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**Effects of Urbanization on Multiple Cropping Patterns in  
Coastal Districts of India**

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## **Effects of Urbanization on Multiple Cropping Patterns in Coastal Districts of India**

### **Abstract**

*Coastal area protects from natural disasters and provides livelihood to population. But over the period of time, industrialized has grown across the coastal area in India. Such industrialization has created higher employment opportunities. Educational achievements of the population of coastal districts are higher as compare to the non coastal districts. Workers engaged service sector activities are higher as compare to non coastal districts in India. Random effect regression results show that the area under non agriculture use is higher in coastal districts. Cereals and rubber production is positively significant in coastal districts. Multiple cropping patterns are negatively co-related to the coastal districts. The policies like community participation, waste recycling of various industrial units, protection of the mangroves and strict implementation of the coastal regulation zone laws will protect the coastal area.*

**Keywords:** Land use, Infrastructure index, Random effect

### **Introduction**

A coastline of India is characterized by several ecosystems and resources. Such ecosystem is characterized by the several economic resources. It consists of man grows, water bodies, sea woods, coral reefs, fisheries and other marine life and marine vegetation. In coastal districts, large economic activities such as construction of ports, jetties, ship building and breaking large export based manufacturing including oil refinery and petroleum based industries; agriculture, tourism aquaculture and fisheries etc. are located. Coastal ecosystem protects the region from saline winds, cyclones, tsunami, waves etc. It promotes raw materials for the number of manufacturing activities. The population in cities is generally increasing because they provide easy access to ocean, rivers beaches and other natural areas and are a good source for raw material and food. In addition, they provide good access to jobs, employment, housing and port access to a wider market (Demitrios E. and Maria V. 2005). Similarly availability of water, cheap manpower, land industry friendly government and new global economic policies saw major expansion of industrialization in the coastal districts.

Population growth and migration has affected on ecology and livelihood of the coastal area. The activities such as intensive agriculture, aquaculture, mining quarrying, infrastructure, industrial, tourism are also taking place in coastal districts. The coastal districts are facing the problem of salinity of land, water depletion and degradation of the coastal ecosystem. The green revolution has resulted in excessive use of the fertilizers, pesticides, seeds and irrigation. Intensive agriculture does not guarantee the adequate care of the land and water resources. The adverse effects are taking place such as destruction of man grows, seawater ingress through shrimp forms and overuse of ground water. Excessive industrialization and agriculture cultivation has resulted in exposing the coast

to strong winds, storms and tsunami waves. It further affecting on safety and security of coastal population. Several states have promoted mining and minerals based industries across the coastal districts. Polluted industries and infrastructure projects like ports and jetties, highways etc. are located on the coast. Excessive activities and disposal of discharges have frequently led to excessive salinity as well as excessive pollution of land, air and water resources in the coastal districts. Mangroves are essential for coastal protection biodiversity, conservation and many other direct and indirect advantages. Mangrove ecosystems are valuable to humankind both in terms of their direct market values and indirect ecological services (Mitra R.et.al.2006). Mangrows are consumed by households in coastal areas a fuel wood for construction of boats and houses and as food. It is also used as household medicines. It is source of fodder for animal husbandry. Several households are cutting and selling mangroves during drought. They also use as a fuel wood. Mangrows support breeding of fish, prawn, shrimp turtles crabs and many other sea lives. The seas outside of mangroves are always found to be rich in fishery and aquaculture. Mangroves also protect agriculture by preventing saline water from entering agriculture land. Mangrows are raw material in manufacturing a large variety of products like alcohol and vinegar, gum, honey and other medicines. (Hirway I. and Goswami S.1999). Industrial, port, urban, tourism related industry and mining have impact on mangrove ecosystems, other coastal resource systems and coastal environment in general (Chuenpagdee R.2003). There is continuous discharge of chemicals, gases in the coastal districts by different industrial units. Many industrial units are discharging the industrial waste water in the sea. Fishing activities are affected due increasing use of the chemicals, fertilizers and pesticides in agriculture. Higher pressure of urbanization has forced the fisher community to shift from the traditional fishing to other activities. Farmers cannot cultivate land due to higher pollution and lack of financial assistance of the government. Their livelihood is in dangerous position due to the government policies. Higher urbanization and industrialization has resulted into the scarcity of drinking water. There is no plan to connect all habitations with safe drinking water on sustainable basis. The women and girls are spending hours and hours to collect few liters of safe drinking water from longer distance. In coastal districts, over the period of time, the demand for sweet water for irrigation purposes has increased. It further leads to depletion of ground water resources. The sea water is entering inside the long sea coast where the water table becomes saline. Such entry of the saline water resulted in sweet water crisis across the coastal districts in India. Due to scanty rainfall and deforestation, water tables are not fulfilled on regular basis in coastal districts. There are no government efforts to control the salinity across the coastal districts.

The first section part of the paper explains about the land use patter, work force participation and educational profile of the coastal and non coastal districts population. The second section of the paper deals with random effect regression result and last section gives the policy implication.

## CMIE Index

In order to calculate the infrastructure index we have used the eleven indicators and the indices have been computed for different coastal and non coastal districts.

The Village electrified railway route per 100 sq.km of area, surfaced roads per 100 sq.km. of area, un-surfaced roads per 100 sq.km. of area, gross irrigated area as percent of gross cropped area, bank branches per lakh population, post offices per lakh population, telephone lines per 100 persons, primary schools per lakh of population, hospital beds per lakh of population, primary health centers per lakh of population are the major indicators. The value of the indicator is calculated as follows

$$Y_{ij}=100*x_{ij}/x_{iA}$$

Where

$x_{ij}$ : value of the  $i^{\text{th}}$  indicator for the  $j^{\text{th}}$  district

$x_{iA}$ : value of the  $i^{\text{th}}$  indicator for all India

The infrastructure Index for the  $j^{\text{th}}$  district denoted by  $I_j$  will be defined as

$$I_j=\sum_{i=1}^{11} w_i y_{ij}$$

It is evident that each of the value of  $y$  for all India would be equal to 100 and subsequently, the Infrastructure Index for India would always be equal to 100. The composition of the index is done for year 1995 (CMIE 2000). We have classified such index according to coastal and non coastal districts and states. The results are presented in the following table.

Table 1 CMIE index in coastal and non coastal districts

States	Coastal districts	Non coastal districts
Andhra Pradesh	107.06	103.84
Kerala	144.46	120.24
Maharashtra	105.77	99.29
Tamilnadu.	173.09	131.78
Karnataka	102.30	96.20

Source: CMIE report 2000

Above table shows that CMIE index for the coastal districts in Tamil Nadu is 173.09. In Tamilnadu higher growth of the urbanization and industrialization is observed. Similarly bank branches, post offices, telephone lines, hospital beds and public health centers per lakh population are higher. In Karnataka, the CMIE index in coastal districts is only 102.30. The CMIE index in the non coastal districts is very low for Karnataka (96.20) and Maharashtra (99.29). In Maharashtra, only Mumbai city has the higher infrastructure facilities. The non coastal districts are lagging far behind as far as different infrastructure facilities are concerned. The CMIE index is higher for (131.97) non coastal districts.

### Land use pattern in coastal and non coastal districts:

Due to industrialization and urbanization, the land use pattern has changed in coastal districts. Government policy towards coastal area development is not new in India. Since the British period, most of the trade and commerce activities are located in the coastal area. The people of coastal districts have given their land for industrial

purposes and new special economic zones are planned across the coast in India. Urbanization is depending on how much industrial area in each coastal district and state.

Table 2 Area under non agriculture use and net sown area

States	Area under non agriculture use		Net sown area	
	Coastal districts	Non coastal districts	Coastal districts	Non coastal districts
Andhra Pradesh	14.41	14.60	41.62	35.95
Kerala	14.86	6.76	60.50	46.32
Maharashtra	19.96	4.56	22.28	60.91
Tamilnadu	20.07	19.06	44.30	38.96
Karnataka	9.12	8.41	22.33	57.21

Source: Land use statistics

Above table shows that in coastal districts of Tamilnadu, 20.07 percent and in non coastal districts, 19.06 percent land is under non agriculture use. The land for non agriculture use is similar in the coastal and non coastal districts of Tamilnadu. It is complete opposite in Maharashtra. In non coastal districts, only 4.56 percent area is under non agriculture use. It is observed that in Kerala, 60.50 percent area of coastal districts is net sown area. In Maharashtra, it is only 22.28 percent. In Maharashtra, coastal area is located in Thane, Mumbai, Raigad, Ratnagiri and Sindhurg district. Agricultural land is not suitable for various crops and the rain water meets to Arabian Sea due to the steep slope of the land. Secondly lack of sweet water, irrigation and storage facilities has reduced the possibility of agriculture area sown in coastal districts. As far as non coastal districts are concerned, then in Maharashtra 60.91 percent area is net sown area. In Andhra Pradesh, net sown area is only 35.95 percent of the total area. The reason is that due to heavy rain, unfertile land, it is not possible for the farmers to cultivate more land.

In each coastal district, forest land has economic and ecological significance. Similarly uncultivable land is higher due to high tide water enters in various villages. Therefore the uncultivable land is higher in the coastal districts. Similarly the coverage of the forest was higher in the coastal districts but due to over industrialization and urbanization, the mangroves are getting cut and the area is used for residential and industrial purposes.

Table 3 Forest, Barren and uncultivable land

States	Forest land		Uncultivable land	
	Coastal districts	Non coastal districts	Coastal districts	Non coastal districts
Andhra Pradesh	20.82	20.28	8.42	6.58
Kerala	18.25	42.86	0.84	0.41
Maharashtra	15.10	15.52	18.47	3.72
Tamilnadu	10.01	16.70	4.07	3.62
Karnataka	44.80	12.78	5.74	4.04

Source: Land use statistics 2005-06

In Karnataka, nearly 44.80 percent of land is forest land in coastal districts. In Tamilnadu, it is only 10.01 percent. In non-coastal district, Kerala has 42.86 percent of forest cover in different districts. In Karnataka, it is only 12.78 percent. Therefore we can say that in Karnataka, coastal districts show the highest coverage of the forest area whereas non coastal district shows the very low coverage of forest area.

In Maharashtra, the coastal districts have 18.47 percent of land is Barren and uncultivable. In coastal district, the sea water enters in the plain surface area. Similarly steep slope meets Arabian Sea. Therefore the uncultivable land is high. In Kerala, such land is only 0.84 percent in different coastal districts. In Kerala, non coastal districts only 0.41 percent land is barren and uncultivable. In Andhra Pradesh 6.58 percent of land in the non coastal districts is barren and uncultivable. Now a day's most of the land is kept fallow due to scarcity of rainfall and majority of the population living under poverty condition. Majority of the farmers raised crops under rain fed condition which resulted in economic loss and financial risks to farmers (Nandhini U. S. et.al. 2006).

Over the period of time population pressure on land is increasing and more and more land is brought under cultivation and for industrial purposes. The grazing land is also not available and it is easily transferred for different purposes.

Table 4 Permanent pasture and other grazing land

(Per cent)

States	Coastal districts	Non coastal districts
Andhra Pradesh	2.5	2.28
Kerala	0.0	0.01
Maharashtra	3.06	4.48
Tamilnadu.	0.62	0.98
Karnataka	2.89	5.15

Source: Land use statistics 2005-06

Above table shows that in Kerala, the permanent pasture and other grazing land is nil in coastal districts. In non coastal districts, it is only 0.01 percent land is permanent pasture and other grazing land. It is highest as far as other states are concerned. In non coastal districts of Karnataka state, the permanents pasture and other grazing land is 5.15 percent.

Total cropped area shows the different crops cultivated during different seasons. Similarly net sown area more than once is an important indicator of the farming activities in various districts. In recent years, due to lack of assistance by the government, farmers are giving their land for industrial purposes. Similarly number of employment opportunities other than agriculture has increased over the period of time in coastal area. Therefore farmers are not ready to cultivate their land. The multiple cropping is possible with encouragement by the government where farmers can maximize their income and purchase different assets which required for agriculture.

Table 5 Total cropped area and area sown more than once

(Per cent)

States	Total cropped area		Net sown area	
	Coastal districts	Non coastal districts	Coastal districts	Non coastal districts
Andhra Pradesh	58.59	43.76	17.50	7.81
Kerala	81.59	71.34	21.08	25.02
Maharashtra	21.19	72.54	1.09	10.59
Tamilnadu	45.81	42.18	4.92	5.83
Karnataka	22.60	67.84	3.36	12.72

Source: Land use statistics 2005-06

In Kerala, total cropped area in coastal districts is 81.59 percent. In Maharashtra, it is 21.19 percent. In Non coastal districts, Maharashtra has 72.54 percent of the total cropped area. In Tamil nadu, it is 42.18 percent. In Maharashtra, the area sown more than once is only 0.9 percent in coastal district. In Kerala, it is 21.08 percent. In non-coastal districts in Kerala, the area sown more than once is 25.02 percent. In Tamilnadu, it is 5.83 per cent.

In the coastal and non coastal districts, the environment for different crops is favorable and unfavorable. We have selected some crops and tried to understand the difference in the area of production. Some crops cannot be cultivated in the coastal districts; therefore they are excluded from this analysis.

Table 6 Area of major crops in coastal and non coastal districts

(Per cent)

Crops	Andhra Pradesh		Kerala		Maharashtra		Tamil nadu		Karnataka	
	coastal	Non coastal	Coastal	Non coastal	Coastal	Non coastal	coastal	Non coastal	coastal	Non coastal
Rice	8.38	11.92	0.99	0.55	1.46	0.14	2.08	3.47	0.63	2.79
Jawar	1.12	1.21	0.00	0.03	0.00	6.85	3.67	3.80	0.00	2.01
Cereals	2.78	1.48	0.00	0.16	0.00	13.49	0.44	1.82	0.0	6.09
Oilseeds	14.99	22.92	38.61	13.68	3.41	17.54	15.72	15.66	9.31	22.65
Fresh and dried fruits	1.68	5.24	11.60	11.40	7.53	1.65	5.10	3.41	3.73	2.53
Sugarcane	2.02	4.31	0.10	0.41	0.00	2.38	3.27	3.34	0.47	2.95

Source: Land use statistics 2005-06



The rice production in non coastal districts of the Andhra Pradesh is 11.92 per cent as compare to all crops. In non coastal districts of Maharashtra, the rice production is only 0.14 per cent. The Jawar production in non coastal districts of Maharashtra is 6.85 percent. In coastal districts of Karnataka, Kerala and Maharashtra, there is no Jawar production. The Cereals production in coastal districts of Maharashtra is 13.49 percent. In coastal districts of the Karnataka, Maharashtra and Kerala has no cereals production. Oilseeds production in the coastal districts of Kerala is 38.61 percent. In coastal districts of Karnataka, such production is only 9.31 per cent.

The production of the fresh and dried fruits in the coastal districts of Kerala is 11.60 percent. In non coastal districts of Andhra Pradesh, it is only 1.65 per cent. In non coastal districts of Andhra Pradesh, the sugarcane production is 4.31 percent. In Coastal districts of Maharashtra, there is no sugarcane production.

### **Educational profile of the population:**

Education helps individuals to accumulate and process information. The returns of technical and higher education is widely known. Highly educated population always search and migrate towards the higher income and employment opportunities. We have tried to understand the link between the coastal and non coastal districts and the educational profile of the people. This is mainly because costal districts are providing more employment, self employment and business opportunities.

Table 7 Education profile of the population (Per cent)

States	Category	Primary	Secondary	Higher secondary	Graduate and above
Andhra Pradesh	Coastal	33.23	14.31	6.25	6.57
	Non coastal	29.48	14.47	8.73	6.73
Kerala	Coastal	23.78	18.01	6.27	5.8
	Non coastal	24.56	17.16	5.8	4.48
Maharashtra	Coastal	27.61	16.36	7.04	7.31
	Non coastal	25.78	14.93	7.17	5.87
Tamil nadu	Coastal	30.67	14.1	6.39	4.52
	Non coastal	27.47	14.81	6.46	5.56
Karnataka	Coastal	31.03	14.3	5.9	6.3
	Non coastal	28.23	16.54	6.59	6.42

Source: Census 2001

As far as primary education is concerned then the Tamil nadu has 30.67 percent of the primary educated population in coastal districts. In Kerala, 23.78 percent of the population is primary studied. As far as secondary education is concerned then the coastal districts of Kerala has 18.01 percent secondary studied population. In Tamil nadu, coastal districts have 14.10 percent literate population. Higher educated population in the non

coastal districts is 8.73 percent. In non coastal districts of the Kerala has 5.80 percent of population which is higher secondary studied. Graduates and above are 7.31 percent in the coastal districts of the Maharashtra. In non coastal districts of the Kerala, the graduate and above studied population is 4.48 percent

### Work force participation:

Work force participation is nothing but the labor participating in different economic activities. The work force participation is given in the following table.

Table 8: WPR among the workers

(Per cent)

States	Coastal districts	Non coastal districts
Andhra Pradesh	58.14	54.91
Kerala	49.76	53.35
Maharashtra	54.92	52.21
Tamilnadu.	55.64	59.15
Karnataka	55.60	56.69

Source: Census 2001

Work participation rate among the coastal districts of Andhra Pradesh is 58.14 percent as compare to other coastal districts. It is opposite in the non coastal districts of Kerala where 53.35 percent of workers have WPR. In Maharashtra nearly 54.92 percent of workers in coastal districts have WPR. In non coastal districts, it is 59.15 percent. It means that the workers are more involved in work in the non coastal districts. In Tamil nadu, small and large industries are located in the non coastal districts. Similar situation is observed in the Kerala state.

The work force participation is almost similar in both the coastal and non coastal districts of various states but it does not show the variation in different activities. We have tried to understand each employment category in more detail manner.

Table 9 Cultivators and agricultural labors in coastal and non coastal districts

(Per cent)

States	Cultivators		Agricultural labors	
	Coastal districts	Non coastal districts	Coastal districts	Non coastal districts
Andhra Pradesh	14.41	14.60	41.62	35.95
Kerala	14.86	6.76	50.50	46.32
Maharashtra	19.96	4.56	22.28	60.91
Tamilnadu.	20.07	19.06	44.30	38.96
Karnataka	9.12	8.41	22.33	57.21

Source: Census 2001

The above table shows that in Andhra Pradesh, cultivators in non coastal districts are 14.60 per cent. It is slightly higher than the coastal districts. But in Kerala, cultivators are 14.86 percent in coastal districts. In non coastal districts, it is 6.76 per cent. In

Maharashtra, WPR among coastal districts workers is 4.56 percent. It is low because Maharashtra is highly industrialized state. Most of the people are involved in the business and industrial production. In Tamil Nadu, 20.07 percent of the workers of coastal districts are cultivators. In Karnataka, 9.12 percent workers of coastal districts are cultivators. It is again higher as compare to the cultivators in the (8.41 percent) non coastal districts.

As far as agriculture laborer in the coastal districts of Maharashtra is concerned then agricultural laborer in coastal districts are 22.28 percent whereas in non coastal districts it is 60.91 percent. In Greater Mumbai and Mumbai suburbs district, agriculture tasks are not present. Therefore such proportion is very low. But in non coastal districts, the agriculture laborers are 60.91 percent. Agricultural labours in coastal districts of Tamil Nadu are 44.30 percent. In non coastal districts, it is 38.39 percent.

Workers engaged in the livestock, mining and quarrying are depending on the local resources. If there is more area as a grazing land, dairy close to village, veterinary doctors then farmers have more livestock as animal assets. Similarly in the coastal districts if mining is located then more workers get involve in the mining activities.

Table 10 Workers engaged in livestock, mining and quarrying

(Per cent)

States	Livestock		Mining and quarrying	
	Coastal districts	Non coastal districts	Coastal districts	Non coastal districts
Andhra Pradesh	3.85	2.94	0.60	1.88
Kerala	14.82	12.84	1.08	0.67
Maharashtra	3.22	2.40	0.86	0.54
Tamilnadu.	3.05	3.88	0.61	0.57
Karnataka	16.55	5.50	1.18	0.71

Source: Census 2001

Above table shows that the workers engaged in livestock are 16.55 percent in coastal district of Karnataka. In Tamil nadu, 3.05 percent of workers are engaged in livestock. Dairy sector is less developed in Tamil nadu. Most of the workers are engaged in the textile and garment related products. In non coastal districts in Kerala, 12.84 percent of workers are engaged in the livestock. The lowest 2.40 percent of the workers engaged in the livestock in Maharashtra. In coastal districts of Maharashtra, workers do not find the jobs which are related to the livestock. It is less developed as compare to other states. Therefore the lower workers are involved in the livestock in coastal districts.

In Karnataka, workers involved in mining and quarrying are 1.18 percent. In non coastal districts, only 0.71 percent workers are involved in quarrying. In Andhra Pradesh, 0.60 percent of workers of coastal districts are involved in mining and quarrying where as 0.57 percent of workers is engaged in such activity in the non coastal districts. In the coastal area there are number of employment opportunities are available in the different sectors. Production is mainly taking place in the small, large industrial units. Household units are also involved in the various productive activities in urban area. The workers are involved in various productive activities but it depends on urbanization in each state.

Table 11 Workers engaged in manufacturing, processing, and manufacturing, processing and others in HI

(Per cent)

States	Manufacturing, processing		Manufacturing, processing and others in HI	
	Coastal districts	Non coastal districts	Coastal districts	Non coastal districts
Andhra Pradesh	2.97	3.61	6.73	7.39
Kerala	2.50	2.04	11.14	6.27
Maharashtra	2.31	2.05	19.36	6.88
Tamilnadu.	2.82	3.68	6.30	11.19
Karnataka	2.93	2.71	9.83	6.46

Source: Census 2001

Above table shows that 2.93 percent of the workers of coastal districts of Andhra Pradesh are involved in manufacturing and processing. In non coastal districts of Tamil nadu 3.68 percent of the workers are involved in the manufacturing and processing in HI. In coastal districts of Maharashtra, 19.36 percent of workers are engaged in manufacturing and processing in HI and others. In Tamil nadu, it is only 6.30 percent. In non coastal districts 11.19 percent of the workers of the Tamil nadu are engaged in the manufacturing and processing in HI and others. Such activities are more developed in the non coastal districts.

In coastal area, construction activities are always going in industrial and real estate sectors. Workers are getting employment in such construction activities. Similarly trade and commerce are also providing number of employment opportunities.

Table 12 workers engaged in construction, trade and commerce

(Per cent)

States	Construction		Trade and commerce	
	Coastal districts	Non coastal districts	Coastal districts	Non coastal districts
Andhra Pradesh	4.45	4.70	9.04	9.56
Kerala	11.89	6.29	15.30	8.17
Maharashtra	6.23	4.06	6.88	8.17
Tamilnadu.	5.55	4.38	6.95	8.42
Karnataka	8.97	4.15	11.61	9.21

Source: Census 2001

In coastal districts of Kerala, 11.89 percent of workers are engaged in construction activities. In non coastal districts 6.29 percent workers are engaged in non coastal districts. In both coastal and non coastal districts, the proportion of the workers in construction activities is more as compare to other states. In coastal districts of Andhra Pradesh, 4.45 percent of workers are engaged in the construction activities. Nearly, 15.30 percent of coastal districts workers are engaged in trade and commerce in the Kerala. In Maharashtra, it is only 6.88 percent. In non coastal districts of Maharashtra and Kerala, 8.17 percent of workers are engaged in trade and commerce in each state.

Urban population is depending on the rural area for number of commodities such as milk, vegetables food grains. In order to supply such commodities to urban area, many people are engaged in the transport sector. In cities, many people are working as transporters of taxi, buses etc. Storage facilities are also playing important role. In government and private storage facility, many workers are also getting employment.

Table 13 Workers engaged in the transport, storage and communication  
(Per cent)

States	Coastal districts	Non coastal districts
Andhra Pradesh	5.15	5.00
Kerala	11.30	8.66
Maharashtra	10.13	4.37
Tamilnadu.	3.18	4.21
Karnataka	7.60	4.54

Source: Census 2001

In Kerala, 11.30 percent of the workers of the coastal districts are engaged in the transport, storage and communication. In Tamil nadu again only 3.18 percent workers are engaged in such activities. In Kerala, 8.66 percent workers are engaged in such activities. In Tamilnadu 4.21 percent workers are engaged in transport, storage and communication activities.

There are number of people which are engaged in the different activities in coastal and non coastal districts. We can say that more workers are engaged in the tertiary sector activities in coastal districts.

### Regression Results:

We have used the random effect model to examine the difference in the coastal and non coastal districts (Gujarati D. 2004). The coastal districts are showing the higher agriculture land under non agriculture use, different types of crop production, human resource etc.

The model is explained as follows

$$Y_{it} = \beta_1 + \beta_2 X_{2it} + \beta_3 X_{3it} + \mu_{it} \quad (1)$$

Where

$$\beta_{1i} = \beta_1 + \epsilon_i \quad i=1 \dots 2 \dots n \quad (2)$$

Substitute 2 in 1

$$\begin{aligned} Y_{it} &= \beta_1 + \beta_2 X_{2it} + \beta_3 X_{3it} + \epsilon_i + \mu_{it} \\ &= \beta_1 + \beta_2 X_{2it} + \beta_3 X_{3it} + W_{it} \end{aligned} \quad (3)$$

$$W_{it} = \epsilon_i + \mu_{it} \quad (4)$$

$$\epsilon_i \sim N(0, \sigma^2 \epsilon)$$

$$\mu_{it} \sim N(0, \sigma^2 \mu) \quad (5)$$

$$E(\varepsilon_i \mu_{it}) = 0 \quad E(\varepsilon_i \varepsilon_j) = 0 \quad (i \neq j)$$

$$E(u_{it} u_{is}) = E(u_{it} u_{js}) = E(u_{it} u_{jt}) = 0 \quad (i \neq j \quad t \neq j)$$

This model comprises as many indicators which are related to the land use pattern, educational achievement, work force participation etc. It is difficult to see the difference in terms of various indicators in coastal and non coastal districts. The results of the significant variables are explained in the following table.

**Table 14 Random effect regression results**

Variables	Co-efficient	Standard error	T test
Area under non agriculture use	0.56**	0.20	2.75
Grazing land	1.30***	0.64	2.02
Cereals	0.86*	0.16	5.26
Rubber	1.12**	0.34	3.29
Multiple cropping pattern	-0.47**	0.17	-2.77
Andhra Pradesh	17.48**	6.37	2.74
Kerala	27.39**	10.39	2.51
Maharashtra	12.60	7.55	1.67
Tamilnadu	42.06*	7.35	5.72
Karnataka	11.59	7.74	1.50
Constant	83.83*	9.38	8.93
LR Chi2(11) = 94.00 log likelihood = -431.24 prob>chi2=0.0000			

\*significant at 1 percent \*\* significant at 5 percent \*\*\* significant at 10 percent

Area for the non agriculture is positively co-related to the coastal districts. Due to the high tides, sea water enters in agriculture land. Land and surrounding area becomes saline. Such land cannot be cultivated and remains as a non cultivated land. Similarly in most of the states land is diverted for industrial purposes. Due to the lack of irrigation facilities and weather condition does not help farmers to cultivate their farm. The grazing land is also positively co-related to the coastal districts in India. The possible reason is that, the land is not cultivated and forest cover is high. Therefore grazing land coverage is higher. The production of cereals and rubber is positive and significant in the coastal districts. Environment for such crop in coastal areas is favorable. Therefore the production is positively significant. But not all the agricultural commodities are produced more in the coastal districts. Multiple cropping is negatively co-related in different coastal districts. Government policies towards coastal districts are unsuitable for agriculture purposes. During the past period, farmers were involved in the farm cultivation and coastal salinity was taken care by the constructing storage reservoirs. Lack of co-ordination among the farmers has also reduced the chances of the multiple cropping. In coastal district, employment opportunities have increased in industrial units. Young generation easily finds employment other than agriculture sector. They are not

ready to cultivate land or take the multiple cropping. Income is maximized from the other sources and not through multiple cropping in agriculture. The results are highly significant for the Andhra Pradesh, Kerala, Maharashtra, Tamilnadu and Karnataka.

### **Policy implication**

In order to overcome with the coastal area problems the alternative policies are required. There is need of community participation in coastal area. Community Based Coastal Resource Management (CBCRM) program that attempts to demonstrate that a people oriented and holistic approach to coastal resources management can lead to better results than the form of management dominated mainly by the government. (Israel D.C. 2001). More community oriented or participatory management approach has been main stream of broader conservation strategy. The key element to decentralization, co-management and community based management approaches is that they have the potential for creating sustainability of coastal resources (Siry H.Y.2006). Such cooperation can be extended through coastal regulatory zone. Community participation can enhance the skills to handle natural resources and increase expertise. There is need to promote information exchange which will disseminate more information. There is also need of coastal monitoring and management. Facilitation skills are central in fostering community based processes and in feeding these lessons into a wider context (Marschke Melissa and Kim Nong 2003). Government must have proper planning as far as the human settlements and industrial zones are concerned. Without planning and sanction of the industrial zones, it will create pollution across the coastal area. There is need of management of the waste disposal. Government must promote more research and development across the coastal districts to gather and provide more knowledge. There is also need to prepare educational material and information to understand coastal process. Participation of the experts, NGO's, government officials in the coastal redevelopment is a need of this hour. People in the Community need to understand how they will benefit from the conservation initiatives. A sustainable enterprise to generate income and continuous community awareness programs should be part of the approach if those conservation programs are to be wok in the long term. (Joeli Veitayaki, J. et.al 2003).

The public hearing on coastal ecosystem could be an important initiative towards the setting up of a long term process of fact finding research dialogue and negotiations on coastal area management. (Bhatta R. 2004).Urban poor affect more from natural calamities across the coast. Therefore there is need to construct more drainage systems under high intensity rainfall, monitoring of urban development, proper solid waste management and environment education for the citizens. (Ibidun O. A delekan 2009). Coastal zone management needs are to be fully addressed at the overall catchments management level (Pedro I.J et.al 2004). If failures are reduced through co-coordinated coastal planning and the redefinition of property rights to avoid open access utilization of coastal assets, then the effects of the physical environment changes will be ameliorated as natural systems and socio-economic systems co-evolve in the vulnerable coastal zones (Turner R.K. et.al. 2009). Coastal areas are important for human settlements, sustainable

agriculture, fisheries and agriculture. Conservation of natural resources on a sustainable basis is an important aspect. For residents of coastal zone, its value in social cultural and spiritual terms far exceeds its economic worth. A detailed assessment of the extent of violation of the setback rule therefore is needed. But even that would provide only a fraction of the information that should be collected with a small setback area at most a few hundred meters, a policy of intense development close to the sea is feasible and can result in a coastal zone that is substantially developed. Thus a wider assessment of the effectiveness of regulations by measuring outcomes is required (Markandya A. et.al 2009). There are number of opportunities as far as coastal areas are concern but looking towards future generations, there are number of threats and challenges. The number of alternative policies area required to tackle the problems of coastal districts. Such efforts will not eliminate the coastal issues but it will reduce such problems at some extents.

## Appendix: 1

Table 15 Coastal and non coastal states and number of districts (Number)

States	Coastal districts	Non coastal districts	Total
Andhra Pradesh	9	14	23
Kerala	10	4	14
Maharashtra	5	30	35
Tamilnadu.	13	17	30
Karnataka	3	24	27

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