

Dynamics of Land Use and Trends of Agriculture in Sikkim

Anjuli Gurung and Abdul Hannan

Sikkim is a Himalayan state, where more than 64% of its populace still depends on agriculture and its allied sectors. As land plays an important role in agriculture, it is vital to comprehend how the land use change makes an impact on the growth of agriculture in Sikkim. State experienced different farming practices over the period of time. Before the merger with Indian union in 1975, there was a traditional farming practice in Sikkim. But with the merger, state got influenced by 'Green Revolution' which introduced chemical based farming (conventional farming). However, during the year 2003 state government took an initiative to convert all the cultivable land into organically cultivable land and became fully organic state in 2016. With the changing pattern of agriculture, land use pattern also get influence. The study found that the net sown area has decreased in all the districts except the east district during 2010-11 from the year 2005-06. Net sown area has decreased, however, there is an increase in the area of current fallow and culturable waste land. The forest area has also increased in Sikkim during 2010-11. The number of operational holdings of all the classes has decreased except the large class. The operated area of all the class has decreased except the medium class. The number and area of irrigation holdings has decreased in north and east district, however, there is an increase in the irrigation status in south and west district. The cropping intensity has also increased in 2010-11 from 2005-06 in Sikkim. The secondary source of data has been used for the study.

Keywords: Organic farming, conventional farming, land use pattern, landholding, cropping intensity.

Introduction

Land changes in altitudes, forms and expressions. Man has played his part on land to portray the different phases of his ties with it (Singh, 1992). Land use is a function of four variables such as land, water, air and man. Land constitutes its body, water runs through its veins, air gives its oxygen and man acts as the dynamic actor to reflect its types, pattern and distribution (ibid, 1992). Land use primarily relates to public problems, key to the most important aspect of land use lies in the relation of people to

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land (ibid, 1992). “The meaning of land use is restricted to various uses that are given to land, but in this use we find sheds of overuse, underuse and misuse which assist us to make a diagnosis for administering the proper dose to attain optimum land use” (Singh, 1992, p. 75).

Land is a crucial natural resource and an important determinant of a country’s socio-economic and ecological health, to a great extent, land use of an area speaks about the economic status of a region (Rathee, 2014; Khan and Singh, 1992). Sustainable use and management of land resource is necessity for the well-being of the people of a country (ibid, 2014; 1992). Land-use change has broad impact in influencing the economic growth, quality of life, management of environmental resources, and national food supply (ibid, 2014; 1992). Monitoring of the land use and agriculture is of vital importance because both the factors have direct bearing on the sustenance of man, land is a finite resource which has been put to agricultural activities; supplying the life source to the mankind (Khan and Singh, 1992).

Sikkim being a hilly and land scarce state experienced different stages of agricultural scenario over the period of time. In the earlier stage (prior to 1874-75) people use to practice slash and burn cultivation *bhasmey*¹ but after the interference of British Government during 1874-75, people were forced to shift from slash and burn to terrace farming (Avasthe et.al. 2014). After their shift to terrace farming there was an improvement in the agriculture in the state, till the period of 1975 people practiced the default organic farming. However, after the merger with the Indian union in 1975, state got influence with the ‘green revolution’ which was in peak of spreading in mainland India (Subba, 2011). There was a free distribution of synthetic fertilizers, HYVs and other chemical pesticides in the state. People used the fertilizers and other materials rampantly in the state. But, during the year 2003, state government realized the negative effects of the utilization of synthetic fertilizers on land, crops, environment and people. Hence, state decided to go an organic way of farming for the sustainable development taking into consideration the health of soil, water, air and its people. Since then, the state is moving forward with the organic farming practice.

The state experienced different forms of agriculture, mainly the traditional (prior to 1975), conventional (1975 to 2003) and organic (2003 till present). Therefore, it is vital to understand the land use change with the change in agriculture pattern in Sikkim. Land use is an important aspect of geographical studies and it can be measured by the way in which its land is used and maintained (Chand and Josh, 1992). Thus, the study tries to explore the dynamics of land use change with spatio-temporal analysis.

Literature Review

Rai et.al (1994) argued that most of the forested areas in the Sikkim Himalaya have been purportedly destroyed for the expansion of agricultural land. Further, they contended that recently due to population pressure and fragmentation of farm-owning families, the balance of land-use, natural resources utilization and conservation has disturbed.

Land always has been a scarce resource in Sikkim and the land use pattern in

Sikkim is determined by its elevation, climate and mountainous terrain (GoS, 2015). Planning decisions for varied land uses such as agriculture, forests, horticulture, grasslands, urban development, mining, infrastructure facilities and recreation need to take into account several interests without risking the principles of land capability, sustainability and environmental security (ibid, 2015). There is an increase in the demand of land for both the settlement and agriculture basically due to high population growth rate in the seventies and eighties and has exerted the enormous pressure on Sikkim's forests and natural resources (ibid, 2015). However, the latest data from the Forest Survey of India (2013) revealed that Sikkim is the only state in the northeastern region that has been able to keep its forest cover intact since 2009. State has recorded zero net loss of forest cover in all its four districts, bucking the regional and national trends (ibid, 2015).

P.K Mishra *et. al.* (2019) argued that mapping and monitoring of land use land cover (LULC) changes in Himalayas is vital for sustainable development, planning and management. Using remote sensing and geographic information system techniques, they attempted to monitor the changes in LULC patterns of Rani Khola watershed of Sikkim Himalaya, where they classified LULC in six major classes i.e. agriculture, barren land, built-up area, dense forest, open forests and water bodies where they identified that the dense forest, built-up area and water bodies have increased while open forest, agriculture and barren land have decreased.

Paul *et. al.* (2016) argued that the urbanization has affected the nature of land cover in hill areas. They have tried to study the various types of changing land use pattern of Gangtok town since 1971 using the integration of remote sensing with GIS technology. Their analysis shows that the built-up area has been growing at a fast rate, especially after 1990 and more area is constantly being added to the built-up area but the percentage of area under cultivation is decreasing every year. They claimed that this type of urban expansion at the expense of fertile cultivated lands is not a symptom for the good health of a city like gangtok where population is increasing and the city is extremely congested.

R. Sharma *et. al.* (2007) argued that the large scale transition of land use to meet the rising demands for food and other ecosystem services for the well being of the societies has been the main problems confronting sustainable development in the mountain areas. They have tried to analyse the role of traditional cardamom agroforestry system on enhancing the ecosystem services in the eastern himalayas. Their findings showed that the agroforestry system is an efficient management system and a unique example of the ecological sustenance and economic viability for the mountain people and it seems quite promising for ecological and economic sustainability.

The above literatures portrays that the management of land use has become a vital in the small hilly state like sikkim. as there is an continuous increasing pressure on land with the change in time. As land is a static resource, its proper utilization is need of the hour.

Objectives

There are three major objectives of the study. These are as follows:

1. To study the spatio-temporal analysis of land use pattern and its changes during 2005-06 to 2010-11 in Sikkim.
2. To capture the relationship of the holding size distribution and irrigation status during 2005-06 to 2010-11 in Sikkim.
3. To identify the changes in cropping pattern and its intensity during 2005-06 to 2010-11.

Research Questions

1. Whether the changes in land use has any impact on cropping pattern in the state?
2. Is there any relationship exist between holding size distribution and irrigation pattern in Sikkim?
3. How the agricultural land is intensively used in different districts under different crops?

Sources of data and Methods of Enquiry

The study is done with the help of secondary data source. The study holds the mixed method approach with the quantitative as a central and qualitative as supportive. To fulfill the objectives, mainly the Report on Agriculture Census, Government of Sikkim for the period of 2005-06 and 2010-11, Annual Progress Report, Government of Sikkim, Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India, 2005-06 and 2010-11 has been used. Apart from that other literature has been preferred. The % variation has been calculated to understand the variation in various aspects of agricultural determinants. The statistical tools like tables, bar graphs and line graphs is used for the eloquent understanding.

Dynamics of Land Use in Sikkim

The dynamics of land use are complex in Sikkim, there are various factors affecting the land use change in Sikkim such as population growth, infrastructural built-up, increase in the number of industries, increase in settlements etc. "The Land use pattern is determined by several interrelated factors like the environmental, socio-economic and also the scientific management of the land use itself" (Chand and Joshi, 1992. p. 129).

Table 1 depicts the temporal variation of land-use in Sikkim from the year 2005-06 to 2010-11. Sikkim has total geographical area of 709600 ha among which the forest area was 326000 ha during 2005-06 which increased to 336000 ha in 2010-11 by (+) 0.03 %. The reporting area decreased from 108600.26 ha to 106682.57 ha in 2010-11. The area under culturable waste land and current fallow has increased by (+) 0.27 % (3310.42 ha in 2005-06 to 4230.51 ha in 2010-11) and (+) 0.40 % (4970.89 ha in 2005-06 to 6980.50 ha in 2010-11) respectively. Despite the increase in the culturable waste land and current fallow, there is not much variation in the net sown area, it remained almost constant with 77408.82 ha in 2005-06 and 77179.41 ha in 2010-11. The overall data depicts that the agriculture area has decreased in Sikkim because people are keeping their land fallow and might be shifting to other sectors.

Table 1. Temporal variation of land use in Sikkim (Area in ha)

Particulars/Years	2005-06	2010-11	% variation
(i) Forest Area	326000	336000	(+) 0.03
(ii) Area under non-agriculture	10651.73	10204	(-) 0.04
(iii) Barren & uncultivable land	--	--	--
(iv) Permanent pasture & other grazing land	--	--	--
(v) Area under miscellaneous trees & grooves	7766.27	3633.74	(-) 0.53
(vi) Culturable waste land	3310.42	4230.51	(+) 0.27
(vii) fallow land other than current fallow	4492.13	4454.41	(-) 0.00
(viii) Current fallow	4970.89	6980.50	(+) 0.40
(ix) Net Sown Area	77408.82	77179.41	(-) 0.00
Reporting area	434600.26	442682.57	(+) 0.01
Geographical Area	709600	709600	

Source: (a) Report on Agriculture Census 2005-06 and 2010-11, Government of Sikkim.

(b) The data for forest area has been extracted from Agricultural Statistical at a Glance-2017, Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmers Welfare Ministry of Agriculture and Farmers Welfare, Government of India. <https://eands.dacnet.nic.in>. Accessed on 31-07-2019.

% Variation = subtracting benchmark number from new number then dividing the result by the benchmark number.

(—) denotes data not available.

District-wise land use change in Sikkim

Table 2 shows the district-wise land use change in Sikkim from 2005-06 to 2010-11. The Sikkim has total four districts namely north, east, south and west.

North District

North district is the largest with the geographical area of 422600 ha but in terms of population it is the smallest with 43,709. The forest area has remained almost constant with 132600 ha in 2005-06 and 131700 ha in 2010-11. The area under non-agriculture uses has decreased by (-) 0.21 %. The area under miscellaneous trees & grooves has decreased by (-) 0.31. Culturable waste land has decreased by (-) 0.23, Fallow Other than Current Fallows has also decreased by (-) 0.38 but the Current Fallows has increased by (+) 0.64. The net sown area has remained almost the same.

South District

South district has the least geographical area with 75000 ha but in term of population it positioned the second highest with 146, 850. The forest area has increased by (+) 0.07 %. The area under non-agriculture uses land not available or cultivation has increased by (+) 0.14 %. The area under miscellaneous trees & grooves has increased by (+) 0.07% non-agriculture uses has increased by (+) 0.14 %. The area under Culturable waste land, Fallow Other than Current Fallows and Current Fallows increased by (+) 1.85 %, (+) 0.20 % and (+) 0.45 % respectively. The net sown area has remained constant with 21991.27 ha in 2005-06 and 21969.06 ha in 2010-11.

East District

East district is the third highest 95400 ha in area but in term of population it reflected the highest position with 283,583. The forest area has increased by (+) 0.02 %. The area under non-agriculture uses has increased by (+) 0.18 %. The area under miscellaneous trees & grooves has decreased by (-) 0.29 %. Culturable waste land and Current Fallows has decreased by (-) 0.03 % and (-) 0.14 % respectively. The area under current fallow has decreased by (-) 0.14 %. The area under net sown area has also decreased by (-) 0.07 %.

West District

West district is the second largest 116600 ha in area but in term of population it is the third highest with 136,435. The forest area has increased by (+) 0.06 %. The area under non-agriculture uses has decreased by (-) 0.28 %. The area under miscellaneous trees & grooves has also decreased by (-) 0.49 %. Culturable waste land, Fallow Other than Current Fallows and Current Fallows has increased by (+) 0.15 %, (+) 0.23 % and (+) 0.76 % respectively. The net sown area has also increased by (+) 0.07 %.

Holding Size Distribution and Irrigation Status in Sikkim

Holding Size Distribution

As per the Annual Report 2016-17, agriculture land holdings in Sikkim are well spread over from an elevation of 300-3000 meters. “An agricultural operational holdings is the ultimate unit for taking decision for development of agriculture at micro level. It is for this reason that an operational holding is taken as the statistical unit of data collection for describing the structure of agriculture” (FS&ADD, 2016, p.23).

The *Table 3* reveals that except the large holdings all the other holdings (marginal, small and medium) increased by (+) 0.01, (+) 0.02 and (+) 0.03 respectively in 2010-11. However, except the operated area of medium class, the operated area of all the classes decreased in 2010-11. Among all the classes, medium class showed quite prominent improvement in terms of both operational holdings and operated area in Sikkim. Inclusively, the operational holdings has increased by (+) 0.02 % whereas the operated area has decreased by (-) 0.01 % from the year 2005-06 to 2010-11 in Sikkim.

Table 2. District wise Land use change in Sikkim (2005-06 to 2010-11) Area (in ha)

Particulars/ Year	North			South			East			West		
	2005-06	2010-11	% variation	2005-06	2010-11	% variation	2005-06	2010-11	% variation	2005-06	2010-11	% variation
(i) Forest Area	132600	131700	(- 0.00)	52900	57100	(+ 0.07)	67900	69900	(+ 0.02)	72800	77200	(+ 0.06)
(ii) Area under non-agriculture uses	1794.97	1404.49	(- 0.21)	2897.67	3328.43	(+ 0.14)	2545.97	3020.93	(+ 0.18)	3413.12	2450.33	(- 0.28)
(iii) Barren & unculturable land	--	--	--	--	--	--	--	--	--	--	--	--
(iv) Permanent pasture & other grazing land	--	--	--	--	--	--	--	--	--	--	--	--
(v) Area under miscellaneous trees & grooves	2294.67	1573.22	(- 0.31)	2271.93	2438.11	(+ 0.07)	2791.33	1966.88	(- 0.29)	3718.62	1886.04	(- 0.49)
(vi) Culturable waste land	929.22	708.50	(- 0.23)	555.05	1586.90	(+ 1.85)	910.59	874.43	(- 0.03)	915.56	1060.68	(+ 0.15)
(vii) Fallow Other than Current Fallow	1670.91	1023.21	(- 0.38)	654.01	787.94	(+ 0.20)	920.45	1097.72	(+ 0.19)	1246.76	1545.54	(+ 0.23)
(viii) Current Fallow	939.62	1535.50	(+ 0.64)	1110.71	1616.78	(+ 0.45)	1451.44	1236.73	(- 0.14)	1469.12	2591.49	(+ 0.76)
(ix) Net Sown Area	10488.32	10447.54	(- 0.00)	21991.27	21969.06	(- 0.00)	23498.09	21697.37	(- 0.07)	21431.14	23065.44	(+ 0.07)
Reporting Area	150717.71	148392.46	(- 0.14)	82380.64	88827.22	(+ 0.07)	100017.87	99794.06	(- 0.00)	104994.32	109799.52	(+ 0.04)
Geographical Area	422600	422600	--	75000	75000	--	95400	95400	--	116600	116600	--

Source: (a) Report on Agriculture Census 2005-06 and 2010-11, Government of Sikkim.

(b) Agricultural Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India, 2005-06 and 2010-11.

(-) denotes data not available.

Table 3. Number of operational holdings and operated area by different categories of farmers in Sikkim

Sl. No.	Size Class/ Year	Operational Holdings (in no.)		% variation	Operated Area (in ha)		% variation
		2005-06	2010-11		2005-06	2010-11	
1	Marginal	39832	40476	(+) 0.01	15021.5	14811.1	(-) 0.01
2	Small	16546	16941	(+) 0.02	20803.7	20397.5	(-) 0.01
3	Medium	16196	16731	(+) 0.03	57093	59170.1	(+) 0.03
4	Large	852	780	(-) 0.08	15680	12304.1	(-) 0.21
5	Sikkim	73426	74928	(+) 0.02	108600	106682	(-) 0.01

Source: Report on Agriculture Census 2005-06 and 2010-11, Government of Sikkim

Note: Marginal means below 1 ha; Small means 1-2 ha; Medium means 2-10 ha; large means 10 and above.

*operational holdings: All land which is used wholly or partly for agricultural production and is operated as one technical unit by one person alone or with others without regard to the title, form, size or location.

*operated area: it would include both cultivated and uncultivated area, provided part of it is put to agricultural production in the reference period.

District-Wise Holdings Distribution

North District

The Table 4 depicts that except the medium class, the operational holdings of all the other classes (marginal, small and large) showed a decreasing trend with (-) 0.69 %, (-) 0.96 % and (-) 0.35 % respectively. Same is the case with operated area where the medium class has increases by (+) 0.31 % and other classes (marginal, small and large) decreased by (-) 0.70 %, (-) 0.96 % and (-) 0.37 % respectively. Inclusively both the operational holdings and operated area has decreased by (-) 0.22% and (-) 0.07 % respectively in north district.

Table 4. Number of operational holdings and operated area by different categories of farmers in north district

Sl. No.	Size Class/ Year	Operational holdings (in no.)		% variation	Operated Area (in ha)		% variation
		2005-06	2010-11		2005-06	2010-11	
1	Marginal	1190	368	(-) 0.69	472.35	137.92	(-) 0.70
2	Small	955	36	(-) 0.96	1329.35	49.34	(-) 0.96
3	Medium	2032	2893	(+) 0.42	9049.13	11856.6	(+) 0.31
4	Large	421	273	(-) 0.35	6337.66	3940.12	(-) 0.37
5	North Sikkim	4598	3570	(-) 0.22	17188.5	15984	(-) 0.07

Source: Report on Agriculture Census 2005-06 and 2010-11, Govt of Sikkim

South District

The *Table 5* depicts that both the operational holdings and operated area of marginal and medium class has increased and small and large class has decreased in the year 2010-11. However, inclusively both the operational holdings and operated area in south district has increased by (+) 0.04 % and (+) 0.04 % respectively.

Table 5. Number of operational holdings and area operated by different categories of farmers in south district

Sl. No.	Size Class/ Years	Operational Holdings (in no.)		% variation	Area Operated (in ha)		% variation
		2005-06	2010-11		2005-06	2010-11	
1	Marginal	11993	13239	(+) 0.10	5006.7	5179.07	(+) 0.03
2	Small	5381	4629	(-) 0.13	6964.58	5554.1	(-) 0.20
3	Medium	4390	4817	(+) 0.09	14355.8	17055.7	(+) 0.18
4	Large	149	144	(-) 0.03	2598.5	2351.42	(-) 0.09
5	South Sikkim	21913	22829	(+) 0.04	28925	30140.3	(+) 0.04

Source: Report on Agriculture Census 2005-06 and 2010-11, Govt. of Sikkim.

East District

The *Table 6* depicts that except the medium class, the operational holdings of all the other class has increased, however, the operated area of medium and large has decreased and marginal and small class has increased. Inclusively, the operational holdings has increased but operated area has decreased by (+) 0.04% and (-) 0.07% respectively.

Table 6. Number of Operational Holdings and Area Operated by different

Sl. No.	Size Class/Year	Operational Holdings (in no.)		% variation	Operated Area (in ha)		% variation
		2005-06	2010-11		2005-06	2010-11	
1	Marginal	13690	13696	(+) 0.00	4587.69	4683.27	(+) 0.02
2	Small	4729	6511	(+) 0.37	5713.35	7995.66	(+) 0.13
3	Medium	5020	4145	(-) 0.17	17198.41	13162.85	(-) 0.23
4	Large	141	214	(+) 0.51	3708.97	3177.85	(-) 0.14
5	East Sikkim	23580	24566	(+) 0.04	31207.42	29019.63	(-) 0.07

Categories of Farmers in East District (Area in ha.)

Source: Agriculture Census Report 2005-06 and 2010-11, Government of Sikkim.

West District

Table 7 depicts that there is an increase in the operational holdings of all the classes as well as increase in the operated area of all the classes except the area of large class in 2010-11. Inclusively, there is an increase in the operational holdings by (+) 0.02 and operated area remain almost constant in 2010-11.

Table 7. Number of Operational Holdings and Area Operated by different Categories of Farmers in West District

Sl. No.	Size class/Year	Operational Holdings (in no.)		% variation	Area Operated (in ha)		% variation
		2005-06	2010-11		2005-06	2010-11	
1	Marginal	12959	13173	(+) 0.01	4957.74	4810.79	(+) 0.02
2	Small	5481	5765	(+) 0.05	6796.45	6798.37	(+) 0.00
3	Medium	4754	4876	(+) 0.02	16489.6	17095	(+) 0.03
4	Large	141	149	(+) 0.05	3034.91	2834.7	(-) 0.06
5	West Sikkim	23335	23963	(+) 0.02	31278.8	31538.8	(+) 0.00

Source: Agriculture Census Report 2005-06 and 2010-11, Government of Sikkim.

Irrigation Status in Sikkim

Irrigation system is vital for agricultural production. Sikkim being a Himalayan state, most of the crops are rain-fed but due to topographical variability there is an unequal distribution of water sources. Some part of the state are abundantly blessed with water sources and some part have no water sources and face the scarcity. Despite the abundant water resources, most of the area are not been properly irrigated due to lack of mechanism for the efficient supply of water. Thus, it is vital in understanding the status of irrigation system in Sikkim.

The state government started paying attention to irrigation only from the year 1976 with the aim of constructing irrigation schemes. Earlier, the panchayat and rural works department use to take up such minor irrigation channel. However, in 1986, a separate department of irrigation with the specific mandate of looking after irrigation had been created. Due to topographical features, medium/major irrigation project is not feasible and therefore only the minor irrigation channels are taken up.² Table 8 depicts the district wise number of operational holdings and irrigation status between the years 2005-06 and 2010-11.

North District

The total number of irrigated holdings decreased by (-) 0.40 % (2618.00 in 2005-06 to 1551.00 in 2010-11). The total number of unirrigated holdings increased by (+) 0.01 % (1980.00 in 2005-06 to 2019.00 in 2010-11). The total irrigated area decreased by (-) 0.38 % (1529.59 ha in 2005-06 to 934.58 ha in 2010-11). The total unirrigated area increased by (+) 1.33 (2740.67 ha in 2005-06 to 6399.91 ha in 2010-11).

South District

The total number of irrigated holdings increased by (+) 0.57 % (5164.00 in 2005-06 to 8127.00 in 2010-11). The total number of unirrigated holdings decreased by (-) 0.12 % (16749.00 in 2005-06 to 14702.00 in 2010-11). The total irrigated area decreased by (+) 0.25 % (2304.10 ha in 2005-06 to 2896.26 ha in 2010-11). The total unirrigated area decreased by (-) 0.08 (15635.62 ha in 2005-06 to 14233.62 ha in 2010-11).

East District

The total number of irrigated holdings decreased by (-) 0.05 % (12721.00 in 2005-06 to 11983.00 in 2010-11). The total number of unirrigated holdings increased by (+) 0.15 % (10859.00 in 2005-06 to 12583.00 in 2010-11). The total irrigated area decreased by (-) 0.21 % (6628.45 ha in 2005-06 to 5207.48 ha in 2010-11). The total unirrigated area decreased by (-) 0.25 (8281.10 ha in 2005-06 to 6162.82 ha in 2010-11).

West District

The total number of irrigated holdings increased by (+) 0.40 % (8417.00 in 2005-06 to 11806.00 in 2010-11). The total number of unirrigated holdings decreased by (-) 0.18 % (14918.00 in 2005-06 to 12157.00 in 2010-11). The total irrigated area increased by (+) 0.34 % (3974.15 ha in 2005-06 to 5349.07 ha in 2010-11). The total unirrigated area remained constant with 11091.26 ha in 2005-06 to 10699.08 ha in 2010-11.

As a whole in Sikkim, the number of total irrigated holdings decreased by (-) 0.15 %, however, the total number of unirrigated holdings decreased by (-) 0.06 %, area decreased by (-) 0.01 %. The area of both irrigated and unirrigated remained constant.

Cropping Pattern and Cropping Intensity in Sikkim**Cropping Pattern**

Cropping pattern refers to the proportion of area under different crops at different points of time (Ghosh, 2012). It is dynamic and varies in time and space. Any changes in cropping pattern would indicate a change in cropping proportion of land under different crops. For understanding the cropping pattern, mainly the food crops has been analyzed which consists of cereals, pulses and oil seeds.

Figure.1 depicts the temporal variation of area of food crops in Sikkim, among the cereals maize is prominent crop which has a major area coverage, followed by paddy. Among the pulses urd is prominent and among the oilseeds both soybean and rapeseed & mustard are prominent. Although rice is a staple food of Sikkim but the area under paddy cultivation has been constantly decreasing with 16050 ha in 1990-91 to 10660 ha in 2015-16. There is almost a decrease of 5390 ha in two and half decade. The area under wheat cultivation remained almost same from 1990-91 to 2000-01 but from the year 2005-06, area tremendously decreased and reached to 320 ha in 2015-16. The area under maize remained constant till the year 2000-01 but in the year 2005-06 it slightly decreased to 36700 ha however it increased to 40170 ha in 2010-11 and again slightly decreased to 38950 ha in 2015-16. There is a fluctuation in the area coverage of maize. The area under barley showed an increasing trend till 2005-06 with 900 ha in 1990-91 to 1230 ha in 2005-06 but it drastically decreased to 640 ha in 2010-11, however, it immensely increased to 2850 ha in 2015-16. The area under buckwheat showed an increasing trend from 1720 ha in 1990-91 to 4390 ha in 2010-11 but it extremely decreased to 440 ha in 2015-16. The area under finger millet remained almost constant till 2005-06 but it decreased in 2010-11 and 2015-16.

Table 8. District wise irrigation status of Sikkim (2005-06 to 2010-11)

Districts/ Year	North		South		East		West		Sikkim	
	2005-06	2010-11	2005-06	2010-11	2005-06	2010-11	2005-06	2010-11	2005-06	2010-11
Total no of irrigated holdings	2618.00	1551.00	5164.00	8127.00	12721.00	11983.00	8417.00	11806.00	28920.00	33467.00
		(-)0.40	(+)0.57	(+)0.27	(+)0.57	(-)0.05	(-)0.05	(+)0.40	(+)0.40	(-)0.15
Total no of unirrigate d holdings	1980.00	2019.00	16749.00	14702.00	10859.00	12583.00	14918.00	12157.00	44506.00	41461.00
		(+)0.01	(-)0.12	(-)0.12	(-)0.12	(+)0.15	(-)0.18	(-)0.18	(-)0.18	(-)0.06
Total irrigated area of holdings	1529.59	934.58	2304.10	2896.26	6628.45	5207.48	3974.15	5349.07	14364.29	14387.39
		(-)0.38	(+)0.25	(+)0.25	(+)0.25	(-)0.21	(+)0.34	(+)0.34	(+)0.34	(+)0.00
Total unirrigate d area of holdings	2740.67	6399.91	15665.62	14233.62	8281.10	6162.82	11091.26	10699.08	37748.65	37495.43
		(+)1.33	(-)0.08	(-)0.08	(-)0.08	(-)0.25	(-)0.00	(-)0.00	(-)0.00	(-)0.00

Source: Report on Agriculture Census 2005-06 and 2010-11, Government of Sikkim.

The area under the urd cultivation has continuously decreased from 4090 ha in 1990-91 to 2900 ha in 2015-16. However, the area under other pulses has remained almost constant throughout the period. The area under soybean has also remained almost the same with little bit of increase in the year 2000-01 and 2010-11. The area under rapeseed and mustard was less in 1990-91 with 31000 ha but there was a tremendous increase from the year 1995-96 with 5840 ha and with 5260 ha in 2010-11. However, the area decreased to 3650 ha in 2015-16. Apart from the area of barley and finger millet, the area of all the crops has decreased in the year 2015-16 in Sikkim.

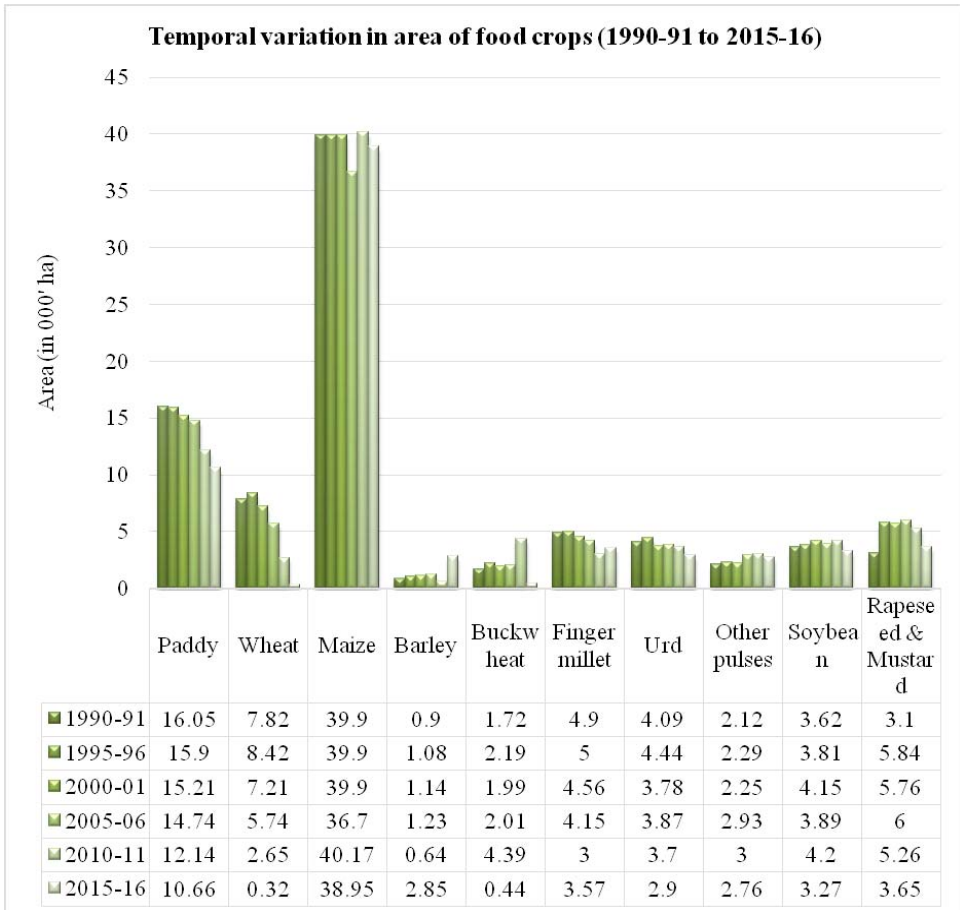


Fig: 1

Source: (a) Handbook of Organic Crop Production in Sikkim, Government of Sikkim, 2014. b) Annual Progress Report, Agriculture Department, Government of Sikkim, 2015-16.

Figure 2. depicts that the production of paddy has constantly decreased from 22030 tonnes in 1990-91 to 19680 tonnes in 2015-16. The production of wheat has tremendously decreased from 1070 ha in 1990-91 to 340 tonnes in 2010-11. The production of maize has gradually increased from 57570 tonnes to 68310 tonnes in 2015-16. The production of barley has remained almost constant from 1990-91 to

2005-06 but decreased to 610 tonnes in 2010-11, however increased greatly with 2910 tonnes in 2015-16. The production of buckwheat remained constant from 1990-91 to 2005-06 but greatly increased with 4060 tonnes in 2010-11 and decreased tremendously to 470 tonnes in 2015-16. The production of finger millet remained almost constant from 1990-91 to 2000-01 but started decreasing from 2005-06. The production of urd and other pulses remained almost same throughout the period. The production of soybean also remained same throughout the period. The production of rapeseed and mustard also remained the same with little bit changes.

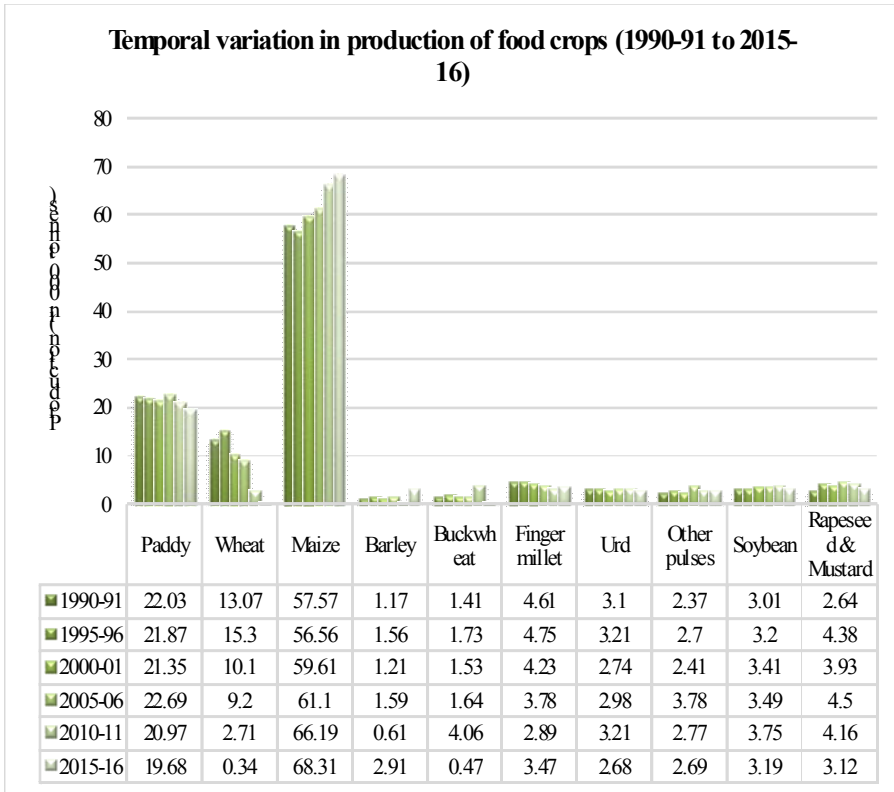


Fig. 2.

Source: (a) Handbook of Organic Crop Production in Sikkim, 2014, FS&ADD, Government of Sikkim. b) Annual Progress Report 2015-16, FS&ADD, Government of Sikkim.

Cropping Intensity

“Cropping Intensity is defined as an extent to which the net area sown has been cropped or resown in the one agricultural year. It can be expressed as the percentage ratio of gross cropped area to the net sown area.” (Pagar, 2016, p. 10). The higher cropping intensity depicts a higher portion of net area cropped more than once during one agricultural year. This implies higher productivity per unit of arable land. The higher the cropping intensity higher will be the agriculture production.

The Table 10 signifies the cropping intensity of two census period i.e.2005-06

and 2010-11 in Sikkim. Apart from the west district, the cropping intensity in all the district has increased in the year 2010-11 from the year 2005-06.

I visited four villages in Sikkim, each village from each district, namely Hee Gyathang (north district); Perbing Dovan (south district); Amba (east district) and Upper Fambong (west district). I found that after the introduction of organic farming in the state, people have become more aware about the value of organic vegetables/crops and its market demand. They have become more enthusiastic to grow the organic vegetables/crops to supply in the market. They basically practice crop rotation system and barely keep their land fallow.

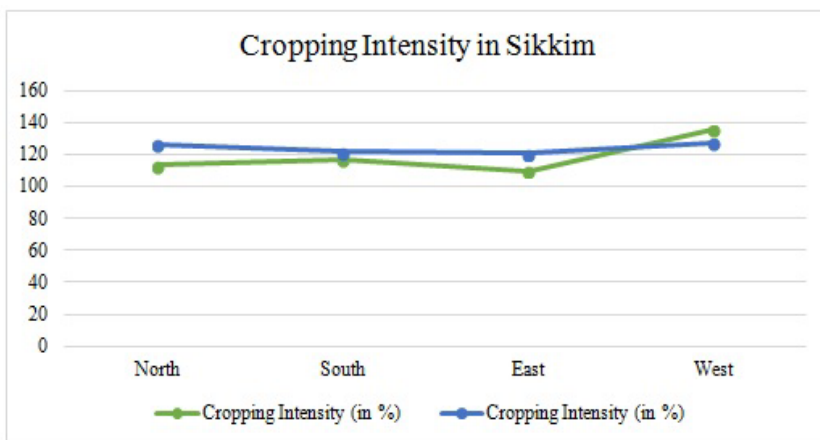


Fig. 3

Sl. No	District	Net Sown Area		Gross Cropped Area		Cropping Intensity (in %)	
		2005-06	2010-11	2005-06	2010-11	2005-06	2010-11
1	North	10488.32 (13.55)	10447.54 (13.54)	11873.44 (12.86)	13231.33 (13.87)	113.20	126.65
3	South	21991.27 (28.41)	21969.06 (28.46)	25623.18 (27.76)	26690.79 (27.98)	116.52	121.49
2	East	23498.09 (30.36)	21697.37 (28.11)	25816.61 (27.97)	26158 (27.43)	109.86	120.56
4	West	21431.14 (27.69)	23065.44 (29.89)	28989.91 (31.41)	29299.46 (30.72)	135.27	127.03
5	Sikkim	77408.82 (100)	77179.41 (100)	92303.14 (100)	95379.58 (100)	119.24	123.58

Table 9 Cropping Intensity in Sikkim

Area (in ha)

Source: Report on Agriculture Census 2005-06 and 2010-11, Government of Sikkim.

Note: Computed figures in the bracket are the percentage value to the total area.

Cropping Intensity: It is the ratio of Net Area Sown to the Gross Cropped Area.

Season wise Area, Production and Productivity of Field Crops in Sikkim

Table 10. Depicts the season wise area and production of field crops from 2005-06 to 2010-11. There are mainly 6 prominent cereal crops in Sikkim, among which paddy is important crop because rice is the staple food in Sikkim. but the area under paddy cultivation is decreasing day by day as it decreased from 14740 ha in 2005-06 to 12140 ha in 2010-11. Production also decreased but the productivity increased in 2010-11 as compare to 2005-06. There is no cultivation of paddy in the Rabi season.

Wheat is a rabi crop, the area under the wheat cultivation has decreased from 5740 ha in 2005-06 to 2650 ha in 2010-11. The Production and productivity decreased drastically in 2010-11.

Maize use to cultivate in both the kharif and rabi season during the period 2005-06 but during 2010-11 it only cultivated during the kharif season. Though the cultivation of maize occurred only during the kharif season but the area increased from 36450 ha in 2005-06 to 40170 ha in 2010-11. The production of maize also increased but the productivity decreased in 2010-11.

Buckwheat is a rabi crop, the area, production and productivity of buckwheat increased progressively from 2005-06 to 2010-11. The reason for the improvement in the production of buckwheat is due to value given to it after the introduction of organic farming in the state. It is given importance due to its export oriented market.

Barley is a rabi crop, the area under barley decreased from 1230 ha in 2005-06 to 640 ha in 2010-11. Production and productivity also decreased tremendously. Finger millet is a kharif crop, the area and production decrease in 2010-11 from 2005-06, but the productivity increased in 2010-11 as compare to the year 2010-11. The reason for the decrease in the area and production of finger millet and barley is due to more input and less output (more cost and less production) and no prominent market price.

Among the pulses urd is prominent in Sikkim, the interesting fact about the pulses is that during the period 2005-06 the cultivation use to happen in both kharif and rabi season but in the year 2010-11 the cultivation shifted only to kharif season. Before there use to be more cultivation during the rabi season but now there is nil cultivation in rabi season. Among the oilseeds soybean and rapeseed & mustard are prominent in Sikkim. Soybean is a rabi crop, the area increased from 3890 ha in 2005-06 to 4200 ha in 2010-11. The production and area also increased in 2010-11. The soybean area and production is increasing due to its multiple utilization, such as oil, cheese and soya chunks etc. The rapeseed & mustard is a rabi crop, the area and production decreased but its productivity increased during 2010-11.

Concluding Remarks

The paper basically analyzes the agriculture scenario of Sikkim, especially by comparing the data of two agriculture census year i.e. 2005-06 and 2010-11. Almost every agricultural aspects has been covered in this paper such as land use, holding distribution, irrigation status and cropping intensity. Spatio-temporal analysis has been done for all the aspects.

The land use has direct impact on agriculture, according to land use data, there is a decrease in net sown area in 2010-11 from the year 2005-06 accordingly there is a decrease in the area of most of the crops such as the area of paddy, wheat, barley,

Table 10. Season wise Area and Production of Field Crops in Sikkim (2005-06 to 2010-11)

Crops	Season	2005-06			2010-11		
		Area (in '000 ha)	Production (in '000 tonnes)	Yield (kg/ha)	Area (in '000 ha)	production (in '000 tonnes)	Yield (kg/ha)
I. Cereals							
Paddy	Kharif Rabi	14.74 --	22.69 --	1539.35 --	12.14 --	20.9734 --	1727.628 --
Wheat	Kharif Rabi	-- 5.74	-- 9.2	-- 1602.79	-- 2.65	-- 2.7101	-- 1022.679
Maize	Kharif Rabi	36.45 0.25	60.68 0.42	1664.75 1680	40.17 --	66.1929 --	1647.819 --
Barley	Kharif Rabi	0 1.23	0 1.59	0 1292.68	0 0.64	0 0.6087	0 951.0937
Buckwheat	Kharif Rabi	0 2.01	0 1.64	0 815.92	0 4.39	0 4.0565	0 924.0318
Finger millet	Kharif Rabi	4.15 --	3.78 --	910.84 --	3 --	2.893 --	964.3333 --
Total Cereals	Kharif Rabi	55.34 9.23	87.15 12.85	1574.81 1392.2	55.31 7.68	90.059 7.375	1628.3 960.3
II. Pulses							
Urd	Kharif Rabi	0.06 3.81	0.12 2.86	2000 756.66	3.7 --	3.209 --	867.2972 --
Other pulses	Kharif Rabi	0.25 2.68	0.32 3.46	1280 1291.04	3 --	2.7669 --	922.3 --
Total Pulses	Kharif Rabi	0.31 6.49	0.44 6.32	1419.35 973.81	6.7 --	5.9757 --	891.9253 --

Table 10 (Contd.) Season wise Area and Production of Field Crops in Sikkim (2005-06 to 2010-11)

Crops	Season	2005-06			2010-11		
		Area (in '000 ha)	Production (in '000 tonnes)	Yield (kg/ha)	Area (in '000 ha)	production (in '000 tonnes)	Yield (kg/ha)
III. Oilseeds							
Soybean	Kharif	3.89	3.4	874.04	4.2	3.7484	892.4761
	Rabi	-	-	-	-	-	-
Rapeseed & Mustard	Kharif	-	-	-	-	-	-
	Rabi	6	4.5	750	5.26	4.1635	791.5399
Total Oilseeds	Kharif	3.89	3.4	874.04	4.2	3.7484	892.4761
	Rabi	6	4.5	750	5.26	4.1635	791.5399

finger millet, urd, and rapeseed & mustard. However, there is an increase in the area of some of the crops such as maize, buckwheat, other pulses and soybean. The cropping pattern can be effected by various factors such as changing in the consumption of food items, changing in climate, changing in land use etc. being a citizen of the state I have experienced that, nowadays people have become more business oriented and they focus on the cultivation of those crops which has better market value. For instance, the demand of raw maize has increased especially with the increase in the inflow of tourist. The value of buckwheat has also increased due to its health benefit, in fact, it is more export oriented. The area of soybean has increased due to its multiple utilization.

Being an agriculture oriented state, irrigation is one of the important input, but due to topographical features, medium/major irrigations project is not feasible in the state. Thus, the only minor irrigation channel are taken up. There is no adequate flow of fund, however, the fund received under the Accelerated Irrigation Benefit Programme (AIBP) has supplemented to create an assured irrigation by taking up sufficient number of schemes. Under the scheme, the irrigation has not only stabilized in kharif but also extended to rabi and other seasons. According to the data, there is an increase in the irrigation area in all the district of Sikkim. Government provides tanks, canals, sprinklers and pipes for the irrigation in the state. The size of the landholdings doesn't makes difference in the irrigation facilities, if the person is having small holdings but progressive in farming then government will give concern to them.

The cropping intensity has increased in Sikkim in the year 2010-11 due to various factors such as increase in the demand of crops/vegetables due to increase in the number of population and due to promotion of organic farming in the state. Understanding land use change is essential to comprehend the agriculture growth because the large number of people's economy of the state is linked with agriculture that serves as the source of livelihood and economic security to sizeable native population. With the change in time, various factors changes (number of population, infrastructural development etc.) which eventually impacts the agriculture lands. The study will be helpful to the academicians, researchers, policy makers and all the enthusiastic readers.

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Notes

¹ The word is used among the Nepali community to denote the slash and burn cultivation.

² Irrigation department of the Government of Sikkim, Gangtok, official website: www.sikkim-irrigation.gov.in

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