

LIST OF HORTICULTURAL RESEARCH STATION (TNAU)
IN THE HIGH ALTITUDE AND HILLY ZONE

S.No.	Station	Existing Functions
1.	Horticultural Research Station THADIYANKUMUDISAI Dindigul Dist.	Studies on disease control on banana and Chow-chow and inter cropping in the hilly regions - Improvements of Pepper and Tree Spices research on Coffee, Cardamom
2.	Horticultural Research Station KODAIKANAL Dindigul Dist	Improvement of Apple and other Temperate Fruits; and Research on Medicinal Plants and Hilly vegetables.
3.	Horticultural Research Station YERCAUD Salem District	Studies on Coffee, Mandarin Oranges and on agronomic aspects of rainfed and temperate vegetables; research on Pepper, Medicinal Plants, etc.,
4.	Horticultural Research Station UTHAGAMANDALAM Nilgiris District	Studies on the improvement on production and protection aspects of major hill crops namely Potato, Cabbage, Garlic, Peas, Flowers Mushroom, etc.

HIGH ALTITUDE AND HILLY ZONE- STATUS PAPER

GENERAL AGRICULTURAL SCENARIO

THE EASTERN GHATS:

Comprising a line of hills, the Javadis, Shevroys, Kalrayans, Pachamalais and Kollimalasi between the Palar and Cauvery rivers and beyond, and linked with the tail of Cuddapah in the Nagari hills. The Eastern Ghats rise steeply above the plateau level of 1,100-1,600 m the Javadis and to 1,525-1,650m in the Shevroys.

THE WESTERN GHATS:

Comprise the Highest mountains of the peninsula. The Nilgiris located on the northern side of the Palghat gap form a compact area of about 2,950 sq.km with a summit level of 1,830 to 2,440m rising with extreme abruptness on all sides. The other group to the south of the Palghat gap contain the Anamalais, one of the Highest peaks of the peninsula. The Pulney hills overlooking peaks of the Peninsula. The pulney hills overlooking the river Vaigai, Cardamom Hills and the outliers represent the further continuation of the western Ghats.

AGRO - CLIMATIC ZONES:

Based on rainfall Distribution, irrigation pattern, soil characteristics, cropping pattern and other physical ecological and social characteristics, Tamil nadu State could be classified into seven distinct agro -climatic zones as follows.

Hilly zone:

This zone covers the hilly regions, namely, 1,the Nilgiris, 2,Shevroys, 3. Elagiri - Javadhu hills, 4.Kollimalai, 5. Pachaimalai, 6.Anamalais, 7.Pulneys and 8.Podhigai malai.

AGRO - ECOLOGICAL SCENARIO IN THE HILL AND TRIBAL ZONE:

The Hilly and Tribal agro - climatic zone shows considerable diversity in physiography, climate, soils, irrigation , rainfall, cropping pattern, etc., This necessitates the delineation of the agro -climatic zone into a number of agro -ecological situations each as homogenous as possible. Since the diversity in soils,rainfall and physiography is large, these factors are considered as basis for delineation of the zone into agro - ecological situations.

The major soil types occurring in this zone are:

1. Laterite in Pulney Hills, Anamalais
2. Laterite in (Deep to very deep non calcareous Loam to clay loam in texture) in Kolli hills,
- 3: Laterite soil with loam to clay loam in texture in Pachamalai
- 4: Dark Reddish Brown in Shevroys,
- 5: Reddish Brown Soil - non calcareous fine Loamy in texture in Kalrayan hills.
- 6: Red loam clay and sandy soil in Javadhu Hills.
- 7: Red loam - sandy loam to loam in texture in Pothigai Hills.
- 8: Reddish Brown with Loamy in texture in Megamalai

The rainfall varies from 850 mm in Kalrayan Hills to 4500 mm in Anamalai Hills.

The zone consists of eight hill sub zones as indicated earlier with different topographical features, Variations occur in soil, altitude and rainfall and with different farming practices.

NILGRIS HILLS

1. Geographical distribution of area of each division of their zone.

The Nilgiris district known as "The Queen of Hill Stations" is situated at an elevation of 900 to 2636 meters above MSL. Approximately 65% of the geographical area of this district lies at an altitude of above 1800-2500 meters above MSL and the remaining 35% at lower altitude. The climate is temperate to sub-tropical. The average annual rainfall ranges from 950 to 1550 mm.

The topography of this district is rolling and steep. About 60% of the cultivable land falls under the slope ranging from 10 to 33%. Nilgiris, being basically a Horticultural District, the entire economy depends on the success and failure of horticulture crops like Potato, Cabbage, Tea, Coffee, Spices and Fruits.

The total geographical area is 2,54,381 ha.

LAND USE PATTERN		(ha)
I.	Total geographical area	2,54,381
a.	Forest	1,43,351
b.	Net cultivable area	76,025
AREA UNDER DIFFERENT CROPS		
	Cereals and Pulses	1,746
	Spices	4,132
	Fruits	1,609
	Vegetables	4,142
	Potato	3,357
	Oil seeds	129
	Flowers	37
	Other food crops	244
	Plantation crops	
	a) Tea	51,503
	b) Coffee	7,289
	c) Other non-food crops	1,837
	Total	76,025

The Nilgiris District consists of four sub divisions namely Ooty, Coonoor, Kotagiri and Gudalur.

1. OOTY SUB DIVISION

Ooty subdivision is located at an elevation ranging from 950 m (Masanagudi) to 2200 m Ooty from MSL. The maximum temperature ranges from 16.6 to 28°C and the minimum temperature ranges from 9 to 0°C during the winter months of November to February. The source of irrigation mainly depends on the summer showers, South West and North East monsoons.

The average annual rainfall ranges from 900 mm to 2000 mm of which about 30% is received during the South West monsoon period. The incessant rains throughout the seasons leads to the formation of rivers like Bavani, Moyar, Kundha, Pykara and various other streams supplement water for drinking and irrigation. Pykara, Mayar and Kundha rivers contribute for the hydro-electric projects enhancing the socio-economic status of the state.

There are three distinct agroclimatic regions.

1. The Thuneri firka which is a rain shadow area.
2. The Kundha firka which receives moderate rainfall.
3. Ooty urban area which receives heavy rainfall.

The predominant soils of this taluk are lateritic loam of kaolonite origin. The fertility status of the soil is medium to high with limitation of nutrition retention capacity due to its loose and friable structure and topography. The soil reaction is acidic and the pH

ranges from 3.8 to 6.2. Due to this acidic condition most of the applied phosphorus is fixed in the soil and not readily available to the crops.

Land use classification

Sl. No.	Particulars	Area in ha.	Percentage
1.	Forests	80633	67.32
2.	Barren and uncultivable land	1688	1.40
3.	Land put to non agricultural use	3158	2.63
4.	Cultivable waste	1286	1.07
5.	Permanent pastures and other grazing lands	1838	1.53
6.	Land under miscellaneous tree crops and groves	1534	1.36
7.	Current fallow lands	6507	5.46
8.	Other area cultivated	18900	12.78
9.	a) Area under annuals	3985	
10.	b) Area fallow lands	14915	
11.	Other fallow lands	4120	3.44
12.	Total geographical area	119764	

2. COONOR SUB DIVISION

Coonoor sub division is situated in Eastern part of the Nilgiris District with elevation ranging from 4000 feet to 6000 feet above mean sea level. The average rainfall ranges from 1200 mm to 1500 mm. It receives rain mostly in the North Eastern Monsoon. The temperature ranges from 20°C to 28°C in Summer from 0°C to 15° during Winter. Slight ground frost is noticed during December and January. The relative humidity ranges from 85% to 100%. Wells continue to be the major source of irrigation.

Plantation crops like tea and coffee, hill vegetables like potato, cabbage and carrot and Temperature Fruits like plum, pear, peach and mandarin orange are being grown in the sub division.

Land use pattern

Sl. No.	Particulars	Area in ha.	Percentage to total
1.	Total geographic area	22779.79	
2.	Forests	4889.30	21.46
3.	Barren and uncultivable land	3.49	0.02
4.	Land put to non agricultural use	2364.00	10.38
5.	Permanent pastures and other grazing land	478.00	2.10
6.	Land under miscellaneous tree crops	2.00	0.01
7.	Cultivable waste	8.00	0.04
8.	Current fallows	1234.00	5.42
9.	Other fallows	221.00	0.97

10.	Net area lown	13580.00	59.60
11.	a) Annuals	1114.00	8.20
	b) Perennials	12466.00	91.80

3. KOTHAGIRI SUB DIVISION

Kotagiri sub division comes under two taluks in the Nilgiris. It comprises 14 revenue villages in Kotagiri Taluk and Kukul Revenue Village in Ooty Taluk. It is surrounded by Erode District in the North and East, Coonoor and Ooty Taluks in the West and Coimbatore District in the South.

The average rainfall of this sub division is 1210.5 mm in 75 rainy days. The maximum temperature ranges from 10°C to 30°C and the minimum temperature ranges from 2°C to 14°C. The main soil type is lateritic red loam, the pH ranges from 3.9 to 7.5. Due to the receipt of adequate rainfall both during South West and North East monsoons and congenial agro-climatic conditions, foreign exchange earning crops like Tea and Coffee are grown on a large scale. The main crops cultivated in this tract are Tea, Coffee and Fruits like Pear, Mandarin Orange and Hill vegetables like Potato, Cabbage, Carrot, Beans and Minor vegetables like Beetroot, Turnips and Knol khol. Thengumarahada village forms part of Kotagiri Taluk. Due to the tropical climate that prevails here crops like paddy, groundnut, soya bean and marigold are cultivated. Spices crops like pepper is being introduced in this sub division.

Land utilization pattern in Kothagiri sub division

Sl. No.	Particulars	Area (ha)	Percentage to total area
1.	Total area	43665.36.5	---
2.	Forests	21804.44.0	49.90
3.	Waste land and other areas not included under cultivation	6860.40.5	15.70
4.	Cultivated area	15000.52.0	34.40
	Annuals	595.92.5	3.97
	Perennials	14404.59.5	96.03

4. GUDALUR SUB DIVISION

Gudalur sub division forms a part of Nilgiris District meeting on the Western ghat at a distance of 50 km from Ooty on the way to Mysore and Kozhikode. It is mainly a hilly region with flat lands enjoying a salubrious climate of sub tropic during most part of the year. The elevation is from 950 to 1500 m. The total geographical area of Gudalur Taluk is 72,171 hectares of which 53.0% in forest and uncultivable land and 56.0% is cultivable area. Out of the total cultivated area 65.7% is under perennial and 14.3% is under annuals. The normal rainfall is 2300 mm per annum. While 75% of the rain is received during the South west monsoon, contribution of North east monsoon is only 15% to the total of rainfall and 8% of the rains are received during the hot weather and 2% during the winter.

	8 am	2 pm
Max. temperature (°C)	19 - 30	22 - 30
Min. temperature (°C)	7 - 18	10 - 20
Relative humidity (%)	70 - 90	42 - 82

Land use pattern

The total geographical area of Gudalur Taluk is 72,171 hectares of which 53.0% are under forest and uncultivable land and 56.0% is cultivable area. Out of the total cultivated area 65.7% is under perennial and 14.3% is under annuals. The total farm families in Gudalur Taluk is 14,075 of which 92.6% are small and marginal farmers and 7.4% are big farmers. Out of the total farm families 32.6% are scheduled caste farmers and 14.2% schedule tribes. The density of population is 197/80 sq. m.

Land utilization

1.	Total geographical area	72171.99.0
2.	Forests	37632.70.0
3.	Barren and uncultivable land	1992.61.0
4.	Land put to non agricultural use	349.57.0
5.	Cultivable waste	367.95.0
6.	Permanent pastures and other grazing land	362.27.0
7.	Land under miscellaneous tree crops and groves not included under area sown	318.38.0
8.	Current fallows	2232.25.0
9.	Other fallow land	1700.26.50
10.	Net area sown	27216.00

2. Rainfall data for Nilgiris division

Month	Rainfall (mm)						
	1961	1962	1963	1964	1965	1966	1967
January	44.00	4.00	35.00	0.00	0.00	22.00	25.00
February	5.00	38.00	21.00	1.00	5.00	0.00	0.00
March	7.00	45.00	9.00	41.00	14.00	15.00	0.00
April	107.00	56.00	105.00	47.00	13.00	154.00	64.00
May	229.00	258.00	100.00	79.00	61.00	15.00	91.00
June	270.00	33.00	55.00	52.00	26.00	53.00	213.00
July	497.00	325.00	239.00	498.00	268.00	253.00	309.00
August	96.00	159.00	101.00	456.00	78.00	88.00	27.00
September	63.00	124.00	136.00	93.00	75.00	0.00	37.00
October	231.00	255.00	264.00	219.00	57.00	339.00	90.00
November	45.00	75.00	103.00	89.00	0.00	153.00	8.00

December	25.00	11.00	52.00	92.00	101.00	31.00	60.00
Total	1619.00	1383.00	1220.00	1667.00	698.00	1123.00	924.00
Average	134.92	115.25	101.67	138.92	58.17	93.58	77.00
	1968	1969	1970	1971	1972	1973	1974
January	0.00	3.00	13.00	9.00	0.00	0.00	0.00
February	6.00	6.00	0.00	6.00	2.00	0.00	0.00
March	70.00	22.00	3.00	18.00	0.00	0.00	0.00
April	92.00	105.00	149.00	65.00	47.00	15.00	66.00
May	21.00	40.00	109.00	137.00	264.00	113.00	117.00
June	178.00	79.00	111.00	123.00	148.00	168.00	69.00
July	235.00	258.00	129.00	167.00	129.00	596.00	240.00
August	96.00	181.00	150.00	290.00	41.00	105.00	171.00
September	119.00	36.00	59.00	305.00	300.00	72.00	191.00
October	69.00	49.00	188.00	190.00	205.00	116.00	58.00
November	49.00	88.00	89.00	208.00	85.00	16.00	32.00
December	34.00	57.00	17.00	77.00	236.00	59.00	12.00
Total	969.00	924.00	1017.00	1595.00	1457.00	1260.00	956.00
Average	80.75	77.00	84.75	132.92	121.42	105.00	79.67
	1975	1976	1977	1978	1979	1980	1981
January	3.00	0.00	0.00	8.00	0.00	0.00	2.00
February	8.00	0.00	27.00	25.00	58.00	0.00	0.00
March	20.00	4.00	27.00	0.00	16.00	27.00	70.00
April	43.00	68.00	46.00	33.00	89.00	53.00	26.00
May	253.00	103.00	240.00	105.00	54.00	121.00	105.00
June	212.00	21.00	140.00	123.00	213.00	229.00	171.00
July	113.00	135.00	155.00	132.00	242.00	197.00	107.00
August	202.00	127.00	92.00	123.00	212.00	63.00	197.00
September	193.00	77.00	169.00	83.00	247.00	75.00	251.00
October	97.00	132.00	211.00	112.00	136.00	124.00	171.00
November	78.00	184.00	265.00	560.00	340.00	157.00	46.00
December	5.00	9.00	1.00	59.00	14.00	4.00	19.00
Total	1227.00	860.00	1373.00	1363.00	1621.00	1050.00	1165.00
Average	102.25	71.67	114.42	113.58	135.08	87.50	97.08
	1983	1984	1985	1986	1987	1988	1989
January	1.00	15.90	9.00	36.00	12.20	0.00	0.00

February	0.10	37.20	0.00	57.80	0.00	0.00	0.00
March	3.00	112.70	15.40	14.60	15.80	95.60	11.40
April	0.00	26.70	94.20	8.80	33.10	143.40	43.20
May	15.80	44.10	32.20	99.00	98.60	98.40	82.10
June	142.20	203.70	181.70	177.30	97.10	93.40	97.90
July	194.90	280.60	33.60	85.80	80.30	293.10	485.70
August	154.90	43.50	85.00	171.70	123.30	187.80	68.20
September	128.80	114.50	153.10	203.70	161.00	212.00	204.80
October	99.50	232.60	56.50	75.30	229.30	79.40	192.50
November	86.40	25.40	73.20	82.70	113.40	29.20	48.50
December	56.10	179.40	100.10	60.40	108.10	16.20	5.00
Total	882.70	1316.30	834.00	1073.10	1072.20	1248.50	1239.30
Average	73.56	109.69	69.50	89.43	89.35	104.04	103.28
	1990	1991	1992	1993	1994	1995	1996
January	47.00	3.20			7.50	12.60	22.20
February	0.00	4.80		2.00	17.50	0.00	7.60
March	3.80	0.00		19.00	9.40	1.00	5.00
April	56.60	0.00	57.10	26.90	102.40	56.00	157.60
May	217.20	111.40	157.40	91.60	66.00	124.30	71.80
June	65.80	85.30	387.20	162.90	169.30	117.10	477.40
July	89.30	153.30	229.60	109.80	291.10	147.10	179.90
August	128.50	279.60	119.40	77.70	70.10	127.90	88.50
September	73.20	141.00	126.50	149.00	148.10	118.60	317.90
October	227.40	123.60	112.70	211.80	266.00	196.60	174.50
November	84.60	242.70	280.00	199.90	137.00	126.60	27.00
December	39.50	72.00	1.70	98.90	3.80	0.00	161.00
Total	1032.90	1216.90	1471.60	1149.50	1288.20	1027.80	1690.40
Average	86.08	101.41	122.63	95.79	107.35	85.65	140.87
	1997	1998	1999	2000			
January	17.80		0.00	20.00			
February	0.00		4.20	8.80			
March	53.40		47.40	0.00			
April	50.20	3.00	182.40	99.00			
May	120.30	3.00	65.60	235.70			
June	150.20	14.00	36.00	124.40			
July	220.80	16.00	215.60	116.60			
August	70.50	11.00	102.00	280.10			
September	126.20	6.00	157.50	226.60			
October	160.50	11.00	961.00	87.00			
November	72.30	8.00	183.40	143.20			

December	70.70	6.00	50.20	107.80			
Total	1112.90	78.00	2005.30	1449.20			
Average	92.74	6.50	167.11	120.77			

3. Different soil type available in their region

The wide occurrence of charnockite or of Nilgiris gneiss rocks are acid one. True peat forms in the hollows on the Nilgiris due to the growth and decomposition of mass as in temperate climate. The soils vary markedly even within a small area.

The average physical and chemical constituents of the Nilgiris soils

I. Physical constituents

1.	Sand	45.8%
2.	Silt	12.4%
3.	Clay	34.8%
4.	Organic carbon	0.7%
5.	pH	4.5

II. Chemical constituents

1.	Alumina (Al_2O_3)	15.70%
2.	Iron oxide (Fe_2O_3)	10.10%
3.	Free sesquioxide	5.7%
4.	Lime (Cao)	0.28%
5.	Magnesia	0.28%
6.	Available phosphorus	20.0 ppm
7.	Available K	92.00 ppm
8.	C.E.C.	9.2 me. per 100 g soil

Nutrient status

The Nilgiris soils are known to have a very low pH and a high phosphorus fixation indicating highly leached conditions. It was observed that inspite of appreciably high total phosphorus content a very little only is available to the crops. The Nilgiris Farmers have been using a uniformly high rate of potato and vegetable fertilizer mixtures for the past so many years, irrespective of the crop requirements, its availability in the soils and also due to non availability of straight fertilizers. The soil status showed that bulb available phosphorus and potassium contents are medium to high in the farmers holdings. The organic carbon content is medium to high. The Magnesium was found to be deficient in about 25% of the area (i.e.) < 100 lb/acre.

In modern agriculture application of fertilizers has become a part of the cultural operations to get the maximum return from the land the need for fertilization is more

because of intensive agricultural practices. A judicious application of the fertilizers is important, particularly in the district like Nilgiris because of its topography and climate.

Under the existing climate and natural conditions, leaching of soluble nutrients especially of 'N' relatively slow mineralisation of organic matter, intensive cultivation of the land, season after season without sufficient compensation with organic matter and the economic strain caused on the farmers by way of heavy expenditure on fertilizer inputs, proper and economic straight fertilizers should be applied to the crop in time based on the soil test value.

Due to the climate and topography the loss of easily soluble bases especially of calcium and Magnesium by leaching, erosions are considerable. This is mainly in potato and vegetable growing areas (Intensive cultivation). Vast areas in Thummanatty (51.1%), Ketti (45.8%) and Thuneri (29.9%) are very much deficient in "Mg" nutrient. The intensive monocropping is likely to deplete the "Mg" nutrient. Cultivation is done through out the year in these areas due to absence of frost and heavy monsoon rains.

4. Different crops cultivated in their area, area covered, varieties popular in that area and their performance

1. OOTY SUB DIVISION

Cropping pattern (annual crops)

Sl. No.	Crop	Irrigated (ha)	Main (ha)	Autumn (ha)	Total (ha)
1.	Potato	339	788	1131	2258
2.	Cabbage	154	248	212	614
3.	Carrot	409	417	659	1485
4.	Beans	45	117	143	305
5.	Garlic	26	21	38	85
6.	Others	122	168	192	482

Total cropped area 5229
 Total area 2854
 Cropping efficacy 183%

4. Different crops cultivated in their area, area covered, varieties popular in that area and their performance.

AREA PRODUCTION AND PRODUCTIVITY OF PRIORITY CROPS IN NILGIRIS 1999-2000

Sl. No.	Crop	Irrigated season			Main Season			Autumn season			Total		
		Area (ha)	Yield (mt/ha)	Total production (mt)	Area ha	Yield (mt/ha)	Total production (mt)	Area (ha)	Yield (mt/ha)	Total production (mt)	Area (ha)	Yield (mt/ha)	Total production (mt)
1.	Potato	402.00	24.08	9680.16	1515.40	15.25	15484.85	1416.00	18.86	26705.76	3333.40	19.40	64654.63
2.	Cabbage	277.00	82.50	22852.50	278.20	68.23	18981.58	240.20	85.03	20424.20	795.40	78.59	62507.30
3.	Carrot	642.00	32.16	20646.72	1167.00	25.75	30050.25	1037.00	32.01	33194.37	2846.00	29.97	85303.16
4.	Garlic	30.00	8.75	262.50	22.00	4.25	93.50	40.50	7.38	298.68	92.50	6.79	628.17
5.	Beans	98.50	11.00	1083.50	260.40	9.13	2377.45	237.00	11.00	2607.00	595.90	10.38	6183.06
6.	Other vegetables	350.00	7.50	2625.00	388.00	7.00	2716.00	319.00	7.50	2392.50	1057.00	7.33	7750.98
7.	Paddy IR 20	50.00	4.86	243.00	95.00	4.40	418.00	--	--	--	145.00	4.63	671.35
8.	Paddy Local	290.00	2.68	777.00	962.00	2.20	2116.00	--	--	--	1252.00	2.44	3054.88
9.	Ginger	150.00	8.65	1298.00	470.00	9.55	4488.50	--	--	--	620.00	9.10	5642.00
10.	Banana	295.00	37.00	10915.00	--	--	--	--	--	--	295.00	37.00	10915.00
11.	Tea	50574.40	10.14	485512.12	--	--	--	--	--	--	50587.40	10.14	485512.12
12.	Coffee	6843.50	0.64	4000.30	--	--	--	--	--	--	6843.50	0.64	4000.30
13.	Pepper	2280.77	1.80	3420.00	--	--	--	--	--	--	2280.77	1.80	3420.00
14.	Orange	667.50	5.00	500.00	--	--	--	--	--	--	667.50	5.00	500.00

2. COONOOR SUB DIVISION

Cropping pattern (annual crops)

Sl. No.	Crop	Irrigated	Main	Autumn	Total
7.	Potato	79.50	150.00	225.00	454.50
8.	Cabbage	45.00	40.00	55.00	140.00
9.	Carrot	175.00	300.00	343.00	818.00
10.	Beans	35.00	45.00	79.00	159.00
11.	Garlic	9.00	---	9.00	18.00
12.	Others	79.50	56.00	42.00	177.50
	Total	423.00	591.00	753.00	1767.00

Total cropped area 1767.00 ha
 Total area 1114.00 ha
 Cropping efficiency 158.63 ha

3. KOTHAGIRI SUB DIVISION

Cropping pattern

Sl. No.	Crop	Irrigated	Main	Autumn	Total
1.	Potato	10.0	20.0	60.0	90.0
2.	Cabbage	90.0	10.0	30.0	130.0
3.	Carrot	80.0	40.0	200.0	320.0
4.	Beans	160.0	130.0	50.0	340.0
5.	Other vegetables	5.0	5.0	5.0	15.0
6.	Soya beans	--	50.0	---	50.0
7.	Marigold	--	60.0	40.0	100.0
8.	Banana	15.0	--	---	15.0
9.	Paddy	--	--	100.0	100.0
10.	Groundnut	--	50.0	--	50.0
	Total	360.0	365.0	485.0	1210.0

Total area : 595 ha
 Cropped area : 1210 ha
 Cropping efficiency : 203.4%

4. GUDALUR SUB DIVISION

Cropping pattern

Sl. No.	Crop	Season Irrigated (ha)	Rainfed (ha)	Area under Perennial crops in ha.	
1.	Paddy	345	1057	1. Tea	15100
2.	Ginger	155	470	2. Coffee	5100
3.	Vegetable	---	345	3. Pepper	2200
4.	Banana	290	---	4. Cardamom	1199
5.	Tapioca	---	150	5. Mandarin orange	240
6.	Sugarcane	21	---	6. Clove	185
				7. Rubber	180
				8. Nutmeg	40
				9. Other minor crops Mango,Jack, Mul - berry	140
	Total	811	2022		24383

Total cropped area (Annual) ha.

2833

Actual area

2488

Cropping efficiency

113.86%

The climatic conditions of Gudalur sub division is well suited for growing sub tropical and temperate crops. The upland (slope) are ideal for growing plantation crops like tea, coffee, rubber, spices crops like pepper, cardamom, ginger, clove, nutmeg and tuber crops like tapioca etc. In valleys, crops like paddy, banana, ginger, sugarcane are being cultivated. The other Horticulture crops grown are mandarin orange, arecanut, coconut, guava, lime, cashew and mango here and there. Of late in the Rice fallows cultivation of tropical vegetables, Banana are gaining importance, pepper forms a major component in the multitier cropping in tea and coffee Plantation.

Varieties popular and their performance

Potato

Varieties: Kufri Jyoti, Kufri Swarna and Kufri Thenmalai.

Among them Kufri Jyoti is the ruling variety covering 95 per cent of the area. But this variety is susceptible to late blight and cyst nematodes.

Cabbage

Varieties: Questo.

The performance of the Questo variety is good.

Cauliflower

Varieties: Ooty-1, Swarna, Sandoz Hybrid.

In Ooty-1 cauliflower curds are large (3-4 kg) with good keeping quality.

Brussels sprout

Varieties: Taceier, Beejo.

Broccoli

Varieties: Pyrite, Packman. The performance of both these varieties are good.

Lettuce

The Berg, Desert Queen, Paris Island, Desert Spring and local type.

Carrot

Varieties: Ooty-1, Zew Kuroda, Early Nantes. The Early Nantes variety is highly susceptible of powdery mildew and blight diseases.

Radish

Varieties: Nilgiris Red (95 per cent of the area is covered with Nilgiris Red).

Knol khol

Varieties: White Vienna, Earliest White. Performance of White Vienna is good.

Peas

Varieties: Bonneville, Ooty-1. Bonneville plants are tall which require stacking and it is susceptible to powder mildew.

French beans

Varieties: Arka Komal and more than 15 types of local types are grown.

Arka Komal is widely grown in Nilgiris.

Pole beans

Varieties: Kentucky Wonder, Ooty-1. Performance of Ooty-1 is good.

5. Constraints and problems of the area in each division

1. In potato crop there is a need to develop a variety resistant to cyst nematode, late blight and frost.
2. In cabbage, number of hybrids are imported and sold at exorbitant rate. to the farmers. Hence there is a need to develop a variety which can set seed in Nilgiris under mild winter condition so as to enable to produce and supply the seeds at lower cost.
3. There is no standard variety in brussels sprout, broccoli and lettuce suitable for Nilgiris. Hence there is no need to develop varieties in these crops and standardise seed production techniques.
4. In carrot number of imported varieties are being sold in different names by the local seed distributors. Most of these varieties are susceptible to the blight, powdery mildew, root rot and cracking. So there is a need to screen these varieties by evaluation.
5. In garlic due to the mono cropping and excessive nitrogen application and irrigation, there is problem of rubberisation in which cloves became spongy before maturity and thereby it loses its marketability. Due to this the farmers have incurred heavy losses. In garlic in the local variety is heavily infested with foliar nematode, blast and rot diseases. Hence there is need to develop a variety resistant to these diseases and management techniques to overcome these problems.
6. In Gudalur area ginger crop is heavily infected with soft rot disease. Hence resistant varieties have to be developed and low cost management techniques have to be developed.
7. In Kukkal valley, which was once very famous for the Mandarin orange production, most of the trees are dying due to the citrus decline. So more areas have to be brought under Mandarin orange by introducing budded plants with different root stocks.
8. At present there is no apple variety suitable for Nilgiris. Hence warm winter, varieties have to be introduced and evaluated.
9. In Pear soft butter types which possess good market quality have to be introduced.
10. Though there is good scope to introduce nut crops like walnut, and chestnut, so far no research work has been done to evaluate suitable varieties in these crops.
11. Though there is a good scope to introduce Kiwi fruit in Nilgiris, so far no systematic work was initiated to introduce and evaluate Kiwi fruits in Nilgiris.
12. In flower crops, due to the lack of marketing facilities, high capital investment for green houses, the area could not be expanded. Cold storage facilities, refrigerated and transport facilities are not available to increase the shelf life.

13. Varieties and seed production techniques have to be evolved in exotic vegetables like brussels sprouts, broccoli, lettuce, artichoke, red cabbage, table radish, leeks, celery, chinese cabbage, sweet peas and colour capsicum. There are no standard varieties in medicinal and aromatic plants also.
14. In Nilgiris, mixed farming was traditionally adopted. Grain crops like wheat, samai, maize, ragi were grown and leguminous vegetables like beans, double beans, scarlet runner beans and peas were also grown. Thereby plenty of fodder was available to feed the cattle population. Due to larger cattle population, sufficient quantities of farmyard manures were available to enrich the soil. After the introduction tea, the areas under annual crops like vegetables were converted in to tea. Due to the expansion of tea area, fodder was not available to feed the cattle. Hence farmers have been forced to sell their cattle. Due to non-availability of cattle manure, the farmers have to do indiscriminate application chemical fertilizers, pesticides and weedicides and thereby the soil became unproductive in many areas.
15. In many pockets of Nilgiris due to the monocropping of carrot, garlic, potato the soil has been infested with pests and diseases. In carrot root knot nematodes and cyst nematodes are major pests.
16. Due to the sudden fall in tea prices, the tea industry in doldrums. Due to monocropping of tea the farmers have incurred losses. If multityre cropping system in tea with fruit crops and other spices was followed such losses could have been avoided. Standard tea based multityre cropping systems have to be developed suitable for the different elevations of the Nilgiris.
17. Potato is subjected to persistent pressure by cyst nematode, *Globodera rostochiensis*, disease late blight (*Phytophthora infestans*), soil pests white grub (*Holotrichia* spp.), cut worms (*Agrotis* spp.) and tuber moth (*Pthorimaea operculella*). The population dynamics of nematode, pathogen and pests are not documented. The recommendation to control the above maladies is mainly by chemical means incorporating various components of pests and disease management in different agroclimatic condition, based on sound ecological methods can conserve the environment with increased yield. In potato, non availability of virus free seed material non availability of nematode, late blight and drought resistant varieties are other constraints.
18. Area under potato cultivation in the hills of the Nilgiris is under threat owing to the devastation caused by the potato cyst nematodes, *Globodera* spp. The only control measure adopted by farmers i.e. application of carbofuran 3 G is not sufficient for the management of cyst nematodes is leads to development of resistance to nematicide. Hence integrated management practices have to be devised.

General Problems

1. The cultivation is extensive and lacks intensive application of inputs and technologies.
2. The undulating nature of soil topography warrants special measures in soil, water and nutritional management.
3. The perennial nature of cropping is a constraint in taking to new varieties, as and when they are released.
4. The total dependence on the monsoon clearly places the productivity and sustainability of this system to the mercy of monsoon.
5. There are lack of transport facilities to interior plantations causing problem of movement of input and produce and also adversely affecting the marketing of produce.
6. The adoption level of improved technologies by the small, marginal and tribal farmers is very low.
7. The poor social economic and financial status is yet another constraint.
8. Though the production of mandarin orange and essential oil yielding plants are quite considerable, agro based industries have not been established in the vicinity of production. Cold storage and other such facilities are also not available.

6. Technologies so far developed i.e. varieties, management, plant protection and other items developed in each research station

I) Varieties released

1. In garlic, a new variety namely Ooty-1 with an yield potential of 17.1 t/ha with resistance to thrips and tip drying has been released.
2. In palak, an high yielding variety namely Ooty-1 with an yield potential of 15 t/ha has been released.
3. A new high yielding variety of carrot namely Ooty-1 was released during the year 1996-97. Carrot seed production was standardized and every year 30 kg of breeder seeds of Ooty-1 is being supplied to the farmers.
4. A new variety of cauliflower namely Ooty-1 with high yield of 46 t/ha was released during the year 1997-98 and seed production technique was standardized. Every year 5 kg of breeder seeds of Ooty-1 cauliflower is being supplied to the farmers.
5. A new oyster mushroom variety namely Ooty-1 was released during the year 1998-99 and every year 500 spawn bottles are being supplied to the mushroom growers.

6. A new variety of button mushroom was released during the year 1998-99. This is the first button mushroom released from Tamil Nadu. This has the yield potential of 1.376 kg of buttons/10kg substrate. The buttons are pure white, round and 5 to 7 cm diameter. It comes up at a temperature range of 15 to 25°C. The buttons are hard and compact and withstand upto five days in room temperature and 10 days under refrigerated conditions. This variety takes a much longer time for opening of sporophore. This mushroom can be produced in hill stations with an elevation of more than 1800 m above MSL. Horse manure and wheat/paddy straw compost can be used as substrate for growing this mushroom. The duration from spawning to final harvest ranges from 75 to 90 days. Every year 1000 spawn bottles are being supplied to the growers.
7. A new French Bean variety (pole type) namely Ooty-1 was released during the year 1998-99. It is a pureline selection from the accession PV-26. It has the yield potential of 33.68 t/ha of green pods in a duration of 80 days. The pods are fleshy, stringless, round and light green in colour. This is suitable for growing during all the three seasons viz., main, autumn and irrigated in the Nilgiris. This variety is moderately resistant to leaf spot, anthracnose and pod borer. This is recommended for cultivation in high and middle elevations (1800-2500 m above MSL) of the Nilgiris. 30 kg of breeder seeds of Ooty-1 French bean variety is produced and supplied to the Dept. of Horticulture.
8. A new dwarf peas variety namely Ooty-1 has been released during the year 1999-2000, which has the yield potential of 12.82 t/ha in a duration of 90 days, which was 47 per cent more than the ruling variety Bonneville of the Nilgiris. A quantity of 20 kg of breeder seeds of this variety has been produced.
9. A high yielding green namely Ooty Chakravarthi keera - 1 with an yield potential of 28.9 t/ha in 50 days, resistant to leaf spot, root rot and white flies has been released during January, 2001.

II. Breeder seed production

The following quantities of breeder seeds of the released varieties are being produced during the year 1999-2000.

Sl. No.	Crop	Variety	Quantity of breeder seeds produced (in kg)
1.	Carrot	Ooty-1	150
2.	Cauliflower	Ooty-1	25
3.	Peas	Ooty-1	20
4.	French bean	Ooty-1	40
5.	Palak	Ooty-1	100
6.	Chakravarthi keera	Ooty-1	200
7.	Oyster mushroom	Ooty-1	500 (bottles)
8.	Button mushroom	Ooty-1	1000 (bottles)

III. Varieties for release in future

1. In radish among the seven accessions tested RS 2 has registered the highest root yield of 35.3 t/ha which is 36 per cent higher than local type. It gives a mean seed yield of 1008 kg/ha which is 28 per cent higher than local type. The mean root length is 39.5 cm with attractive deep pink colour. The roots are fleshy and soft with good consumer preference.
2. In pepino the culture SMu-1 has registered the highest mean yield of 83.8 t/ha as against 22.7 t/ha of SMu-7.
3. In garlic, among the eight cultures tried AS 8 has recorded the highest yield of 25.5 t/ha which is 38 per cent higher than local type.
4. In celery among the five cultures tried for three years, the accession PC 3 has excelled the local type. PC 3 has registered a mean per plant yield of 333 g which is 54 per cent higher than the local type.
5. In thyme among the 4 accessions evaluated, the accession TV 2 has registered the highest leaf yield of 4.2 t/ha which is 46 per cent higher than local type. This accession has 6.8 per cent oil content.
6. In rosemary among the five accessions tried RO 4 has registered the highest leaf yield of 6.05 t/ha which is 32 per cent higher than the local type. This accession has 0.9 per cent oil content.
7. In *Mentha* spp. among the twenty types assembled, the Fernhill type (*Mentha piperita*) has recorded the highest yield.
8. In carnation among the eleven types evaluated, the highest flower number of 15.5 flowers/plant/year was recorded in Killer variety followed by Sangria variety which yielded 15.2 flowers/plant/year.
9. In gerbera among the eleven genotypes assembled and evaluated. Among the variety Sangria has recorded 34.8 flowers/plant/year, Rosenet 32.5 flowers/plant/year and Gold spot 30.5 flowers/plant/year. These varieties are highly suitable for commercial cultivation in Nilgiris.
10. In mushroom, a new high yielding type AB 2 has been isolated which has recorded a yield of 1.5 kg/10 kg of substrate as compared to 1.3 kg/10 kg substrate in Ooty-1. This new strain is found to be pure white with long stripe and hard buttons and it is free from scaling.

B. CROP MANAGEMENT

I. HORTICULTURE

1. Biodynamic farming: In biodynamic experiment in cabbage with the variety Questo, biodynamic treatments has recorded the highest yield 59.6 per 10 sq. m. which is 106 per cent higher than the conventional chemical farming methods.
2. In Pepino in the experiment conducted on the effect of different months of planting on the yield of Pepino (*Solanum muricatum*), planting of Pepino rooted cuttings in the month of 15th April recorded the highest plant height of 43.30 cm, number of fruits (16.26) and yield (4.25 kg) per plant under Nilgiris condition. In the spacing with the genotype SMu-1 the spacing 75 x 60 cm recorded the highest yield of 4.38 kg per plant. In the study undertaken to assess the exact fertilizer requirement with different treatments, the treatment with 225:150:100 kg N, P₂O₅ and K₂O/ha has increased all the growth parameters, yield attributing characters and ultimately the yield.
3. In Gladioli, in the study conducted on the effect of different spacing, spacing of the bulbs at 7.5 x 7.5 cm has recorded the highest plant height (56.2 cm), spike length (56.2 cm) and number of florets (12). In the study conducted on the effect of different doses of nutrients, the highest number of florets (12) and plant height (106.3 cm) was recorded in the treatment that received 100:100:100 kg NPK/ha and 25 t/ha on farmyard manure.
4. In Carnation, in the study conducted to study the effect of different rooting hormones on the rooting of cuttings, treating the cuttings with NAA 400 ppm for 5 minutes has recorded the highest rooting percentage of 98%, plant height of 32.5 cm and number of nodes of 9.2.
5. In Garlic application of 75 kg N, 75 kg K₂O and 75 kg P₂O₅, 50 kg Magnesium sulphate and 50 kg well rotten farmyard manure is found to give highest yield of healthy bulbs without splitting and rubbering.
6. In micronutrient experiments in garlic spraying of micronutrient mixture containing boron at 0.1 per cent and sodium molybdate at 0.05 per cent has increased the yield up to 18 per cent on reduced and reduced the premature sprouting and rubbering.
7. In growth regulator studies, spraying of growth regulators either cycocel or maleic hydrozide at 1500 ppm has reduced premature sprouting and rubbering at 80-90 per cent with 15 per cent increase in yield.
8. In garlic eight accessions with the variety Ooty-1 as standard check were evaluated under field conditions for their resistance reaction to foliar nematode, *Aphelenchoides saprophilus* during the summer season 1999. Among them, one variety DG-1 was graded as resistant recording below 6 juveniles and adults/2 g of clove scales (5 per cent of the population of local check variety Ooty-1) and two of them i.e., PGS-14 and AVT-GG-2 were graded as moderately resistant recording 7 to 20 juveniles and adults/2 g of clove scales. Rest of the five varieties and Ooty-1 check were graded as either moderately susceptible or highly susceptible.

II. PLANT PATHOLOGY

Mushroom

Production technology for speciality mushrooms viz., Shiitake mushroom (*Lentinus edodes*) and Jew's ear mushroom (*Auricularia polytricha*) were standardized

III. SOIL SCIENCE

Carrot root N increased with increasing levels of N fertilizer application. The quality parameters like specific gravity of the roots, root length and girth showed no significant variation. Carrot root yield varied from 12.98 t/ha to 30.00 t/ha with a mean of 20.29 t/ha. The cost:benefit ratio was worked out based on current fertilizer prices. The NPK combination 135:100:135 kg/ha recorded the highest C:B ratio with a root yield of 21.7 t/ha. Considering the root yield and C:B ratio, the NPK combination, 135:100:135 kg/ha is recommended for economic carrot production in The Nilgiris. The nutritional requirement for potato is also being standardized.

IV. MICROBIOLOGY

Biofertilizers for vegetable crop

Ten isolates of peas rhizobium and ten isolates of beans rhizobium were obtained from respective root nodules collected from different locations of the Nilgiris. Among these RL-4, RL-3 and RL-8 isolates of peas rhizobium and RP-10, RP-9 and RP-7 of beans rhizobium were found promising in their symbiotic efficiency.

Fifteen isolates of *Azospirillum* were obtained from the rhizosphere soil samples of potato, carrot and cabbage collected from different locations of the Nilgiris. Among them PA-4, CA-3 and CBA-3 isolates were found highly promising in their nitrogen fixing ability.

Fourteen phosphobacterial isolates were obtained from the soil samples collected from different locations of the Nilgiris and their efficiency is being evaluated.

The efficiency of the above biofertilizer isolates was evaluated under laboratory and pot culture conditions and the field evaluation is in progress. The most efficient strains found in these tests were used for the biofertilizer inoculant production. By making use of the one 100 litre capacity fermentor purchased with the financial assistance of HADP, biofertilizer inoculants are being produced.

Potato

Soil application of *Azospirillum* strain, PA-4 isolated from potato rhizosphere soil sample enhanced the tuber yield by 14% when 100% of recommended nitrogenous fertilizer (120 kg/ha) was used and by about 27% when 75% of recommended nitrogenous fertilizer (90 kg/ha) was applied compared to other two isolates tested.

C. CROP PROTECTION

I. ENTOMOLOGY

Potato

In the field trial for control of white grubs, Dursban 10 G @ 20 kg/ha resulted in 71.38% control of soil larval population. Dursban 10 G @ 30 kg/ha gave 70.3% control which was on a par. The biocontrol agent *Metarrhizium anisopliae* in powder form, gave 62.33% control. The potato yield was 21.11 t/ha from Dursban 10 G 30 kg/ha. Hence, Dursban 10 G at 20 kg was found to be the optimum dose. *Metarrhizium* plots produced 18.68 t/ha of potato. The yield from untreated plots was 12.62 t/ha.

Cauliflower

In the studies on control of DBM, application of Delfin 125 g/ha gave the highest larval mortality and yield of 30.62 t/ha, compared to 18.62 t/ha in untreated plots.

II. PLANT PATHOLOGY

Potato

Potato crop is affected by many viruses such as PV-X, PV-Y, Potato leaf roll, PV-S, PV-1, Potato acuba mosaic etc. Continued use of virus affected seed tubers for planting leads to the degeneration of stock and reduction in yield. Many of the viruses produce symptoms, which cannot be detected by farmers. Hence, work on production of virus free potato seed tubers was taken up at Horticultural Research Station, Ooty from 1995-99. Potato crops raised at Wood house Farm was thoroughly examined by Plant Pathologists for the presence of various viruses at different stages of the crop. As and when viral symptoms were detected, the affected plants were completely uprooted along with the tubers and destroyed. Only healthy and virus free plants were allowed for tuberization and seed tubers were collected only from such plants for further multiplication and distribution to farmers. By adopting this procedure a total 48.5 tonnes of virus free seed tubers were distributed to farmers for planting.

Cabbage

Seed treatment and soil application of the biocontrol agents *Trichoderma viride* and *Pseudomonas flourescens* were effective in checking downy mildew and club root.

French bean

For disease management in French beans, seed treatment with biocontrol agents, fungicides and foliar spray with fungicides and TNAU neem formulations were studied. Spraying with carbendazim (0.1%) recorded lesser incidence of anthracnose (PDI:21.47) angular leaf spot (PDI:42.17) and bacterial blight (PDI:31.84) with the highest yield of green pods (4711 kg/ha). This treatment recorded a C:B ratio of 1:6.4. Yield recorded by this treatment was on par with the treatment foliar spraying with mancozeb (0.25%), seed treatment with talc based formulation of *Trichoderma viride* and *Pseudomonas fluorescens* @ 4 g/kg recorded a C:B ratio of 1:181 and 1:147 respectively.

III. NEMATOLOGY

Potato

Sowing of mustard at planting of potato at plant ratio of 1:1 potato-mustard with application of carbofuran @ 1 kg a.i./ha at planting recorded less number of females/inch, eggs and larvae/cyst and eggs and larvae/g of soil of post harvest population and increase in yield of potato tubers by 30.7, 67.4, 84.5 and 71.4 per cent respectively over pure crop of potato. The cost benefit ratio of the above treatment was 1:1.6.

Garlic

Eight accessions with the variety Ooty-1 as standard check were evaluated under field conditions for their resistant reaction to foliar nematode, *Aphelenchoides saprophilus* during the summer season 1999. Among them, one variety DG-1 was graded as resistant recording below 6 juveniles and adults/2 g of clove scales (5 per cent of the population of local check variety Ooty-1) and two of them i.e., PGS-14 and AVT-GG-2 were graded as moderately resistant recording 7 to 20 juveniles and adults/2 g of clove scales. Rest of the five varieties and Ooty-1 check were graded as either moderately susceptible or highly susceptible.

7. Prospects of Agro based industries

I. Production and marketing of cut flowers in Nilgiris

Flowers are sold in the markets of classical Athens and Rome. Even now, "Flower lunch" is a speciality in many of the famous hotels in developed countries, wherein the customer is served only petals of select species of flowers known for their nutritional and medicinal values.

Increased urbanization combined with general rise in living standards resulted in rapid growth of floriculture industry on a per capita basis during the late 19th and early 20th centuries. Starting about 1925, scientific research methods were applied to the production of commercial flower crops.

There is considerable economic stability in the flower producing and selling business. This stability is undoubtedly the reflection of the fact that most flowers are purchased in Europe and the USA for reasons other than the buyers' aesthetic appreciation. Flower giving is among the most popular of social amenities. As much as 80% of all flowers sold serve as tokens of respect for those deceased; as decorations at weddings and other ceremonies; as cheering gifts to shut-ins; as expressions of thanks to hostesses and of affection for friends and loved ones.

Through the years a distinct marketing channel has been developed for flowers. Usually, the flowers are sold through wholesalers to retail florists. There are a number of variations of this general method including direct sale to the consumer by the producer and the auction sale. Most cut-flower crops are of the long stem varieties, which make them useful for all kinds of floral decorations. Among this group, the top ten cut flowers are.

- | | | | | |
|------------|------------------|--------------|---------------|------------------|
| 1. Rose | 2. Chrysanthemum | 3. Carnation | 4. Tulip | 5. Lily |
| 6. Freesia | 7. Gerbera | 8. Cymbidium | 9. Gypsophila | 10. Alstroemeria |

Floriculture will become the major activity and it is proposed to encourage growers to ten major crops of cut flowers on a regular basis and ten minor crops against orders and in small quantities. The produce could be marketed both in India and gulf countries. The list of major and minor flower crops are given below.

MAJOR CROPS	MINOR CROPS
Alstroemeria	Agapanthus
Asiatic Lily	Eustoma (Lisianthus)
Bird of Paradise (Serlitzia)	Freesia
Carnation (Dianthus)	Iris
Chrysanthemum (Denranthemum)	Gladiolus
Gerbera	Gypsophila
Limonium	Liatis
Oriental Lily	Longiflorum lily
Statice (Limonium Sinuatium)	Torch Lily
Zantedeschia (Calla Lily)	Tulip

Production technologies can be developed for the above cut flowers and the training can be implemented to the farmers.

Advantages of cut flower production in Nilgiris

The following are the competitive advantages of floriculture in the elevated areas of this hill district of Nilgiris. These statements are made for further promotion of floriculture in this area.

1. Climate

Low temperatures and high light intensity induce formation of strong plants. Therefore stems and flowers will be of exceptionally good quality, i.e. strong stems, large leaves and very large bud size. The temperature range in this region is very suitable throughout the year and is accompanied by a reasonable rainfall distribution. The colder months will induce a lower production, but the quality will be consistently high over the year. Other parameters, like humidity and wind velocity are seen to be normal. These climatic conditions are proven to be very suitable for floriculture in countries like Colombia, Equator and Kenya, where flowers are grown respectively on altitude above sea level of 2,600 mts., 3,000 mts. and 2000 mts. respectively. Flowers produced there over the last 2 to 3 decades have been seen in the international markets, as of highest quality for which premium prices are paid.

2. Investments

In view of the climatic conditions described above, the investments for greenhouses and cooling facilities will be considerably lower than other areas in India (e.g. Bangalore, Pune and Hyderabad). The green houses can have lower roofs. This saves material and needs less reinforcement. Cold storage and cooled transport demand less isolation and cooling equipment of less capacity. The favourable conditions also have an effect on the cultivation itself. Pests and diseases develop much slower and are therefore easy to control and at lower cost.

3. Cultivation practices

Intensive research work have to be carried out to formulate the package of practices on these flower crops.

4. Opportunities

The reigning climatic conditions offer the possibility to grow a range of flowers, some in green houses, others in the open field or under shade netting. Especially during the dry spell in the year, December, January and February these open field flowers can be exported to the international markets. During this period these flowers are highly appreciated and high prices are paid.

5. Distance to the market

The larger distance to the market or airports demands a strict organization and co-operation between the growers. This can be done by central post harvest handling and collective transport. This is more true in case of small scale production. Examples of these systems are existing in the Netherlands, Israel, Spain and other countries.

6. Position on the world map

Floriculture business has to be developed and undertaken in Nilgiris in the true international context, i.e. in contact with suppliers on international level and selling to markets where international competition exists. If sufficient technical skill is acquired, Nilgiris will be able to compete with the highest quality levels, because of its exceptional climatic conditions. The produce from this area will distinguish itself in the domestic market also and to be sold in special flower shops targeting the highly demanding and spending consumer. In smaller markets abroad, it will be recognized because of its high quality. It will be paid at premium prices. In the true international markets, like Netherlands, other European countries and also Japan, it will compete with other flowers with the same high quality criteria.

7. Special position in Indian context

The floriculture developments in India have not been a "path of roses". Many aspects over this period of development have played the role. Under estimates of problems and difficulties and over estimates of productions and returns have been the causes for not achieving the objectives and not answering the expectations. One of the main reasons have been, the continuously favourable focus on mass production of average quality. These types of flowers have come under pressure of over supply. Efforts are on to increase the quality everywhere in world. Although this is, important, achieved by highly professional floricultural management (not strong in India yet because of being a young industry), favourable climatic conditions make it a much easier task. Therefore the Ooty region is in a very favourable position within the context of Indian floriculture and hence this opportunity shall be utilized.

II. Commercial cold storage services

Cold storage is an essential aspect of floriculture and it is rather impossible to compete in the world floriculture market without having cold chain facilities. Planting materials especially bulbs require cold storage for the resting period and the cut flowers require cold storage for keeping them fresh for certain period. It is not economical to have a cold storage for smaller farms. At present, the florists of Nilgiris have to be depend on the commercial cold storage facilities at Mettupalayam, which is not logistically well located. The cold storage families have to be encouraged either by co-operative firms like Nilgiris Co-operative marketing societies, by the private agencies in Nilgiris.

III. Commercial refrigerated truck services

Almost the entire quantity of floriculture produce from Nilgiris is being sent to Bangalore. A considerable quantity of exotic vegetables is also being sent to Bangalore everyday. There is no commercial goods carrier operating between Bangalore and Ooty, which could handle perishables like flowers and vegetables. All the perishables sent to Bangalore are through luxury tourist service buses. If the tourist inflow to Ooty from Bangalore is less on account of changes in seasons, many of the tourist companies cancel the

transport operation to Ooty. Many of these buses operate only up to Mysore and the transshipment takes place at Mysore at midnight. While the sleeping passengers are woken-up to board the other bus proceeding to Bangalore, the goods are forgotten often and many a floriculturist have incurred considerable loss on account of loss of parcel at Mysore. Many transport operators do not issue receipt for perishables and it is impossible to trace the lost parcels. In the absence of valid transport documents neither the transport operators could be held responsible nor there is any remedy by way of insurance. It is also not economical to go to Mysore and trace the parcels if the value of the goods sent is less. Theft of parcels also takes place often. Some of the flower buyers at Bangalore cheat the Nilgiri floriculturists taking the shelter under the above reasons. Even after receiving the parcels in good conditions they simply inform the growers that, they have not received the parcel. It is a practice that the growers inform the buyers, over phone, the details of the parcels sent. If this information is not sent by the growers occasionally for problems at their end, some of the buyers exploit such situations and cheat the growers. There is no standard parking place for these luxury buses at Ooty. On account of this the growers have to run to different hotels where these buses are likely to be parked, wasting lot of time, energy and money, besides the tension, whether their parcel will reach Bangalore or not.

All the above difficulties were experienced by the promoters and were amply revealed by other growers also during the survey made by the promoters, in this regard. It was also revealed that the farmers are ready to pay even double the cost, charged by the luxury passenger buses, if a separate commercial goods vehicle is operated between Ooty and Bangalore with a facility to door deliver the parcels to the buyers at Bangalore. If the goods vehicle operated is a refrigerated one, it is even more welcome and the growers are ready to pay extra cost for refrigeration. Hence government can encourage either government or private organization to operate refrigerated, commercial goods vehicles for perishables from Ooty to Bangalore. There is enough potential for the load for the return journey from Bangalore to Ooty. Plenty of apples, oranges, floriculture planting materials, seeds, ornamental rose plants, vegetables are being transported from Bangalore to Ooty regularly.

IV. Production and marketing of dry flower and dry foliage

Several types of dry flowers, foliage and dried part of plants are used in Ikibana, permanent dry flower arrangement and pot pourri. Being a hilly area, there are several species of plants whose parts can be dried and used in the type of arrangements said above are available in Nilgiris. It has become compulsory for every florist to keep a collection of dry flowers and foliage also, as and when the customers ask for permanent dry flower arrangement to be kept in bathrooms, dressing rooms, etc. Few farmers can be encouraged to produce dry flowers.

V. Production and marketing of pot plants in commercial scale

Marketing of cut flowers will be easy and more remunerative when offered with similar and allied products like foliage, garden seedlings, dry flowers, exotic vegetables, exotic fruits and culinary herbs. Hence it is proposed to encourage at least few growers in Nilgiris to the following exotic types of pot plants in a nursery being planned in an area of 25

cents with green house, drip irrigation, foggers and artificial lightning to take care of the plant which require more of day atmosphere. The list of species recommended are given below.

1. Anemone	15. Hydrangea
2. Begonia	16. Impatiens
3. Carnation	17. Kalanchoe
4. Chrysanthemum	18. Phalaenosis
5. Cyclamen	19. Peperomia
6. Euphorbia	20. Rhododendron
7. Ficus	21. Rose
8. Gerbera	22. Spathiphyllum
9. Hedera	23. Syngonium
10. Hibiscus	24. Zantedeschia

VI. Commercial production and marketing of cut foliage

Cut foliage are an integral art of any cut flower arrangement. A lot important and attention is paid worldwide for breeding improved and new varieties of cut foliage. Like cut flowers the prime factor to be considered in the selection of cut foliage is the vase life. The cut foliage should remain fresh along with the cut flowers. Nilgiris has a wide variety of cut foliage, which can be professionally and commercially grown in farms. To start with it is proposed to encourage the growers to grow five varieties of cut foliage along the periphery of the farm, in slopes and ridges in the farm. Thus, utilizing the land, which cannot be used otherwise for growing cut flowers.

The cut foliage crops proposed to be grown in Nilgiris are

1. Ivy creeper
2. Boxwood
3. Euonymus
4. Philodendrum
5. Monstera

VII. Commercial production and marketing of exotic fruits like strawberry

Nilgiris is endowed with the best Agro-climatic conditions for production of several varieties of exotic fruits of which strawberry is highly suitable for commercial exploitation. There is a big gap between the supply and demand. On account of the short supply, the fruits are sold at Rs.200 and above per kg, which is ten times more than the average production cost of Rs.20 per kg. The quality of fruits produced in Nilgiris is very good compared to the quality produced by Maharashtra farmers. The production cost is inclusive of everything including importing materials (runners) mulching, drip irrigation and packing materials. The fruit can be grown through out the year, if it is grown in low cost green house. Climatic condition is an advantage in Nilgiris compared to the seasonal production in Maharashtra. There is good demand in the capitals and district head quarters of Tamil Nadu, Karnataka

and Kerala which exceeds 5 tonnes per day. Hence, being an highly perishable commodity, the risk of deterioration of quality on account of no sales is not there. Moreover the fruits produced in Nilgiris are comparatively hard and crisp with good self life up to 4 days in normal storage conditions and 5 to 6 days in home refrigerator. The varieties found to be suitable for Nilgiris are, Chandler, Came Rosa and Sweet Charlie

VIII. Commercial production and marketing of exotic vegetables

There is an ever growing demand for the exotic vegetables, like Brussels Sprouts, Broccoli, Artichoke, Lettuce, Red Cabbage, Table Radish, Leeks, Baby Carrots, Celery, Chinese Cabbage, Sweet Peas, Colour Capsicum. While the supply is increasing in arithmetic progression, the demand is increasing in geometric progression. Nilgiris is known for good quality of English vegetables and a small segment of the farmers have started producing exotic vegetables. The production activity has to be a well planned and programmed one, because the supplies to the customers (mostly star hotels and big super markets) have to be on a daily/alternate day basis.

IX. Commercial production and marketing of culinary herbs in Nilgiris

Culinary herbs being a part of the luxury market segment can be produced in small quantities to complement the marketing activities of cut flowers, exotic vegetables and fruits. When approached with these three products many consumers ask for the supply of culinary herbs also, which fulfils a considerable part of their purchasing activity for the kitchen. Customers have also expressed that, to source good quality of culinary herbs is very difficult and time consuming. This is on account of the fact that, there are not many professional growers of these products. Moreover the products are not available continuously through out the year. The farmers of Nilgiris can be encouraged to grow culinary herbs, since the supply volume is very low at present compared to the demand. The following are the culinary herbs proposed to be cultivated in Nilgiris on commercial scale.

- | | |
|---------------------------|-----------------|
| 1. Thyme | 2. Marjoram |
| 3. Sage | 4. Horse Radish |
| 5. Rosemary | 6. Mary Gold |
| 7. German/Roman Chamomile | 8. Calendula |
| 9. Tarragon | 10. Parsley |
| 11. Oregano | 12. Chieves |
| 13. Mint | 14. Basil |
| 15. Lavender | |

X. Commercial production and marketing of medicinal plants

There is huge potential for export of medical plants, which are unique to this part of the country. Medical plants grown in this area are reported to be containing higher percentage of useful alkaloids/phyto chemicals. To be economically viable most varieties of medical plants have to be grown in large areas of several hectares under organic farming system. However to encourage this field of horticulture in Nilgiris, it is proposed to

encourage the farmers to grow 10 species medicinal plants in small areas to start with namely, *Digitalis lanata*, Dandelion (*Taraxacom officinalis*), *Ruta groveolens*, *Cilimum marianum*, Fewer Few (*Chrysanthemum parthinium*), *Lippia citreodora*, *Calendula officinalis*, Jalap, *Cineraria martima*, *Mappia foetida*.

XI. Commercial production and marketing of tissue culture plants

Tissue culture plant are the order of the day in Hi-tech horticulture industry. Many of the achievement in this field would not have been possible without this technique of micro propagation of plants. Most of the planting materials for the cut flower industry start with plant tissue culture and it is imperative, young horticulture/agricultural graduates/private companies should be encouraged to establish tissue culture laboratories on commercial scale to produce tissue culture plants, to propagate fruits like persimmon and ornamental plants and in new varieties of vegetables. This will reduce the cost of planting materials to other growers.

XII. Distillation of aromatic oil

In Nilgiris there is a wide scope to establish commercial aromatic oil distillation units for the distillation of rosemary oil, thyme oil, mint oil, gaultheria oil, lemon grass oil, citrodora oil and citronella oil by bringing more area under these crops.

XIII. Mushroom

Button mushroom and Oyster mushroom can be grown in the Nilgiris through out the year. Training to farmers and farm women is being imparted as an when required. Spawn bottles are also being produced and distributed to the farmers. At present only a few farmers have taken up button mushroom production and some farmers have taken up oyster mushroom production. Due to the falling of tea prices in recent times, more farmers are evincing interest in mushroom production and there is good scope for increasing the mushroom production. Besides, efforts are being taken for large scale production of speciality mushrooms like Shiitake and Jelly mushrooms which have got medicinal properties. Hence there is good prospects for production of mushrooms in large quantities in the Nilgiris.

8. Suggestion to alleviate the problems and constraints and improvement of Agricultural productivity and production

1. To continue research work on crop improvement in temperate hill vegetables and to formulate seed production techniques in cabbage.
2. To conduct research on commercial flower crops like carnation, gerbera, gladioli, rose and asiatic lily.
3. To continue research work on the improvement of fruit crops like plum, pear, peach, apple and strawberry and other fruits.

4. To assemble new species of medicinal plants and herbal spices suitable for commercial cultivation and work out the production techniques.
5. To introduce new horticultural species like saffron, nut crops and others with high commercial value.
6. To work out the production techniques for the bio-dynamic organic farming to reduce the pesticide and chemical fertilizer application.
7. To establish Pasteurised Compost Unit for the production of button mushroom
8. To establish high cost semi-automatic poly green house for commercial floriculture.
9. To design and run a pilot plant for the mass production of the biocontrol agent, the green muscardine fungus *Metarrhizium spp.*
10. To standardize Integrated Nutrient Management for hill crops.
11. To mass multiply biofertilizers suitable for Nilgiri soils.
12. To impart training for farmers in mushroom production and supply of spawn to farmers.
13. Mixed farming and dry farming techniques may be developed for Nilgiris ecosystem.
14. Recently, *Pseudomonas fluorescens* has been found as a potential biocontrol agent for potato cyst nematodes. Intercropping of potato with mustard also reduces the potato cyst nematode considerably. With the promising approaches, an integrated management strategy should be developed in order to protect the area under potato cultivation.
15. Suggestions to alleviate the problems of the Tea industry in Nilgiris

By April 2001, by when QR on tea imports into India are likely to be removed, it will be a turning point for India's trade. That means any one can import tea into India either for domestic consumption or for re-export. Nonetheless, if it is for domestic consumption, import duty would have to be paid; no duty will be payable in respect of re-export. Thus even though tea could be imported, the Government of India could use the level of import duty to act as a deterrent against imports in order to protect the domestic industry. However, some of the cheap teas from other producing countries could still come to our country even with a high import duty.

In the years to come, like the removal of QRs, the import duties are also likely to be gradually reduced and finally phased out by when all the protection and insulation of the domestic industry will vanish and it will be a free-for-all situation. It will be then a case

of the survival of the fittest. Nilgiris tea growers have, therefore, to chalk out a medium and long-term plan to face the emerging situation. Our products have to be competitive failing which imported commodities will take over in our domestic market. Towards this end, the tea growers in Nilgiris have to take up the following measures.

The tea growers in Nilgiris have to ensure cost-effectiveness of our products. It has to be a joint effort of the growers, the workers and the Governments - Central and State Research Programmes have to be strengthened to further improve land productivity. It may become necessary to link future increases in labour wages to labour productivity. Mechanization, both in field and factories will be necessitated.

1. The quality profile and image of the Nilgiris tea would have to be improved.
 2. A promotional campaign will have to be chalked out to increase consumption in the domestic market.
 3. The Producers and exporters have to make joint effort on export promotion.
 4. The laws of the land in the country would have to be strictly implemented, especially in respect of imported products.
 5. Awareness programme on quality upgradation among small growers should be done
 6. Demonstration on fine plucking, field advisory visits to individual farmers in different areas in Nilgiris.
 7. Grading and procurement of quality green leaf at different collection centres from the small growers.
 8. Collection and transportation of quality leaf at the factory site.
 9. Studying the existing manufacturing technique for modification and standardization of scientific tea manufacture adopted.
10. Commercial aromatic oil distillation unit in Nilgiris.

9. Future thrust

1. Hill vegetables

In the changing global scenario, nutritional security in the country is an important issue in agriculture. Vegetables have to play a vital role to supply adequate quantity of nutrition in the human diet. Hybrid technology has contributed for increased vegetable production in the country. During the recent past hybrid varieties especially in Cabbage, Cauliflower, Radish, Carrot etc. have increased the hill vegetable production tremendously. Several private sector companies have taken up this venture and have developed adequate infrastructure facilities for the development of new hybrids as well. They are also introducing the hybrids from other countries. The key areas for research can be 1) Standardisation of production technologies, export potential to be assessed for high value vegetables like Brussels sprout, Broccoli, Lettuce, Asparagus, Artichoke and Chive. 2) Introduction/evaluation of suitable varieties in Brussels sprout, Broccoli, Lettuce, Asparagus, Artichoke and Chive and studying their performance under Nilgiris conditions. 3) In order to achieve the potential in yield and quality of high value vegetables, on-farm processing techniques have to be evolved for better shelf life during storage and long distance transport and 4) Introduction/development of hybrids in vegetables like, Cauliflower, Carrot and Radish.

2. Herbal spices

Spices like Mint, Parsley, Horseradish, Hyssop, Bay Leaf, Lovage, Marjorum, Basil, Rosemary, Sage, Savory, Thyme, Oregano and Tarragon etc., are commonly called herbal spices. A survey conducted by the Spices Board on the scope and potentialities in India revealed that there exists a wide gap between demand and total production and we import a sizeable quantity of different herbal spices. Nilgiris is bestowed with a wide range of climatic conditions such as tropical, subtropical and temperate as well as humus rich to laterite soil which are conducive to grow these herbs on a commercial scale. It is estimated that annual Indian consumption of various herbs is roughly 200 t, out of which 64 t are produced in India and the rest is imported mostly through Singapore by individual hotel groups. Major quantity of the herbs is used for culinary purpose (estimated to be as 188 t) and the balance is consumed for medicinal and cosmetic purposes.

On an average, fresh herbs cost Rs.75/kg while the cost of dehydrated one is Rs.500/kg, and the imported herbs cost almost Rs.1200/kg to Rs.2000/kg.

Herbs are easily grown and unlike many plants, they are hardly afflicted with pests and diseases.

The present popularity of herbs is due to the rediscovery that their flavours can lift a recipe out of the good, into the top class. They put new life and taste into food, much of which nowadays has lost its piquancy. Adding salt often simply makes it salty, instead of enhancing the natural flavour. Additionally some of them have appreciable food value, for e.g., Vitamin C in parsley and mint and iron in sorrel.

The herbal spices are widely used in food preparation, cosmetic and beauty aid as well as in medicinal preparations. In cuisine, they are mainly used for flavouring many dishes like salad, sauces, vinegar, juices, butter, tea, jellies, cheese and chutney etc.

Most of the spices can be cultivated through out the year successfully in the Nilgiris and the following are considered as candidate species for cultivation.

- | | | | |
|-------------|------------------|---------------------------|---------------|
| 1. Rosemary | 2. Thyme | 3. Tarragon | 4. Celery |
| 5. Parsley | 6. Basil | 7. Marjoram | 8. Lemongrass |
| 9. Vanilla | 10. Horse Radish | 11. <i>Arnica montana</i> | |

1. The logistics details on these crops such as on-farm processing techniques, oil extraction, drying etc. are the areas on which research has to be concentrated.
2. Since these herbal spices have great demand in the international market, thrust should be given in areas of marketing research to assess the potential for export, popularity of the species, the quality standards to be maintained, packaging techniques to be adopted etc.
3. Based on the export potential, availability of wild species in the Nilgiris can be assessed, tapped and suitable production technologies can be evolved.

3. Medicinal and aromatic plants

The plant based pharmaceuticals, herbal medicine, perfumery, cosmetics, fragrances and food flavour industries have made a phenomenal expansion in market size over last 10 years. This sector figures in high annual growth rate industries in agribusiness. Consumers in industrialized countries are seeking viable alternatives to abstract medicines, antibiotics, steroids and hormonal drugs, which have shown rise in ill-effects on body functions.

India has done fairly well in export of psyllium husk and seed (Rs.6,500 lakhs), mint oil (Rs.1,075 lakhs), menthol (Rs.1,310 lakhs) and Jasmine concrete (Rs.397 lakhs).

The All India Coordinated Research Project (medicinal and Aromatic plants) launched by the ICAR led to the introduction of several medicinal and aromatic plants into agriculture, development of new varieties and improved productivity of traditionally grown crops. The research and developmental efforts culminated in rapid growth of market share of farm based raw materials over products emanating from forestry sector. It has significantly added to export of value added products in the form of intermediary phytochemicals, perfumery, food flavour, cosmetics and toiletry goods, but has also placed a rider in fostering stringent regulatory laws by prescribing quality parameters and maximum limits for microbial counts, pesticide residue, heavy metal content and radio-activity etc. The Indian System of Medicine (ISM) employs a large number of native medicinal plants in compounding of drugs. The manufacturing sector in ISM has also expanded very rapidly resulting in scarcity of several plant-based raw materials.

The recent survey conducted at Horticultural Research Station, Ooty showed that more than 150 species can be commercially exploited.

Some of the problems that have to be attended to are:

- i. Evaluation of local flora for their medicinal properties.
- ii. Evolving high oil yielding cultures of scented Geranium and Patchouli combining resistance to wilt and nematodes, respectively. These crops need faster and cheaper methods of producing plant lets in bulk either by use of mist chamber or through tissue culture and commercialization of the new devices to eliminate shortage.
- iii. Wide assembly of cultivated varieties from Europe to select suitable cultures for Indian conditions of Lavender, Rosemary and Sage in the country.
- iv. Cropping systems research where-by medicinal and aromatic plants are introduced as intercrop or companion crops in field crop and catch crop etc., under horticulture and plantation sector.
- v. Development of molecular biology and tissue culture techniques has to be focussed upon for commercial synthesis of high value secondary metabolites.

4. Biodynamic farming

Over the last 100 years, Agriculture has endured a time of enormous changes and difficulties. Indiscriminate use of fertilizers, pesticides and herbicides has polluted the earth, water and atmosphere. Huge amount of poisonous chemicals are sprayed on plants and fields to combat pests and diseases and to control weeds. Many such chemicals are not completely degradable and further more appeared to have carcinogenic side effects.

Increasing chemicalisation of Horticulture has led to poisoning of the food chain. Pesticides have substantial toxic residues in plant and environment. Many important insect species had already developed resistance and many non-target organisms have been poisoned or killed resulting in secondary pest out breaks and pest resurgence.

Experience of many scientists show that it is possible to do farming without causing violence to environment and one self. Hence biodynamic organic farming is formulated to grow horticultural crops without pesticides and chemical fertilizers. Special compounds are used in biodynamic farming to strengthen and restore the health of the soil and the plants. It is a matter of giving the life forces and the astral forces better access to the life processes in the soil, the composting process and the plants. This is achieved by making use of very ordinary raw materials such as cow manure and of plants such as dandelions, yarrow and vallerian which are treated in a special way to prepare compounds. The effect of these preparations is comparable to the effect of a homeopathic remedy, in so far as very small amounts are involved. These are sprayed on the soil/plants or added to the manure and compost heaps. These manure preparations particularly affect the biochemical processes in soil in that part of soil where water, earth and humus interacts. This helps the plant to take firm root and interact with the life of the soil.

On young plants it encourages processes of assimilation and the development of strong structure. In mature plants, it aids the maturation process as well as the plants fragrance and flavour which in turn will enhance the keeping qualities.

Research work on biodynamic organic farming may be initiated in the Nilgiris to save the Nilgiris ecosystem. The priority vegetable crops of the Nilgiris like Potato, Carrot and Cabbage and other horticultural crops like temperate fruits, herbal spices, medicinal plants and plantation crops may be selected for the study. If suitable biodynamic organic farming systems are developed for the Nilgiris District, it is a great boon to the farmers since the system reduces the use of pesticide and chemical fertilizers to the soil ecosystem which in turn reduces the cost of cultivation. The organic system will help in the production of quality products and thus the eco -development with economic improvement.

5. Fruits

India has an age old tradition of cultivation of varieties of fruits. It is now the largest producer of fruits. Geographically India is close to important world market of fruits. The International trading of fruits is also increasing at a very fast rate.

Lack of infrastructural facility which results in heavy post harvest losses, non-availability of export quality fruits due to lack of proper pre-harvest practices, coupled with low productivity and high prices of raw materials makes our export incompetent in the international market.

The strategies to be evolved for popularising fruit production in Nilgiris are

1. Agropactices for production of fruits like Tree tomato have to be standardised and popularised. Tree tomato can be used in the production of chutney, pickles and juices. This has a very high demand in Israel and Newzealand market.
2. Research on fruits like Cape gooseberry (*Physalis peruviana*), Passion fruit, Rambutan, Carambola, Durian, Mangosteen and Litchi has to be intensified and these fruits should be made popular and the farmers should be encouraged to take up their cultivation.
3. At present in Pomological station, Coonoor only old varieties of temperate fruits are maintained. In the international market there is a large demand for new varieties. So warm winter varieties have to be introduced and their performance evaluated under the Nilgiris conditions. Research on Kinnaur apple, which fetches a high price in Delhi market has to be taken up. Such market specific and value added varieties to be evolved for local and international markets.
4. Wild fruits like *Rhodomirtus tomentosum*, *Berberis aristata*, *Eleagnus latifolia* etc. are peculiar to the Nilgiris conditions. These fruits are however becoming extinct due to invasion of their native growing area. Hence the growing of these crops to be popularised and their potential and demand in both domestic and international markets to be assessed and production technology to be standardised and post harvest technology for these fruits have to be developed.
5. Nilgiris is facing problems like hill desertification due to monocropping of tea and growing water depleting trees like Eucalyptus, Pinus has led to various problems like water scarcity, pest and disease problem, fluctuation of tea price etc. Alternate cropping systems like growing of Plum, Pear, Peach, Strawberry, Apricot and Berry fruits like Raspberry, Cranberry, Blueberry and Billberry can be taken up. Research on these crops have to be strengthened.
6. Techniques for making value added products from fruits so that it fetches a higher price in the market, have to be evolved. Also post-harvest technology to be standardised for better shelf life and to withstand long distance transport and storage.
7. No attempts have been made to introduce nut crops into the Nilgiris till now. So efforts can be directed for introduction of nut crops suitable to Nilgiris conditions.

6. Floriculture - cut flowers

India has competitive advantages in terms of suitability for growing larger varieties of flowers, low labour costs, highly skilled and scientific manpower, technical advancement in the industry supporting horticulture and increasing investment in hi-tech agriculture. Also India's agriculture system is least cost intensive as compared to most other countries. All the countries which are presently the best for production are becoming by and by more expensive and sooner than later, the highly developed countries will have to shift production to the countries with lower cost of production. This trend is already visible in floriculture where larger investment in modern production facilities have been made by Indian companies in collaboration with the Dutch and Israeli companies for producing cut flowers.

With changing lifestyles and increasing urban affluence, floriculture has assumed a commercial status during the current century. Appreciation of the potential of commercial floriculture, in the last 10 years or so, in view of extent of usage and availability of natural resources like favourable and diverse climatic conditions, has resulted in blossoming of this field into a viable agri-business option. More and more people are taking up scientific floriculture in the country.

Floriculture now includes all the activities related to production and use of flowers, ornamental plants, seeds and bulbs etc. This realisation of the diverse nature of floriculture products has led to increased investments in their production and trade. The flowers which are predominantly grown for cut flowers include Rose, Carnation, Gladiolus, Orchids, Gerberas, Liliams and Anthuriums. The percentage share of rose farm exceeds any other flower. Most of the Indian rose exporting units have identified the large flowered varieties for production. Carnation and Gerbera are among other flowers, which have good production potential in India.

The mild winter, mild summer, rich soil conditions and the different elevations of the Nilgiris hills are highly conducive to grow high quality flowers like Carnation, Asiatic lily, Gerbera as they are suitable for the International market.

7. Flower seeds

In the earlier days, most flower seeds were imported from Europe and other places. Subsequently, several large seed companies have opened up production facilities in India. In some items like Pansy, Sabra, Antirrhinum, Petunia etc., new varieties can be brought from abroad. The only limiting factor in this regard is the high cost of seeds. Standardization of large scale production and maintenance of their germinability and vigour, will help in their affordability. Several major seed companies are taking up production of flower seeds in India both for marketing locally, as well as for exports.

8. Tissue culture

A large number of tissue culture units have been set up by the private sector in the recent years. Tissue cultured plants of Carnation and Gerbera are very popular with the flower growing entrepreneurs.

9. Floral extracts

This sector with considerable potential has largely remained untapped. The demand for natural extracts in the world market is growing. In spite of the growth of industry for synthetic aroma chemicals and reconstituted essential oils, the more expensive natural products are sought after. The natural occurrence of Jasmine, Tuberose and Rose remain unimitable till date. There are large areas devoted to cultivation of these crops in different parts of the country. What is lacking presently, is low cost method for their primary processing and extraction. Most producers still use outdated systems and equipments for extraction of concretes/concentrates. Many still sell the raw material to industries for processing. A slight value addition to the product would fetch the producers much better returns.

Germplasm collection of international varieties of temperate zone flowers like Asiatic lily, Liatrice, Carnation, Gerbera, Germini (miniature gerbera), Archidole, Hyacinth lily, Scented lilies and Gardenia should be taken up for popularisation of the same in India.

Low cost greenhouses have to be constructed suitable for different elevations to grow different commercially important flower crops.

10. Vermiculture

The potential for earthworms to improve soil structure, fertility and agricultural production has been tested by agricultural researchers and land managers. Earthworms can influence soil properties by soil ingestion and cast production, which results in the continuous turnover of the soil and mixing of minerals and organic constituents. Through their feeding and burrowing, earthworms can:

- * incorporate surface organic matter lime and fertilisers,
- * improve porosity and soil aeration,
- * increase water infiltration,
- * encourage plant root growth,
- * improve soil aggregate stability,
- * enhance nutrient availability and
- * reduce the incidence of root diseases

The potentialities of exploiting earthworm activities for our economic interests are multiple. Earthworms along with soil microorganisms play a major role in degrading organic waste

materials and thus maintain the nutrient flux in the system. That the presence of earthworms resulted in higher yield and plant growth is an undisputed fact as has been evinced by several workers. Plants have specific responses to earthworm activities. In recent times, the commercial vermiculturists have started promoting a product called vermiwash. It is opined that this wash would have enzymes, secretions of earthworms which would stimulate the growth and yield of crops and even develop resistance in crops receiving this spray. Such a preparation would certainly have the soluble plant nutrients apart from some organic acids and mucus of earthworms and microbes. Survey of earthworms in and around Nilgiris, identifying species suitable for production of vermicompost and harnessing them to effectively produce sufficient quantities of vermicompost are avenues which need to be explored.

11. Biocontrol

The revival of interest in microbial insecticides over the last 20 years has led to large scale production of *Bacillus thuringiensis*, *Verticillium lecani* and *Metarrhizium anisopliae*. Metaquino is a formulation based on *M. anisopliae*. The compound destruxin which is a component of *M. anisopliae* is highly toxic to insects like root grubs. Root grubs are an ever prevalent problem in the Nilgiris. The more widespread acceptance and use of myco insecticides will depend on improvement in a number of key areas. Widespread use of myco- insecticides in China, Brazil and Russia may be repeated in the low-input, labour intensive agriculture around the world. In the short term, with our present level of knowledge, it seems likely that the commercial production of myco-insecticides is going to be restricted to small scale production in specific areas. At present there appears to be a situation in which fungi would provide a viable option where conventional chemical control gives insufficient control or where there is insecticide resistance; where conventional chemicals are very expensive or there is restriction in the application of chemicals.

12. Mushroom

Mushrooms have been recognised as an alternate source of good quality protein. They can produce the highest quality of protein from unit area. They are capable of converting worthless agro-wastes into useful materials. Besides providing good food, rich in protein, vitamins and minerals, they have also got medicinal properties. White button mushrooms which require a temperate climate for growing, can be produced in the Nilgiris in large quantities. Besides, certain species of oyster mushrooms, can also be grown by the farmers. These two types of mushroom can be grown in large quantities with minimum effort by the farmers and they can easily provide an alternate source of income. Besides these, other speciality mushrooms like Shiitake mushroom and Gelly mushroom which possess more medicinal values can also be introduced into Nilgiris for growing in commercial scale.

Horticultural Research Station, Yercaud

1. Geographical distribution of area

Shevroy hills is situated in the Eastern ghat hills of Tamil Nadu with a total area of 382.7 sq.km. covering 67 villages and 25 hamlets. Yercaud is the Taluk head quarters with an area of 22.8 sq. km. and is one of the important hill stations of Tamil Nadu. It is situated at latitude of 11.4 to 11.5°N. The elevation is 1500 m MSL and it receives an average rainfall of 1600 mm per annum. The mean temperature ranges from a maximum of 32.2°C to a minimum of 11°C. The relative humidity ranges from 58 to 75 per cent. The soil is lateritic with a depth of 0.52 to 1.55

m. The soil pH varies from 4.75 to 6.25. The Shevroy hills enjoys a very pleasant climate with a mild temperature all the year round. The highest rainfall is received during the north east monsoon period (September-November) and there is a dry hot spell for a period of 4 to 6 months (December-May). The Horticultural Research Station, Yercaud was started in the year 1976. It is situated in Athiyur village, 3 km away from Yercaud town on Nagalur Road and 35 km from Salem. The total area of the station is 45.16 ha.

2. Rainfall data of HRS, Yercaud from 1961 to 2000 (Avg. in mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
?	147.3	0.0	47.0	51.6	0.0	157.5	157.5	235.0	193.0	339.1	129.5	61.0	1518.4
1962	6.4	10.2	28.4	161.3	127.0	92.7	95.3	302.3	276.9	175.3	139.7	117.3	1532.6
1963	57.2	6.4	2.5	82.6	142.2	91.4	221.0	151.6	302.3	555.0	110.5	118.4	1841.0
1964	0.0	0.0	12.7	24.1	29.2	38.1	462.3	208.3	279.4	270.5	383.5	81.3	1789.4
1965	2.5	2.5	0.0	29.2	394.0	162.6	188.0	290.8	190.5	138.4	62.2	163.8	1624.6
1966	1.3	0.0	143.5	57.2	152.4	109.2	138.4	247.7	281.9	341.6	555.0	108.0	2136.1
1967	69.9	0.0	35.6	21.6	134.6	120.7	243.8	196.9	330.2	106.7	279.4	162.6	1701.8
1968	0.0	3.8	19.1	49.5	143.5	185.4	130.8	189.2	285.8	189.2	102.9	67.3	1366.5
1969	0.0	17.8	5.1	35.6	186.7	171.5	176.5	200.7	142.2	295.9	199.4	88.9	1520.2
1970	22.9	17.8	27.9	31.8	294.6	109.2	210.8	354.3	231.1	304.8	91.4	2.5	1699.3
1971	22.9	0.0	0.0	76.2	162.6	161.3	330.2	193.0	276.9	224.8	57.2	170.2	1675.1
1972	0.0	0.0	0.0	43.2	92.7	153.7	73.7	224.8	237.5	284.5	31.8	553.7	1695.5
1973	0.0	0.0	5.1	36.8	147.3	123.2	219.7	428.2	168.9	161.3	62.2	68.6	1421.4
1974	0.0	8.4	27.9	29.2	342.9	45.7	198.1	130.8	537.2	356.9	14.0	0.0	1691.1
1975	0.0	0.0	0.0	14.0	0.0	232.4	330.2	457.2	311.2	492.8	73.7	0.0	1911.4
1976	0.0	0.0	12.7	165.1	62.2	35.4	122.4	201.4	133.1	393.0	167.2	33.9	1292.5
1977	0.0	28.8	31.2	169.2	184.2	90.4	92.8	258.5	163.8	204.0	444.2	2.0	1669.1
1978	0.0	2.8	19.6	70.6	73.4	144.0	34.2	163.4	205.6	111.0	263.4	125.7	1213.7
1979	3.2	164.8	10.6	39.8	111.6	163.0	153.8	125.8	352.0	153.7	334.6	340.0	1952.9
1980	0.0	0.0	47.7	32.2	130.0	70.2	129.4	5.2	89.3	176.0	197.4	13.2	890.6
1981	14.4	0.0	57.4	124.8	130.0	6.1	203.0	84.7	479.4	407.6	35.8	56.8	1600.0
1982	0.0	0.0	6.0	14.6	95.4	144.4	35.8	29.9	108.2	72.8	223.8	6.2	737.1
1983	0.0	6.0	8.2	16.4	200.6	133.2	114.0	151.2	216.3	211.6	24.2	227.6	1309.3

1984	5.8	92.2	72.6	21.0	66.0	53.8	73.6	23.0	195.4	210.8	41.2	53.0	908.4
1985	47.4		24.8	82.0	40.6	148.0	178.4	159.2	301.8	80.0	140.0	52.6	1254.8
1986	35.6	8.8	3.0	7.8	183.6	41.8	83.2	198.0	440.4	314.8	147.4	26.0	1490.4
1987	31.2	0.0	91.4	57.5	205.0	218.1	81.4	267.0	389.6	258.2	132.6	113.4	1845.4
1988	0.0	30.0	29.8	120.0	75.2	112.0	265.4	379.6	567.8	81.0	81.0	0.0	1741.8
1989	1.8	0.0	49.2	67.4	152.8	200.4	332.4	100.2	237.2	234.1	118.8	28.8	1523.1
1990	108.6	14.0	55.2	40.2	168.6	65.0	57.0	175.4	335.0	151.9	100.7	24.6	1296.2
1991	5.2			133.0	83.6	234.7	101.0	134.7	115.6	369.2	534.8	9.8	1721.6
1992				45.8	67.8	94.2	117.5	138.0	363.4	155.7	264.4	23.5	1270.3
1993				13.6	127.0	216.6	160.5	221.9	248.3	358.5	422.4	229.0	1997.8
1994						114.2	201.6	265.0	210.6	368.1	212.5	23.4	1395.4
1995	9.4		10.8	93.8	221.0	223.6	348.9	292.6	137.1	135.0	108.5	5.2	1585.9
1996				193.2	41.7	272.4	34.8	317.6	476.5	187.9	76.5	356.7	1957.3
1997	12.0			54.3	225.0	167.6	174.9	238.2	478.2	352.5	295.5	111.9	2110.1
1998				73.0	92.6	164.0	154.8	320.7	136.4	327.5	162.7	195.4	1627.1
1999				102.0	348.4	63.2	144.2	217.6	208.2	380.6	254.3	76.0	1794.5
2000		130.0	7.0	136.2	172.1	57.7	44.0	170.2	305.0	250.8	247.9	46.0	1566.9

Source : 1961 – 1975 given by Seller of the land ; 1976 – 2000 Research station's data

3. Different soil type available in their region

Major soil series of Yercaud Taluk

1. Yercaud series (YCD) 2280 ha
2. Ooty series (Oty) 20470 ha
3. Kumbuthukki series (kbi) 4650 ha
4. Nagalur series (Ngr) 55 ha

Characteristics of soil series of Shevroys

Character	Yercaud series	Ooty series	Kombuthukki series	Nagalur series
Location and extent	Karadiyur Village 2280 ha.	Pilandwe village 20470 ha.	Kombuthukki village 4650 ha.	Nagalur village 55 ha
Soil character				
Soil depth	Upto 152 cm	Upto 155 cm.	Upto 130 cm.	Upto 152 cm.
Surface colour	Dark Yellowish Brown	Dark greyish brown to reddish brown	Dark brown to dark yellowish brown	Dark reddish brown to yellowish

Texture	Sandy clay loam to clay loam	Clay loam to sandy clay loam	Fine sandy clay to loam	Gravelly clay loam to sandy clay
Soil taxonomy	Fine loamy, mixed isohyperthermic Paleudalts	Fine loamy mixed isohyperthermic Halplustalfs	Coarse loamy mixed isohyperthermic Typic Tropohumults	Fine loamy mixed isohyperthermic Halplustalfs
Soil order	Alfisol	Ultisol	Ultisol	Alfisol
Drainage and permeability	Well drained with moderately slow permeability	External drainage is excessive and internally slow.	Well drained externally and moderately slow permeability	Well drained with slow permeability
Soil				
- Productivity	Good	Good	Excellent	Poor
- Irrigability	Good	Good	Excellent	Poor
- Potential	Moderate soil limitation for sustained use under irrigation	Severe soil limitations for sustained use under irrigation	Severe soil limitations for sustained use under irrigation	Severe soil limitations for sustained use under irrigation
Limitations	Permeability, topographic	Topography, erosion, permeability	Topography, erosion permeability	Topography, erosion, permeability
Improvements needed for better use	Land shaping, irrigation, erosion control.	Erosion control, landshaping, irrigation, Supply of organic matter and nutrients.	Land shaping, erosion control, irrigation	Inclusion of organic matter, irrigation

4. Different crops cultivated in the area, area covered, varieties popular in the area and their performance

a. Crops cultivated in the area

Coffee is the major crop grown in Shevroys besides mandarin orange, jack, pine apple, banana, guava, annona, spices like pepper, cinnamon, clove, nutmeg and cardamom, flowers like anthurium, gerbera, orchids, dahlia, vegetable like beans, chow chow, cauliflower, tomato, tapioca, carrot, beetroot etc.

The low lying areas of the Shevroys are being cultivated with paddy, ragi, samai, varagu, maize, onion, banana, coconut, tamarind, mango, wheat, mustard etc.,

b. Areas covered under major crops

Crop	Area in ha
Coffee	6366.0
Pepper (Pure crop)	446.0
Mandarin orange	267.0
Silver oak (Pure crop)	2280.0
Flowers	0.6
Clove	40.0
Banana	79.0
Jack	62.0

The area pertaining to other crops mentioned above is not available.

Popular varieties of different crops grown in Shevroys in this region

Coffee

In coffee, two different species viz., *Coffeae arabica* and *Coffeae canephora* (or) *robusta* are being cultivated. However *Coffeae arabica* is the most preferred species among the farmers which occupies 90 per cent of the total area and 10 per cent under *C. canephora / robusta*. In *Coffeae arabica*, the varieties S-795, S-9, S-7, Kavery and San Raman are the most popular varieties and high yielding varieties. The *Coffeae robusta* yield is low when compared to *Coffeae arabica*.

New selections viz., Hemavathy and Sachimar are recently introduced and they are performing well under Shevroy region.

Pepper

In pepper, Karimunda, Panniyur-1, Panniyur-3, Kottanadan are the important varieties grown in Shevroys. Among them, Panniyur-1 and Kottanadan are suitable for lower elevations. Panniyur-3 and Karimunda are performing well under medium and higher elevations.

Mandarin Orange

Coorg and Nagpur Santra are the varieties predominantly cultivated in Shevroys as an intercrop in coffee plantations. Generally mandarin orange is performing well in this region at all elevations.

Banana

In Shevroys, the Ladan, Karpooravalli, Santhanavazhai are the important cultivars grown and among them, Ladan is the most preferred one and highly remunerative.

Jack

The firm fruited type and Kuzha pala are the types grown in this tract. Among them, the firm fruited types and Kuzha pala are consumed by village tribals. It is widely cultivated as a shade tree in coffee plantations.

Silver oak

It is raised by seedlings. It is grown as a main shade tree (temporary) in coffee plantations and used as soft timber after felling. It is a highly remunerative timber tree.

Pear

The cultivable pear types are kieffer, william and country pear in Shevroys. It is grown as intercrop in coffee plantations.

Tree spices

In tree spices, clove, nutmeg and cinnamon are grown as intercrop in coffee plantations. In clove and nutmeg, the seedling progenies are being grown and in cinnamon, YCD-1 variety released by Horticultural Research Station, Yercaud is gaining popularity among the planters.

Pomegranate

YCD-1, Ganesh and Jyothi are the popular varieties grown in Shevroys. YCD-1 released from Horticultural Research Station, Yercaud is widely accepted by farmers.

Fig

YCD-1 Timla Fig released from Horticultural Research Station, Yercaud is the ruling variety in Shevroys besides country fig which is grown as shade tree in old coffee plantations.

Guava

The varieties like Allahabad, Lucknow-46, Lucknow-49, Red Flesh and Country guava are being cultivated as intercrop in coffee plantations.

Flowers

In rose, YCD-1, 2 and 3 and Happiness are the popular varieties. In gerbera, YCD-1, YCD-2 and certain F1 hybrids are popular among the growers. In anthurium, Red, Scarlet, Orange, Green and bicolour cultivars are widely cultivated for both domestic and export market. However, certain cut flowers like Bird of Paradise, Heliconium, Limonium, Chrysanthemum, Carnations are presently getting importance among the growers.

French Beans

Both bush and pole types are being cultivated in Shevroys. In bush type, YCD-1 released from Horticultural Research Station, Yercaud is the most preferred variety among farmers.

Medicinal Plants

Tippili, Aswagandh, Aloe and Chicory are the medicinal plants cultivated in small pockets. Generally growers are using local cultivars. Coleus is cultivate in larger area in Salem district.

5.Contraints and problems of the area in the division

For the past 3 years, the major cash crop prevailing in Shevroys is facing a severe setback due to price fluctuation. The price ranges from Rs.140 (1996-97) to Rs.35 to 40 (2000-2001) per kg The price variation gives lot of hurdles in maintaining the coffee plantations. Indiscriminate felling of silver oak trees nowadays in the existing coffee plantations resulted in shortage of shade and it ultimately resulted in infestation of stem borer

and yield loss per unit area. Due to poor coffee price prevailing in the market, the growers are felling silver oak trees for their livelihood and maintenance of coffee plantations. This automatically disturbs the ecosystem of Shevroys. This may be one of the reason for irregular, unseasonal and poor to highly intensified rainfall.

Though the average annual rainfall is 1600 mm, its distribution is not uniform and the scattered downpour leads to poor pollination and fruit set in coffee and black pepper which are the two important commercial crops of Shevroys.

In cut flowers, the marketing feasibility is not adequate and the growers are facing problems in timely selling of these highly commercial commodity.

In guava, generally the fruit harvest falls between the months of July to September which coincides with monsoon showers. The growers find it difficult to sell the products on higher market rate. Therefore the excess production of guava apart from the market utility can be processed for jelly preparation which will fetch good return to the growers.

In the case of medicinal plants, lot of enquires are forthcoming from all over Tamil Nadu regarding their cultivation and marketing prospects. The technologies for their cultivation is being routinely provided from Horticultural Research Station, Yercaud to the interested farmers and others. But the marketing feasibility is not available with us and the existing marketing of some of the medicinal plants lies with few private exporting companies. The entire marketing set up depends on the commercial people. Therefore proper transparent marketing channel has to be evolved for the upliftment of the cultivation of medicinal plants. Further, our Indian pharmaceutical companies depend on foreign companies to get the chemicals (alkaloids) extracted from the medicinal plants which are mainly exported from India by paying higher price. Therefore, an urgent need to exploit the ways and means to standardise the protocols for the extraction of various chemicals present in the rich medicinal plants. This will definitely pave a way to earn good amount of foreign exchange.

6. Technologies so far developed i.e., varieties management, plant protection and other items developed in each research station

Variety	Year of release	Yield	Salient features
YCD-1 Pomegranate	1982	60 - 70 fruits/tree/yr.	Soft seeded, purple aril, high TSS (15.6° Brix)
YCD-1 Rose	1985	100 - 120 flowers/plant/yr.	Yellow flowers, vase life - 7 days.
YCD-2 Rose	1991	200 flowers/plant/yr.	Buds are yellow with scarlet margin, changes to red at full bloom

YCD-1 Gerbera	1991	60 flowers/plant/yr.	Cherry red flowers with long, sturdy stalk.
YCD-1 French Be	1992	9.9 tons pods / ha.	Bush type, fleshy pods with bold seeds.
YCD-1 Timla fig	1992	2000 - 3000 fruits/tree /yr.	Introduced from Pune, Crimson red colour fruits.
YCD-3 Rose	1994	153 flowers/plant./yr.	Flowers crimson in colour with 9.5 cm diameter
YCD-2 Gerbera	1994	80 flowers/plant/yr.	Flowers light pink in colour, devoid of blunt neck
YCD-1 Cinnamon	1996	360 kg. dry bark/ ha	Oil in quills 2.8%, in leaves 3.0%, quills tasty, sweet and pungent.

Technologies developed

Rose

- In Rose Cv. Happiness, flowers packed with cellophan paper for 24 hrs. was found to be the best for long distance transports.
- Pulsing with a vase solution containing sucrose (3%), Aluminium sulphate (300 ppm) and 8 HQC (200 ppm) recorded the longest vase life of 7.6 days in rose Cv. Happiness.
- Spraying fish oil resin soap at 1 kg in 40 litres of water ; quinalphos 25 EC at 2ml /lit ; endosulfan 35 EC at 2ml/lit was found to effectively control scale insects.

Mandarin Orange

- To obtain regular and earlier yield, vegetative propagation by budding on Rangpur lime root stock was found to be ideal.
- Application of P as enriched FYM (0.5 kg P_2O_5 / tree mixed with 20 kg FYM) along with 700 g N and 600 g K_2O / tree recorded the highest yield and improved the fruit quality.
- Application of 375 g P_2O_5 / tree as mussoriphos + 500g VAM recorded the highest yield of 35.35 kg with 386 fruits / tree.
- Placement of cylindrical and triangular shaped yellow coloured sticky traps installed at 6 feet height helped in attracting more aphids.
- To control stem borer, injection of 5ml monocrotophos (36WSC) through fresh bore holes after dilution with water at 1:2 ratio is recommended as and when the pest occurrence is seen.

- To control fruit fly menace, a fish meal trap comprising of 5-10g of over night water soaked fish meal with 2-3 drops of dichlorvos in cotton kept in poly bags has been recommended for placement at the rate of 50 traps per hectare.
- Spraying of triademifon 1 g / l or dinocap 1ml / l or wettable sulphur 2.5 g / l three times at fortnightly intervals was found to effectively control powdery mildew disease.
- Foliar spraying of micronutrient mixture by dissolving FeSO₄, MnSO₄, CuSO₄, ZnSO₄ sodium tetraborate each at the rate of 150 g along with MgSO₄ 300 g in 450 lit. of water was found to improve the yield and quality.

Timla Fig

- Washing the fruits in the combination of potassium meta bisulphate 0.1% + citric acid 0.1% + acetic acid 0.1% dissolved in cold water recorded the lowest (16%) rotting whereas the untreated fruits recorded 100 per cent rotting on the 10th day after treatment.

French beans

- For the rainfed crop the optimal fertilizer dosage was worked out to be 75:60:20 kg NPK/ha.
- Use of superphosphate enriched farm yard manure increased the yield by 21 percent.
- Three sprays with carbendazim 1g/litre or mancozeb 2g/litre effectively controlled anthracnose incidence.

Coffee

- Application of biofertilizers viz., *Azospirillum* 200 g , phosphobacteria 200g and 500g of VAM mixed in 25 kg of pot mixture enhanced germination, plant growth and nutrient uptake in coffee seedlings.
- Application of N, P, K @ 160 : 90 : 120 kg/ha recorded the highest yield of ripe berries.
- Application of 120 kg N /ha as neem cake blended urea given in two split doses in March and August registered a higher yield of 5.23 t of ripe berries /ha.
- *Streptomyces sp. and Agaricus bisporus* were found to be effective biodegraders for degradation of coffee pulp waste.
- Application of 2.5 t of agriculture lime / ha once in 2 years was found to enhance the yield by 8 – 12 per cent.
- Incidence of white stem borer can be minimised by giving proper shade regulation avoiding exposure of open crop area to sun light.

Pepper

- Application of 75 g N, 30 g P₂O₅ and 105 g K₂O / vine in two equal split doses during May - June and October - November along with *Azospirillum* (20 g/vine) recorded the highest green pepper yield.
- The treatment in combination including soil application of *Trichoderma viride* + swabbing with bordeaux paste was equally effective as systemic fungicides like metalaxyl + mancozeb 0.2 per cent spary + bordeaux paste swabbing effectively checked the pepper wilt.

Nutmeg

- To obtain true to type plants,grafting of orthotropic and semi hard wood scions on two leaved root stocks were found to be ideal.
- Application of 100 kg FYM, 400 : 300 : 1200 g NPK / tree and 50 g in each of *Azospirillum* and phosphobacteria recorded the highest yield of 672 fruits / tree.

Clove

- Application of 100 kg FYM, 400 : 350 : 1200 g NPK / tree and 50 g in each of *Azospirillum* and phosphobacteria recorded the highest yield (4.92 kg green bud / tree).

Cinnamon

- Among the eight accessions,the Sel. 189 recorded the highest dry bark yield (4.5 g) and bark oil (4%). The leaf oil was the highest (4.1%) in Sel. 44, bark oleoresin was the highest in Sel. 63 and Sel. 189 (16%).

Medicinal Plants

Tippili

- In tippili, single node cuttings taken from terminal and middle portion of the plant recorded good rooting under intermittent mist.

Aswagandh

- Aswagandh seeds treated with *Azospirillum* (200 g), phosphobacterium(200 g) and VAM (200 g / kg) recorded the highest percentage of germination in nurseries.
- In Aswagandh, the plants harvested 6 months after sowing recorded the highest total withanolide content (0.476%).

Herbal Spices

- The treatment, 25 x 20 cm spacing along with FYM and biofertilizer combination recorded maximum fresh and dry herbage yield in parsley.
- In marjoram, maximum fresh and dry herbage yield were recorded in the treatment combination of 20 x 20 cm spacing with neem cake @ 0.2kg/m².

Mushroom

- The production technology for growing oyster mushrooms under Shevroy conditions has been standardised.
- *Pleurotus florida* was found to be highly efficient registering an yield of 421.5 g per bed of 500g paddy straw with a bio-efficiency of 84.3 per cent.
- For the cultivation of Jelly mushroom (*Auricularia polytricha*), the substrate silver oak saw dust+ paddy straw + wheat bran 20% + tapioca tippi 5% was found to be the best media for growing and recorded the highest yield of 840 g / kg of substrate.
- For *Lentinellus* mushroom production, silver oak saw dust+ wheat bran 20% + tapioca tippi 5% has recorded maximum yield of 380.45 g / kg of substrate followed by silver oak saw dust+ wheat bran 20% + tapioca tippi 5% recorded 304.4 g / kg of substrate.

7.Prospects of agro-based industries

- A. Cold storage unit for storing fruits and vegetables produced in the region. This will have a better prospect for those who are interested in investing their money in the agro-based industry. Small farmers will find such small cold storage units located at different places of this zone, to be very useful to store their harvested produce to a sufficiently long period many crop produces will finds its utility. (Eg. Pepper, Cardamom, medicinal products, coffee, fruits, etc.,)
- B. Packaging material production industry – Lot of timbers like silver oak and other forest trees are being taken down to Salem from this hill region and sawed for various uses. From these saw mills, the bye products like saw dust, side cut out waste planks are not efficiently used. These materials can be properly used with suitable know-how in making packing material production.
- C. Alkaloid extraction units – The zone is already having good prospective for medicinal plants production. The active principles can be extracted by establishing suitable units for various herbal plants which can be grown in this region.

- D. Mushroom production and processing units – This hill zone is having good scope for cultivation of different types of mushrooms viz., Oyster, Jelly, *Lentinellus* etc., Since the climatic conditions are very favourable for the above types of mushrooms, both landless and small holding farmers can be motivated and encouraged in cultivation of mushrooms. Establishment of processing and packing units, if provided in this zone, the farmers will come forward readily to grow mushrooms.
- E. Establishing apiculture units – This zone is having sufficient forest area and also coffee plantations with various kinds of trees flowering in different seasons. Bee keeping will be a promising industry for local people and it will be helpful for an additional income.
- F. Biofertilizer/bio-inoculants production units- Use of biofertilizers and bioinoculants to various crops is gaining momentum. Establishment of biofertilizer/bio-inoculants will be a promising industry in this zone with its ideal climatic conditions and availability of organic matter like coir pith waste, saw dust, coffee pulp waste and other bio-wastes.
- G. Organic farming produce centres – Demand for pesticide and pollution free food produces is gaining awareness among the people. Hence, establishing organic farms collectively on industrial basis or individual basis will have good prospect for export as well as cater the needs of domestic markets.before they sell at a reasonable rate.
- H. Production and export of cut flowers – Consciousness on the aesthetic value of cut flowers both in the domestic and foreign markets are picking up. Development of this industry with tie up facilities with foreign companies will definitely augment the income of the growers.
- I. Processing units can be established using the available excess production of coffee, guava, mandarin orange, pear, etc., during the peak season.
- J. Agro-products grading industries – Since the quality of various agro-products is essentially stressed in the international as well as domestic markets, establishment of grading centres for

8. To alleviate the problems and constraints and improvement of agricultural productivity and production

As described in item nos. 5 and 7, proper education on the concerned aspects are to be imparted to various levels of farmers and agro-based industrial entrepreneurs. This needs proper motivation, imparting trainings through suitable agencies to guide them properly ;

arranging financial help through various agencies like Nationalised banks etc., and also helping them in finding suitable markets for agrobased produces.

Creation of separate department on medicinal plants under horticulture faculty comprising horticulture, biochemistry, pharmacology, pathology, entomology, microbiology and soil science disciplines including doctors of different systems of medicines is a urgent need to exploit, identify and develop suitable strategies to separate the alkaloids from various medicinal plants and testing them properly before their release into the market as valuable and acceptable products. Creation of model organic farm on different horticulture crops being cultivated in Shevroys using latest advanced agro techniques available elsewhere to improve the economic status of the local flowers.

9.Future thrust

- The perspectives given item no. 7 and 8 may be envisaged and planned suitably as future thrust.
- Introduction of new horticultural crops viz., vegetables (cauliflower, beans, cabbage, carrot, beetroot etc.), medicinal plants and other important suitable commercial, valuable crops to the Shevroy region.
- Availability of required planting materials to the needed farmers at all times.
- Setting up of various committees to monitor and coordinate with different departments in this region (e.g., marketing persons (domestic and exports), Nationalised banks, government agencies (Department of Horticulture, Department of Agriculture, Agricultural University, Forestry departments etc.)) to implement the above said agrobased industries effectively..

HORTICULTURAL RESEARCH STATION-THADIYANKUDISAI.

LOWER PULNEY HILLS

1. Geographical distribution of area - Lower Pulney hills:

The Pulney hills (of Western Ghat) is situated in Kodaikanal Taluk of Dindigul District. The hills lie between 10°-5' and 10°-25' North and 77°-15' and 77°-50' East. The Pulney hills are an eastward off shoot of 65 km length and a width of 40 km (mean width of 24 km), and an area of 2068 sq.miles. The hills are divided into two district geographical zones viz., The Upper and Lower Pulneys. The Lower Pulneys include the revenue villages of Kamanur, K.C. Patti, Pannaikadu, Pachalur, Poolathur, Periyur, Thandigudi, Vada kavunchi and Vellagavi.

The Lower Pulneys consist of a confused jungle of peaks from 1000 to 1500 M height separated from one another by steep wooded valleys. These hills are some times designated as Thandigudi and Virupatchi hills.

The Lower Pulney hills enjoy a subtropical climate, with a maximum temperature of 20 °C to 30 °C, and a minimum of 15 °C to 20 °C. The rainfall is around 1455 mm. Nearly, 43 to 46% of the rainfall is received during the North East monsoon. The South West monsoon, summer showers and winter season rains account for 25%, 22% and 5% respectively.

The Horticultural Research Station, Thadiyankudisai was started in the year 1972. It is located 3 km from Perumbarai village in the Chitharevu to Thandigudi road. It is located at 10 degree South latitude and 77 degree East longitude, at an altitude of 1098 metres. The station has an area of 21.82 ha. of which 18.00 ha are cultivated. The major crops grown in the Horticultural Research Station, Thadiyankudisai are coffee, banana, pepper, chow-chow, avocado, mandarin orange and tree spices. The nursery in the station supplies needed plants to the farmers of this and other areas.

Major crops/Cropping pattern/Cropping systems:

In the Lower Pulney hills, farming is mainly done under rainfed conditions. Under the Lower Pulney hills condition, coffee is grown as a base crop under multitier cropping system. In order to optimise production and minimise the risk of crop failures due to erratic rainfall, the planters follow inter cropping (two or more crops grown simultaneously in rows). In this system cash crops like banana, orange, pepper and chow-chow are mostly grown as inter crops. Normally pepper is trained on the standards raised as shade crop (silver oak and jack) for coffee. Pineapple is grown in some rocky patches as single crop or inter crop with banana, orange, etc., Cardamom was normally grown in reserve forests earlier, but now in patta lands.

Lower Pulneys:**a) Single crop:**

- 1) Pine apple
- 2) Cardamom

b) Multitier cropping system:

- 1) Coffee + banana + orange
- 2) Coffee + orange + silver oak (or) jack (with pepper)
- 3) Coffee + orange + silver oak
- 4) Coffee + chow chow
- 5) Coffee + orange + chow chow
- 6) Coffee + lime + jack (or) silver oak
- 7) Pine apple + banana
- 8) Pine apple + orange

2. Different soil types available in Lower Pulney hills:

Soils of the Pulney hills fall under the broad soil group ‘Laterite’. Soils are very deep and the surface texture ranges from loam to clay loam. The colour of the soil ranges from brown to black depending upon the organic matter content of the soil. The structure of surface soil is in general spheroidal in nature. The soils are friable under moist condition and offer no resistance for root penetration. The colour of the ‘B’ horizon soils ranges from dark yellowish brown to yellowish red, with texture ranging from sandy clay loam to clay loam. The structure is generally well drained with moderate to very rapid permeability. Morphological examination of soils reveals no visual soil physical problems such as surface hardening, crusting, sub surface hard pan, etc.,

Rainfall data of Horticultural Research Station, Thadiyankudisai. From 1982 to 2000
(Avg. in mm)

Month	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
January	-		80.2	10.0	36.8	64.0	-	-	188.6	95.6
February	-	118.0	153.1	-	22.8	3.2	-	-	-	-
March	6.5	-	338.0	16.5	68.5	69.6	-	160.8	188.1	28.8
April	66.1	36.0	89.2	84.5	66.0	36.0	-	103.6	46.6	138.3
May	46.2	256.5	70.0	60.7	76.0	25.0		87.4	171.0	72.0
June	41.0	108.2	42.2	34.1	38.0	123.6	-	117.0	87.6	38.8
July	58.1	74.5	165.1	100.7	37.0	-	-	109.1	46.8	16.8
August	134.1	141.7	71.2	59.0	28.0	-	-	34.0	69.5	100.2
September	241.6	197.6	247.1	249.1	116.0	-	-	285.6	143.0	179.0
October	398.0	188.1	83.7	261.3	328.0	-	92.4	276.2	52.67	404.3
November	363.6	87.6	126.9	92.3	167.0	-	84.2	167.0	195.3	148.4
December	30.0	275.3	154.6	42.1	69.6	-	56.4	55.7	89.2	73.3
Total	1985.2	1637.5	1853.3	1092.3	1090.5	321.4	233.0	1396.2	1753.2	1355.5

Month	1992	1993	1994	1995	1996	1997	1998	1999	2000
January	19.4	-	3.0	32.0	31.5	12.0	10.2	-	11.0
February	-	3.0	117.0	2.0	-	-	4.0	7.0	262.0
March	-	274.0	15.0	108.6	7.0	41.0	-	-	6.0
April	69.0	85.0	116.1	123.2	21.8	77.0	36.0	299.0	12.0
May	99.0	51.6	101.1	183.1	16.0	146.0	31.1	161.0	1.0
June	46.6	74.8	34.6	132.1	89.0	94.0	-	114.7	34.0
July	72.6	26.1	30.7	48.0	35.0	135.5	28.2	66.7	48.0
August	50.8	78.2	73.0	113.0	251.0	51.0	351.25	102.25	195.3
September	240.3	190.0	154.8	15.4	233.0	156.0	85.0	108.0	272.0
October	159.4	408.3	646.2	327.0	295.0	447.0	163.0	626.0	92.1
November	568.4	512.2	323.0	224.0	136.0	648.2	148.0	381.0	127.9
December	76.8	131.8	16.0	-	286.0	222.0	4.0	30.0	125.4
Total	1401.3	1835.0	1630.4	1308.4	1401.3	2029.7	860.75	1895.65	1186.5

Soil profile in Lower Pulney hills:**Profile No.3 Location : Poolathur village**

Horizon	Depth	<u>Description</u>
A1	0-40	Dark brown (7.5 YR 3/2) clay loam, weak coarse to very coarse; subangular; locally blocky, breaking to the medium to coarse crumb; dry, slightly hard; moist, wet sticky and slightly photic; plentiful very fine to very coarse roots, very rapid permeability and clear smooth boundary.

Profile No.4 Pachalur village

Horizon	Depth	<u>Description</u>
A1	0-37	Dark yellowish brown (10 YR 3/4), clay loam, weak, medium to coarse, sub angular blocky breaking to moist friable, wet sticky and slightly plastic, plentiful fine to coarse roots, moderately rapid permeability, abrupt smooth boundary.
B2	37-117	Dark reddish brown (5 YR 3/4), clay loam, moderate coarse to very coarse, subangular blocky, dry hard, most friable, wet sticky and plastic, few fine to medium roots, moderately rapid permeability, angular to rounded fragments distributed in the horizon, abrupt smooth boundary.
B3	117-190	Strong brown (7.5 YR 5/6) gravelly sandy clay, loam, weak, medium to coarse sub angular blocky; moist very friable; wet slightly sticky and slightly plastic, few fine to medium roots, rapid permeability, angular to rounded to genesis fragments, seen clear smooth boundary.

Profile No. 5 : Location : Manjal parappu

AP	0-12	Dark brown (7.5YR 4/4): sandy clay loam , weak medium, sub angular blocky, breaking to crumb; moist very friable; wet very sticky and slightly plastic.
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B1	12-75	Brown (7.5YR 5/4): gravelly clay loam; weak coarse and very coarse; subangular blocky. Moist very friable, wet sticky and plastic; few fine to coarse roots, patchy thin clay. Moderately rapid perme- ability abrupt smooth boundaries.
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B2	75-132	Strong brown (5YR 5/6): clay loam , moderate coarse to very coarse, sub angular blocky, moist-very friable; wet sticky and plastic, few fine to coarse roots. Patchy thin clay films on ped faces. Moderately rapid permeability, gradually wavy boundary.
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B3	132-180	Brown (5YR 5/4): sandy clay loam , weak coarse to very coarse. Subangular blocky; moist, very friable; wet slightly sticky, and slightly plastic. Few fine to coarse roots. Patchy thin clay films on ped faces, rapid permeability.
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Profile No;6 Location : Pannaikadu

A1	0-27	Very dark brown (10 YR 2/2); clay loam; weak medium to coarse; sub angular blacky breaking to crumb. Moist very friable; wet sticky and plastic; abundant, very fine to coarse roots, moderately rapid permeability, abrupt smooth boundary.
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B2	27-67	Yellowish red (5YR 4/6), clayloam moderate coarse, sub angular blocky; moist very friable, ordinary sticky and plastic, patchy thin clay films on ped faces, abundant fine to coarse roots, rapid permeability, clear smooth boundary.
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B2	67-153	Yellowish red (5YR 5/6), sandy, clay loam, weak, medium to coarse sub angular blocky, dry very hard, moist very friable wet sticky and slightly plastic; patchy, thin clay films on ped faces; abundant, fine to coarse roots, very rapid permeability, diffuse boundary.
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C	1534	Weathered genesis with muscoite mica.
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3. Different crops cultivated in their area, area covered, varieties popular in that area and their performance.

a) Crops cultivated in this area:

Coffee is the major crop being cultivated with pepper, mandarin orange, banana, cinnamon, clove, jack, pine apple, nutmeg, cocoa , ginger and vegetables like chow-chow and beans.

The low lying areas of Lower Pulney hills are being cultivated with paddy, castor, coconut, arecanut, banana, mango, etc.,

b) Areas covered under major crops:

S.No	Crop	Area in ha.
1.	Coffee	7178
2.	Pepper	424
3.	Mandarin orange	1782
4.	Hill banana	1272
5.	Pine apple	159
6.	Cardamom	203

7.	Lime	512
8.	Jack	86
9.	Cocoa	16
10.	Silver oak	1
11.	Ginger	17

The area pertaining to other crops (not mentioned above) is not available.

c) **Varieties released:**

Variety	Year of release	Yield
TKD-1 Pole beans	1987	3.36 tons/ha.
TKD-1 Avacado	1996	26.4 ton/ha

Different crops grown in Lower Pulney hills region:

Coffee:

In coffee, two different species viz., *Coffeae arabica* and *Coffea canephora* (or) *robusta* are being cultivated. However, *Coffea arabica* is the most preferred species in this area.

In *Coffeae arabica*, S.795, SLN.7, SLN-9, San Ramon, and Kaveri are the major varieties adopted by the farmers. The robusta coffee comes up well in the lower elevation (below 700 metres MSL). In robusta, farmers adopt local types and S-294 and CXR.

Pepper:

Panniyur-1, Kotanadan and Karimunda are popular varieties in the Lower Pulney hills. Among these varieties, Panniyur-1 performs well in lower elevations up to 1100 metres, with early bearing with high yield with longer spikes. Karimunda and Kotanadan perform well in higher elevations (Above 1500 metres MSL).

Mandarin orange:

The kodai orange (or) kamala orange and coorg orange are the major varieties grown in Lower Pulney hills. Coorg orange is the predominant variety in this region.

Hill banana:

Virupatchi, Sirumalai, Karpuravalli and Red banana are grown. The farmers prefer Virupatchi and Karpuravalli in Sirumalai and Lower Pulney hills.

Pine apple:

The varieties viz., Kew and Queen are cultivated in the Lower Pulney hills. The Kew is predominantly grown and has good taste and keeping quality.

Chow-chow:

Locally available high yielding chow-chow types are under cultivation. Training the vines in pandals of 2 metre height is followed by the farmers.

Jack:

The “Kuzha pala” is the variety grown in this tract and it is widely cultivated as a shade tree in coffee plantations. Jack with crisp flakes are also available to a limited extent.

Tree spices:

The tree spices viz., All spice, clove, nutmeg and cinnamon are very major in Lower Pulney hills. Popularised tree spices is a must.

Avacado:

The TKD-1 avacado variety is released from Horticultural Research Station, Thadiyankudisai during the year 1996. This variety is now getting popularity among the farming community in Lower Pulney hills.

Medicinal plants:

32 species of medicinal plants have been assembled from Horticultural College & Research Institute, Periyakulam and Horticultural Research Station, Kodaikanal, are planted for further studies.

5. Constraints & problems of the area in the division:**Coffee:**

- a) Due to running blossom and non-adoption of community approach in adopting pest management practices (especially for berry borer), yield is erratic. The coffee price also is getting lower.
- b) Cost of synthetic fungicides (Curative fungicides) for leaf rust disease is high.
- c) Small and marginal farmers do not have enough capital to do intercultivation, manuring and plant protection. They also are not aware of latest technology in berry borer management (eg.) traps for berry borer.

Pepper:

- a) Most farmers are not aware of timely application of correct dosage of fertilizers. So deficiency problem results.
- b) Fruit setting is erratic due to uneven distribution of rainfall. Pepper crop needs rains or showers for pollination.
- c) Wilt is a serious problem, and several farmers are not aware of Trichoderma viride application.
- d) Timely applications of recommended dose of manures, fertilizers, lime and monofix is not adopted by the growers.
- e) Pepper is considered as a secondary crop since the planters are mainly concentrating on coffee.

Hill banana:

- a) Bunchy top disease is serious and knowledge on phytosanitation measures is required compulsorily by the farmers.
- b) Non-availability of sufficient quantity of disease free hill banana suckers.
- c) Pseudo-stem weevil problem is getting serious.
- d) Lack of knowledge in identifying panama wilt and adopting control measures by the farmers.
- e) Nematode problem exists in certain endemic areas.
- f) Lack of transport facility for inputs and harvested produce.

Mandarin orange:

- a) Micro-nutrient deficiency; farmers are not aware of deficiency symptoms, and correct remedial measures.
- b) Nematode problem:- Identification is difficult.
- c) Borer attack in stem, branches and roots and lack of knowledge to follow prophylative measures to avoid the infestation.
- d) Non availability of budlings from reliable sources. Fruit drop is another serious problem leading to reduction in yield. Use of plant growth regulators, to control fruit drop is not adopted.

- e) Non availability of cold storage facilities/processing factories to get premium price during glut period, by storing/processing the excess fruits.
- f) Sale price is not predictable, so marketing losses are incurred by growers.
- g) Fruit flies cause fruit drop and many growers do not use fish meal trap.

Pine apple:

- a) The pine apple produced in Kerala is cheaper than these produced in hills. There is lack of transport facilities, cold storage facilities and processing factories nearby.

Chow-chow:

- a) Mosaic virus impedes yield.
- b) Fruitfly attack is serious and many farmers do not adopt fish meal trap.
- c) Lack of irrigation facilities leading to deterioration of fruit quality.

General:

Farmers need to diversify the cropping system. Medicinal plants, herbal spices, tree spices, vegetable crops, flower crops, etc., need popularization.

6) Technologies developed in Lower Pulney hills:

a) Crop production:

Coffee:

- Soil application of 120 kg of rock phosphate and 5 kg of phosphobacterium per ha increases nutrient content of leaves and the yield of coffee.

Pepper:

- Panniyur-1, Kottanadan, Karimunda and Kudiraivali are the suitable varieties of pepper for Lower Pulney hills.
- Application of planofix @ 40 ppm reduces the flower dropping in pepper.
- Application of N, P and K @ 50:40:150 g/plant along with 25g magnesium sulphate gives higher yield of pepper.

Clove:

- Dipping hard wood cuttings of clove in 2000 ppm of IBA solution gives maximum germination and rooting.

Ginger:

- The ginger variety “Suruchi” performs well in this area.

Mandarin orange:

- Spraying of magnesium sulphate + zinc sulphate 0.6% increases fruit yield of mandarin orange.

Hill banana:

- The treatment of 3g Azospirillum, 3g phosphobacterium plus 50% of recommended dose of nitrogen and phosphorus and a constant dose of potassium @ 360 g/plant along with 5 kg/pit FYM registered a higher plant height of 363.5 cm and 15.3 kg of bunch weight.

Nutmeg:

- In nutmeg, soft wood grafting recorded hundred per cent success during the month of June, July and August month of grafting. The bio-metric characters recorded after 180 days of grafting indicated that plant height and number of leaves produced were highest during the month.

Vanilla:

- In vanilla, propagation trial was laid out with the following treatments viz., one node, two nodes, three nodes, four nodes and one metre length cuttings were used. The cuttings treated with 1000, 2000, 5000 ppm planted in polythene bags mixed with two different media viz., 1:1:1 ratio of sand, Forest soil and FYM and 1:1:1 ratio of sand, forest soil and coir pith. The mean data recorded on the parameters percentage of rooting, mean plant growth (New flesh formation) and root length (cm). It may be inferred that among the various type of cuttings tried one metre length cuttings registered the highest per cent of rooting (100%) followed by four, three, two and one nodal cuttings. The one metre length cuttings also produced more plant growth and root length. There is no perceptible the success of rooting. Among the various concentrations of IBA tried, 2000 ppm induced better rotting with better plant and root growth.

Avocado:

- For standardization of vegetative propagation five methods is being followed in avocado viz., soft wood grafting, splice grafting, slide grafting, patch budding and terminal cuttings were tried. Among the methods, the maximum level of success (90%) was recorded in soft wood grafting method. The same method took 42 days for union and curing.

b) Crop protection:

- To attract fruit flies in orange, fish meal trap is recommended @ 20 traps/acre.
- To attract and kill fruit flies of chow-chow , fish meal traps @ 20 traps/acre are recommended.
- Spraying of an alternate fungicide, namely 0.5% boardeaux mixture, in the first round during June, 0.02% triadimefon in the second round and 0.5% boardeaux in the third round reduces the coffee rust diseases.
- To control quick wilt of pepper, soil application of Trichoderma viride @ 20g/vine mixed with 2kg of FYM is effective.
- Sodium chloride test has been developed to identify the bunchy top virus (BTV) infected suckers of banana.
- Application of 400mg of 2,4-D along with 100g of urea in a hole made in the pseudostem kills the BTV affected banana.
- Acephate application @ 400mg one week before 2,4-D application kills the vector insect of BTV.
- *Pseudomonas flourescens* as capsule application reduces the banana wilt.

7) Prospects of agro-based industries:

- a) Exploring the possibility of manufacturing spray – dried powder of mandarin orange.
- b) Cold storage and processing units can be established.
- c) Collaborative approach by nationalized banks, departments of Agriculture, Horticulture and University can be boost up.
- d) Coffee curing industries are not at present available in the Pulney hills. All the parchment is transported to curing at foot hills of the Lower Pulney hills. So curing centres may be started at Lower Pulney hills.

There is a hope for establishment of processing units through which the spice value and price could be bringing up by manufacturing value added products in spices viz., pepper, clove, nutmeg, capsicum, etc., Since, preserving the value added products have a demand in the international market.

Cold storage facilities can be provided to store the harvested fruits and vegetables during the glut period in order to sell the produce at premium price after a long period of storage.

There is great scope for production and export of cut flowers in collaboration with foreign companies. This will definitely augment the income of growers, since there is a great demand both in domestic and international market for cut flowers.

Agro based grading and marketing centres can be established for spice crops since grading is stressed in international market and even in domestic market. The growers can sell their produce in Lower Pulney itself and thereby reduce transport cost and loss due to damage during transport.

Processing and preserving units to preserve fruits and vegetables such as orange, jack, guava, pine apple, chow chow, beans, capsicum etc., can be thought of. An Industry for manufacturing biofertilizers and bio pesticide from coffee pulp waste, coir waste, saw dust and other bio waste.

Honey processing industry:

Since, more tribals have a native knowledge of bee keeping in forest areas with wild bees and also domesticated bees.

9) Suggestions to alleviate problems and the constraints:

- a) Need based and timely training to the farming community through suitable agencies will help to increase yield of plantation crops, fruits, vegetables, etc.,
- b) Co-operation of efforts by banks, university and Departments.
- c) Training on soil and water conservation measures.
- d) Improvement in road facilities; marketing, schooling and medical facilities.
- e) Self-help groups formation needs to be intensified for farm-women for purpose of financial and social relationship building.
- f) Financial assistance through arranging loans from nationalized banks and providing free consultancy services about improved technologies on crops grown by the farmers.

- g) Diversifying income-generation projects(e.g) mushroom, bee keeping, sericulture, poultry etc.,
- h) A model farm needs to be developed in each Panchayat.

9) Future thrust:

- a) Coffee requires a drought tolerant variety.
- b) Grafting of wild pepper to impart wilt resistance to Panniyur-1 and other cultivated varieties of pepper.
- c) Tree spices popularisation, by increasing the area under tree spices at Horticultural Research Station, Thadiyankudisai.
- d) Grafting techniques(vegetative propagation techniques) need to be strengthened in tree spices.
- e) Popularisation of cardamom, vegetable crops, flower crops, etc., among the grower of Lower Pulney hills.
- f) Using biofertilizers to increase yield in pepper, orange, coffee, etc.,
- g) Usage of bio-fungicides in pepper.
- h) Survey and collection of mild strain of BTV (bunchy top virus) affected plants for cross infection studies to revive hill banana in Lower Pulney hills.
- i) Management of chow-chow mosaic
- j) Popularising, mushroom culture, vermi composting, home preservation of fruits and vegetables; preparation of balanced diet.
- k) Health and hygiene education.
- l) Introduction of nut fruits, strawberry, etc., in Lower Pulney hills.
- m) Bee keeping.

HORTICULTURAL RESEARCH STATION- KODAIKANAL

Geographical Distribution Of Area

This station was established as Apple Research Station in 1961 and it was renamed as Horticultural Research Station in 1971 after taking over of the station by Tamil Nadu Agricultural University

It is situated at an altitude of 2225 meters above main sea level with the latitude of 10.2 N and longitude of 77.5 0 E. M the Maximum temperature of this station range from 15.3 to 25.6 0 C . The Minimum temperature ranges from 5.2 to 12.3 0c . This station receives the annual rainfall of 1650 mm in 170 days. The type of soil is lateritic and part with the pH of 5.5 to 6.5 Average depth of the soil is 0.25 to 1.metre.

Area :

Total area of this station is 18.08 ha with the cultivable area of 14.05 ha. The crops like apple, pear, plum and peach one growing within an area of 4.5 13, 3.5 and 3.0 acres respectively. The persimmon crop was borsht from the kullu valley of Himachal Pradesh and has been introduced in this station.

Besides the fruit crop, flower crops like carnation, Gladiolus and Rose have also brought from different places of India and from Isreal for research purposes

Medicinal and aromatic plants have been brought from different places for research purposes and a modal herbal nursery have been developed and it is being maintained at Horticultural Research Station, Kodaikanal.

Monthly Rainfall data from 1/1978 to 12/2000

MONTH	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1989	1990
JANUARY	-	-	-	19.1	-	9.5	111.7	132.5	33.0	27.5	-	-
FEBRUARY	12.9	181.5	-	4.8	-	21.8	140.2	-	123.5	6.5	3.0	-
MARCH	6.0	12.0	83.0	-	21.0	22.0	404.8	29.0	22.6	53.5	65.0	187.0
APRIL	206.0	87.0	75.9	18.2	92.7	43.4	101.1	254.5	22.2	12.0	68.0	211.5
MAY	90.9	25.0	60.0	151.0	118.1	144.8	45.2	95.8	85.1	183.9	25.5	152.0
JUNE	35.1	55.4	29.3	62.5	27.1	71.8	32.7	47.7	109.5	118.5	61.0	85.0
JULY	92.3	102.9	55.5	164.8	92.5	107.0	156.7	42.5	45.0	29.0	123.5	149.5
AUGUST	20.8	37.2	114.9	99.4	25.3	81.0	61.8	89.0	43.4	73.5	198.0	43.0
SEPTEMBER	185.0	362.2	14.6	89.6	227.1	201.9	188.1	115.7	231.9	269.9	264.0	457.0
OCTOBR	260.7	160.0	274.5	341.5	298.8	202.7	204.5	97.7	156.8	250.3	31.0	264.0
NOVEMBER	356.8	949.5	231.7	236.7	173.7	140.0	120.2	250.0	142.6	137.8	78.0	273.0
DECEMBER	173.4	28.2	34.3	142.5	100.6	299.6	180.0	146.6	73.2	303.0	41.0	75.0

MONTH	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
JANUARY	-	12.0	1.0	-	22.5	7.9	-	4.3	-	17.5
FEBRUARY	-	-	13.0	38.0	-	28.4	-	-	4.7	45.9
MARCH	-	-	79.0	12.0	60.9	31.4	18.0	167.7	5.4	3.6
APRIL	-	82.7	69.0	143.0	293.0	371.3	79.0	152.0	56.0	29.6
MAY	87.0	184.5	88.0	127.0	103.3	112.3	46.7	12.0	66.7	82.1
JUNE	140.0	52.3	84.0	21.0	98.0	92.4	33.2	202.2	27.2	12.0
JULY	64.0	37.1	42.0	49.5	159.6	48.7	321.2	37.6	27.2	70.9
AUGUST	72.1	64.2	202.0	25.0	311.6	174.8	151.0	26.4	83.0	138.7
SEPTEMBER	136.8	154.9	229.0	186.0	41.10	245.8	313.3	196.4	87.5	248.5
OCTOBER	359.9	188.0	48.0	558.0	275.9	106.3	106.1	315.7	27.4	85.6
NOVEMBER	204.0	496.0	441.0	397.5	106.4	67.0	194.3	-	15.1	62.9
DECEMBER	61.0	117.0	176.0	6.0	-	59.1	-	-	-	46.8

Soil Of Pulney Hills

Soil of Palani Hills falls under the brood soil group "LATERITE" Soil are very deep and the surface texture ranges from loam to clay loam. The color of the soils ranges from brown (7.5 YR 4/4) to black (2.5 YR 2/0) depending from the organic matter contend of the soil. The strawelure of the surface soil is in general splroidal in nature. The soil are friable under moist condition and offers no resistance for root perpetration. The colour of the B horizon soil ranges from dark yellowish brown (10 YR 3/4) to yellowish red (5 YR 5/6) with texture ranging from sandy clay loam to clay loam. The structure in generally blocky in the 'B' horizon. The soils are generally well drained with moderate to very rapid permeability. Morphological examination of soils reveals no visual soil physical problems such as surface hardening crusting sub surface hard panel. The morphological descriptions of soils examined in different transacts of pulney hills are given in.

Fertility Status Of Soils Of Pulney Hills

The soils are acidic to near neutral in reaction (pH 4.25 - 6.6) and are non saline (Electrical conductivity 0.04 to 0.39 mbs/cm). The available nitrogen status ranges from 408 to 2038 kg /ha with very high proportion falling under high status. Available phosphorus is low to medium and available potassium is low to high. As regards to micronutrients, iron is present in sufficient level and the contents ranges from H to 200 ppm and copper content ranges from 0.8 to 80.0 ppm. Very low percentage of the area was found to be deficient in copper (<1.2ppm) and manganese (<2 ppm). Zinc content ranges from 0.3 to 3.15ppm with high percentage of area deficient in zinc (< 1.2ppm)

Profile No. 1 : Kodaikanal

Location : Poombarai Village Horizon	Depth	Description
AP	0-16	Very dark brown (10 YR 2/2; sandy clay loam; weak medium to coarse sub- angular blocking to granular moist very friable; wet sticky and slightly plastic; plentiful, fire to medium roots very rapid permeability; abrupt smooth boundary.

B2	16-40	Dark yellowish brown (10 YR 3/4) gravelly sandy clay loam, weak coarse, sub-angular blocky, moist very friable, we sticky and non plastic, few very fine to medium roots, very rapid permeability abrupt smooth boundary.
B2t	40-71	Dark brown (7.5 YR 4/4); clay loam; moderate medium to course sub-angular blocky; moist friable wet sticky and plastic; very few medium roots, moderately rapid permeability; powdery manganese deposits; clear smooth boundary
B 3	71-118	Strong brown (7.5 YR 5/8) sandy clay loam, moist friable wet slightly stocky and slightly plastic; very few fine to medium roots; very rapid permeability, few powdery manganese deposits, gradual waxy boundary
E	118 - 160t	Weathered genesis
Profile No. 2 Kodaikanal		
Location		VADAKAUNJI
A1	0-26	Black (7.5 YR 2/0); clay loam moderate fine to medium, crust, moist friable wet slightly sticky and slightly plastic coarse to very coarse roots; very rapid permeability; abrupt smooth boundary
B1	26-71	Very dark grey (10 YR 3/1), gravelly clay loam; weak coarse, Sub-angular blocky; moist friable. Wet slightly sticky and sticky plastic ; few medium to coarse roots, very rapid permeability, clear waxy boundary
B2	71-200	Yellowish red (5 YR 5/8), clay loam, moderate, coarse to very coarse, sub-angular blocky, moist friable, wet sticky and plastic very few very fine to medium roots; moderately rapid permeability clear waxy boundary
C	200-300	Weathered genesis
Profile No. 3 Kodaikanal		
Location POOLATHUR VILLAGE		
A1	0-40	Dark brown (7.5 YR 3/2); clay loam, weak coarse to very coarse, sub-angular blocky breaking to medium to coarse crumb; dry slightly Hard, moist very friable wet sticky and slightly plastic; very fine to very coarse roots, very rapid permeability; clear smooth boundary

B2	40-124	Yellowish red (5 YR 4/6) gravelly sandy, clay loam; moderate coarse to very coarse sub-angular blocky : dry hard; moist very friable wet Slightly plastic; fine to very coarse roots; gradual smooth boundary
B 224	46-77	Strong brown (7.5 YR 6/6); clay moderate coarse, very sticky and very plastic coarse to very coarse roots, moderately rapid permeability powdery manganese deposits, gradual wavy boundary
B3	77-108	Reddish yellow (7.5 YR 6/6) clay loam; moderate, medium to coarse Sub-angular blocky, moist friable wet sticky and plastic Coarse to very coarse roots, powdery manganese deposits, moderate Rapid permeability, diffuse boundary
	108 - 125t	Weathered gneiss
PROFILE NO: 8 KODAIKANAL		
LOCATION BERIJAM(MIXED FOREST)		
A 1	0-20	Block (2.5 YR/2/0) loam moderate, crumb dry broft, moist very Friable, wet non sticky, non plastic fine to coarse roots, very rapid permeability abrupt smooth boundary
B1	20-70	Very dark gray (10 YR 2/1) gravelly sandy clay loam, weak coarse to very coarse, sub-angular blocky, moist friable wet slightly sticky and non plastic, fine to medium roots; very rapid permeability; abrupt smooth boundary
B2 t	70-250	Yellowish red (5YR 5/8); clay loam; moderate coarse to very coarse, sub-angular blocky, moist friable, wet sticky and plastic, few very fine to coarse roots moderately rapid permeability clear smooth boundary
C	250 - 270	Weathered senesis

4 (A)
KODAIKANAL BLOCK AREA UNDER HORTICULTURE CROPS

S.No.	CROPS	AREA (Hectare)
	I. <u>FRUIT CROPS</u>	
		13.38.0
01.	Apple	1782.00.0
02.	Orange	1404.00.0
03.	Pear	1272.00.0
04.	Banana	547.00.0
05.	Plum	512.00.0
06.	Lime	159.00.0
07.	Pine Apple	178.00.0
08.	Others	5867.38.0
	III. <u>VEGETABLES</u>	
01.	Carrot	783.00.0
02.	Beans	567.00.0
03.	Chow-chow	284.23.0
04.	Peas	168.24.0
05.	Potato	2408.00.0
06.	Others	118.00.0
		4328.47.0
	III. <u>SPICES AND PLANTATION CROPS</u>	
		203.01.5
01.	Cardomam	424.00.0
02.	Pepper	7178.00.0
03.	Coffee	21.18.0
04.	Tea	603.00.0
05.	Garlic	16.00.0
06.	Cocoa	16.00.0
07.	Others	8461.19.5
	Total Area	18657.04.5
	<u>OTHER DETAILS</u>	
	Forest	9697.00.0
	Cultivable Land	6495.00.0
	Uncultivable Land	560.00.0
	Roads & Buildings	10586.00.0
	Others	51895.00.0

Sl.No	Crop	Area (ha)	Production (ton)	Productivity Average M.T/ha
<u>I. FRUITS</u>				
01.	Banana	2932	40060	
02.	Lime	3253	5080	13.66
03.	Orange	1896	10240	1.56
04.	Pear	1357	28497	5.40
05.	Other Citrus Fruit	85	1020	21.00
06.	Pineapple	157	3520	12.00
07.	Other Fresh Fruits	1025	5638	22.42
	Total Fruits	12200	111235	5.50
				93.03
<u>II. VEGETABLES</u>				
01.	Potato	876	11940	
02.	Carrot	882	21168	13.63
03.	Greens	22	110	24.00
04.	Beans	917	6419	5.00
05.	Cabbage	10	1030	7.00
06.	Beet root	46	1012	103.00
07.	Other Vegetables	1861	50247	22.00
	Total Vegetables	10812	143096	27.00
				216.05
<u>III. SPICES & CONDIMENTS</u>				
01.	Cardomam	361	40	
02.	Pepper	631	230	0.11
03.	Garlic	811	4950	0.36
04.	Cloves	8	10	6.10
05.	Other Spices	18	36	1.25
	Total Spices	1829	5266	2.00
				9.82

Sl.No.	Crop	Area (ha)	Production (ton)	Productivity Average M.T/ha.
	IV. PLANTATION CROPS			
01.	Tea	74	555	7.50
02.	Coffee	11624	6393	0.55
	Total Plantation Cro	11698	6948	8.05

S.No.	Crop	Varieties
I	<i>Fruit crop</i>	
01	Apple	KKL - 1 , Parlins beauty
02	Pear	Jargonelle, Keifer, William, Country Pear (Local)
03	Plum	Hale
04	Peach	Floridasan
II	<i>Vegetables:</i>	
01	Corrot	Early Nantes
02	Beet root	Detroit Dark Red, Crimson Globe
03	Radish	Japanese white
04	Potato	Kufri Jyothi
05	Cabbage	September, Early Drum Head,
06	Cauliflower	Kalyan Hybrid
07	Beans	KKL - 1
08.	Peas	Bonneville
09.	Butter Beans	KKL - 1
III	<i>Spices and Plantation Crops</i>	
01.	Pepper	Panniyur - 1 and Karimunda
02.	Cardamum	Vazhuka, Green Globe
03.	Ginger	Local
04.	Coffee	Selection 7,9,7-9, cauvery

Constraints and problems of the area in Kodaikanal

Sl.No.	Crops	Problems
I	<i>FRUIT CROPS</i>	
01	Apple	Wooly aphis, fruit Cracking
02	Pear	Litchens, stem borer, fruit Cracking, Loranthus
03	Mandarin	Micronutrient deficiency, fruit fly powdery mildew
04	Plum	Fruit cracking , litchens, stem borer
05	Banana	Wilt, Stem weevil Bunchy top
II	<i>VEGETABLES:</i>	
01	Cabbage	Club root, cut worm, Diamond Back moth
02	Cauliflower	Whip tail, club root, Diamond back moth
03	Corrot	Club root, Nematodes
04	Peas	Powdery Mildew born
05	Beans	Leaf miner, mosaic, fruit borer, wilt and powdery Mildew
06	Potato	Late and early bright, Nematodes, wilt, mosaic
IV	<i>SPICES AND PLANTATION CROPS</i>	
01	Pepper	Quick wilt, show wilt, berry borer, Pollu beetle
02	Coffee	Stem borer, berry borer, Golden rust

06. Technologies so for developed ie. varieties, management :-

So for one variety in fruits and 2 varieties in vegetables and one variety in flowers and one Variety in essential crops have been related from Horticultural Research Station, Kodaikanal

S.No.	Crop	Variety	Year of release	Characters
01	Apple	KKL - 1	1987	Variety of July - August months It yield 25 Kg/fruits with 250 - 300 fruits there. Total so much 20 bits of the fruit is 14-16%
02	Butter beans	KKL - 1	1991	Cluster bearing by the I yields 3.47 to

03	Moringa Beans	KKL - 1	1996	Fruits are fleshy and beds, with white seeds it yields 7 ton/ha
04	Gladiolus	KKL - 1	1993	If yields 21 flower per squire Meter Each cluster has 16 shows Red flowers with white tinch in the under
05	Geranium	KKL - 1	1987	It yields 37 ton leaves/hectare oil recovery is 0.13

Crop improvement

- 01 Varieties like William, Jargonelle and kefir in Pear and varieties like, Hale inn plums are suitable to certificate under (Kodaikanal condition)
- 02 By using MM rootstock, for grafting are can prefect the apple crop from wooly aphid
- 03 Varieties like Bonneville Gloriosa super alaska and Telephone in beans and Randm surut in carrot are suitable to cultivate in upper pulney hills
- 04 The cut flower variety Arthursim in Carnation has high keeping quality

Crop management

- 01 Apple and plum grafts come up well when the grafting work is done during the month of November to February with whip and tongue grafting method.
- 02 the dormancy in apple can be broken by spraying 0.5% sandolin a + 2% mineral oil in the month of January
- 03 In the country from by top working method we can graft the improved varieties
- 04 Plums of peach can be effectively propagated by 'T' budded method in the month of November to February
- 05 35% of germination in peach seeds can be obtained by arranging the peach seeds and sand in alternate rows and keeping them in moist condition by codling water.
- 06 The persimmon tree variety (Hi-kumi) has come to bearing after 5 years. It has given 8 kg fruits/tree with the total soluable solids of 13-15%
- 07 By spraying gibberlic acid 40ml in one litre of water seeds can be produced in cabbage.
- 08 By doing cross cuts in the cauliflower during the month of August - September 80 kg seeds per hectare can be obtained

- 09 By removing the 1/3 rd fraction from the upper side of the carrot of 1/4 portion from the lower side , 22 grams of seeds can be obtained

FERTILIZER MANAGEMENT

- 01 For apple spray 0.05kg, 6.25kg and 1.75kg of Urea, Super and Potash should be applied for getting higher yield. In plum trees Urea, Super and potash should be applied at the rate of 1.3, 0.95, and 0.5 kg/year/tree
- 02 For Cauliflower and Cabbage, by applying the recommended close of 135: 135: 135 by of NPK along with 10 packets in each of Azospirillum and Phosphobacteria and 2.5 ton fundamental savage, the increased yield of 20.65 and 22.5% was obtained.
03. By applying 120,240,120 ly of NPK in two split doses, are as basal and sowed half on 45th day after planting, along with Azospirillum and Phosphobacteria 10 packets in each 34% increased yield was obtained potato
04. By applying Rhizobium, Azospirillum and Phosphobacteria through seeds oil, the yield can be increased to 6-8 % in Peas and Beans.
05. Star not can be reduced by spraying 01.% Zn So₄, 0.3% Am. Sulphate and 0.1% MnZ_o₄, on 30,45 and 60th day after planting.
06. By adding 100, 75, 50 Kg. of NPK along with 25Kg. ZnSo₄, the yield can be increased to 20% in garlic.

At the Horticultural Research Station, Kodaikanal the following projects are in operation :

I. Horticulture :-

Pomology :-

1. Introduction and evaluation of newer varieties in temperate fruits.
2. Studies on high density planting and growth retardants in pear and plum.
3. Introduction, conservation and evaluation of medicinal plants.

Floriculture:-

1. Studies on Gladiolus.
2. Collection, assessment and maintenance of carnation germplasm.
3. Standardisation of technologies for dry flower production at Kodaikanal.

II. Soil science and Agricultural Chemistry :-

1. Studies on nutritional requirement of pear Cv.Jargonelle involving bio-fertilizers.
2. Optimizing fertilizers schedule with microbial inoculation on plum Cv.Hale.

III. Entomology :-

1. Control of diamond back moth by cultural and biological methods.
2. Management of leaf miners in Peas and pole beans grown in the upper pulney hills.
3. Integrated pest management of Garlic thrips, Thrips tabaci (Thysanoptera thripidae) in upper pulney hills.

07. Prospects of Agro-based industries.

Processing and preservation of temperate fruits and vegetables had not yet been taken up. These industries could be developed. In the dry flower technology mostly plants from temperate regions are used. This is another avenue for agro based industries.

The produce ie. vegetables and fruits can be stored for lengthier periods under ambient storage because of the prevailing low temperature and high humidity. Store houses and packing industries could be developed to transport the produce for long distance and also for processing.

Industries for extraction of alkaloids from medicinal plants and essential oils from aromatic plants could be developed.

08. To alleviate the problems and constraints and improvement of agricultural productivity and production.

1. Arranging on farm trails on the technologies developed.
2. Organizing farmers' trainings and farmers' work shops including field days.
3. Motivating farmers to promote subsidiary industries such as packing units.

09. Future thrust.

1. Introduction of newer varieties of fruits, vegetables, flowers and medicinal plants.
2. Initiation of projects on cropping systems and farming systems.
3. Standardisation of seed production technologies in temperate vegetables.
4. Developing awareness on the market intelligence.
5. Processing and preservation technologies for temperate fruits and vegetables
6. Standardization post harvest technologies of Horticultural crops

A N A M A L A I H I L L S

1. DELINEATION OF THE AREA:

The Anamalai Hill Region is situated in the Western Ghat, and belongs to Coimbatore District of Tamilnadu. This hill zone lies between the latitude $10^{\circ} 10' - 30'$ North and longitude $76^{\circ} 30'$ and $77^{\circ} 0'$ East.

This Hill is situated in Pollachi Taluk of Coimbatore District and is surrounded by Kerala state in the west and south and Udumalpet Taluk in the East.

2. PHYSIOGRAPHY:

The total geographical area of this hill zone is 97280 acres, and the altitude ranges from 800 to 1200m. above MSL. Valparai is the only revenue village in this hill zone and there are about 60 estates in this region. Valparai is situated about 110km. from Coimbatore and 70km from Pollachi.

Top Slip is the highest point in Anamalai Hills. The Hills is abounded with funge with dense forest, which is responsible for the highest amount of rainfall.

3. CLIMATE:

The annual mean maximum temperature of this Hills zone is 28°C and the annual mean minimum temperature is 13°C , The relative humidity ranges from 50-90%.

High and evenly distributed rainfall is observed in the Anamalai Hills. This zone is benefitted by both the monsoons. Southwest and Northeast monsoon, An average rainfall of

400mm is received annually with a range of 3000mm to 4500mm. South west monsoon is most effective accounting 77% of the total rainfall.

4. SOILS:

The Soil type in Anamalai hills is mostly acidic (ph ranges from 4.5 to 5.5 in tea plantations and 5.5 to 7.0 in other plantations.)

The soils are lateritic, Kaolinite clay predominates. The soil is rich in iron and aluminium. Because of the porous nature of the soil and continued heavy rainfall, The nutrient “K” is leached out and there is no fixation of “K” in this Kaolinite type clay. There is zinc deficiency in the soils which needs to be supplemented through foliar sprays.

5. LAND USE PATTERN:

An area of 13324.29 ha. (23.83 per cent of the area of situation) is under gross cropped area Nearly 4.77 percent of the area is under forest.

6. IRRIGATION:

The crops in this zone are totally rainfed, and irrigation has not been done for any of the plantation crops except in some plantations where the stored water is used for sprinkler irrigation of the plantation crops. The reservoirs in this zone are utilised as a catchment area for Aliyar Reservoir Project which irrigates the lands in the plains.

7. LAND HOLDING PATTERN:

Population and socio-economic characteristics. Small and marginal farmers own 61 percent of the total holdings. Of the total working population 99.6 percent are workers.

8. MAJOR CROPS / CROPPING PATTERN / CROPPING SYSTEMS:

Perennial Plantation crops like Tea and coffee occupy major areas in this zone. Cardamom, spices cinchona are the other crops. Spices crops like nutmeg and fruit crops like oranges, banana and citrus are grown in limited area, Cinchona Plantation are owned by Government and no private grower grows cinchona. Cereals, Millets and vegetables are cultivated in some pockets by the tribals of this zone.

Tea is the Major crop of this hill zone, The soil and rainfall pattern are very conducive for the maximum production of tea. The world's highest productivity of 4000 kg / ha. is obtained in the Anamalai hills and it is the most suitable area for the cultivate of tea in India.

9. GENERAL CONSTRAINTS:

Because of the porous nature of the soil and continued heavy rainfall the nutrient "K" is leached out and there is no fixation of 'K' in this Kaolinite type clay.

The problems of the small tea growers are the following:

- Low price of tea leaves in year 2000.
- Absence of proper machinery for processing green tea leaf.
- lack of established market facilities subjecting them to the obligation of biestates and agents.
- Communication gap between the farmers and the extension personnel.

LINKAGES WITH RESEARCH AND EXTENSION:

The is the major crop of this hill zone. The soil climate and rainfall pattern are conducive for the maximum production of tea. 61. percent of the farmers belong to small and

marginal category. Tea planters of all category depend the United Planter's Association of South India (UPASI) for cultivation of tea. The UPASI was formed in 1893 to promote the interests of planting products, namely tea, coffee, rubber and cardamom, and to this association a number of associations, both at state and District levels were affiliated.

HILL TRIBES - THEIR CHARACTERISTICS:

There are nine tribal villages in Anamalai hill sub-zone. They are Keelpoonachi, Pannikkuchi, Paramankau, Nedungundru, Manampalli, Kithakkuchi, Udumanparai and Kallar, all belonging to valparai Panchayat. There are four kinds of Tribals called, Kadar, Muduvar, Malai Malasar and Pulayar. They speak a language which is mixture of Tamil and Malayalam. Their main occupation is collection of forest produce like Honey, soapnut, Kungilium etc., Majority of the tribes are kadars who are still food gatherers. Pulayas and Muduvars follow agriculture, mostly raise rainfed crops. Muduvars are hard workers and comparatively better in economic condition. Kadar and Malaimalasar are not that active. Malaimalasar are the most primitive among them. They collect food and eat mostly tubers. They keep bamboos in between the walls as a sort of providing reinforcement to the walls.

There are only few literates among Kadars, They are closely related with the Kadar of Cochi Malai Malasar are the primitive among them.

K O L L I H I L L S

1. DELINEATION OF THE AREA:

Kolli hills is one of the developing blocks situated in Namakkal and Rasipuram taluks. The total population of this block is 28,499 of which Scheduled Tribes constitute 27,202 i.e., 95.45% of total population. The total area of the block is 22,793ha. of which forest constitutes about 4688 ha. It lies at a longitude of 78.20' to 78*.30'E and a latitude of 11*-10' to 11*-30' N. There are 14 villages and 247 hamlets in this block. Agriculture is the principal occupation of the people. The temperature prevailing here is conducive for pine - apple, coffee, banana citrus etc., Among the food crops, paddy, ragi and samai are the major crops.

2. PHYSIOGRAPHY:

Kolli hills, which is located on the south eastern side of the Salem District contains peaks over 1,300m. The dense forest reserves of this hills. yield good fuel and timber yielding trees. The general slope of the hill is grading towards west and southwest.

3. CLIMATE:

A tropical monsoon climate prevails in this area, with mild to pleasant temperature, which is conducive, for raising horticultural crops like pine - apple, coffee, etc.,

The Mean annual temperature ranges from 14*c to 28*C. The average annual rainfall of the hill is around 1600mm of which a major portion is obtained during the months of September. October and November.

4. SOILS OF KOLLI HILLS:

The soils are deep to very deep to very deep, non- calcareous and developed from weathered gneiss. Colour of surface soil ranges from reddish brown to dark yellowish brown and texture, Loam to clay loam. They are excessively drained externally with moderate permeability. Reaction is strongly medium acid. the foot hills, and soil is very deep, clayey and saline alkaline in nature. These soils are poor in drainage.

5. LAND USE PATTERN:

The net area sown of this hill tract. accounts to 4997ha. (i.e.21.92%) of the total geographical are) Nearly 4668 ha. is under forest (20.48%)

6. IRRIGATION:

Almost all the crops are raised as rainfed crops, excepts paddy, which is irrigated with natural streams. The total irrigated area comes to about 1958 ha. Which is 39% of the total area sown.

7. LAND HOLDING PATTERN, POPULATION AND SOCIO - ECONOMIC CHARACTERISTICS:

Apart from agriculture the people are engaged in forestry, livestock maintenance. Hunting, fishing, house - hold industries, petty trade etc.,. Of the total holdings, 70.9% are small and marginal farmers. Majority of the population are scheduled tribes and scheduled caste which constitute 95.45%.

8. MAJOR CROPS, CROPPING PATTERN AND CROPPING SYSTEMS:

Pine - apple and banana are the major horticultural crops grown. Tapioca, acid lime, mango, coffee, cardamom, coriander, Jack, orange, and guava are also cultivated on a large scale. Ginger, turmeric, pepper and mustard are grown in certain pockets only. Chillies is the major vegetable crop grown on a commercial basis. In levelled areas and in some valleys,

paddy, is grown. It is the only irrigated crop, grown in this hill tract. Besides paddy, ragi, small millets and pulses are also grown. Irrigation is only through the natural streams and flooding is the irrigating method followed.

Coffee is slowly getting importance and the area under this crop is gradually increasing.

Cropping Systems:

Season

a)	1.	Paddy	:	November - December
		Paddy	:	June - July
	2.	Tapioca	:	June - July]
	3.	Cardamon	:	Perennial crop
	4.	Chillies	:	June - July
b)	1.	Paddy	:	November - December
		Paddy	:	June - July
	2.	Cholam	:	June - July
		Ragi	:	September - October
	3.	Paddy	:	June - July
		Black gram	:	November - October
	4.	Ragi	:	September - October
		small	:	June - July

C. MULTITIER CROPPING SYSTEM:

1. Coffee. + jack + pepper
2. Coffee + mandarin orange + Pepper
3. Coffee + Pine - apple
4. Pine - apple + acid lime + Banana
5. Pine - apple + Pepper + jack

In the multiter system, coffee or pine - apple is the base crop. Jack, oranges, lime, mango, guava and banana are grown as intercrop without having a regular sequence. These trees are seen within the plantation, either in a scattered manner or in groups. In coffee plantation, silver oak, and jack are the common shade trees over which are trained pepper vines. Banana is also grown in coffee plantation to a limited extent.

Along the sides of natural streams, cardamom is grown, The area under cardamon is very meagre (i.e.. less than 1 %).

GENERAL CONSTRAINTS:

1. Lack of transport facilities:

This is a major constraint for the farmers to have their produce sold at market

2. Electricity:

Electricity is not available for most of the villages.

3. Lack of irrigation:

No crop is irrigated, except paddy, which is irrigated by natural streams. If irrigation facilities are available, the farmers can grown vegetable crops like chillies, tomatoes, etc., on a large scale.

4. Poor management practices:

Generally, the farmers are unaware of the improved agro - techniques.

5. Lack of finance:

Lack of finance and the poor economic conditions are the main reason why the farmers are not following proper management practices. Credit facilities are lacking and more than 51% of farmers are small farmers.

6. Adoption pattern and production constraints:

i) Pine - apple:

This is the major horticultural crop grown in the hill. The total area under this crop accounts to about 11.% of the total area sown. Erratic flowering is a problem here. Uniform flowering is not obtained .

ii) Tapioca:

Tapioca ranks next to pine - apple in area and production of horticultural crops in this hill. Manuring is not done to tapioca in general

iii) Banana:

In this crop also, regular and systematic manuring is not followed. Due to lack of nutrients, the crop gives a low yield. Plant protection measures are also not adopted .

iv) Mango:

More than 70 ha. are under the crop. There is no high yielding variety. Only local varieties are grown and they are alternate bearers with a very low yield.

v) Cardamom:

Cardamom is raised only in certain pockets. Proper shade is not maintained. No Manuring is done. The crop is attacked by stem borer, capsule borer and thrips, and mosaic,

vi) Coffee:

This crop is slowly being introduced in this area. Shade trees are not maintained with proper spacing. The plants are not manured due to lack of finance among the coffee growers.

SOCIO - ECONOMIC CHARACTERISTICS OF THE TRIBALS:

The tribals who live in kolli hills are Malayalis. They are not very different from Tamils who live in plains. They speak Tamil with a slang.

Most of the tribals are engaged in agriculture. The crops generally grown in this area are paddy, ragi samai, thenai, and varagu. Fruits such as mango, Jack pine - apple, citrus varieties, guava and hill vegetables. like cabbage, knolkhol, carrot, radish, potato and beetroot are also grown. Several of them work as landless farm labourers.

Communication is very important in the development of tribal community in the kolli hills. There is need for laying good roads in the tribal area connecting the tribal hamlets and villages. A communication net work will be useful for marketing the produce of the tribals, for extending medical facilities. and for exploiting the natural resources.

The root cause for most of the problems faced by the tribals in their area can be traced to general lack of education.

Some of the noted and widely prevalent diseases in the tribal areas are anaemia, Jaundice, hookworm, roundworm, fungal infection etc.

K A L R A Y A N H I L L S

1. DELINEATION OF THE AREA:

The Kalrayan hills measure 16 miles from North to south and 23 miles from East to west. Totally, it extends over an area of 854.63sq.km. The Southern side lies in the North eastern part of the Salem. district, while the Northern part lies in Cuddalore District. They are respectively called as chinnakalrayan and Periyakalrayan hills. The Kalrayan hills lie within 78°31' Longitude to 11°51' latitude.

Agriculture is the main occupation of the people. paddy. ragi and varagu are grown extensively. Besides horticultural crops like tapioca, chillies, french beans, and fruits like banana, guava, citrus etc., are also under cultivation, The total population is 52, 165 of which 92.88% are scheduled tribes and scheduled castes.

2. PHYSIOGRAPHY:

The entire Kalrayan hills are divided into two by a valley running Eastward to pappanaickanpatti. The Chinnkalrayan forms a similar pattern which is cut into two by a lofty ridge. The northwest portion is called Melnadu. and Southwest portion is called Kilnadu. The elevation of the hills ranges between 760m - 1370m above mean sea level. Of the total geographical area, forest land accounts for about 42.02% while the net cultivated area comes to about 21.42%

3. CLIMATE:

It enjoys a mild tropical climate with a mean annual rainfall of about 860mm. The Major share of rainfall is obtained during north east monsoon period especially in the months of October and November.

4. SOIL:

The soil in the hill is reddish brown to dark red, shallow to moderately deep, fine loamy, non - calcareous, excessively drained and subjected the severe erosion and run off. In the bottom of the valley, the soils are red to dark reddish brown, very deep, fine loamy to fine non - calcareous moderately well drained and subjected to soil deposition. In general, the soils have a low nutrient status and are badly affected by erosion.

5. LAND USE PATTERN:

The total cropped area of this hill is 173223.05 ha. Which is nearly 21.25% of the total geographical area. The area under forest is 44273.33ha i.e. 42.02%. Among the revenue villages, Therkunadu of Chinnakalrayan hills has a maximum cropped area of about 1337.97 ha. followed by Vadakkundau.

6. IRRIGATION:

There are about 486 wells which are utilised for irrigating crops. Natural springs are also utilised for irrigation where ever possible. Area under irrigation is only 622.37 ha. i.e., nearly 3.59% of the total cropped area. Most of the crops are raised under rainfed condition only.

7. LAND HOLDING PATTERN, POPULATION AND SOCIO- ECONOMIC CHARACTERISTICS:

The total number of holdings comes around 14672 of which 8.78% are constituted by small and marginal farmers.

Population:

The total population of kalrayan hills is 52,165 of whom 92.88% are Scheduled Tribes and Schedule castes.

8. MAJOR CROPS / CROPPING PATTERN / CROPPING SYSTEM:

Tapioca is the major horticultural crop which is cultivated over an area of 1542.16% ha. The other crops are chillies, banana, turmeric and coriander which are grown only in some pockets. The major food crop grown are cereals and millets (paddy, Cholam, Samai, Thenai and Varagu) which are cultivated in larger area.

Cropping pattern:

a) Single crop		Season
Tapioca	-	April - March
Turmeric	-	May - June
Paddy	-	June - July
Chillies	-	June - July
b) Double crop:		
Paddy	-	June - July
Paddy	-	November - December
Ragi	-	June - July
Ragi	-	September - October
Paddy	-	June - July'

Ragi	-	November - December
Chillies	-	May - June
Coriander	-	December - January

9. GENERAL CONSTRAINTS:

The farmers are raising only local strains of a paddy under rainfed conditions. Improved strains are not grown because of costly inputs involved and lack of proper management facilities like availability of plants. protection equipments etc., for controlling pests and diseases.

SOCIO - ECONOMIC CHARACTERISTICS OF THE TRIBAL:

The tribals who live in all these villages are 'Malayalis'. The Malayalis in this region are well built and sturdy and capable of doing hard work. They are basically agriculturists. They raise crops like ragi,, cumbu, cholam, thenai, samai, horsegram and beans. The soil is well suited for growing fruit trees like guava, jack, mango, lime, pineapple, pomegranate and banana. Generally the Literacy rate is poor and mostly the literates are in Malayalam Patty which is the plains.

SOCIAL ACTIVITIES:

They speak Tamil with a slang and worship only the ordinary gods of the low country. All the sections of the community agree in saying that they are vellalas also emigrated from Kancheepuram to these hills bringing with them their God Hari Raman. Marriages take place either before of after puberty. widows are free to remarry. The dead are generally buried. In the case of Jagvidars, They are burnt. Pongal is celebrated with great pomp. They like games like hunting. The malayalis themselves do the puja and religious feeling among them seems to be very strong. The tribals have it as a custom to use country drinks during marriage and festivals.

P A C H A M A L A I H I L L S

1. DELINEATION OF THE AREA:

Pachamalai hill is situated in the two districts of Salem and Trichy of Tamil Nadu. The hills lie between 78.31' Longitude and 11.28' latitude. The total geographical area is 14,122 ha. There are two villages in Gangavalli block of Salem district and 17 and 34 villages respectively in Uppiliapuram and Thuraiyur blocks of Trichy district.

2. PHYSIOGRAPHY:

Generally the elevation of Pachamalai ranges from 1000 metres above MSL to 1200 metres. This has wooded Jungle with dense forests.

3. CLIMATE:

A Sub - tropical climate prevails with a maximum temperature ranging between 23 to 31°C, And a minimum temperature range of 12°C to 18°C. The annual rainfall varies with years. A maximum of 1250 mm. had been recorded so far in the past ten years. Generally Maximum amount of rainfall is received only during Northeast monsoon (i.e.,) in the months of September, October and November. Southwest monsoon rains are received during the months of June, and August. The northeast monsoon rains are however more dependable

4. SOILS:

The soils are classified as hill soils. The surface soil is reddish brown to dark yellowish brown in colour with a texture ranging from loam to clay loam; soil depth is about a meter and the soil reaction is near neutral (6.5).

5. LAND USE PATTERN:

The total area of pachamalai is 14, 121 ha. out of this 3470.22 hectares are not available for cultivation, which work out to 24.5%. In the remaining area, forests occupy 3806.92 ha. (26.96%)/

6. IRRIGATION:

Totally there are about 150 wells used for irrigating about 150 ha. Generally most of the crops are grown as rainfed in the revenue village Pachamalail, where as in the Veyppedi revenue village, the crops are grown mostly as irrigated. The water table is at 6 to 8 meters. The net area irrigated is about 150 hectares.

7. MAJOR CROPS / CROPPING PATTERN / CROPPING SYSTEM:

Paddy,	Thenai,	Samai, Ragi,
Paddy,	Cumbu,	Gingelly,
Paddy,	Ragi,	Samai ,
Fruit trees,		

Dry Paddy is the major crop. Only local variety is grown in this hill. Among the fruit trees. Seedlings of guava, Cashew, mango, Jack, lime, oranges, and coconut have been tried. The farmers are very much reluctant to take up new ventures, even though these plants are supplied at subsidized rates by the Governments. Previous experience and knowledge of management aspects in these crops are lacking among the farmers.

GENERAL CONSTRAINS:

Transport facility is not fully developed. Marketing facilities, introduction of high yielding milch animals, sheep breeding, poultry rearing are to be taken up for large scale development. Providing agricultural implements on subsidized rates could also be considered.

Benefits of contour bunding etc., will not only improve the soil but maintain the soil fertility and in turn increase the yield of crops in general.

SOCIO - ECONOMIC CHARACTERISTICS OF THE TRIBALS:

The tribals who live in Pachamalai hills are Malayalis. They are forest dwellers. The tribals are engaged in economic activities such as collection of walnut, tamarind etc., several of them also work as landless farm labourers. The villages are scattered all over the hills. They are generally very backward and with very low literacy rate, Their income is very low which is earned mainly from the soil proceeds of tamarind and walnut, Agriculture is primitive.

Due to poverty and illiteracy they suffer from malnutrition and other ailments like cold, cough, etc., Children are the worst sufferers due to malnutrition and undernutrition. Personal hygiene and environmental sanitation are far from satisfactory, The general condition of the livestock is also poor. The housing condition in this area covered is deplorable and particularly during the monsoon, life becomes miserable, The tribals usually carry their produce by head loads to the nearest market centre. This area has got considerable forests resources. The forests are of the evergreen and mixed deciduous. type forest produce like sandal, walnut, etc., are valuable. The main field crops grown are paddy, ragi, cholam, cumbu, maize, thenai, samai, lablab, beans, gingelly, horsegram, redgram and varagu. Vegetable such as tomato, brinjal and beans are also grown. Fruits that are grown extensively are varieties like mango, guava, banana, Jack and lemon,

SOCIAL ACTIVITIES:

Patriarchal system is prevalent. The father is the head of the family and only sons inherit property. Marriages are endogamous. Monogamy is often the case. Widow marriage is permitted. Women enjoy equal freedom with men. The tribals of this hill have a well organised and tradition bound system of tribal administration.

Y E L A G I R I & J A V A D H U H I L L S

1. DELINEATION OF THE AREA:

Yelagiri and Javadhu hills are within the district boundaries of Vellore District. the Yelagiri hills is situated in the Jolarpet Panchayat Union of Thirupattur taluk, surrounded in the north, west and south by Vaniambadi taluk, This hill is situated 92 km. east of vellore and 30 km. West of Tirupattur. It has only one revenue village namely Athanavoor with thirteen hamlets. It has an area of 51 square km.

Javadhu hills are spread over five taluks namely Thirupattur, Vaniambai, Vellore, Polur and Chengam. It is surrounded in the North by Thirupattur and vellore taluk and in the Southwest and west by part of Thirupattur taluk. This hill lies between 78.35* and 79.35* East longitude and 12.24* and 12.55* North Latitude with an area of 2405 square km. It has fifty revenue villages. Government of Tamil nadu in G.O.Ms.No.598, Rural Development dt.29.07.85 have constituted a new Panchayat Union by name Jamunamarathur Panchayat Union comprising of all the hill and tribal villages of Javadhu Hills with head quarters at Jamunamarathur Mainly for the welfare of the Hill tribes of Javadhu hills. It is 54km. west of Tirupattur via. Alanagayam.

2. PHYSIOGRAPHY:

The Yelagiri hills situated in Jolarpet Panchayat Union of Tirupattur taluk, have a district geographical unit and have an elevation of about 1411m. It has an area of 51 square km. of which 3297.68 ha. are under reserve forest. The hill villages are situated mostly at an elevation of 1889 meters.

The Javadhu hills have an elevation of 762 meters. The highest points in this hills are pattimals Vellanda Ponmalai and Pudur Nadu which have an elevation of 1094 meters.

The hill has an area of 2405 square km. of which forests constitute 14 percent. The Javadhu hills contain sandalwood trees which grow widely due to the favourable topographic situation. In the Plateau Region of Kavaloor, an astronomical observatory has been established which is the biggest in southeast Asia.

3. CLIMATE:

The temperature of Yelagiri hills during summer (April) reaches 27*c and the minimum temperature goes down in winter (December - January) to 11*C. It is comparative dry climate with low humidity of 45-50. The mean annual rainfall for Elagiri hills is 1026.16mm. with maximum of 131.8 mm during South West monsoon and 333.7 mm during Northeast monsoon. Javadhu hills enjoys an equable climate . During the cold season there is a substantial amount of dewfall which generally benefits the vegetation. The mean maximum temperature is 36.6*C Minimum temperature ranges from 20.7*C to 26.0*C, The mean annual rainfall for javadhu wills is 1100.85 mm with 480mm in south west monsoon (June - September) and 429mm in North east monsoon (October - December).

4. SOILS OF YELAGIRI AND JAVADHU HILLS:

About 50 percent of the land area is red loam clay and sandy soil, roughly constituting 13 and 12 percent respectively, This type of soil is derived basically from felspar and hormablend. In this plateau regions near Kavaloor and Nellivasal in Javadhu hills, the soil is derived basically from felspar and hormblend and the soil is fairly loamy. In the valleys near Paramanadal and Channasamudram, the soil is clayey. It has been observed that mineral resources such as Sulphides, Quartz,Haryte, apatite and vermiculite occur in areas adjoining Tirupattur units of these hills.

5. LAND USE PATTERN:

An area of about 21443 in the Javadhu hills (77.2 percent of the area of situations under gross cropped area nearly 7.9 percent of the area (2219 ha) is under gross cropped area. (Annexure) 61.08 percent of the area (3297 ha) is under forest.

6. IRRIGATION:

These hills are not served by any perennial rivers. However, in Javadhu hills, Cheyyar drains into the central and southern parts of the region. There is a tributary of this river which drains on the eastern side. On the western portion, there are quite a few small streams, similarly in the northern portion there is a small river called Kamandala nadhi. But major cultivated area of these region depend upon rains. the Javadhu hills about 227091 ha. and in yelagiri hills about 247ha. are irrigated through wells.

7. LAND HOLDING PATTERN, POPULATION AND SOCIO-ECONOMIC CHARACTERISTICS:

The small and marginal farmers in Jamunamarathur own 56.63 percent of the total holdings and in Yelagiri (Jolarpet) own 62.39 percent of the total holdings. In Jamunamarathur Panchayat Union, 91.73 percent of the total population belong scheduled caste and scheduled tribes. 88.47 percent to scheduled tribe who are called as Malayalis. They live in 260 tribal villages. In Yelagiri hills (Jolarpet) 58.40 percent belong to scheduled caste and scheduled tribes. Among the working population are workers and 14.99 percent are agricultural labourers. In Yelagir., 20.96 percent are workers, 12.71 percent are agricultural labourers and 66.3 percent are cultivators.

Malayalis are the predominant hill tribes of this area. The literacy rate is 6.3 percent. They live and lead a primitive life Hindus by religion, they have an unique social life. They earn their livelihood mostly from agriculture and animal husbandry. Collecting and selling forest produce also form a major occupation. Few tribals are engaged as informers by

the Forest Department to prevent Sandalwood pilferage from Javadhu Hills. There is a high incidence of STD and other skin infection among the tribals.

8. MAJOR CROPS / CROPPING PATTERN / CROPPING SYSTEMS:

In the Javadhu hills, farming is mainly done under rainfed conditions. The Major dry crops are samai, thinai, ragi, paddy., groundnut. Few other crops like sugarcane, Vegetable, and groundnut are cultivated by well irrigation. In Yelagiri hills, major rainfed crops are samai thinai, mango, citrus and vegetables are grown. Minor Forest produces like galnuts, wood apple, avaram, soapnut, nellikkai, surul bark etc, and obtained.

The main cropping systems are as follows:

Javadhu Hills:

Jamunamarathur

a) Single Crop:

Sugarcane 0.2 % (June - July)

Perennial fruit plants 2.52%

b) Double crops:

- | | | | |
|----|-----------|---|--------------------|
| 1. | Paddy | - | June - July |
| | + | | |
| | paddy | - | December - January |
| 2. | Paddy | - | June - July |
| | + | | |
| | Groundnut | | |
| | Ragi | - | December - January |

Rainfed:

- | | | | |
|----|-----------------------|---|--------------------|
| 1. | Samai | - | June - July |
| | Ragi | - | December - January |
| | + | | |
| | Pules | - | |
| 2. | Samai | - | June - July |
| | + | | |
| | Niger | | |
| | Horsegram | - | December - January |
| 3. | Vegetables | - | June - July |
| | + | | |
| | Vegetables (Pumpkin)- | | December - January |

Yelagir Hills:

a) Single Crop: :Sugarcane (June -July) 0.9%
Perennial fruit plants. 8.18%

b) Double crops:

- | | | | |
|----|-----------|---|--------------------|
| 1. | Paddy | - | June - July |
| | + | | |
| | paddy | - | December - January |
| 2. | Paddy | - | June - July |
| | + | | |
| | Groundnut | - | December - January |

Rainfed:

- | | | | |
|----|---------------|---|--------------------|
| 1. | Samai | - | June -July |
| | Ragi +Pules | - | December - January |
| 2. | Samai + Niger | - | June - July |
| | Horsegram | - | December - January |
| 3. | Vegetables | - | June - July |
| | + | | |
| | Vegetables | - | December - January |

GENERAL CONSTRAINTS:**Inadequate transport facilities:**

Jamanamarathur is the head quarters of the Jamunamarathur Panchayat union, comprising of all the tribal settlements in Javadhu hills, but the transport facilities are very much limited. Transport is one of the main constrain for its development. Bus services are not very frequent. Hence it is very difficult for the farmers to bring their produce especially vegetable and fruits to the market in the plains. In yercaud hills also, transport is a constraint, But thanks to the tourism industry. The farmers in Yercaud are able to get better price for their fruits compared to Javadhu hills,

Lack of Irrigation:

Major area of these hills are under rainfed condition.

Lack of Marketing facility:

LAMPS (large Area Multi - Purpose cooperative Societies) are functioning in Yelagiri and Javadhu hills.

Illiteracy:

Illiteracy is a serious problem among the tribal farmers.

Linkages with Research and Extension:

For improving the Socio - economic condition of the Hill Tribals of Javadhu Hills, a separate Panchayat Union comprising of all the tribal village of the Hills had been formed on 29.07.85 with Jamanamarathur as its head quarters.

The Khadi and village Industries Board have established sub units in Javadhu hills and Yelagiri hills under the Integrated Tribal development programme. Training given for bee keeping. Tamarind fruit processing. Carpentry and bamboo basket making. Bee keeping societies have been formed on cooperative basis enlisting the tribals as members, thus boosting tribals economy by providing technical know - how.

Hill Tribes - their Characteristics:

“Malayalis” are the predominant hill tribes living in the hills of Yelagiri and javadhu Hills. Their main profession is agriculture, animal husbandry and collection of minor forest produce.

The staple food for most of the tribals is ‘thinai’ and ‘samai’

The Malayalis are in the habit of spending large sums on social functions. Such social customs render the average man is indebted to the middlemen.

P O T H I G A I H I L L S

1. **DELINEATION OF THE AREA:**

Thus Pothigai hills are situated in Tirunelveli District, And traditionally called as “Agasthiya Malai” . This hill zone lies between 8.25* and 9.10 of the Northern Latitude and 77.89 and 78.25 of the Eastern longitude. It is flanked by the kanyakumari District in the south. by the ranges of Eastern ghat with the kerala state on the west.

2. **PHYSIOGRAPHY:**

The prominent hills are part of the Western Ghat and form the boundary between Kerala state and this district of Tirunelveli on the western side. The Altitude of Pothigai hills is 6132 ft.

3. **CLIMATE:**

The Climate in this hill sub - zone is equitable. Thousands of people from all over Tamil nadu and even from other states visit the famous courtallam falls during June -August to enjoy in the showers of the waterfalls (Sara).

Minimum temperature is 14C during January and the maximum is 34 c during may. The humidity is 65-80% during October November and below 60% during January - march.

This hill receives rains both the monsoons. The average rainfall in the hills at shenkottai and at Ambasamudram is around 1400 - 2000 mm. Around 65% of the rainfall is receive during North East ,monsoon.

4. **SOILS:**

The hills areas comprises of two major groups of rocks viz. the knondalities and the charnockites with pyrozeno granulites and the associated migmatistic rocks. Bands of quartzites and crystalline limestones occur with the geneiss and are found around Ambasamudram.

In Shengottai, deep red soils, in patches on hill slopes and mountains are formed. In Ambasamudram Sandy loam to loam in texture due to alluvium deposits are found which are acidic in reaction.

5. LAND USE PATTERN:

An area of 1603 .08 (37.82% of the area is under gross cropped are . Nearly 12.01% of the area is under forest. In Shengottai 38.47% of the area is under gross cropped area and in Ambasamudram 37.45% of the area is under gross cropped area.

6. IRRIGATION:

Tambaraparni river has its origin in the western Ghats. The Chittar river originates in the Shengotai hill region, Which is the source of supply for the waterfalls at courtallm, join the Tambaraparaini near Tiruneleveli. It runs for a distance of 120 km. in the district before it reaches the sea. The riven get water from both south west and North East monsoon and is never dry. The water is used for generating hyeroelectric power at Pabanasam.

7. LAND HOLDING PATTERN, POPULATION AND SOCIO-ECONOMIC CHARACTERISTICS:

Small and marginal farmers own 90.24 percent of the total holding of the total working population 9.25 percent are cultivators and 10.24 percent are agricultural labourers.

8. MAJOR CROPS / CROPPING PATTERN / CROPPING SYSTEM:

Perennial plantation crops like coffee, cardamom and tea occupy major areas in this zone. paddy vegetables, fruit crops are also grown in the hill slopes and near the plains. Tea is the major crop in Jamin Singampatty and Vikramasingapuram areas.

9. GENERAL CONSTRAINTS:

Heavy winds during May -June affect the tea plants. Heavy rains affect tea during December. The soil is very poor with sandy and gravelly loam. The water table goes down very low during summer. Average production of tea is around 2500 kg per ha. Whereas in Anamalais it is 400 kg per ha. Pepper is being cultivated but they are getting only around 500 gm. Per wine compared to 3 kg in Kerala. It is due to poor soil and lack of rain.

M E G A M A L A I H I L L S

1. DELINEATION OF THE AREA:

The sub-zone of Megamalai region consists of Megamalai Hills, Highways estate, Manalar Estate and Venniar Estates of the Tea Estates of India, Megamalai Villages and Highways Township. This sub-zone lies in two taluks of Uthamapalayam and Periyakulam of Theni District. The elevation of the Hill range from 290 to 1980 M. MSL.

2. PHYSIOGRAPHY:

Stretching between the Surliar river on the west and Vaigai river on the East in Periyakulam taluk, bordering Kerala on the South near Thekkadi and Periyar wild life sanctuary, this zone extends up to Surli Forest and Gandamanaickanur Reserve Forest on the North and Northeast. The two main rivers in this zone are surliar river on the west and Vaigai river on the East. Legend says that ‘Kannagi’ the heroine of the great epic Silappathigaram, travelled to Kerala above Gudalur from Madurai through the river banks of Vaigai. On the west, the Surliar river is joined by Veeravan river from Thekkadi and passes through Megamalai. There is a storage dam at Surliar Lower camp situated in the Tea Estate of India viz., Highwavys Estate.

3. ELEVATION:

The elevation of the Hilly region in this zone varies from 1000m to 1800mt. Megamalai lies in Kadamalaigundu Mayiladumbarai, Panchayat Union of Periyakulam Taluk. The tea estates of India has an assigned area of 4297.5 ha. in Narayanathevanpatty village of Cumbum panchayat union in Uthamapalayam taluk.

4. CLIMATE:

This zone is sub tropical with cool climate during winter months, the temperature going down to 6 *c during December - January. The maximum temperature goes upto 32*C during April.

The average humidity is from 40 to 100%. Wind is normal throughout the year but high velocity is experienced during July - August. This high velocity has been considered as one of the constraints by the tea planters.

The mean annual rainfall in Megamalai hills is 745.91mm of which 64.00 percent is received during Northeast monsoon.

5. SOIL:

The soil texture in Megamalai hill region is loamy with 20 to 120 cm. depth. In the hilly region, the top soil appears to be black because of the high humus content. Below the depth of 15cm. the soil is red load. Depth of the soil varies from 60cm to 120cm. The slope ranges from 20 to 50 percent which encourages soil erosion.

6. LAND USE PATTERN:

The total geographical area in this Hilly situation is 31,165.65 hectare of which 5196.5 hectare (16.67%) is the net cultivable area. The current fallows account for 2.3 percent. The major crops are perennial in nature of which tea is cultivated in 1042.5 ha followed by spices with 1981 ha. and medicinal and aromatic plants in 825 ha.

7. IRRIGATION:

Of the total net area cultivated only 536 ha. (12.3%) is under well irrigation in Megamalai villages. The rest are under rainfed cultivation. In the hill slopes of the tea estates of India moderate rainfall is uniformly distributed during the / year which helps for normal tea growth.

LAND HOLDING PATTERN, POPULATION AND SOCIO-ECONOMIC CHARACTERISTICS:

Out of the 315 holdings in Megamalai villages, among the 3955 persons in this village, sheduled caste constitute 23.48 percent and sheduled tribes constitute 7.2 percent. They are Phalias and most of them are agricultural laborers. Cultivators constitute 14.97 percent, agricultural labourers constitute 64.66 percent and 20.35 percent are workers of different categories.

MAJOR CROPS AND CROPPING PATTERN / SYSTEMS:

The major crops grown in this region are perennial in nature. They are tea, coffee, spices, citrus, banana and vegetables. Medicinal and aromatic plants are also grown in smaller area in Megamalai village.

GENERAL PRODUCTION CONSTRAINTS:

High velocity of wind during the month of June-July affects the crop. In addition to high velocity of wind, adverse climate conditions like excessively of rain, forest bite affect the yield. The rains during the monsoon periods leads to soil erosion.

TRIBAL POPULATION:

Phalias the nomadic and semi-nomadic tribals of this region whose population is above 300 and are living in the following villages. They are Pommorasapuram, Koodamparai and

Elumbukkadi of Megamalai Panchayat. They work as Agricultural labourers in the nearby plantations.

WESTERN GHAT DEVELOPMENT PROGRAMME:

Soil conservation measures have been undertaken by Agricultural Engineering Department under Western Ghat Development programme for Megamalai hills with Head quarters at Chinnamanur.

HILLY AND TRIBAL ZONE

STATUS REPORT – 2001

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