## CHAPTER - 4
### METHODOLOGY USED FOR THE STUDY

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CHAPTER - 4

METHODOLOGY USED FOR THE STUDY

In order to fulfill the objectives of the research, an appropriate methodology for conducting the research was followed. In this chapter, the methodology adopted for the present study including the selection of study area and respondents, the methods of collection of primary data and tools used for the analysis are discussed.

This chapter is also devoted for explaining the major concepts used in the study. It also reports some of the findings in related studies using similar methodology. Details of the methodology deployed for secondary data analysis are also discussed in the final section. Although the techniques applied may be almost same, the results may differ due to the diversity within or between regions, their institutional environment, period of study, data base specification of the variables etc.

4.1 Sampling Method

In general, multi stage random sampling technique was adopted in the selection of districts, taluks, villages and respondents for the study. Out of the fourteen districts in Kerala, ten districts viz., Thiruvananthapuram, Kollam, Alappuzha, Kottayam, Ernakulam, Thrissur, Malappuram, Kozhikode, Kannur and Kasargod come under the purview of coastal agro-ecosystem. Among this, Alappuzha, Pathanamthitta, Kottayam, Ernakulam and Thrissur districts accommodate two major agro-ecosystem of the state viz., the Kuttanad ecosystem and the Pokkali ecosystem. Since Pathanamthitta district will not come under the purview of coastal agro-ecosystem, the district was removed from the sample list.
For a comparative analysis in each of the ecosystems, the samples were drawn from two sample districts with equal representation in the total sample size. Hence from the three districts representing the Pokkali ecosystems, Ernakulam and Alappuzha were randomly selected. Since the districts left over under the Kuttanad ecosystem were Alappuzha and Kottyam, both of them were selected to derive the required samples assigning equal weights to each of the district. From the selected districts, one community development block each with typical ecosystems was randomly selected as sample location. Thus Alappuzha district with two ecosystems was given two sample locations; one representing the Kuttanad ecosystem and the other representing the Pokkali ecosystem. This was followed by a random selection of rice growing padasekharom/polder from the selected block as sample locations. For the detailed study of the farming systems in selected locations, thirty farmers each, representing rice mono culture and rice based rotational farming system, have been selected using random sampling method. This gave 60 samples from each location. At the aggregate level, 120 samples represented farmers following rice monocropping and the same figure numbered respondent farmers undertaking rice-prawn or rice-fish rotational farming. Since the analysis was undertaken separately for the two ecosystems the total sample size of each systems provided information on 120 samples. Altogether, 240 farmers in the coastal ecosystem constituted the sample framework for the study. The details of the stratified random sampling procedure are furnished in the Table 4.1.
Table 4.1
Sample Framework for the Study

<table>
<thead>
<tr>
<th>State</th>
<th>Agro-Eco Systems</th>
<th>Selected Districts</th>
<th>Selected Sample locations (CD Blocks)</th>
<th>Polders</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerala</td>
<td>Pokkali</td>
<td>Alappuzha and Ernakulam</td>
<td>Pattanackad &amp; Paravur</td>
<td>2x2 (rice monocropping &amp; rice-prawn sequential farming) =4 nos.</td>
<td>4x30 samples =120 nos.</td>
</tr>
<tr>
<td></td>
<td>Kuttanad</td>
<td>Alappuzha and Kottayam</td>
<td>Champakulam &amp; Pallom</td>
<td>2x2 (rice monocropping &amp; rice-fish sequential farming) =4 nos.</td>
<td>4x30 samples =120 nos.</td>
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</table>

Monocropping is defined in the study as a system wherein only the rice crop is cultivated in the paddy field either as a single crop or as a double crop. Rice based rotational farming system is meant for the system followed in those paddy fields wherein an additional crop of prawn or fish is raised on a seasonal basis by selective stocking of seeds and supplementary feeding as a rotational or a sequential practice along with the single crop rice. Farmers in the Pokkali system who let out their paddy fields on lease for prawn filtration were also treated as rice mono crop samples as the system does not incorporate any elements of scientific
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prawn farming activity. A detailed picturisation of the sample framework is given in Figure 4.1

**Figure 4.1**

Sample Framework for Primary Data Collection

Since random sampling was followed at all levels and segregation across samples as per the nationally accepted rule for size class doesn’t provide desirable sample size for statistical analysis, size class-wise analysis is not undertaken in the present study. In the pilot survey, it was found that the farmers in the study region belong to two accepted size-classes namely marginal of holding size less than 1 hectare and small of holding size between 1 to 2 hectare.

### 4.2 Period of Study

The data related to the agricultural year 2012-13 were collected and field enquiries were conducted during the years 2013 and 2014. Paddy cultivation details of the farmers of the study area for their main crop,

Total Sample Size = 240 nos.

Pokkali System = 120 nos.

- Rice Monocropping = 60 nos.
  - Paravur (Ernakulam) – 30 nos.
  - Pattanackad (Alappuzha) – 30 nos.

Kuttanad System = 120 nos.

- Rice- Prawn Farming = 60 nos.
  - Paravur (Ernakulam) – 30 nos.
  - Pattanackad (Ernakulam) – 30 nos.

Rice- Fish Farming = 60 nos.

- Champakulam (Alappuzha) - 30 nos.
- Pallom (Kottayam) - 30 nos.

Rice-Rice Monocropping = 60 nos.

- Champakulam (Alappuzha) - 30 nos.
- Pallom (Kottayam) - 30 nos.

Kuttanad System = 120 nos.

- Rice-Rice Monocropping = 60 nos.
  - Champakulam (Alappuzha) - 30 nos.
  - Pallom (Kottayam) - 30 nos.
either the Virippu Season or the Punja Season were collected. Similarly, Prawn or Fish farming of the off-season (fallow/flood season in Kuttanad and saline phase in Pokkali system) was taken for getting the data base of fish farming.

4.3 Methods of Data Collection

In order to get an insight into the physical and economic environments of the selected districts, taluks, blocks and villages a reconnaissance survey was undertaken. The secondary data required for the study were collected from the published sources and also from the records of Governments and Quasi Government institutions. The time-series data for a period of 15 years from 1997-'98 to 2011-'12 on the area, production and yield of major crops grown in the districts coming under the coastal agro-eco system of the state was taken for trend analysis. The secondary data also included physiography, geology, soil series, rainfall distribution, cropping pattern, infrastructural facilities and human resources of the coastal districts of the state.

The primary data required for the study were collected through personal interview of the randomly selected respondents with a pre-tested research schedule. The primary data concerned aspects such as educational status, assets position, cropping pattern, availability of resources like land, labour, capital, machine and animal power, input-output relationship, cost of cultivation of crops, income from crop activities, extent of adoption of package of practices, constraints involved in the production of crops and the like. The data collected were tabulated, processed and subjected to statistical analysis.
4.4 Measurements and Valuation

The cost of seeds was assessed at the prevailing market prices. The cost of machine labour was computed at the prevailing hire charges in the study area. Human labour was calculated in terms of man day equivalents. Since minimal family labour was found during the pilot survey, imputed family labour value, taking into consideration of the wages paid to men and women labourers of the concerned district, was added to the total labour. Fertilizers and plant protection chemicals were valued at actual price paid and farm produced manures was valued at the prevailing market rates. The cost of the land was computed based on the prevailing rent if it was leased. In the case of owned land, the rental value equivalent prevailed (ranging from $\frac{1}{5}$th to $\frac{1}{7}$th of the produce) in the area for similar type of land was considered. The interest on working capital was calculated at simple interest rate of 9 per cent per annum which was the prevailed rate of interest on short-term agricultural credit charged by commercial banks.

4.5 Tools used for Secondary Data Analysis

To examine the growth rates of area, production and yield of major crops cultivated in Coastal Kerala, the popular method of Compound Growth Rate (CGR) analysis was used. The linear growth rate has inherent limitations to perform the comparison of growth rates between periods and crops. Thus, it seems more appropriate to use the compound growth rate for analyzing the growth trend of agricultural crops. The compound growth rate (CGR) is estimated by fitting a semi-log trend equation (1) of the following form:

\[ \ln Y = a + bt \]

where,

\[ Y \] - Defines the time series data of production, area and yield of major crops,
‘t’ - is the trend term,
‘a’ - is the constant coefficient and
‘b’ - the slope coefficient, measures the relative change in Y for a given absolute change in the value of explanatory variable ‘t’.

To derive the percentage change or growth rate in Y for an absolute change in variable ‘t’ the relative change in Y was multiplied by 100. The slope coefficient ‘b’ also measures the instantaneous rate of growth. We can calculate the compound growth rate using the following equation:

\[ \text{CGR} = \left(\text{antilog } b - 1\right) \times 100 \]

The t-test was applied to test the significance of ‘b’. This equation presumes that a change in agriculture output in a given year would depend upon the output in the preceding year (Deosthali and Chandrehekhar, 2004).

4.6 Tools used for Primary Data Analysis

4.6 (a) Conventional Analysis

Averages and percentages were used to examine the family size, age, educational status, size of operational holdings, net area cultivated, cropping pattern adopted, share of components of cost, income distribution, family expenditure, adoption of package of practices, employment potential, constraints in the cultivation of crops etc.

Along with this, tools of analysis used in statistics and econometrics as detailed below are also used for deriving at conclusions and inferences.

4.6 (b) Cost of Cultivation and Cost of Production

The relationship between cost and returns is of crucial importance in agriculture. Cost of cultivation is an important determinant of price. In agriculture, cost of cultivation refers to the various input expenditures incurred by a farmer to attain the final produce. The nature of cost incurred
by a farmer is of two kinds- (i) variable or operational cost, and (ii) fixed cost.

Variable cost is the cost incurred by a farmer on factors of production such as seeds, human labour, bullock power, machine power, fertilizer, pesticides, farm yard manure, pumping charges etc. On the other hand, fixed cost is the cost incurred on rent, taxes, depreciation of implements and machinery, interest, insurance premium etc. The former varies with changes in the quantity of output produced, while the latter remains constant over time and does not vary with changes in the level of output. In the process of cultivation, variable cost is the driving factor which determines how much and what is to be produced. Fixed cost helps to make important decisions on the technological practice to be adopted and the quantity of output to be produced. Fixed cost exists even in the absence of cultivation, while variable cost does not.

The Farm Management Studies in India (Kahlon et al, 1981) broadly classifies cost of cultivation into; (I) Cost \(A_1\), (II) Cost \(A_2\), (III) Cost \(B\), and (IV) Cost \(C\). Cost \(A_1\) is incurred by a farmer when he is the owner and contributes his own land and other resources. Cost \(A_2\) is the tenant cost incurred by him when all the land is leased-in and rent has to be paid for it. Cost \(B\) is incurred when, in addition to the above costs, imputed interest is paid on owned fixed capital. Cost \(C\) is incurred when the imputed cost of family labour is also included. It is the most comprehensive cost.

In their study on the cost and returns of principal crops in the districts of Tamil Nadu, Rajagopalan (1978), considered only Cost \(A\) and Cost \(C\). The two cost concepts included the following components.
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1. **Cost A**:  
   i. Value of human labour, including family labour  
   ii. Value of bullock labour,  
   iii. Value of machinery charges,  
   iv. Value of seed,  
   v. Value of insecticide,  
   vi. Value of manures and fertilizers,  
   vii. Cost of irrigation, and  
   viii. Interest on working capital

2. **Cost C**:  
   
   Cost A + rent (including rent paid by the tenant or rental value of owned land) + interest on fixed capital, excluding land.

   In the present study, Cost A (variable cost) and Cost C (fixed cost) are considered for the analysis of the cost structure of paddy cultivation. Cost A alone constitute Cost of Cultivation and the sum total of Cost A and Cost C returns the Cost of Production or the total Cost. The two categories of cost include the following items:

1. **Cost A**:  
   i) Human labour including family labour,  
   ii) Machine power,  
   iii) Chemical fertilizers including Lime,  
   iv) Plant Protection,  
   v) Seed  
   vi) Farm Yard Manure,  
   vii) Irrigation/pumping,  
   viii) Repair and Maintenance  
   ix) Miscellaneous
Interest on working capital calculated at the simple rate of 9 per cent per annum

2. **Cost C:**
   i) Rent of land and
   ii) Interest on fixed capital and implements

### 4.6 (c) Benefit-Cost Analysis

Benefit-Cost Analysis (BCA) is a technique for evaluating a system or investment by comparing the economic benefits with the economic costs of the activity. Benefit-cost analysis can be used to evaluate the economic merit of a project. In the present study, benefit-cost (B-C) ratio is used to evaluate the comparative economics of different farming practices analyzed. To estimate benefit, total farm receipts through the sale of main product and by-product calculated on per hectare basis are used. The cost side refers to the per hectare total cost of production of the farm. Accordingly, a B-C ratio greater than 1 reflect the farming practice as economically viable and profitable, whereas equality maintains break-even and a lesser value informs non-viability of the enterprise respectively.

### 4.6 (d) Yield Gap Analysis

Agricultural scientists have evolved High-Yielding Varieties with the object of solving food problems prevailing in parts of the world, through increase of productivity rather than expansion in the area cultivated. Agricultural research centres strive to maximize yield through optimum use of resources. The validity and viability of experiment findings are examined by undertaking on-farm testing, demonstrations, operational research projects, etc. However, the farmer’s yields are often reported to be lower than the experiment situation yield.

There are two common ways of defining the concept of yield gap. First, directly comparing the experiment station yield with the yield
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received at farm level. Second, comparing the yield received by the best farm with the average or the poorest farm. Thus, yield gap may be classified into two kinds- Yield gap I and Yield gap II. The Yield gap I represents the difference between experiment station yield and potential farm yield. The Yield gap II corresponds to the potential farm yield and actual farm yield. The maximum yield obtainable from a variety under a particular situation is called ‘potential yield’, while the average yield attained under farm conditions is known as the ‘actual yield’. The factors that prevent farmers from achieving the potential yield under farmers’ conditions are known as ‘yield constraints’.

Yield gap analysis becomes instrumental in measuring the magnitude of gap in the yields and in the identification of constraints responsible for it. It is not proper to consider Yield gap I in a study, as experiment stations rarely encounter the constraints experienced by the farmers. Such estimates would be biased and larger than what it is actually under farmers’ conditions. Hence, Yield gap II has been examined in the study. It was defined as the difference between the highest yield (maximum yield reported) obtained by the most efficient farmer in the sample and the average level of yield achieved under farmers’ conditions.

4.6 (e) Technical Efficiency Analysis

Frontier Production Function was employed to measure the technical and economic efficiency of paddy cultivation among the farmers in the rice based integrated system and rice mono culture systems covered in the two ecosystems under the study. The concept of production frontier is the same as that of production that describes the great possible output from a given combination of inputs \((i.e)\) it is a production frontier. It involved the farm’s ability to obtain the maximum output from a given set of inputs or resources. If a farm used the best practice/method and could
achieve the maximum output with a given inputs and technology, it was likely to be superior to another farm which did not get the same output with a given similar bundle of inputs and technology.

The essential idea behind the stochastic frontier model is that the error term is composed of two parts. A symmetric component permits random variation of frontier across the farms and captures the effects of measurement error, other statistical variations and random components outside the farm’s control. A one sided component captures the effects of inefficiency relative to the stochastic frontier.

A (linear) stochastic frontier model is specified as

\[ Y = f(x_1, x_2, \ldots, x_n) + (v \pm u) \]

where in 'v' is the symmetric component causing the deterministic kernel of the production frontier and \( f(x_1, x_2, \ldots, x_n) \) to vary across the farms. Technical efficiency relative to the stochastic production frontier is captured by the one sided error component \((\pm u \text{ depending on whether one specify a production or cost of frontier}), u \geq 0\). Given the density function for u and v, the frontier function can be estimated by maximum likelihood technique.

However, individual observation specific technical efficiency measures are more useful from a policy viewpoint. The approach to identifying firm specific technical efficiency requires some estimators that allow for separating the effects of the one-sided error term u from the combined effects of u and v using the estimated frontier functions. In effect the problem is to predict \( u_i \) under the assumption that \( u_i + v_i \) is known. The best predictor of an unknown random variable \( u_i \) under the value of the combined random variables \( u_i + v_i \) is the minimum mean squared error predictor given by the conditional expectation of \( u_i \). Assuming a half
normal distribution for $u_i$ and normal distribution for $v_i$, the frontier model becomes

$$ Y = f(X_1, X_2, ..., X_n) \pm (v \pm u) $$

Where, $u = |u|$ and $u \sim N[0, \sigma_u^2]$ and $v \sim N[0, \sigma_v^2]$

The components of the disturbance are assumed to be independent and the frontier is assumed to be linear case. Now, the firm or observation specific $u_i$ can be estimated as

$$ E \{u_i / (u_i + v_i)\} = Y \sigma_u \sigma_v / \sigma \{f(.)/(1-F(.)-{(u_i + v_i)/ \sigma}) \{r/(1-r)\}^{1/2} \} $$

where

$f(.)$ and $F(.)$ are standard normal density and distribution functions evaluated at

$$ \{(u_i + v_i)/ \sigma\} \{r/(1-r)\} ^{1/2}, r = \sigma_u^2 / \sigma^2 and \sigma^2 = \sigma_u^2 + \sigma_v^2 $$

alternatively,

$$ E (u|\theta) = \sigma \lambda / (1 + \lambda^2) [f(\lambda / \sigma)F(\lambda / \sigma)- \lambda / \sigma] $$

where

$$ \lambda = \sigma_u^2 / \sigma_v^2 $$

The estimates for the parameters of $\lambda$ and $\sigma$ are provided through maximum likelihood estimates and are provided by computer packages like LIMDEP.

The frontier function model was applied to explain the technical efficiency of the sample respondents of the rice-fish/prawn and rice monoculture farms separately. In the function, the variables worked out are as follows;

$Y$ = Yield of paddy in Kg per acre
$X_1$ = Area under paddy per farm in acre
$X_2$ = Quantity of seed used in Kg per acre farm
$X_3$ = Machine power used in rupees per acre farm
$X_4$ = Bullock labour utilized in rupees/acre farm
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\[ X_5 = \text{Amount Spent on labour in rupees/ acre farm} \]
\[ X_6 = \text{Amount spent on manure in rupees/ acre farm} \]
\[ X_7 = \text{Amount spent on fertilizer in rupees/ acre farm} \]
\[ X_8 = \text{Amount spent on ppc in rupees/ acre farm} \]
\[ X_9 = \text{Age of the respondent farmers in years} \]
\[ X_{10} = \text{Education level of the respondent farmers (0-Illiterate, 1- primary, 2- secondary, 3- higher secondary/diploma holders, 4- graduates, 5- professional degree and post graduation)} \]
\[ X_{11} = \text{Farming experience in years and} \]
\[ X_{12} = \text{Level of technology indicated by extent of adoption of Package of Practice recommendation for the crops raised [Adopters =1(extent of adoption of PoP >75%) and , Non-adopters = 0 extent of adoption of PoP >75%)} \]
REFERENCES

