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Sustainablity of Land Resources: A Case Study of Kendrapara District

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ABSTRACT

Sustainable land management (SLM) refers to practices and technologies that aim to integrate the management of land, water, biodiversity and other environmental resources to meet human needs while ensuring the long-term sustainability of ecosystem services and livelihoods. Sustainability refers to meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. The major objective of this paper is to make the land resources more sustainable. The present study is an attempt to observe the reduction in the quality of agricultural land of Kendrapara district which forms a part of fertile Mahanadi delta. Land use is a manifestation of use of land resources. This study adopted both the primary and secondary sources of data. The area under non- agricultural use and permanent pasture and other grazing land is increasing, whereas, the area under barren and uncultivable waste land, current fallow and other than current fallow land and net sown area goes on decreasing. This creates an alarming situation for the sustainability of land resources. This is due to the heavy population pressure and trends of urbanization. Land is a non- renewable resource. All the advancement in science and technology cannot produce land for us. Hence, proper management and sustainable use of available land resources is a must. The present study area being a part of fertile Mahanadi delta, the findings can be replicated in other such areas.

Key Words : Sustainability, Land management, Urbanization, Technology, Population pressure

INTRODUCTION

The World Bank defines sustainable land management as a process in a charged environment between environmental protection and the guarantee claim of ecosystem services on the one hand. On the other hand, it is about productivity of agriculture and forestry with respect to demographic growth and increasing pressure in land use. Sustainable Land Management (SLM) is defined as a knowledge-based procedure that helps integrate land, water, biodiversity, and environmental management to meet rising food and fibre demands while sustaining ecosystem services and livelihoods. SLM is necessary to meet the requirements of a growing population. Improper land management can lead to land degradation and a significant reduction in the productive and service functions of watersheds and landscapes. Land management is the process by which the resources of land are put to good effect. It covers all activities concerned with the management of land as a resource both from an environmental and from an economic perspective. It can include farming, mineral extraction, poverty and estate management and the physical planning of towns and the countryside.

Land is the sole source of the sustenance of mankind supporting the plants and animals on it providing the food, fibre and shelter. The growing pressure of population coupled with an increasing variety of demands being made on land resources have brought extra pressure on the available resources all over the country. Hence it is a necessary pre-requisite to know the present or existing used of land in order to plan for optimal use. “Since 1930, the world population grew more than triples. As a result,

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energy and food demands have increased, which has resulted in more land cover changes for food production and settlements" (Molders, 2012). "Decision making process how and for what purposes the land in question to be used, in turn, is affected by different factors prevailing at local, regional and global level. Different researchers have put the reasons for land use/ cover changes in two broad categories as proximate or direct and underlying or indirect/ root causes" (Geist and Lambin, 2002; Liverman and Cuesta, 2008). Lambin *et al*. (2003) further contend that "proximate factors occur at local or household/ farm level. As a consequence, proximate variables are context and region specific while the root causes on the other hand are the result of complex political, economic and social conditions occurring at a distance". Study by Brink and Eva (2009) also reveals that "there is a significant degree of land use/cover change in Sub-Saharan Africa. These changes have resulted due to man-made and natural drivers related to high rate of population increase, economic development and globalization on one hand and natural hazards such as floods, landslides, drought and climate change on the other end of the spectrum."

The present study area is flood prone and the economy is agro-based. Due to the fertile land the land use/land cover pattern is mainly based on agriculture. Most of the areas of Kendraparaare rural. So, the land is used mainly on agricultural and residential purpose. The frequent flood brought by the three major rivers *i.e.* Mahanadi, Brahmani and Baitarani affect the main economic activity of the rural people, *i.e.* agriculture. The land use change in the last few years is due to the high growth of population and limited availability of agricultural land, as many are converted to residential and commercial purposes. Land is a non- renewable resource. All the advancement in science and technology cannot produce land for us. Hence, proper management and sustainable use of available land resources is a must. The major objective of this paper is to make the land resources more sustainable. The present study is an attempt to observe the reduction in the quality of agricultural land of Kendrapara district which forms a part of fertile Mahanadi delta. Land use is a manifestation of use of land resources.

Objectives:

The objectives of the study are to

(a) Make the land resources more sustainable

(b) Observe the reduction in the quality of agricultural land

(c) Assess the possibilities to make the land resources more sustainable.

METHODOLOGY

Data has been collected both from primary and secondary sources and simple ratios and percentages and analysis has been used to interpret them and arrive at conclusions. Secondary data is obtained from Bureau of Statistical Department, Bhubaneswar, District Gazetteer, Kendrapara and District Profile Kendrapara, Government of Odisha, 2000-01 and 2010-11.

Study area:

Kendrapara extends from 20^0 20'N to 20^0 47'N latitude and 86^0 14'E to 87^0 01'E longitude and situated in central coastal plain zone as per the agro-climate classification of the Odisha. It is situated in the eastern portion of the state and is bounded on the north by Bhadrak, on the east by Bay of Bengal, on the South by Jagatsinghpur, on the west by Cuttack and on the north-west by Jajpur. It extends over an area of 2644 Sq.km. Physiographically, Kendrapara is situated in the eastern coastal plains of Odisha. Kendrapara stretch on the eastern coastal plains of Odisha of about 48 km. from Dharma Mahan to Batighar. The district headquarter is 85 km from the State headquarter. The coastal plain is widest near this district. The district is located in the flood plains of Baitarani, Brahmani and Mahanadi River. The river Luna (a branch of Mahanadi) is flowing out side of Kendrapara district. The other rivers of Kendrapara are Karandia, Gobari, Brahamani, Birupa, Kani, Baitarani, Kharasrota, Paika, Chitrotpala and Hansua. The climatic condition of the district is generally hot with high humidity during April and May and cold during December and January. The monsoon generally breaks during the month of June. Annual rainfall of the district was 1509.6 m.m. in 2011 which is lower than the normal rainfall *i.e.* 1556.0 m.m. The mean annual temperature 28^o C. Maximum temperature recorded is 41^oC and minimum temperature is 9^o C in the month of May and January, respectively. The Mean relative humidity ranges from 70-85% throughout the year. The temperature in the region can go up to 34^oC in summer while in winter the temperature can drop to 13^o C. These soils are generally fertile with low status of nitrogen and available phosphoric and at certain places. They usually contain sufficient quantity of potash. Soil reaction is slightly acidic in nature. Within

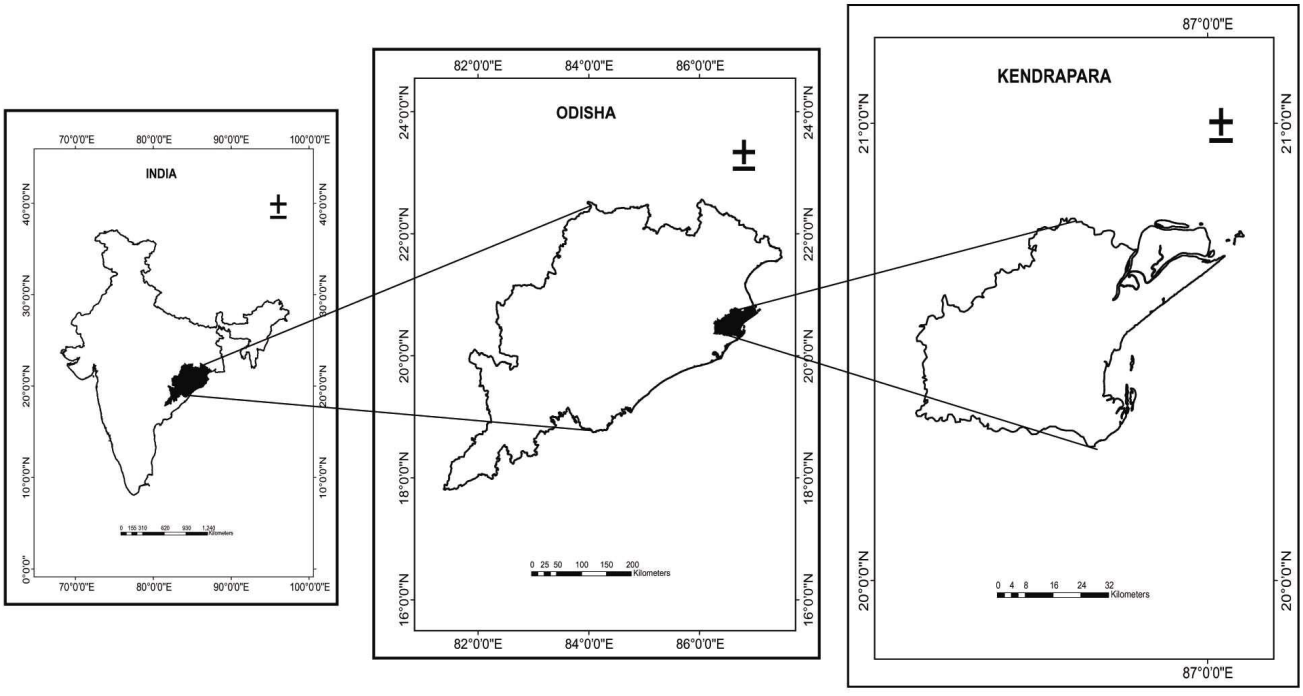

Fig. 1 : Location of the study area

10 kms. proximity to the sea, the soils are saline and narrow strips of sandy soils are also met with. The district has mainly two varieties of soils *viz*., alluvial soil in the south east and northern parts and normal strip of saline soil in the North-East along the coastal belt.

Index of change in Land use:

A formula from Wang (2000) was used to quantify the degree of land use change. The degree of individual land use dynamics is calculated through the numerical change in particular land use dynamics multiplied by the length of time of the study. The formula is:

$$LC = \frac{U_b - U_a}{U_a} \times \frac{1}{T} \times 100$$

In the formula, LC represents the degree of land use change, U_a the amount of the particular land use at beginning of year 'a', U_b the amount at the end of year 'b' and T represents the length of time. When unit of T is set as a year, LC indicates the degree of annual individual land use dynamics. The degree of integrated land use dynamics is defined by the integrated numeric changing of all the categories of land use during the length of time of the study in the area. Its formula is as follows:

$$LC = \frac{\sum_{i=1}^{n} \Delta LUi - j}{2\sum_{i=1}^{n} LUi} \times \frac{1}{T} \times 100$$

LUi represents the area of category I at the beginning year of the study, ΔLUi–j the amount of category I converted to other categories and T represents the length of the study. When the unit of T is set as a year, LC indicates the degree of annual integrated land use dynamics.

Changing pattern of Land use:

Human requirements have increased manifold due to rising population pressure and progress of Science and technology. The concomitant effect is imprinted in the land use. "Land use change is a continuous process as a result of various natural and human factors. The study of land use requires a comprehensive understanding and monitoring of all the factors responsible for change" (Rahman *et al*., 2011). Landuse has been classified into eight categories. *i.e.* Miscellaneous tree crops, pasture land, cultivable waste, land under agricultural uses, uncultivable land, current fallow, other fallow and net sown area.

RESULTS AND DISCUSSION

Table 1 shows the changing pattern of land use of the Kendrapara district from 2001 to 2011. Changes over the 10-year period show that forest area cover only 25 thousand hectares from 2001 to 2011. But there are areas under the non agricultural land cover 26 thousand hectares in 2001 and increasing 59 thousand hectares in 2011. The Barren and uncultivable lands are decreased from 4 thousand hectares in 2001 to 2 thousand hectares in 2011. Permanent pasture and other grazing lands are increased from 7 thousand hectares in 2001 to 12 thousand hectares in 2011. Otherwise land under misc. trees and groves, culturable waste land, fallow land other than current fallow, current fallow land and net area sown land mostly decreased from 2001 to 2011 like 6 thousand hectares to 2 thousand hectares, 7 thousand hectares to 2 thousand hectares, 14 thousand hectares to 8 thousand hectares, 23 thousand hectares to 10 thousand hectares and 152 thousand hectares to 144 thousand hectares, respectively.

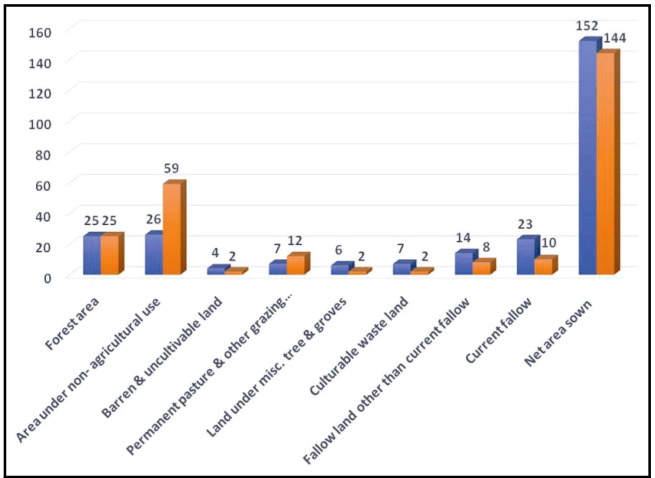

Fig. 1 : Land use change in 2001 to 2011 in Kendrapara district

Table 2 shows the pattern of land use in the Kendarapara District from 2001 to 2011. Changes over 10 years period shows that the land use has become more fragmented. Net sown land remains the principle cover in the district decreasing from 57.48% of total area in 2001 to 54.46% in 2011. The second most cover is non-agricultural land, which has increased from 9.83% in 2001 to 22.31% in 2011. The changes in land use from 2001 to 2011 have been quite diverse. The annual change index ranges from only 12.69 for rural settlement to -7.14 for culturable waste land. Other significant changes include 7.14% increase in pasture and grazing land and 5.6% decrease in current fallow.

Annual land use change index very clearly explains the landuse changing pattern of Kendrapara district between 2001 to 2011. There is no change in forest cover area in this decade from 201 to 2011. The decadal change in area under non-agricultural use is 12.481% and annual land use index is 12.692%. Decadal change in barren and uncultivable land is -0.756% and annual land use index is -5.0%. Decadal change in permanent pasture and other grazing land is -1.891% and annual land use change index is 7.142%. Decadal change in miscellaneous tree and groves is -1.512% and annual land use change index is -6.666%. Decadal change in culturable wasteland is -1.891% and annual land use change index is -7.142%.

Table 1 : Changing pattern of land use

Year	Total area (in '000 hectares)	Forest area	Area under non-agricultural use	Barren and uncultivable land	Permanent pasture and other grazing land	Land under misc. trees and groves	Culturable waste land	Fallow land other than current fallow	Current fallow	Net area sown
2001	264.4	25	26	4	7	6	7	14	23	152
2002	264.4	25	26	4	7	6	7	14	23	152
2003	264.4	25	49	4	7	6	7	14	21	131
2004	264.4	25	49	4	8	6	7	14	16	136
2005	264.4	25	51	1	8	6	7	14	12	140
2006	264.4	25	51	1	8	6	7	14	14	138
2007	264.4	25	51	1	8	6	7	14	14	138
2008	264.4	25	49	5	8	5	6	14	14	138
2009	264.4	25	59	5	8	5	6	14	6	146
2010	264.4	25	59	1	11	2	2	8	10	146
2011	264.4	25	59	2	12	2	2	8	10	144

Data Sources: Directorate of Economics & Statistics, Odisha

Table 2 : Land use changes between 2001 to 2011 in the Kendrapara district

	Area (ha.)		Area change (ha)	Per cent of total area		Change %	Annual landuse change index
Year/ land use	2001	2011		2001	2011		
Forest area	25	25	0	9.455370	9.455370	0	0
Area under non- agricultural use	26	59	33	9.833585	22.314674	12.481089	12.692308
Barren and uncultivable land	4	2	- 2	1.512859	0.756429	-0.75643	-5.000003
Permanent pasture and other grazing land	7	12	5	2.647503	4.538577	1.891074	7.142858
Land under misc. tree and groves	6	2	- 4	2.269288	0.756429	-1.512859	-6.666668
Culturable waste land	7	2	- 5	2.647503	0.756429	-1.891074	-7.142858
Fallow land other than current fallow	14	8	- 6	5.295007	3.025718	-2.269289	-4.28571483
Current fallow	23	10	- 13	8.698940	3.782148	-4.916792	-5.652173
Net area sown	152	144	- 8	57.488653	54.462934	-3.025719	- 0.526315
Total area (in '000 hect.)	264.4	264.4	--	100	100		

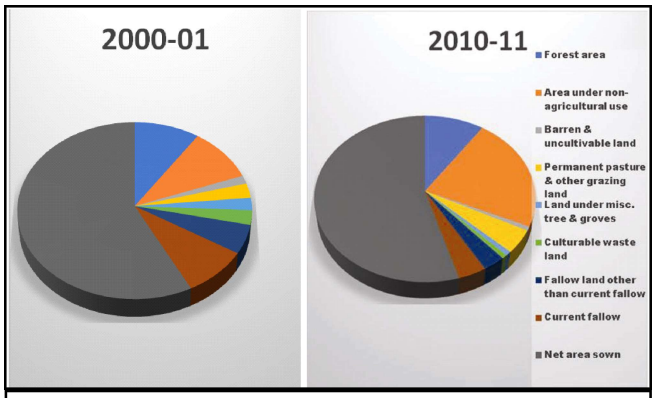

Fig. 2 : Pie diagram showing comparison of change in percentage of Land utilization out of total area

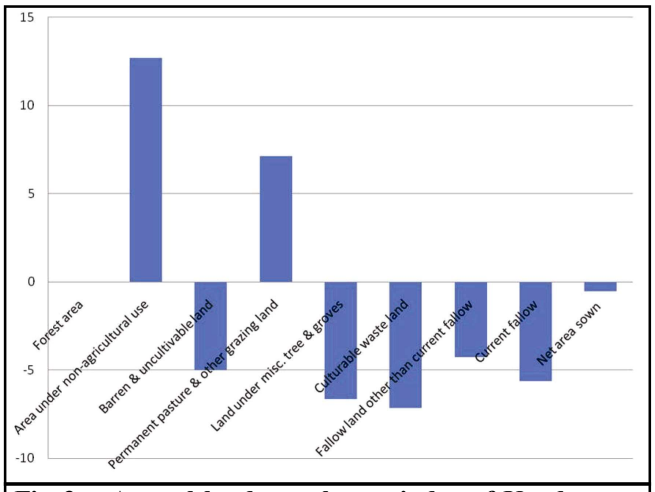

Fig. 3 : Annual land use change index of Kendrapara district

Decadal change in fallow land other than current fallow is -2.269% and annual land use change index is -4.285%. Decadal change in current fallow is -4.916% and annual land use change index is -5.652%. Decadal change in net area sown is -3.025% and annual land use change index is -0.526%.

Agriculture is the main occupation of the people of the study area. On the other hand, population pressure on land is increasing rapidly. As a result of which there is a remarkable change in land use pattern of the study area. The area under non-agricultural use and permanent pasture and other grazing lands are increasing at the cost of barren and uncultivable land, land under misc. tree and groves, culturable waste land, current fallow land, other than current fallow land, net sown area. Forest areas remain unchanged in this decade. Due to the heavy population pressure, the unused lands are converted to areas other non-agricultural use such as roads, bridges, buildings, commercial purposes, etc.

Suggestions and Conclusion:

Kendrapara district lies in the river delta region formed by the Brahmani, Baitarani and branch rivers of Mahanadi. The district is blessed with plenty of water resources, but due to lack of sufficient irrigation infrastructures, water logging and salinity problem are the major concern. Following are some of the suggestions and planning for the development of the rural land use of Kendrapara district.

(i) Intensive agricultural planning must be undertaken to increase the food security and to meet the challenges.

(ii) Quality of used land through irrigation and conservation of the fertility of land must be improved.
(iii) Waste land should be leased out to the landless farmers every year.
(iv) Proper measures should be adopted to increase the quality of waste land.
(v) Farmers need to be trained in order to consider the importance of rotation of crops leading to greater capacity of the land.
(vi) Agricultural research institution should be opened at the regional level to develop low cost technologies which would suit the needs of small and marginal farmers.
(vii) Proper financial support must be provided to the farmers to carry out their cultivation.
(viii) Use of appropriate methods of conservation and management of tools for maintaining and improving land fertility.
(ix) Earmarking each piece of land for specific uses, keeping in view the ecology and economic viability.
(x) Indicating potentialities of each piece of land through various levels of technological application.
(xi) Appropriate Governmental plan must be undertaken for proper drainage system in order to channelize the flood water.

The findings of this research will be beneficial for the decision makers to make plan for land sustainability and to develop strategy for the well-being of the rural inhabitants of the Kendrapara district.

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