Evaluation of Indian Dairy and Agro Industry on Green Performance Index for Implementing Green Supply Chain Management

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Abstract

This paper aims to evaluate Indian dairy and Agro industry on green performance index so as to implement green supply chain management effectively. To achieve this, twenty dairy and agro industries had been selected for survey. Primary data was collected through survey in dairy and Agro industry using standard questionnaire. The initial score is then calculated using the questionnaire based on five point linker type scale. Thereafter, it is checked for reliability. The score is then multiplied with the weighted score to get the final score. The weighted score has been taken from the results of AHP analysis.

The measurement of dairy and agro industry on GPI shows that few industries are in the initial stage of adoption of GSCM where as some are medium adopters but found no company Who is an early adopter of GSCM depending upon their final scores on the GPI scale. This work is the first attempt to evaluate dairy and agro industry on GPI which gives self assessment tool to the company who is being evaluated for implementation of GSCM.

Keywords - Green Supply Chain Management (GSCM), Green Performance Index (GPI), International Organization for Standardization (ISO), Analytic Hierarchy Process (AHP).

Introduction

In the present scenario, almost every industry is showing concern towards environmental sustainability and is keen to implement more and more green practices due to global trend of implementing green operations. There is also a lot of pressure from environmental regulations and growing demand of more and more green products by the customer. Green supply chain management is the latest approach by which we can add green concept in the life cycle of product development. This is why? GSCM is gaining special attention amongst the policy makers and research scholars. At this point of time, every industry wants to access and rate itself to some scale of green practices so as to know where it stands and how it can do further improvements in implementing green operations. The aim of the present study is to measure the performance of different dairy and agro based industry to green performance index.

GSCM and GPI

GSCM: It is a system improvement approach in which green factor is incorporated in the traditional supply chain by implementing green practices e.g. green design, green manufacturing, green purchasing, and green transportation etc. so as to achieve eco efficiency. Green supply chain with integrated green factor is depicted in Fig 2. It has emerged as a very effective tool to attain goals set for achieving environmental sustainability. The main objective of the traditional supply chain is economic where as in

green supply chain management it is economic and ecological at the same time. Ecological factor is also considered while selecting suppliers. The transportation and the use of warehouses are usually collaborative in GSCM instead of individual as in the case of traditional supply chain. Recovery of used and waste material is also carried out in GSCM.

Figure 1 : Traditional Supply Chain

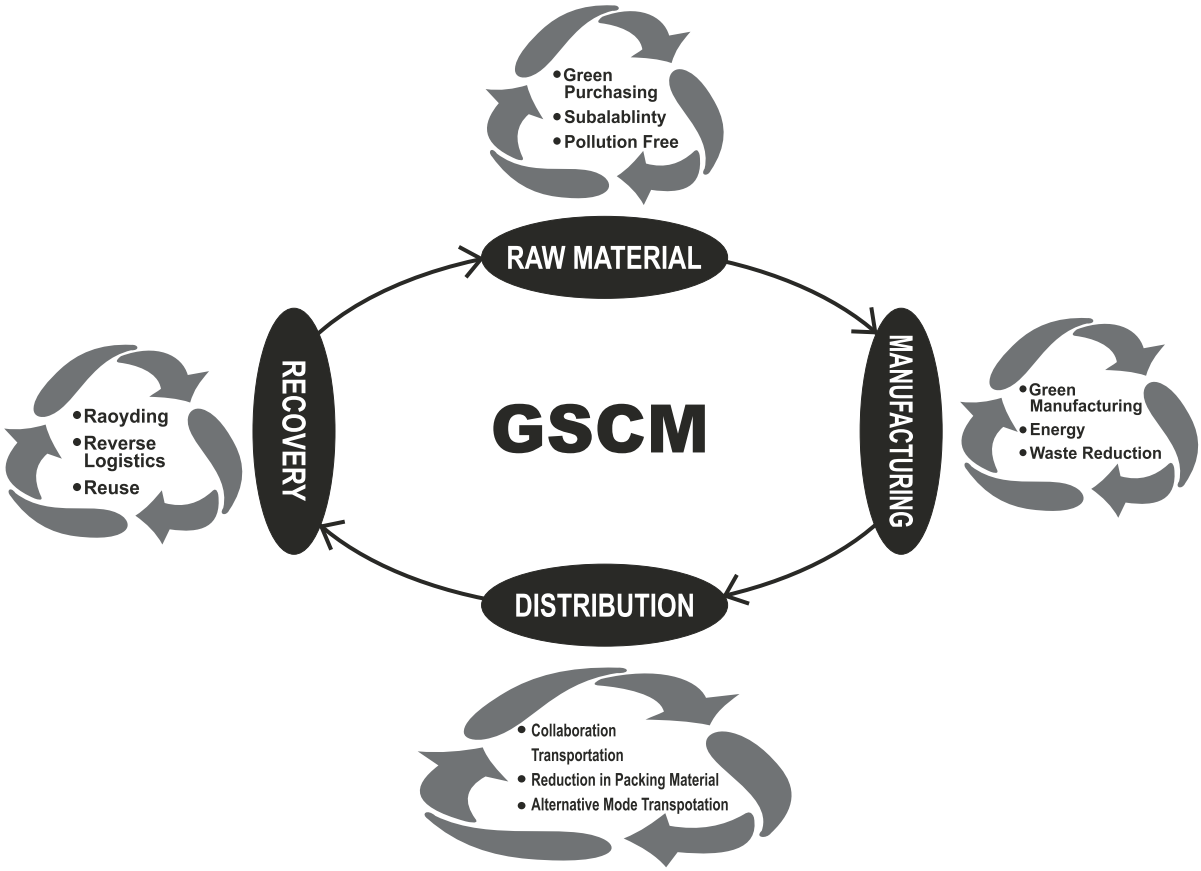

Figure 2: Green Supply Chain Management.

GPI: Green performance index is an indicator which tells the degree to which some firm / company has implemented or adopted green practices and green supply chain management. It is calculated at the scale of 100. The higher the value of GPI score, the better will be the performance of company in regard to GSCM implementation.

0-40	41-70	71-100
←Laggard→	←Medium adopters→	←Early adopters→

Literature Review

Literature review on Green Supply Chain management reveals that much work has been done on sustainability, lean management, greening the supply chain, green manufacturing, green purchasing etc. Many researchers have felt the necessarily of implementing green practices in various type of industry so as to control the environmental hazards.The study focuses on sustainability issues in manufacturing and production. The prime focus is to develop an appropriate tool and strategies to satisfy the ISO 14001 standard requirements (Bruke *et al*., 2007*)*. The research explores the organizations that adopt EMS more frequently implement GSCM practices, regardless of how long the EMS has been in place (Darnall *et al*., 2008).The paper investigates the correlation of major factors i.e. organizational learning and management support for adopting GSCM. It also tells that GSCM can easily be implemented in the organizations who have already adopted ISO 9000 & ISO 14001 (Zhu *et al*., 2008). The study presents the researchers with a twenty one item measurement scale for evaluating the different facets of their GSCM practices implementation. The study suggests twenty one items are critical attributes for implementation of GSCM (Zhu *et al*., 2008).This paper focuses on the effects of ISO 14001 certification on the implementation of advance practices e.g. green supply chain management (Arimura *et al*., 2014). The study is focused on identification of various barriers in implementing of GSCM in Indian perspective. The results shows treat Managers of Indian Industry have started realigning importance of sustainability concern (Zaabi *et al*., 2013). The paper explores the effect of decisions of Managers of the companies on GSCM Implementation (Sireme *et al*., 2013). The researchers have focused on reducing the carbon footprints throughout the TSCM (Traditional supply chain management) and also on green purchasing so as to reduce the carbon footprints (Mathiyazhagan *et al.,* 2014).

The work based on identification of those barriers which are obstacles in adopting GSCM. As per this study, 47 barriers are identified which must be eliminated for successful implementation of GSCM (Govindan et al., 2014). This paper suggest a network model to evaluate GSCM in presence of dual role factor, undesirable output etc (Mishedayation *et al.*, 2014). The research aims at presenting framework for the measurement of environmental performance. It also tells as how performance in respect of environment be successful by using the framework (Bjorklund *et al*., 2012). The study is focused on implementation of green supply chain practices in there manufacturers. It reveals that the companies that are quality conscious are more likely to adopt green practice and the companies based on low cost production are less likely to go for these green practices. It also tells that regulatory pressure is a prominent factor for environment (Laoririhogthong *et al.*, 2013). The paper focuses on the effect of green supply chain practices on the performance of the company. It also studies the GSCM practices and performance model (Green *et al.,* 2102). The study aims to suggest scale for evaluation of GSCM practices implementation among manufacturers (Zhu *et al.,* 2008).

It provides 21 items measurement scale for evaluating the different facets of their GSCM practices implementation. The study targets boll small scale's large scale industry with a aim to assess their green performance from procurement to raw material to final dispatch of the products (Bhateja *et al.,* 2011). The study also focuses on identification of performance indicator and sub-indicators for GSCM implementation. It also focuses on ranking of performance indicators based on their weighted score (Bhateja *et al.,* 2011). After thorough literature review eight factors and thirty sub-factors have been extracted this will be further used for the formulation of questionnaire and are shown in figure 4.

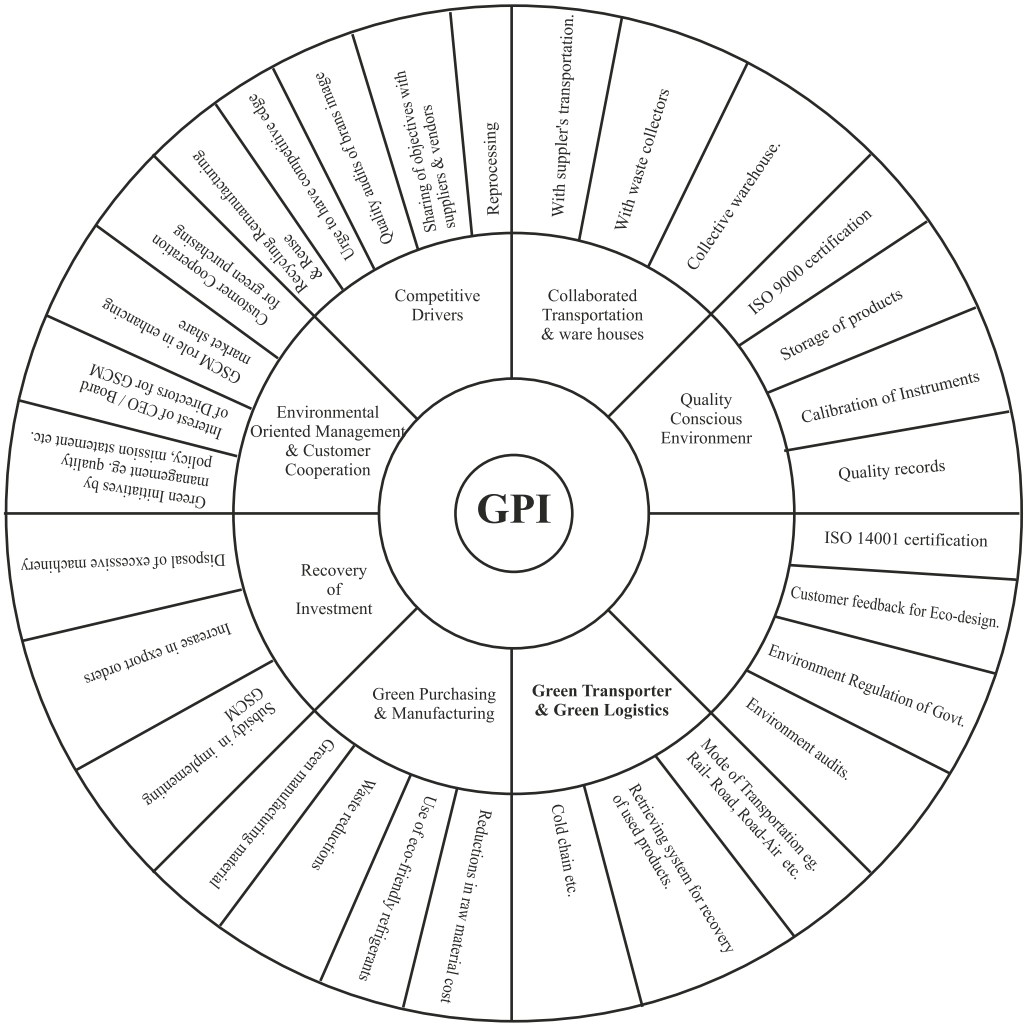

Figure- 4: Factor and Sub-Factors for Implementation Of GSCM.

Research Gap Analysis

The previous literature reflects that work has been done on environmental sustainability, lean manufacturing, Identification of critical factors of GSCM, barriers of GSCM implementation etc. It is also observed that very little research is being carried out on measuring the green practices of the companies and in fact no work has been done to evaluate the existing green practices of any company in Indian context. This work is unique and very important since it provide insight to the policy maker for effective implementation of green practices which improve their brand image, market share etc.

Methodology

The following methodology is used to measure the performance of dairy and agro industry on the scale of GPI:

Development of questionnaire

The questionnaire was formulated based on literature survey and after thorough discussion with the academic and industrial experts. It contains eight factors /parameters and thirty sub factors/ parameters.

The questions are based on these thirty sub factors of green supply chain management. The questionnaire is designed on five point liker-type scale.

Questionnaire testing and launching

The developed questionnaire is then tested by experts of industry and academic for ambiguity if any to improve the questionnaire before its launching. The necessary amendments had been done as per the suggestions of the experts. The launching is carried out by distributing the questionnaire among managers / in-charge of the different production stages in various industries.

Data collection

The data is collected through survey in almost twenty industries using the questionnaire. The distribution of the questionnaire was done through e-mails and personal contacts. The data has been collected through managers and at shop floor level in different stages of the product development. Before answering the questionnaire, the respondents were provided GSCM literature to make them understand about the GSCM approach.

Data analysis

During this stage the data collected is analyzed by the methods mention below:

Reliability analysis

With the help of reliability analysis we can study the features of measuring index and the items that constitute this index. In reliability analysis we can calculate a number of commonly used measures of scale reliability and can also get an idea about the relation between individual items in the scale. The correlation coefficients of the inter class is also used to calculate inter-rater reliability estimates. To measure the internal consistency based on the average inter item correlation is called Alpha (Cronbach) i.e. how closely related a set of items are as a group. A high value of Alpha is often used generally more than 0.6. It is a coefficient of reliability or consistency

$$\alpha = \frac{N.\bar{C}}{\bar{v} + (N\text{-}1).\ \bar{C}} \qquad \text{...(1)}$$

Here N= no of items,
C-bar is the average inter item covariance among the items and
V-bar equals the average variance.

Calculation of GPI

How GPI of GSCM is measured?

Green performance index is calculated by using given below four steps:

Step 1 Data collection: The data has been collected from twenty dairy and agro industry using questionnaire which is formulated based on critical factor and sub-factors of green supply chain management. These questionnaire are answered by industrial experts on five point scale (one to five) .

Step 2 Calculation of initial score: The initial score of each industry is then calculated based on its answers given in the questionnaire corresponding to the questions related to each sub-factor. The average value of each factor is then calculated by taking mean value of sub-factors corresponding to that factor to get the initial score.

$$A1 = \frac{X_1+X_2+X_3..... +X_n}{n} = \frac{\sum_{i=1}^{n} Xi}{n} \qquad \text{.....(2)}$$

A1= mean value of sub-factors of factor1/Initial score.
X1 = value of sub factor 1
X2 = value of sub factor 2
Xn = value of sub factor n
n = number of sub factors

similarly the mean of factors 2, 3, 4 …… n can be calculated as A2, A3, A4 and An.

Step 3 Calculation of final score: For calculating the final score, mean value of each factor calculated in step 1 is then multiplied with the weighted value of that factor to get the weighted score of that particular factor. The weighted value is taken from Table no.2.Subsequently, average of total weighted score of each factor is calculated to get the final weighted score of the company which is the overall performance of that company on green performance index.

$$P = \frac{A1 \times w.v1 + A2 \times w.v2 \ldots\ldots\ldots\ldots + An \times w.vn}{N}$$

P=final weighted score / score on GPI

A1, A2 …. An=mean value of each factor.

w.v1, w.v2….w.vn = weighted value of each factor.

N=number of factors

Step 4 Measuring progress using GPI Scale: The final green performance index score of each company is then evaluated on green performance index scale which is as shown below

0-40	41-70	71-100
←Laggard→	←Medium adopters→	←Early adopters→

Table 1: Result of Reliability Analysis

S. No.	Performance Indicators / Factors	Total No of sub factors	Cronbach's alpha(α)
1	Environmental Oriented Management and customer cooperation	4	0.748
2	Recovery on investment	3	0.719
3	Green purchasing and manufacturing	4	0.665
4	Green transportation and green logistics	3	0.668
5	Environmental management system	4	0.712
6	Quality conscious environment	4	0.675
7	Collaborative transportation & warehouses	3	0.725
8	Competitive drivers	5	0.680

Table 2: Ranking of Critical factors

Factor No.	Factor name	Priority weightage	Ranking of factor
1	Competitive drivers (Product quality, Brand image, Transportation and 3Rs (Recycling, Remanufacturer, Reuse))	14.98757	3
2	Collaborative transpirations and warehouses to reduce emissions	4.402932	6
3	Quality conscious environment	20.44658	2
4	Environmental management system	2.650466	7
5	Green transportations and reverse logistics	1.642685	8
6	Green purchasing and Green manufacturing	11.20494	4
7	Recovery on investment	6.997885	5
8	Environmental-oriented management and customer cooperation	37.66695	1

Vijay Kumar Sharma, et al. (2014)

Table 3: Calculation of final score of company 'A' on GPI

Sr No.	Factor	Sub-factor score out of 5		Mean of sub factors scores (Initial score), m	Weighted Value of Factors (wv)	Weighted Score	Final score / score on the GPI (p)
		Sub Factor	Value				
1	Environmental Oriented Management and customer cooperation	X1 X2 X3 X4	3 2 2 3	2.5 (A1)	37.67 (wv1)	94.17	Sum of Weighted score of all factors
2	Recovery on investment	X5 X6 X7	5 4 4	4.33 (A2)	6.99 (wv2)	30.26	No. of factors
3	Green purchasing and manufacturing	X8 X9 X10 X11	4 4 1 2	2.75 (A3)	11.20 (wv3)	30.8	349.15 / 8 = 43.64
4	Green transportation and green logistics	X12 X13 X14	5 4 5	4.67 (A4)	1.64 (wv4)	7.65	
5	Environmental management system	X15 X16 X17 X18	4 3 2 5	3.5 (A5)	2.65 (wv5)	9.27	
6	Quality conscious environment	X19 X20 X21 X22	5 5 4 4	4.5 (A6)	20.44 (wv6)	91.98	
7	Collaborative transportation & warehouses	X23 X24 X25	4 4 5	4.33 (A7)	4.40 (wv7)	19	
8	Competitive drivers	X26 X27 X28 X29 X30	5 5 4 3 5	4.4 (A8)	14.98 (wv8)	65.9	

Table 4: Calculation of GPI score and progress of companies

SR No	Company	Final Score on GPI	Progress on GPI Scale		
			0-40	41-70	71-100
1	A	43.64		☑	
2	B	48.45		☑	
3	C	51.63		☑	
4	D	52.17		☑	
5	E	61.23		☑	
6	F	31.64	☑		
7	G	51.63		☑	
8	H	53.55		☑	
9	I	51.63		☑	
10	J	51.63		☑	
11	K	38.10	☑		
12	L	53.12		☑	
13	M	51.44		☑	
14	N	52.58		☑	
15	O	46.23		☑	
16	P	46.31		☑	
17	Q	47.68		☑	
18	R	48.68		☑	
19	S	38.78	☑		
20	T	45.14		☑	

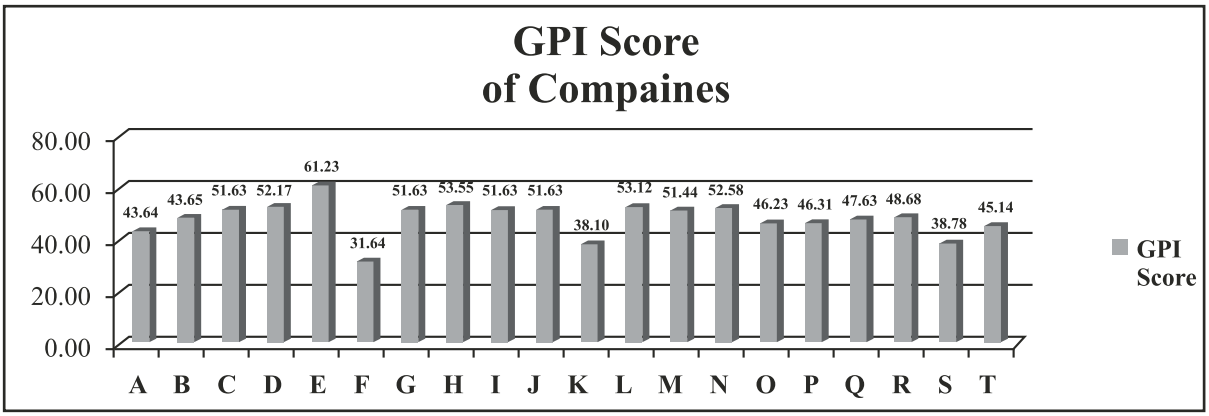

Figure-5: Bar Chart showing the GPI scores of the companies

Results and discussion

The main focus of this research is to evaluate the dairy and agro industry on green performance index. If the industry scores well on this GPI then certainly performs better in implementing GSCM. The responses of various dairy and agro industry based on the questionnaire on 5 point liker type scale were collected and were tested for reliability. The results of reliability analysis can also be seen in Table 1 which reveals that data collected is reliable since value of Alpha (Cronbach) is more than desired value 0.6. The Table 4 reflects the final weighted score of each company on GPI and its progress on GPI scale which also reflects its status of GSCM implementation. The Table 2 reflects the weighted value of each factor and its ranking which is used to calculate the final weighted score. The better the score of industry on GPI scale better will be its performance to implement GSCM. It can easily be inferred from table 2 that Environmental-oriented management and customer cooperation factor is ranked first followed by Quality conscious environment and so on. The ranking of factor also provide very useful information to the policy makers in GSCM implementation. They also come to know about the areas where there is a scope of improvement in order to develop system of green operations.

Conclusion and future research work

With the increasing trend of global industry towards green practices, more and more industry of almost all the sectors are deliberated to implement green supply chain management. The aim of the research is to provide the Dairy industry a scale in terms of GPI so as to give them self assessment tool for improvement in the area of GSCM. It also throws light upon the vital green practices to be implemented and their weightage it is clearly seem from the result that if the company scores good on GPI it concluded that it has already implemented GSCM system to certain extent.

In nutshell; this paper is first to provide an idea as how to construct GPI and how to assess company based on GPI. The work can also be extended further to compare two different type of industry in terms of GPI score and their level of compliance of GSCM implementation. The impact of supplier's policy on GPI can also be calculated.

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