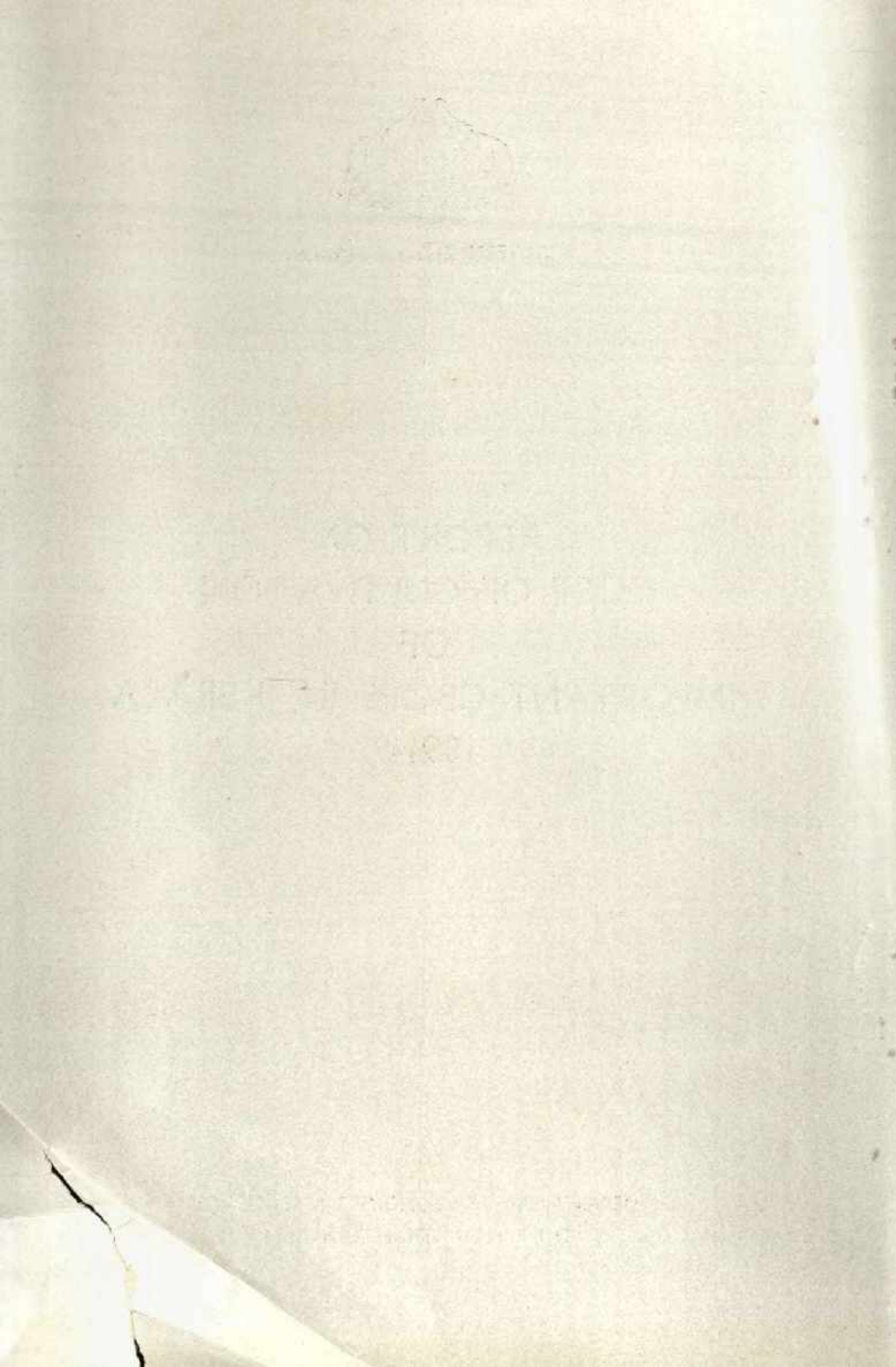




GOVERNMENT OF KERALA

REPORT ON  
COST OF CULTIVATION  
OF  
IMPORTANT CROPS IN KERALA  
1991-92

DEPARTMENT OF ECONOMICS & STATISTICS  
THIRUVANANTHAPURAM, 1994.



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## P R E F A C E

Reliable data on cost of cultivation of crops are very important for evolving rationale price policies and other strategies for agricultural development. It is now an accepted fact that a stable and remunerative price for agricultural commodities is the most important incentive for farmers to increase production. The Kerala State Government as part of its new Agricultural Development Policy of 1992 established an Agricultural Prices Board in the State in 1994. The Board requires data on cost of cultivation of important crops on regular basis for market intervention by fixing support prices in the event of fall in prices. If prices are to be fixed at levels which will be fair to the producers and consumers, then these prices must be based on costing studies conducted on a scientific method.

This report is based on the 12th round of the Survey on Cost of Cultivation of Important Crops conducted during 1991-92. The crops covered during this round are paddy (3 seasons), coconut, tapioca, banana, arecanut and pepper. This report was prepared by Smt.T.Bhavana, Research Officer, with the assistance of Research Assistant and Compilers. It is hoped that this report will be useful to the planners, researchers and others interested in farm management studies.

Thiruvananthapuram,  
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Dr.M.Kuttappan  
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# REPORT ON THE COST OF CULTIVATION OF IMPORTANT CROPS IN KERALA - 1991-92

## CHAPTER I - GENERAL

### 1.1 Introduction:-

A realistic assessment of the cost of cultivation and value of product is necessary for formulation and implementation of schemes in agricultural sector, fixation of floor and support prices etc. Keeping this in view the Government of Kerala accorded sanction for conducting annual surveys on cost of cultivation of important crops in the State. The present report relates to the twelfth round of the survey conducted during 1991-92.

The following crops were covered in the study:-

- i. Paddy (3 Seasons)
- ii. Coconut
- iii. Arecanut
- iv. Tapioca
- v. Banana
- vi. Pepper

### 1.2 Objectives:-

The main objectives of the survey were:-

- i. to estimate the cost of cultivation per hectare of important crops.
- ii. to compare the costs under different concepts, over a period.

### 1.3 Staff:-

The following staff were engaged for the survey.

<u>Category</u>		<u>Number</u>
Field	U.D. Investigator	14
	L.D. Investigator (4 posts were shifted to Directorate for consolidation of the report)	28
Head Office -	Research Assistant	1
	U.D. Compiler	1

### 1.4 Period of the Survey:-

The period of the survey was the Agricultural Year 1991-92 (July to June).

### 1.5 Design of the survey:-

The present survey was conducted in 38 taluks, which are the predominant centres growing the crops under study. From each selected taluk two Investigator zones of the survey under the scheme were selected using simple random sampling method.



### Selection of Paddy Cultivator

In each selected Investigator zone a list of cultivators growing paddy in the previous Autumn Season will be prepared from the last years form I Diary of the Investigator. From this list of paddy growing cultivator plots of last Autumn Season 5 cultivators will be selected at random for the current years cost of cultivation study on Autumn Paddy. Similar procedure is adopted for the selection of cultivators for winter and summer paddy respectively by preparing a list of paddy growing plots in winter and summer of the previous TRS round in the zone.

In case the cultivators selected for cost of cultivation study on Autumn paddy possess suitable number of plots with specified crops in stipulated area they may be selected for the cost of cultivation study on other crops like Coconut, Arecanut, Tapioca, Banana etc.

If sufficient number of suitable plots are not available with the cultivators selected for autumn paddy the required number of plots for crops other than paddy will be selected from the list of wet and dry land plots of the same Investigator zone in the last year. If the selected investigator zone in a taluk does not provide the required number of plots for these crops another investigator zone in the Taluk will be selected at random for selection of the remaining required number of plots/cultivators for the study on other crops.

The number of holdings selected for each crops in a taluk was as follows:-

1.	Paddy	-	Autumn	-	10	(5 holdings each from one Investigator zone)
			Winter		10	"
			Summer		10	"
2.	Coconut				10	"
3.	Arecanut				10	"
4.	Tapioca				5	(Minimum 2 holding in one Investigator zone)
5.	Pepper				5	"
6.	Banana				5	"

A holding was considered for the study only if it contained at least 25 cents under the crop in the case of paddy and tapioca, 10 cents in the case of Banana. In the case of perennial crops coconut, arecanut and pepper the holdings should have 25 trees/plants with at least 50% bearing.

The holding size group of a crop was determined on the basis of the area under the crop under study in the holding as shown below.

Size group	Holding size	
	Paddy	Other crops
1. Small	0.40 hectare	0.2 hectare
2. Medium	0.40 to 2 hectare	0.20 to 0.80 hectare
3. Large	2 hectare	0.80 hectare



## 1.6 Schedules

Three Schedules were designed for the survey.

Schedule - I This schedule is used for listing the plots for selection of holdings and recording the details of the selected holdings.

Schedule - II This schedule is used for recording details of the cultivators, area of holdings, inventory of agricultural implements, livestock etc.

Schedule - III In this schedule the cultivation expenses incurred for a crop in each fortnight is reported.

## 1.7 Field work

Field work was done by 38 investigators posted at the rate of one Investigator in each taluk. The investigators visited the selected holdings every fortnight and recorded fortnightly operations in Schedule III. The field work was supervised by Taluk Statistical Officer at the taluk level and by Deputy Director/District Officer at the district level.

## 1.8 Analysis

The compilation and tabulation were done at the district level by the Investigators posted for the survey. Five Compilers were posted in the Directorate for the consolidation of the data at the State level. Report was also prepared in the Directorate.

## 1.9 Method of estimation of Cost:-

a) **Concept of Cost:-** Different cost concepts, Cost 'A', Cost 'B1' and Cost B and Cost 'C' have been followed in the analysis as shown below:-

### Cost 'A':-

Cost 'A' consists of cash and kind expenses (paid out costs) actually incurred by the cultivators. This includes -

- i. Hired human labour
- ii. Animal labour
- iii. Machine labour
- iv. Seed (Seedlings)
- v. Farmyard manure
- vi. Chemical fertilizers.
- vii. Plant protection
- viii. Land tax
- ix. Irrigation Cess.
- x. Repair and maintenance charges of implements, machinery and buildings.
- xi. Interest on working capital.
- xii. Other expenses.

### Cost 'B1':-

Cost 'A' + Interest on fixed assets (excluding land)



Cost 'C' :- Cost 'B' + Imputed value of family labour.

b) Procedure for Imputation of values of owned inputs.

Some of the inputs from homestock are used in the production process. While computing the cost of cultivation it is necessary to impute the value of these inputs. The procedure used for the imputation of values of such homestock inputs is indicated below.

- |       |                                   |  |
|-------|-----------------------------------|--|
| i.    | Family labour                     | Imputed on the basis of average wage rate per work hour of hired labour.   |
| ii.   | Owmed and exchange human labour   | The rate of wages per hour for hired human labour is taken for imputing the value of owned and exchange human labour.  |
| iii.  | Owmed and exchange animal labour  | The charges paid per hour for hired animal labour is taken for imputing the value of owned and exchange animal labour.   |
| iv.   | Owmed and exchange machine labour | The hire charges per hour for machine labour has been taken.   |
| v.    | Implements                        | Repair and maintenance charges of implements.  |
| vi.   | Owmed seed                        | Farm produced (home grown) seed has been imputed at the prices prevalent in the investigator zone concerned at the time of sowing.   |
| vii.  | Farm produced manure              | Imputed at the rates prevalent in the zone concerned.  |
| viii. | Interest on owned fixed capital   | Interest on the present value of fixed assets such as land, farm, building, implements, machinery, irrigation structure, equipments and livestock (only draught animals) at the rate of 10% per annum has been calculated.                               |
| ix.   | Interest on working capital       | Interest has been charged at the rate of 10% per annum on the working capital, cash and kind expenses excluding items in respect of which payments are generally made after harvest (ie. rent, land tax etc.) incurred during the period of cultivation. |
| x.    | Payments in kind                  | The payments in kind have been evaluated at the market prices prevalent in the locality at the time of payment. Perquisites have been included in the payments in kind calculated at the market prices.  |

c) Allocation of joint costs to different crops-

Some of the inputs used for the cultivation of one crop are common for many other crops also. For the purpose of computing the cost share of individual crops, the cost of such inputs is apportioned in the following

- i. Repair and maintenance charges of implements In proportion to the area under the crop.
- ii. Interest on owned fixed capital (excluding land) In proportion to the area under the crop.
- iii. Interest on land value Interest on the value of land under the crops.
- d. Procedure for valuation of farm assets.
- i. Own farm buildings (cattle sheds, storage sheds etc.) Valuated at prices prevailing in the locality.
- ii. Implements and other machinery. Valuated at prevalent market prices.
- iii. Livestock (only draught animals) Valuated at prevalent market prices.

In calculating the cost of production of paddy crop in each season the interest on land value at the rate of 10% per annum for the period of 6 months is taken into account. The land value is estimated at the current market rate in the different areas.

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## CHAPTER - 2 RESULTS OF THE SURVEY

The results of the cost studies in respect of all the crops taken up during this round are discussed hereunder.

The crops selected for this round were Paddy (Autumn, Winter and Summer) Coconut, Arecanut, Tapioca, Pepper and Banana.

### 2.1 Paddy:-

Paddy is cultivated during the three seasons Autumn, Winter and Summer. The total area under paddy during 1991-92 was 5.42 lakh hectares and rice production is estimated at 10.60 lakh tonnes. The area under paddy during the three seasons are given below:-

#### 1. Area under paddy during the year 1991-92 (in lakh hectares)

Season	Area	Percentage to total cropped area
1	2	3
Autumn	2.19	7.25
Winter	2.54	8.41
Summer	0.69	2.28
<b>Total</b>	<b>5.42</b>	<b>17.94</b>

Source:- EARAS Estimate.

The gross area under paddy was about 18% of the total cropped area as seen from the table.

#### 2. Percentage of area under paddy in each season to the total area under paddy during 1991-92

Season	Percentage
1	2
Autumn	40.41
Winter	46.86
Summer	12.73
<b>Total</b>	<b>100.00</b>

The rice production during the three seasons stood at 10.60 lakh tonnes as can be seen from the following table:-

#### 3. Production of rice during 1991-92 (in lakh tonnes)

Season	Production of rice (lakh tonnes)	Percentage
1	2	3
Autumn	4.02	37.92
Winter	5.07	47.83
Summer	1.51	14.25
<b>Total</b>	<b>10.60</b>	<b>100.00</b>

Source:- EARAS estimate.



The average yield rate of paddy per hectare in each season is given in the following table:-

#### 4. Average yield of paddy during 1991-92

Season	Average yield (tonne/hectare)
1	2
Autumn	1.84
Winter	1.10
Summer	2.21

About 59% of the total irrigated cropped area is under paddy.

#### i. Autumn (Virippu) Paddy:-

For the cost study of autumn paddy a total of 360 holdings were selected. The details of these holdings in each size class (Viz. Small, medium, large) of holdings are given below:-

#### 5. Area under autumn paddy during 1991-92

Holding Size Class	No. of Selected holdings	Area under the crop in the Sample (hectare)	Percentage	Area per holding (hectare)
1	2	3	4	5
Small	215	50.18	28.71	0.23
Medium	149	105.56	60.40	0.71
Large	6	19.02	10.89	3.17
<b>Total</b>	<b>370</b>	<b>174.76</b>	<b>100.00</b>	<b>0.47</b>

The average area per sample holding under study is 0.47 hectare.

#### A. Cost of Cultivation

The cost of cultivation is worked out on the basis of the concepts given in the previous paragraphs. The estimated cost of cultivation of different items per hectare of autumn paddy is given below. The details of estimated cost according to size classes are given in Appendix I.

**Cost of Cultivation Per Hectare of Paddy (Autumn)  
During the Year 1991-92**

Sl. No.	Component of different Cost concept	Cost per hectare in Rs.	% distribution of Cost
1	2	3	4
1.	Hired Human Labour	5814	53.30
2.	Animal Labour	.46	6.23
3.	Machine Labour	474	6.62
4.	Seed/Seedlings	478	6.68
5.	Farmyard manure	1298	18.15
	Chemical Fertilisers		
6.	Plant Protection	114	1.59
7.	Land Tax	2	0.58
	Irrigation Cess		
8.	Repairs & Maintenance Charge of Implements, Machinery & building	80	1.12
9.	Interest on working capital	335	4.68
10.	Other Expenses	75	1.05
11.	Total Cost A(1-10)	7156	100.00
12.	Interest on fixed capital	40	-
13.	Cost B1 (11+12)	1496	-
14.	Interest on land value	6881	-
15.	Cost 'B' (13+14)	14377	-
16.	Imputed value of household labour	375	-
17.	Cost 'C' (15+16)	14752	-

From the above table it is seen that total cost 'A' of cultivation of autumn paddy per hectare works out to Rs.7156/-. About 53% of the total Cost 'A' is towards hired human labour. Animal labour and machine labour accounts to 6% and 7% respectively. The percentage of hired human labour hours to total labour hours engaged in autumn paddy cultivation in respect of males and females is given below:-

**7. Percentage of hired human labour hours to total human labour hours.**

Sex	Holding size class			
	Small	Medium	Large	All Sizes
1	2	3	4	5
Male	29.86	22.61	21.17	24.95
Female	60.21	69.52	77.43	67.00
<b>Total (hired)</b>	<b>90.07</b>	<b>92.13</b>	<b>98.60</b>	<b>91.95</b>

The proportion of hired human labour hours is about 92% of the total human labour hours. Proportion of hired human labour to total human labour input increases with the increase in the size of holding. Cultivators belonging to large size class are seen to depend for 99% of their requirements on hired labour.



For Seed/Seedlings about 8% of the cost 'A' is accounted. It is higher in the case of large and small holdings than that of the medium holdings. Farmyard manure and chemical fertilizers forms 18% of the total Cost 'A'. When compared to the previous year per hectare cost towards chemical fertilizers showed a decreasing trend from Rs.676/- to Rs.642/-. While cost towards farmyard manure showed an increasing trend i.e. from Rs.403/- to Rs.656/-. This type of a change in this item may be attributed to the impact of withdrawal of fertilizer subsidy during the period under review. It can be seen that expenditure towards plant protection measures also showed a decreasing trend from Rs.151/- to Rs.114/-. Expenditure on land tax and irrigation cess showed to less than 1%. The percentage share for repair and maintenance of implements and machinery comes to only 1% of the total Cost 'A'. The interest on working capital is about 5% and the expenditure towards other items accounts to 1% only.

### Cost 'B1'

Cost 'B1' is estimated by adding the interest on fixed capital (excluding land) to Cost 'A'. It works out to Rs.7496/-.

The interest on land value is found to be Rs.6881/- during the period and it is seen that the interest on land value is minimum in large class and maximum in the case of small size class. The same trend was seen in the previous rounds also.

### Cost 'B' and Cost 'C'

Cost 'B' is estimated by adding the interest on land value to Cost 'B1' and Cost 'C' is estimated by adding the imputed value of household human labour to Cost 'B'. Cost 'B' is found to be Rs.14377/- and Cost 'C' is Rs.14752/- per hectare. The imputed value of household human labour is Rs.375/- per hectare. A comparative analysis of this labour input with the different size class indicate that the rate of involvement of family labour is higher in the case of small holdings and lower in the case of large holdings. This has important implication that for the large farmer, participation of the household labour is only in the form of supervision and management. The estimates of cost under three major concepts relating to the year under study and to the previous year are given below.

### **B. Cost of cultivation of (autumn) paddy in Rs./hectare for 1990-91 and 1991-92**

Concept of Cost	Year	Holding size class			
		Small	Medium	Large	All Sizes
1	2	3	4	5	6
Cost 'A'	1990-91	7772	6095	5432	6291
	1991-92	8175	6747	6759	7156
Cost 'B'	1990-91	15119	11578	9685	11859
	1991-92	16975	13666	11508	14377
Cost 'C'	1990-91	15694	11943	9724	12182
	1991-92	17524	14020	11536	14752

Compared to the previous year the cost of cultivation has increased to 14% during this year. The percentage increase of Cost 'B' and 'C' being 21% each.



**B. Output:-**

The value of the product and by-product of paddy cultivation viz. paddy and straw for the year under study is given in the following table.

**9. Value of product and by-product per hectare (in Rs.) during 1991-92**

Product by-product	Holding size class			
	Small 2	Medium 3	Large 4	All Sizes 5
Paddy	7141	7825	12516	8139
Straw	1771	1274	743	1359
<b>Total</b>	<b>8912</b>	<b>9099</b>	<b>13259</b>	<b>9498</b>

The total value of output per hectare is estimated at Rs.9498/- during the year. During 1991-92 the value of output has increased to Rs.9498/- per hectare from Rs.8660/- of the previous year 1990-91.

The general trend in the growth of the value of product from 1980-81 is given in the following table. It can be seen that the value of product has showed an increasing trend from 1986-87 onwards.

**10. Value of Product/hectare (in Rs.)**

Year	Value of Product
1	2
1980-81	2262
1981-82	3446
1982-83	3937
1983-84	5012
1984-85	4368
1985-86	4801
1986-87	4618
1987-88	5189
1988-89	5254
1989-90	6690
1990-91	7259
1991-92	8139

**C. Cost of production of paddy per quintal:-**

Cost of production of paddy per quintal is estimated by dividing the cost of cultivation per hectare (after deducting the value of by-product per hectare from the cost of cultivation per hectare) by the quantity of paddy produced per hectare.

**11. Cost of Production of paddy per quintal during autumn season (in Rs.)**

Concept of Cost	Holding size class			
	Small 2	Medium 3	Large 4	All Sizes 5
Cost 'A'	320	261	172	264
		595	308	592

## 14. Cost of Cultivation per Hectare of Paddy (Winter)

The cost of production of paddy per quintal during the period under report is Rs.264/- when Cost 'A' is considered. It is seen that the cost is higher in the case of small size class. It could be seen from the table that the cost of production per quintal of paddy during the year 1991-92 is higher than the previous year according to the cost 'A', 'B' and 'C'.

## 12. Cost of Production per quintal of Autumn paddy during 1990-91 and 1991-92 (in Rs.)

Concept of Cost	1990-91	1991-92	Percentage increase
Cost 'A'	184	264	43
Cost 'B'	394	592	50
Cost 'C'	406	609	50

## ii. Winter (Mundakan) Paddy:-

The number of holdings selected for the winter paddy crop was 380 during the reference period. The number of holdings and the area covered under the three size classes are given below.

## 13. Area and number of holdings selected during 1991-92

Holding size class	No. of holdings	Area under the crop (ha.)	Percentage to total area	Area per holding (ha.)
Small	214	49.40	24.59	0.23
Medium	152	108.03	53.78	0.71
Large	14	43.46	21.63	3.10
All size	380	200.89	100.00	0.53

The average area per holding is found to be 0.53 hectares. About 25% of the area comes under the small size class, 54% under medium size class and 22% under large size class.

## A. Cost of Cultivation:-

The cost of cultivation per hectare of winter paddy during 1991-92 is given below. Item-wise cost for different size class are given in Appendix.



**14. Cost of Cultivation per Hectare of Paddy (Winter)  
During the year 1991-92.**

Sl. No.	Component of different Cost concept	Cost Per hectare (in Rs.)	% distribution of Cost 'A'
1	2	3	4.
1.	Hired Human Labour	4384	51.60
2.	Animal labour	506	5.96
3.	Machine labour	545	6.41
4.	Seed/Seedlings	541	6.37
5.	Farmyard manure & Chemical fertilizers	1523	17.93
6.	Plant Protection	94	2.28
7.	Land Tax & Irrigation Cess	50	0.59
8.	Repair & Maintenance charge of implements, machinery & buildings	91	1.07
9.	Interest on working capital	398	4.68
10.	Other Expenses	269	3.11
11.	Total Cost (A) (1 to 10)	8496	100
12.	Interest on fixed capital	342	-
13.	Cost B1 (11+12)	8838	-
14.	Interest on land value	6309	-
15.	Cost 'B'(13+14)	15147	-
16.	Imputed value of household labour	457	-
17.	Cost 'C' (15+16)	15604	-

More than half of Cost 'A' is accounted by hired human labour in Winter Paddy cultivation and it is seen to be Rs.4384/-. The percentage of hired human labour hours engaged in the winter paddy cultivation to the total labour hours is given in the following table.

**15. Percentage distribution of hired human labour hours to total labour hours**

Sex	Holding Size Class			
	Small	Medium	Large	All Sizes
1	2	3	4	5
Male	27.88	21.82	15.86	22.20
Female	59.21	68.59	81.27	68.71
<b>Total</b>	<b>87.09</b>	<b>90.41</b>	<b>97.13</b>	<b>90.91</b>

It is seen that the hired human labour hours accounted for 91% of the total human labour hours in winter paddy cultivation. Hired labour is more in the case of females. The cost of animal labour utilised for winter paddy cultivation relating to large size class is smaller than that of the medium and small cultivators. While machine labour utilisation is larger in the case of large cultivators than that of the small and medium cultivators. Cost towards seed/seedlings accounts to 6% and 18% is towards farmyard manure and chemical fertilizers. The cost of plant protection measures is estimated Rs.194/- in 1991-92. only a nominal amount is spent for land tax and irrigation cess i.e. Rs.50/- per hectare. Percentage share towards repair and maintenance charges of implements, machinery and buildings is 1% and interest on working capital is estimated to be Rs.398/- which is about 5% of the total cost 'A'. 3% comes under other expenses.



The interest on fixed capital excluding land is estimated at Rs.342/- per hectare and Cost 'B1' is found to be Rs.8838/-. Interest on land value is worked out to Rs.6309/- and the Cost 'B' comes to Rs.15147/- per hectare. It is maximum in the case of small cultivators and minimum in the case of large cultivators.

The estimated cost for the cultivation of winter paddy per hectare under three major concepts of cost are given below.

#### 16. Cost of cultivation of winter paddy (Rs./ha.)

Concept of Cost	Holding Size class			
	Small	Medium	Large	All Sizes
1	2	3	4	5
Cost 'A'	8952	8303	8441	8496
Cost 'B'	16964	15363	12684	15147
Cost 'C'	17709	15836	12819	15604

Cost of cultivation of winter paddy for 1990-91 and 1991-92 are given below.

#### 17. Cost of cultivation of winter paddy (Rs./ha.) for 1990-91 and 1991-92

Concept of Cost	Year	Holding Size Class			
		Small	Medium	Large	All Sizes
1	2	3	4	5	6
Cost 'A'	1990-91	8690	6786	4946	6904
	1991-92	8952	8303	8441	8496
Cost 'B'	1990-91	15653	11853	9717	12385
	1991-92	16964	15363	12684	15147
Cost 'C'	1990-91	16267	12148	9859	12759
	1991-92	17709	15836	12819	15604

#### B. Output

The estimates of value of paddy and straw obtained from winter paddy cultivation is given below.

#### 18. Value of output (Rs./ha.)

Product and by-product	Holding size class			
	Small	Medium	Large	All Sizes
1	2	3	4	5
Paddy	9859	9964	15394	11113
Straw	2771	2139	1189	2089
<b>Total</b>	<b>12630</b>	<b>12103</b>	<b>16583</b>	<b>13202</b>

### C. Cost of Production of paddy per quintal:-

Cost of producing one quintal of paddy is worked out by dividing the cost of cultivation per hectare (after deducting the value of by-product per hectare from the cost of cultivation per hectare) by the yield per hectare.

#### 19. Cost of production of winter paddy (Rs./Ql.)

Concept of cost	Holding size class			
	Small	Medium	Large	All Sizes
1	2	3	4	5
Cost 'A'	257	218	183	216
Cost 'B'	590	467	290	439
Cost 'C'	621	484	293	455

The cost of production of winter paddy per quintal for 1990-91 and 1991-92 are presented below for the purpose of comparison.

#### 20. Cost of production of winter paddy per quintal (in Rs.) for 1990-91 and 1991-92

Concept of Cost	Year	Holding size class			
		Small	Medium	Large	All Sizes
1	2	3	4	5	6
Cost 'A'	1990-91	231	194	116	186
	1991-92	257	218	183	216
Cost 'B'	1990-91	502	395	272	396
	1991-92	590	467	290	439
Cost 'C'	1990-91	526	407	277	409
	1991-92	621	484	293	455

When compared to the previous year cost of production of winter paddy per quintal relating to Cost 'A', 'B' and 'C' showed an increasing trend.

#### iii. Summer (Punja) Paddy:-

During 1991-92 370 holdings covering an area of 147.71 hectares were selected for estimating the cost of cultivation of summer paddy. The average area per sample holding is found to be 0.39 hectare.

The estimated per hectare cost of different items are presented below. The details according to size class are presented in Appendix 3.

#### 21. Size-wise number of selected holdings and area

Holding Size class	Number of Selected holdings	Area under paddy (in hectare)	Percentage to total area under paddy	Area per holding (hectare)
1	2	4	5	6
Small	253	48.92	33.11	0.19
Medium	111	82.80	56.06	0.75
Large	6	15.99	10.83	2.67
<b>Total</b>	<b>370</b>	<b>147.71</b>	<b>100.00</b>	<b>0.39</b>



**22. Cost of cultivation per hectare of paddy (summer)  
During the year 1991-92**

Sl. No.	Component of different Cost Concept	Cost per hectare in Rs.	% distribution of Cost
1.	Hired Human Labour	5049	53.65
2.	Animal labour	49	4.77
3.	Machine labour	447	4.75
4.	Seed/Seedlings	604	6.42
5.	Farmyard manure and Chemical fertilisers	1513	16.07
6.	Plant protection	354	3.76
7.	Land Tax and Irrigation Cess	50	0.53
8.	Repair & Maintenance charges of implements machinery & buildings	98	1.04
9.	Interest on working capital	441	4.69
10.	Other Expenses	407	4.32
11.	Total Cost 'A' (1 to 10)	9412	100
12.	Interest on fixed capital	422	-
13.	Cost B1 (11+12)	9834	-
14.	Interest on land value	5716	-
15.	Cost 'B' (13+14)	15550	-
16.	Imputed value of household labour	520	-
17.	Cost 'C' (15+16)	16070	-

The labour cost towards human, animal and machine constitutes 63% of the total cost 'A'. The percentage of hired human labour hours engaged in the cultivation of summer paddy during 1991-92 is given below.

**23. Percentage of hired human labour hours engaged in  
Summer paddy cultivation**

Holding Size Class	Output:-		Total
	Male	Female	
	2	3	4
Small	24.80	56.71	81.51
Medium	29.57	65.34	94.91
Large	34.77	62.94	97.71
<b>All Sizes</b>	<b>28.31</b>	<b>61.88</b>	<b>90.19</b>

In summer paddy cultivation 90% of the total human labour hours is hired human labour. 6% of the total cost 'A' is for seed/seedlings 16% of the total Cost 'A' constitutes the cost of farmyard manure and chemical fertilizers. About 4% was spent towards plant protection. The expenditure per hectare of land tax and irrigation cess is found to be Rs.50/-. The interest on working capital is estimated to be Rs.441/-.

### Cost 'B1' and Cost 'B'

Cost 'B1' is obtained by adding the interest on fixed capital (excluding land) to Cost 'A' and is seen to be Rs.9834/-. Interest on land value is maximum in the case of small holding size class and minimum in the case of large holding size class. Cost 'B' is seen to be Rs.15550/-. The imputed value of household labour is maximum (Rs.1072/-) in the case of small class and minimum (Rs.72/-) in the case of large size class i.e. small size class engaged themselves in the cultivation practices than the cultivators belonging to large size class. Animal labour has decreased as size class increases. Machine labour is lower in the case of medium class. This goes to show that medium size class are not interested in using machines for cultivation.

The table below gives cost of cultivation of summer paddy during 1990-91 and 1991-92.

#### 24. Cost of cultivation of (Summer) paddy in Rs./hectare for 1990-91 and 1991-92

Concept of Cost	Year	Holding size class			
		Small	Medium	Large	All Sizes
1	2	3	4	5	6
Cost 'A'	1990-91	8630	8163	6946	8078
	1991-92	9620	9287	9346	9412
Cost 'B'	1990-91	15363	12831	9612	12951
	1991-92	17454	14910	12537	15550
Cost 'C'	1990-91	16331	13226	9662	13438
	1991-92	18526	15190	12609	16070

When the cost of cultivation is compared with the previous year, the Cost 'A' has increased by 16.51% and Cost 'B' 20.06% and Cost 'C' by 19.58%.

### B. Output:-

The value of output is seen to be Rs.14156/- per hectare for the summer paddy. The details for the different holding size classes are given as follows.

#### 25. Value of product and by-product per hectare of 1991-92.

Product/by-product	Holding size class			
	Small	Medium	Large	All Sizes
1	2	3	4	5
Paddy	10254	12130	15434	11866
Straw	2615	2156	1984	2290
<b>Total</b>	<b>12869</b>	<b>14286</b>	<b>17418</b>	<b>14156</b>



Cost of producing one quintal of paddy is got by dividing the cost of cultivation per hectare (after deducting the value of by-product per hectare from the cost of cultivation per hectare) by the yield per hectare.

### 26. Cost of production of summer paddy per quintal

Concept of Cost	Holding size class			
	Small	Medium	Large	All Sizes
1	2	3	4	5
Cost 'A'	259	223	171	229
Cost 'B'	550	399	245	428
Cost 'C'	589	407	247	445

A comparison between the cost of production of paddy per quintal during 1990-91 and 1991-92 is given in the following table.

### 27. Cost of production of paddy/quintal during 1990-91 and 1991-92

Concept of Cost	1990-91	1991-92
1	2	3
Cost 'A'	200	229
Cost 'B'	353	428
Cost 'C'	369	45

## 2.2 Coconut

During the agricultural year 1991-92 about 8.63 lakh hectare is under coconut cultivation i.e. about 29% of the total cropped area in the state is under coconut. The area and the average yield per hectare is given in the following table.

### 28. Area and average yield of coconut 1991-92

Area under Coconut (ha.)	Percentage to total cropped area	Average yield per hectare (No. of units)
1	2	3
863061	28.57	5377

Source: TRS Estimates 1991-92.

### Selected holdings

380 holdings were selected during 1991-92 for the study on cost of cultivation of coconut. The area under coconut (Size class-wise) is given below.

**29. Number of holdings and area under coconut**

Holding size Class	No. of holdings	Area under Coconut with Sample (ha.)	Percentage	Area per holding (ha.)
1	2	3	4	5
Small	95	13.29	6.96	0.14
Medium	220	88.64	46.45	0.40
Large	65	88.91	46.59	1.37
<b>All Sizes</b>	<b>380</b>	<b>190.84</b>	<b>100.00</b>	<b>0.50</b>

The average area per sample holding is 0.50 hectare.

**Number of bearing trees in the selected holdings**

In the selected holdings the average number of bearing trees per hectare is found to be 134 and non bearing trees 70.

**30. Number of bearing and non-bearing trees per hectare.**

Type of trees	No. of trees per hectare	Percentage
1	2	3
Bearing	134	65.69
Non-bearing	70	34.31
<b>Total</b>	<b>204</b>	<b>100.00</b>

**A. Cost of Cultivation**

The three different cost concept of coconut cultivation is mentioned below.

**(i) Cost 'A'**

The per hectare cost of cultivation of coconut towards cash and kind expenses during 1991-92 is Rs.6028/- The estimated cost of cultivation of different items per hectare of coconut is given in the following table. (Please refer appendix-4 also.)



### 31. Cost of Cultivation Per Hectare of (Coconut) During the year 1991-92.

Sl. No.	Component of different Cost Concept	Cost per hectare in Rs.	% distribution of Cost A
1	2	3	4
1.	Hired Human Labour	2704	44.86
2.	Animal Labour	23	0.38
3.	Machine labour	85	1.41
4.	Seed/Seedlings	35	0.58
5.	Farmyard manure and Chemical Fertilizers	2211	36.68
6.	Plant protection	7	0.12
7.	Land tax and Irrigation cess	21	0.35
8.	Repair & Maintenance charge of implements, machinery & building	97	1.61
9.	Interest on working capital	537	8.91
10.	Other Expenses	308	5.10
11.	Total Cost A(1 to 10)	6028	100.00
12.	Interest on fixed capital	489	-
13.	Cost B1 (11+12)	6517	-
14.	Interest on land value	47307	-
15.	Cost 'B' (13+14)	53824	-
16.	Imputed value of household labour	325	-
17.	Cost 'C' (15+16)	54149	-

The expenditure towards human, animal and machine labour constitutes to 46.65% of total cost 'A'. The percentage of hired human labour hours to total human labour hours is given below.

### 32. Percentage distribution of hired human labour hours to the total human labour hours.

Sex	Holding Size Class			All Sizes
	Small	Medium	Large	
1	2	3	4	5
Male	65.51	73.36	80.87	75.58
Female	3.25	9.58	12.48	10.15
<b>Total</b>	<b>68.76</b>	<b>82.94</b>	<b>93.35</b>	<b>85.73</b>

From the above table it is seen that 86% of the total human labour hours has been constituted by hired human labour. For Seed/Seedlings per hectare cost constitutes to Rs.35/-. The cost for farmyard manure and chemical fertilizers per hectare is Rs.2211/- showing that about 37% of the total cost 'A' is spent on these items. Plant protection cost for coconut cultivation accounts to a nominal share i.e. 0.12% of the total cost 'A'.

The expenditure towards land tax and irrigation cess is found to be Rs.21/-. The charges towards repair, maintenance of implements, machinery, building etc. is Rs.97/- per hectare. Interest on working capital is estimated to be Rs.537/-. The other expenses were found to be Rs.308/- per hectare. The interest on fixed capital is estimated to be Rs.489/- per hectare (excluding land improvement).

#### ii. Cost 'B1' and Cost 'B'

Cost 'B1' is estimated by adding the interest on fixed capital (excluding land) to cost 'A'. It is found to be Rs.6517/- per hectare.

During this round cost 'B' for coconut cultivation is estimated to be Rs.53824/-. Imputed value of household labour is Rs.325/-. It is seen that the interest on land value is minimum in medium class and maximum in the case of small size class.

#### Cost 'C'

As usual the family labour is seen to be higher in small holding size class and lower in large holding size class. Cost 'C' is estimated as Rs.54149/ per hectare.

### 33. Cost of Cultivation of coconut per hectare during 1990-91 and 1991-92

Concept of Cost	Cost per hectare (in Rs.)		Percentage of increase
	1990-91	1991-92	
1	2	3	4
Cost 'A'	4955	6028	21.66
Cost 'B'	43520	53824	23.68
Cost 'C'	43775	54149	23.70

#### B. Value of Product

The total value of output per hectare is seen to be Rs.19083/- during 1991-92.

### 34. Value of Output/hectare

Output	Value (in Rs.)
1	2
Product	18288
By-product	795
<b>Total</b>	<b>19083</b>



### 2.3. Arecanut

The arecanut palm grows under different climatic and soil conditions. The total area under arecanut cultivation and the average yield per hectare for the year 1991-92 are given in the following table.

#### 35. Area and average yield of arecanut

Area under Arecanut (hectare)	Percentage to total cropped area	Average yield per hectare (Nos.)
1	2	3
63437	2.10	206756

Source: TRS estimates.

From the above table it is seen that 2% of the total cropped area is under arecanut.

#### Selected holdings:

375 holdings were selected for the estimation of cost of cultivation of arecanut during 1991-92. The details of these holdings in each size class is given in the following table.

#### 36. Number of holdings and area under arecanut

Holding Size class	No. of holdings	Area under arecanut in the sample (hectare)	Percentage	Area per holding (hectare)
1	2	3	4	5
Small	337	17.33	46.52	0.05
Medium	32	11.23	30.15	0.35
Large	6	8.69	23.33	1.44
<b>Total</b>	<b>375</b>	<b>37.25</b>	<b>100.00</b>	<b>0.09</b>

The number of holdings selected for the period under report has a total operational area of 37.25 hectare. The average size of per sample holding is 0.09 hectare.

#### A. Cost of cultivation

The cost of cultivation of arecanut is estimated under three different concepts of cost.

### 37. Cost of cultivation per hectare of Arecanut during the year 1991-92.

Sl. No.	Component of different Cost Concept	Cost per hectare (in Rs.)	% distribution of Cost 'A'
1	2	3	4
1.	Hired human labour	3808	43.14
2.	Animal labour	4	0.05
3.	Machine labour	388	4.40
4.	Seed/Seedlings	7	0.08
5.	Farmyard manure and Chemical fertilizers	3054	34.60
6.	Plant protection	477	5.40
7.	Land tax and irrigation cess	41	0.46
8.	Repair & maintenance charge of implements, machinery & buildings	119	1.35
9.	Interest on working capital	788	8.93
10.	Other expenses	140	1.59
11.	Total Cost 'A' (1-10)	8826	100.00
12.	Interest on fixed capital	215	-
13.	Cost 'B1' (11+12)	9741	-
14.	Interest on land value	35422	-
15.	Cost 'B' (13+14)	45163	-
16.	Imputed value of household labour	985	-
17.	Cost 'C' (15+16)	46148	-

As in other crops, labour cost is the major component of cost 'A' in arecanut cultivation. The percentage share of cost estimated under this head is 48% of cost 'A'. It is also seen that hired human labour cost formed the major portion of the labour cost. It accounts to 43% of the total cost 'A'. The percentage of hired human labour hours engaged in arecanut cultivation to the total labour hours is given below.

### 38. Percentage distribution of hired human labour hours

Sex	Size Class			
	Small	Medium	Large	All Size
1	2	3	4	5
Male	59.80	61.99	60.54	60.74
Female	9.22	10.52	32.03	16.29
<b>Total</b>	<b>69.02</b>	<b>72.51</b>	<b>92.57</b>	<b>77.03</b>

The above table reveals that 77% of the total human labour hours has been constituted by hired human labour.

A nominal amount is seen i.e. Rs.7/- incurred towards the cost of seed/seedlings for the new plantation in the selected plots. During the period under report, the cost towards farmyard manure works out to Rs.3054/-. It accounts to 35% of the total cost 'A'. The expenditure incurred on plant protection is Rs.477/-. Land tax and irrigation cess accounts to Rs.41/-. The estimated expenditure on repair and maintenance charges of implements and machinery works out to Rs.119/- during the period under study. Interest on working capital shares to 9% of cost 'A'. The cost towards other expenses comes to 2% of cost 'A'.



**Cost 'B1' and Cost 'B'**

Cost 'B1' is estimated by adding the estimated value of interest on fixed capital to cost 'A'. It works out to Rs.9741/- during the year. Cost 'B' for arecanut cultivation is estimated to be Rs.45163/-. Imputed value of household labour is Rs.985/-.

**Cost 'C'**

Cost 'C' is estimated by adding the imputed value of household labour to cost 'B' and it is found to be Rs.46148/- during 1991-92.

**B. Value of output**

The value of product per hectare from arecanut cultivation is found to be Rs.33228/- for the year 1991-92.

**2.4 Tapioca**

During 1991-92 the area under tapioca is 1.42 lakh hectare. The total area under tapioca cultivation and the average yield per hectare are given below:-

**39. Area and average yield of tapioca during 1991-92**

Area under tapioca (lakh hectare)	Average yield per hectare (tonnes)	% of area under tapioca to total cropped area
1.42	18.73	4.70

The average yield of tapioca per hectare during the period under report was 18.73 tonnes and the percentage of the total cropped area was about 5%.

A total of 180 holdings were selected for studying the cost of cultivation of tapioca in Kerala. The number of holdings and area are given below.

**40. Area and number of holdings selected during 1990-91**

Size Class	Number of holdings selected	Area under tapioca in the sample (hectare)	Percentage to total area	Area per holdings (hectare)
Small	113	13.12	34.83	0.12
Medium	65	22.09	58.64	0.34
Large	2	2.46	6.53	1.23
<b>All Sizes</b>	<b>180</b>	<b>37.67</b>	<b>100.00</b>	<b>0.20</b>

Male	18.02	69.17	98.92	
Female	35.25	19.22	9.22	
<b>Total</b>	<b>53.27</b>	<b>88.39</b>	<b>100.00</b>	

The average area per sample holding is 0.20 hectare. The total area of the holdings selected for studying the cost of cultivation of tapioca was 37.67 hectare.

#### A. Cost of cultivation

The cost of cultivation of tapioca estimated under different cost concepts are given below:-

#### 41. Cost of Cultivation per hectare of (Tapioca) during the year 1991-92.

Sl. No.	Component of different cost concept	Cost per hectare in Rs.	% distribution of Cost A
1	2	3	4
1.	Hired Human labour	4 434	53.80
2.	Animal labour	7	0.69
3.	Machine labour	140	1.70
4.	Seed/Seedlings	238	2.89
5.	Farmyard manure and Chemical fertilizers	2143	26.00
6.	Plant Protection	9	0.11
7.	Land Tax and Irrigation Cess	19	0.23
8.	Repair & Maintenance charge of implements, machinery & buildings	55	0.67
9.	Interest on working capital	743	9.01
10.	Other Expenses	04	4.90
11.	Total Cost 'A' (1 to 10)	8242	100.00
12.	Interest on fixed capital	005	-
13.	Cost B1 (11+12)	8847	-
14.	Interest on land value	31563	-
15.	Cost 'B' (13+14)	40410	-
16.	Imputed value of household labour	975	-
17.	Cost 'C' (15+16)	41385	-

The above table shows that the cost 'A' for tapioca cultivation during this round is estimated to be Rs.8242/- per hectare.

The percentage of hired human labour hours engaged in tapioca cultivation is give below:-

#### 42. Percentage distribution of hired human labour hours

Sex	Holding size class			
	Small	Medium	Large	All Sizes
1	2	3	4	5
Male	58.49	69.17	50.31	64.53
Female	9.53	19.95	32.25	16.73
<b>Total</b>	<b>68.02</b>	<b>89.12</b>	<b>85.56</b>	<b>81.26</b>



In tapioca cultivation the proportion of hired human labour to total human labour input is minimum in small size class and maximum in medium size class. About 3% of Cost 'A' is spent for cuttings in tapioca cultivation. The percentage share of farmyard manure and chemical fertilizers accounts to 26% of cost 'A'. Land tax and irrigation cess accounts to 0.23% and plant protection measures is Rs.9/- only during the period. The repair and maintenance charges on implements and machinery per hectare is Rs.55/-. The interest on working capital is Rs.743/- and other expenses is Rs.404/- per hectare.

The interest on fixed capital (excluding land value) is estimated as Rs.605/- during 1991-92. Cost 'B' is estimated by adding the interest on fixed capital (excluding land) to cost 'A'. It is found to be Rs.8847/- per hectare. The interest on land value is higher than that of the previous year i.e. Rs.31563/-. Cost 'B' is estimated to be Rs.40410/-. The imputed value of household labour showed a nominal increase during this year i.e. Rs.975/- per hectare. Cost 'C' is estimated to be Rs.41385/- per hectare.

The estimated cost of tapioca cultivation under different cost concepts are shown below:-

#### 43. Estimated cost of Tapioca cultivation

Concept of Cost	Cost per hectare (Rs.)
1	2
Cost 'A'	8242
Cost 'B'	40410
Cost 'C'	37145

A comparison between the cost of production of tapioca during 1990-91 and 1991-92 is given in the following table.

#### 44. Cost of tapioca cultivation per hectare during 1990-91 and 1991-92

Concept of Cost	Cost per hectare (Rs.)		% increase in cost of cultivation
	1990-91	1991-92	
1	2	3	4
Cost 'A'	6724	8242	22.57
Cost 'B'	36340	40410	11.19
Cost 'C'	37145	41385	11.41

#### B. Output:

The value of output per hectare is found to be Rs.13146/- during the current year.

## 2.5 Banana:

Banana is an important fruit crop of Kerala. The area and average yield of banana during 1991-92 are given below:-

## 45. Area and average yield of Banana during 1991-92

Area under the crop (hectare)	Average yield per hectare (Kg.)	Percentage of area under the crop to total cropped area
1	2	3
22682	13410	0.75

Source: TRS Estimates.

## Selected holdings

A sample of 174 holdings were selected for studying the cost of cultivation of banana during 1991-92.

The details of the holdings are given in the following table.

## 46. Area and Number of holdings selected

Size Class	No. of selected holdings	Total area under the crop (hectare)	Percentage to total area of selected holdings	Area per holding
1	2	3	4	5
Small	155	12.28	60.70	0.08
Medium	17	5.32	26.30	0.31
Large	2	2.63	13.00	1.31
All Sizes	174	20.23	100.00	0.11

The total area under the crop coming under the selected holdings is 20.23 hectare for the year 1991-92. The average size of holding is 0.11 hectare.

## A. Cost of cultivation of banana

The cost of cultivation of banana estimated under three different concepts of Cost, Cost 'A', Cost 'B' and Cost 'C' are presented below.

## Cost 'A'

Labour cost for the cultivation of banana per hectare is estimated to be Rs.7950/-. 24% of the total cost 'A' comes under this item. The major portion of the labour cost is constituted by hired human labour. The percentage of hired human labour hours engaged in banana cultivation to total human labour hours is given in the following table.



#### 47. Percentage distribution of hired human labour hours to total human labour hours

Sex	Holding size class			Total
	Small	Medium	Large	
1	2	3	4	5
Male	54.27	58.82	90.98	59.45
Female	6.90	9.35	-	6.54
<b>Total</b>	<b>61.17</b>	<b>68.17</b>	<b>90.98</b>	<b>65.99</b>

The proportion of hired human labour increases as size class increases.

The expenditure towards seed/seedlings is found to be Rs.3406/- i.e. 10% of the total cost 'A'. Major portion of the total cost 'A' i.e. 41% is expended for the application of farmyard manure and chemical fertilizers. Only a small percent of the total cost 'A' accounts towards the cost of plant protection, land tax and irrigation cess and repair and maintenance charge i.e. 1.35%, 0.55% and 0.37% respectively. The interest on working capital is Rs.2955/- per hectare. 9% of the total cost 'A' accounts for this item. 13% is spent for other expenses.

The estimated cost under different items per hectare and their corresponding percentage to total cost 'A' are furnished in the following table.

#### 48. Cost of cultivation per hectare of Banana 1991-92

Sl. No.	Components of different cost concepts	Cost per hectare	% distribution of Cost 'A'
1	2	3	4
1.	Hired human labour	7915	24.12
2.	Animal labour	32	0.10
3.	Machine labour	3	0.01
4.	Seed/Seedlings	3406	10.38
5.	Farmyard manure and Chemical Fertilizers	13376	40.77
6.	Plant protection	442	1.35
7.	Land tax and irrigation cess	180	0.55
8.	Repair & maintenance charge	123	0.37
9.	Other expenses	4377	13.34
10.	Interest on working capital	2955	9.01
11.	Total cost 'A' (1 - 10)	32809	100.00
12.	Interest on fixed capital	768	-
13.	Cost 'B1' (11 + 12)	33577	-
14.	Interest on land value	25075	-
15.	Cost 'B' (13 + 14)	58652	-
16.	Imputed value of household labour	3827	-
17.	Cost 'C' (15+16)	62479	-

**Cost 'B1'**

Cost 'B1' is estimated by adding the interest on fixed capital (excluding land) to cost 'A' and is estimated to Rs.33577/- during 1991-92.

**Cost 'B'**

Cost 'B' is arrived at by adding the interest on land value to Cost 'B1' and is seen as Rs.58652/-. It is seen that interest on land value decreases as size class increases.

**Cost 'C'**

The imputed value of household human labour is added to cost 'B' to get cost 'C'.

The imputed value of household labour is estimated as Rs.3827/- and Cost 'C' for the cultivation of banana per hectare is Rs.62479/- during this round.

**B. Value of Output**

Value of output per hectare from banana cultivation is Rs.58159/- during 1991-92.

**2.6 Pepper**

As a foreign exchange earner pepper occupy an important place in Kerala economy. The total area under pepper and the average yield per hectare during 1991-92 are given in the following table:-

**49. Area and average yield of pepper**

Area under pepper (in hectare)	Average yield of pepper in Kg. per hectare	Percentage of area under pepper to the total cropped area
1	2	3
178126	282	5.89

Source: TRS estimates.

The coverage of area under pepper cultivation is about 6% of the total cropped area.

**Selected holdings**

During 1991-92, 185 holdings were selected for studying the cost of cultivation of pepper. The area and the number of holdings selected for pepper are given in the following table.



## 50. Area under pepper in the sample

Holding size class	No. of selected holdings	Total area under the crop (hectare)	Percentage to Total area of selected holdings	Area per holding
1	2	3	4	5
Small	176	8.67	66.64	0.05
Medium	7	2.33	17.87	0.33
Large	2	2.02	15.49	1.01
<b>All sizes</b>	<b>185</b>	<b>13.04</b>	<b>100.00</b>	<b>0.07</b>

The operational area under the crop in the selected holdings is 13 hectare during the period.

## A. Cost of cultivation of pepper:

The different concepts of cost estimated for the crop pepper are discussed in the following paragraphs. The components of Cost 'A' per hectare of pepper cultivation for the year 1991-92 are given in the following table.

## 51. Cost of cultivation per hectare of pepper 1991-92

Sl. No.	Components of different cost concepts	Cost per hectare (Rs.)	% distribution of cost 'A'
1	2	3	4
1.	Hired human labour	2475	57.61
2.	Animal labour	2	0.04
3.	Machine labour	50	1.08
4.	Seed/Seedlings	31	0.67
5.	Farmyard manure and chemical fertilizers	1377	29.82
6.	Plant protection	60	1.30
7.	Land tax and irrigation cess	16	0.35
8.	Repair & maintenance charge	100	2.17
9.	Other expenses	97	2.10
10.	Interest on working capital	409	8.86
11.	Total cost 'A' (1 to 10)	4617	100.00
12.	Interest on fixed capital	663	-
13.	Cost 'B' (11 + 12)	5280	-
14.	Interest on land value	3328	-
15.	Cost 'B' (13+14)	38528	-
16.	Imputed value of household labour	1079	-
17.	Cost 'C' (15+16)	39607	-



The labour cost towards per hectare of pepper cultivation is Rs.2527/- during 1991-92. About 55% of the cost 'A' accounts for this item. The percentage of hired human labour hours engaged in pepper cultivation to the total labour hours is given below.

**52. Percentage distribution of hired human labour hours to total human hours**

Sex	Holding size class			
	Small	Medium	Large	All Sizes
1	2	3	4	5
Male	58.94	64.16	76.74	62.06
Female	5.09	3.79	10.37	5.59
<b>Total</b>	<b>64.03</b>	<b>67.95</b>	<b>87.11</b>	<b>67.65</b>

About 68% of the total human labour hours constituted for hired human labour and the remaining towards household exchange human labour hours. Female hired human labour is low in the case of pepper cultivation.

The per hectare cost towards seed/seedlings is Rs.31/-. This amount is spent for new planting in pepper growing plots. Rs.1377/- is spent for the cost of farmyard manure and chemical fertilizers which is 30% of the total cost 'A'. The expenditure towards plant protection is found to be Rs.60/- per hectare. Where as the share towards land tax and irrigation cess constitutes only a negligible percent i.e. 0.35% of the total cost 'A'. The cost towards repair and maintenance charges of implements and machinery accounts to 2.17% of the total cost 'A'. Interest on working capital shares to 9% and 2% of the total cost is spent towards 'other expenses'.

**Cost 'B1'**

Cost 'B1' is estimated by adding the interest on fixed capital (excluding land) to cost 'A'. It works out to Rs.5280/- for 1991-92.

The interest on land value is estimated to be Rs.33248/- during the period under report.

**Cost 'B' and Cost 'C'**

Cost 'B' is estimated by adding the interest on land value to cost 'B1' and cost 'C' is estimated by adding the imputed value of household labour to cost 'B'. Cost 'B' is found to be Rs.38528/- and cost 'C' is Rs.39607. The imputed value of household labour is Rs.1079/- per hectare.

**B. Value of Output:**

The value of pepper is found to be Rs.11210/- per hectare during the period under study.



### Chapter - 3 - Summary of findings

The cost of cultivation of important crops viz. Paddy (autumn, winter and summer), coconut, arecanut, banana, tapioca and pepper are worked out by analysing the data collected through the survey 1991-92.

#### 1. Autumn Paddy:

Cash and other kind expenses incurred i.e. cost 'A' for the cultivation of Autumn Paddy is estimated to be Rs.7156/- during 1991-92. It showed an increase of 14% compared to the previous year.

#### 2. Winter Paddy:

Cost 'A' for the cost of cultivation of winter paddy per hectare is worked out to be Rs.8496/- for the year 1991-92. The increase over the previous year is 23%.

#### 3. Summer Paddy:

The cost of cultivation of summer paddy per hectare (cost 'A') is estimated at Rs.9412/- during 1991-92 which is 17% more compared to the previous year.

#### 4. Coconut:

During this round the cost 'A' per hectare of coconut cultivation is worked out at Rs.6028/-. This is 22% more than the corresponding cost of the previous year.

#### 5. Arecanut:

The per hectare cost of cultivation (i.e. cost 'A') of arecanut is estimated to be Rs.8826/- and the value of product is found to be Rs.33228/- for the year 1991-92.

#### 6. Tapioca:

In tapioca cultivation the estimated per hectare cost ('A') during '91-92 is Rs.8242/-, which showed an increase of 23% when compared to the previous year.

#### 7. Banana:

The estimated cost 'A' for banana cultivation is Rs.32809/- and the value of output per hectare is Rs.58159/- during 1991-92.

#### 8. Pepper:

During the period under review the per hectare cost of cultivation of pepper (Cost 'A') is estimated to be Rs.4617/-. As in the previous year during this year also the cost 'A' recorded a decrease of about 6% when compared to the previous year. This can be attributed mainly to the low prices of pepper and also to the quick root-wilt disease which affected pepper cultivation in important growing centres.



**Appendix 1 - Cost of cultivation per hectare of Paddy(Autumn)  
during the year 1991-92**

Sl. No.	Component of different cost concept	Holding size class			All sizes
		Small	Medium	Large	
1	2	3	4	5	6
1.	Hired human labour	4472	3485	3904	3814
2.	Animal labour	653	429	-	446
3.	Machine labour	431	493	478	474
4.	Seed/Seedlings	511	458	509	478
5.	Farmyard manure & Chemical fertilizers	1441	1306	882	1298
6.	Plant protection	99	102	219	114
7.	Land tax & Irrigation Cess	14	35	155	42
8.	Repair & maintenance charge of implements & buildings	83	72	117	80
9.	Interest on working capital	385	316	309	335
10.	Other expenses	86	51	184	75
11.	Total Cost 'A' (1 - 10)	8175	6747	6757	7156
12.	Interest on fixed capital	336	340	366	340
13.	Cost 'B1' (11+12)	8511	7087	7123	7496
14.	Interest on land value	8069	6579	4385	6881
15.	Cost 'B' (13+14)	16975	13666	11508	14377
16.	Imputed value of household labour	549	354	28	375
17.	Cost 'C' (15+16)	17524	14020	11536	14752

**Appendix 2 - Cost of cultivation per hectare of Paddy(Winter)  
during the year 1991-92**

Sl. No.	Component of different cost concept	Holding size class			All sizes
		Small	Medium	Large	
1	2	3	4	5	6
1.	Hired human labour	4744	4269	4262	4384
2.	Animal labour	641	570	198	506
3.	Machine labour	496	491	733	545
4.	Seed/Seedlings	554	538	535	541
5.	Farmyard manure & Chemical fertilizers	1629	1459	1564	1523
6.	Plant protection	170	145	344	194
7.	Land tax & irrigation cess	46	32	101	50
8.	Repair & maintenance charge of implements and machinery	93	101	34	91
9.	Interest on working capital	420	389	396	398
10.	Other expenses	159	309	274	264
11.	Total Cost 'A' (1 - 10)	8952	8303	8441	8496
12.	Interest on fixed capital	290	319	615	342
13.	Cost 'B1' (11+12)	9242	8622	9056	8838
14.	Interest on land value	7722	6741	3628	6309
15.	Cost 'B' (13+14)	16964	15363	12684	15147
16.	Imputed value of household labour	745	473	135	457
17.	Cost 'C' (15+16)	17709	15836	12819	15604



**Appendix 3 - Cost of cultivation per hectare of Paddy(Summer)  
during the year 1991-92**

Sl. No.	Component of different cost concept	Holding size class			All sizes
		Small	Medium	Large	
1	2	3	4	5	6
1.	Hired human labour	4736	5213	5256	5049
2.	Animal labour	632	378	258	449
3.	Machine labour	531	366	607	447
4.	Seed/Seedlings	610	606	577	604
5.	Farmyard manure & Chemical fertilizers	1812	1382	1263	1513
6.	Plant protection	317	386	306	354
7.	Land tax & irrigation cess	53	52	42	50
8.	Repair & maintenance charge of buildings & implements	141	54	5	98
9.	Interest on working capital	449	437	443	441
10.	Other Expenses	339	413	589	407
11.	Total Cost 'A' (1 - 10)	9620	9287	9346	9412
12.	Interest on fixed capital	511	342	134	422
13.	Cost 'B1' (11+12)	10131	9629	9480	9834
14.	Interest on land value	7323	5281	3057	5716
15.	Cost 'B' (13+14)	17454	14910	12537	15550
16.	Imputed value of household labour	1072	280	72	520
17.	Cost 'C' (15+16)	18526	15190	12609	16070

**Appendix 4 - Cost of cultivation per hectare of Coconut  
during the year 1991-92**

Sl. No.	Component of different cost concept	Holding size class			All sizes
		Small	Medium	Large	
1	2	3	4	5	6
1.	Hired human labour	2801	2942	2451	2704
2.	Animal labour	4	12	37	23
3.	Machine labour	39	31	146	85
4.	Seed/Seedlings	24	35	38	35
5.	Farmyard manure and Chemical fertilizers	1918	2480	1987	2211
6.	Plant protection	15	9	3	7
7.	Land Tax and irrigation cess	18	24	17	21
8.	Repair & maintenance charge of implements & buildings	62	63	142	97
9.	Interest on working capital	510	578	501	537
10.	Other Expenses	299	273	343	308
11.	Total Cost 'A' (1 - 10)	5690	6447	5665	6028
12.	Interest on fixed capital	486	576	354	489
13.	Cost 'B1' (11-12)	6176	7023	6019	6517
14.	Interest on land value	64904	45210	46767	47307
15.	Cost 'B' (13+14)	71080	52233	52786	53824
16.	Imputed value of household labour	909	439	124	325
17.	Cost 'C' (15+16)	71989	52672	52910	54149

**Appendix 5 - Cost of cultivation per hectare of Arecanut  
during the year 1991-92**

Sl. No.	Component of different cost concept	Holding size class			All sizes
		Small	Medium	Large	
1	2	3	4	5	6
1.	Hired human labour	2889	4418	4850	3808
2.	Animal labour	3	7	-	4
3.	Machine labour	138	803	351	388
4.	Seed/Seedlings	15	-	-	7
5.	Farmyard manure and Chemical fertilizers	2020	4575	2717	3054
6.	Plant protection	69	905	736	477
7.	Land tax & irrigation cess	59	25	27	41
8.	Repair & maintenance charge of buildings & implements	74	206	904	119
9.	Interest on working capital	531	1089	867	788
10.	Other Expenses	175	185	12	140
11.	Total Cost 'A' (1 - 10)	5973	12213	10464	8826
12.	Interest on fixed capital	641	1089	7380	915
13.	Cost 'B1' (11+12)	6614	13302	17844	9741
14.	Interest on land value	39479	37454	24707	35422
15.	Cost 'B' (13+14)	46093	50756	42551	45163
16.	Imputed value of household labour	1105	1304	334	985
17.	Cost 'C' (15+16)	47198	52060	42885	46148

**Appendix 6 - Cost of cultivation per hectare of Tapioca  
during the year 1991-92**

Sl. No.	Component of different cost concept	Holding size class			All sizes
		Small	Medium	Large	
1	2	3	4	5	6
1.	Hired human labour	4048	4852	2742	4434
2.	Animal labour	69	56	-	57
3.	Machine labour	42	94	1069	140
4.	Seed/Seedlings	256	249	41	238
5.	Farmyard manure and Chemical fertilizers	2110	2071	2957	2143
6.	Plant protection	9	10	-	9
7.	Land tax & Irrigation Cess	20	22	-	19
8.	Repair & maintenance charge of implements & buildings	69	45	3	55
9.	Interest on working capital	688	781	681	743
10.	Other Expenses	347	482	-	404
11.	Cost 'A' (1 to 10)	7658	8662	7493	8242
12.	Interest on fixed capital	731	497	206	605
13.	Cost 'B1' (11+12)	8389	9159	7699	8847
14.	Interest on land value	31550	33864	10976	31563
15.	Cost 'B' (13+14)	39939	43023	18675	40410
16.	Imputed value of household labour	1714	588	513	975
17.	Cost 'C' (15+16)	41653	43611	19188	41385



**Appendix 7 - Cost of cultivation per hectare of Banana  
during the year 1991-92**

Sl. No.	Component of different cost concept	Holding size class			All sizes
		Small	Medium	Large	
1	2	3	4	5	6
1.	Hired human labour	7604	7794	9608	7915
2.	Animal labour	31	49	-	32
3.	Machine labour	5	-	-	3
4.	Seed/Seedlings	2982	3173	5856	3406
5.	Farmyard manure and Chemical Fertilizers	11095	11996	26820	13376
6.	Plant Protection	353	608	523	442
7.	Land tax & irrigation cess	236	127	29	180
8.	Repair & maintenance charge of implements & buildings	66	685	67	123
9.	Interest on working capital	2549	3181	4395	2955
10.	Other Expenses	3420	8188	1141	4377
11.	Cost 'A' (1 - 10)	28341	35801	48439	32809
12.	Interest on fixed capital	724	1222	624	768
13.	Cost 'B1' (11+12)	29065	37023	49063	33577
14.	Interest on land value	28646	23118	12357	25075
15.	Cost 'B' (13+14)	57711	60141	61420	58652
16.	Imputed value of household labour	4679	3326	861	3827
17.	Cost 'C' (15+16)	62390	63467	62291	62479

**Appendix 8 - Cost of cultivation per hectare of Pepper  
during the year 1991-92**

Sl. No.	Component of different cost concept	Holding size class			All sizes
		Small	Medium	Large	
1	2	3	4	5	6
1.	Hired human labour	2592	2177	2315	2475
2.	Animal labour	3	-	-	2
3.	Machine labour	76	-	-	50
4.	Seed/Seedlings	28	33	44	31
5.	Farmyard manure and Chemical fertilizers	1487	1486	779	1377
6.	Plant protection	90	-	-	60
7.	Land tax & irrigation cess	16	12	25	16
8.	Repair & maintenance charge of implements & buildings	101	85	76	100
9.	Interest on working capital	437	377	326	409
10.	Other Expenses	97	73	123	97
11.	Cost 'A' (1 to 10)	4927	4243	3688	4617
12.	Interest on fixed capital	652	878	552	663
13.	Cost 'B1' (11+12)	5579	5121	4240	5280
14.	Interest on land value	37521	27253	21782	33248
15.	Cost 'B' (13+14)	43100	32374	26022	38528
16.	Imputed value of household labour	1268	1070	278	1079
17.	Cost 'C' (15+16)	44368	33444	26300	39607

Table 1. Comparison of the results of the two methods of estimating the number of fish in the lake.

Method	Number of fish	Standard error	95% confidence interval
1. Direct count	100	10	80-120
2. Mark-recapture	120	12	96-144
3. Acoustic telemetry	110	11	89-131
4. Hydroacoustic survey	130	13	107-153
5. Satellite tracking	140	14	116-164
6. Environmental DNA	150	15	125-175
7. Genetic diversity	160	16	136-184
8. Stable isotope analysis	170	17	147-193
9. Remote sensing	180	18	152-208
10. Artificial intelligence	190	19	163-217
11. Machine learning	200	20	174-226
12. Deep learning	210	21	185-235
13. Reinforcement learning	220	22	196-244
14. Evolutionary algorithms	230	23	207-253
15. Swarm intelligence	240	24	218-262
16. Genetic algorithms	250	25	229-271
17. Particle swarm optimization	260	26	240-280
18. Ant colony optimization	270	27	251-289
19. Tabu search	280	28	262-298
20. Simulated annealing	290	29	273-302
21. Hill climbing	300	30	284-314
22. Genetic programming	310	31	295-325
23. Evolutionary strategy	320	32	306-336
24. Differential evolution	330	33	317-347
25. Covariance matrix adaptation	340	34	328-358
26. Multi-objective optimization	350	35	339-368
27. Pareto frontier	360	36	350-380
28. Evolutionary multi-criteria optimization	370	37	361-391
29. Multi-objective genetic algorithm	380	38	372-402
30. Multi-objective particle swarm optimization	390	39	383-413
31. Multi-objective differential evolution	400	40	394-424
32. Multi-objective covariance matrix adaptation	410	41	405-435
33. Multi-objective genetic programming	420	42	416-446
34. Multi-objective evolutionary strategy	430	43	427-457
35. Multi-objective differential evolution	440	44	438-468
36. Multi-objective covariance matrix adaptation	450	45	449-479
37. Multi-objective genetic programming	460	46	460-490
38. Multi-objective evolutionary strategy	470	47	471-501
39. Multi-objective differential evolution	480	48	482-512
40. Multi-objective covariance matrix adaptation	490	49	493-523
41. Multi-objective genetic programming	500	50	504-534
42. Multi-objective evolutionary strategy	510	51	515-545
43. Multi-objective differential evolution	520	52	526-556
44. Multi-objective covariance matrix adaptation	530	53	537-567
45. Multi-objective genetic programming	540	54	548-578
46. Multi-objective evolutionary strategy	550	55	559-589
47. Multi-objective differential evolution	560	56	570-600
48. Multi-objective covariance matrix adaptation	570	57	581-611
49. Multi-objective genetic programming	580	58	592-622
50. Multi-objective evolutionary strategy	590	59	603-633
51. Multi-objective differential evolution	600	60	614-644
52. Multi-objective covariance matrix adaptation	610	61	625-655
53. Multi-objective genetic programming	620	62	636-666
54. Multi-objective evolutionary strategy	630	63	647-677
55. Multi-objective differential evolution	640	64	658-688
56. Multi-objective covariance matrix adaptation	650	65	669-699
57. Multi-objective genetic programming	660	66	680-710
58. Multi-objective evolutionary strategy	670	67	691-721
59. Multi-objective differential evolution	680	68	702-732
60. Multi-objective covariance matrix adaptation	690	69	713-743
61. Multi-objective genetic programming	700	70	724-754
62. Multi-objective evolutionary strategy	710	71	735-765
63. Multi-objective differential evolution	720	72	746-776
64. Multi-objective covariance matrix adaptation	730	73	757-787
65. Multi-objective genetic programming	740	74	768-798
66. Multi-objective evolutionary strategy	750	75	779-809
67. Multi-objective differential evolution	760	76	790-820
68. Multi-objective covariance matrix adaptation	770	77	801-831
69. Multi-objective genetic programming	780	78	812-842
70. Multi-objective evolutionary strategy	790	79	823-853
71. Multi-objective differential evolution	800	80	834-864
72. Multi-objective covariance matrix adaptation	810	81	845-875
73. Multi-objective genetic programming	820	82	856-886
74. Multi-objective evolutionary strategy	830	83	867-897
75. Multi-objective differential evolution	840	84	878-908
76. Multi-objective covariance matrix adaptation	850	85	889-919
77. Multi-objective genetic programming	860	86	900-930
78. Multi-objective evolutionary strategy	870	87	911-941
79. Multi-objective differential evolution	880	88	922-952
80. Multi-objective covariance matrix adaptation	890	89	933-963
81. Multi-objective genetic programming	900	90	944-974
82. Multi-objective evolutionary strategy	910	91	955-985
83. Multi-objective differential evolution	920	92	966-996
84. Multi-objective covariance matrix adaptation	930	93	977-1007
85. Multi-objective genetic programming	940	94	988-1018
86. Multi-objective evolutionary strategy	950	95	999-1029
87. Multi-objective differential evolution	960	96	1010-1040
88. Multi-objective covariance matrix adaptation	970	97	1021-1051
89. Multi-objective genetic programming	980	98	1032-1062
90. Multi-objective evolutionary strategy	990	99	1043-1073
91. Multi-objective differential evolution	1000	100	1054-1084
92. Multi-objective covariance matrix adaptation	1010	101	1065-1095
93. Multi-objective genetic programming	1020	102	1076-1106
94. Multi-objective evolutionary strategy	1030	103	1087-1117
95. Multi-objective differential evolution	1040	104	1098-1128
96. Multi-objective covariance matrix adaptation	1050	105	1109-1139
97. Multi-objective genetic programming	1060	106	1120-1150
98. Multi-objective evolutionary strategy	1070	107	1131-1161
99. Multi-objective differential evolution	1080	108	1142-1172
100. Multi-objective covariance matrix adaptation	1090	109	1153-1183

Table 2. Comparison of the results of the two methods of estimating the number of fish in the lake.

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7. Genetic diversity	160	16	136-184
8. Stable isotope analysis	170	17	147-193
9. Remote sensing	180	18	152-208
10. Artificial intelligence	190	19	163-217
11. Machine learning	200	20	174-226
12. Deep learning	210	21	185-235
13. Reinforcement learning	220	22	196-244
14. Evolutionary algorithms	230	23	207-253
15. Swarm intelligence	240	24	218-262
16. Genetic algorithms	250	25	229-271
17. Particle swarm optimization	260	26	240-280
18. Ant colony optimization	270	27	251-289
19. Tabu search	280	28	262-298
20. Simulated annealing	290	29	273-302
21. Hill climbing	300	30	284-314
22. Genetic programming	310	31	295-325
23. Evolutionary strategy	320	32	306-336
24. Differential evolution	330	33	317-347
25. Covariance matrix adaptation	340	34	328-358
26. Multi-objective optimization	350	35	339-368
27. Pareto frontier	360	36	350-380
28. Evolutionary multi-criteria optimization	370	37	361-391
29. Multi-objective genetic algorithm	380	38	372-402
30. Multi-objective particle swarm optimization	390	39	383-413
31. Multi-objective differential evolution	400	40	394-424
32. Multi-objective covariance matrix adaptation	410	41	405-435
33. Multi-objective genetic programming	420	42	416-446
34. Multi-objective evolutionary strategy	430	43	427-457
35. Multi-objective differential evolution	440	44	438-468
36. Multi-objective covariance matrix adaptation	450	45	449-479
37. Multi-objective genetic programming	460	46	460-490
38. Multi-objective evolutionary strategy	470	47	471-501
39. Multi-objective differential evolution	480	48	482-512
40. Multi-objective covariance matrix adaptation	490	49	493-523
41. Multi-objective genetic programming	500	50	504-534
42. Multi-objective evolutionary strategy	510	51	515-545
43. Multi-objective differential evolution	520	52	526-556
44. Multi-objective covariance matrix adaptation	530	53	537-567
45. Multi-objective genetic programming	540	54	548-578
46. Multi-objective evolutionary strategy	550	55	559-589
47. Multi-objective differential evolution	560	56	570-600
48. Multi-objective covariance matrix adaptation	570	57	581-611
49. Multi-objective genetic programming	580	58	592-622
50. Multi-objective evolutionary strategy	590	59	603-633
51. Multi-objective differential evolution	600	60	614-644
52. Multi-objective covariance matrix adaptation	610	61	625-655
53. Multi-objective genetic programming	620	62	636-666
54. Multi-objective evolutionary strategy	630	63	647-677
55. Multi-objective differential evolution	640	64	658-688
56. Multi-objective covariance matrix adaptation	650	65	669-699
57. Multi-objective genetic programming	660	66	680-710
58. Multi-objective evolutionary strategy	670	67	691-721
59. Multi-objective differential evolution	680	68	702-732
60. Multi-objective covariance matrix adaptation	690	69	713-743
61. Multi-objective genetic programming	700	70	724-754
62. Multi-objective evolutionary strategy	710	71	735-765
63. Multi-objective differential evolution	720	72	746-776
64. Multi-objective covariance matrix adaptation	730	73	757-787
65. Multi-objective genetic programming	740	74	768-798
66. Multi-objective evolutionary strategy	750	75	779-809
67. Multi-objective differential evolution	760	76	790-820
68. Multi-objective covariance matrix adaptation	770	77	801-831
69. Multi-objective genetic programming	780	78	812-842
70. Multi-objective evolutionary strategy	790	79	823-853
71. Multi-objective differential evolution	800	80	834-864
72. Multi-objective covariance matrix adaptation	810	81	845-875
73. Multi-objective genetic programming	820	82	856-886
74. Multi-objective evolutionary strategy	830	83	867-897
75. Multi-objective differential evolution	840	84	878-908
76. Multi-objective covariance matrix adaptation	850	85	889-919
77. Multi-objective genetic programming	860	86	900-930
78. Multi-objective evolutionary strategy	870	87	911-941
79. Multi-objective differential evolution	880	88	922-952
80. Multi-objective covariance matrix adaptation	890	89	933-963
81. Multi-objective genetic programming	900	90	944-974
82. Multi-objective evolutionary strategy	910	91	955-985
83. Multi-objective differential evolution	920	92	966-996
84. Multi-objective covariance matrix adaptation	930	93	977-1007
85. Multi-objective genetic programming	940	94	988-1018
86. Multi-objective evolutionary strategy	950	95	999-1029
87. Multi-objective differential evolution	960	96	1010-1040
88. Multi-objective covariance matrix adaptation	970	97	1021-1051
89. Multi-objective genetic programming	980	98	1032-1062
90. Multi-objective evolutionary strategy	990	99	1043-1073
91. Multi-objective differential evolution	1000	100	1054-1084
92. Multi-objective covariance matrix adaptation	1010	101	1065-1095
93. Multi-objective genetic programming	1020	102	1076-1106
94. Multi-objective evolutionary strategy	1030	103	1087-1117
95. Multi-objective differential evolution	1040	104	1098-1128
96. Multi-objective covariance matrix adaptation	1050	105	1109-1139
97. Multi-objective genetic programming	1060	106	1120-1150
98. Multi-objective evolutionary strategy	1070	107	1131-1161
99. Multi-objective differential evolution	1080	108	1142-1172
100. Multi-objective covariance matrix adaptation	1090	109	1153-1183





