CHAPTER 10
SUMMARY AND CONCLUSION

10.1 INTRODUCTION
An immediate and urgent need for industry, specifically MSMEs, is the adoption of CP until a new generation of technologies and processes takes over from the present manufacturing systems. Across the globe there are plenty of success stories related to CP which are not successfully transcended into fruitful realization by all. Hence, there is a need to promote this strategy to help the industry, society and environment by assessing the present Cleaner Production level (CPL) of a unit and exploring the potential of penetration of this strategy. Implementation of CP initiative in an organisation requires wide spread dissemination of benefits of CP and a baseline for its levels.

This envisages the need for having a method to appraise the prevailing CPL which can be further be utilised to identify the CP potential. Generalizing the CP evaluation method is difficult as the nature of operations of industries is non-homogeneous. Majority of explorations that depicts success stories are case studies and hence they fail to suggest the CPL of general industry or at least the level of a particular industry sector. Hence, gaining the knowledge about the practices of industries and benchmarking them to expose the performance of an enterprise against the best performer in the sector from the perspective of CP is essential to understand why its implementation is not wide spread in spite of its benefits.

MSMEs are a crucial industrial group, characterized by the continued growth, rural orientation, and wider geographical dispersion on the one hand and on the other by their tendency to concentrate in the industrial estates, low efficiency levels, growing sickness etc. The environmental impacts resulting from their brisk economic activities are remarkable and become increasingly serious in the context of clusters, as they produce a major portion of the total industrial waste. Due to the small scale of operation, these units rarely employ methods of treating waste due to lack of technical skill, space, finance and motivation. The incorrect notion that environmental protection always makes the production of goods more costly and is not affordable is deeply rooted in the industries, particularly MSMEs, in developing countries like India.
Among the total large and medium scale industries in our country, about 45% of them use the agricultural products as their raw materials. Agro based industries are resource and energy intensive and produces significant amount of by-products. Efficient management of the resources in agro-based industries would certainly bring huge positive results. In this context, investigation of issues concerning CP in agro-based MSMEs offers a great opportunity to gain knowledge to bring out rewarding outcomes and underscores the importance of the current study.

10.2 AIMS OF THE STUDY AND TOOLS & TECHNIQUES EMPLOYED
The present study was under taken in the three agro-based MSME clusters of Bakery, Cashew Processing, and Rice-mills with the following specific goals.

1. To study the production processes in the three selected agro based MSME clusters.
2. To understand energy consumption patterns and to estimate environmental impact.
3. To assess the prevailing CPL and to probe the factors influencing it.
4. To assess the CP performance and explore the potential for CP practices.
5. To identify, analyse and rank the drivers and barriers for CP initiatives.

These objectives were met through a sound research design, field visits, and primary data collection using a researcher administered structured questionnaire in all the three clusters. Further, the collected data was analysed using advanced statistical and other techniques like Multiple Regression Analysis (MRA), Fuzzy Logic, Data Envelopment Analysis (DEA), Exploratory Factor Analysis (FA), and Analytic Hierarchy Process (AHP), apart from qualitative analysis to meet the stated goals. Appropriate interpretations are made based on the results obtained through these analyses.

10.3 SUMMARY OF RESEARCH FINDINGS
10.3.1 Energy Consumption Pattern and Environmental Impact
The study intended to understand the production process followed in each of the industrial clusters. The review of background of the clusters and processing methods followed revealed, processing methods and operating conditions within a given cluster are more or less similar. The energy consumption analysis focussed on the thermal, electrical, and manual energies consumed in the respective process. Using the primary data collected from the MSME units in each of the three clusters, Specific Energy Consumption (SEC),
and total energy used were determined to project energy requirement for the entire cluster. Thermal energy requirement was predominant in all the three clusters constituting 76%, 61.4%, and 90% of total energy in the bakery, cashew processing, and rice milling clusters respectively. SEC for each cluster was estimated at 6.93 MJ, 3.73 MJ and 3.75 MJ per kg of raw material processed.

After studying energy consumption pattern and estimation of SEC, environmental impact in terms of air pollution was estimated. Major Green House Gases (GHGs) generated due to energy use was calculated. At this stage, only global pollution was estimated, however local pollutions (land fill and water pollution) were considered during the CP assessment. GHG emission calculation was based on Intergovernmental Panel on Climate Change (IPCC) guidelines. The pollution intensity estimation was in terms of amount of GHG emitted per kg of raw material processed. The air pollution estimation showed, even though pollution intensity of bakery processing was high due to its dependence on fossil fuels and higher SEC, the total pollution load from this cluster is less due to lower raw material processing capacity. Among the three clusters compared, pollution load from rice mill cluster was highest.

10.3.2 Development of CP Index
Assessment of CP has vagueness with respect to contribution from different aspects of the process thus making the task of evaluation cumbersome. CP thrusts on using fewer resources and generate less pollution apart from being sustainable. The contributing criteria considered in this study for the assessment of degree of CP are: evaluation of process efficiency, environmental burden it causes, and sustainability of the process. To measure above mentioned criteria, several proxy indicators were developed and in turn used to estimate the CP index for the enterprise. Even though the quantitative values of attributes were available, it may not be appropriate to aggregate them directly for assessment. This was due to the fact that individual attributes influence CP at different levels and hence their contribution was to be effectively captured separately. The performance study revealed that among the three industries, cashew processing cluster was relatively best and bakery cluster was the poorest. Among bakeries, 60% of the units were operating below average and 40% were operating at average CPL. In rice mill cluster about 71% were operating at an average level and only 5% were performing at good CPL. In the cashew processing cluster CPL was best compared to the other two
clusters with 70% of them were in good and 15% were in excellent CPL. The average CPL of these industries was around 50%, and hence there exists a good opportunity for further improvement. This assessment helps the industries to understand their status of CP involving various criteria; and can identify areas where they lack and compare with the best performers to facilitate further improvement. At an aggregate level the overall CPL was best in Cashew processing industry cluster (around 69%), followed by Rice mill industry cluster (47%), and Bakery industry cluster (33%) in that order.

10.3.3 Factors Influencing CPL
Evaluation of CPL in an organisation depends on the prevailing processing practices and the results obtained through fuzzy logic approach revealed that there was wide variation within the performance of the three industrial clusters. Since the fuzzy analysis considered only technical issues associated with CP it may not comprehensively bring out all the contributory factors responsible for the prevailing CPL. Thus, it was essential to know what other factors are influencing CP. In this backdrop, some other factors like Economic Factor (EF), Human Resource Factor (HRF), Technical Factor (TF), and Organizational & Behavioural factor (OBF) were considered. It was hypothesized that the variation in the CPL may be explained by the combination of these factors. Multiple Regression Analysis (MRA) was performed with CPL as dependent variable and the identified factors as independent variables. The factor strengths were quantified with summated value of two contributing variables.

The results of MRA in the three clusters revealed that in the bakery cluster, TF and OBF were influencing CPL significantly. The results implied latest technology and better awareness and attitude were important factors for bakery. Results for cashew processing showed HRF and OBF were significant contributors to CPL. Being labour intensive; influence of HRF was justified where skill and education played a significant role. In both bakery and cashew clusters, OBF contributed significantly to CPL, stressing the essential requirements of hygiene conditions, awareness and attitude in the cluster. MRA in the rice mill cluster established EF, TF and HRF as influencing factors to CPL. Since rice-mills require state of the art technology to be competitive in terms of quality and productivity, they require huge capital. Also, higher scale of production resulted in better plant capacity utilization. Newer rice mills adopted latest technology and well educated people with good skills which have significant influence on CPL in the cluster. It was
surprising to observe awareness and attitude, and housekeeping constituting OBH did not have significant influence on CPL in this cluster.

10.3.4 CP Potential in the Studied Agro-Based Clusters

After getting the sense of factors influencing CP, the next step was to examine whether it was worthwhile to practice the CP strategy. Hence, it was decided to establish the benchmark and demonstrate to the industries their rank with respect to the better performing units within their cluster. Thus to bring out the gaps in CP practices among agro-based MSMEs, Data Envelopment Analysis (DEA) was adopted. The DEA approach considered the maximization of outputs with the given input or produce same level of output with reduced inputs. But for CP benchmarking, inclusion of relevant inputs and outputs were very crucial. Contributing factors considered for CP on the input side were raw material input, total energy consumption, and total water consumption. The outputs in the analysis were carefully chosen to be only desirable outputs while undesirable outputs like solid waste and effluent generated, global warming potential were omitted. The desirable outputs considered were; the quantity of the final product, the extent of recycling of by-products produced, clean energy used, and employment generated. In the bakery cluster, only 42% of the units were using clean energy culminating in very poor performance. The better performance was exhibited by only 17.5% of the bakeries with large variability in the ranks acquired. In the cashew processing cluster, 60% of the units showed efficient CP performance. The results of CP benchmarking of rice mill cluster found 45% of the units performing efficiently.

10.3.5 Barriers and Drivers to CP Implementation

At present implementation of CP is not widely seen in the studied clusters due to the existence of many barriers. Thus, it is essential to understanding the barriers faced by MSMEs in implementing CP. In this backdrop, barrier perception of stakeholders was gathered through a researcher administered structured questionnaire using five point Likert Scale. 25 variables corresponding to different dimensions of barriers were included to extract a few underlying factors. The exploratory factor analysis was adopted for this purpose. The barriers identified for bakery cluster were ‘lack of awareness and attitude towards environmental initiatives’, ‘lack of financial strength required for initiating the action’, and ‘non-availability of knowledge about latest technological development’. In the cashew processing cluster, ‘non-existence of supporting structure to take forward the
CP strategy' was the main barrier. 'Availability of appropriate technologies and information about them', and 'lack of financial strength' are the other barriers in this cluster. Rice-mill cluster had 'need for availability of better technologies', 'financial constraint', 'nonexistence of supportive policy and regulations' as major barriers for CP.

There are also drivers for practicing CP strategy in these industries. Based on literature and discussion with the experts in the field, five drivers viz., Financial Benefits (FB), Improved Compliance with Regulations (ICR), Minimized Environmental Degradation (MED), Social Image (SI), and Improvement in Quality and Productivity (IQP) were considered in this study. The selected drivers to implement CP were prioritized based on the perception and value judgment of entrepreneurs using Analytic Hierarchy Process (AHP). Preferences of ten experts from each sector were collected based on the pair wise comparison which was later aggregated using the geometrical mean. Prioritization of drivers to CP implementation in the three agro-based clusters yielded different results. Top motivator to adopt CP initiative in bakeries as well as in cashew processing units was 'improved quality and productivity', whereas for rice-mill cluster it was 'financial benefit'. But, all the clusters ranked 'enhancement of social image through CP' at the end.

10.4 MAJOR CONTRIBUTIONS OF THE THESIS
This thesis focused on the opportunities and benefits of CP in the three agro-based MSME clusters, by systematically framing the specific objectives and following the widely accepted methodology in empirical research. Most of the published literature focuses on various dimensions of CP like raw material substitution, technology modification, reuse and recycle, process modification, role of managerial initiatives etc., in the context of an industrial unit. However, this research work attempted to understand the agro-based MSME clusters, in the Indian context, by thoroughly examining present status of CP, and existing potential for further exploitation along with drivers and barriers for it. Although the approach and outcome of each of the objectives were discussed at length in different chapters, the following points present the specific contributions of the research work in a nutshell.

- It covered three agro-based MSME clusters located in diverse geographical locations.
- It involved an overview of production process followed in each of the three industries.
It analysed the present energy consumption pattern and estimated the environmental impact in terms of emission of GHGs (at the global level). The other pollutions of local nature are considered during the assessment of CPL.

It developed a model to evaluate CP in agro-based industries using fuzzy logic. The model facilitates assessing CP index of individual industrial units and hence the comparison of units within a given industrial cluster.

It modelled the factors influencing CPL in a cluster comprising the non-technology issues related to CP, using Multiple Regression Analysis.

It facilitated benchmarking of CP in a given industrial cluster through Data Envelopment analysis. Thus, assessment of the potential improvement in an industrial cluster could be estimated.

It established and ranked the vital barriers for CP implementation in industrial clusters by reducing the various dimensions of barriers through Factor Analysis.

It recognized and prioritized the drivers for CP in industrial clusters employing entrepreneurial perspectives using Analytic Hierarchy Process.

10.5 POLICY IMPLICATIONS

It has been observed that agro based MSMEs due to their characteristics requires different approaches to deal with their environmental issues. The approach has to be financially rewarding for sustainability. MSMEs focus on short term gains and reluctant to investments. CP strategy is not stressing on the huge investments but focus on improvement with better processes and practices. From this perspective, CP strategy is believed to provide a great opportunity for MSMEs.

Government of India through ministry of MSME encourages adoption of pollution control processes by the industrial undertakings. Government of India also introduced a scheme to provide incentive for technical up-gradation; quality improvement and better environment management. It encourages MSMEs to acquire ISO 9000 (QMS) or ISO 14001 (EMS) certification. Another scheme supports technology and quality up-gradation to sensitize the MSME sector in India to adopt energy efficient technologies (EETs) to reduce emissions of GHG, improve their quality and reduce cost of production, etc., towards becoming globally competitive. The major activities planned under the scheme include capacity building of MSMEs, clusters for energy efficiency and clean development.

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interventions, implementation of energy efficient technologies in MSME sector, setting up of carbon credit aggregation centres and encouraging MSMEs to acquire product certification licences from National or International bodies.

In the backdrop of the existing policies and based on the outcome of the current research study, the following recommendations are made to fine tune the MSME policies, especially in the clusters.

- The latest technologies available for industries covered in this study are not sector specific. Thus, technologies and its research must address the local needs with involvement of local industries.
- It is also important to popularize inexpensive efficient production practices among specific MSME clusters. Use of end-of-pipe solutions are to be discouraged which is highly encumbering on MSMEs.
- Judicial use of the energy resources helps the industry, environment and society. Agro-based industries have potential to save substantial amount of energy. Though there is an incentive scheme, it is not popular among MSMEs. Biomass is generally a by-product in agro-processing industry. Policies should be designed to encourage/mandate re-using such biomass by MSMEs.
- Efficient combustion devices are to be made available to encourage use of the biomass to achieve huge savings on fuel and material handling costs. The policy should insist on using recommended devices.
- Financial assistance to incorporating efficient technologies, though existing is not effectively used. The government should encourage the strategy by providing necessary financial support in the form of loan at reduced interest, tax benefits, and incentives. The industries are to be encouraged to achieve higher capacity utilization through appropriate policy framework.
- MSME policies in clusters must address lack of dissemination of information, lack of synergy within the cluster, inadequate coordination amongst MSME development institutions and industrial units.
- Overall, a carrot and stick approach is needed in the policy frame work towards enhancing CP in MSME clusters.
10.6 CONCLUSION

The present research work has attempted to bring out CP status in three different agro-based industrial clusters through an empirical study. It has probed the phenomenon of CP focussing mainly on the process parameters and few non-technology issues associated with CP like human resource factor, economic factor, organisational and behavioural factor, and technical factor. However, the future research may consider large number of other agro-based industries which are not covered here. Further, research involving single industry with clusters located at different geographical positions may also throw light on problems and prospects of CP in that particular industry. There is scope for future works on clean technology development and its assessment. Similarly, investigating financial implications of CP with cost-benefit approach may also be useful. On the whole, considerable research avenues exist in the field of CP, especially in MSME clusters.

Finally, for ensuring sustainable development of MSMEs, they must perform well on three vital dimensions of sustainability viz., Environmental, Economic, and Social. Among the different choices available for MSMEs to achieve the environmental sustainability, Cleaner Production (CP) strategy seems to be very attractive. However, implementing CP strategy encounters on-field barriers and drivers apart from challenges in assessment of CP itself. It is sincerely believed that the current piece of research has contributed in this direction by exploring the problems and prospects of CP in the context of three agro-based MSME clusters. It is hoped that this study would assist in triggering the various stakeholders of MSMEs to consider CP strategy more earnestly in the times to come so as to facilitate the sustainable growth and development of MSME clusters in general and agro-based MSME clusters in specific.