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Role of Female Participation in the Changing Economy of Sunderban Blocks of South 24 Parganas, West Bengal, India

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Abstract

Sunderban is the largest space of tidal halophytic mangrove forest in the globe. It is a delta of the rivers Ganga, Brahmaputra and Meghna and located in West Bengal state of India and neighboring country of Bangladesh. The present paper deals with the changing nature of work participation with the changing agro-climatic condition in Sunderban blocks of South 24 Parganas and its effect on the traditional economy of that region. Economy is such an indicator which determines the status of living. The present paper looks into the recent changes occur in the composition of workforce of that region. Thus the paper will also give emphasis on the relation between the climate change and its impact on regional economy. Not only but also the paper will try to evaluate the role of female participation in changing economy of Sunderban blocks of South 24 Parganas as a part of adaptation to maintain the livelihood.

Introduction &Study area

Sunderban is one of the dynamic ecosystems of the world, formed by interactions between land and water, and is considered as one of the most productive wetlands on earth. Sunderban, a World Heritage Site, is the largest contiguous block of tidal halophytic mangrove forest in the globe. It is a delta of the rivers Ganga, Brahmaputra and Meghna and located in West Bengal state of India and neighbouring country of Bangladesh. The entire Sunderban is about 26000 sq. km, the one-third of which falls in India. The present paper deals with the Sunderban blocks of South 24 Parganas. Sagar, Namkhana, Kakdwip, Patharpratima, Kultali, Mathurapur I , Mathurapur II, Jaynagar I, Jaynagar II, Canning I, Canning II, Basanti and Gosaba belong to the South 24-Parganas part of Indian Sunderban region.

Objective

The present paper deals with the climate change of Sunderban blocks of South 24 Parganas and the changing nature of economy of that region. Economy is such an indicator which determines the status of living. The present paper deals with the changing nature of work participation with the changing agro-climatic condition in Sunderban blocks of South 24 Parganas and its effect on the traditional economy of that region. Thus the paper will try to evaluate the role of female participation in changing economy of Sunderban blocks of South 24 Parganas as a part of adaptation to maintain the livelihood.

Methodology

The present paper is based on the intensive collection of secondary data from different official documents and literatures. On the basis of available statistical data, an intensive analysis has been done to represent the relationship between climatic change and the response of local inhabitants, especially by women of those sunderban blocks. Field verification has also been done to evaluate the ground reality of the studied matter.

Change of physical environment

The climate of the whole world is changing gradually and Sunderban region is not the exceptional one. If we give stress on the general climatic characteristics of Sunderban, we can observe that the average temperature of the water surrounding Sunderban, gradually increases over the time. The increase in this sea surface temperature (SST) has been much higher than the global average. The SST in the Bay has increased at the rate of 0.5 degree C per decade since 1980. While the globally observed SST warming rate is 0.06 degree C per decade between 1970 and 1999, that for the Indian Ocean for the same is 0.2 degree C per decade (Chand B.K.,Trivedi R.K., Dubey S.K., Beg M.M., Aquaculture in changing environment in Sunderban, West Bengal University of Animal and Fishery Science, 2012). In according to Indian Meteorological Department (2001), an increase in SST of 0.5 degree C in the eastern part of Sunderban. MIT said that the average temperature to have increased from 31.0C to 32.6 degree C between 1980 and 2007 in the pre-monsoon periods. Higher SST affects the process of evaporation, condensation, cloud formation and rate of precipitation etc. The following table shows that the average decadal change in SST is greater than half a degree in recent time in Indian Sunderban. At the same time it has also been observed that the average maximum monthly land mass temperature also denotes a positive trend in last decade, particularly from the month of September to April. Sea level rise has also been higher than the global average in Sunderban. In according to School of Oceanographic Studies, JU, Kolkata an increase at 17.8 mm/year in sea level between 2000 and 2009. National Institute of Oceanography (2006) indicates an increase of 5.7 mm/year between the year 2000 and 2004. Earlier, during 1991 and 1999, sea level rise in that area was 3.14 mm/year13.The current rate of sea level increase in Indian Sunderban is far higher than the global average rise in sea level which was in the range of 1.7 mm/year between 1870 and 2000 and 3.27 mm/year between 1993 and 2010. In according to the report of IMD, rate of rainfall has marked a sharp increase in rainy days as well as intensity of rain that enhance the risk of more frequent and disastrous cyclones (Aila, Nargis) in that region. At the same time it can also be observed that most of the severe cyclones take place in the span of April to June in recent years. Severe cyclonic storms over the Bay of Bengal have registered a 26 per cent increase over the last 120 years, intensifying in the post-monsoon period. The intensity of storm has been increasing time to time. The decadal frequency of storms in the Bay of Bengal from 1891 to 1961 as per the 1964 records of the IMD indicates that 56 cyclones occurred during 1921-1930, while 32 storms were reported for the period 1951-1960 (Gupta S. and Sarkar G., Climate Change and Economic Adaptability of Indian Sunderban, 2014).

Changing economy of Sunderban blocks

Monoculture of rice has been considered as the mainstay of sunderban blocks of South 24 Pargans. Most of the people of Indian Sunderban traditionally engaged themselves with the paddy cultivation. Aman cultivation is the mainstay of economy of the inhabitants of that region for a long span of time. There is a favourable condition of rice farming prevails in that region, that is why the local people choose this traditional option and have been enlisted themselves as the main worker of that region. If we give stress on the economic structure of that region, it has been found that agriculture plays as dominant economic feature for most of the development blocks. Basanti, Kultali, Sagar and Canning II are so significant in this case, as they hold more than 70% share as agricultural labour. So, it can be concluded that Indian Sunderban has been dominated by agriculture (Gupta S. and Sarkar G., Climate Change and Economic Adaptability of Indian Sunderban, 2014).

Table – 1: Changing land use pattern of Sunderban blocks of South 24 parganas

Type of land use	Year 2001 (Area in %)	Year 2009 (Area in %)	Change occur (Area in %)
Forest land	32.33	31.14	-1.2
Settlement	19.34	26.16	+6.8
Agricultural land	43.20	36.74	-6.5
Others	5.13	5.96	0.8
Total	100	100	

*data source-S.Hazra, 2010, 'Temporal change detection study of Sunderban' and calculated by authors

The above areal statistics represents the temporal change in land use of Sunderban blocks of South 24 Parganas. It has been clearly observed that the percentage of agricultural land sharply decreases in recent time in those blocks. Few of them have been converted into bheri or occupied by the inhabitants to build their houses as the land losses its productivity and became unfertile, specially after the occurence of Aila. Thus a real difference has been made in landuse of Indian Sunderban. It has already been detected that the amount of agricultural land gradually decreasing as a result of landmass sinking and subsidence. The local inhabitants have been facing a real problem as most of the people are engaged with agricultural based economy. They have lost their land and became helpless. People who have been lost their own land of agriculture due to sea level rise, are unable to plough their agricultural field due to excessive salinity. The saline water of sea often enters into the agricultural field by overtopping the embankment in the time of severe cyclones. As a result, the productivity of land decreases sharply and paddy production of Indian Sunderban has been threaten by such climatic phenomena.

Population increase with an uncontrolled manner in the studied region creates a complex situation day- by- days. It is not possible for a region to provide proper opportunity for such a growing population with sharp increase. At the same time it should take under consideration that the changing nature of climate creates more complex condition and creates challenge for the inhabitants to live. As we know that the sea level of the studied area gradually rises, it has been found that a number of islands are being disappeared and the others being degraded regularly with the rise of sea level. As example Jambudwip, Dhanchi, Dalhousie, Ghoramara, Mousuni exhibits the trend of gradual erosion and subsidence in the part of Indian Sunderban. Lohachara has completely been disappeared. Now-a-days the people of Indian Sunderban have no option to go with their earlier choice of agriculture. They have to find some other way to get their job in their changing environment. So, a significant change should be observed in occupational pattern of those people. Sharp declines in the number of main workers signify that the poor inhabitants find no way to stay with their tradition of agriculture based economy and they have to shift to other economic sector for their survival. A parallel increase of marginal workers refer that the landless people have chosen an alternate economic system for their livelihood. Thus the main workers of Indian Sunderban have been converted into marginal workers with the changing nature of climate (Gupta S. and Sarkar G., Climate Change and Economic Adaptability of Indian Sunderban, 2014).

Table-2: Composition of female worker in Sunderban blocks of South 24 parganas

Name of block	Main worker (in %) Year 1991	Marginal worker (in %) Year 1991	Non worker (in %) Year 1991	Main worker (in %) Year 2001	Marginal worker (in %) Year 2001	Non worker (in %) Year 2001
Canning I	51.00	2.96	46.04	47.26	16.52	36.22
Canning II	52.41	1.25	46.34	44.51	15.13	40.36
Basanti	52.05	6.61	41.34	43.16	19.91	36.93
Gosaba	56.46	14.32	29.22	45.02	31.42	23.56
Joynagar I	47.70	2.85	49.45	47.12	13.08	39.80
Joynagar II	47.16	2.01	49.17	45.16	18.49	36.35
Mathurapur I	47.29	3.52	43.77	37.22	16.82	45.96
MathurapurII	51.38	4.52	46.86	46.56	16.90	36.54
Kultali	48.06	3.25	48.69	43.27	17.85	38.88
Patharpratima	51.53	12.69	35.78	52.46	32.13	15.41
Kakdwip	50.91	6.94	42.15	45.91	22.94	31.15
Namkhana	55.06	33.49	11.45	50.88	34.10	15.02
Sagar	48.28	4.53	47.19	45.37	35.02	19.61

*data from Census of India report, 1991, 2001 and calculated by authors

The change of climate as well as environment creates a severe threat the livelihood of Sunderban inhabitants. They have to allow themselves with some limited options of alternative economy other than the traditional agriculture. Not only that the challenging situation have forced them to make an improvement in their dependency ratio and allow the female members of family to play an active

role in economic practices. Thus the share of non worker has been reduced as the female non workers have engaged themselves to maintain their livelihood.

Table-3: Decadal transformation of dependency ratio in Sunderban blocks of South 24 parganas

Name of block	Dependency ratio Year 1991	Dependency ratio Year 2001
Canning I	0.85	0.56
Canning II	0.86	0.68
Basanti	0.70	0.59
Gosaba	0.41	0.31
Joynagar I	0.98	0.66
Joynagar II	0.97	0.57
Mathurapur I	0.78	0.85
MathurapurII	0.88	0.58
Kultali	0.95	0.64
Patharpratima	0.56	0.18
Kakdwip	0.73	0.45
Namkhana	0.13	0.18
Sagar	0.89	0.24
Average	0.75	0.50

*calculation done by authors

It has been observed that most of the blocks experience an improvement of the dependency ratio in last decades. The non-worker female members join with economic activity in recent time and as a result the dependency ratio gradually improves in recent years. A significant improvement in dependency ratio has been observed in Sagar, Joynagar I and Joynagar II.

Table-4: Female work participation in Sunderban blocks of South 24 parganas

Name of block	Female worker (in %)		
	Year 1991	Year 2001	Decadal change (in %)
Canning I	4.76	12.64	7.88
Canning II	3.81	11.16	7.35
Basanti	8.30	12.35	4.05
Gosaba	17.5	20.40	2.90
Joynagar I	3.65	10.86	7.21
Joynagar II	3.23	14.40	11.17
Mathurapur I	4.03	5.60	1.57
MathurapurII	5.98	10.92	4.94
Kultali	3.76	9.76	6.00
Patharpratima	12.94	29.60	16.66
Kakdwip	8.12	16.24	8.12
Namkhana	33.47	29.03	-4.44
Sagar	5.41	27.67	22.26

*data from Human development report, South 24 Pgs, 2009 and calculated by authors

Active participation of female members has been seen in recent time for the Sunderban blocks of South 24 Parganas. Sagar, Patharpratima and Joynagar have been set a remarkable example in case of female participation in main stream economy. Most of the other blocks, except Namkhana have been shown the positive gowth of female worker in recent decades. Female members of family have really realized the economic crisis and come forward to make a successful alternative economy with the change of environment of Sunderban.

Table- 5: Gender gap of work participation in Sunderban blocks of South 24 parganas

Name of block	Year 1991						Year 2001					
	Main worker (in %)			Marginal worker (in %)			Main worker (in %)			Marginal worker (in %)		
	M	F	deviation	M	F	deviation	M	F	deviation	M	F	Deviation
Canning I	48.05	2.95	45.1	1.15	1.81	0.7	40.58	6.68	33.9	10.56	5.96	4.6
Canning II	49.6	2.81	46.8	0.25	1.00	0.8	40.40	4.11	36.3	8.08	7.05	1.0
Basanti	49.23	2.82	46.4	1.13	5.48	4.4	39.19	3.97	35.2	11.53	8.38	3.2
Gosaba	51.55	4.91	46.6	1.73	12.59	10.9	41.03	3.99	37.0	15.01	16.41	1.4
Joynagar I	45.70	2.00	43.7	1.20	1.65	0.5	41.00	6.12	34.9	8.34	4.74	3.6
Joynagar II	45.27	1.89	43.4	0.67	1.34	0.7	40.06	5.10	35.0	9.19	9.30	0.1
Mathurapur I	45.21	2.08	43.1	1.57	1.95	0.4	34.26	2.96	31.3	14.18	2.64	11.5
MathurapurII	48.90	2.48	46.4	1.02	3.50	2.5	42.36	4.20	38.2	10.18	6.72	3.5
Kultali	46.75	1.31	45.4	0.80	2.45	1.7	40.35	2.92	37.4	11.01	6.84	4.2
Patharpratima	48.44	3.09	45.4	2.84	9.85	7.0	43.73	8.73	35.0	11.26	20.87	9.6
Kakdwip	48.36	2.55	45.8	1.37	5.57	4.2	41.39	4.52	36.9	11.22	11.72	0.5
Namkhana	49.70	5.36	44.3	5.38	28.11	22.7	44.74	6.14	38.6	11.21	22.89	11.68
Sagar	46.70	1.58	45.1	1.15	3.83	2.68	40.86	4.51	36.4	11.86	23.16	11.2

*data from Human development report, South 24 Pgs, 2009 and calculated by authors

The deviation of work participation between the male and female inhabitants has been reduced for most of the Sunderban blocks of South 24 Parganas in case of main work force. It reveals that a significant number of male workers have bound to leave the agricultural field and join with some possible alternatives. At the same time it also to be said that the female members of family, who generally like to stay at home, come out and have been started to work as rented daily labour in agricultural practices. On the other hand it can be observed that the deviation of work participation between the male and female inhabitants has been also reduced for most of the Sunderban blocks of South 24 Parganas. So, it can be said that women of Sunderban blocks have already come forward to join with the main stream economy of Sunderban region and playing a very significant role to survive in such a challenging situation.

Table-6: Decadal increase of female main and marginal worker in Sunderban blocks, South 24 Parganas

Name of block	Female worker (in %)					
	Female Main worker			Female Marginal worker		
	Year 1991	Year 2001	Increase	Year 1991	Year 2001	Increase
Canning I	2.95	6.68	3.73	1.81	5.96	4.15
Canning II	2.81	4.11	1.30	1.00	7.05	6.05
Basanti	2.82	3.97	1.15	5.48	8.38	2.90
Gosaba	4.91	3.99	-0.92	12.59	16.41	3.82
Joynagar I	2.00	6.12	4.12	1.65	4.74	3.09
Joynagar II	1.89	5.10	3.21	1.34	9.30	7.96
Mathurapur I	2.08	2.96	0.88	1.95	2.64	0.69
MathurapurII	2.48	4.20	1.72	3.50	6.72	3.22
Kultali	1.31	2.92	1.61	2.45	6.84	4.39
Patharpratima	3.09	8.73	5.64	9.85	20.87	11.02
Kakdwip	2.55	4.52	1.97	5.57	11.72	6.15
Namkhana	5.36	6.14	0.78	28.11	22.89	-5.22
Sagar	1.58	4.51	2.93	3.83	23.16	19.33

*calculation done by authors

The above table shows that the female segment of the society have been introduced themselves as main worker as well as marginal workers in almost every blocks of Indian Sunderban of South 24 Paraganas in recent time. A greater percentage of female main workers have been added in the blocks, like- Patharpratima, Joynagar l, Joynagar ll and Canning l. The similar criterion has been noticed for Sagar, Pathrpratima, Joynagar ll, Canning ll for the segment of marginal workers. Only Gosaba and Namkhana show the opposite

character for the main and marginal worker segment respectively.

Table-7: Structural change of marginal workers in Sunderban blocks, South 24 Parganas

Name of block	Dominant Worker					
	Main worker			Marginal worker		
	Dominance in Year 1991	Dominance in Year 2001	Change occur	Dominance in Year 1991	Dominance in Year 2001	Change occur
Canning I	M	M	No change	F	M	✓
Canning II	M	M		F	M	✓
Basanti	M	M		F	M	✓
Gosaba	M	M		F	F	
Joynagar I	M	M		F	M	✓
Joynagar II	M	M		F	F	
Mathurapur I	M	M		F	M	✓
MathurapurII	M	M		F	M	✓
Kultali	M	M		F	M	✓
Patharpratima	M	M		F	F	
Kakdwip	M	M		F	F	
Namkhana	M	M		F	F	
Sagar	M	M		F	F	

*calculation done by authors

The above table represents an interesting view to see that the male workers still maintain their dominant position as the main worker, where as a significant change has been observed in few blocks for the marginal portion, where the male people has been shifted from the main to marginal category and create their dominance in that segment. It reveals that a significant number of main workers of Canning l, Canning ll, Basanti, Joynagar l, Mathurapur l, Mathurapur ll and Kultali have been compelled to change their mode of occupation to adapt with the changing environment of Indian Sunderban

Conclusion with findings

The paper gives stress on the recent structural change occurs in work force of Sunderban blocks of South 24 Parganas. The analysis shows that the female member of family have been participated in economic sector to survive in struggle for existence. The participation of female member in main stream economy helps to reduce the dependency ratio of that region. At the same time the gender gap between male and female worker has also been reduced. The percentage of non-worker has also been reduced in recent years. The tendency of positive growth has been experienced for both segments of main and marginal female workers. The recent trend of female participation restructures the worker composition of this region and brings a revolution to the holistic development of Sunderban blocks of Soth 24 Parganas. At the same time it is also very significant that a sharp trend of transformation from main to marginal sector has been observed for the male workers and they are found as dominant work force for those Sunderban blocks, like-Canning I, ii, Basnti, Jaynagar I, Mathurapur I,II and Kultali. Thus the present paper successfully represents the structural or compositional change of workforce in that geographical region in recent time and tries to give emphasis on the change of female participation ratio for those blocks of Indian Sunderbans.

Reference

1. Agarwal A., Arora D.R.(1989), Women in rural society, Vohra publication, Allahabad.
2. Agriculture and Rural Development, Report of conference, FAO, Rome(1993) From forum to field:NGO perspective and concern, Development education exchange papers
3. Ahmed, A.U. and M. Alam, 1998. Development of climate change scenarios with general circulation models. In: S. Huq, Z. Karim, M. Asaduzzaman and F. Mahtab (eds.). Vulnerability and Adaptation to Climate Change for Bangladesh. Kluwer, Academic Publishers, Dordrecht. pp: 13-20
4. Ahmed, A.U., 2006. Bangladesh climate change impacts and vulnerability. Climate change cell, Department of Environment, Comprehensive Disaster Management Programme, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
5. Ali, A., 1999. Climate change impacts and adaptation assessment in Bangladesh. Clim. Res., 12: 109-116 Banerjee, K., Roy Chowdhury, M. et al. 2012. Influence of anthropogenic and natural factors on the mangrove soil of Indian Sundarbans wetland. Arch. Environ. Sci. (2012), 6, 80-91
6. Bose, Shivashish. 2006 Mangrove forests in Sunderbans active delta – ecological disaster and remedies.
7. Blower J (1985). Sundarbans forest inventory project, Bangladesh. Wildlife conservation in the Sundarbans. Project report 151. Overseas

Development Administration, Land Resources Development Centre, Surbition, UK, 39
8. Bhusan C., Living with changing climate, Center for Science and Environment, 2012
9. Biswas, K.R., (2001), Rivers of Bengal, Acompilation volume II, West Bengal district Gazetteers, Higher Education Department, Govt. of West Bengal
10. Chand B.K.,Trivedi R.K., Dubey S.K., Beg M.M., Aquaculture in changing environment in Sunderban, West Bengal University of Animal and Fishery Science, 2012
11. CEGIS, 2006. Impacts of Sea Level Rise on Land use Suitability and Adaptation Options, Draft Final Report, Submitted to the Ministry of Environment and Forest, Government of Bangladesh and United Nations Development Programme (UNDP) by Centre for Environmental Geographic Information Services (CEGIS), Dhaka.
12. Chaffey, D.R., F.R. Miller and J.H. Sandom, 1985. A forest inventory of the Sundarbans, Bangladesh. Main report, Overseas Development Administration, England. pp: 196.
13. Choudhury, A.M., S. Neelormi, D.A. Quadir, S. Mallick and A.U. Ahmed, 2005. Socio economic and physical perspectives of water related vulnerability to climate change: results of field study in Bangladesh. Science and Culture (Special Issue), 71(7-8): 225-238. Census of India, Ministry of Home Affairs, Government of India
14. Das, C.S. (2000), Environmental impact assessment of snakes in Sunderban, West Bengal, ILEE
15. Das, G.k., Sundarbans Environment and Ecosystem, Sarat Book Distributors
16. District Statistical Handbook, South 24 Parganas, 2009.
17. DoZ (Department of Zoology), 1997. Survey of Fauna, Draft Final Report, National Conservation Strategy Implementation Project 1 Ministry of Environment and Forest, Government of Bangladesh. pp: 225.
18. Elliott, C.; L. Hyde, L. McDonell, M. Monroe, D. Rashash, W., Sheftall, V.S. Brown, T. Worthley, G. Crosby and L. Topas. 2008. Sustainable living education: a call to all extension. Journal of Extension, 46(2): Article no. 2COM1
19. Environmental Sciences, 8(1), pp 35-41
20. Forest Conservation Act (1980), with Amendments Made in 1988, Ministry of Environment and Forest, Govt of India
21. Falguni, A., 2009. Aila after Sidr. The Daily Star online news, Dhaka, Bangladesh. Hossain, M.B., 2011. Macrobenthic community structure from a tropical estuary, LAP Publishing Company, Germany. pp: 84.
22. Ghosh A.K., 2013, Status of Environment in West Bengal, Second citizen's report
23. Government of West Bengal. 2005. Sundarbans Development Board. Administrative
24. Report: 2004-2005. Sundarbans Development Board, Sundarbans Affairs Department, Government of West Bengal
25. Human Development Report, South 24 Parganas, Govt. of West Bengal, 2009
26. Huq, S., A.U. Ahmed and R. Koudstaal, 1996. Vulnerability of Bangladesh to climate change and sea level rise. In: T.E. Downing (eds.). Climate change and world food security, NATO ASI Series, I 37, Springer-Verlag, Berlin,Heidelberg. pp: 347-379.
27. Human Security and Vulnerability, Human Development Report, Chapter 7, 2007
28. Houghton, T., Y. Ding, D.J. Griggs Gareau, B.J. 2007. Ecological values amid local interest: natural resource conservation, social differentiation and human survival in Honduras. Rural Sociology, 72(2): 244-268
29. IPCC, 2004. Intergovernmental Panel on Climate Change
30. Jalis, Annu. 2007. The Sundarbans: Whose World Heritage Site? Conservation and Society. Volume: 5(3).
31. Kanjilal, Tushar. 2000. Who Killed the Sundarbans?. Tagore Society for Rural Development, Calcutta
32. Kadavul, K.; J. Presena and J.R. Diane. 2005. Traditional medicinal usage of tree barks of Pondicherry region, India. Nature Environment pollution technology, 4(2): 241-246
33. Khan, M.A. 2006. Depletion of forest cover portends climatic disaster. The Daily Star, Dhaka
34. Kumar, V. 2009. Indigenous technical knowledge in agriculture (Indigenous Knowledge)
35. Kutub Uddin, H.M.,(2013) Impact of natural calamities on agriculture-Reclaimed land of Sunderban, Volume I
36. Lahiri, T.B., (2002) Environmental diversity, opportunity and challenge, ILEE, pp 8-19
37. Lillesand, T.M., and Keifer, R.W., (1994), Remote Sensing and Image Interpretation (5th Edition), John Wiley and Sons Inc.
38. Lu, D., Mausel, P., Brondizio, E., and Moran., E., (2004), Change Detection techniques, International Journal of Remote Sensing, 25(12), pp 2365-3401
39. Mandal A.K., Ghosh R.K., Sunderbans- A socio-bio-ecological study, Bookland Pvt Ltd
40. Mandal S.K., Mandal S, (2003), Survey of weed flora of thelower Ganga plain, ILEE.
41. M. Noguer, P.J. Van der Linden, X. Dai, K. Maskell and C.A. Johnson (eds.), 2001. Climate Change 2001. The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK. pp: 881.
42. Manonmani, R., and Mary Divya Suganya G., (2010), Remote Sensing and GIS Application in Change Detection Study In Urban Zone Using Multi Temporal Satellite, International Journal of Geomatics and Geosciences, 1(1), pp 60-65.
43. Mahdavi, A., (2010), IRS-1C image data applications for landuse / landcover mapping in Zagros region, Case Study: Ilam Watershed, West of Iran
44. Mukherjee, K.N. (1996) Agricultural land capability of West Bengal, part II

45. Nyong, A.; F. Adesina and B.O. Elasha. 2007. The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. Mitigation and adaptation Strategies for Global Change, 12(5): 787-797
46. Notification under Section 3(1) and Section 3(2)(v) of the Environment (Protection) Act, 1986 and Rule 5(3) (d) of the Environment (Protection) Rules, 1986 Declaring Coastal stretches as Coastal Regulation Zone (CRZ) and Regulating Activities in the CRZ, New Delhi, 1991 (as amended up to 3rd October 2001), available at http://www.moef.nic.in/legis/crz/crznew.html
47. Sunderban: Future Imperfect, Climate adaptation report, WWF, India, 2010.
48. Smith J.B., N. Bhatti, G. Menzhulin, R. Benioff, M. Campos, B. Jallow, F. Rijsberman, M.I. Budyko and R.K. Dixon (1996), Adapting to Climate Change: An International Perspective. New York: Springer, pp: 476.
49. Thompson, P.M. and M.A. Islam (eds.), 2010. Environmental Profile of St. Martin's Island. United Nations Development Programme, Dhaka.
50. Tomascik, T., 1997. Management Plan for Resources of Narikel Jinjira (St. Martin's Island). National Conservation Strategy Implementation Project 1, Ministry of Environment and Forest, Government of Bangladesh. Pp 125.
51. Warrick, R.A. and Q.K. Ahmad, 1996. The implications of climate and sea-level change for Bangladesh. Kluwer Academic Publishers, Dordrecht, Boston, London. pp: 415.
52. Water Resource Planning Organization, 2004. Where land meets the sea- a profile of the coastal zone of Bangladesh. Dhaka University Press Limited, Dhaka, Bangladesh.
53. World Bank (WB), 2000. Bangladesh: Climate Change and Sustainable Development. Report No. 21104-BD. Rural Development Unit, South Asia Region, Dhaka. pp: 95
54. Wanmali S. (1972), Micro level planning of regional development of rural growth centre, NICD, Hyderabad . .