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NEED TO PREVENT THE LAND DEGRADATION FOR SUSTAINABLE DEVELOPMENT OF AGRICULTURE SECTOR: A CASE STUDY OF KARNATAKA STATE

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ABSTRACT:

Land is the most important basic natural resource. It is a dynamic and complex combination of geology, topography, hydrology, soil and flora and fauna and influences every sphere of human activity. Different sectors including agriculture, industries, infrastructure, and power projects put forth competing demand for land. Subsistence farming practices, accelerated soil and water erosion, erratic rainfall, increasing population and high density of livestock population have all contributed to unsustainable land use that has lead to degradation of this valuable resource, in Karnataka. The main objectives of this paper are to study the present scenario of degraded land and to analyze the controlling measure to reduce the land degradation.

Out of the total geographic (1,91,79,100 hectares) area (TGA), 69,51,000 hectares or 36.24% of land in Karnataka is under the process of degradation (non-arable land) as per the data for 2011-15. Out of the total non-arable land in the state, 9.67 percent are rock lands are found in dry and transition zones (93.12%). About 27 percent of these lands have high slopes, high proportion of sloppy land occurs in hill zone (50.8 %) and coastal zone (35.32 %). Soil with less than 25 cms depth occurs in dry (39.6%) and transition zones (47.60%). Out of ***125.85 lakh hectares, 68 lakh hectares (57%) needs soil conservation****. The salinization has become acute problem in the command areas of the State. It is reported that nearly 10 percent of the total irrigated area in the State is subjected to water logging, salinity and alkalinity. Soil and water erosion has caused soil fertility loss, thus reducing its productive capacity. The soil structure, texture and moisture holding capacity are also affected due to soil erosion. While Karnataka at 36.24% of its land under degradation beats the national average of 29.32%, analysis with respect to TGA of the individual states.*

In a span of less than a decade, the State has seen over 100 sq. kms. of its area becoming irreversibly degraded, says a report by the ISRO. Using satellite imagery to study the extent of desertification between 2011 and 2013, the report shows that Karnataka is the fifth largest State in terms of land degradation. The State follows the arid Rajasthan, Maharashtra, Gujarat and Jammu & Kashmir in terms of degraded area. For controlling continues growing land degradation has urgently needs integrated approach and to planning for conservation to improve soil health and land degradation for sustainable development of a region.

Key Words : Land Degradation, Sustainable Development, Soil Health, Crop Combination, Valuable Resource, Integrated Approach.

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INTRODUCTION:

Land is the most important basic natural resource. It is a dynamic and complex combination of geology, topography, hydrology, soil and flora and fauna and influences every sphere of human activity. Different sectors including agriculture, industries, infrastructure, and power projects put forth competing demand for land. Subsistence farming practices, accelerated soil and water erosion, erratic rainfall, increasing population and high density of livestock population have all contributed to unsustainable land use that has lead to degradation of this valuable resource in Karnataka. Land is classified into two categories: arable and non arable. Non arable land comprises of area under forests, permanent pasture land, current fallow, cultivable waste land and land put to non agricultural use. Arable land includes area sown with crops (net sown area), area sown more than once and gross sown area. The extent of non arable land is 60.50 lakh hectares. Out of the total non-arable land in the state, 9.67 percent are rock lands. High proportion of rock lands occur in dry and coastal zones (about 15% each). Non-arable lands are strongly gravelly in about 79 percent in the state and a very high proportion (99.91%) is found in dry and transition zones (93.12%). About 27 percent of these lands have high slopes, high proportion of slopy land occurs in hill zone (50.85%) and coastal zone (35.32%). Soil with less than 25 cm depth occurs in dry (39.60%) and transition zones (47.60%). Erosion is a problem associated with non-arable land and 54.51 percent of the non-arable lands are severely eroded. Severe erosion of non-arable lands is a major problem particularly in dry zones (73.55%) and transition zones (97.05%).

The land and forest degradation has caused severe soil erosion in the maidan areas of Karnataka. The observed average rate of sedimentation is ranging between 2.19 to 23.59 hectare-meter/100 square kilometers, where as the threshold level is between 0.29 to 4.29 hectares. Most of the tanks have been silted up to more than 30 percent of their capacities reducing their command area by 35 percent. The rate of silt deposition in irrigated tanks is estimated at 8.51 hectare-meters/100 square kilometers/year against the assumed siltation of 3.02 hectare-metres/100 square kilometers/year. As per the estimates of the State Government about half of arable land in the State needs protection. Out of 125.85 lakh hectares, 68 lakh hectares (57%) needs soil conservation. The salinization has become acute problem in the command areas of the State. It is reported that nearly

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10 percent of the total irrigated area in the State is subjected to water logging, salinity and alkalinity.

Soil and water erosion has caused soil fertility loss, thus reducing its productive capacity. The soil structure, texture and moisture holding capacity are also affected due to soil erosion. Excessive chemical usage for agriculture is a problem in the cotton growing areas of the state. The average fertilizer used for growing paddy and sugarcane usually ranges between 80-150 kilograms/hectare. The arid regions of the state where rainfall is low are vulnerable to soil erosion. In a span of less than a decade, the State has seen over 100 sq km of its area becoming irreversibly degraded, says a report by the ISRO. Using satellite imagery to study the extent of desertification between 2011 and 2015, the report shows that Karnataka is the fifth largest State in terms of degraded land (Rajasthan, Maharashtra, Gujarat and Jammu & Kashmir). For controlling continues growing land degradation has urgently needs integrated approach and to planning for conservation to improve soil health and land degradation for sustainable development of a region.

STUDY AREA :

Out of the 1,91,79,100 hectares of total geographic area (TGA) of Karnataka state, about 69,51,000 hectares (36.24%) of land is under the process of degradation as per the data of 2011. The most significant process of land degradation in the Karnataka State is water erosion (26.29%) followed by vegetation degradation (8.39%). Karnataka has 80 percent of the land under rain fed cultivation and only around 20 percent covered under irrigation next only to Rajasthan. As much as 70 percent of the total geographical area of the state falls under arid climatic zone where the rainfall is scanty and the mean temperature is high. The rain-fed crop production is the most common practices in this region. As the state's major area falls in the arid and semi-arid zone, moisture is the major limiting factor in crop production. Out of 120.85 lakh hectares of cultivated area, 68 lakh hectares (57 percent of total geographical area) needs soil and moisture conservation treatment. Cropping intensity in the state is highest in the coastal area.

Soils have been degraded by human activities like intensive irrigated agriculture, over grazing, deforestation, enhanced industrial growth and contamination which has lead to water and wind erosion, soil compaction, salinisation, loss of nutrients and toxicity problems. Such degradation processes in turn limit the productive capacity of lands making it more difficult and expensive for the farmers to increase production of food, fiber and fodder. It is reported that about

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7.7 million hectares representing 40.3 percent of the total geographical area of the state is affected by various soil degradation problems in the three landforms of Coastal plains, Western Ghats and Eastern plain region. Water erosion is the major problem causing loss of topsoil and terrain deformation.

Table : 1. Land Degradation Level in Different Regions of Karnataka State.

Sl. No.	**Various Reasons for Land Degradation**	**No. of Districts**	**Area (in %)**
1	Excessive chemical use	Shimoga, Mandya, Bellary, Raichur	38.42
2	Excessive Pesticide use	Gulbarga, Vijayapur, Raichur	8.53
3	Soil erosion	All north-eastern plain Districts	18.37
4	Water erosion	Coastal and Western Ghat districts	26.29
5	Vegetation degradation	Western Ghat Region	8.39
	Total	Degraded Land	100% (69,51,000 hectares -36.24% to TGA)
	Total	Geographical Area of Karnataka State	100% (1,91,79,100 hectares-TGA)

OBJECTIVES:

The main objectives of this paper are :

- to study the present scenario of degraded land and to analyze the reason for land degradation..
- to plan for degraded land management (controlling measure) for reduce the land degradation.
- to conserve the basic resources of soil, rain water and vegetation,
- to achieve higher biomass production both in arable and non-arable areas,
- to imparting stability to crop yields through proper runoff water management, improve in situ moisture and developing suitable alternative land use systems.

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DATA BASE:

The necessary data to analyze the land degradation in Karnataka state are collected from various secondary sources, they are: Annual Reports of National Bureau of Soil Survey and Land Use Planning, Bangalore, State Statistical Annual Reports, Dept. of Agriculture and Irrigation, etc.

METHODOLOGY:

Using satellite imagery to study the level of land degradation (desertification) between 2001 and 2011, the report shows that Karnataka is the fifth largest State in terms of degraded land. The Karnataka state follows the arid Rajasthan, Maharashtra, Gujarat and Jammu & Kashmir in terms of degraded area. Over 36.24 per cent of the geographical area is desertified or degraded by various factors. This represents a 0.05 per cent increase since the last report in 2001. However, even this increase represents a worrying trend (said by head of the National Bureau of Soil Survey and Land Use Planning, Bangalore, which worked with ISRO for the study).

SCENARIO OF LAND DEGRADATION:

"Degradation has set in Karnataka and continues to grow as there is no integrated approach to improve soil health. The very definition of degradation means that it cannot be reversed in a man's lifetime". The primary cause of degradation is water erosion, which accounts for nearly a quarter of observable desertification in the State and vegetation degradation. The erosion is most apparent in rain-fed areas where there is an excessive number of sheep and goats. Over-grazing here leads to low regeneration of grassland and is a vicious cycle which sees more erosion, there needs to be "control" to ensure a balance of number of livestock and carrying capacity of the land. For Karnataka's forests, encroachments and lack of maintenance of replanting under forest development programmes have led to land being degraded. Degradation of land due to poor soil and water conservation measures, and lack of watershed approach has impacted the land in many ways. It is estimated that nearly 250 tons of soil per hectare is washed away annually. Realizing the importance of arresting land degradation, the state government launched watershed development programmes since the mid 80's.

The main causes for land degradation in Karnataka state:

- Soil and water erosion due to unsustainable practices leading to loss of fertility of farmlands.
- Excessive irrigation and faulty water regimes causing land degradation.
- Loss of vegetation and increasing pressure on the land capacity

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- Use of chemicals in agriculture which leads to soil and water contamination
- Mining and quarrying leading to land degradation
- Developmental activities fragmenting the landscape and habitats.

So far 29.10 lakh hectares been brought under watershed projects still more than 50 percent is uncovered and the target area to be covered under various watershed programs is 12.50 lakh hectares. One of the major environmental problems is fertilizer chemicals, which contaminate the soil and water. The green revolution triggered factors are influencing the fertilizer use all over the world. India accounts for 61 kilograms/hectare fertilizer consumption as compared to 54 kilograms/hectare of the world average.

Table 2: Karnataka : Different Category-wise Distribution of Land Degradation in 2001 and 2011.

Sl. No	Wasteland Categories	2000-01 (in 000 Hactares)	2010-11 (in 000 Hactares)
1	Gullied / ravinous land-Medium	5.11	6.42
2	Gullied / ravinous land-Deep	0.00	0.06
3	Land with Dense Scrub	5.46	8.25
4	Land with Open Scrub	6.52	0.31
5	Waterlogged and Marshy land-Permanent	3.23	1.70
6	Waterlogged and Marshy land-Seasonal	4.63	4.49
7	Land affected by salinity/alkalinity-Moderate	2.97	7.13
8	Land affected by salinity/alkalinity-Strong	0.35	0.30
9	Degraded notified forest land-Scrub dominated	5.32	4.10
10	Degraded notified forest land-Agriculture	4.85	5.86
11	Degraded pastures/grazing land	4.36	7.83
12	Degraded land under plantation Crops	7.04	0.54
13	Sands-Riverine	1.62	3.09
14	Sands-Coastal	7.22	4.65
15	Mining wastelands	6.36	4.10
16	Industrial wastelands	0.00	5.88
17	Barren rocky area	3.09	4.90
	Total Land Degradation Area	**68.13**	**69.61**

In Karnataka the average use of fertilizer is about 10-11 kilograms/ hectare which is appreciably less than the national average. The use of chemicals and fertilizers in the crop

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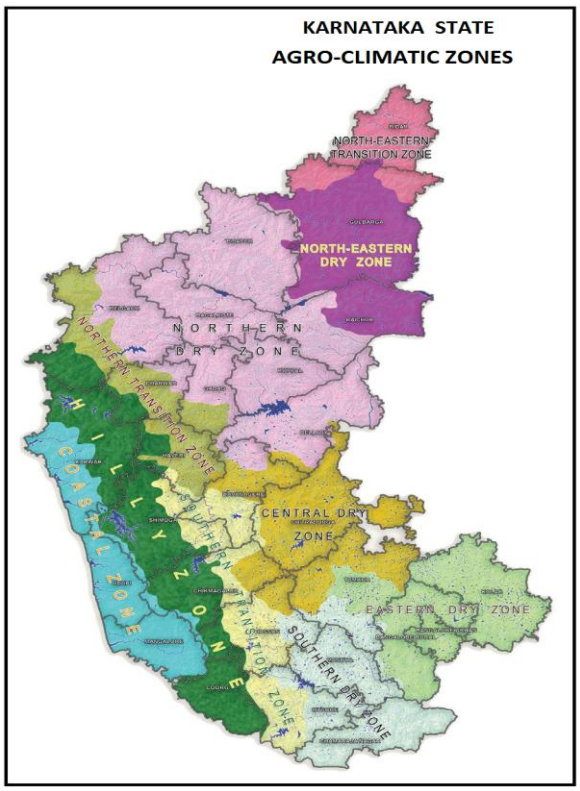
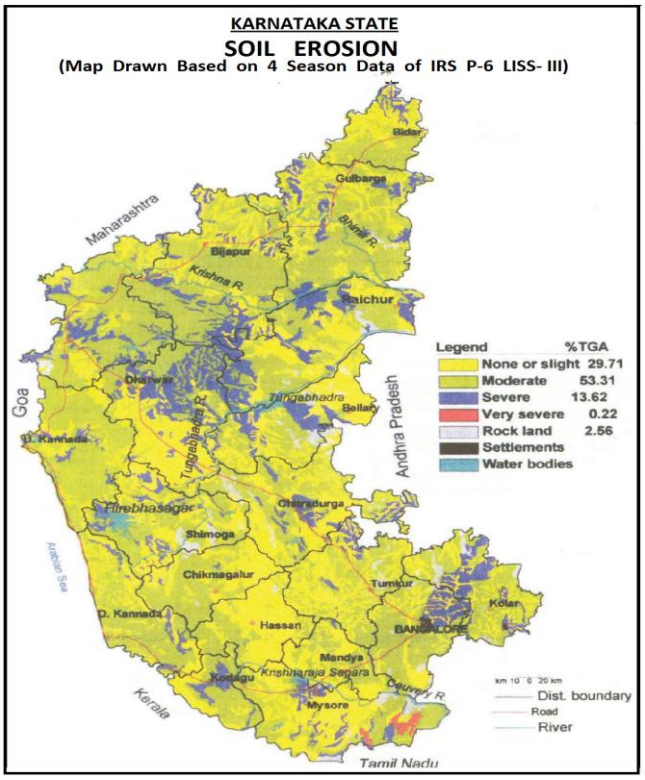
production is one of the major environmental concerns in the agriculture sector causing severe soil and water contamination. The chemical fertilizers use is increasing as the crop production practices such as use of high yielding varieties and intensive crop husbandry practices are very remunerative to the farmers. Similarly, the pesticides use to control pests and diseases are a serious problem in the crop production practices causing soil and water contamination.





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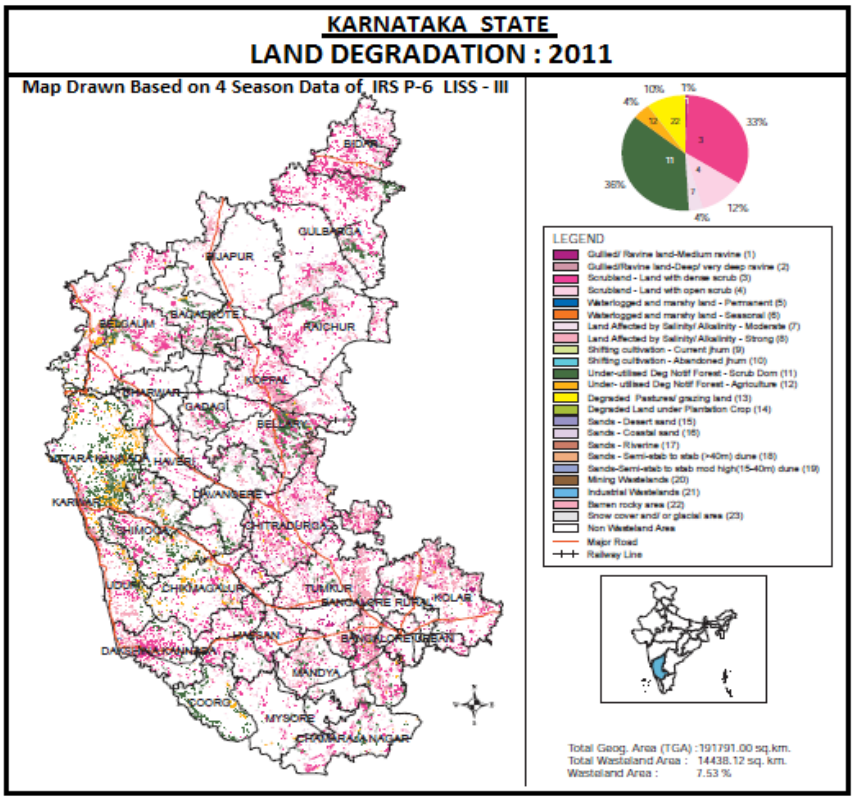

The use of fertilizers and chemicals is on the rise in the last five years. The per capita use of fertilizer in the state is high in the command areas of Krishna, Bhadra, and Cauvery compared to dry farming practiced in the Arid zone of the state. The average fertilizer and pesticide used in the state in the last four years has shown a rising trend whereas, the quantum of pesticides consumed during the same period has declined. In the last five years the types of fertilizers used is given in the table. The ratio of the different Nitrogen, Phosphorous, Potassium nutrient fertilizers used in the ratio of 3.10 : 1.55 : 1.00 respectively. There has been an increasing trend in the use of fertilizers in the last 10 years.

Table : 3. Major Fertilizers Consumed for Growing Crops in Agriculture Land.

Type	Year			
	1995-96	2000-01	2005-06	2010-11
Nitrogenous	5.17	6.05	6.38	6.63
Phosphorous	1.92	3.15	3.36	3.55
Potassium	1.17	1.89	1.74	2.16

Note :Fertilizers Consumption in Million Tons.
Source: Annual Reports of National Bureau of Soil Survey

The average consumption of fertilizer is also increasing over the years ranging from **100 kilograms/hectare to 115 kilograms/hectare in Karnataka** as compared 170

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kilograms/hectare in Andhra Pradesh and 150 kilograms/hectare in Tamil Nadu respectively. Similarly the all India average of fertilizer consumption is 87-90 kilograms/hectare/ year. Predominantly rice-growing states use maximum amount of fertilizers. Belgaum, Bellary, Raichur, Mandya and Davanagere consume maximum amount of fertilizers as in these districts the rice and sugar cane are the major crops cultivated. It is gratifying to note that the fertilizer consumption over the years has stabilized in Karnataka. In India, insecticides constitute the highest group (80%), followed by fungicides (10 %), herbicides (7 %) and others (3%). The average consumption of pesticide is very low in India (300 grams/ hectare) as compared to Japan (12,000 grams/ hectare). The pesticides, which are not easily biodegradable enter the aquatic fauna, herbivores and human body through food or water and is likely to bio-accumulate.

In Karnataka the use of pesticide is to protect crops like cotton, red gram and other vegetables is prevalent. Over the years the use of pesticides in Karnataka has declined due to several reasons. The most important cause is the ban imposed on the use of Di-chloro Di-phenyl Ttri-chloro ethane (DDT) and Benzene Hexa Chloride (BHC) and increased adoption of Integrated Pest Management. At present the total pesticide consumption is around 1692 tons indicating the declining trend. The two major crops on which the pesticide used are Cotton and Tur. However the pesticides used in the states of Tamil Nadu , Andhra Pradesh in rice cultivation is very high as compared to Karnataka.

In Karnataka ,more than 50 percent of the total pesticide used is in cotton followed by Tur and Rice however, the environmental load of pesticide is much less than Andhra Pradesh. Studies in the state have revealed that the Hexa chloro hexane (HCH) contamination in the ponds of coffee plantation in Chickmagalur was ranging between 0.02-0.2 parts per million. Where as in other states the contamination is around 0.2-0.5 parts per million indicating the comparatively lower level of residual effect in the state of Karnataka. Some of the studies conducted in Mysore reveal the enormity of pesticide residue in the vegetables. In one of the study conducted on residual insecticide in fruits and vegetables it is reported that Aldrin traces were found ranging between traces to 2 as compared to 35 and 25 in Andhra Pradesh and Delhi respectivel.

Table: 4. Insecticide Contamination in Vegetables (Sample Tests Showing in %).

Crops	Nil	BHC	DDT	HCH+DDT	Sample Size
Tomato	**05**	**67**	**14**	**14**	**100**

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Brinjal	44	15	25	16	100
Chillies	02	57	26	15	100
Peas	36	39	11	06	100
Cowpea	14	70	12	04	100
Potato	18	48	23	11	100
Cabbage	33	41	18	08	100
Cauliflower	14	37	36	13	100

Source: Laboratory Test.

Note: Nil – Nicotinamide iso-leucine**, BHC** - Benzene Hexa Chloride,
DDT- Di-chloro Di-phenyl Ttri-chloro ethane, **HCH – Lindane / hexa chlorocyclo hexane,**

Unsustainable agricultural practices have contributed to land degradation. Irrigation induced salinity and water logging is a common problem in the irrigation command areas. Drainage in these areas is taken for granted and receives scant attention. Salinity has become very acute in the command areas of Tungabhadra, Cauvery, Ghataprabha, Malaprabha, Upper Krishna, etc. Alkalinity is a serious problem in the recently developed areas of Upper Krishna Project. It is reported that nearly 1.27 lakh hectares of land is affected by water logging, salinity and alkalinity accounting for 10 percent of the total land under irrigation in the state.

There have been significant changes in the gross area sown in the state in the last five years due to increased irrigation potential. The gross sown area has increased from 117.59 lakh hectares to 120.02 lakh hectares in the last ten years. Similarly, the area sown more than once in an year has increased by about 18 percent indicating the pressure on the land. Among the crops the cereals and pulses area has remained same with marginal change. The area under the horticulture and plantation crops has increased over the last five years by about 20 percent. This additional area under plantation and horticulture has come either from wastelands brought under the cultivation or from the common lands that show the declining trend.

The net sown area under various crops has remained the same with marginal variation. However what is intriguing is the stagnation in the over all productivity of the state despite considerable increase in the area under irrigation and fertilizer use. The reason for the stagnation in productivity could be the decline in fertility due to land degradation. It has to be noted that the consecutive dry spells in 2003, have led to reduction in the area under Kharif crops. Mining and quarrying is another major activity which is causing land degradation. Sand quarrying has been very rampant in and around urban centers to meet the construction demand of roads and buildings.

The rivers and stream beds are mined causing water depletion. The common lands like gomals, tanks, road sides and railway lines are encroached and the solid wastes are dumped. The

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tanks and lakes are affected by siltation and infested with weeds like water hyacinths and others. The tank siltation is very common in many of the tanks causing tank breaches. In Bangalore city more than 125 tanks are in a highly degraded state due to solid waste dumping and encroachments.

Laterisation is a process of land degradation in the high rainfall areas leading to hardening of the soil due to washing away of iron and aluminum cat-ions. In the coastal districts the problem is severe due to deforestation and over grazing. The laterisation is a serious problem in the tropics as it results in the loss of surface soil and low ground water recharge. The water bodies such as river basins, tanks and river valleys continue to degrade due to increased human activities and lack of regulatory mechanisms. The common lands continue to degrade due to unsustainable land use practices by the community. The loss of gomal lands, pastures, tank beds, river basins and minor forests is very severe.

CAUSES FOR LAND DEGRADATION:

The factors responsible for degradation of land include unsustainable land use practices, overgrazing, poor control and regulation of common property resources and non- adoption of soil and water conservation measures. Due to excessive irrigation in the command areas and growing of water intensive crops such as paddy and sugarcane, groundwater levels are rising and as a result water logging has taken place. Since the groundwater levels are at or very near the surface, fresh water is evaporated leaving the salts back in the soil and as a result salinity of the soil and water is increasing gradually. Landscape fragmentation has adversely affected the ecological processes. Further, the hydrological cycles have been disturbed affecting water bodies and river basins, affecting the population and survival of plant and animal species. Soil erosion, loss of soil fertility, changes in the river/stream courses are some of the immediate manifestations of landscape fragmentation. Loss of vegetation has resulted in increase of temperature, wind speeds and other phenomena.

Unsustainable landscape management practices and absence of regulatory mechanism of common property resources have aggravated the problem. The policy governing the natural resources such as mangrove vegetation, non-forest habitats, river basins, water bodies, etc. are not adequately addressed with the exception of forestry sector. The policies on forest management though in place, the other natural resources like water, land and soil, coastal zone are not covered by any policy framework. The process of mining causes adverse impact on land. Open-cast

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mining scars the landscape, disrupts ecosystems and destroys microbial communities. The degraded environment created in the aftermath of open- cast mining often does support biomass development. In other words, extensively mined land usually does not possess sufficient surface soil to anchor plants, and the plant growth that does take place is inhibited by the presence of toxic metals. Over the long term, open-cast mining reduces forest productivity, damages aquatic and atmospheric ecosystems and sometimes leads to substantial alterations in microclimates.

The loss of vegetation in the river basins, catchments, encroachment of common property resources, sedimentation of water bodies due to mining and soil erosion have degraded the landscape. The common lands including Gomals (Village pasture lands), wastelands which are unfit for agriculture, tank foreshore areas, river banks, beaches, streams and canal banks are in a highly degraded state due to unregulated use of resources by the community.

The causes of degradation can be attributed to encroachment, excessive use of resources and lack of regulatory policy mechanism and agencies to protect these natural resources. Absence of any agency to regulate the natural resources is severely affecting the sustainability of these resources. The Joint Forest Planning & Management policy adopted in 1996 addresses peoples participation in the protection and management of natural forests. However the policy needs further modification and improvement to make it sustainable and viable. The land use policy governing crop cultivation is very weak and does not address and regulate unsustainable farming practices like monoculture, excessive use of water, non-adoption of multiple cropping pattern and land fallow practice.

The integrity and stability of the landscape is very critical in maintaining the structure and function of ecosystem. The landscape comprises various landscape elements such as forest ecosystem, water bodies, river basins, lakes and other such elements. Forest ecosystems play a critical role in regulating hydrological cycle. In Karnataka major rivers like Cauvery, Sharavathi, Kali, and Bhadra have their origin in the forests forming catchments. Any disturbance to these ecosystems will disturb the hydrological cycle. The deforestation has resulted in the floods, siltation of water bodies (rivers and streams) and lowering of water table. The inflow of water in the rivers has reduced over the years due to change in the rainfall pattern and disturbances in the hydrological cycle. The absence of integrated landscape management has resulted in degradation of landscape elements.

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Unscientific agronomic practices owing to traditional farming practices and low investment have also contributed substantially to land degradation. These include:

- Over tillage: Over tillage and cultivation along the slopes besides cultivating steep land are some of the causes for soil erosion and loss of fertility. Low infiltration and poor retention of moisture also contribute to land degradation.
- Soil compactness: Over grazing and absence of vegetation result in compactness of soil leading to the infiltration.
- Fallow lands and wastelands: Absence of vegetation and leaving the land fallow is also contributing for the compactness leading to low infiltration.
- Lack of crop rotation: Subsistence farming practices and poor adoption of crop rotations also contributes for nutrient depletion and land degradation.
- Excessive use of chemicals leads to loss of fertility.

PATTERNS OF LAND DEGRADATION:

The trend of land degradation is continuing with accelerated pace due to many socio-economic factors. The land use policy is not strong enough to regulate its use and has lead to degradation. Unregulated cropping practices, cultivation in the hills, shifting cultivation, slash and burn cultivation, excessive irrigation are some of the causes of land degradation. Indiscriminate use of pesticides and fertilizers, mono cropping, unregulated livestock population especially the unproductive cattle populations etc have contributed for the land degradation. As the state's major landscape falls in the arid and semi- arid zone, the moisture is the major limiting factor in the crop production. Subsistence farming practices, accelerated soil and water erosion, erratic rainfall, over population, and high density livestock population have contributed to the unsustainable land use practices leading to land degradation. As per a survey by the National Bureau of Soil Survey and Land Use Planning, out of 120.85 lakh hectares of cultivated area, 68 lakh hectares (57 percent of the total geographic area) needs soil and moisture conservation treatment.

Land degradation due to poor soil and water conservation measures and lack of watershed approaches has impacted the land in many ways. It is estimated that nearly 250 tons of soil per hectare is washed away annually. So far 32 lakh hectares has been brought under watershed projects; still more than 50 percent is uncovered. The rate of infiltration and siltation is very high in the arid zones indicating the severity of the problem. The use of chemicals and fertilizers

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and imbalanced nutrient management in agriculture is one of the major environmental concerns. There is an increase in chemical fertilizers usage with increasing crop production and use of high yielding varieties. Similarly the use of pesticides to control pests and diseases is a serious problem as it causes soil and water contamination.

The per capita use of fertilizer in the state of Karnataka is highest in the command areas of Krishna, Bhadra, and Cauvery as compared to dry farming practiced in the arid zone of the state. There have been significant changes in the gross area sown in the state in the last 10 years due to increased irrigation potentialities. The gross sown area has increased from 117.59 lakh hectares to 120.02 lakh hectares in the last ten years. Similarly, the area sown more than once in a year has increased by about 18 percent in the last ten years. Among the crops the cereals and pulses area has remained the same with marginal change. The area under the horticulture and plantation crops has improved over the last 10 years by about 20 percent. This additional area under plantation and horticulture has come either from wastelands brought under the cultivation or from the common lands.

HOT-SPOTS OF DEGRADED LAND:

The land and forest degradation has caused severe soil erosion in the maidan areas of Karnataka. The observed average rate of sedimentation is ranging between 2.19 to 23.59 hectare-meter/100 square kilometers, where as the threshold level is between 0.29 to 4.29 hectares. Most of the tanks have been silted up to more than 30 percent of their capacities reducing their command area by 35 percent. The rate of silt deposition in irrigated tanks is estimated at 8.51 hectare-meters/100 square kilometers/year against the assumed siltation of 3.02 hectare-meters/100 square kilometers/year. As per the estimates of the State Government about half of arable land in the State needs protection. Out of 125.85 lakh hectares, 68 lakh hectares (57 percent) needs soil conservation. The Stalinization has become acute problem in the command areas of the State. It is reported that nearly 10 percent of the total irrigated area in the State is subjected to water logging, salinity and alkalinity.

Soil and water erosion has caused soil fertility loss, thus reducing its productive capacity. The soil structure, texture and moisture holding capacity are also affected due to soil erosion. Excessive chemical usage for agriculture is a problem in the cotton growing areas of the state. The average fertilizer used for growing paddy and sugarcane usually ranges between 80-150 kilograms/hectare. The arid regions of the state where rainfall is low are vulnerable to soil erosion.

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IMPACT OF LAND DEGRADATION:

Accelerated soil and water runoff coupled with low water infiltration have resulted in reduction in the ground water table. The rate of soil and water erosion has caused siltation in the tanks and reservoirs. The dead water storage capacity of many of the reservoirs has been reduced due to accumulated silts in the reservoirs. The siltation of water bodies and the encroachment of common property resources have led to the loss of aquatic and terrestrial bio-diversity. The regenerative capacity of water bodies is lost due to prolonged periods of dryness and encroachment of the catchment area. Use of chemicals in agriculture has added to the problem. Fertilizers and pesticides applied on land are carried by water into water bodies where, algal bloom results from the accumulation of Nitrogen and Phosphorus. Algal bloom kills other aquatic life by blocking sunlight and limiting oxygen availability. Pesticides may accumulate in the bodies of aquatic organisms as a result of bio magnification. The hexa chloro hexane contamination was as high as 0.02 to 0.2 parts per million in the ponds of coffee plantation in Chikkamagalur.

Contamination of soil due to chemicals and fertilizers is a serious problem leading to the land degradation. In high rainfall areas, leaching of Calcium and Magnesium can lead to formation of soils with low pH (acidic soils). Availability of nutrients like Phosphorus and Boron gets reduced in such soils. The use of pesticides kill beneficial microbes in the soil and cause loss of fertility. The extensive use of fertilizers also affects quality of ground water. Agricultural chemicals also alter the pH of soil which in turn inhibits essential microbial activity. Soil erosion leads to the loss of fertile soil and nutrients leaving the soil barren and sterile. This leads to low water infiltration and low water recharge. This problem is very acute in some of the grey and dark taluks in the state. The socio-economic impact of the land degradation is quite enormous as the natural resources are depleted very rapidly. The water scarcity, salinity and water contamination also affect the health and productive capacity of people to a large extent. Low crop production, non availability of fodder and the loss of soil fertility has resulted in low crop production. In an effort to improve the yield the farmers resort to use of excess chemical fertilisers.

INITIATIVES OF GOVT. TOWARDS DEGRADED LAND DEVELOPMENT:

- The National degraded land Development Programme is being implemented in 26 districts. This programme involves reclamation of alkaline and saline lands for afforestation programme.

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- Under the integrated nutrient and pest management programs, the Agriculture department is providing green manure seeds and bio agents to the farmers.
- In order to ensure sustainable use of water, the Horticulture department is implementing drip irrigation programme on a vast scale.
- The Integrated degraded land (Wasteland) Development Programme is in operation since 1991. It envisages checking land degradation, putting wastelands to sustainable use and increasing the biomass availability, especially fuel, wood and fodder.

SUGGESTATION TO REDUCE THE LAND DEGRADATION:

- Bio-fertilizers (Eco friendly fertilizers): The use of chemical fertilizers and pesticides has resulted in tremendous harm to the environment. An answer to this is the bio-fertilizer, an eco friendly alternative now being used in many countries. Bio-fertilizers are organisms that enrich the nutrient quality of soil. The main sources of bio-fertilizers include bacteria, fungi, and cyno-bacteria (blue-green algae). Bio-fertilizers will help solve problems like increased salinity of the soil and chemical run-offs.
- Extensive use of chemicals in agriculture has degraded the soil quality to a great extent. In order to overcome the problem, organic farming practices and use of bio technology needs to be promoted through research and extension activities.
- Salinization due to extensive water logging should be addressed through adoption of cropping plan, bio drainage practices.
- Nearly 35 percent of the farmland is subjected to soil and water erosion in the state. There is an urgent need for adopting watershed practices to cover all the and masses that are vulnerable for soil and water erosion.
- Diversification of rain fed farming practices combining with tree cultivation needs to be promoted to reduce evaporation loss in the arid zones and to increase the farm income.
- To prevent further land degradation proper landuse and crop planning practices are to be developed tested and practiced.
- In the command areas, crop compensation for good farming practice including leaving land under fallow should be introduced. Additionally, use of organic manure should be rewarded with a higher farm harvest procurement prices. Distillers supplying spent fuels, as organic fuels should be rewarded.
- Knowledge regarding measures required for reclaiming degraded land and ensuring

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sustainable use of land should be made available to farmers through village societies.

- There is a need to increase awareness regarding sustainable agricultural practices like integrated nutrient and pest management practises, in situ generation and use of manure.
- Soil quality monitoring to check the physio-chemical and biological properties of soil should be conducted on a regular basis in order to capture significant enhancements or deterioration over time.

RECLAIMING THE DEGRADED LAND FOR SUSTAINABLE DEVELOPMENT:

Measures to be adopted to reclaim degraded land vary depending on the type and extent of degradation. In eroded areas, appropriate soil conservation measures can be implemented in addition to afforestation, building water harvesting structures and establishing horticultural fruit trees and grass lands. Areas covered by shallow ravines can be utilised for silvipasture which will also encourage livestock enterprise. Aerial seeding of grasses of improved strains like Marwar Anjan and 358 of Cenchrus ciliaris, Marwar Dhawan, 175 and 296 of Cenchrus setigerus etc. may also be tried to reclaim the shallow ravines. Erecting mechanical checks and stablisation of ravine slopes wherever possible should be taken up to prevent further degradation

In saline soils, the excess salts need to be flushed out. This can be achieved by irrigating the land and providing suitable vertical and horizontal subsurface drainage to wash away the excess salt. Once the salt concentration comes down, green manure crops can be raised followed by salt tolerant species like paddy and sugarcane. Suitable tree species such as Prosopis juliflora, Acacia nilotica, and Tamarix articulata are recommended for plantation in salt affected soils. Long-term field studies indicated that growing leguminous tree species such as Prosopis Acacia, Casuarina, etc., can help ameliorate alkali soils at much faster rate than non leguminous trees because of formers' ability to build-up soil nitrogen/organic matter status. Growing legume trees in highly sodic soils can contribute in their amelioration for crop production, in future.

Alternate furrow irrigation can be provided as a temporary measure allowing salt to accumulate in the un-irrigated furrows which can be scraped out and disposed. Soils with high salt content in rainfed areas need particular attention. In such areas, rain water conservation can be done together with application of organic manure and soil amendment. In the initial years, salt tolerant species like safflower can be grown. The other amendments useful for reclaiming salt affected soils include pyrite and organic manures. Sodic soils are those having high proportion of exchangeable sodium. In such cases, the sodium has to be replaced by Calcium. This can be done

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by adding gypsum to the soil. Growing green manure and leguminous crops is also beneficial in such soils.

For acidic soils, having pH less than 6.3, lime can be applied. In high rainfall areas, application should be done periodically as, the applied calcium is lost due to flushing. Soil crusting is another common problem in both red and black soils. Crusting is the formation of a thin hard layer on the surface of soil. It inhibits seed germination and percolation of water. Measures to curb crusting include breaking the crust after formation with the aid of a crust breaker or deep ploughing, improving organic content of soil and adding gypsum in sodic black soils. Soil productivity can be enhanced by adopting the integrated biotechnological approach. It involves the use of diverse organic materials (for example, such industrial wastes as pressmud, a by-product of sugar mills, and treated sludge, a by-product of paper mills) to build soil productivity. These organic materials, which nourish the depleted soil, can be supplemented by the planting of saplings that contain specialized cultures of endomycorrhizal fungi and such nitrogen-fixing bacteria as Rhizobium and Azotobacter.

DEGRADED LAND FOR SUSTAINABLE DEVELOPMENT:

Land degradation can be prevented by ensuring sustainable use of land. In non arable lands, soil conservation should be given the utmost priority. Options for soil conservation include live fencing, vegetative filter strips in diversion drains, gully control structures, loose boulder checks sunken ponds etc. In arable land, conservation measures adopted include contour vegetative hedges, gully control measures and adoption of contour cultivation systems. Proper drainage should be provided through natural or artificial means to ensure that excess water is drained from the area. Excess water from the field should be allowed to go out of the field into natural streams. Natural drainage can be provided by means of bio-drainage involving removal of excess groundwater through the process of transpiration by vegetation. This is achieved by enhancing transpiration capacity of the landscape by introducing high-water use vegetation types in large enough areas to balance recharge/discharge processes to maintain groundwater balances below the root zone of the agriculture crops

In addition, the concept of mulching wherein organic matter is applied on the surface of soil should be adopted. Mulching prevents excess evaporation and ensures enhanced availability of water. Soil fertility is also enhanced due to increased quantity of organic matter availability. Mulching can be done on both cultivated and fallow lands. For heavy black soils, vertical mulching

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is recommended to facilitate greater intake of rainwater. An increase of 25-30 percent was recorded in the yield in rabi sorghum at Sholapur and Vijayapur when vertical mulching was done at 5 meters interval.

Vegetative materials can be used as barriers for control of runoff and soil loss. These structures being porous, permit the runoff while retaining the soil and thus, overcome the problem of breaching. Vettiver, lemon grass, glyricidia and Cenchrus are some of the materials that have been evaluated with varying degree of success. While most barriers arrest soil loss and check the velocity of the overland flow, the yield improvements have been variable. Contour planting of vegetative barriers proved further beneficial in soil and water conservation. In marginal lands, alternate land use systems like agro-horticulture, agro-forestry can be followed. Useful trees like Acacia nilotica, neem, tamarind and jackfruit can be planted. Among the horticultural crop, mango, sapota etc can be planted. In degraded hill slopes, contour trenches and contour ditches can be dug in addition, high value fruit trees can be introduced with deep pits for individual trees.

In agricultural lands, lay farming involving rotation of a legume or a non-legume forage with cereals can be practiced. This system improves soil quality besides providing fodder. can be implemented in addition, green manure method in which, a quick growing crop is grown and ploughed under the soil to increase the supply of nitrogen and organic matter can be adopted. Green manure supplemented with bio-fertilizers can increase crop production by as much as 40-55 percent. To reduce dependence on fertilizers and pesticides, integrated nutrient and pest management practices can be adopted. Annual crops cultivated on land capability Class IV and above are prone to lower yields/risks, and lack of response to inputs. Soils in these capability classes can be best utilized for alternative land uses where self generating grasses, legumes and perennial woody tress constitute the major components. Agro-forestry approach includes agrisilviculture, agrihorticulture, hortipasture and silvipasture. Management of lands of lower capability through such interventions is the best way of integrating livestock production in rain-fed areas and contributing to the sustainability of the production system. Alternate land use not only provide fodder, fuel wood and timber and fruits but also enhance the quality of resource base through greater biomass production and providing a land cover for most part of the year which constitutes the basic step for control of soil erosion by wind and runoff. Off-season rainfall which otherwise goes un-utilised in single kharif cropping areas can thus be best utilized with such production systems. Trees also make the microclimate more favorable to crop growth.

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CONCLUSION:

As per the estimates of the State Government about half of arable land in the State needs protection. Out of **125.85 lakh hectares, 68 lakh hectares (57%) needs soil conservation**. The salinization has become acute problem in the command areas of the State. It is reported that nearly 10 percent of the total irrigated area in the State is subjected to water logging, salinity and alkalinity. Soil and water erosion has caused soil fertility loss, thus reducing its productive capacity. The soil structure, texture and moisture holding capacity are also affected due to soil erosion. While Karnataka at 36.24% of its land under degradation beats the national average of 29.32%, analysis with respect to TGA of the individual states. Land degradation of land is a major problem associated with non-arable land (54.51 % of the non-arable lands) is a major problem particularly in dry zones (73.55%) and transition zones (97.05%). As per the estimates of the State Government about half of arable land in the State needs protection.

In a span of less than a decade, the State has seen over 100 sq. kms. of its area becoming irreversibly degraded, says a report by the ISRO. Using satellite imagery to study the extent of desertification between 2011 and 2013, the report shows that Karnataka is the fifth largest State in terms of land degradation. The State follows the arid Rajasthan, Maharashtra, Gujarat and Jammu & Kashmir in terms of degraded area. Over 36.24 per cent of the geographical area is desertified or degraded. This represents a 0.05 per cent increase since the last report in 2003-05. However, even this increase represents a worrying trend, said by the National Bureau of Soil Survey and Land Use Planning, Bangalore, which worked with ISRO for the study. For controlling continues growing land degradation has urgently needs integrated approach and to planning for conservation to improve soil health and land degradation for sustainable development of a region.

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