Physiological Characteristics of Land and Crop Diversification in Kerala

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Abstract: *The study examines the physiological characteristics of land and explores its linkages with the land use pattern , cropping pattern, cropping intensity and identifies the crop ranking combinations in the districts of Kerala using the land use data collected from Directorate of Economics and Statistics and calculated the Index of Crop Diversification. Many risky and uncertain situations which arise on account of variations in the physiological factors such as temperature precipitation, rainfall, altitude, soil type and economic factors such as price fluctuations, bacterial infections. These problems are mitigated by farmers through crop diversification via selection of the crops, which are more suitable to the particular area. Crop diversification observed through their revealed preference for multiple cropping instead of monotonic cropping and the preference for perennial crops instead of seasonal and annual crops and, high value crops instead of low value crops in cultivation, seem to be a rational move and provides relatively better earnings to the farmers which further protects themselves from agricultural crisis. The study concludes by observing that the regional variations in physiological characteristics influence the areal pattern of agricultural land use, crop diversification as well as the selection of crops, and results in variations in the cropping intensity in terms of productivity per unit of arable land.*

Key Words: Physiological Characteristics, Crop Diversification, Cropping Intensity, Crop Ranking Combinations, Food Security.

Introduction

Kerala, the state which was formed on 1st November 1956 as the result of recommendations of States Reorganisation Act 1956, comprises only 1.8 per cent of the total geographical area of India, but 2.76 per cent of the total Indian population. The Total Geographical Area of Kerala with 38852 sq.kms is too small that it occupies only the 22nd position among 29 states of India out of which 10.24 percent is Lowlands, 41.76 percents is Midlands and 48 percent belongs to Highlands. The 48 percent of Highlands with a stretch of land as part of Western Ghats is naturally protecting Kerala climatically and provides a base for all the economic as well as living activities of its inhabitants with all the blessings of nature and the people in Kerala is utilizing the land with the maximum possible manner without an over- exploitation of the land resources. The crops cultivated in the Climatic Physiological areas are diversified according to the variations in climate, rainfall, slope, topography, soil type and the selection of crops is based upon the physiological features and efficient utilisation of the particular area by the farmers. But risky and uncertain situations arising in agriculture always creates hurdles to farmers and have to be mitigated with a number of alternative solutions such as Crop Diversification with which the farmers can be resilient to the price fluctuations, climatic fluctuations and pest infections. So rather than specializing in a single crop, the farmers may be preferring diversification of crops not only to meet the fluctuations arising from price, climate and insects, but also according to the existing topology.

Objectives and Methodology:

The purpose of the study is to examine the linkage between physiological characteristics of land, Crop Diversification as well as the preference or selection of the crops in the Net Area Sown in the fourteen districts of Kerala. The areal strength of the crops cultivated in Kerala is identified from secondary sources and area-wise crop-ranking procedure is applied to analyse the leading crops which are cultivated in the districts. The ranking of the crops in each district is conducted with the help of percentage of Net Area Sown which is obtained by the proportion of Net Area Sown to the Total Geographical Area and ranked according to the proportion. The Modified version of Bhatia's (1965) Index of Crop Diversification was calculated to identify the spatial pattern of crop diversification and the proportion of crop- area under cultivation with equal to or more than five percent. Crop- area with less than five percent is excluded as the particular crops will not be contributing much to the Net Area Sown (Vaidya, 1997). The Index of Crop Diversification is calculated by the formula

$$\text{Index of Crop Diversification (ICD)} = \frac{Si}{ni}$$

where S_i represents the percentage of Net Area Sown which is equal to $\frac{Net\ Area\ Sown\ of\ ith\ district}{Total\ Geographical\ Area\ of\ ith\ district} \times 100$ and 'n_i' represents the number of crops cultivated in ith district. The four levels of Crop Diversification is identified as

1) Area with High level of Crop- Diversification(0 < ICD < 10)
2) Area with Moderate level of Crop- Diversification (10 < ICD < 20)
3) Area with Low level of Crop- Diversification(20 < ICD < 30)
4) Area with Very Low level of Crop- Diversification(ICD > 30)

The index is applied to trace the existence of diversification in crops and reflects the non- specialization through multiple cropping system which helps the farmer to earn a regular income if the other crop is affected either by topological or economic reasons.

Crop Diversification and Cropping Intensity in Kerala :

Crop Diversification refers to the change in spatial land use pattern which is done either in crops or the cropping systems. It acts as a climate adaptation strategy and a new paradigm for sustainable agriculture. By Crop Diversification, the crop activities may be changing from a less valued crop to a high valued crop, a more water consuming crop to a less water consuming crop, an annual or seasonal crop to a perennial crop, a monotonic crop to a multiple cropping system or a less profitable crop to a more profitable crop. The Classifications of Crop Diversification- Vertical and Horizontal Diversification – both occur in Kerala as the Horizontal Diversification operates through crop substitution and Crop intensification while Vertical Diversification occurs through the expansion of processing, branding or packaging activities related to the particular crop in cultivation. The Cropping Intensity refers to the raising of a number of crops from the same field during one agricultural year and implies the proportion of net area which is cropped more than once during the agricultural year. It is calculated as the proportion of Gross Cropped Area to Net Area Sown and multiplying it by 100. The data related to the Crop Diversification Index and Cropping Intensity for all the fourteen districts of Kerala in 2017-18 in Table 1 elucidates the number of crops existing in each district in Kerala which occupies equal to or greater than 5 percent Net Area Sown.

Table 1. Index of Crop Diversification and Cropping Intensity in Districts of Kerala (2007-08 & 2017-18)

States	Geographical Area	Net Area Sown		No:of Crops		ICD		Cropping Intensity	
		2007-08	2017-18	2007-08	2017-18	2007-08	2017-18	2007-08	2017-18
TV	218781	140881	129602	3	4	21	15	121	113
KL	248788	128342	124540	5	3	10	17	114	133
PT	265277	82169	79924	4	2	8	15	132	130
AL	141011	84479	83726	3	2	20	30	132	130
KT	220442	166866	162568	3	3	25	25	127	129
ID	436328	208363	205466	7	7	7	7	140	142
ER	305826	159699	148295	3	2	17	24	111	116
TS	302919	129350	130311	4	3	11	14	132	135
PL	447584	196787	206841	6	4	7	12	131	165
MA	355446	185161	173764	4	3	13	16	139	132
KZ	234641	156366	148476	6	4	11	16	129	135
WA	212966	115454	113407	8	7	7	8	149	173
KN	297112	198793	187500	5	3	13	21	117	110
KS	199166	136319	145995	5	3	14	24	108	106
STATE	3886287	2089029	2040415	5	3	11	18	126	132

Source: Kerala Economic Review 2007-08, 2017-18.

The Net Area Sown in three Districts – Thrissur (TS), Palakkad (PL) and Kasargode (KS) showed an increasing trend while all the other districts showed a decreasing trend and the number of crops under cultivation is showing a declining trend by one or two crops which implies the reduction in crop diversification. The Index of Crop Diversification in Idukki(ID)and Wayanad(WA) which are in High ranges are areas of High Diversification with a magnitude of less than 10, while Thiruvananthapuram(TV), Kollam(KL), Pathanamthitta(PT), Thrissur(TS), Palakkad(PL), Malappuram(ML), Kozhikode(KZ) are areas with moderate crop diversification and low magnitude of diversification between 20 and 30 exists in Alappuzha(AL), Kottayam(KT), Ernakulam(ER), Kannur(KN) and Kasargode(KZ) in 2007 and 2017 . The area under very low diversification or pure specialization in a single crop is not existing in Kerala and it reflects the proper utilisation of the agricultural land adopted by farmers to face the unforeseen market fluctuations and frequently affecting landslides, floods and droughts. The Magnitude of Crop Diversification and Cropping Intensity in the districts is represented in Table 2.

Table 2. Spatial Distribution Pattern of Diversification in Districts of Kerala in 2007-08 & 2017-18

Crop Diversification	Year		Cropping Intensity	Year	
	2007-08	2017-18		2007-08	2017-18
0-10(H)	ID, WA,PT,PL	ID,WA	**Above 140(H)**	PL,WA,ID	ID,WA
10-20(M)	KL,ER,TS,MA,KZ,KN,KS	TV,KL,PT,TS,PL, MA,KZ	**120-140(M)**	KL,PT,AL,KT,TS, MA,KZ	TV,PT,AL,KT,TS,PL,MA,KZ
20-30(L)	AL,KT,TV	AL,KT,ER,KN,KS	**100-120(L)**	TV,ER,KN,KS	KL,ER,KN,KS

Above 30(VL)	Nil	Nil	**Below 100(VL)**	Nil	Nil

Source : Kerala Economic Review 2007-08, 2017-18.

The Magnitude of Crop Diversification and Cropping Intensity is high(H) for two districts in Kerala in both the years- Idukki and Wayanad which belongs to Highlands with the Maximum number of Crops, Pathanamthitta (PT) and Palakkad (PL) which belongs to Midlands also has the highest Diversification in 2007-08 and cropping intensity is also high in Palakkad(PL) in 2007-08. Majority of the districts have a moderate(M) diversification in between 10 and 20 and Cropping Intensity in between 120 and 140 while five districts – Alappuzha, Kottayam, Ernakulam, Kannur and Kasargode have a low(L) level of diversification and Cropping Intensity. Since Alappuzha, Kottayam, Ernakulam are under the categorization of lowlands or wetlands, there exists only limited possibility of higher diversification. High Cropping Intensity in the highlands reflects the fact that the number of crops cultivated as well as the process of raising a number of crops in the same field during one agricultural year is high in the humid, high altitude cold climates of Kerala while it is low in the dry or rainfed regions. The high cropping intensity also reflects the higher productivity of the agricultural land during one agricultural year.

Table 3. Area-wise Crop Ranking Combinations along with Climatic Physiological Features in 2007-08 & 2017-18

	2007		**2017**		
No:Of Crops	**Crop Combinations**	**District**	**Crops**	**District**	**Topography**
One Crop	NIL	……	……	…….	……
Two Crops	NIL	……	PA+CO	AL	Lowland
	NIL	……	R+TA	PT	Malayoram
	NIL	……	R+CO	ER	Coastal Sandy Lands
Three Crops	CO + R+TA	TV	CO+R+TA	KL	Midlands
	CO+PA+R	AL	R+CO+PA	KT	Malayoram
	R+CO+PA	KT,ER	CO+PA+R	TS	Midlands, Coastal Sandy
	NIL	……	CO+R+ AR	KS,MA	Malappuram Lands
	NIL	……	CO+R+CA	KN	Malayoram
Four Crops	R+CO+TA+PE	PT	CO+ R+TA+PL	TV	Red Loam Lands
	CO+PA+R+AR	TS	PA+ CO+R+BA	PL	Coastal Plains, Black Soils
	CO+R+AR+PA	MA	CO+R+AR+J	KZ	Malappuram Lands
Five Crops	CO+R+ AR+CA+PE	KS	……..	…..…	……
	CO+R+CA+PE+AR	KN	……..	…….	……
	CO+ R+TA+PE+J	KL	……..	…….	……
Six Crops	PA+ CO+R+BA+MA+PL	PL	……..	…….	……
	CO+R+AR+PE+J+MA	KZ	……..	…….	……
Seven Crops	PE+R+CAR+TE+CO+COF+J	ID	PE+R+CAR+TE+J+CO+COF	ID	Highland
			COF+AR+BA+PE+CO+R+PA	WA	Highland
Eight Crops	COF+PE+PA+AR+BA+CO+R+J	WA	……	…….	……..

Source: Kerala Economic Review 2007-08, 2017-18.

CO- Coconut, PA-Paddy,R-Rubber, TA-Tapioca, PE-Pepper, CA-Cashew, AR-Arecanut, J-Jackfruit, BA-Banana, COF-Coffee, T-Tea, PL-Plantain, CAR-Cardomom.

The physiological factors are influencing the crop ranking combinations which are structured by farmers to tackle the consequences of agricultural crisis of districts in Kerala. The combinations of Perennial and Seasonal Crops are preferred mainly by majority of the farmers. Kerala, the name which derived out of land of Keras(Coconut) is still worthy as seven districts which belong to Midlands in Kerala is giving the first preference to Coconut cultivation in Total Net Area Sown. Paddy was opted as the first preference by two districts – Alappuzha(Lowland) and Palakkad(Palakkad Coastal Plains) The Lowlands mainly wetlands in Alappuzha prefer Two- crop combinations such as Paddy, a seasonal crop as the first rank crop along with Coconut a perennial crop as the second. Paddy is preferred as it is grown mainly in highly irrigated areas and a preference of High water consuming crop is seen in Wetlands while Coconut, a perennial crop is also prefered to make it cost- effective as no further replanting is required for a whole lifetime. Two crop combinations such as Rubber and Tapioca is preferred in Pathanamthitta with a topography of Malayoram and Rubber and Coconut is preferred in Ernakulam with Coastal Sandy Lands. A crop diversification via crop substitution and Crop Intensification is seen within the duration of 10 years from 2007-08 to 2017-18 in the crop ranking combinations of the districts. In the two crop combinations, Crop Diversification via Crop substitution from Coconut to Paddy in Alappuzha, Intensification in Rubber cultivation in Pathanamthitta, Ernakulam while High Diversification with Seven Crop Combinations are cultivated in Wayanad and Idukki with irrigated cold climates reflecting the existence of multiple cropping with the combinations of Annual, Seasonal and Perennial Crops with first rank crop as Pepper and Coffee which are High Valued Crops. Thus the Cultivation in Highlands are true models of agricultural development in which the topography, selection of crops, combination of crops and profitability of farmer are together linked up in a common proportion to bring a balanced ecological development with a proper food security along with a proper utilisation of land.

Conclusion:

The Agricultural System adopted in Kerala appears to be one of the best examples for the Utilisation of Net Area Sown on the basis of the Physiological Climatic features. Strong preferences for Multiple Cropping, High Valued Crops and for crops that need relatively less irrigation among the farmers of Kerala are highly commendable. Intensive cultivation and cost effective crops are also necessary for the farmers in order to resolve the problems related to agrarian crisis which arises from climate change, changing market demands and other related risks. This will be helpful in provisioning of diverse items of food and nutrition apart from increasing the farmer's income. Diversification especially, Horizontal Diversification via crop substitution and crop intensification is a "step forward" through which the farmers can maintain a stable agricultural income and a better living. Through an efficient Agricultural Information and Management System, the farmers can be made aware about the opportunities for attaining the preferences through which a better livelihood and food security can be provided to the existing population. With the complete knowledge and awareness, the farmers can properly utilise the limited land and other scarce resources without over- exploitation and thereby create a healthy population.

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