A STUDY ON EFFICIENT VALUE CHAIN MANAGEMENT OF GRAPES IN NORTHERN KARNATAKA

NIRANJAN NADONI¹, K. UMA² & SHREEDEVI GANGANAVAR³

¹Research Scholar, Department of Agricultural & Rural Management, Tamil Nadu Agricultural
University, Coimbatore, Tamil Nadu, India

²Professor, Department of Sericulture, Forest College and Research Institute, Mettupalayam, TNAU, Tamil Nadu, India

³Project Officer, Indian Society of Agribusiness Professionals, New Delhi, India

ABSTRACT

Grapes are the rich sources of vitamins and minerals for consumers and income for those involved in production and marketing. Having first-hand information about grape production and marketing system is essential to devise appropriate strategies aimed at enhancing grape market chain development. The study was based on primary data collected from the sample of grapes growers, PHC, wholesalers, Commission agents and retailers in Vijayapura, Belagavi and Bagalkot districts of Karnataka. The relative efficiency of the production stage and marketing stage was calculated by using the variable returns to scale method as well as the peer groups and their weights of variable returns to scale were computed using the input-oriented DEA. It was used to examine the efficiency level of the farmers and to indicate how the efficient peer group farmers would be helpful to inefficient farmers in improving their efficiency level. The results of the study indicated that Vijayapura farmers were highly efficient in grapes farming followed by Belagavi and Bagalkot districts. Vijayapura farmers had a relatively better efficiency in marketing stages due to a lesser number of intermediaries and lower transaction costs. From the Two Stage Value Chain Model, it was inferred that grapes producers in three districts were doing much better in production than in marketing. This indicated an opportunity to improve incomes from the marketing perspective rather than production in the study area. Reasons could be stated as the use of optimal inputs, technical advice, capacity development, better crop care coupled with good agricultural practices.

KEYWORDS: Data Envelopment Analysis, Efficient Value Chain & Two Stage Value Chain Model

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INTRODUCTION

India is the fruit and vegetable basket of the world. It is the home of a wide variety of fruit and vegetables and holds a unique position in production. The area under fruit crops has increased from 4.0 million ha in 2001-02 to 6.3 million ha in 2015-16, accounting for almost 23 per cent of the area under horticulture in India. Correspondingly, the production of fruits has almost doubled from 43.0 to 90.1 million tonnes, accounting for about 31.5 per cent of the total production of horticulture crops. In particular, India annually produces 29.1 million tonnes of banana followed by 18.6 million tonnes of mango, 11.5 million tonnes of citrus, 5.66 million tonnes of papaya, 4.0 million tonnes of guava and 2.5 million tonnes of grapes that accounts for 32.30 per cent of the country's banana and 2.87 per cent of the country's grape supply, respectively (Indian Horticulture Database, 2016). Among fruits, grapes vine is a most remunerative crop. It occupies sixth position among fruit crops in India.

The area under grapes is 1.9 per cent of total fruit crops and production share is 2.8 per cent in India.

In India, there is a sizeable increase in acreage and production of grapes in India. In acreage, there is an increase from 47.5 thousand ha in 2001-02 to 121.65 thousand ha in 2015-16. Similarly, the production has increased from 1,184.2 thousand tons in 2001-02 to 2,590.04 thousand tons in 2015-16. Maximum grape production takes place in Maharashtra (2048.11 thousand tons) State followed by Karnataka (429.78 thousand tons), and Tamil Nadu (34.10 thousand tons). Karnataka is India's second largest producer of grapes. It has prominent grape growing regions like Nandi Valley, Cauvery Valley, and Krishna Valley. The climate of the State is also conducive to grape cultivation. As such, the State has several vineyards and enjoys a healthy production of high -quality grapes every year. The total area and production of grapes in Karnataka are 23,350 ha, 4.29 lakh tonnes of grapes that accounts for 16.59 per cent of the country's share in the production of grapes. Vijayapura is the leading district in Karnataka with respect to both area and production of grapes. The total area and production of grapes in Vijayapura was 10.58 thousand hectares and 190.86 MT, accounting for 45.31 and 44.41 per cent of area and production of grapes in Karnataka respectively during 2015-16. Followed by Chikballapur (12.72 per cent), Belgavi (11.57 per cent), and Bagalkot (9.16 per cent) are the other major grapes growing districts of Karnataka.

The study was based on primary data collected from a sample of grapes growers, PHC, wholesalers, Commission agents and retailers in Vijayapura, Belgavi and Bagalkot districts of Karnataka. The results of the study will be helpful to improve grapes production and marketing practices for high- value realization. Effective value chain management would minimize production cost and increase market efficiency, thereby enhancing the profitability of the grapes farmers. The importance of studying the variability among actors in the value chain in terms of production and marketing is to bridge the gap between local and export market, as well as to help promote its value addition in each stage of the value chain and to understand the main factors that might help to reduce the variability in the grapes value chain. Therefore, The technical efficiency of the chains was calculated at both production and marketing stages to identify the chain efficiency. The main objective of the paper was to suggest suitable strategies for efficient value chain management of grapes in northern Karnataka.

METHODOLOGY

DEA was initiated by Charnes, Cooper, and Rhodes (1978) with assumptions of constant returns to scale in the production process. Banker, Charnes, and Cooper (1984) later proposed an alternative model that can handle more flexible cases of variable returns to scale. Following Sexton and Lewis (2003), we extend the classical DEA model to two-stage model. Please refer to Figure 1. The first Sub-DMU consumes inputs x_i to produce intermediate products z_d . These, in turn, are the inputs to the second Sub-DMU, which are used to produce the DMU's final outputs y_r . The advantage of the two-stage value chain model is capable to evaluate the relative efficiencies of each DMU and each of its sub-DMUs in a value chain.

In a two-stage value chain model, the grape value chain was conceived as a two-stage consisting of production and marketing operations. Grape value chain was visualized into DMUs, with production stage as sub-DMU1 and marketing stage as sub- DMU2. In the first stage, Cost of planting materials (Rs/ha), Farmyard manure (tonnes/ha), Fertilizers (kilograms per hectare), Human labour (Mondays'/ha), use of plant protection chemicals and growth regulators (Rupees per hectare) and managerial index were considered as input factors and quantity of grape produced by the farmers were considered as output factor. Managerial index was calculated by using educational status of the farmers (Illiterate-0, Primary education-1, Secondary-2, Higher secondary-3, Graduates-4), experience of the farmers (Less than 10 years of experience-1, 10-25 years-2, More than 25 years of experience-3), and knowledge level of the farmers (Trainings attended-1, Freshers-0). Sum of the values of educational status, experience and knowledge level of the farmers were considered as a managerial index and used for the analysis. In the second stage, harvested grape, farmer's net price, and intermediaries marketing costs were considered as input factor and the value of sold grapes was considered as output factor.

The relative efficiency of the production stage and marketing stage was calculated by using the variable returns to scale method as well as the peer groups and their weights of variable returns to scale were computed using the input-oriented DEA.

RESULTS AND DISCUSSIONS

1. Calculation of the Relative Efficiency of Grape Growers in Production and Marketing Stages

1.1 Evaluating the Relative Efficiency of Grape Growers in Production Stages

The efficiency scores under constant returns to scale (CRS) and variable returns to scale (VRS) assumptions, as well as the peer groups and their weights of variable returns to scale, were computed using the input-oriented DEA methodology and with the help of DEAP Version 2.0 software. It is noted that the results of CRS assumption are only appropriate when all DMUs are operating at optimal scale but this is not the case often due to constraints such as financial support, technological factors and knowledge level, thus making the VRS assumption a better model for evaluating efficiency.

District: Bagalkot

The results in Table 1, showed that in CRS assumption, About 53 per cent of farmers operated within a technical efficiency range of 0.70 to 0.90, followed by 35 per cent of the farmers greater than 0.90. Results implied that 65 per cent were not technically efficient with respect to the inputs (Fertilizers, manures and plant protection chemicals) usage in grapes production. They were identified mostly as small farmers. Furthermore, technical efficiency varied substantially between 0.6 and 1.00, with a mean technical efficiency of 0.84. Results suggested that, farmers were not utilizing their production resources efficiently, indicating that they are not obtaining maximal output from a given quantity of inputs available with them. In other terms, technical efficiency among farmers can be increased by 16 per cent through the better use of available production resources, given the current state of technology. Under VRS assumption almost all farmers (65 per cent) were highly efficient with an efficiency score of greater than 0.90, which infers that farmers were more efficient in grapes farming in the study area. About 36.65 per cent of grapes farmers operated in the scale efficiency group (0.70 to 0.90) which revealed that they had the scope to increase production by decreasing the input cost. About 58.33 per cent of grapes farmers belonged to the most efficient scale group (>0.90). The mean scale efficiency was 0.89.

Table 1: Frequency Distribution of the Relative Efficiency for Production Stage Efficiency Estimates

Efficiency Estimates	Frequency (CRS)	Percentage	Frequency (VRS)	Percentage	Frequency (Scale)	Percentage
District: Bagalkot						
<0.50	0	0.00	0	0.00	0	0
0.50 to 0.70	7	11.67	0	0.00	3	5.00
0.70 to 0.90	32	53.33	21	35.00	22	36.67
≥ 0.90	21	35.00	39	65.00	35	58.33
Mean	0.84		0.93		0.89	
Minimum Efficiency	0.6		0.76		0.63	
Maximum Efficiency	1.00		1.00		1.00	
District: Belagavi						
<0.50	0	0	0	0	0	0
0.50 to 0.70	0	0	0	0	0	0
0.70 to 0.90	16	26.67	5	8.33	10	16.67
≥ 0.90	44	73.33	55	91.67	50	83.33
Mean	0.92		0.97		0.94	
Minimum Efficiency	0.7		0.84		0.75	
Maximum Efficiency	1.00		1.00		1.00	
District: Vijayapura						
<0.50	0	0	0	0	0	0
0.50 to 0.70	0	0	0	0	0	0
0.70 to 0.90	26	43.33	13	21.67	10	16.67
≥ 0.90	34	56.67	47	78.33	50	83.33
Mean	0.90		0.94		0.95	
Minimum Efficiency	0.70		0.82		0.70	
Maximum Efficiency	1.00		1.00		1.00	

It could be observed from the Annexure 1, in Bagalkot district, that the efficient DMU's under the assumption of CRS and VRS were DMU 1, DMU 2, DMU 19, DMU 24, DMU 29, DMU 32, DMU 33, DMU 35, DMU 45 for the year 2015 -16. It could be noted from the Annexure 1, that the DMUs that were seen as more efficient and very much referenced by peers, by other relatively inefficient DMUs of the same or different peers. The "Peers" were the more efficient DMUs that have similar input usage as that of the less efficient, thereby representing the best practice that could be adopted by the less efficient DMU. The "lambda" values (peer weights) are computer generated weights to be assigned and used in the linear combination of the each peer's inputs so that a less efficient DMU could achieve its best practice target. For example, it could be inferred from the Annexure 5.2, that, DMU 5 needed to use 2.5, 46.8 and 50.8 per cent of inputs of DMU 2, DMU 22 and DMU 24, in order to be highly efficient under VRS. On production stage, most of the DMUs were efficient under the assumption of VRS but peered DMU would do best practices and technology to improve the product with available inputs, so all DMUs can adopt and show more efficiency and to maintain the current efficiency. Increasing returns to scale means farmers can increase their grapes production if they could operate at full technical efficiency levels while decreasing returns to scale indicates that efficiency can be improved if the DMU reduces its inputs used in the production. Annexure 1 also showed that most of the DMUs experienced an increasing return to scale with scale inefficiency except DMU 1, DMU 2, DMU 19, DMU 24, DMU 29, DMU 32, DMU 33, DMU 35 and DMU 45, which depicted constant returns to scale with 100 per cent scale efficiency.

District: Belagavi

It can be established that in CRS assumption, about 73.37 per cent of the farmers had higher efficiency scores ranging greater than 0.90. Only 27 per cent of the farmers were low efficient with the efficiency range 0.70 to 0.90. The mean efficiency under CRS assumption was 0.92. Results succinctly brought out the fact that, farmers were not efficiently using their resources and technical efficiency among farmers can be increased by 8 per cent through the better use of available inputs, given the current state of technology. Under VRS assumptions, about 91.67 per cent were efficient with an efficiency score of greater than 0.90, which infers that these farmers were efficient in grapes farming. About 83 per cent of grapes farmers belonged to the most efficient scale group (>0.90) which inferred that they had the scope to increase production by decreasing the input cost. The mean under scale efficiency was 0.94

District: Vijayapura

It can be stated that in CRS assumption, about 43 per cent of the small farmers had the efficiency ranging from 0.70 to 0.90. About 57.00 per cent of the farmers were highly efficient with the efficiency scores greater than or equal to 0.90. The mean efficiency under CRS assumption was 0.90. Almost all farmers (78.33 per cent) were highly efficient with an efficiency score of 1.00 in VRS assumptions, which infers that farmers were highly efficient in grapes farming. About 83 per cent of grapes farmers belonged to the most efficient scale group (>0.90). The mean under scale efficiency was relatively high of 0.95.

Results summarize that Vijayapura farmers were highly efficient in grapes farming followed by Belagavi and Bagalkot districts. Reasons can be stated as the use of optimal inputs, technical advice, capacity development, better crop care coupled with good agricultural practices.

1.2 Evaluating the Relative Efficiency of Grapes Growers in Marketing Stages

The efficiency of grapes growers in marketing stages is presented in the Annexure 1. It could be observed from the Annexure 1, in Bagalkot district, that the efficient DMU's under the assumption of CRS and VRS were DMU 24, DMU 35, DMU 39, DMU 40, DMU 42, DMU 48, DMU 50, DMU 51, DMU 56 and DMU 59 which had 100 per cent efficiency in both CRS and VRS assumption.

The DMUs that were seen as more efficient and very much referenced as peers by other relatively inefficient DMUs of the same or different were DMU 56 followed by DMU 22 for a record of 26 and 17 times respectively under VRS assumption. From the peer weights, it could be inferred from the Annexure 5.2, that DMU 1 needed to use 37.5 per cent and 62.5 per cent of the marketing tactics of DMU 22 and DMU 56 in order to be efficient under VRS assumption. Decreasing returns to scale indicates that efficiency can be improved if the DMU reduces its transaction cost while marketing. Increasing returns to scale means farmers can increase their income if they could operate at full technical efficiency levels. All DMUs experienced increasing returns to scale with scale inefficient expect DMU 7, DMU 24, DMU 35, DMU 39, DMU 40, DMU 42, DMU 48, DMU 50, DMU 51, DMU 56, and DMU 59 which depicted constant returns to scale with 100 per cent scale efficiency.

Table 2: Frequency Distribution of the Relative Efficiency for Marketing Stage Efficiency Estimates

Efficiency Estimates	Frequency (CRS)	Percentage	Frequency (VRS)	Percentage	Frequency (Scale)	Percentage
District: Bagalkot						
<0.50	0	0	0	0	0	0
0.50 to 0.70	2	3.33	0	0	2	3.33
0.70 to 0.90	24	40.00	0	0.00	23	38.34
≥ 0.90	34	56.67	60	100	35	58.33
Mean	0.90		0.99		0.90	
Minimum Efficiency	0.64		0.92		0.64	
Maximum Efficiency	1.00		1.00		1.00	
District: Belagavi						
<0.50	0	0.00	0	0.00	0	0.00
0.50 to 0.70	0	0.00	0	0.00	0	0.00
0.70 to 0.90	25	41.67	0	0.00	20	33.33
≥ 0.90	35	58.33	60	100	40	66.67
Mean	0.91		0.99		0.92	
Minimum Efficiency	0.78		0.94		0.78	
Maximum Efficiency	1.00		1.00		1.00	
District: Vijayapura						
<0.50	0	0.00	0	0.00	0	0.00
0.50 to 0.70	0	0.00	0	0.00	0	0.00
0.70 to 0.90	6	10.00	0	0.00	3	5.00
≥ 0.90	54	90.00	60	100	57	95.00
Mean	0.95		0.99		0.95	
Minimum Efficiency	0.86		0.95		0.89	
Maximum Efficiency	1.00		1.00		1.00	

The results in Table 2 stated that in CRS assumption in Bagalkot district, About 97 per cent of farmers operated within a technical efficiency range greater 0.70. Results implied that 3.00 per cent are not technically efficient in marketing. Furthermore, technical efficiency varied substantially between 0.64 and 1.00, with a mean technical efficiency of 0.90. Results suggested that marketing efficiency among farmers can be increased by 10 per cent through reduction of transaction costs.

In Belagavi district, about 58 per cent of the farmers had higher efficiency scores ranging greater than 0.90. The mean efficiency under CRS assumption was higher at 0.91. Results indicate that marketing efficiency among farmers can be increased by 9 per cent by reduction of margins of intermediaries and transaction costs or choosing intermediaries of less marketing costs.

Similarly, in Vijayapura district, 90 per cent had a higher efficiency ranging greater than 0.90. The mean efficiency under CRS assumption was 0.95.

Results summarize that Vijayapura farmers had a relatively better efficiency in marketing stages due to lesser no of intermediaries and lower transaction costs. In a Two Stage, Value Chain Model inferred that grapes producers in three districts are doing much better in production than in marketing. This indicated an opportunity to improve incomes lie in marketing perspectives rather than for production in the study areas.

CONCLUSIONS

In the present study, the relative efficiency of grape growers in production stages results summarized that Vijayapura farmers were highly efficient in grape farming followed by Belagavi and Bagalkot districts. This was plausible with better use of optimal inputs, technical advice, and capacity development, better crop care, coupled with good agricultural practices by Vijayapura farmers as compared to Belagavi and Bagalkot districts. And in the relative efficiency of grape growers in marketing stages results summarize that Vijayapura farmers had a relatively better efficiency in marketing stages due to lesser no of intermediaries and lower transaction costs.

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Annexure 1: Efficiency Scores – DEA Approach

DMU's	Production Stage						Marketing Stage					
	CRS	VRS	Scale		Peer Groups	Peer Weights	CRS	VRS	Scale		Peer Groups	Peer Weights
BAGALKOT DISTRICT												
1	1.000	1.000	1.000	-	1	1.000	0.768	1.000	0.768	irs	22 56	0.375 0.625
2	1.000	1.000	1.000	-	2	1.000	0.851	0.981	0.868	irs	15 29 56 22	0.251 0.319 0.049 0.381
3	0.923	1.000	0.923	irs	3	1.000	0.817	0.978	0.836	irs	15 29 22 11	0.498 0.292 0.071 0.139
4	0.763	1.000	0.763	irs	4	1.000	0.855	1.000	0.855	irs	15 22	0.333 0.667
5	0.799	0.990	0.807	irs	2 22 24	0.025 0.468 0.508	0.957	1.000	0.957	irs	15 56	0.375 0.625
6	0.937	0.938	0.999	irs	46 24 33 2	0.113 0.011 0.170 0.706	0.851	1.000	0.851	irs	15 56 22	0.118 0.208 0.674
7	0.823	0.870	0.946	irs	39 2 33 24	0.261 0.443 0.279 0.017	1.000	1.000	1.000	-	7	1.000
8	0.691	0.786	0.879	irs	4 39 24	0.287 0.590 0.123	0.827	0.979	0.845	irs	56 22	0.514 0.486
9	0.746	1.000	0.746	irs	9	1.000	0.830	1.000	0.830	irs	9	1.000
10	0.979	0.987	0.992	irs	2 24 46 33	0.138 0.148 0.502 0.212	0.767	1.000	0.767	irs	56 22	0.625 0.375
11	0.753	0.826	0.912	irs	39 24 4	0.639 0.205 0.156	0.820	1.000	0.820	irs	11	1.000
12	0.952	0.999	0.953	irs	39 44 28 33	0.153 0.056 0.156 0.635	0.852	1.000	0.852	irs	35 56 15	0.049 0.146 0.806
13	0.976	0.982	0.994	irs	39 33 24 1	0.096 0.152 0.412 0.341	0.854	1.000	0.854	irs	15 22 56	0.118 0.674 0.208
14	0.857	1.000	0.857	irs	14	1.000	0.843	0.992	0.849	irs	39 24 22	0.271 0.036 0.693
15	0.727	0.793	0.917	irs	33 24 39 4	0.035 0.095 0.822 0.048	0.997	1.000	0.997	irs	15	1.000
16	0.874	1.000	0.874	irs	16	1.000	0.871	0.979	0.890	irs	15 56 22 29	0.258 0.162 0.356 0.224
17	0.839	0.925	0.907	irs	33 2 24	0.011 0.257 0.732	0.755	1.000	0.755	irs	9 15 35	0.608 0.203 0.190
18	0.622	0.859	0.725	irs	24 23 39 4	0.173 0.167 0.259 0.400	0.777	0.967	0.804	irs	11 9 35 15 22 29	0.197 0.485 0.065 0.183 0.059 0.011
19	1.000	1.000	1.000	-	19	1.000	0.791	0.965	0.820	irs	24 15 29 56	0.557 0.115 0.078 0.250
20	0.830	0.859	0.966	irs	39 33 1	0.340 0.649 0.011	0.852	0.981	0.868	irs	56 15 22	0.118 0.284 0.598
21	0.667	0.767	0.869	irs	33 39 28 44	0.095 0.863 0.025 0.017	0.818	0.979	0.835	irs	15 22 56	0.138 0.755 0.106
22	0.783	1.000	0.783	irs	22	1.000	0.786	1.000	0.786	irs	22	1.000
23	0.636	1.000	0.636	irs	23	1.000	0.844	0.980	0.861	irs	24 35 22 28	0.214 0.109 0.648 0.029
24	1.000	1.000	1.000	-	24	1.000	1.000	1.000	1.000	-	24	1.000
25	0.746	0.885	0.843	irs	24 2 37 22	0.698 0.065 0.084 0.153	0.645	1.000	0.645	irs	56 29	0.526 0.474
26	0.824	0.986	0.835	irs	28 1 14	0.041 0.004 0.956	0.677	1.000	0.677	irs	56 29	0.526 0.474
27	0.941	1.000	0.941	irs	27	1.000	0.886	0.982	0.902	irs	15 29 22 24	0.324 0.435 0.147 0.094
28	0.777	1.000	0.777	irs	28	1.000	0.858	1.000	0.858	irs	28	1.000

Table Continued

29	1.000	1.000	1.000	-	29	1.000	0.868	1.000	0.868	irs	29	1.000
30	0.814	0.893	0.912	irs	2 33 29 28	0.127 0.455 0.030 0.387	0.791	0.927	0.853	irs	24 15 11 56 29 22	0.002 0.035 0.160 0.107 0.429 0.268
31	0.930	0.989	0.940	irs	33 28 39 2	0.562 0.235 0.166 0.037	0.970	1.000	0.970	irs	35	1.000
32	0.972	0.972	1.000	-	24 29 33 46	0.009 0.103 0.766 0.122	0.909	1.000	0.909	irs	56	1.000
33	1.000	1.000	1.000	-	33	1.000	0.976	1.000	0.976	irs	56 39	0.800 0.200
34	0.827	1.000	0.827	irs	34	1.000	0.926	1.000	0.926	irs	56 39	0.400 0.600
35	0.870	0.870	1.000	-	1 24 39 33	0.331 0.320 0.005 0.344	1.000	1.000	1.000	-	35	1.000
36	0.976	0.997	0.978	irs	2 3	0.947 0.053	0.963	0.985	0.978	irs	56 48 50	0.670 0.042 0.288
37	0.860	1.000	0.860	irs	37	1.000	0.909	1.000	0.909	irs	35	1.000
38	0.679	1.000	0.679	irs	23 4 3	0.097 0.742 0.161	0.969	1.000	0.969	irs	50	1.000
39	0.910	1.000	0.910	irs	39	1.000	1.000	1.000	1.000	-	39	1.000
40	0.966	0.970	0.995	irs	2 46 33 24	0.175 0.195 0.546 0.084	1.000	1.000	1.000	-	40	1.000
41	0.696	0.834	0.835	irs	24 28 39 23	0.161 0.210 0.587 0.042	0.964	1.000	0.964	irs	41	1.000
42	0.843	0.882	0.956	irs	1 33 39	0.206 0.389 0.404	1.000	1.000	1.000	-	42	1.000
43	0.838	0.976	0.859	irs	2 37 39 24 4	0.353 0.048 0.313 0.238 0.048	0.969	1.000	0.969	irs	39	1.000
44	0.875	1.000	0.875	irs	44	1.000	0.971	1.000	0.971	irs	44	1.000
45	0.779	0.858	0.908	-	44 28 24 39	0.370 0.027 0.145 0.457	0.949	0.979	0.970	irs	35 56	0.574 0.426
46	1.000	1.000	1.000	irs	46	1.000	0.970	1.000	0.970	irs	56	1.000
47	0.729	0.868	0.840	irs	2 3 37 24 4	0.226 0.024 0.256 0.318 0.176	0.939	1.000	0.939	irs	35	1.000
48	0.737	0.877	0.840	irs	33 4 39 24	0.036 0.727 0.079 0.158	1.000	1.000	1.000	-	48	1.000
49	0.815	0.853	0.955	irs	33 4 39 2	0.629 0.099 0.245 0.027	0.939	1.000	0.939	irs	35	1.000
50	0.851	0.859	0.990	irs	33 24 1 39	0.248 0.263 0.297 0.192	1.000	1.000	1.000	-	50	1.000
51	0.770	0.906	0.850	irs	23 39 24 4	0.064 0.338 0.180 0.418	0.979	0.979	1.000	-	35	0.259 0.138 0.521 0.082
52	0.923	0.928	0.994	irs	39 24	0.095 0.905	0.947	0.993	0.954	irs	48 50 39 44	0.750 0.250
53	0.600	0.869	0.691	irs	23 4 24 37 3	0.355 0.516 0.069 0.030 0.030	0.970	1.000	0.970	irs	48 56	0.400 0.600
54	0.930	0.955	0.974	irs	33 1 39	0.207 0.563 0.230	0.982	1.000	0.982	irs	39 56	1.000
55	0.796	0.824	0.966	irs	1 44 33 39	0.011 0.044 0.649 0.297	0.939	1.000	0.939	irs	35	1.000
56	0.831	1.000	0.831	irs	39	1.000	1.000	1.000	1.000	-	56	1.000
57	0.790	0.874	0.904	irs	24 39 37 3	0.271 0.040 0.162 0.528	0.949	0.979	0.970	irs	35	0.490 0.091 0.216 0.160 0.043
58	0.778	1.000	0.778	irs	58	1.000	0.941	0.995	0.946	irs	48 50 41 56 44	1.000
59	0.840	0.854	0.983	irs	2 33 24	0.316 0.545 0.139	1.000	1.000	1.000	-	35	1.000
60	0.954	0.983	0.971	irs	24 2 33 39	0.678 0.050 0.117 0.154	0.970	1.000	0.970	irs	56	1.000

Table

DMU's	Production Stage						Marketing Stage					
	CRS	VRS	Scale		Peer Groups	Peer Weights	CRS	VRS	Scale		Peer Groups	Peer Weights
BELAGAVI DISTRICT												
1	0.892	1.000	0.892	irs	1	1.000	0.868	1.000	0.868	irs	1	1.000
2	0.910	0.945	0.963	irs	(15 5 19 36 40)	0.169 0.283 0.290 0.241 0.017	0.814	1.000	0.814	irs	2	1.000
3	0.912	0.927	0.984	irs	(57 58 19 48)	0.206 0.223 0.474 0.097	0.862	1.000	0.862	irs	35 59	0.500 0.500
4	0.771	1.000	0.771	irs	4	1.000	1.000	1.000	1.000	-	4	1.000
5	0.956	1.000	0.956	irs	5	1.000	1.000	1.000	1.000	-	5	1.000
6	1.000	1.000	1.000	-	6	1.000	0.946	0.960	0.985	irs	59 5 26	0.500 0.489 0.011
7	0.970	0.972	0.999	irs	(40 15 59)	0.157 0.160 0.68	0.849	0.943	0.900	irs	26 59 56	0.235 0.531 0.235
8	0.989	1.000	0.989	irs	8	1.000	1.000	1.000	1.000	-	8	1.000
9	0.919	0.992	0.926	irs	19 21 25	0.342 0.056 0.602	0.929	1.000	0.929	irs	49 59	0.400 0.600
10	0.932	0.952	0.980	irs	15 8 40 58 30	0.022 0.786 0.072 0.026 0.093	0.966	0.978	0.988	irs	26 59 5	0.463 0.250 0.287
11	0.769	0.890	0.864	irs	19 57 4 30 56	0.464 0.179 0.224 0.053 0.079	0.988	0.997	0.990	irs	5 8 26 1	0.342 0.389 0.205 0.065
12	0.959	0.959	1.000	-	58 40 19 24	0.187 0.075 0.565 0.173	0.918	0.969	0.947	irs	26 5 59	0.163 0.337 0.500
13	0.946	0.962	0.984	irs	19 21 40 36 23 30	0.344 0.033 0.031 0.104 0.429 0.059	0.874	0.955	0.915	irs	26 59 56 16	0.081 0.637 0.182 0.101
14	0.768	1.000	0.768	irs	14	1.000	0.959	0.982	0.977	irs	26 59 16	0.273 0.500 0.227
15	1.000	1.000	1.000	-	15	1.000	1.000	1.000	1.000	-	15	1.000
16	0.905	0.944	0.959	irs	8 40 30 48	0.413 0.023 0.519 0.046	1.000	1.000	1.000	-	16	1.000
17	0.954	0.983	0.970	irs	40 5 15 19 36	0.040 0.236 0.295 0.199 0.230	0.869	1.000	0.869	irs	35	1.000
18	0.842	0.877	0.960	irs	36 30 15 21 40	0.283 0.008 0.109 0.591 0.010	0.927	1.000	0.927	irs	18	1.000
19	1.000	1.000	1.000	-	19	1.000	0.914	1.000	0.914	irs	19	1.000
20	0.891	0.993	0.896	irs	19 21 14 1	0.141 0.532 0.139 0.188	0.804	1.000	0.804	irs	59	1.000
21	1.000	1.000	1.000	-	21	1.000	0.893	0.983	0.908	irs	41 35 2 59	0.105 0.190 0.138 0.567
22	0.931	0.979	0.951	irs	19 57 40 48 25	0.134 0.151 0.045 0.382 0.288	0.853	0.981	0.870	irs	44 35 42	0.494 0.500 0.006
23	0.994	1.000	0.994	irs	23	1.000	0.830	0.980	0.847	irs	41 59	0.939 0.061
24	1.000	1.000	1.000	-	24	1.000	0.939	1.000	0.939	irs	16 59	0.500 0.500
25	0.904	1.000	0.904	irs	25	1.000	0.978	0.995	0.983	irs	34 5 35 48	0.011 0.624 0.120 0.246

Table Continued

26	0.879	0.974	0.903	irs	40 30 8	0.044 0.543 0.413	1.000	1.000	1.000	-	26	1.000
27	0.950	0.999	0.951	irs	23 25 40 21 5	0.604 0.170 0.041 0.171 0.014	0.914	0.983	0.930	irs	8 16 1	0.567 0.006 0.428
28	0.700	0.881	0.795	irs	30 51 21 4	0.492 0.087 0.413 0.008	0.871	0.944	0.923	irs	59 44	0.308 0.692
29	0.971	0.971	1.000	-	19 58 40 59 15	0.051 0.226 0.035 0.493 0.195	0.952	0.964	0.987	irs	5 26 16 59	0.074 0.275 0.151 0.500
30	0.950	1.000	0.950	irs	30	1.000	0.996	1.000	0.996	drs	8	1.000
31	0.901	0.978	0.921	irs	30 40	0.713 0.287	1.000	1.000	1.000	-	31	1.000
32	0.989	0.991	0.998	irs	58 40 19 48	0.039 0.095 0.822 0.043	0.942	1.000	0.942	irs	59 16	0.500 0.500
33	0.932	0.932	1.000	-	58 40 19 24	0.299 0.097 0.449 0.155	0.844	0.960	0.879	irs	41 59 16	0.187 0.627 0.187
34	0.888	0.984	0.902	irs	19 25 51 40 4	0.018 0.879 0.075 0.018 0.010	0.976	1.000	0.976	irs	34	1.000
35	0.928	0.999	0.929	irs	19 57 56 51 4	0.302 0.393 0.020 0.278 0.007	0.874	1.000	0.874	irs	35	1.000
36	1.000	1.000	1.000	-	36	1.000	0.853	1.000	0.853	irs	2 59	0.500 0.500
37	0.921	0.939	0.982	irs	19 21 25	0.850 0.023 0.126	0.819	1.000	0.819	irs	41	1.000
38	0.937	0.939	0.998	irs	58 19 8	0.739 0.087 0.173	0.784	0.980	0.800	irs	59 41 2	0.505 0.051 0.444
39	0.877	0.981	0.894	irs	40 30	0.609 0.391	0.961	1.000	0.961	irs	42	1.000
40	1.000	1.000	1.000	-	40	1.000	0.979	0.990	0.988	irs	44 59	0.451 0.549
41	0.808	0.849	0.952	irs	30 40 15 21	0.532 0.202 0.080 0.186	0.869	1.000	0.869	irs	41	1.000
42	0.919	0.923	0.996	irs	8 15 19 58	0.332 0.010 0.554 0.104	0.961	1.000	0.961	irs	42	1.000
43	0.941	0.970	0.971	irs	19 21 25	0.731 0.015 0.254	0.961	1.000	0.961	irs	42	1.000
44	0.966	0.989	0.977	irs	8 5 40 19 58	0.336 0.458 0.026 0.056 0.124	1.000	1.000	1.000	-	44	1.000
45	0.918	0.935	0.982	irs	40 5 15 19 36	0.090 0.027 0.393 0.047 0.443	0.823	1.000	0.823	irs	45	1.000
46	1.000	1.000	1.000	-	46	1.000	0.849	1.000	0.849	irs	59	1.000
47	0.750	1.000	0.750	irs	47	1.000	0.891	0.940	0.948	irs	55 48 5 59 56	0.050 0.060 0.443 0.444
48	0.955	1.000	0.955	irs	48	1.000	1.000	1.000	1.000	-	48	1.000
49	0.883	0.916	0.965	irs	8 48 40 57 58	0.045 0.703 0.069 0.100 0.083	1.000	1.000	1.000	-	49	1.000
50	0.956	0.958	0.998	irs	40 24 58	0.214 0.650 0.136	1.000	1.000	1.000	-	50	1.000
51	0.888	1.000	0.888	irs	51	1.000	1.000	1.000	1.000	-	44 5 35	0.012 0.744 0.244
52	0.904	0.940	0.962	irs	5 19 25 23 36	0.470 0.335 0.092 0.089 0.013	0.862	1.000	0.862	irs	59	1.000
53	0.948	0.976	0.972	irs	8 57 5 40 19	0.274 0.516 0.143 0.007 0.061	1.000	1.000	1.000	-	53	1.000
54	0.949	1.000	0.949	irs	19	1.000	0.886	1.000	0.886	irs	2 59	0.500 0.500
55	0.846	0.890	0.951	irs	21 19 40 25 30 51	0.282 0.302 0.119 0.055 0.125	0.922	1.000	0.922	irs	55	1.000
56	0.820	1.000	0.820	irs	56	1.000	0.806	1.000	0.806	irs	56	1.000
57	0.970	1.000	0.970	irs	57	1.000	0.860	0.980	0.878	irs	2 41 59	0.439 0.061 0.500
58	1.000	1.000	1.000	-	58	1.000	0.903	1.000	0.903	irs	58	1.000
59	1.000	1.000	1.000	-	59	1.000	1.000	1.000	1.000	-	59	1.000
60	0.950	0.995	0.954	irs	8 57 40 30	0.351 0.181 0.189 0.279	0.784	1.000	0.784	irs	35	1.000

Table

DMU's	Production Stage						Marketing Stage					
	CRS	VRS	Scale		Peer Groups	Peer Weights	CRS	VRS	Scale		Peer Groups	Peer Weights
VIJAYAPURA DISTRICT												
1	1.000	1.000	1.000	-	1	1.000	0.897	0.981	0.914	irs	24 29 35	0.494 0.502 0.005
2	1.000	1.000	1.000	-	2	1.000	0.903	0.971	0.930	irs	12 22 26 13 16	0.250 0.100 0.423 0.217 0.009
3	0.936	0.963	0.972	irs	1 8 58 19 2	0.001 0.233 0.210 0.370 0.188	1.000	1.000	1.000	-	3	1.000
4	0.860	0.895	0.962	irs	10 27 11 51 2	0.185 0.042 0.384 0.116 0.273	0.893	0.990	0.902	irs	13 22 15	0.103 0.759 0.138
5	0.760	0.888	0.856	irs	36 10 21 18	0.234 0.398 0.107 0.262	0.935	1.000	0.935	irs	5	1.000
6	0.919	0.955	0.962	irs	39 1 8 27	0.063 0.144 0.686 0.107	0.953	0.953	1.000	-	12 9 17 26	0.070 0.288 0.080 0.562
7	1.000	1.000	1.000	-	7	1.000	0.890	0.988	0.901	irs	22 26 16	0.548 0.147 0.305
8	0.998	1.000	0.998	irs	8	1.000	0.916	0.984	0.931	irs	26 9 22	0.236 0.493 0.271
9	0.897	0.985	0.911	irs	27 51 19 8	0.405 0.078 0.207 0.310	1.000	1.000	1.000	-	9	1.000
10	0.879	1.000	0.879	irs	10	1.000	0.911	0.979	0.930	irs	26 12 22 9	0.693 0.143 0.163 0.001
11	1.000	1.000	1.000	-	11	1.000	0.939	1.000	0.939	irs	11	1.000
12	0.932	0.951	0.980	irs	2 11 43 49	0.403 0.200 0.108 0.289	1.000	1.000	1.000	-	12	1.000
13	0.836	0.914	0.915	irs	27 19 51 8	0.767 0.084 0.028 0.121	1.000	1.000	1.000	-	13	1.000
14	0.709	1.000	0.709	irs	14	1.000	0.906	1.000	0.906	irs	14	1.000
15	0.818	0.835	0.980	irs	8 18 51 36	0.770 0.134 0.051 0.046	0.945	1.000	0.945	irs	15	1.000
16	0.999	1.000	0.999	drs	16	1.000	0.937	1.000	0.937	irs	16	1.000
17	0.953	0.955	0.998	irs	10 21 27 35	0.011 0.052 0.836 0.101	1.000	1.000	1.000	-	17	1.000
18	0.963	1.000	0.963	irs	18	1.000	0.882	0.983	0.897	irs	9 32 26 11	0.307 0.000 0.188 0.504
19	1.000	1.000	1.000	-	19	1.000	0.914	0.974	0.938	irs	11 24 9 26 29	0.028 0.356 0.450 0.080 0.086
20	0.824	0.958	0.860	irs	51 21 56 36	0.049 0.278 0.310 0.363	0.999	0.999	1.000	-	13 9 12 26	0.081 0.156 0.155 0.607
21	1.000	1.000	1.000	-	21	1.000	0.893	0.995	0.897	irs	22 13	0.381 0.619
22	0.947	0.948	0.998	irs	7 58 8 27	0.078 0.006 0.030 0.886	0.949	1.000	0.949	irs	22	1.000
23	0.969	0.987	0.981	irs	27 2 35 10	0.278 0.392 0.104 0.227	1.000	1.000	1.000	-	23	1.000
24	0.852	0.868	0.982	irs	27 11 2 10	0.340 0.242 0.174 0.244	0.949	1.000	0.949	irs	24	1.000
25	0.850	0.870	0.977	irs	2 11 10 27 49	0.051 0.198 0.285 0.451 0.015	0.973	1.000	0.973	irs	25	1.000
26	0.929	0.929	1.000	-	7 35 16 27	0.063 0.361 0.305 0.272	1.000	1.000	1.000	-	26	1.000
27	1.000	1.000	1.000	-	27	1.000	1.000	1.000	1.000	-	27	1.000
28	0.802	0.926	0.866	irs	10 51 19 27	0.272 0.415 0.060 0.253	0.907	1.000	0.907	irs	9 29 22	0.200 0.400 0.400
29	0.967	0.971	0.996	irs	8 7 2 58 27	0.086 0.037 0.396 0.081 0.399	0.974	1.000	0.974	irs	29	1.000

Table Continued

30	0.781	0.874	0.893	irs	10 49 27 1 8	0.450 0.142 0.106 0.008 0.293	0.863	0.965	0.894	irs	26 13 12 22 11	0.520 0.083 0.205 0.144 0.048
31	0.777	0.875	0.888	irs	8 39 1	0.438 0.313 0.250	0.974	1.000	0.974	irs	31	1.000
32	0.866	0.901	0.961	irs	49 27 56 11	0.516 0.175 0.183 0.127	0.930	1.000	0.930	irs	32	1.000
33	0.987	1.000	0.987	drs	33	1.000	0.956	1.000	0.956	irs	35 59	0.500 0.500
34	0.876	0.897	0.977	irs	8 27 2 51	0.029 0.616 0.163 0.193	1.000	1.000	1.000	-	34	1.000
35	1.000	1.000	1.000	-	35	1.000	0.920	1.000	0.920	irs	35	1.000
36	1.000	1.000	1.000	-	36	1.000	0.957	0.990	0.967	irs	26 48 32 55 50	0.009 0.065 0.429 0.463 0.034
37	0.943	0.947	0.996	irs	35 2 21 27	0.424 0.365 0.144 0.067	0.911	0.982	0.929	irs	26 47 35 32 56	0.017 0.288 0.340 0.235 0.119
38	1.000	1.000	1.000	-	38	1.000	0.946	1.000	0.946	irs	50	1.000
39	1.000	1.000	1.000	-	39	1.000	0.963	1.000	0.963	irs	43	1.000
40	0.901	0.907	0.994	drs	7 39	0.236 0.764	0.990	0.998	0.992	drs	44 55	0.809 0.191
41	0.808	0.897	0.901	irs	8 39 27	0.292 0.221 0.487	0.930	1.000	0.930	irs	41	1.000
42	0.796	0.842	0.945	irs	27 49 56 11	0.512 0.361 0.034 0.093	0.963	1.000	0.963	irs	42	1.000
43	0.930	1.000	0.930	irs	43	1.000	0.963	1.000	0.963	irs	43	1.000
44	0.854	0.907	0.942	irs	27 8 58	0.287 0.554 0.159	1.000	1.000	1.000	-	44	1.000
45	0.927	0.945	0.981	irs	1 10 27 49	0.253 0.206 0.516 0.024	0.913	1.000	0.913	irs	35	1.000
46	0.897	0.910	0.986	irs	35 21 2 8 10	0.271 0.073 0.469 0.023 0.163	0.956	1.000	0.956	irs	35 59	0.500 0.500
47	0.764	0.832	0.918	irs	10 51 1 35	0.707 0.129 0.056 0.109	0.945	1.000	0.945	irs	47	1.000
48	0.889	1.000	0.889	irs	39 8	0.161 0.839	0.965	1.000	0.965	irs	78	1.000
49	1.000	1.000	1.000	-	49	1.000	1.000	1.000	1.000	-	55	1.000
50	0.922	0.923	0.999	-	7 58 2 8	0.144 0.062 0.463 0.332	0.946	1.000	0.946	irs	50	1.000
51	1.000	1.000	1.000	-	51	1.000	0.974	1.000	0.974	irs	51	1.000
52	0.785	0.939	0.836	irs	10 1 19 27	0.134 0.118 0.155 0.592	0.928	0.996	0.931	irs	44 35 47 9	0.080 0.159 0.747 0.014
53	1.000	1.000	1.000	-	53	1.000	0.929	0.992	0.936	irs	47 41 26 50	0.176 0.569 0.008 0.248
54	0.912	0.937	0.974	irs	2 49 11 27 10	0.514 0.022 0.061 0.056 0.346	0.958	1.000	0.958	irs	35 59	0.500 0.500
55	0.878	0.891	0.986	irs	35 2 10 27	0.067 0.080 0.166 0.687	1.000	1.000	1.000	-	55	1.000
56	0.859	1.000	0.859	irs	56	1.000	0.928	1.000	0.928	irs	56	1.000
57	0.925	0.955	0.968	irs	39 7 27	0.232 0.009 0.759	0.956	0.985	0.971	irs	26 50 51 32 48 55	0.014 0.247 0.220 0.069 0.135 0.315
58	1.000	1.000	1.000	-	58	1.000	0.962	0.997	0.965	irs	44 41 26 35 55 32	0.270 0.357 0.003 0.075 0.229 0.066
59	0.756	0.826	0.916	irs	2 27 10 8 58	0.037 0.353 0.224 0.381 0.005	1.000	1.000	1.000	-	59	1.000
60	0.875	0.920	0.951	irs	58 7 39 27	0.032 0.066 0.433 0.469	0.928	1.000	0.928	irs	47 35	0.500 0.500