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Environmental Implications of Agricultural Development in Odisha State

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Abstract

The state of Odisha is an agrarian one with agriculture and allied sector contributing about 20% of Net State Domestic Product (NSDP) in 2017-18 at 2011-12 prices and providing employment to more than 70% of the population either directly or indirectly. Agriculture is the mainstay of the economy and substance of life for the people of the state. The study includes both qualitative and quantitative techniques as it involves both observations and analysis. The study mainly focuses on the environmental implications of the input use on the development of the state. As environment plays a major role in the success and viability of any agricultural project taking into account the risks and uncertainties associated with them, we have here focused on the environmental-social impact indicators along with the extent of strain on environment viz. low, medium and high levels associated with the use of inputs and selected projects as well as the impact of the microclimate on the development of agriculture in the state thereby analyzing the future prospects and mitigation strategies for sustainable growth. The paper also analyses the positive and negative externalities of few agricultural projects in selected districts of Odisha that were undertaken for sustainable means of livelihood for the rural poor.

Keywords: Externalities, Livelihood, Environment, Agricultural Projects, Risks

JEL Codes: **D62, Q15, Q53**

INTRODUCTION

Importance of Agriculture, Sustainability and Climate Change Concerns

Agriculture is a major and integral component of the Indianeconomy with a contribution of about 18% to the GDP of the country and employment to over 55 per cent of the population (Source:Economic Survey, Odisha 2017-18).

Odisha, the south-eastern state of India has 47% of its population living under poverty and 85% of the state's population live in villages (Source:EAS, TRIPTI, 2007). Agriculture is the state's dominant sector with a contribution of nearly 20 per cent to the Net State Domestic Product (NSDP). About 73 per cent of total main workers are engaged in agriculture including 44.3 per cent cultivators and 28.7 per cent agricultural laborer (Source: Economic Survey, Odisha 2017- 18).

The performance of a crop is directly related to the climate of the concerned area. During the last decade the changes in global climate have a significant effect on agriculture.

Climate change has beenalso affecting people around the world, threatening the basic elements of life – access to water, food, health and use of land, and the basic environment. In thecase of a developing country like India and her states, climate change is an additional burden because ecological and socio-economic systems are already facing pressures from rapid population, industrialization and economic development.The climate of Odisha is a tropical one, characterized by high temperature, high humidity, medium to high rainfall and short and mild winters. On the basis of climate type, Orissa has been divided into ten agro-climatic zone. The normal rainfall of the state is 1451.2 mm. About 75% to 80% of rainfall is received from June to September, which is south west monsoon season. Floods, droughts and cyclones occur almost every year varying intensity (Source:State of Environment, Odisha).

There is a close, complex and dynamic relationship between natural resources used in agriculture and the environment. The extent of the environmental impacts depends on agricultural structures, the amount of land and other resources used, and the effects of farming practices on ecosystems at the local, regional and national level. There is a general recognition of the need to improve environmental performance of agriculture, through enhancing the beneficial, and reducing the harmful environmental effects, and to ensure the sustainability of resource use (Kullaj, 2005).Agriculture, as an economic activity, is not neutral in relation to natural environment because, it is directly or indirectly linked with environment.The main environmental impacts of agriculture projects may be based onparameters such asSoil quality (erosion, desertification, compaction, pollution, stepping, nutrient supply, moisture balance, salinity);Air quality(pollution,greenhouse gas,carbon dioxide); Land quantity (ecological

management of agricultural land); Water quality (nutrient, pesticide, sediment runoff and leaching, salinity) and Water quantity (irrigation consumption, use efficiency, water retention capacity, flood prevention) (Kullaj,2005).

Besides agricultural activities a number of other projects and developments impact the environment. In states like Odisha with mineral resources, this is a natural phenomenon. In the last 50-60 years the industrial development has centered on mining activities and industries for mineral processing and manufacturing goods based on minerals are being set up. The major industries that have come up in Orissa are the iron and steel, sponge iron plants, aluminum industries, thermal power and other related industries. They have created the problem of air pollution by fly ash and red mud and water pollution by release of effluent into the rivers.

Odisha has a total forest cover spread over 51,345 Sq. km, which is about 32.98% of the total geographicarea of the state (Source-ISFR, Odisha 2017). Forests with canopy density more than 40% comprises 18% and the open forestswith canopy density less than 40% accounts for about 13% of the total forest area. This is one positive factor that will counter the negative implications of other sectors including that of agriculture development on environment.

Climate change has the potential to deepen the poverty along with derailing the current growth strategy in Odisha. Continuous variation in the climate will probably alter the sectoral growth, including the ability of the rural poor to engage in farm and non-farm activities. The direct effects of extreme climate-induced events could include loss of life, livelihoods, assets andinfrastructure. All of these could affect the state's economic growth and nullify the effectiveness of macro-economic policies and pro poor initiatives. Some of the specific climatic risks for Odisha are:

- Highly variable rainfall, leaving people with two peak periods of food scarcity,
- Dry and drought spells at an interval of every two years in Western Odisha,
- Heat waves in summer and flash floods during rainy season.
- Intense floods and cyclones in coastal areas.

Environmental Implications of Development projects

Environment is living things and what is around them. It can be living or non-living things such as human, soil, mineral, plant, animal, water and air. It includes physical, chemical and other natural forces.

The importance of studying the environmental issues lies in the fact that it is a bench mark for sustainable development and can be used to specify the priorities, needs, resources and the ability of the state to establish sustainable development programmes.

An indication of some of the major environmental issues faced in Odisha is given below (Source: EAS, TRIPTI, 2007).

Air Pollution

There is a major issue of Fly Ash, Red Mud and Hazardous Waste disposal in Orissa. Some13 million tonnes of fly ash and 1-3 million tonnes of red mud are generated per year. Besides, 81,000 tonnes of Hazardous Wastes are also generated from various industries.

Water Pollution

The two major rivers of the State namely Brahmani and Mahanadi are polluted due to industrial and municipal effluents. At Paradeep, the Mahanadi river system receives around 5,280 KLD (Kilo Liters per Day) of effluent per day with BOD (Biological Oxygen Demand) load of 15 Kg/day, COD (Chemical Oxygen Demand) load of 35 Kg/day and Oil and Grease of 75 Kg/day. Odisha has 103 Urban Local Bodies. None of these urban and small town centers have municipal solid waste treatment and management facilities (Source: State of Environment Orissa, 2006).

Salinity Hazard

A considerable area of about 5 Lakh hectares of the coastal alluvial tract suffers salinity hazard. Agricultural development projects are the ones that aim at reducing the rural poverty by improving and increasing agricultural production through a community-based approach in designing and implementing components which directly impact the lives of the poor in the particular province or district (Source: The World Bank).

It is in this context that a study on the environmental implications of agricultural development inthe state of Odisha was undertaken with the following objectives:

1. To identify the potential viable agriculture projects in selected districts of Odisha.
2. To identify the positive and negative externalities associated with the selected agricultural projects.

3. To suggest suitable mitigation strategies.

METHODOLOGY

The study used data from secondary sources through review of literature. Functional analysis has been done by mapping of the different inputs and few projects (irrigation) according to the environment of Odisha. The information on key issues were also derived from FGDs held with various community groups, stakeholder interactions, and interviews with key informants. The data was compiled and analyzed with appropriate tools for further interpretations.

RESULTS AND DISSCUSSION

The analysis presented in this paper is based on information and data from a series of sub- studies. To fulfill the above listed objectives the following analysis were carried out.

The agricultural landscape of any region is defined more by the climate specifically the rainfall, supported by the irrigation, the soil types and the forest cover. Accordingly these situations have been described and analyzed in this section.

Rainfall

The average annual rainfall of the state is above the national average (1100 mm) with over 1300 mm. However, the state is often faced with natural calamities (Table 1). Among the frequently occurring calamities, floods and cyclone which together occurred for 60 per cent of the years in the 53 years since 1961.

Table1. Frequency of Natural Calamities in Odisha state (1961 -2014)

S.No.	Type of Calamities	Frequency (in 53 yrs)	% Frequency
1	Severe Drought	8	15.1
2	Moderate Drought	11	20.8
3	Floods	25	47.2
4	Cyclones	7	13.2
5	Tornadoes	2	3.8
6	Hailstorms	1	1.9
7	Moisture Stress	5	9.4

Source: Author's own compilation

Irrigation

Of the overall cultivated area of 61.80 lakh ha of gross cultivated area in the state, about 54% is under irrigation with almost 45 per cent under canal irrigations (major/ medium projects) with the rest under minor irrigation sources. The irrigation potential created from all sources till Kharif'2013 is 39.39 lakh ha & in Rabi'2013-14 is 16.52 lakh ha. The gross irrigated cropped

area is 35.21 lakh ha, which is about 70.5% of the potential created. There is a constant endeavor to enhance the irrigation capacity in the state.

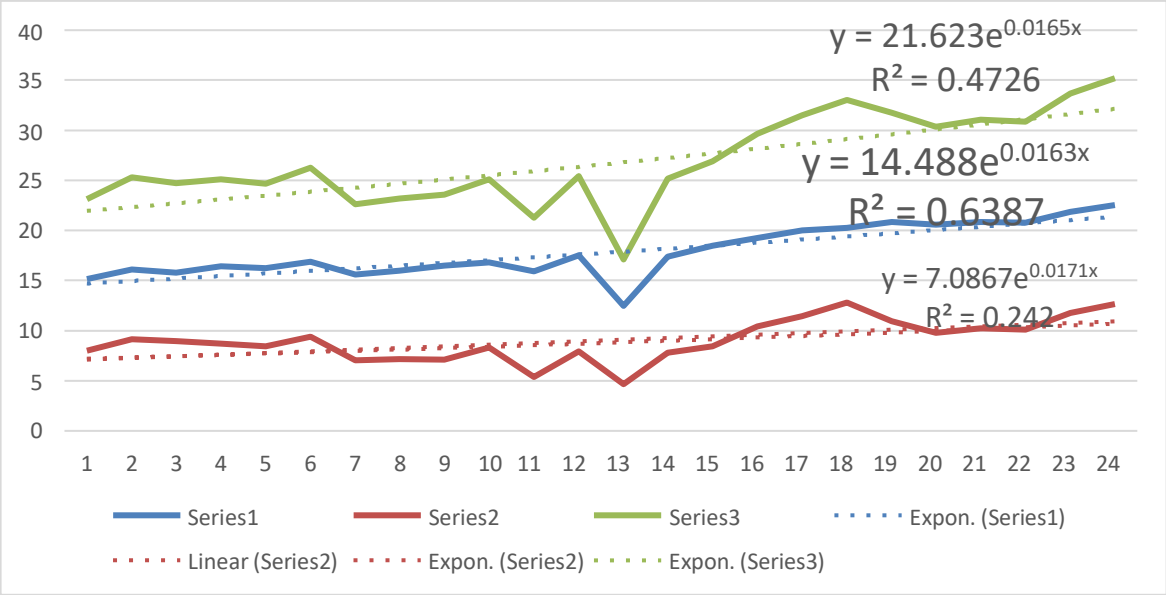

Figure 1. Growth Rate of Irrigation Potential Created over the Years

The irrigation potential utilized since 1991 has increased from 23.14 to 35.21 lakh ha by 2013- 14 with almost two thirds in kharif and the rest in rabi season. This showed a very marginal CAGR of 1.67 %. Besides, the irrigation potential created through government sector mainly through flow system, private irrigation sources are also being developed. The number of shallowtube wells, bore wells, dug wells and surface lifts installed since 1996-97 till 2013-14 is indicated below (Table 2).

Table 2. Number of Shallow Tube Wells, Bore Wells, Dug Wells and Surface Lifts Installed.

Items	Nos. installed till 2012-13	Nos. installed during 2013-14	TOTAL till 2013-14	Nos. installed during 2014-15 till 30.09.2014
Shallow Tube Well	144966	5148	150114	1669
Bore Well	30453	6511	36964	2368
Dug well	10653	1634	12287	488
Surface lift	933	04	937	1
Total	**187005**	**13297**	**200302**	**4526**

Source: Status of Agriculture in Odisha, 2014-15

Table 3. List of Completed and Ongoing Irrigation Projects in Odisha

Sl No.	Type of Project	No. of Projects	Cumulative Potential Created ('000 ha)	
			Kharif	Rabi
A	**Completed Projects**			
1	Major	10	937	476
2	Medium	49	280	100
3	Creek	16	24	0.1
Total			1241	576.1
B	**Ongoing Projects**			
1	Major	5	137	68
2	Medium	8	29	7
3	Extension, Renovation & Modernization (ERM)	2	6	0
4	Creek	7	12	0.4
Total		22	184	75.4
Total Completed & Ongoing Projects		97	1425	652
C	**Mega Lift Projects**			
1	Cluster No-XIV	12	14.3	0
2	Cluster No-III	14	16.82	0
3	Cluster No-XV	15	21.15	0
4	Cluster No-II	2	1.4	0
Total		43	53.67	0
Total Mega Lift Projects		43	53.67	0

Source: Department of Water Resources, Odisha

Additional 295.4 thousand hectares of agriculture land to be brought under irrigation through various sources. (Major & Medium-34.00Th.Ha., Minor-31.54 Th.Ha., Megalift-65.00 Th.Ha., OLIC-139.86 Th.Ha. & Agriculture Dept.-25.00 Th.Ha.) (Source- Activity report dept of water resources Odisha, 2017-18). At any standards the proportion of irrigation is higher in Odisha compared to national average of about 45 per cent indicating that the intensity of irrigation is more oriented towards area expansion and development focused. Further, the effort on minor and individual farmers' oriented interventions meant that the environmental implications would be that much lower.

Seeds

The seed distribution more specifically of quality seeds is another indicator of development of agriculture sector. The distribution of certified/ quality seeds in the state was to the tune of 594728 quintals, of which paddy alone accounted for almost three fourth of the quantity (Table 4). The area covered by such quality seeds increased from mere 2 to 13 per cent in the last 35 years. One negative implication of use of seeds that are not guaranteed with quality means lot of area is used for producing same of production that too under anaerobic conditions emitting lot of carbon emissions during cultivation.

Table 4. Quantity of Quality Seeds Distributed (in quintals)

Year	Distribution of Certified/ Quality Seeds(quintals)		
	Paddy	Other Crop Seeds	Total
1980-81	103324	25844	129168
1990-91	44770	55230	100000
2000-01	220135	71814	291949
2005-06	160223	71664	231887
2013-14	548710	46018	594728

(Source: Status of Agriculture, Odisha, 2014-15)

Fertilizer

The consumption of fertilizer in the state has taken great strides from a meager 0.76 kg/ ha during 1961-62 to 63.78 ha during 2014-15. However, the consumption is much below the national average and thus can be raised to a higher level with availability of the materials in required quantities at affordable price. Fertilizer consumption of the state from 1961-62 to 2014-15 is indicated below (Table 5)

Table 5. Fertilizer Consumption over the Years in Odisha

Year	Fertilizer consumption in nutrient basis in '000 MT				Consumption in Kg./ha
	N	P	K	Total	
1961-62	4.38	0.49	-	4.87	0.76
1971-72	37.43	8.38	4.01	49.82	7.25
1981-82	54.16	17.92	9.91	81.99	9.68
1991-92	126.22	41.52	28.29	196.03	19.96
2001-02	221.17	71.95	51.55	344.67	41.00
2002-03	185.41	62.86	42.29	290.56	39.00
2003-04	210.07	66.64	49.50	326.21	39.00
2004-05	223.54	77.99	53.77	355.31	43.00

2005-06	243.21	91.05	60.62	294.88	46.00
2006-07	256.54	92.77	53.57	402.88	47.00
2007-08	273.63	121.48	67.21	462.32	52.10
2008-09	297.77	147.93	89.17	534.87	61.50
2009-10	292.29	148.59	78.46	519.34	59.78
2010-11	294.72	153.97	89.16	537.85	62.85
2011-12	323.41	135.48	55.80	514.69	62.85
2012-13	315.04	124.19	50.97	490.20	58.74
2013-14	312.99	117.70	56.45	487.14	57.11
2014-15	324.91	143.76	75.42	544.09	63.78

Source: Agricultural Statistics at a Glance 2014, Govt. of India

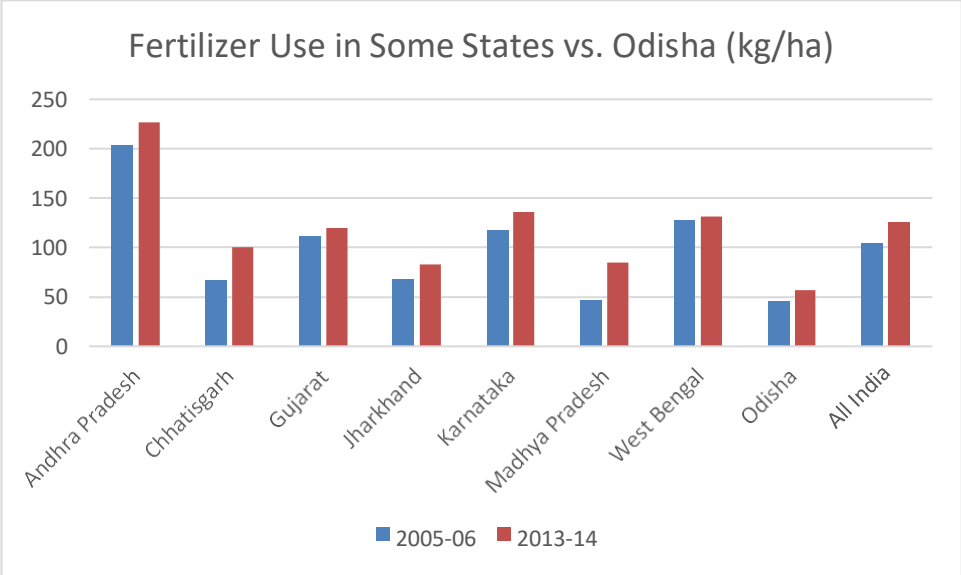

Figure 2. Fertilizer Use in Some States vs. Odisha (kg/ha)

The average consumption of fertilizer in Odisha is much below the national average. It stands at the 16th position all over India in terms in fertilizer use. This is in one way advantageous as the state can become by default organic in many crops and districts. On the other handwe can argue that the full potential of the soil and crop productivity is not achieved due to less consumption. Odisha can have better growth in terms of crop yield and increase in soil health by the use of more fertilizers.

Plant Protection (Technical Grade in MT):

Table 6. Consumption of Pesticides in Odisha

Year	Total Pesticides consumed			Per hectares Consumption (gms of a.i.)
	Chemical	Bio-pesticides	Total	
2000-01	780.55	225.00	1005.55	157.00
2001-02	757.00	261.00	1018.00	159.00
2002-03	748.00	280.00	1028.00	139.00
2003-04	710.90	317.60	1028.50	138.00
2004-05	669.00	318.00	987.00	148.68
2005-06	720.00	319.00	1039.00	138.53
2006-07	812.00	343.00	1155.00	148.94
2007-08	744.25	345.00	1089.25	148.34
2008-09	810.75	345.00	1155.75	149.00
2009-10	921.24	297.19	1218.43	141.00
2010-11	870.50	305.00	1175.50	159.00
2011-12	844.00	311.00	1155.00	148.00
2012-13	928.50	277.00	1205.50	158.00
2013-14	904.00	315.00	1219.00	144.00

Source: Status of Agriculture in Odisha, 2014-15

There has been an increase in the use of chemical pesticides over the decade though the rate of increase is comparatively slower with the advent of bio-pesticides. Nevertheless, it has few major negative side-effects on the environment e.g. toxicity of leaves and fruits, and also giving way to air and water pollution. Emphasis must be laid on Integrated Pest Management (IPM) with more use of bio-pesticides for curbing the environmental pollution, thereby even reducing the deaths related to pesticide poisoning. Adoption of Integrated Pest Management (IPM), emphasizing conservation and augmentation of natural enemies of pest such as parasites, predators and pathogens for control of harmful insects and diseases of crops, should be given due thrust for increasing the crop productivity.

(v) Farm Mechanization

Farm mechanization has become highly essential for timely operation of agricultural activities leading to increase in production and productivity besides reduction in drudgery of labour associated with farm activities. It also enables efficient utilization of agricultural inputs and reduces the cost of production. The Government has been encouraging the farmers to adopt improved farm machinery & equipment by providing financial assistance in form of subsidies and credit facility. Besides, the Agriculture Directorate is equipped witha proto-type Development Center (Odisha Farm Machinery Research and Development Center, Bhubaneswar) which designs, and manufactures popular implements for supply to

farmers. It also indulges in training, testing and modifying the equipments as per the farmer's requirement.

Because of the awareness generation programme taken up by the Department through demonstration and farmers awareness trainings, mechanization has picked up in the State and there is a great demand for tractor, power tiller, paddy reaper, and other power driven/ self-propelled equipments. Similarly, small manually operated/ bullock drawn implements are also being increasingly used by the farmers of hilly and tribal areas. The farm power input touched 1.405 kWH/ hect. by the end of 2011-12 and it has been targeted to increase 2.00kWH/ha by the end of 12thPlan period.

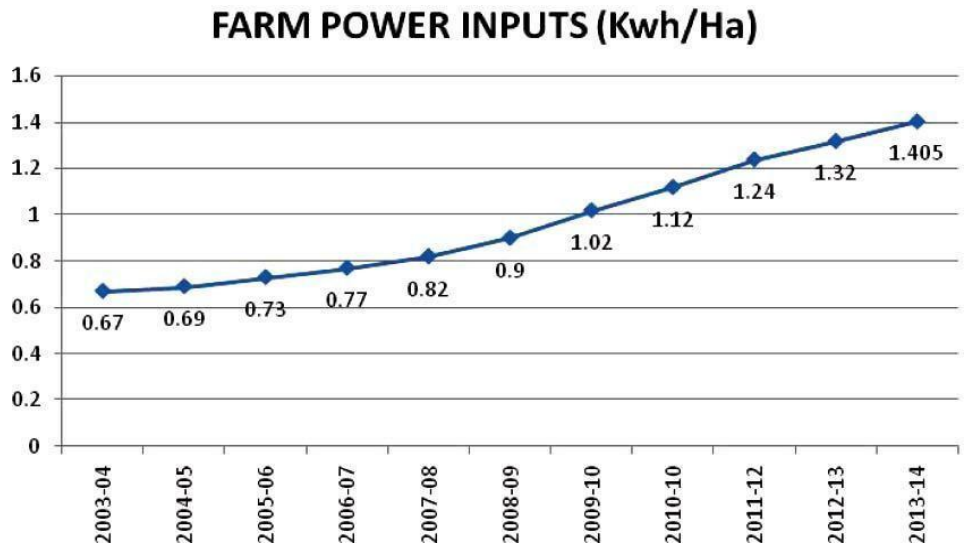

Figure 3. Farm Power Inputs(Kwh/ha)

Source:-Status of Agriculture in Odisha, 2014-15

Table 7: The trend of tractors & power tiller popularized in Odisha

Year	Numbers		Total (Tractors + Power Tillers)
	Tractors	Power Tillers	
1992-93	76	--	76
1993-94	152	--	152
1994-95	273	--	273
1995-96	103	76	179
1996-97	512	345	857
1997-98	774	393	1167
1998-99	303	748	1051
1999-00	143	783	926
2000-01	168	775	943
2001-02	102	822	924
2002-03	251	1242	1493
2003-04	585	1734	2319
2004-05	788	2125	2913
2005-06	800	1631	2431
2006-07	1247	2974	4221
2007-08	705	3364	4069
2008-09	1500	5280	6780
2009-10	2325	7615	9940
2010-11	4750	12742	17492
2011-12	5317	11257	16574
2012-13	5977	12503	18480
2013-14	4534	13032	17566

Source: Status of Agriculture in Odisha, 2014-15; Author's own compilation

Major Impacts of Few Development Activities on the Environment

Clearing of Forests and land resettlements

Extinction of rare species of flora and fauna, creation of condition for mosquito breeding giving way to infectious diseases such as malaria, dengue, etc.

Shifting cultivation in upland agriculture

Soil erosion occurs in upland areas, soil fertility declines due to shorter cultivation cycle, which is done due to population pressure, flooding of low land areas. The problems could be mitigated by terraced cultivation.

Agro industries

Air pollution occurs due to burning of bagasse as fuel in sugar mills, large amount of highly polluting organic wastes, surface water pollution.

Introduction of new varieties of cereals

Reduction in the genetic diversity of traditional monoculture that results in instability and danger of multiplication of local strains of fungus, bacteria or virus on new variety.

Use of pesticides

Organisms develop resistance so new control methods are needed (e.g. in malaria, widespread use of Dieldrin as a prophylactic agent against pests of oil palms made the problem worse), creation of complex and widespread environment problems. The pesticides used in agriculture at times go into food chain or in water bodies which may result in health hazards.

Timber extraction

It is highly detrimental as indiscriminate timber extraction degrades land, destroys surface soil, and reduces the production potential of future forests.

Framework of Environment Statistics and their main Characteristics including its Development.

Issues	Socio-economic Activities or Events	Impacts and Effects	Responses to impacts	Inventories, Stocks, Background Conditions
Economic	Real GDP per capita growth rate	EDP/EVA per capita	Environmental protection expenditure as % of GDP	
Issues	Production and consumption patterns Investment share in GDP	Capital accumulation (environmentally adjusted)	Environmental taxes and subsidies as % of govt. revenue	Produced capital stock
Social/Demographic	Population growth Rate, Population density, Urban/ rural migration rate	% of urban Population exposed to concentrations of SO2 particulates, Ozone, CO &Pb	Pop. Living in Poverty. Adult literacy rate Combined (Primary & secondary) school enrollment ratio	Life expectancy at birth Females per 100 males in secondary school
Issues	Calorie supply per capita	Infant mortality rate Incidence of environmental related diseases		
NATURAL RESOURCES Biological resources Mineral energy Resources	Annual round Wood production Fuelwood consumption per capita Catches of marine species Annual energy consumption per capita Extraction of other mineral resources	Deforestation rate Threatened, extinct species Depletion of mineral resources (% of proven reserves) Lifetime of proven reserves	Reforestation rate Protected forest area as % of total land area	Forest inventory Ecosystems inventory Fauna and flora inventory Fish stocks Proven mineral reserves Proven energy reserves
AIR/CLIMATE	Emissions of CO_2,SO_2 and NOx Consumption of	Ambient concentrations of CO, SO2, NOx O3 and TSP in urban	Expenditure on air pollution abatement Reduction in	Weather and climate conditions

	Ozone depleting substances	areas Air quality index	Consumption of substances and emissions	
LAND/SOIL	Land use change Livestock per km^2 of arid and semiarid lands Use of fertilizers Use of agricultural pesticides	Area affected by soil erosion Land affected by desertification Area affected by salinization and water logging	Protected area as % of total land area	Arable land per capita
WATER Fresh water Resources	Industrial, agricultural and municipal discharges directly into freshwater bodies Annual withdrawals of ground and surface water Domestic consumption of water per capita	Concentration of lead, cadmium, mercury and pesticides in fresh water bodies. Concentration of fecal coliform in fresh water bodies. Acidification of fresh water Bodies.	Waste water treatment, total & by type of treatment (% of population served) Access to safe drinking water (% of population served)	Groundwater Reserves
Marine water Resources	Industrial, agricultural water use per GDP Industrial, agricultural and municipal discharges directly into marine water bodies Discharges of oil into coastal waters	BOD and COD in fresh water bodies Water quality index by fresh water bodies Deviation in stock from maximum sustainable yield of marine species Loading of N & P in coastal waters		
WASTE	Municipal waste disposal Generation of hazardous waste Imports & exports of	Area of land contaminated by toxic waste	Expenditure on waste collection and treatment Waste recycling	

	hazardous wastes			
HUMAN SETTLEMENTS	Rate of growth of urban population % of population in urban areas Motor vehicles in use per 1000 habitants	Area and population in marginal settlements Shelter index. % of population with sanitary services	Expenditure on Low cost housing	Stock of shelter and infrastructure
NATURAL DISASTERS	Frequency of natural disasters	Cost number injuries and fatalities related to natural disasters	Expenditure on disaster prevention mitigation	Human settlements vulnerable to natural disasters

Source: Compendium of Environment Statistics, Odisha, 2016

Important Livelihood Activities of Selected Districts in Odisha and Related Environmental Implications

District	Important Livelihoods	Important environmental issues pertaining to livelihoods	Other major environmental issues
1. Puri	1. Fish and Fisheries 2. Tourism 3. Cottage Industry (PipliChandua, Artisan Wood, Stone Carving &Patta Painting) 4. Agriculture 5. Horticulture (Coconut, Cashew nut, Betel leaf, Mango & Banana)	1. Fishing in Chilika area and coast 2. Prawn gheries 3. Fish & prawn processing 4. Effluents and sewage waste discharged to sea 5. Salinity in groundwater 6. Presence of cultural heritage sites	
2. Khurda	6. Forest based cottage industry (Wood and Bamboo) 7. Fish and fisheries 8. Horticulture (Coconut, Cashew, Mango & Banana) 9. Agriculture	1. Fishing in Chilika area and coast 2. Prawn gheries 3. Fish & prawn processing 4. Salinity in groundwater 5. Quarry mining 6. Presence of	

		cultural heritage sites	
3. Jagatsinghpur	10. Fish and fisheries 11. Agriculture 12. Horticulture (Betel leaf, Bamboo, Mango, Cashew & Banana) 13. Industry	1. Fishing on coast 2. Prawn gheries 3. Fish & prawn processing 4. Salinity in groundwater	Industrial pollution at Paradeep
4. Kendrapara	14. Fish and fisheries 15. Agriculture 16. Mangrove based livelihood 17. Horticulture (Betel leaf, Banana)	1. Fishing on coast and Bhitarkanika coast 2. Extraction of forest produce from Bhitarkanika 3. Prawn gheries 4. Salinity in groundwater	
5. Bhadrak	18. Fish and fisheries 19. Industrial Mining 20. Mangrove based livelihood 21. Betel leaf, banana, mango 22. Agriculture	1. Fishing in Chilika area and coast 2. Prawn gheries 3. Fish & prawn processing 4. Intrusion in habitat of salt water crocodiles 5. Salinity in groundwater 6. Chromite mining	
6. Balasore	23. Fish and fisheries 24. Tourism 25. Industrial 26. Horticulture (betel leaf, cashew, mangrove, coconut) 27. Agriculture	1. Fishing in Chilika area and coast 2. Prawn gheries 3. Fish & prawn processing 4. Salinity in groundwater	Industrial pollution source at Balasore Town.
7. Cuttack	28. Cottage industries (Silver filigree, Textile) 29. Fish and fisheries, Aquaculture 30. Agriculture, livestock	1. Fishing in rivers, Ansupa lake 2. Pressure on forest bamboo 3. Municipal effluents discharged to rivers	
8. Jajpur	31. Industrial 32. Fish and fisheries 33. Agricultural, livestock	1. Presence of cultural heritage sites	Chromite mining pollution and industrial discharges.

		2. Industrial effluents and emissions 3. Chromite mining	
9. Angul	34. Forest based cottage industries. 35. Horticulture (litchi, mango, orange) 36. Agriculture 37. Coal based industries	1. Industrial effluents and emissions 2. Coal mining 3. Fly ash 4. Fishing in Satkosia gorge protected natural habitat 5. Reserve forests – extraction of forest produce	Fluoride pollution in ground water
10. Nayagarh	38. Forest based cottage industry 39. Horticulture (mango, coconut, cashew) 40. Agriculture 41. Livestock	1. Fishing in Satkosia gorge protected natural habitat 2. Reserve forests – extraction of forest produce 3. Presence of cultural heritage sites	In some block fluoride pollution due to soil and industry

Source: Environmental Impact Assessment Study of TRIPTI, 2007

Assessment Criteria for determining extent of pressure on environment

Extent of strain on environment	Criteria	Remarks / Examples
Low	• All products as well as by-products are bio-degradable • The process does not involve extensive or unsustainable use of natural resources such as groundwater, forest, biomass, etc. • Non-biodegradable substances could be produced, but they are readily re-usable and easily recyclable.	Tailoring, small tea stalls, etc. Activities in which only woody biomass based fuels are used
Medium	• Non-biodegradable and non-hazardous substances are produced in small or insignificant quantities. Re-cycling of these is possible - at least a major part • Bio-degradable substances with high	E.g. Plastic materials or Groundwater containing fluoride, iron, etc. but these are treatable BOD3 of the effluent not exceeding 100

	organic loading are produced • Natural resources, if used in significant quantities, are replenishable • Fossil fuels could be used albeit in small quantities	mg/litres4 E.g. - Tractors, diesel irrigation pumps used seasonally
High	• Non-biodegradable, hazardous and toxic substances that create severe and adverse environmental impacts are produced in significant quantities • Sustainable re-cycling or disposal of these is not easily possible • Natural resources are used in significant quantities which are not sustainable • • Fossil fuels are the routinely used energy source	E.g. - Chemical fertilizers and pesticides E.g. - Large brick kilns E.g. - Furnaces & boilers using coal

Source: Environmental Impact Assessment Study of TRIPTI, 2007

Environmental risk management

Sector	Activities likely to affect environment	Environmental Issues and Risks	Mitigation Measures	Applicable Legislations
Agriculture	• Irrigation • Crop Residue Burning • Pesticide usage • Fertilizer usage • Use of plastics	• Ground water depletion • Methane emissions (due to crop surplus residue) • Groundwater contamination due to pesticide and fertilizer usage	• Promote drip / sprinkler irrigation methods • Spread awareness about proper plastic disposal • Use permissible classes of pesticides • Dispose off crop residue as fuel or manure • Residue recycling and composting	• The EP act 1986 • The Insecticides Act, 1968 • The Plastic sale and usage rules 1999
Horticulture	• Irrigation • Crop Residue Burning • Pesticide usage	• Ground water depletion • Groundwater contamination due to pesticide and	• Promote drip / sprinkler irrigation methods • Spread awareness about proper plastic disposal	• The EP act 1986 • The Insecticides Act, 1968 • The Plastic

	• Fertilizer usage	fertilizer usage • Decomposed organic waste from plant and animal sources in mushroom cultivation	• Dispose off crop residue as fuel or manure • Residue recycling and composting • Mushroom culture rooms should be disinfected • Promote use of hand gloves • Mushroom waste should be converted to manure	sale and usage rules 1999
Forest	• Extraction of NTFP • Plucking of leaves from selected species • Cutting of Bamboos & cane, broom, etc. • Plucking of medicinal plants • Grazing of domestic animals	• Stunted growth of selected species • Resource depletion and effect on bio-diversity	• Encourage multi-species use for leaf plate making and similar activities • Advice against plucking very young leaves • Promote setting up of herbal gardens consisting of medicinal plants • NTFP extraction should not be beyond permitted 69 minor forest products as permitted • Random grazing of cattle on public land or forest areas should be permitted only in exceptional cases and that too, subject to permitted numbers in permitted areas as allowed by the local DFO at different times of the year	• The Indian Forest Act 1927, The Forest (Conservation) Act 1980, amended in 1988. • The Wildlife (protection) Act, 1972 (forest) • The Orissa Forest Act, 1972
Aquaculture	• Fishing in	• Effluent water	• Use settling tank,	The Orissa

	forests and natural habitats • Periodic changing of water. • Use of salt water from the sea for prawn culture	may be contaminated with left-over food and dead living material • Land becomes saline and unfit for cultivation	separators and proper dosing before releasing preservatives to the outside • Prawn culture to be allowed only within 2 kilometer from the sea shore	Marine Fishing Regulation Act (OMFRA), 1982
Livestock	• Grazing of domestic animals • Construction of animal shelters • Fodder residue wastes • Animal wastes	• Proximity of animal shelter to human habitats • Methane emissions • Epidemics from diseased animals	• Disinfect animal shelters periodically • Animal shelters should be at least 100 mtrs away from human habitats • U se anaerobic digester and use gas for heating • Promote use of hand gloves and masks • Periodically monitor animal health and undertake immunization measures • Promote stall feeding • Grazing as per guidelines issued by DFO	• The Indian Forest Act 1927, The Forest (Conservation) Act 1980, amended in 1988. • The Orissa Forest Act, 1972

Source: Environmental Impact Assessment Study of TRIPTI, 2007

CONCLUSION

The integration of agricultural project and environmental policies is a way to sustainable development. In Odisha, the environmental and agricultural policies for project formulation are still disintegrated. The active role of governments and societies in the form of adequate environmental policies is essential to the sustainable development of agriculture. The main problem is associated to the lack of inter-institutional co-operation. This is a special cause of concern at ministerial level, given that the Ministry of Agriculture and Food and the Ministry of Environment are the main institutions defining the policy guidelines on agricultural project and environmental matters. Co-operation between the two ministries is therefore an essential precondition for the formulation of effective policy measures and to avoid agro-environmental impact. The above analysis focuses on those environmental issues that have been identified in thisreview as being the most important from a policy perspective.

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