CHAPTER IX
SUMMARY, FINDINGS, CONCLUSION AND POLICY IMPLICATIONS

9.1 Introduction

This chapter provides a brief summary, major findings, conclusion, and relevant policy implications of the study. This chapter also suggests the areas for further research.

9.2 Summary

The impact of human activities on the environment has increased due to industrial expansion and rapid population growth. With the rise in population level, there is ever increasing demand for goods for consumption, especially processed food products. To counter the rising demand for food products, more and more food processing industries are flourishing each day. The food processing industry is widely recognised as 'sunrise industry' in India. The food processing sector in India is dominated by the small-scale industrial units. Madurai and Dindigul districts are known for the location of large number of small-scale food processing unit in Tamil Nadu. Favourable climatic conditions, cheap labour, and availability of raw materials are the main factors for food processing industrial concentration in these districts.

The food processing industry in general and small-scale units in particular consumes large amount of raw materials and consequently generates both solid and liquid wastes. It is estimated that the food processing industry in India produces about 4.5 million tonnes of solid wastes per year and 50 to 60 million litres of liquid waste per day.
These wastes are mostly disposed of in open dumps or nearby water streams contaminating both surface and ground water, thus posing serious health hazards and environmental problems. Laxity in disposal of these wastes are leading to the outbreak of many diseases such as dengue, malaria, and chikungunya.

These problems are further aggravated by the fact that most of the small-scale food processing units lack the knowledge on waste management techniques by which the waste can be effectively recycled or exchanged or treated before being disposed to the outside environment. Moreover, these units are not aware about the policies and regulations of waste management.

With this background, the present study tries to examine the waste management practices adopted by the small-scale food processing units namely, grain milling, fruit and vegetable processing, milk processing, oil crushing/extraction, soft drink (beverage), and bakery and confectionery, and meat and poultry in the select districts of Tamil Nadu, namely Madurai and Dindigul districts. In addition, the study has assessed the knowledge of the selected industrial entrepreneurs on the existing policies and regulations on waste management in India and finally it has attempted to suggest some suitable policy implications to overcome the problems identified in the study.

More specifically, the objectives of this study are: (i) to study the production process and the subsequent waste generation in the select small-scale food processing units; (ii) to analyse the waste management practices and linkages of these waste in selected units; (iii) to examine the relationship
between cost of waste management, output, quantity of waste and profit of the sample units; and (iv) to assess the knowledge about government policies and regulations on waste management among the entrepreneur's of select small-scale food processing units. Three hypotheses were formulated for empirical testing.

Both primary and secondary data were collected to test the hypotheses and to accomplish the objectives of the study. Secondary data was collected for a period of three decades, from 1973-74 to 2002-03. Since majority of the objectives were centered around primary data, the study has relied more on the primary data. The primary data were collected from 350 small-scale food processing units drawn through a stratified random sampling method. The data collected were analysed with the help of statistical techniques such as percentages, growth rates, and diagrams. The relationship between the waste management cost, output, quantity of waste and profit was assessed with the help of correlation and multiple regression models. The analysis of data with the help of the framed models revealed several features relating to the study. A summary of the major findings of the study are given below.

9.3 Major Findings

9.3.1 Production Process and Generation of Waste

The food processing sector covers a wide spectrum of industries. All the food processing industries in one way or the other depend on agriculture and allied activities like animal husbandry for their basic raw materials. Majority of the selected small-scale food processing units (95 per cent) are procuring their raw materials from private sources.
With respect to distance of procurement of the raw materials, majority of the units are purchasing their raw materials from a distance of 101 to 300 kilometres whereas only a few units (from grain milling, fruit and vegetable processing, and oil crushing) are receiving their raw materials from a distance of more than 500 kms. These units travel long distance due to non availability of pulses, vegetables, and oil seeds in nearby areas.

On the basis of loss incurred during the transportation of raw materials three industrial categories, namely fruit and vegetable processing, milk processing, and meat and poultry units have experienced loss of raw materials in the form of physical damage, spillage and weight loss during the transportation process.

One of the important problems associated with the production process is the scarcity of raw materials. Around 43 per cent of the industrial units from milk processing, soft drink (beverages), bakery and confectionery have not reported any scarcity, while rest of the units are facing the problem of raw material scarcity. These units are meeting out their raw material scarcity with alternative measures such as purchasing of the raw material at a high price, obtaining the raw materials from far away places, reduce production, and finally stop production if problem persisted.

Water is one of the important raw materials used in all food processing units for cleaning, processing, and formulating products. The quantity of water usage varies from one unit to the other. The study shows that grain milling, soft drink (beverages), and milk processing units have consumed more water whereas oil crushing / extraction, and meat and poultry, fruit and vegetable processing, bakery and confectionery are the least water consuming units.
Chemicals are also used by the food processing units for enhancing the quality of the finished products and also for cleaning purposes. Fruit and vegetable processing and soft drink (beverages) are using chemicals for preservation. Milk processing units use the chemicals for cleaning purpose and the oil units use it for recovering residual oil. The study reveals that more than 50 per cent of the selected units are not using any chemicals at all.

Majority of the selected units (60 per cent) require one to two days for converting the raw materials into finished products. Only a few units, namely grain milling and oil extraction units require a longer time to convert the raw materials into finished products.

One of the important aspects of production process is the conversion of raw materials into finished products. The study found that highest percentage conversion of input into output (above 80 per cent) is noticed in milk processing, soft drink (beverages), and bakery and confectionery units as there is no product loss during production process except spillover, whereas the conversion rate is moderate (60-80 per cent) in grain milling, fruit and vegetable processing, and meat and poultry units as both product loss and weight loss occur, which reduce the conversion ratio. On the other hand, the conversion rate is lowest in oil crushing units (40-60 per cent). It is due to large quantities of raw materials that go as waste during crushing.

Among the oil units the solvent extraction units have the lowest conversion rate (40 per cent) they use the oil cake generated from the oil crushing units and rice bran from grain milling units. One of the important
inferences drawn from the above findings is that the more the conversion rate
the less would be the wastage and the less the conversion ratio the more would
be the wastage. Thus, there is an inverse relationship between conversion rate
and quantity of waste.

All the selected small-scale food processing units are generating both
solid and liquid wastes in the study area. The quantity of waste varies from
unit to unit. It is found from the study that 55 per cent of the units have
generated less than 25 tonnes of solid waste in a year. All bakery and
confectionery, 72 per cent of meat and poultry, and milk processing units fall
under this category. The oil crushing / extraction and grain milling are
generating more than 101 tonnes of solid waste per year.

With respect to the quantity of liquid waste, majority of the units are
generating less than 5 lakh litres of liquid waste per year. The fruit and
vegetable processing (70 per cent), and bakery and confectionery (66 per cent)
units fall under this category. Over 28 per cent of the units generate 6 to 10
lakh litres of liquid waste per year. The meat and poultry units fall under this
category. 17 per cent of the units generate more than 26 lakh litres of liquid
waste per year. Soft drink (beverages) and grain milling units fall under this
category.

The type of pollution arising out of the operation of the selected units
shows that majority of industrial units (76 per cent) are polluting both land and
water. Fortunately, the selected food processing units are not polluting the air
and noise to a great extent.
9.3.2 Waste Management Practices and Linkages of Waste in Selected Units

The environmental pollution can be drastically reduced if waste management practices are followed properly. The study reveals that only 147 units (42 per cent) are practicing waste management out of 350 units selected for the study, whereas majority of the units (58 per cent) are not following it.

Among the waste management practicing units, the oil crushing / extraction units top the list (100 per cent) followed by grain milling (60 per cent), and milk processing (44 per cent) units. Fruit and vegetable processing, soft drink, (beverages) bakery and confectionery and meat and poultry units (10 per cent) are not effectively practicing the waste management.

Out of 147 waste management practicing units, majority (65 per cent) are using in-plant control measures, such as use of non-sticky vessels for minimising product loss and effective layout of processing equipment.

Waste reusing and recycling are the most important measures to reduce the quantity of waste and enjoy an important place in the waste management hierarchy. Out of 147 waste management practicing units, 70 per cent of the units are either reusing or recycling their waste. All the units under milk processing, and fruit and vegetable processing, 83 per cent of the grain milling, and 60 per cent of the oil crushing / extraction units are reusing both the solid as well as liquid wastes. The oil crushing / extraction units are reusing the wastes such as groundnut husk and lint as fuel for the boiler, whereas in rice milling units the husk is reused as boiler fuel for parboiling the paddy. In other units the waste water is recycled and reused.
Reduction of waste water discharge is also one of the important components of waste management. Among the 147 waste management participating units, (75 per cent) is using reduction of waste water discharge. The practicing units include milk processing at the top slot followed by grain milling, soft drink (beverages), oil crushing / extraction, and bakery and confectionery. The fruit and vegetable processing, and meat and poultry units are at the bottom.

Majority (64 per cent) of the waste management participating units have adopted pollution load reduction measures. The milk processing, fruit and vegetable processing and meat and poultry units have dominated over other units in terms of adoption of pollution load reduction measures.

One of the important ways of reducing the impact of waste on environment is recovering valuable by-products from the waste. Among the total waste management practicing units, majority convert their waste into animal feed. Some units are composting their wastes into manure, few of them recovering methane gas from their waste and also have adopted economic measures such as selling the waste to other industries for money.

The study found that majority of the waste management practicing units are using both primary and secondary treatment techniques whereas one-third of the units are practicing only primary treatment. Although all the units are generating effluents, there is no common effluent treatment plant found in the study area to treat the wastes emerging from various food processing units.
The waste exchange between the waste management practicing units shows that 40 per cent of them are passing their waste to other small-scale food processing units as raw material. It was found that 83 per cent of the grain milling units and 68 per cent of the oil crushing units are passing their wastes (bran and oil cake) to the solvent extraction units.

The study shows that majority of the selected units (69 per cent) are disposing their waste into open dumps, whereas around 31 per cent are using landfills as the final destination of their waste. Open dumps are favoured over landfills, as they are relatively cheaper on the economic front than environment front. It is also noticed that all the selected units are disposing their waste by themselves.

The major barriers in the implementation of waste management techniques in the selected units are economic barrier followed by technological barrier, human resource barrier, and information barrier. On the other hand, the impact of regulatory barrier on the implementation of waste management practices in the study area is minimal.

The study found that those units (147) practicing waste management are getting a number of benefits such as reduction in the cost of production, increase in profit, reduction in waste generation, good relationship with the Pollution Control Board (PCB), and good working environment.
9.3.3 Relationship between Cost of Waste Management, Output, Quantity of Waste, Profit of the Units

All the selected small-scale food processing units assign a separate amount for waste management. 42 per cent of the units are allocating their budget for the dual purpose, namely waste utilisation and waste treatment whereas majority (58 per cent) of the units are pumping their budget towards waste disposal. The amount spend on the above said activities varies from one unit to the other. About 32 per cent of the units are spending between Rs.51,000 to Rs.1 lakh and 24 per cent of them spend between Rs.1.01 lakhs to Rs.1.50 lakhs. A few of the units also spend more than Rs.1.51 lakhs per year on waste management and disposal activities.

The output of the selected units varies from one another. It ranges from less than 100 tonnes to more than 2500 tonnes per year. Highest number of units fall in the range of 101 to 500 tonnes per year. Among the units the grain milling produced the highest output and the bakery and confectionery produce the lowest output per year.

The profit earned by the selected units range between less than Rs.3 lakhs to more than Rs.9 lakhs per year. Majority of the units (46 per cent) earn less than Rs.3 lakhs per year. The grain milling units are the highest profit earners and the fruit and vegetable processing units are the least profit earners.

The regression results confirm the existence of a positive and significant relationship between waste management cost, output, quantity of waste, and profit of the unit. The regression results of the selected units show that 74 per
cent of variation in waste management cost is caused by the quantity of waste and profit of the unit. The value of the co-efficient implies that when quantity of waste increases by one kilogram and the profit increases by one rupee, it would lead to an increase of 54 paise and 10 paise respectively on the cost of waste management.

9.3.4 Awareness about Regulations on Waste Management Among the Entrepreneurs of the Selected Units

Among the various acts and regulations enacted for waste management, the most widely prevalent are the Water (Prevention and control of pollution) Act 1974; the Air (Prevention and Control of Pollution) Act 1981; and the Environmental (Protection) Act 1986. The study shows that majority of the entrepreneurs of the selected units are not having the basic awareness among these three acts. However, the Environmental (Protection) Act 1986 is familiar to few of the entrepreneurs.

In order to encourage the industries to implement waste management practices the government is providing some economic incentives, which includes Water Cess Act (1977), effluent charges, subsidies, and other incentives. The study shows that the awareness about economic incentives is very low or none among the selected entrepreneurs. Eventhough the government was spending huge money on such activities, however, it has not reached the target group.
9.4 Testing of Hypotheses

The empirical findings of the study helped to test the hypotheses formulated for the study. The first hypothesis of the study stated that small-scale food processing units are generating waste, which are not managed properly due to lack of awareness on waste management practices. This hypothesis was proved in this study. All the selected small-scale food processing units were generating waste comprising of both solid and liquid. Out of 350 units selected for the study, majority of them (58 per cent) were not using any waste management technique in their respective units. These details thus confirmed that a large number of small-scale food processing units were lacking knowledge on waste management practices. Hence, the hypothesis is proved.

The second hypothesis stated that limited extend of linkage existed between the waste generation and waste recycling among the small-scale food processing units. Out of the total units selected 17 per cent of the units (grain milling and oil crushing units) were passing their waste to other small-scale food processing units (solvent extraction units) for raw material purpose. On the other hand majority of the units were neither giving nor taking the waste from other industry for their business activity. All these developments establish the fact that the waste linkage mechanism among the selected units were active to limited extends only. Thus, the second hypothesis is also proved.
The third hypothesis framed for this study was that there existed a relationship between the waste management cost, output, quantity of waste and profit among the small-scale food processing units. This hypothesis was also validated by the findings of the study. It was found from the regression results that there exists a significant positive relationship between the dependent variable (waste management cost) and independent variables (output, quantity of waste, and profit). The regression results for the selected units show that the independent variables have jointly expressed more than 90 per cent of the variations in waste management cost in fruit and vegetable processing units, meat and poultry units, grain milling units, oil crushing / extraction units, bakery and confectionery units, and soft drink (beverages) units. On the other hand, it was more than 70 per cent in milk processing units. These factors contributed to prove the above said hypothesis.

9.5 Conclusion

The food processing units are generating both organic and inorganic wastes in the form of solid and liquid state. If these wastes are properly utilised with the usage of waste management practices, environmental pollution can be reduced to a great extent. Though many waste management techniques have been developed, however, the adoptability depends upon the availability of capital and willingness of these units to convert their waste into wealth. There are a number of unresolved issues and constraints, which hamper the implementation of waste management practice in the selected units. Suggestions have been made towards the end.
9.6 Policy Implications

Food processing units should adopt modem technology so as to generate low quantity of solid and liquid waste. The adopted technology should have a higher conversion rate of raw materials.

A linkage mechanism among the food processing units should be developed in order to disseminate the information on the source of waste generation and disposal. For instance, linkages could be established between milk processing, bakery and confectionery, and soft drink (beverage) units.

Waste generation in the selected small-scale food processing units can be curtailed by procuring quality raw materials and also from purchasing it from nearby markets. In this respect the units can explore the possibility for establishing linkages with farmers. This tie-up arrangement may help to reduce waste and safeguard the environment.

Reusing, recycling, recovering valuable by-products, and energy generation from the waste are the other options for efficient and effective waste management practices of the small-scale food processing units.

The cost of waste management can be reduced by reusing the waste. If the utilisation and treatment cost is lower than the disposal cost, the small-scale food processing units should adopt the former process than the latter. The cost can be further reduced if the units practice collective disposal of waste in well constructed landfills instead of open dumps. Effective waste auditing could also help cost control.
The government should provide incentives to those units, which are willing to implement/participate in waste management practices. This may be in the form of financial and technical incentives. Further, the government should make it compulsory for the new food processing units to install pre-treatment facilities within their units while granting license to them.

As majority of food processing units are lacking knowledge on government policies and regulations on waste management, the District Industries Centre and Pollution Control Board should provide counselling to the entrepreneurs and periodic training to the workers on reuse, recycle, treatment and disposal of waste.

Most of the waste arises due to improper selection of raw materials in grain milling units. Hence, the grain milling units should take utmost care in the selection of good quality raw materials. Similarly installing modern machineries and equipments and adopting screens for collecting floating and suspended impurities can further reduce wastage problems. Increasing chimney height to 12 metres above ground level shall reduce air pollution problem. Further, completely enclosed rigid type of enclosures would prevent noise pollution to a greater extent.

The most effective way of minimising the waste in fruit and vegetable processing units includes the reduction of losses during the process. While procuring the raw materials efforts should be made to select quality raw materials, free from dirt and pesticides. Installing coarse screening system within the production premise will also help to remove large size solid waste
particles. Change in technology, namely caustic peeling instead of manual peeling, adopting micro wave and hot air blanching system can substantially reduce the volume of pollution load in this units.

The wastage in milk processing units can be reduced by adopting modern equipments in pipe lining and in production. The process equipments and milk tankers should rinsed as soon as possible after use so that the product will not dry in the pipe as well as in the container. Hence, water requirement for cleaning can be curtailed. The spillover during transportation, shut-off values or supply lines, losses should be corrected by adopting standard equipments. Further, the spilled solid products shall be re-processed for animal feed purposes. Suitable waste treatment techniques can be installed to recover valuable by-products like methane gas.

Although oil crushing / extraction units are considered as eco-friendly units in terms of pollution discharged on land and water, however, the profitability of the units could be further boosted through procuring quality raw materials, reducing stock holding and oil spills, reduction in product loss during production process, cleaner work place and recovering by-products.

The wastages in soft drink (beverages) units shall be contained by maintaining good sanitation practices, reduction of water points, hose size, use of nozzles and squeezing of solid waste. The broken glasses, bottles and waste cardboard can be sent for recycling.
The bakery and confectionery units are considered as environment-friendly units, cause lesser damage to soil and water. Although all the wastages arising in the units are reused / recycled in the units itself the waste bread, over baked biscuits, flour and yeast could be sent to animal feed industry.

The waste arising in meat and poultry units, namely bones, hair, horn, teeth and liquid wastes can be sent to appropriate industry for by-product recovery.

9.7 Areas for Further Research

The area of research in waste management is very versatile. The present study has attempted to explore the avenues of waste management in one category of industry, namely small-scale food processing units. Therefore, further studies can be carried out in other industries too. A very limited area was taken for this study, which can be extended to a wide area, covering a large number of products, including other variables like energy management, production management, and total quality management. Further research can be carried out on the impact of waste on the health of the people, studies on joint production, hazardous waste management, application of hazard analysis and critical control point system in small-scale food processing units.