

# DIVERSIFICATION OF CROPS AND CHEMICAL POLLUTION: A CHALLENGE TO THE SUSTAINABILITY OF THE AGRO-BASED ECONOMY OF KASARAGOD DISTRICT OF KERALA

**N. Karunakaran\***

*Kerala in general and Kasaragod district in particular is an agro-based economy and a major portion of the labour force is working in agriculture and related activities. The statistical profile of Kasaragod clearly revealed crop diversification in the district. Diversification of crops and the subsequent application of chemical fertilizers and pesticides heavily result in the depletion of inherent nutrients of the soil and also create chemical pollution. There is wide difference in the recommended and actual application of chemical fertilizers and pesticides. This creates imbalance in the environment have serious consequences on the farm sector and the health of the farmers is a challenge to the sustainability of the agrarian economy of Kasaragod district of Kerala.*

**Key words:** Kasaragod; crop diversification; chemical pollution: sustainability.

## INTRODUCTION

Kasaragod in Kerala is predominantly an agriculture oriented district. The cropping pattern scenario of the district shows that in terms of their claim on total cropped area, the leading crops in the district were rice, coconut, arecanut, rubber, pepper, cashewnut, tapioca, ginger, banana and other plantains. Together they accounted for 91.67 percent of the gross cropped area.

During 1985-86 the order of the first five crops were coconut, cashewnut, rice, rubber and pepper, in the descending order of shares to the total cropped area. At present, they are coconut, rubber, arecanut, cashewnut and pepper. Rubber came to the second position by pushing rice to the sixth. Coconut, rubber and arecanut together constituted 80 percent of the total cropped area. This change in cropping pattern reflects shift from subsistence cropping to commercial cropping and leads to diversification in agriculture.

This also creates imbalance in the agricultural system have major economic and environmental consequences on the farm sector and the sustainability of the agrarian economy of the district requires serious consideration. The ever-widening supply gap in food grains (Karunakaran N, 2015), the increasing conversion of paddy lands, the filling of paddy lands and the expansion of rubber (Srikumar Chattopadhyay, 2015) will bring out the main thrust of the ecological transformation that is experiencing today. Diversification of crops and the consequent application of chemical fertilizers and pesticides heavily result in the depletion of inherent nutrients of the soil. There is wide concern on the deterioration of surface and groundwater quantity and quality (Karunakaran N, 2014). Hence it is felt that an analysis of diversification of crops and chemical pollution and its consequences on the farm sector and the health of the farmers in the agrarian economy of Kasaragod district is very relevant in the context of the sustainability of Kerala.

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\* Head of the Post Graduate Department of Economics, EKNM Government College Elerithattu, Elerithattu-671314, Nilishwar, Kasaragod, Kerala, India, E mail: [narankarun@gmail.com](mailto:narankarun@gmail.com)

## METHODS AND DATA

The study used secondary and primary data. The major sources of secondary data are various published reports of the Department of Economics and statistics and State Planning Board, Government of Kerala, Thiruvananthapuram.

To know whether there is over use of chemical fertilizers and pesticides in the Kasaragod district, data on the difference between suggested dose and actual used doses of chemical fertilizers to various crops (paddy, coconut, arecanut, cashewnut, rubber and banana) were collected using primary data. In the district six panchayaths were selected for data collection: Vorkady panchayath for paddy, Panathady panchayath for coconut, Karadka panchayath for arecanut, Enmakaje panchayath for cashewnut, West-Eleri panchayath for rubber and Mangalpady panchayath for banana; where these crops were largely cultivated. A total number of 210 farmers were interviewed to get information on the total quantity of NPK fertilizers used, lime used, pesticides applied and organic manure consumed in their respective farms or plants and also to get information on various health issues due to Endosulphan use. On the basis of this average actual dose of chemical fertilizers (NPK), lime and organic manures applied by farmers for paddy, coconut, arecanut, cashewnut, rubber and banana plants were worked out.

Herfindahl Index (HI) is used to measure the extent of crop diversification and is calculated by taking sum of squares of acreage proportion of each crop to the total cropped area.

$$HI = \sum_{i=1}^N p_i^2$$

Where, N is the total number of crops and  $P_i$  represents acreage proportion of the  $i^{th}$  crops to total cropped area. Herfindahl Index is a measure of concentration and Diversification Index (DI) is calculated by subtracting it from one.

$$\text{Diversification Index (DI)} = 1 - HI$$

Proportional Morbidity Ratio and Average Monthly Health Cost and Benefit Ratio were also used in the study. Proportional Morbidity Ratio is in percentage terms and is calculated by dividing the particular number of ill affected persons with total number of victims. The average monthly health cost and health benefit ratio per individual level is calculated by dividing per monthly health benefit with average monthly health expenditure of each victim.

## CROP DIVERSIFICATION IN THE KASARAGOD DISTRICT

Diversification is an integral part of the process of structural transformation of an economy. Diversification in agriculture can mean any of the three situations: (i) A shift from farm to non-farm activities, (ii) A shift from less profitable crop to more profitable crop, (iii) Using resources in diverse but complementary activities (Vyas, 1996). On a whole, crop diversification is a process, which helps the grower to improve percapita income and diffuse risk. On the other hand it provides more diversified food items to the consumers. It minimizes the risk associated with production of single crop and helps the farmers to liberate from the poverty trap (Deshpande, 2000).

**Table 1. Changes in the Area Under Major Crops in Kasaragod District**

Sl. No.	Year	Rice	Coconut	Arecanut	Rubber	Pepper	Cashewnut	Tapioca	Ginger	Banana and plantains
1	1985-86	22336	34977	8907	13200	9267	28397	5520	557	1824
2	1990-91	14292	44334	12269	18308	6803	24739	2433	166	2466
3	1995-96	11659	60197	12710	19280	6625	24560	1485	170	3027
4	2000-01	9158	59073	13515	22232	6229	20448	1373	139	3539
5	2005-06	6030	58088	17622	25374	6672	18068	576	56	3305
6	2006-07	5323	58236	14910	26620	6657	14518	503	60	3192
7	2007-08	5164	57057	15060	28230	6660	11667	452	65	2801
8	2008-09	4991	52266	14927	29380	5407	9487	245	17	2098
9	2009-10	4394	54224	15256	30624	4764	8205	389	22	2177
10	2010-11	4155	56174	18039	31740	6830	6803	335	22	2283
11	2011-12	3857	59656	19552	32650	2729	8250	292	23	2459
12	2012-13	3514	58836	18937	32650	2707	7981	274	20	2494
13	2013-14	4205	61836	19488	33705	2927	7811	331	29	2504

Area in hectare.

Source: - Computed from (i) Statistics for planning (various issues), Department of Economics and Statistics, Govt. of Kerala, Thiruvananthapuram. (ii) Economic Review (various issues), State Planning Board, Govt. of Kerala, Thiruvananthapuram.

Crop diversification acquires special significance in Kerala because of the ecological and environmental problems and strain on natural resources associated with the green revolution technology and difficulty in sustaining growth in output and income. Crop diversification refers to the competition among the growing crops in a region. The keener the competition, the higher the magnitude of crop diversification, and the lesser the competition, the greater will be the trend towards crop specialization or monoculture farming, where emphasis is on one or two crops.

The cropping pattern scenario of the district for the period 1985-86 to 2013-14 has been shown in Table 1. In terms of their claim on total cropped area, the leading crops in the district were rice, coconut, arecanut, rubber, pepper, cashewnut, tapioca, ginger, banana and other plantains. It would be noted that percentage of area under rice, tapioca, cashewnut, pepper and ginger has shown decreasing trend and other crops has shown increasing trend during the different years. In recent years, rubber seems to be replacing rice and other crops in the midland and highland areas.

**Table 2. Land Use Pattern in the Kasaragod District in 2013- 14.**

Sl. No.	Classification of Area	In percentage
1	Total Geographical Area	100.00
2	Forest	2.82
3	Land put to non-agricultural use	13.7
4	Barren and uncultivated land	3.97
5	Land under miscellaneous tree crops	0.30
6	Cultivable waste	5.09
7	Fallow other than current fallow	0.93
8	Water logged area	0.01
9	Social forestry	0.07
10	Still water	2.06
11	Net Area Sown	71.27
12	Area sown more than once	1.49
13	Total Cropped Area	72.76

Source: - Computed from Agricultural Statistics (2013-14), Department of Economics and Statistics, Govt. of Kerala, Thiruvananthapuram.

To analyze the extent of crop diversification in the district, the status of land utilization pattern is examined and is shown in Table 2.

**Table 3. Cropping Pattern According to Land Use Statistics in Kasaragod District  
(Percentage to Total Cropped Area)**

Sl. No.	Crops	1985-86	1990-91	1995-96	2000-01	2005-06	2013-14
1	Rice	16.19 (3)	10.08 (4)	7.39 (5)	5.94 (5)	3.89 (6)	2.90 (6)
2	Coconut	25.35 (1)	31.28 (1)	38.15 (1)	38.33 (1)	37.52 (1)	42.67 (1)
3	Arecanut	6.46 (6)	8.65 (5)	8.05 (4)	8.77 (4)	11.38 (4)	13.45 (3)
4	Rubber	9.57 (4)	12.92 (3)	12.22 (3)	14.42 (2)	16.39 (2)	23.26 (2)
5	Pepper	6.72 (5)	4.79 (6)	4.19 (6)	4.04 (6)	4.31 (5)	2.93 (5)
6	Cashewnut	20.58 (2)	17.45 (2)	15.56 (2)	13.26 (3)	11.67 (3)	5.39 (4)
7	Tapioca	4.00 (7)	1.72 (8)	0.94 (8)	0.89 (8)	0.37 (8)	0.23 (8)
8	Ginger	0.40 (9)	0.12 (9)	0.11 (9)	0.09 (9)	0.04 (9)	0.02 (9)
9	Banana and other plantains	1.32 (8)	1.74 (7)	1.92 (7)	2.29 (7)	2.13 (7)	1.73 (7)
10	T C A	100.00	100.00	100.00	100.00	100.00	100.00

Figures in bracket shows rank

Source: - Computed from (i) Statistics for planning (various issues), Department of Economics and Statistics, Govt. of Kerala, Thiruvananthapuram. (ii) Economic Review (various issues), State Planning Board, Govt. of Kerala, Thiruvananthapuram.

Table 3 reveals the decline in the percentage of area under food crops and increase in the non-food crops. During 1985-86 to 2013-14 percentage shares of food crops like rice and tapioca declined tremendously; whereas non-food crops like rubber, coconut, arecanut, etc, improved. The picture in Table 3 clearly reveals that there has been diversification of crop area away from food crops to non-food crops and is a clear evidence of substitution of area from food to non-food crops.

**Table 4. Crop Diversification Indices for Kasaragod District in Different Years  
(1985-86 to 2013-14)**

Sl. No.	Year	Crop Diversification Index
1	1985-86	0.848 (0.152)
2	1990-91	0.858 (0.142)
3	1995-96	0.861 (0.139)
4	2000-01	0.863 (0.137)
5	2005-06	0.866 (0.134)
6	2009-10	0.869 (0.131)
7	2012-13	0.872 (0.128)
8	2013-14	0.874 (0.126)

Figures in bracket shows Herfindahl Index

During 1985-86 the order of the first five crops was coconut, cashewnut, rice, rubber and pepper, in the descending order of shares to the total cropped area changed to coconut, rubber, arecanut, cashewnut and pepper. Rubber came to the second position by pushing rice to the sixth. Table 3 clearly shows shift from food crops, mainly rice and tapioca, in favour of tree crops such as rubber, arecanut and coconut in the district, which was supported by the diversification index shown in Table 4. It may be observed that the transformed values of Herfindahl Index were lower in the initial years of study. This implies less diversification in the initial years and higher values in the later years, viz, 2005-06, 2009-10 and 2013-14; which indicates more diversification.

## CHEMICAL POLLUTION IN THE AGRICULTURAL SECTOR OF THE KASARAGOD DISTRICT

Table 5 shows the overuse of NPK fertilizers in the rubber plantations compared to suggested dose in the Kasaragod district. The analysis shows that crop diversification and expansion of rubber creates pollution in the soil is a serious challenge to the sustainability of the agro-based economy of the district.

### Chemical Pollution of Agricultural Sector Due to Endosulphan Use and Health Issues of Farmers in the Kasaragod District

In the different parts of Kasaragod district, the aerial spraying of Endosulphan on cashew plantations had begun from 1976 onwards. This toxic pesticide had been sprayed over cashew plantations located in panchayaths namely, Bellur, Muliya, Karadka, Kallar, Ajanur, Kumbadaje, Badiyadka, Kayyoor-Chemeni, Panathady, Enmakaje and Pullur-Periya.

**Table 5. Difference Between Suggested and Actual applications of Fertilizers to Various Crops in the Kasaragod District**

Crops Item	Paddy	Coconut	Arecanut	Rubber	Banana	Cashewnut
Lime	(-) 50.00	(-) 1.00	(-) 0.500	(-) 0.700	(-) 0.350	(-) 0.700
Deviation (in %)	(-) 16.67	(-) 66.67	(-) 71.43	(-) 100.00	(-) 58.33	(-) 100.00
NPK total	(+) 12.00	(-) 0.365	(-) 0.05	(+) 1.226	(+) 1.598	(+) 0.200
Deviation (in %)	(+) 7.36	(-) 15.43	(-) 11.11	(+) 158.40	(+) 113.98	(+) 25.00
Organic manure	(-) 1250	(-) 5.00	(-) 14	(-) 8.00	(-) 8.00	(-) 8.00
Deviation (in %)	(-) 50.00	(-) 20.00	(-) 58.33	(-) 80.00	(-) 80.00	(-) 80.00

In Kg per hectare for paddy and Kg per plant for other crops

Source: - Primary Data

The pesticide mixed with air, water and soil had polluted the environment which caused multiple health issues to human beings and animals. The health issues were first reported from Enmakaje Grama panchayath. Health problems which are complex, rare and no way to deal by local health facilities had been reported. It includes cancer, cerebral palsy, locomotors disabilities, mental retardation, deaf and dump, vision problems, skin disorders and other anomalies as shown in Table 6.

Table 6 gives details on Endosulphan health issues identified by the health department, government of Kerala in Kasaragod. A total of 2836 cases were identified with different complicated health issues in 2010. The officials of Special cell for rehabilitation of Endosulphan victims constituted at Kasaragod district has informed that at present there are 4107 Endosulphan cases with same diseases that mentioned in Table 6. Various local activists and members of local community claimed that now there are 9500 persons in Kasaragod district suffering from Endosulphan pollution.

**Table 6. Number of Health Cases Identified Due to Endosulphan Spray in the Kasaragod District.**

Name of Panchayath	Health problems												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Badiyadka	59	4	30	4	0	2	3	0	14	15	1	13	145
Bellur	24	4	36	16	9	15	2	2	7	25	7	13	160
Muliyar	42	6	23	7	5	17	1	19	11	9	11	15	166
Karadka	76	4	37	18	8	21	5	8	37	14	17	29	274
Kallar	88	4	32	4	31	18	13	19	34	21	36	102	402
Ajanur	74	3	15	6	17	15	2	10	14	10	23	59	248
Kayyoor-Chemeni	33	7	18	65	58	29	10	12	28	25	26	100	411
Panathady	113	0	36	11	30	4	8	30	35	15	17	52	351
Kumbadaje	54	1	25	22	9	7	1	27	9	14	6	26	201
Pullur-Periya	49	6	51	26	14	15	1	4	13	18	9	13	219
Enmakaje	56	23	61	35	12	10	1	6	28	11	9	7	259
Total	668	62	364	214	193	153	47	137	230	177	162	429	2836

Note: Health problems (1. Mental retardation, 2. Cerebral Palsy, 3. Locomotors Disabilities, 4. Multiple disabilities, 5. Other anomalies, 6. Mental illness, 7. Cancer, 8. Infertility, 9. Deaf and Dump, 10. Vision Problems, 11. Skin disorders, 12. Others).

Source: Govt. of Kerala (2010), Health department, Kasaragod district.

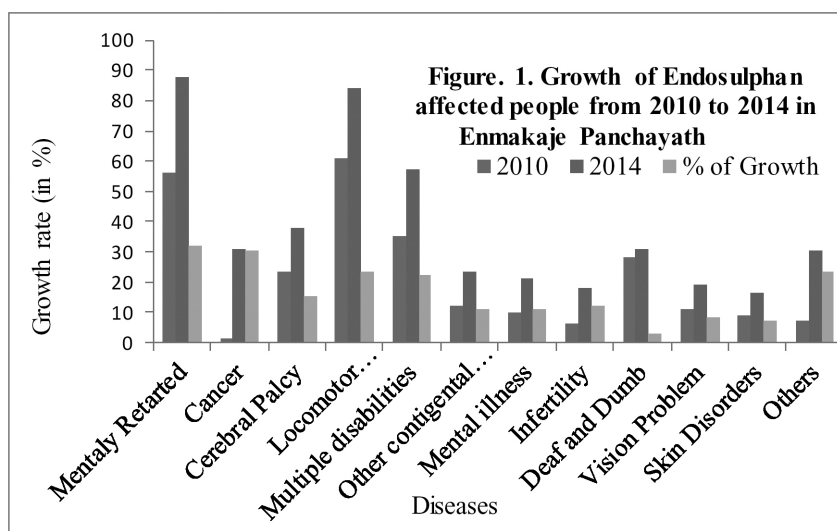
To analyze the severity of the issue among farmers, one panchayath in the Kasaragod district, where Endosulphan pollution is very high is used for detailed analysis. Table 7 and Figure 1 shows that in 2014 there are 466 Endosulphan affected persons with many health issues identified compared to only 259 in 2010, that is, 207 additional cases were reported.

**Table 7. Growth of Endosulphan affected people from 2010 to 2014 in Enmakaje Panchayath of Kasaragod**

Sl. No.	Disease category	2010	2014	Percentage growth
1	Mental retardation	56	88	57
2	Cancer	1	31	3000
3	Cerebral Palsy	23	38	65
4	Locomotors disabilities	61	84	37
5	Multiple disabilities	35	57	63
6	Other anomalies	12	23	92
7	Mental illness	10	21	110
8	Infertilities	6	18	200
9	Deaf and Dumb	28	31	11
10	Vision problem	11	19	73
11	Skin disorders	9	16	78
12	Others	7	30	329
	Total	259	466	80

Source: (1) Govt. of Kerala (2010), Health department, Kasaragod district and (2) Enmakaje Endosulphan field worker report, 2014.

From Table 7 it is seen that Enmakaje panchayath has 466 Endosulphan victims. Endosulphan victim means those who directly exposed to this pesticide either by air, water or soil; these are the major pathways of Endosulphan contamination into human body and suffering with any of illness such as mental retardation, locomotors, cancer and other health issues that seemed to have largely reported from the areas of Endosulphan spray misery as mentioned in Table 6. These health issues are primarily because of toxic effect of Endosulphan into human body particularly central nervous system, kidney, liver functions, skin, eye and other parts of human body.



Out of 466 persons the study identified and analysed 60 Endosulphan affected persons, 34 female and 26 male, who were mainly from the households of agricultural sector. These persons were selected from different places of Enmakaje panchayath like Kattukukke, Padre, Perla and Vaninagar.

The affected persons have lot of health problems like mental retardation, cancer, locomotors diseases, cerebral palsy, mental illness, deaf and dumb, skin disorders, vision problems and other multiple disabilities. Table 8 and figure 2 gives proportional morbidity ratio among Endosulphan affected persons in the study area.

**Table 8. Proportional Morbidity Ratio Among Endosulphan Affected Persons in the Study Area**

Sl. No.	Category of Disease	Endosulphan affected persons	Proportional morbidity ratio (in percent)
1	Mental retardation	11	18.33
2	Cancer	8	13.33
3	Cerebral palsy	7	11.66
4	Locomotors disabilities	16	26.66
5	Multiple disabilities	5	8.33
6	Mental illness	4	6.66
7	Deaf and dumb	2	3.33
8	Vision problem	4	6.66
9	Skin disorders	3	5.00
Total		60	100.00

Source : Primary data

From Table 8 it is evident that both mental retarded and locomotors cases combine 44 percent of total illness in the sample studied. Table 9 revealed the age wise composition of Endosulphan affected persons. 17 out of 60 are below the age of 15 indicates, 17 victims of children includes 7 mentally retarded, three locomotors, three vision problems two have cerebral palsy and two mentally ill. 5 cancer patients out of total 8 are in between the age of 30 to 60 and locomotors cases have been reported from all the age groups. Out of 5 multiple disable 3 are above the age 60. Only 2 deaf and dumb persons are in the age group of 30 to 60.

**Table 9. Age Wise Group of Endosulphan Affected Persons in the Study Area**

Age group (in years)	Category of health problem									Total
	1	2	3	4	5	6	7	8	9	
0-15	7	0	3	2	0	3	2	0	0	17
15-30	0	2	2	0	0	0	3	1	0	8
30-60	3	5	6	2	2	1	0	1	2	22
above 60	1	1	5	0	0	0	2	3	1	13
Total	11	8	16	4	2	4	7	5	3	60

Note: Health problems (1. Mental retardation, 2. Cancer, 3. Locomotors disabilities, 4. Mental illness, 5. Deaf and dumb, 6. Vision problems, 7. Cerebral palsy, 8. Multiple disabilities, 9. Skin disorders).

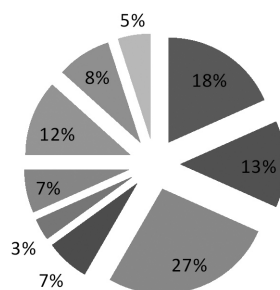
Source : Primary data

Table 9 shows that half of the Endosulphan affected persons in the sample fall in the category of age 15 to 60 and they are mainly farmers, which badly affect the ability to work, earn, consume and save among them. The rare and complicated health issues among them may significantly create a rise in health expenditure of these families.



**Figure.2. Proportional Morbidity Ratio among Endosulphan affected persons in the study area**

■ Mentally Retarded    ■ Cancer    ■ Locomotor Disabilities  
 ■ Mental Illness    ■ Deaf and Dumb    ■ Vision Problems



Out of 60 Endosulphan affected persons studied, 23 are excluded from receiving monthly health benefit. The monthly health benefit includes mainly pension amount that varies from Rs 1000 to 2700. Here average regular monthly health benefit is included that are somewhat fixed in nature. 7 victims of Endosulphan currently have no treatment; this does not mean they are completely cured. 16 have to bear the cost of health expenditure from their own personal disposable income. 19 people are experiencing the problem of inadequate health benefit. Their monthly health expenditure exceeds monthly health benefit. Only 18 victims are able to cover their monthly health expenditure by monthly health benefit.

**Table 10. Average Monthly Health Finance of Endosulphan Affected Persons in the Study Area Based on Morbidity.**

Sl. No.	Category of disease	No of victims have no health benefit	No of victims who bears more health cost	No of victims who bears more health benefit	Currently no treatment cases	Total
1	Mental retardation	3	6	2	0	11
2	Cancer	2	4	1	1	8
3	Locomotors	4	5	5	2	16
4	Multiple disability	2	2	1	0	5
5	Mental illness	2	0	2	0	4
6	Cerebral palsy	2	2	3	0	7
7	Deaf and dumb	0	0	1	1	2
8	Vision problem	0	0	2	2	4
9	Skin disorder	1	0	1	1	3
10	Total	16	19	18	7	60

Source: Primary data

The unavailability of adequate regular health benefit and increased nature of monthly health expenditure are the two problems identified from Table 10. This is particular in the case of chronic illness like cancer. From Table 10, it is evident that out of 8 cancer victims of Endosulphan, 2 have no health benefit and 4 of them fail to meet their rising health cost with low health benefit. This increased health cost and exclusion from attainment of health benefit is present in all diseases mentioned in Table 10 in connection with Endosulphan aerial spray and continuous chemical pollution in Enmakaje panchayath of Kasaragod district.

## CONCLUSION

Traditionally, Kasaragod district is agro-based and a major portion of the labour force is working in agriculture and related industries. During 1985-86 the order of the first five crops in Kasaragod district was coconut, cashewnut, rice, rubber and pepper, in the descending order of shares to the total cropped area; but in 2013-14, it is changed in the form of coconut, rubber, arecanut, cashewnut and pepper. This change in cropping pattern reflects shift from subsistence cropping to commercial cropping. It is also observed that the transformed values of Herfindahl Index were lower in the initial years of study and implies less diversification and higher values in the later years, viz, 2005-06, 2009-10 and 2013-14 indicates more diversification. It is also observed that the crops whose growth rate in area are increasing only in the case of rubber, arecanut and coconut. Taking into consideration the crops individually, rice, cashewnut, tapioca and ginger showed negative growth rate at increasing rate.

The diversification of crops away from food crops to garden land tree crops, analysed in terms of chemical pollution, revealed certain important results and findings in the sustainability of the agricultural sector of Kasaragod district. The analysis on the difference between the suggested dose and actual used dose of chemical fertilizers in the district revealed certain valuable issues and concerns associated with application of overdose or under-dose of fertilizers and chemical pollution:

- (i) The rubber and cashewnut cultivators in the sample area were not using lime for their plants. For coconut, arecanut and banana the usage was below 50 percent as suggested. Paddy farmers used 83 percent of the lime as suggested.
- (ii) All the farmers in the study area were using NPK total fertilizers rather than separate dosage as suggested. Rubber and banana farmers in the area are using over dosage of total NPK chemical fertilizers. Cashewnut farmers were using 20 percent more of the NPK fertilizers per plant of the dose recommended. The paddy cultivators in the area were using a margin of 12 Kg per hectare more of total NPK fertilizers as suggested. Coconut and arecanut farmers were using approximately the same amount of fertilizers of the suggested dose.
- (iii) All the cultivators in the study area are using organic manures in the form of farm yard manures like cow-dug, ashes, green leaf, etc and readymade organic manures. Paddy cultivators were using 50 percent of the suggested dose, coconut cultivators were using 80 percent of the suggested dose and arecanut farmers were using 42 percent of the suggested dose of organic manures; whereas the rubber, cashewnut and banana cultivators were using 20 percent of the suggested dose.
- (iv) Among six crops selected for study rubber and banana cultivators used overdose of chemical fertilizers and under use of organic manures and lime showing ineffective application of fertilizers compared to other four crops.
- (v) In the different parts of Kasaragod district, the aerial spraying of Endosulphan on cashew plantations had begun in different panchayaths, namely, Bellur, Muliya, Karadka, Kallar,

Ajanur, Kumbadaje, Badiyadka, Kayyoor-Chemeni, Panathady, Enmakaje and Pullur-Periya. The pesticide mixed with air, water and soil had polluted the environment which caused multiple health issues to human beings and animals. The health issues includes cancer, cerebral palsy, locomotors disabilities, mental retardation, deaf and dumb, vision problems, skin disorders and other anomalies. The analysis revealed the severity of the issue among farmers and in one panchayath selected for study in the Kasaragod district, 207 additional cases were reported between 2010 and 2014.

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