0.7421	0.9983	DRS	0.7941	0.961	0.8264	DRS
86	PALAKONDA	0.5672	0.6639	0.8544	irs	0.6037	0.6329	0.9539	irs	0.6487	0.6784	0.9561	irs	0.6003	0.6416	0.9356	irs
87	PATHAPATNAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	0.5866	0.8844	0.6633	irs
88	PONDURU	1	1	1	crs	1	1	1	crs	1	1	1	crs	0.9836	1	0.9836	DRS
89	RAJAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	0.9829	1	0.9829	DRS
90	SOMPETA	0.8009	0.824	0.9719	irs	0.7487	0.7609	0.9839	irs	0.931	1	0.931	DRS	0.6927	0.7808	0.8871	irs
91	SRIKAKULAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
92	TEKKALI	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
93	BOBILI	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
94	CHEPURUPALLI	0.958	0.9898	0.9679	irs	0.757	0.9952	0.7606	irs	0.8458	0.9709	0.8712	irs	0.7589	0.9979	0.7605	irs
95	GAJAPATHINAGARAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
96	KOTHAVALASA	0.6745	0.8359	0.8069	irs	0.6745	0.8983	0.7509	irs	0.6745	0.8359	0.8069	irs	0.6745	0.8394	0.8035	irs
97	KURUPAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
98	PARVATHIPURAM	1	1	1	crs	1	1	1	crs	0.9479	1	0.9479	DRS	0.9167	1	0.9167	DRS
99	PUSUPATHIREGA	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
100	SALURU	0.8875	0.9235	0.961	irs	0.6445	0.9099	0.7083	irs	0.6445	0.8432	0.7644	irs	0.6445	0.8395	0.7678	irs
101	VIJAYANAGARAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
102	ANAKAPALLI	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
103	BHEEMUNEPATNAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
104	CHINTHAPALLI	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
105	CHODAVARAM	0.8216	0.9958	0.8251	irs	0.7969	0.9998	0.7971	irs	0.5593	1	0.5593	irs	1	1	1	crs
106	NARSIPATNAM	1	1	1	crs	0.9169	1	0.9169	irs	1	1	1	crs	0.8433	0.9319	0.9049	irs

Table 5 (Cont'd) : DEA analysis – Calculation of CRS, VRS, Scale efficiency and Return to Scale of selected AMCs in Coastal region of A.P. during 2005-2009 :

#	Name	CRS	VRS	Scale	RTS	CRS	VRS	Scale	RTS	CRS	VRS	Scale	RTS	CRS	VRS	Scale	RTS
107	PADERU	1	1	1	crs	1	1	1	crs	1	1	1	crs	0.5359	0.9912	0.5407	irs
108	VISAKAPATNAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
109	YELAMANCHELLI	0.8226	1	0.8226	irs	0.8468	1	0.8468	irs	1	1	1	crs	0.9618	1	0.9618	irs
110	ACHANTA	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
111	AKIVIDU	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
112	ATTILI	1	1	1	crs	1	1	1	crs	0.995	1	0.995	DRS	1	1	1	crs
113	BHEMADOLU	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
114	BHIVARAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
115	CHINTALAPUDI	0.7999	0.8623	0.9277	irs	0.8623	0.8889	0.9701	irs	0.8672	0.8691	0.9978	irs	0.9618	1	0.9618	DRS
116	DENDLURU	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
117	ELURU	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
118	GOPALAPURAM	0.7165	1	0.7165	irs	0.7888	1	0.7888	irs	0.6746	0.9792	0.6889	irs	0.5224	1	0.5224	irs
119	KOVVUR	0.832	0.9063	0.918	DRS	1	1	1	crs	0.7366	0.769	0.9579	irs	0.9842	1	0.9842	DRS
120	NARSAPURAM	0.9076	0.9472	0.9582	DRS	1	1	1	crs	0.7418	0.7422	0.9995	irs	0.6691	0.7083	0.9446	irs
121	PALAKOLLU	1	1	1	crs	0.8619	1	0.8619	irs	0.8559	1	0.8559	irs	0.922	1	0.922	irs
122	PENUGONDA	1	1	1	crs	1	1	1	crs	0.916	1	0.916	DRS	0.8833	0.9866	0.8953	DRS
123	POLAVARAM	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
124	TADEPALLEGUDEM	1	1	1	crs	1	1	1	crs	1	1	1	crs	0.5529	0.699	0.7909	irs
125	TANAKU	1	1	1	crs	0.9974	1	0.9974	DRS	1	1	1	crs	1	1	1	crs
126	UNDI	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
127	UNGUTUR	1	1	1	crs	1	1	1	crs	1	1	1	crs	1	1	1	crs
	MEAN	0.9138	0.9724	0.9381		0.9221	0.9782	0.9415		0.9112	0.9678	0.9399		0.8871	0.9696	0.9127	
	S.D.	0.1572	0.069	0.1371		0.1436	0.064	0.1265		0.1453	0.0737	0.1221		0.1736	0.0782	0.1505	

Table 6: Mean Technical Efficiencies – District-wise and Year-wise for AMCs in Coastal region of A.P. during 2005-2009

District	2005-06			2006-07			2007-08			2008-09		
	CRS	VRS	SCALE	CRS	VRS	SCALE	CRS	VRS	SCALE	CRS	VRS	SCALE
EG	0.9609	0.9851	0.9747	0.9745	0.9944	0.9799	0.9393	0.9676	0.9707	0.9208	0.9681	0.9485
Guntur	0.813	1	0.813	0.8509	1	0.8509	0.8864	1	0.8864	0.8495	1	0.8495
Krishna	0.8678	0.9171	0.9383	0.8805	0.9416	0.9274	0.8516	0.9291	0.909	0.873	0.9383	0.9227
Nellore	0.9593	0.9858	0.9697	0.9833	0.9969	0.9859	0.9679	0.9915	0.9748	0.9205	0.974	0.9417
PRKS	0.9361	0.9776	0.9575	0.9275	0.9701	0.9562	0.8972	0.957	0.9352	0.8978	0.9867	0.9092
SKLM	0.8714	0.9382	0.9274	0.874	0.9305	0.9415	0.9059	0.9554	0.9493	0.8087	0.9437	0.8579
VJNR	0.9467	0.9721	0.9706	0.8973	0.9782	0.9133	0.9014	0.9611	0.9323	0.8883	0.9641	0.9165
VSKP	0.9555	0.9995	0.956	0.9451	1	0.9451	0.9449	1	0.9449	0.9176	0.9904	0.9259
WG	0.9587	0.9842	0.9734	0.9728	0.9938	0.9788	0.9326	0.9644	0.9673	0.9164	0.9663	0.9456

Note : EG=East Godavari, PRKS=Prakasam, SKLM=Srikakulam, VJNR=Vijayanagaram, VSKP=Visakapatnam, WG=West Godavari.

Table 7 : AMCs along with efficiencies and Statistical analysis in Coastal region of A.P. during 2005-2009 :

Description	2005-06			2006-07			2007-08			2008-09		
	CRS	VRS	SCALE	CRS	VRS	SCALE	CRS	VRS	SCALE	CRS	VRS	SCALE
No. of AMCs evaluated	127	127	127	127	128	127	127	127	128	127	12	127
No. of efficient AMCs	83	103	83	85	107	85	80	101	80	71	101	71
No. of Inefficient AMCs	44	24	44	42	20	42	47	26	47	56	26	56
Mean Score	0.9138	0.9724	0.9381	0.9221	0.9782	0.9415	0.9112	0.9678	0.9399	0.8871	0.9696	0.9127
Standard Deviation	0.1572	0.069	0.1371	0.1436	0.064	0.1265	0.1453	0.0737	0.1221	0.1736	0.0782	0.1505
Maximum Score	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Minimum Score	0.3158	0.6639	0.3158	0.3158	0.6329	0.3158	0.4390	06784	0.4556	0.3158	0.6990	0.3158