CHAPTER VII

SUMMARY OF FINDINGS, CONCLUSION AND SUGGESTIONS
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7.1 General

Energy is said to be the engine for growth and development in all economies of the world. In all parts of the world today, the demand for energy is increasing almost on a daily basis. According to Pimental (1992), energy is one of the most valuable inputs in agricultural production. Sufficient availability of the right energy and their effective and efficient uses are prerequisites for improved agricultural production (Handan et al. 2009).

The amount of energy used in agricultural production, processing and distribution is significantly high in order to feed the expanding population and to meet other social and economic goals of a society (Handan et al. 2009). It has been realized that crop yield and food supplies are directly linked to energy availability or consumption. Also, increases in yields in the developed countries are as a result of commercial energy inputs, in addition to improved varieties (Tolga et al. 2009).

Energy use in agriculture has become more intensive as the Green Revolution led to the increasing use of high yielding seeds, fertilizers and chemicals as well as diesel and electricity. Energy consumption per unit area in agriculture is directly related to the development of technology in farming and the
level of production. Inputs such as fuel, electricity, machinery, seed, fertilizer and chemical take significant share of the energy supplies in the production system of modern agriculture. Thus, the use of intensive inputs in agriculture and access to plentiful fossil energy has provided an increase in food production and standard of living.

7.2 Findings

Profile of the Sample Farmers

1. The study reveals that majority of the farmers are in the age group of 40-50 years which remains a productive age group for active participation in agricultural activities.

2. The age of the respondent deviates from the mean age by 7.814 for the small farmers and 7.822 for the medium farmers as seen from the calculated standard deviations. The minimum age of the respondent is 28 for small farmers and 27 years for medium farmers and the maximum for the small farmers is 57 and the medium farmers is 58 respectively.

3. Majority of the respondents are from the two groups of farmers namely the small and medium farmers who belong to backward community, which constitutes 48.10 per cent and 49.81 per cent respectively. The researcher also found that the least percentage of respondents from the two groups belong to the forward community.
4. The study reveals that the majority of the respondents 70.66 per cent are Hindus, about 14.99 per cent of the respondents are Christians and 14.35 per cent of the respondents are Muslims.

5. The study reveals that the marital status-wise distribution of respondents, about 10.06 per cent of the farmers are unmarried and the remaining 83.73 per cent married farmers are involved in agricultural activities.

6. The study depicts that about 92 per cent of the respondents of the paddy cultivators are literates. It is a peculiar situation in the study area that everyone has a positive attitude towards education.

7. Out of 467 respondents, 139 respondents 29.77 per cent are from joint family system and the remaining 328 respondents 70.24 per cent are from nuclear family system.

8. The average size of the family in the study area is 4.1. On the whole, 60.39 per cent of the total sample respondents have large families. This account for over population in the study area and it shows the economic backwardness of the paddy cultivators households.

9. The study explains that out of the 467 respondents, 71.09 per cent of the respondents have their own houses, 15.20 per cent of the respondents are living in rented houses, 8.57 per cent of them own free houses given by the government and the remaining 5.14 per cent of them live in leased houses in the study area.
10. Majority 96.79 per cent of the small and medium farmers live in terraced and tiled houses as their standard of living is moderate.

Cost, Returns and Energy Utilisation

11. The study shows that the difference in average requirement of human labour per acre was significant and it was 128.87 mandays in the case of the small farmers and 139.54 man days in the case of the medium farmers. Per acre utilisation of fertilizer and pesticides by the small farmers was ₹1,764.10 and ₹922.06 respectively as against ₹2,005.50 and ₹1,104.43 by the medium farmers respectively. The use of fertilizer and pesticides was also found statistically significant between the two groups of farmers.

12. The medium farmers were found to utilize more mechanical power and the utility of irrigation cost per acre was more than the small farmers in the study area. For instance, the medium farmers used 7.98 hours of mechanical power and ₹715.62 for irrigation cost per acre while the small farmers used only 5.56 hours of mechanical power and ₹692.55 as irrigation cost per acre.

13. The study reveals that the yield per acre of paddy for the small farmers was 2,742.45kg. and that for the medium farmers was 2,910.36kg. Therefore, the first hypothesis that „there is no difference in the yield of paddy between the small and medium farmers’ is disproved. Hence, there was
indeed a significant difference in yield per acre between the small and the medium farmers.

14. The study shows that the net income earned by the small farmers was ₹17,728.35 as against ₹19,990.50 by the medium farmers. The total cost incurred by the small farmers was ₹31,635.75 which was lesser than the cost incurred by the medium farmers (i.e. ₹32,395.98). The variable cost accounted to 79.16 per cent for the small farmers and 81.64 per cent for the medium farmers.

15. The input-output ratio per acre of paddy cultivation in terms of operational cost was ₹1.97 for the small farmers and ₹1.98 for the medium farmers. The profit gained by the medium farmers was greater than the benefit enjoyed by the small farmers. Benefit-cost ratio reveals that the medium farmers gained ₹0.62 and the small farmers gained ₹0.56 only. Thus, it was observed that the cost of production and output per acre for the medium farmers was higher than small farmers.

16. The study reveals the fact that the small farmers raised paddy in 412.36 acres and consumed 12,80,395.46 MJ of energy. The medium farmers required 11,92,337.34 MJ of energy for cultivating paddy in 421.57 acres. The largest share contributed by fertilizer energy was 4,89,830.07 MJ and 49,53,300.32 MJ for small and medium farmers respectively. The least share was for seed energy, which was worked out to be 22642.53 MJ and 20,059.48 MJ.
17. The study shows that per acre energy consumption on fertilizer usage was 896.48 MJ for the medium farmers which was higher than 910.61 MJ consumed by the small farmers. The medium farmers consumed 14.72 MJ of seed energy as against 16.84 MJ consumed by the small farmers. When compared to the small farmers with reference to the mechanical energy consumption, the medium farmers consumed greater energy to the value of 590.95 MJ per acre.

18. The medium farmers also consumed more energy per acre than the small farmers, in terms of pesticide energy (328.35MJ) and mechanical energy (509.95MJ). This may be due to the area of cultivation and the need of integrated management of energy use in huge systems. Thus, the per acre energy consumption determined for the small farmers was 2,495.12MJ. This was lesser than the energy consumed by the medium farmers (2,527.01MJ).

19. The study shows that for the production of paddy, the ratio of energy output-input was greater than one. This shows that the energy inputs were being effectively utilised by both the small and medium farmers. It means that there is a need to improve paddy crop production technology to increase the efficiency of energy inputs used by the medium farmers. It is also understood that over a mega joule spent on the cultivation of paddy, the small farmers earned a benefit of 0.19 MJ, while the medium farmers gained 0.21 MJ.
20. The study shows that in the case of small farmers, a rupee spent on seed energy earned as low as 0.02 MJ, while fertilizer energy earned the highest of 0.97 MJ. This was followed by human energy 0.43 MJ; mechanical energy, 0.42 MJ; bullock energy 0.39 MJ; pesticide energy, 0.33 MJ and irrigation energy, 0.10 MJ and per rupee on inputs.

21. In the case of medium farmers, a rupee spent on seed energy earned the lowest of 0.02 MJ, while fertilizer energy earned the highest of 0.93 MJ. Mechanical energy, 0.53 MJ; Human energy earned 0.39 MJ; pesticide energy, 0.34 MJ; bullock energy 0.32 MJ and irrigation energy 0.09 MJ per rupee spent on inputs.

22. Analysis of variance was used to understand the cultivation costs variation between the farmers of paddy cultivation among different land groups. It was proved through the ANOVA test that the cultivation cost has varied among the small and medium farmers of paddy cultivation. The result implies that the small farmers paddy cultivation cost is more than the medium farmers paddy cultivation cost. Thus ANOVA results suggest that there is a significant difference between the small and medium farmers with respect to paddy cultivation cost.

23. The total respondents of the paddy cultivation farmers earned agricultural income of ₹47,365.61, the cost of cultivation is ₹29,919.01 and profit of paddy cultivation ₹16,885.96 and Return on Investment ₹0.53 per acre / per year.
24. Return on investment for the small farmers who are cultivating paddy was around र 0.51 and the return on investment for the medium farmers who are cultivating paddy was around र 0.62. From the study it was observed that return on investment from paddy cultivation was high in the medium farmers and it was low in the small farmers in the study area.

25. Duncan test was grouped into two categories, the small farmers and the medium farmers. It remains as a separate group and the rate of investment are high. The result implies that the return on investment was high for the medium farmers than the small farmers. Thus ANOVA results suggest that there is significant difference between the small and medium farmers of paddy cultivation with respect to return on investment.

26. Theoretically a large number of independent variables are determining dependent variable like the Return on Investment (ROI). To understand the implications of the results a detailed discussion is necessary in the case of positive coefficient of land value per acre was found with rate on investment of paddy cultivation followed by production, yield, irrigation energy, irrigated area, human energy and seed energy. According to Ricardo cross section model, the agricultural land values are determined by “marginal productivity of land”. It is obviously stated that high marginal productivity land always have high land value. This implies that return on
investment goes up when there is high land value. In other words, higher the land values higher the return on investment respectively.

27. The implications are interesting as land value per acre, irrigated area, production, yield, irrigation energy and human energy increases the ROI of the medium farmers also increases. In regard to seed energy and fertilizer energy variables are turned to negative with medium farmers in paddy cultivation. It implies that higher the seed and fertilizer cost lower the ROI of the medium farmers in paddy cultivation.

**Energy Requirement and Determinants**

28. In the case of small farmers producing paddy, all the seven regression coefficients of independent variables were positive and they accounted for 89 per cent of the variations in the per acre output energy of cultivation of paddy. The coefficients of human energy (0.2050), bullock energy (0.1289), fertilizer energy (0.2694) and irrigation energy (0.1326) calculated were statistically significant at 5 per cent level. Fertilizer energy showed a greater influence on the determination per acre output energy.

29. As regards all the total farmers, the seven variables were responsible for 89 per cent of the variations in the per acre output energy. The coefficients of human energy (0.2209), fertilizer energy (0.0197), irrigation energy (0.1485) and mechanical energy (0.1795) were statistically significant at 5 per cent level. Human and mechanical energy had greater influence on per
acre output energy determination. One per cent increase in these variables has lead to 0.12209 and 0.1795 per cent variations respectively on per acre output energy.

30. It may be concluded from the above results, that all the seven variables have some influence on per acre output energy of both the small and medium farmers producing paddy. But human energy alone has a greater influence on per acre output energy than the other factors for medium farmers. The overall model has also emerged significant at one per cent level.

31. In order to understand whether structural difference existed between the small and medium farmers producing paddy, Chow's test was made and the results shows that the computed F-value was found to be about 3.43 which was higher than 1.95, the table value. Therefore, the second hypothesis namely „There is no difference in the amount spent for inputs between small and medium farmers producing paddy’ is invalid. Hence, it is concluded that there was structural difference between small and large farmers producing paddy.

32. The results of the regression analysis relating the determination of per acre output energy for paddy, in the case of the small farmers, all the explanatory variables were positively related to per acre output energy. The variables such as human energy, irrigation energy, mechanical energy, and seed energy were statistically significant at 5 per cent level. It indicates
that an additional percentage of these variables could increase per acre output energy by 0.2326, 0.1461, 0.1021 and 0.1953 per cent for the variables respectively. It may be noticed that structural difference between the small and medium farmers producing paddy was caused by the variable mechanical energy.

33. In order to examine the resource-use efficiency in producing output energy of paddy by the small and medium farmers, Marginal Value Productivity (MVP) of different energy inputs was computed and the results reveals that the ratio of MVP to MFC in respect of significant resource inputs namely human energy, bullock energy, fertilizer energy and irrigation energy for the small farmers producing paddy was 0.11, 0.92, 0.52 and 0.72 respectively. This indicates that for every additional rupee spent on these variables, gross revenue of paddy could be increased by ₹0.11, ₹0.92, ₹0.52 and ₹0.72 rupees respectively. Among the significant variables, bullock energy was found to be the most important factor input in the production of paddy.

34. It is observed that the ratios of MVP to MFC for all the variables were more than unity for medium farmers producing paddy. It shows that there was scope to increase these resource-inputs to maximise their return. Among the seven variables, four variable inputs namely human energy, fertilizer energy, irrigation energy and mechanical energy were found to have significant influence, which means that every additional rupee spent
on these variables could increase the gross revenue by ₹0.11, ₹-0.13, ₹0.63 and ₹0.24 respectively. Further it could be inferred that these resources were underutilized. Fertilizer energy was found to have significant influence negatively.

Complementarities between Energy Inputs of Paddy

35. The cost of cultivation of paddy in the case of the small farmers was found to increase with an increase in the cost of price of energy inputs. Among the five price variables included in the translog cost function model, three variables namely price of human energy; fertilizer energy and mechanical energy were found to be significant at 5 per cent level. It implies that for one per cent increase in their respective prices, the cost of cultivation of paddy could be increased by 1.0219 per cent, 0.4710 per cent and 0.8659 per cent respectively. It is therefore, inferred from the results that the price of human energy had a greater impact on the cost of cultivation of paddy in the case of the small farmers.

36. There was also a positive relationship between the cost and output. An additional percentage made in the output of paddy was observed to increase its cost of cultivation by 0.5653 per cent.

37. In the case of the medium farmers producing paddy, out of five price variables incorporated in the model, three variables namely human energy, fertilizer energy and mechanical energy are statistically significant at 5 per cent level. It indicates that one per cent increase in the price of these
energy inputs could affect 0.8332 per cent, 0.5210 per cent and 0.8725 per cent increase respectively in the cost of cultivation. The impact of a change in price of mechanical energy on cost was observed to be greater than those of the other energy inputs. It is also inferred that there was a positive relationship between cost and output.

38. In the pooled category, mechanical energy had a greater impact on the cost of cultivation of paddy in the study area. There was also a positive relationship found between the cost and output. Therefore the third hypothesis that „There is positive relationship between cost and output of paddy in the study area“ is proved.

39. As this study is related to the paddy production, the respondents are asked to rank the factors affecting paddy cultivation. Five factors are given. „Henry’s Garrett Ranking Principles“ has been applied to find out the factors influencing paddy production. The main factor on economic and institutional factors which limit paddy cultivation is high labour cost which has scored the first rank. The second factor which limits paddy cultivation is scarcity of labourers. The third factor is „higher cropping cost“. „Non-availability of credit“ and „higher pesticide cost“ are the fourth and fifth in the order of rank.

40. The study reveals that in the case of the general problems, it is clear that high cost of production 54.07 per cent was the first main problem faced by the paddy cultivators. Secondly, natural calamities 50.68 per cent was the most important problem. Thirdly, severity diseases 49.21 per cent, fourthly,
severity of pests 48.35 per cent and finally, scarcity of labour 47.71 per cent was the least important problem faced by the paddy cultivators.

7.3 Conclusion

Agriculture in India, the principal sector of the economy, is the source of livelihood of almost two thirds of the workforce in the country. The contribution of agriculture and allied activities to India's economic growth in recent years has been no less significant than that of industry and services. The importance of agriculture to the country is best summed up by renowned economists by this statement: "If agriculture survives, India survives".

Agricultural energy management has a critical role in issues like higher agricultural production and rural employment generation. Periodic assessment of energy use and need through surveys, operations research and liaison with the line departments, private, public and non-governmental organizations, farmers and other interest groups should be carried out for finding timely solutions for such issues.

It is concluded from the above analysis that, the levels of input application was greater for the medium farmers when compared with the small farmer producing paddy. The more intensive use of energy inputs were done by the medium farmers than by the small farmers. The net income earned would be comparatively higher even though the medium farmers spent more on cultivation of paddy crops. The total cost for the small farmers was found to be less than that for the medium farmers.
The input-output ratio of paddy cultivation shows that the cost of output per acre for the medium farmers was higher than that of the small farmers. The rate of energy consumption through seeds was found to be very low for paddy crop in both the small and medium farmer’s category. Thus it is observed that the medium farmers have utilized more quantity of inputs than the small farmers. Further the medium farmers applied more quantity of inputs than the small farmers. The reason is that the rate of return was high in the case of the medium farmers.

In the pooled category, mechanical energy had a greater impact on the cost of cultivation of paddy in the study area. There was also a positive relationship found between the cost and output. Further, the result showed the existence of complementarities of fertilizer energy with pesticide energy. It implies that a higher dose of fertilizer application may reduce a much more use of pesticide in the cultivation of paddy. A negative significant elasticity of substitution was found between mechanical energy and fertilizer energy. It indicates the complementarities between the mechanical and fertilizer energy. This may be due to the higher use of tractors necessitated by fertilizer-induced increase in paddy productivity in the case of the medium farmers producing paddy.

7.4 Suggestions

- Farmers should be enlightened on the negative effect of excessive use of herbicide on the environment and also the long run impact on climate change. The adoption of high yielding paddy varieties such as the Nerica
varieties should be promoted in the study area in order to improve the energy productivity in paddy production.

➢ Introduction of early maturing and improved varieties of paddy would help in obtaining two or three harvest in a year.

➢ Integration of modern scientific knowledge and proven eco-friendly techniques of conservation and utilization of natural resources using area specific tools, implements and agricultural practices as well as scientific management of cattle and others. These indigenous systems can be made more economically viable.

➢ It is clear from the study that the high cost of production 54.07 per cent was the first main problem faced by the paddy cultivators. Therefore the Government takes necessary steps to reduce the cost of cultivation through seed subsidy and fertilizer subsidy.

➢ Natural calamities, severity diseases and severity of pests are the second, third and fourth problems faced by the paddy cultivators. Therefore, the Government to provide the loss amount on the proportion of losses.

➢ Water is the major constraints outside the monsoon period. Rain water harvesting and storage in tanks offers immense possibilities for irrigation.

➢ The utilization of available energy resources more efficiently to partially address the supply constraints and obviously, technological solutions have an advantage in this task.
➢ A majority 32.33 per cent of the farmers want to fix the proper price for paddy. Therefore, Government proper implementation of „Minimum Support Price’ for paddy cultivators.

➢ The next approach should be on promoting alternative renewable sources of energy involving technologies, institutions and policy measures.

➢ Major constraints faced by paddy cultivators in the study area are lack of access to finance and poor storage facilities. There is therefore the need to provide financial support through micro-credit scheme to help the farmers purchase inputs. Farmers should be assisted and educated on the need to organize themselves into cooperative groups. This will enable them mobilize the required financial resources for the acquisition of increased farm land for paddy production.

➢ Policy interventions aimed at protecting local production of rice are needed as this could improve the profitability of the enterprise. This is because affinity to foreign rice consumption, largely because of its availability in the market has affected local production negatively. Total ban on importation of rice or increase in tariff will be helpful in this area.

7.5 Scope for Further Research

This study gives scope for further research in “Investigation Energy and Economic Analysis of Three Varieties of Rice Production in Thoothukudi District”.

This study opens up for further avenues of research in the context of a “Energy Consumption Pattern in Transplanted Paddy Cultivation in Tamil Nadu”.

Further, “A Comparative analysis of Energy Requirements and Economic analysis of Banana and Paddy Production in Thoothukudi District”.

205