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Shift in Cultivation vs Sustainable Agriculture: Evidence from Kerala

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Abstract

The statistical profile of the Kerala agriculture since 1960 reveals a shift in cultivation in Kerala. This creates imbalances in the cropping system, which have serious economic and environmental consequences for the farm sector and the sustainability of the agrarian economy. A shift in cultivation and the subsequent application of chemical fertilisers and pesticides result in the depletion of inherent nutrients of the soil and create chemical pollution. There is wide concern on the quantity and quality of surface and groundwater. Sustainability has three important indicators: continued profitability, soil stability overtime and absence of adverse impact on the environment. In this context, the shift in cultivation and the sustainable agriculture are analysed in terms of soil fertility status, groundwater level, chemical pollution and total factor productivity growth, taking evidences from Kerala. The analysis shows that there are chemical pollution and decrease in soil fertility status, groundwater level and total factor productivity growth in the crop sector of Kerala.

Keywords

cultivation, sustainable agriculture, soil fertility, groundwater level, pollution, Kerala

Introduction

As per the data from the Directorate of Economics and Statistics, Government of Kerala, Thiruvananthapuram, the land put to agriculture in Kerala had almost reached a saturation point (Government of Kerala,

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2015). Together with forests, land devoted for agriculture stood at as high as 82per cent of the total geographical area (Karunakaran, 2015). The state of Kerala is very keen on making use of every bit of land. Another peculiarity is that where population density is very high, agricultural land is getting diversified and put to non-agricultural uses.

The agricultural development experience of the state since the 1970s has been characterised by a shift in cultivation. The area under food crops has decreased from 67 per cent of the total cropped area during 1960–61 to 12 per cent. But the situation is just the reverse in the case of non-food crops, which went up from 33 per cent to 88 per cent of the total cropped area. The agriculture scenario of Kerala thus indicates a heavy concentration of non-food crops. The dominance of perennial crops as against annual or seasonal crops and predominance of crops dependent on world market conditions are two main characteristics of the cropping pattern nowadays. The emergence of cash crops as a dominant sector over the last four decades is another notable feature of Kerala's agricultural development.

The main feature of the cropping patterns at present is a shift in cultivation: shift in the cultivated area under food grain crops for non-food grain crops, and a shift in the cultivated area under one non-food grain crop to another non-food grain crop. The statistical data on the area under major crops in Kerala depicts this feature. The area under paddy cultivation has decreased from 347,000 hectare in 2000–01 to 234,000 hectare in 2013–14, the area under coconut cultivation decreased from 925,000 hectare in 2000–01 to 778,000 hectare in 2013–14, the area under cashewnut cultivation decreased from 92,000 hectare in 2000–01 to 48,000 hectare in 2013–14 and the area under pepper cultivation decreased from 202,000 hectare in 2000–01 to 171,000 hectare in 2013–14, whereas the area under rubber cultivation increased from 474,000 hectare in 2000–01 to 575,000 hectare in 2013–14 (Government of Kerala, 2014a).

The statistical profile on agriculture since 1960 shows a shift in cultivation in the state. This creates imbalances in the agricultural system that have serious economic and environmental consequences for the farm sector and the sustainability of the agrarian economy of Kerala. The ever-widening supply gap in food grains has grown to alarming proportion of 85 per cent, creating irreversible threat on Kerala's food security (Karunakaran, 2014b). The increasing conversion of paddy lands, the filling of paddy lands and the expansion of rubber will bring out the main thrust of the ecological transformation of the state that Kerala is experiencing today (Chattopadhyay, 2015). A shift in cultivation and the consequent application of chemical fertilisers and pesticides result in the depletion of inherent nutrients of the soil. There are concerns on the deterioration of surface and groundwater quantity and quality. Hence, it is felt that some of the indicators of sustainable agriculture, like total factor productivity (TFP), soil fertility, groundwater resource and pollution, are most relevant in the context of the shift in cultivation and the sustainability of the agrarian economy of Kerala.

Shift in Cultivation in Kerala

During 1960–61, the order of the first five crops was rice, coconut, tapioca, rubber and pepper in the descending order of shares to the total cropped area. Table1 reveals that in 2013–14, the first five crops were coconut, rubber, rice, pepper and arecanut. Coconut occupied the second position in the area of cultivation during 1960–61, which in 2013–14 became the first and rubber the second. The main crops that were losing area between 1960–61 and 2013–14 were rice and tapioca. This change clearly established a shift from the traditional subsistence cropping to the recent commercial cropping, like coconut and rubber. From Table1, it is clear that among the four plantation crops, rubber has emerged as the most significant crop with largest area in the state next only to coconut.

Table 1. Shift in cultivation in Kerala (rank of each crop in the total cropped area)

Crops	*1960–61*	*1970–71*	*1980–81*	*1990–91*	*2000–01*	*2013–14*
Rice	1	1	1	2	3	3
Coconut	2	2	2	1	1	1
Areca nut	6	7	7	10	8	5
Rubber	4	4	4	3	2	2
Pepper	5	5	6	4	4	4
Cashew nut	6	6	5	6	7	9
Tapioca	3	3	3	5	5	7
Coffee	10	11	8	7	9	8
Tea	8	10	11	11	11	11
Cardamom	9	9	9	8	10	10
Ginger	11	12	12	12	12	12
Banana and other plantains	7	8	10	9	6	6

Table 2 reveals variations in cropping pattern in the state, decline in the percentage of area under food crops and increase in non-food crops. Between 1960–61 and 2013–14, the percentage share of food crops, like rice and tapioca, declined by 70 per cent, whereas non-food crops, like rubber, coffee, arecanut and pepper, improved to 328 per cent, 404 per cent, 83 per cent and 72 per cent. The figures in Tables 1 and 2 support the shift from food crops to non-food crops, mainly rice and tapioca, in favour of tree crops, such as rubber and coconut, in Kerala.

Table 2. Variation in the cultivated area of Kerala: 1960–61 to 2013–14 (in %)

Crops	*1970–71 over 1960–61*	*1980–81 over 1970–71*	*1990–91 over 1980–81*	*2000–01 over 1990–91*	*2013–14 over 2000–01*	*2013–14 over 1960–61*
Rice	12	–8	–30	–38	–33	–70
Coconut	44	–9	24	15	–15	55
Areca nut	58	–29	6	35	14	83
Rubber	46	33	73	15	11	328
Pepper	18	–8	56	19	–15	72
Cashew nut	89	38	–18	–20	–47	–10
Tapioca	21	–16	–40	–22	–35	–70
Coffee	88	84	29	13	0.1	404
Tea	–0.1	–4	–4	6	0.00	–2
Cardamom	66	14	24	–38	0.7	45
Ginger	1	4	11	–18	–53	–55
Banana and other plantains	9	1	33	52	–0.3	123
Other crops	7	12	14	3	–4	33

Shift in Cultivation vs Total Factor Productivity Growth in the Crop Sector of Kerala

The TFP growth in the crop sector of Kerala and different districts is shown in Table 3. It shows that only two districts, namely Idukki and Wayanad, observed more than one per cent growth in TFP during 1980–81 to 1989–90 time period; other 12 districts have less than zero per cent TFP growth. During 2000–01 and 2009–10, more than 71 per cent of the districts exhibited less than 1 per cent and 0 per cent TFP growth in Kerala. Table 3indicates negative and low growth rates of TFP during the periods under study; stagnation in the crop sector has been a major cause of concern and is a threat to the sustainability of the agrarian economy of Kerala.

Table 3. Total factor productivity growth (TFPG) in Kerala and in districts

Period	*TFPG category stagnation (<0%)*	*<1%*	*>1%*
1980–81 to 1989–90	Thiruvananthapuram, Kollam, Palakkad, Pathanamthitta, Kottayam, Thrissur, Alappuzha, Ernakulam, Malappuram, Kannur, Kozhikode, Kasaragod (12)	(0)	Idukki, Wayanad (2)
1990–91 to 1999–2000	Pathanamthitta, Alappuzha, Kannur, Ernakulam, Thrissur, Palakkad, Wayanad, Kozhikode (8)	Thiruvananthapuram, Kollam, Kottayam, Malappuram, Idukki, Kasaragod (6)	(0)
2000–01 to 2009–10	Kottayam, Idukki, Kozhikode, Kannur, Wayanad, Kasaragod (6)	Pathanamthitta, Ernakulam, Thrissur, Malappuram (4)	Thiruvananthapuram, Kollam, Alappuzha, Palakkad (4)
1980–81 to 2009–10	Thiruvananthapuram, Pathanamthitta, Kottayam, Alappuzha, Ernakulam, Thrissur, Malappuram, Kannur, Kozhikode, Kasaragod (10)	Kollam, Palakkad, Idukki, Wayanad (4)	(0)

Note: Figures in parenthesis show number of districts.
Source: Karunakaran, 2014c, p. 559.

Shift in Cultivation vs Decline in Native Soil Fertility

Decline in native soil fertility, deficiency of plant nutrients and decline in micronutrients are the three main indicators for the unsustainability of land; and the first one is used in this analysis, taking evidences from Kasaragod district as a case. Soil fertility statuses in different crop-growing areas for paddy, coconut, arecanut and rubber were worked out from the Assistant Soil Chemist Office of Kasaragod district. The soil fertility evaluations on the basis of soil test results are done by analysing the macronutrients (NPK) and pH status.

Figure 1. Soil pH in major crop-growing areas of Kasaragod district

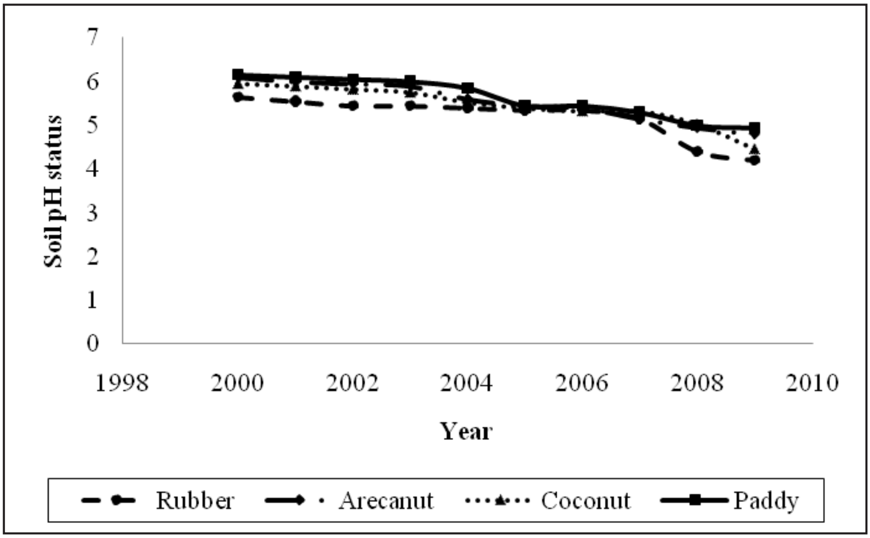


Figure 2. Soil N status in major crop-growing areas of Kasaragod district

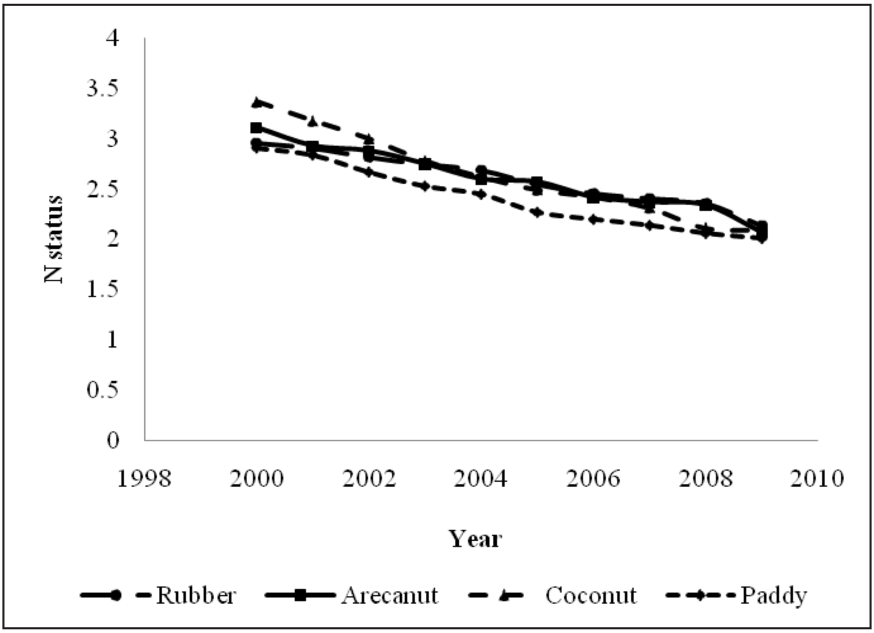


Figure 3. Soil P status in major crop-growing areas of Kasaragod district

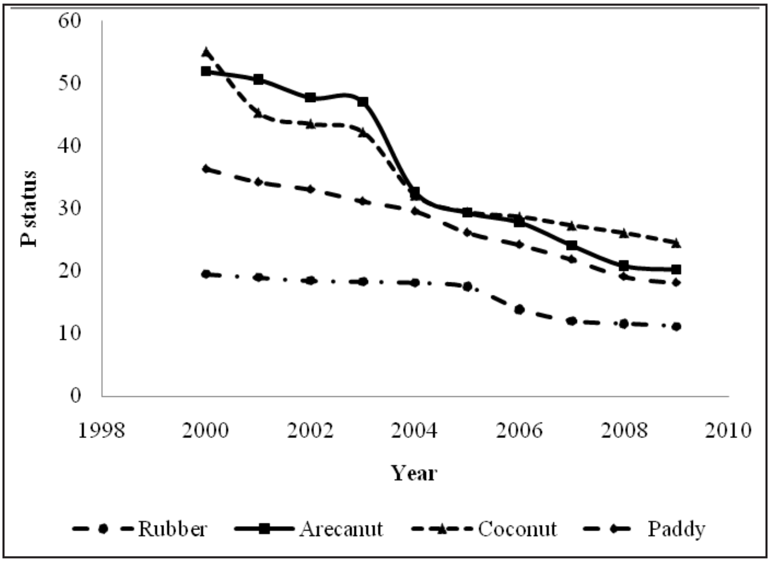


Figure 4. Soil K status in major crop-growing areas of Kasaragod district

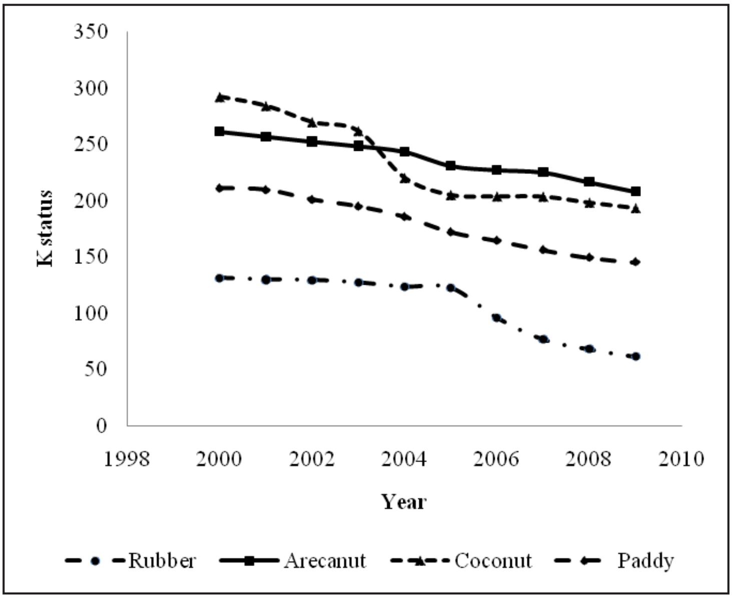
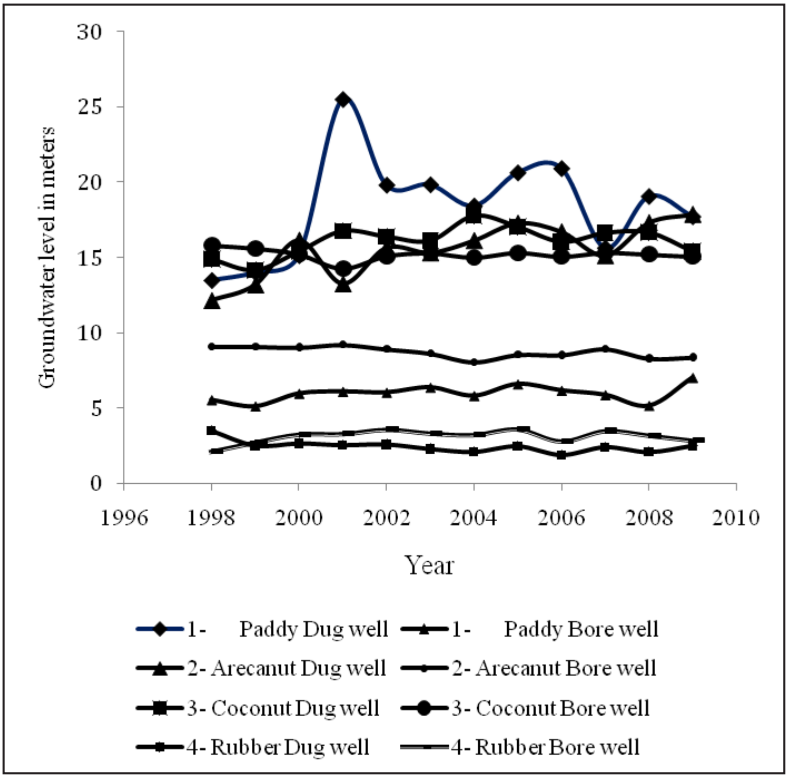


Figure 1 shows that there is a decrease in the average soil pH status in all the crop-growing areas; the decline was severe in rubber-cropped systems. Figures 2–4 show the continuous decline of soil fertility and soil health in general and the deterioration of P and K soil status in particular to the rubber-cropping system in Kerala. It is also found that P and K elements are low in the rubber plantations of the study area (Karunakaran, 2014a).

Figure 5. Average groundwater level in different crop-growing areas



Shift in Cultivation vs Decline in the Quantity of Underground Water

Figure 5 shows the crop-wise average groundwater level in different years of Kerala by taking evidences from Kasaragod district as a case. This figure reveals that the average groundwater level of dugwells in the paddy, arecanut- and coconut-growing areas increased, while for areas growing rubber decreased.

The average groundwater level in the rubber crop-growing areas was very low (below four metres) compared to other crop-growing areas. It was observed that the recharge of water in the rubber-cropped areas was very low compared to other crops and the discharge of water was high.

Shift in Cultivation vs Chemical Pollution

Table 4 gives details on health issues in Kasaragod district identified by the Health Department of the Kerala Government as evidence due to aerial spraying of endosulfan on cashew plantations. A total of 2,836 cases were identified with different complicated health issues in 2010. The officials of the Special Cell for Rehabilitation of Endosulfan Victims in Kasaragod district have informed that at present, there are 4,107 endosulfan cases with same diseases that are mentioned in Table 4. Various local activists and members of local community claimed that now there are 9,500 persons in Kasaragoddistrict suffering from endosulfan pollution.

Table 4. Health cases due to endosulfan spray in Kasaragod district

Panchayat	*Health problems*												
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*Total*
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
Kayyur-Cheemeni	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. locomotor disabilities, 4. multiple disabilities, 5. other anomalies, 6. mental illness, 7. cancer, 8. infertility, 9. deaf and dumb, 10. vision problems, 11. skin disorders, 12. others).

Source: Government of Kerala, 2011, p. 24.

To analyse the severity of the issue, one panchayat in Kasaragod district where endosulfan pollution is very high was selected. Table 5 shows that in 2014, there were 466 endosulfan-affected persons with many health issues, compared to only 259 in 2010.

Table 5. Growth of endosulfan-affected people from 2010 to 2014 in Enmakaje Panchayat of Kasaragod

Disease category	*2010*	*2014*	*No. of growth*
Mental retardation	56	88	32
Cancer	1	31	30
Cerebral palsy	23	38	15
Locomotor disabilities	61	84	23
Multiple disabilities	35	57	22
Other anomalies	12	23	11
Mental illness	10	21	11
Infertilities	6	18	12
Deaf and dumb	28	31	3
Vision problem	11	19	8
Skin disorders	9	16	7
Others	7	30	23
Total	259	466	207

Sources: Government of Kerala, 2011, p. 24) and Government of Kerala, 2014b, p. 26.

These health issues discussed above are primarily due to the toxic effect of endosulfan on the human body, particularly central nervous system, kidney, liver, skin, eye and other parts of human body (Embrandhiri et al., 2012). Out of the 466 persons, the study identified and analysed 60 endosulfan-affected persons, 34 women and 26 men. They were selected from different places of Enmakaje Panchayat, like Kattukukke, Padre, Perla and Vaninagar. The affected persons had serious health problems (Kumar et al., 2012), like mental retardation, cancer, locomotor diseases, cerebral palsy, mental illness, deaf and dumb, skin disorders, vision problems and other disabilities. Table 6 gives proportional morbidity ratio among endosulfan-affected persons in the study area.

Table 6. Proportional morbidity ratio among endosulfan-affected persons in the study area

Category of disease	*Endosulfan-affected persons*	*Proportional morbidity ratio (in per cent)*
Mental retardation	11	18.33
Cancer	8	13.33
Cerebral palsy	7	11.66
Locomotor disabilities	16	26.66
Multiple disabilities	5	8.33
Mental illness	4	6.66
Deaf and dumb	2	3.33
Vision problem	4	6.66
Skin disorders	3	5.00
Total	60	100.00

Source: Primary data.

From Table 6, it is evident that both mentally retarded and locomotor cases form 44 per cent of the total illness in the sample. Table 7 reveals the age-wise composition of endosulfan-affected persons. Seventeen out of 60 were below the age of 15. Seventeenvictims of children included seven mentally retarded cases, three locomotor disabilities, three vision problems, two cerebral palsy and two mental illness. Five cancer patients out of eight were in the age group of 30–60. Locomotor cases have been reported from all the age groups. Five locomotor cases were above 60 years. Out of five, multiple disabled three were above the age of 60. Only two deaf and dumb persons were in the age group of 30–60.

Table 7 shows that half of the endosulfan-affected persons in the sample fell in the category of age 15–60, and they were the working population, particularly farmers, which badly affected their ability to work, earn and consume. The rare and complicated health issues among children and old age may create a rise in health expenditure of these families.

Table 7. Age-wise group of endosulfan-affected persons in the study area

Age group (in years)	*Category of health problem*									
	1	2	3	4	5	6	7	8	9	Total
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

Legend: Health problems (1. mental retardation, 2. cancer, 3. locomotor disabilities, 4. mental illness, 5. deaf and dumb, 6. vision problems, 7. cerebral palsy, 8. multiple disabilities, 9. skin disorders).

Source: Primary data.

Conclusion

There are no quick tests to indicate the shift in cultivation and the sustainability of the agricultural sector. Mainly, sustainability has three important components: continued profitability, soil stability overtime and absence of adverse impact on the environment. In this context, the sustainability of the agricultural sector analysed as a result of shift in cultivation in Kerala revealed the following results:

1. The performance of the agricultural sector in Kerala at the state and district levels, measured in terms of the TFP growth, indicated that except Wayanad, Idukki, Palakkad and Kollam, all other districts and the state as a whole registered negative growth rates and derived deceleration in the TFP growth.
2. Decline in soil fertility status measured by calculating the average soil fertility status of four crop-growing areas, paddy, coconut, arecanut and rubber, analysing the pH status and NPK status revealed that (i) pH status was decreasing over the years in all crop-growing areas, but the decline was severe in rubber-cropped systems. (ii) The continuous decline of soil health and soil fertility in general and the decline of P and K soil status in particular were observed in the rubber-cropped areas compared to other cropped areas.
3. The decrease in the average groundwater level by analysing four crop-growing areas revealed that the water level in rubber crop-

growing areas was very low (below four metres) compared to rice-, coconut- and arecanut-growing areas.

4. Chemical pollution due to the aerial spray of endosulfan in the cashewnut farms revealed that 207 newly additional cases were reported. In the study area, rare and complex health issues, like mental retardation, cancer, locomotor disabilities, cerebral palsy, mental illness, deaf and dumb, visual problems and skin disorders, which were not so common before aerial spraying of toxic endosulfan pesticide, had been largely found.

These negative indicators that arise in the context of a shift in cultivation in Kerala experienced in the recent years seem to be more serious and question the sustainability of the agrarian economy of Kerala.

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