SEMINAR REPORT

Dynamics of Land Use Pattern in Kerala: Perceptions and Realities

By

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CERTIFICATE

This is to certify that the seminar report entitled **"Dynamics of Land Use Pattern in Kerala: Perceptions and Realities"** has been prepared by Otieno Felix Owino (2018-11-115) under my guidance and has not been copied from any other seminar reports.

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DECLARATION

I, Otieno Felix Owino (2018-11-115) declare that the seminar entitled **"Dynamics of Land Use Pattern in Kerala: Perceptions and Realities"** has been prepared by me, after going through various cited references and has not been copied from any other previous works.

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CERTIFICATE

This is to certify that the seminar report entitled **"Dynamics of Land Use Pattern in Kerala-Perceptions and Realities"** is a record of seminar presented by Otieno Felix Owino (2018-11-115) on 20th December, 2019 and is submitted in fulfilment of the course Ag Econ 591.

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Land is a basic input for agriculture and it occupies an important position among all the resources. Land is put to other uses as need arises in addition to agriculture. Consequently, because of these needs that arise, land use is not static. This leads to diversion of agricultural land to non-agricultural uses.

Diversion of agricultural land to non-agricultural uses has become an issue of public debate in every agrarian economy experiencing industrial development and population growth. The changes in land use pattern certainly provide many social and economic benefits but they also affect the previous uses to which the land employed prior to the changes. With the rapid rise in human population, human induced changes in land-use form an important component of regional environmental change (Turner, *et al.,* 1994).

Land conversion is caused by many factors but increasing population growth is the most prevalent cause among them. Besides demographic factors, socio-economic, political and cultural factors also play a decisive role in land conversion.

The issue of land conversion has become more complex in India due to widely varied perceptions about the extent of diversion of agricultural land and the causes. This report therefore analysed the data on land use for the state of Kerala from 1970-71 to 2017-18 based on the different land classifications. The land use in Kerala was initially categorised into eleven fold land classes:

i. Area under forests
ii. Land put to non-agricultural uses
iii. Barren and uncultivable lands
iv. Permanent pastures and other grazing lands
v. Cultivable wastes
vi. Miscellaneous tree crops
vii. Current fallows
viii. Fallows other than current fallow and
ix. Net area sown
x. Area sown more than once
xi. Gross cropped area

However in 2005-06, the State Government of Kerala introduced four more categories. These were:

i. Marshy Land
ii. Still Water
iii. Water Logged Area
iv. Social Forestry

This study concentrated on the first ten categories since they had shown significant changes for the last five decades, that is, from 1970-71 to 2017-18. Generally land under permanent pastures and other grazing lands, net sown area, area sown more than once, gross cropped area was observed to be declining while land put to non-agricultural use, fallow other than current fallow and current fallow were gaining in area. This report hence sought to understand these changes over time and the interactions between the land use classifications. This report also looked into paddy land that had been on the decline while other perennials like rubber and coconut had been gaining in the area coverage. Interaction between the pattern of change in the paddy land and the other land also formed part of the analysis.

In addition to the empirical evidence on the dynamics of land use in Kerala, there had been varied perceptions and myths surrounding the issue of land conversion. This analysis therefore try to determine whether the perceptions are consistent with empirical evidence on land use competition and identify main drivers that contribute to loss of agricultural land.

2. Review of Literature

Pandey and Tewari (1987) studied the ecological implications of land use dynamics in Uttar Pradesh from 1967-68 to 1983-84. Both linear and log-linear time trend equations were estimated using time-series data on the land use for the state as well as its different economic regions to find the annual rate of change in various land use classes. Inter-sectoral land budgeting revealed that substantial land shifts had taken place from the undesirable part E2 of the ecological sector, i.e. from usar and other barren lands to other sectors throughout the state and this favoured highly to both the desirable part E1 of the ecological sector and the agricultural sector. It appeared that almost half of the land released from E2 sector has gone to the non-agricultural sector and the remaining half was shared by the ecological sector E1 and agricultural sector.

Sharma and Pandey (1992) examined the trends and dynamics of annual shifts among different land use classes in Indian states which may have adverse implications for agricultural growth and ecological balance. A general declining trend was observed in the area under permanent pastures, grazing lands and, barren and uncultivable lands. The area under non-agricultural uses, cultivable wastes and fallow land showed a positive growth in most of the states. Inter-sectoral land budgeting revealed that area shifts were occurring from both desirable and undesirable ecology sectors towards agricultural as well as non-agricultural sectors. Further, the study identified the operation of vicious circle of land use dynamics within agricultural sector.

Rajesh and Ramasamy (1998) studied the extent and determinants of under-utilized lands in Tamil Nadu. Multiple regressions was used to study the changes in land use and regressed with area under cereal crops (ha), area under irrigation (ha), etc. The study revealed that there was a greater scope for extension of area under cultivation, as there exist a vast area under current fallows, other fallows and cultivable wastes. They observed that these lands could be reclaimed and used for cultivation by applying scientific methods.

Sreeja (2004) conducted the study on dynamics of land use pattern in Kollam district of Kerala by using Markov chain analysis and the results showed that the area under forest, net area sown, other uncultivated land excluding fallow land and land not available for cultivation were the most stable land use categories in period-I (1982-83 to 1991-92) and all the land use categories attained stability in the second period and the probability of retention of the share was more in period II(1992-93 to 2001-02) when compared to the first period.

Ramasamy *et al.* (2005) studied the dynamics of land use pattern with special reference to fallow lands in Tamil Nadu. Instability index was used to measure the extent of variability or the absence of stability in time-series data. The study revealed that the instability index during 1970-2000 was highest for the area under current fallows fallowed by the area under other fallows land. The decadal instability was also found to be higher for fallow lands as compared to other categories of land use in all the three decades during the study period. The highest instability in current fallows was due to the fact that the area under current fallows showed a very high year to year fluctuation in rainfall as more than 50 per cent of the cultivated area in Tamil Nadu constitute rained lands and this fact was supported by the continuous reduction in instability in gross irrigated area in the state. The instability in net and gross cropped area remained almost constant over the last three decades.

Wani *et al.* (2009) studied the land use dynamics in Jammu and Kashmir from 1966-67 to 2004-05. The exponential function was fitted to quantify the determinants of productive land use. The study revealed that the net irrigated area, literacy level and area not available for cultivation were positive and significant determinants for the variation in cropping intensity. The regression coefficient of the average holding size (0.15) revealed its positive contribution to the improvement of cropping intensity, although the relation has not been found statistically significant. The regression coefficient for area not available for cultivation (0.79) indicated that further increase in this area may significantly improve cropping intensity. The increasing demand for land for urbanization and infrastructural development due to increasing population may increase pressure on area left for cultivation and improve cropping intensity.

Gupta and Sharma (2010) conducted the study on dynamics of land utilization in Himachal Pradesh from 1972-73 to 2003-04. The instability index during the entire study period was highest for barren land followed by the area under non-agricultural uses and other fallows land. The decadal instability was highest for other fallow land in period first (1972-81), cultivable wastes in second period (1981-91) and for barren land in period third (1991-2004) as compared to other categories of land. The instability was found very less in net sown area and in the other categories of land there was no specific trend observed. The above studies reported that the instability index was highest for the area under current fallows fallowed by the area under fallows other than current fallow. The decadal instability was also found to be higher for fallow lands as compared to other categories of land use during the study period. The highest instability in current fallows was due to fluctuation in year to year rainfall pattern. Another study found highest instability index for barren land followed by the area under non-agricultural uses and fallows other than current fallow land. The decadal instability was highest for other fallows in period first, cultivable wastes in period second and for barren land in period third as compared to other categories of land. The instability was found very less in net sown area and in the other categories of land there was no specific trend observed.

Sharma (2015) used multiple regression analysis and found out that urbanization, industrialisation and rapid increase in road development in the country are the main factors influencing conversion of prime agricultural land. He also found a consistent pattern across majority of states which showed loss of net sown area and total arable land to other sectors. From TE1991-92 to TE2011-12, about 1.8 million hectares of net area sown and over 3 million ha of total arable land were lost to other sectors.

Aneesh *et al.* (2018) studied the pattern of land use change and found that the proportion of built up lands and plantations had increased sharply during the period 1967-1991 and 1991-2017. Built up lands expanded by 243.71 per cent and that of plantations by 137.22 per cent. However, found that there occurred a considerable reduction in the areas of paddy which decreased by 62.17 per cent.

3. Methodology

The dynamics of land use pattern in Kerala was analysed using the data on land use pattern from 1970-71 to 2017-18. The data was obtained from published resources of the Economics and Statistical Department of Government of Kerala between the periods. The analytical tools used in the study were averages, percentages, Compound Annual Growth Rates (CAGR), Coefficient of Variation (CV) and Markov chain analysis. It also studies the patterns and trends of land use

3.1 Compound Annual Growth Rates

Growth of any variable indicates its past performance. The analysis of growth is usually used in economic studies to find out the trend of a particular variable over a period of time. The growth in the area under different land use categories was estimated using the exponential growth function of the form:

$Y_t = ab^t e^{ut}$………………………. (1)

Where,

Y_t: Dependent variable for which growth rate was estimated

a: Intercept

b: Regression coefficient = (1+g)

t: Years which takes values, 1, 2, …,n

ut: Disturbance term for the year t

The equation was transformed into log linear form for estimation purpose and was estimated using Ordinary Least Square (OLS) technique. The compound annual growth rate (g) in percentage was then computed from the relationship,

$$g = \{\text{Antilog of } (b)-1\}*100.$$

The significance of the regression coefficient was tested using the students't test

3.2 Markov chain analysis

The Markov chain analysis is an application of dynamic programming to the solution of a stochastic decision process that can be described by a finite number of states. The Markov process was used to study the shifts in the shares of land use categories thereby gain in understanding about the dynamics of the changes in land use.

3.2.1. Markov probability model

Any sequence of trials (experiments) that can be subjected to probabilistic analysis is called a stochastic process. For a stochastic process it is assumed that the movements (transitions) of objects from one state (possible outcome) to another are governed by a probabilistic mechanism or system. A finite Markov process is a stochastic process whereby the outcome of a given trial t (t=1, 2……… T) depends only on the outcome of the preceding trial (t-1) and this dependence is the same at all stage in the sequence of trials. Consistent with this definition,

Let, Si = be the i^{th} state of r possible outcomes; i=1, 2, ………, r

W_{it} = be the probability that state Si occurs on trial t or the proportion observed in trial t in alternate outcome state I of the multinomial population based on a sample of size n, *i.e.* Pr (S_{it}).

P_{ij} = Represent the transitional probability which denotes the probability that if for any time t the process is in state Si, it moves onto next trial to state Sj, *i.e.,* Pr (Sj. t+1/s_{jt}) = P_{ij}

P = (P_{ij}) = Represent the transitional probability matrix which denotes the transitional probability for every pair of states (i, j=1,2…………r), and has the following properties.

$0 < P_{ij} < 1$,…………………………………………………(1)

and

$SP_{ij}=1$, for I=1, 2 …r, ……………………………………..(2)

Given this set of notations and definitions for a first order Markov chain, the probability of a particular sequence Si on trial t and Sj on trial t+1 may be represented by

Pr (S_{it}, S_jt+1) = Pr (Sit) Pr(Sj.t+1 /Sit) = Wit P_{ij}. ……………… (3)

and the probability of being in state j at trial t+1 may be represented by,

Pr (S_j.t+1) = S Wit Pj or Wj, t+1 = S Wit P_{ij} . . ….. . …..… (4)

The data for the study are the proportion of area under land use. The proportions change from year to year as a result of different factors. It is reasonable to assume that the combined influence of these individually-systematic forces approximates a stochastic process and the propensity of farmers to move from one land use category to another category differs according to the land use category involved. If these assumptions are acceptable, then the process of land use dynamics may describe in the form of a matrix P of first order transition probabilities. The element P_{ij} of the matrix indicates the probability of a farmer in land use category i in one period will move to land use category j during the following period. The diagonal element P_{ij} measures the probability that the proportion share of ith category of land use will be retained.

The transition probability matrix was estimated using the Minimum Absolute Deviation (MAD) estimator. The elements P_{ij} of the matrix are the conditional probabilities of the area under a particular land use category in time t given its share in time t_{-1}. The diagonal elements P_{ij} (i=j) indicate the extent of stability of land use categories. Hence, as the diagonal elements approach zero, area under a particular land use become less and less stable, and as they approach one, the land use categories tend to exhibit more and more stability over time. The off-diagonal elements P_{ij} (i^1j) are the probabilities of switching over between different land uses categories. If P_{ij} is the diagonal element corresponding to the ith land use category, the other elements in the ith row give the proportions of previous period's area of ith land use category it is likely to lose to other categories in the current period. The elements of the ith column gives the proportions of areas of other land use categories in the previous period the ith land use category is likely to gain in the current period.

3.2.2. Estimation of transition probability matrix

Equation (4) can be used as a base for specifying the statistical model for estimation the transition probabilities. If errors are incorporated in equation (4) to account for the difference between the actual and estimated occurrence of Wj (t+1), the sample observations may be assumed to be generated by the following linear statistical model

$Wjt = SWi\ t\text{-}1_{Pij} + Ujt$ ……………………………….. (5)

or in matrix form it can be written as

$Yj = XjPj + Uj$……………………………………….……… (6)

Where, Yj is a (Tx1) vector of observations reflecting the proportion in land use pattern in time t, Xj is a (Txr) matrix of realized values of the proportion in land use pattern I in time t-1, Pj is a (rx1) vector of unknown transition parameters to be estimated and Uj is a vector of random disturbances.

3.3. Instability index

Instability index is a simple analytical technique to find out the fluctuation or instability in any time series data. It is estimated as follows:

i. Estimate the parameter of a log-linear trend line for the variable (Yt) for which instability is to be estimated
ii. If the estimated parameter is statistically significant, then the instability index (IIN) is defined as
    $IIN = CV \times (1-r^2)0.5$
    Where,
    CV = Coefficient of variation
    r^2 = Coefficient of determination
    CV = (SD/ Mean) x 100
    Where,
    SD = Standard deviation
iii. If the estimated parameter in the regression equation in not significant, then the CV itself is the instability index.

4. Results

4.1. Land use status and trends

Averages and percentages were used to understand the pattern of change in the different land classifications, arable land and cropping intensity. The net sown area was 20,40,415 ha in 2017-18, which was 0.06 ha per capita less than the Indian average (0.1 ha), and four times less than that of the world average of 0.23 ha (GoI, 2015).

Table. 1: **Trends in land use pattern in Kerala state: 1972-73 to 2017-18**

Category	TE 1972-73	TE 1992-93	TE 2002-03	TE 2017-18
Land put in non-agricultural use	2,75,500 (7.1)	3,00,517 (7.7)	3,89,189 (10.0)	4,39,874 (11.3)
Barren and uncultivable use land	70,000 (1.8)	56,224 (1.4)	29,542 (0.8)	11,925 (0.3)
Permanent pastures & other grazing land	28,000 (0.7)	1,797 (0.0)	220 (0.0)	0 (0.0)
Land under misc. tree crops	1,23,500 (3.2)	34,241 (0.9)	14,015 (0.4)	2,453 (0.1)
Cultivable waste	77,000 (2.0)	92,878 (2.4)	64,098 (1.6)	99,123 (2.6)
Fallow other than current fallow	22,000 (0.6)	26,866 (0.7)	35,833 (0.9)	53,416 (1.4)
Current fallow	24,226 (0.6)	43,354 (1.1)	75,974 (2.0)	66,511 (1.7)
Net area sown	21,85,667 (56.3)	22,48,111 (57.9)	21,95,118 (56.5)	20,26,323 (52.1)
Area sown more than once	7,73,613 (19.9)	7,81,067 (20.1)	7,99,655 (20.6)	5,70,771 (14.7)
Total cropped area	29,59,127 (76.2)	30,29,200 (78.0)	29,94,773 (77.1)	25,97,095 (66.8)
Arable land	24,32,393	24,45,450	23,85,037	22,47,826
Cropping intensity	135.4	134.7	136.4	128.2

Note: Figures in parenthesis are percentages

Source: Estimated using the data from Directorate of Economics and Statistics, Kerala

This problem of limited availability of land has been compounded by growth in population, urbanisation and diversion of productive agricultural land for non-agriculture purposes.

Total cropped land of 3,62,032 ha (7542.3 ha per year) was lost to other sectors in the years between Triennium Ending (TE) 1972-73 and TE 2017-18. In contrast, area under non-agricultural uses increased from 2,75,500 ha to 4,39,874 ha in the same period showing an increase of 7.1 per cent to 11.3 per cent. The empirical results thus confirmed that urbanization, road infrastructure expansion and industrial development were the most important factors affecting agricultural land. It was estimated that a total net sown area of about 1,59,344 ha (3319.6 ha per year) has been lost during TE 1972-73 and TE 207-18. This loss of agricultural land is mainly due to rapid economic and industrial development, infrastructure expansion, rising population, urbanization, land degradation, etc.

It is evident from Table 1 that during the last 38 years, barren and uncultivable land have been declining. The share of barren and uncultivable declined from 2.2 per cent in TE 1982-83 to 0.3 per cent in TE 2017-18. However, the cultivable waste land area has been on the rise for the last two decades from a share of 1.6 percent in TE 2002-03 to 2.6 percent in TE 2017-18. The share of permanent pastures and other grazing land has declined from 28,000 ha in TE 1972-73 to 0 ha in TE 2017-18 while current fallows initially increased from 0.6 per cent in TE 1972-73 to 1.1 per cent then rose to 2.2 per cent in 2002-03 and 2012-03 but eventually declined to 1.7 per cent of the reporting area in TE 2017-18. Degraded cultivated lands mainly due to unsustainable use have frequently been left fallow. It is evident from Table 1 that area under fallow land has increased from about 24226 ha in TE 1972-73 to 66,511 ha in TE 2017-18. This equates to about 2.6 per cent of present cultivated land. Similarly, area under cultivable wastelands has also increased by about 18 per cent, from about 64,098 ha in TE 2002-03 to 99,123 ha in TE 2017-18.

The arable land decreased over the period from 24,32,393 ha in TE 1972-73 to 22,47,826 ha in TE 207-18. The annual loss of arable land therefore was found to be 4298 ha. Cropping intensity, consequently declined from 135.4 per cent to 128.2 per cent from TE 1972-73 and 2017-18. Due to conversion of paddy fields to other uses. This is true due to the fact that paddy covers the largest area of net sown area. In this period, the area under fallow lands increased.

4.2 Dynamics in area under paddy

4.2.1. Performance of area under paddy in relation to select land uses

Changes in area under paddy and net sown area for the years 2013-14 to 2017-18 was compared to the changes in land put to non-agricultural use, cultivable waste, current fallow and fallow other than current fallow. The area under paddy in Kerala declined from 1,99,611 ha to 1,71,398 ha during the period from 2013-14 to 2016-17. In turn, the land put to non-agricultural use, cultivable waste and fallow land increased in the same period. However, in the year 2017-18, the area under paddy increased to 1,94,235 ha from 1,71,398 ha in 2016-17.

Table 2: Comparison of changes in area under various land uses to changes in area under paddy

YEAR	Land put to non-agricultural use	Cultivable waste	Fallow other than current fallow	Current fallow	Area under Paddy	Net area sown
2013-14	4,05,826	97,069	57,346	70,976	1,99,611	2,050,994
2014-15	4,19,128	1,00,676	54,741	65,329	1,98,159	2,042,881
2015-16	4,34,646	99,499	55,258	70,003	1,96,870	2,023,073
2016-17	4,41,934	1,01,379	55,530	72,008	1,71,398	2,015,482
2017-18	4,43,041	96,491	49,461	57,522	1,94,235	2,040,415

Source: Estimated using the data from Directorate of Economics and Statistics, Kerala

Interestingly, the area put to non-agricultural use, cultivable waste and fallow land decreased for the same year, 2017-18. This relationship between area put to paddy and area under non-agricultural uses, cultivable waste land, fallow other than current fallow and current fallow show that their employment are directly related. In that when land put to paddy decreases, chances are that the lost area has been taken up with either of the discussed land uses. The net sown area also responded to the changes in fluctuation of area under paddy showing that the area under paddy had significant effect on the net sown area. This implies that area under paddy takes up a significant amount of the net sown area among other crops in the Kerala state.

4.2.2. Area under paddy versus area under other crops

A comparison was made between the changes in area under paddy and area under crops like tapioca, coconut, banana and rubber for the years TE 1982-83 to TE 2017-18. A gain in area under perennial crops was observed in the period from 1982-83 to 2017-18. The area under coconut increased from 23 per cent to 30 per cent of Gross Cropped Area (GCA), while that of rubber and banana increased from 8 to 21 per cent and 1.7 to 2.3 per cent of the GCA respectively. In the same period, the area under paddy declined from 28 per cent to 7 per cent of the GCA. This meant that the land lost from paddy was being taken by the perennial crops.

However, the total area of land lost from paddy was 6 lakh ha and the total land gained by the perennial crops was 4.1 lakh ha. A balance of 1.9 lakh ha was observed and this can be concluded to have been taken by the other land uses.

Table 3: Comparison of changes in area under various crops to changes in area under paddy

Period	Paddy	Tapioca	Coconut	Banana & other plantain	Rubber	Total Cropped Area
TE 1982-83	795680 27.6	240225 8.3	664122 23.0	49096 1.7	243940 8.5	2884056 100
TE 1992-93	546128 18.0	141133 4.7	870033 28.7	66221 2.2	427166 14.1	3029200 100
TE 2002-03	326781 10.9	109992 3.7	910233 30.4	105315 3.5	475150 15.9	2994772 100
TE 2012-13	206208 7.8	72122 2.7	796500 30.2	108495 4.1	537786 20.4	2633650 100
TE 2017-18	187501 -7.2	69420.67 -2.7	777387.3 29.9	59700.33 2.3	551001.7 21.2	2597095
Change 1982-83 over 2017-18	6,00,000		1,00,000	10,000	3,00,000	

Source: Estimated using the data from Directorate of Economics and Statistics, Kerala

This relationship between paddy and perennial crops and, other land uses showed that area lost from paddy was being put to non-agricultural uses, cultivable waste, fallow land and or perennial crops.

4.2.3. Pattern of shift from paddy to other crops

Markov chain analysis was used to observe the stability of area under paddy. That is, the probability of retaining the area under paddy and transitioning to other crops for the different decades. It was observed that the area under paddy had a retention probability of 77 per cent in 1980-90, 73 per cent in 1990-00, 48 per cent in 2000-10 and 45 per cent in 2010-18. The transition probability in 1980-90 for tapioca was 12 per cent and 7 per cent for vegetables.

The transition probability in 1990-00 was 10 per cent each for tapioca and vegetables, 7 per cent for coconut. In the decade 2000-10 the transition probability pf tapioca increased to 16 per cent mainly due to remunerative nature compared to paddy. Coconut had 25 per cent probability in the same period showing a 60 per cent increase from the previous decade. The transition probability of vegetables also increased to 11 per cent showing a more sustained instability of area under paddy. In the decade 2010-18, the transition probability of area under tapioca remained constant at 16 per cent while that of tapioca reduced to 5 per cent.

Table 4: Retention and transition probabilities of area under rice

Period	Retention probability of area under paddy	Transition probabilities from paddy to other crops
1980-90	77%	Tapioca 12%, Vegetables 7%
1990-00	73%	Tapioca 10%, Vegetables 10%, Coconut 7%
2000-10	48%	Tapioca 16%, Coconut 25 %, Vegetables 11%
2010-18	45%	Tapioca 16%, Coconut 5%, Vegetables 15%, Banana & Plantains 13%

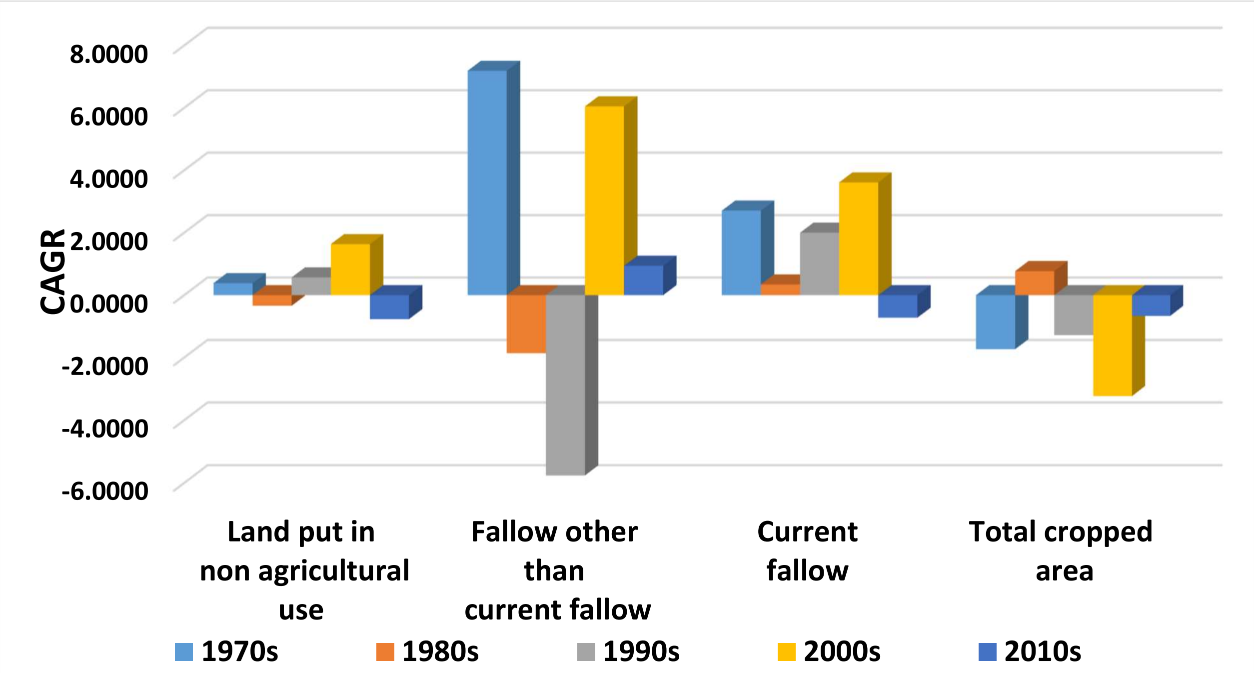
Source: Self estimated using the data from Directorate of Economics and Statistics, Kerala

This reduction was mainly due to prohibition of conversion of paddy lands to other uses and sustained promotion of cultivation of paddy in the fallow lands. The transition probability of vegetables further increase in the decade to15 per cent while banana and plantains had a 13 per cent probability

4.3. Analysis of growth of different land classes

The compound annual growth rates show the rate of growth if the rate of growth was to be the same. Hence the analysis showed that the land put to non-agricultural use was positive in all the decades apart from in the 2010s when it was negative.

Fig. 1: Decadal growth in selected land classes



Source: Self estimated using the data from Directorate of Economics and Statistics, Kerala

This was mainly because of slowing on the conversion of the paddy lands which had gone on in the previous decades unchecked. Area under fallow other than current fallow was negative in the decades 1970s and 1980s but remained positive for the rest of the decades.

This shows that as the cultivation of paddy lost its glory among farmers, more farmers continuously left their land fallow for extended periods of time. The growth of current fallow was negative in the 1980s and 2010s. The reason why it showed a negative growth rate in 2010s can be attributed to the sustained promotion of cultivation in the fallow lands by the state Government. The area under total cropped area had a positive growth in the decades apart from the 2010s. As land under paddy shrunk, so did the total cropped area. This was observed in the growth of total cropped area in the decade 2010s

5. Suggestions

i. Using fallow land and cultivable waste land to increase net sown area. It was observed that the net sown area is directly affected by the area under paddy. Hence, more land under fallow and waste land can be brought to cultivation to improve the net sown area

ii. Efforts to be made to utilise barren and uncultivable land for non-agricultural uses. Land put to non-agricultural use competes directly with land put to agricultural activities. It would therefore ne imperative to use lands that are not arable for the purposes other than agricultural to preserve the agricultural lands.

iii. Area under current fallow due to non-availability of irrigation facility or variation in rainfall pattern can be minimised and stabilised. Farmers keep their lands fallow due to many reasons one of them being due to lack of water resources. To help farmers desist from leaving their lands fallow, assistance can be given to them in form of provision of irrigation facilities to ensure season to season cultivation.

iv. Judicious implementation of legislations to protect paddy land and promote agricultural growth. It was observed that the legislation protecting paddy lands was being violated with evidence showing sustained conversion of paddy lands. Therefore, the state government can intensify implementation of the legislation in order to protect the paddy lands.

v. Ensure proper regulation of construction activities which results in indiscriminate paddy land conversion and over exploitation of natural capital. Construction activities should also be monitored especially near urban centres to ensure neither no built up areas encroach on agricultural lands nor mining of natural capital in already designated agricultural lands

vi. Prepare judicious land use planning based on local agro-climatic as well as economic potentials specific for each region. Since land forms the base of land-water-forests/plants complex, maintain a balance between the availability of land and projected demands in various sectors.

vii. Harmonise land resources databases at the national scale to address the key issues of land degradation, land reclamation, land evaluation and land use planning. Evaluate the degree, type, extent and severity of soil erosion and its effect on production and nutrient losses.

viii. Use remote sensing and geographic information system-based decision support system with database on climate, soil, land use and crop yields for assessing, mapping, and monitoring land use performance under given technological conditions.

6. Conclusion

Understanding the mechanism of land use changes and its adverse impacts t is important in the understanding of resources and sustainable economic development on the global, national and regional scales.

In view of these emerging trends in land use pattern, improving the use and access to the land is critically important. Consequently, since scope for bringing additional land under agriculture is limited, increased agricultural productivity per unit area and reclamation of degraded lands should contribute towards increased agricultural production in the country.

References

Aneesh, M. R., Suresh, S and Mani, K. 2018. The processes and pattern of land use change: a case study of the Thiruvananthapuram district of Kerala. *Eco Chronicle* 13(3): 133 – 141.

GoI [Government of India]. 2015. *Land Use Statistics at a Glance 2003-04 to 2012-13*.125p. Available: https://eands.dacnet.nic.in/LUS_2012-13.htm [Accessed 09 Dec. 2019].

GoK [Government of Kerala]. 2017. *Agricultural Statistics 2017-18.* Available: www.ecostat.kerala.gov.in/images/pdf/publications/Agriculture/data/2017-18/arcssk_crop_stat_201617.pdf [Accessed 19 Oct. 2019].

Gupta, S. and Sharma, R. K. 2010. Dynamics of land utilization, land degradation and factors determining land degradation in Himachal Pradesh. *Indian J. Agri. Econ*. 65(2): 245-260.

NABARD [National Bank for Agriculture and Rural Development]. 2017. All India Rural Financial Inclusion Survey 2016. Department of Economic Analysis & Research, Mumbai. 190p

Pandey, V. K and Tewari, S. K. 1987. Some ecological implications of land use dynamics in Uttar Pradesh. *Indian J. Agric. Econ*. 42(3): 388-394.

Rajesh, R. and Ramasamy, C. 1998. Extent and determinants of under- utilized lands in Tamil Nadu. Agric. *Situ. India* 55(4): 215 – 220.

Ramasamy, C., Balasubramanian, R. and Sivakumar, S. D. 2005. Dynamics of land use pattern with special reference to fallow lands- An empirical investigation in Tamil Nadu. Indian *J. Agri. Econ*. 60(4):629-644.

Sharma, V. P. 2015. Dynamics of Land Use Competition in India: Perceptions and Realities. IIMA Working Papers WP2015-06-02, Indian Institute of Management Ahmedabad. RePEc:iim:iimawp:13663

Sharma, U. K and Pandey, V. K. 1992. Dynamics of land use in different states of India. *Agric. Econ. Res. Rev*. 5(1): 24-33.

Sreeja, M. 2004. Land use dynamics in Kerala- an economic analysis. M. Sc. (Agri) Thesis Univ. Agric. Sci., Dharwad, Karnataka (India).

Teshome, M. 2014. Population growth and cultivated land in rural Ethiopia: Land use dynamics, access, farm size, and fragmentation. *Resource and Environment* 4(3):148-161. Available: doi:10.5923/j.re.20140403.03 [Accessed 10 Nov. 2019].

Turner, B. L, Meyer, W. B., and Skole, D. L. 1994. Global land use/land cover change: Towards an integrated study. *Ambio* 23: 91-95.

Wani, M. H., Baba, S. H. and Yousuf, S., 2009, Land use dynamics in Jammu and Kashmir. *Agric. Econ. Res. Rev*. 22(1): 145-154.

Discussion

i. The legislation on paddy conversion effective in checking the conversion of paddy lands?

 Kerala has been experiencing rapid urbanization over the last few decades, which accelerated during the last decade. High economic growth during the last five decades has also spurred growth in rail, road, port traffic and special economic zones (SEZ), necessitating further infrastructure improvements and therefore demand for more land. Therefore, paddy lands continue to shrink and empirical evidence show loss of paddy land to other crops and non-agricultural uses

ii. How have the schemes on development of paddy cultivation performed?

It was believed that the schemes would gradually reverse the decline in paddy cultivation and enhance sustainability. However, despite the huge budget outlays, results show dismal improvement on the intended results of the schemes beyond the implementation periods.

iii. Area under paddy is considered to be gained by other crops especially perennial crops. Is it true?

Results show land from paddy is lost to a mix of other land uses as well as to perennial crops. However, empirical evidence point to an increasing loss of agricultural land to non-agricultural uses. In addition to declining availability of agricultural land, farmland fragmentation, as a demographically-induced change in landholding structure, and declining farm size are other major problems of Kerala State agriculture. The average farm size has declined to 1.1 ha in 2016-17 (NABARD, 2018) as compared to 1.16 ha in 2013-14 (NABARD, 2018). The small and marginal holdings (below 2.00 ha) accounted for over 85 per cent in 2016-17. Kerala also reported an average agricultural household land holding of 0.74 ha against an all-India average of 1 ha in 2016-17 (NABARD, 2018). According to NABARD (2018), Kerala had the second highest proportion of agricultural households to have leased land at 27 percent against an India average of 12 per cent. The overall findings reflect a greater tendency of agricultural households to lease in land from large land owners for agricultural use. Empirical evidence shows that there is an inverse relationship between farm size and per hectare agricultural productivity in India. However, farm holdings below 0.8 ha do not generate enough income to keep a farm family out of poverty despite high productivity (Teshome, 2014). Hence, there is a need to increase effective farm size to make it economically viable.

With increasing urbanization, industrialization with focus on Make in India and need for creation of infrastructure such as roads, railways, irrigation, there is no doubt that these developments will continue to have impact on the Kerala economy. One of the consequences is that these initiatives require more land and there is a general fear that it might encroach upon agricultural land, particularly the fertile lands in the rural areas. Hence, the conflict between declining availability of agricultural land and population increase, as well as more requirement of land for industrial and infrastructure development has attracted special attention of political system, academics, industry, civil society and other stakeholders.

Appendix

Abstract

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Economics

Ag Econ 591: Master's Seminar

Name : Otieno Felix Owino | **Venue :** Seminar hall

Admission No : 2018-11-115 | **Date** : 20-12-2019

Major Advisor : Dr. Anil Kuruvila | **Time** : 11.30 am

Dynamics of land use pattern in Kerala: Perceptions and Realities

Abstract

Land and its uses provide a key link between human activity and the environment. Therefore, purposes for which land is put to use can change anytime to satisfy changing human needs (Teshome, 2014). This study tries to determine whether the perceptions on the dynamics of land use pattern in Kerala are consistent with the empirical evidence on land use changes.

The dynamics of land use pattern in Kerala was analysed using the data on land use pattern from 1970-71 to 2017-18. The analytical tools used in the study were averages, percentages, Compound Annual Growth Rates (CAGR), Coefficient of Variation (CV) and Markov chain analysis.

The Net Sown Area (NSA) in Kerala was 2.04 Million hectares (M ha) in 2017-18, which was equivalent to a per capita net area sown of 0.06 ha. This was much below the Indian average (0.1 ha) and four times less than the world average of 0.23 ha (GoI, 2015; GoK, 1970; 2018). A total cropped area of 0.36 M ha (7542.3 ha per year) was lost to other sectors from Triennium Ending (TE) 1972-73 to TE 2017-18. In contrast, the area under non-agricultural use increased from 0.28 M ha to 0.44 M ha in the same period, showing an increase from 7.1 per cent to 11.3 per cent of the geographical area. It was estimated that a total cropped area of 0.35 M ha (7350.8 ha per year) was lost in Kerala during the period from 1970-71 to 2017-18 due to economic and industrial development, infrastructure expansion, rising population and urbanisation.

In Kerala, the farmers are leaving their land fallow for many years due to reasons such as increasing cost of inputs including labour, declining remuneration from paddy cultivation

and speculative motives. The extent of fallow land has increased from 24,226 ha in TE 1972-73 to 66,511 ha in TE 2017-18, which amount to an increase of 174 per cent. Similarly, the area under cultivable wastelands also increased by about 55 per cent from 64,098 ha in TE 2002-03 to 99,123 ha in TE 2017-18.

The area under paddy in Kerala declined from 0.87 M ha to 0.17 M ha during the period from 1970-71 to 2016-17, showing a decline of 80 per cent. In turn, the land put to non-agricultural use, cultivable waste and fallow land increased in the same period. However, in the year 2017-18, the area under paddy increased to 0.19 M ha. Interestingly, the area put to non-agricultural use, cultivable waste and fallow land decreased for the same year. There was also a gain in area under perennial crops from 1982-83 to 2017-18. The area under coconut increased from 23 per cent to 30 per cent of Gross Cropped Area (GCA), while that of rubber and banana increased from 8 to 21 per cent and 1.7 to 2.3 per cent of the GCA respectively. In the same period, the area under paddy declined from 28 per cent to 7 per cent of the GCA. This relationship between paddy and, perennial crops and other land uses shows that area lost from paddy was being put to non-agricultural uses, cultivable waste, fallow land and perennial crops.

Therefore, understanding the dynamics in the land use pattern and its adverse impacts on the economic environment is conducive to the understanding of sustainable economic development at the global, national and regional scales (Turner, *et al*. 1994). In view of these emerging trends in land use pattern in Kerala, improving the use and access to the land are critically important. Since the scope for bringing additional land under agriculture is limited, increased agricultural productivity per unit area and reclamation of degraded land should be aimed for sustaining the agricultural production in the state.

References

GoI [Government of India]. 2015. *Land Use Statistics at a Glance 2003-04 to 2012-13*. 125p. Available: https://eands.dacnet.nic.in/LUS_2012-13.htm [Accessed 01 Dec. 2019].

GoK [Government of Kerala]. 2017. *Agricultural Statistics 2017-18.* Available: www.ecostat.kerala.gov.in/images/pdf/publications/Agriculture/data/2017-18/arcssk_crop_stat_201617.pdf [Accessed 19 Oct. 2019].

Teshome, M. 2014. Population growth and cultivated land in rural Ethiopia: Land use dynamics, access, farm size, and fragmentation. *Resource Environment* 4(3):148-161. Available: doi:10.5923/j.re.20140403.03 [Accessed 10 Nov. 2019].

Turner, B. L, Meyer, W. B., and Skole, D. L. 1994. Global land use/land cover change: Towards an integrated study. *Ambio* 23: 91-95.