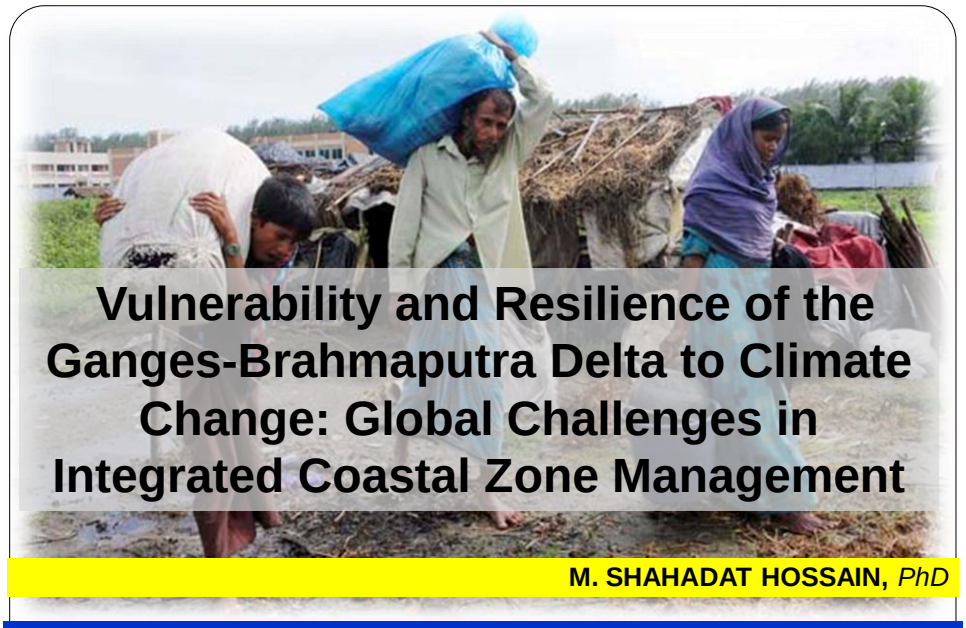
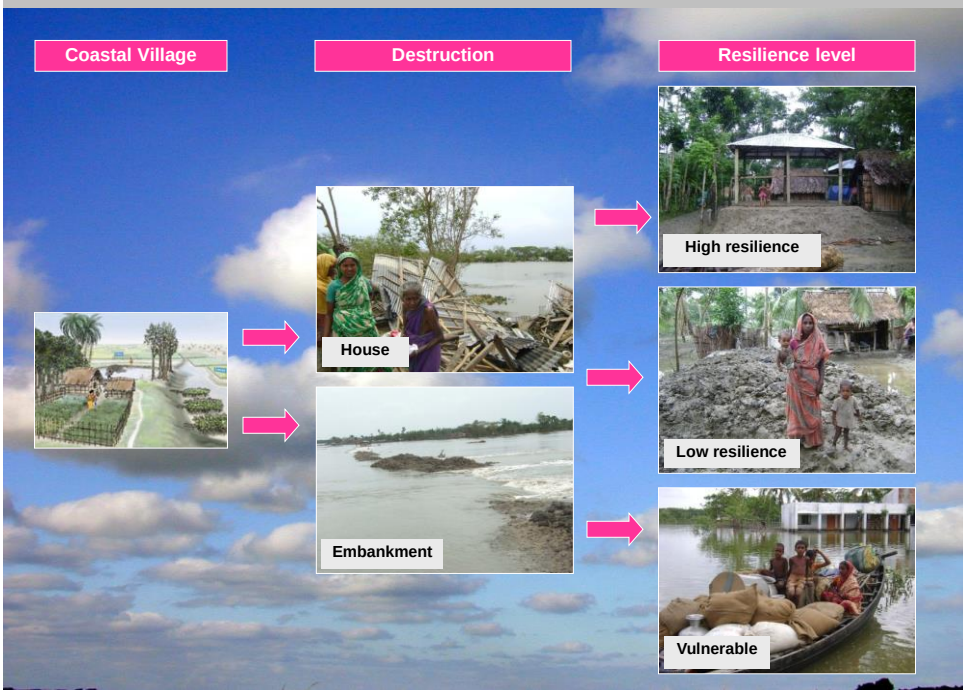


Vulnerability and Resilience of the Ganges-Brahmaputra Delta to Climate Change: Global Challenges in Integrated Coastal Zone Management

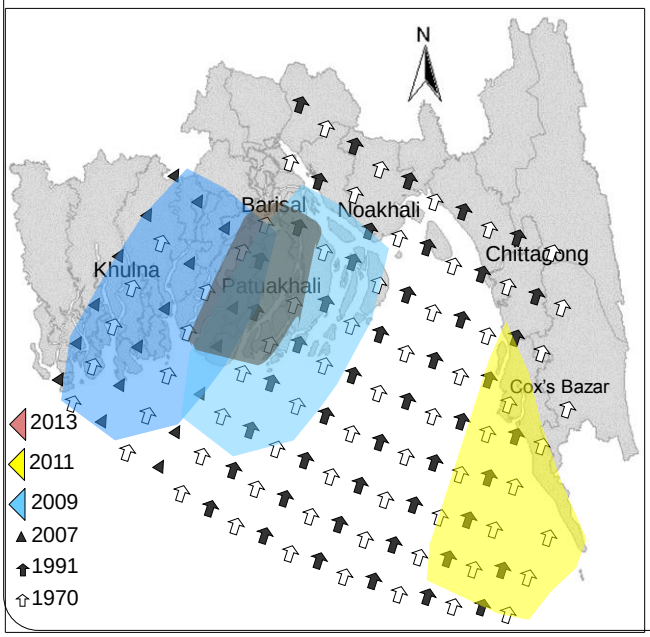
M. SHAHADAT HOSSAIN, *PhD*

Institute of Marine Sciences and Fisheries
University of Chittagong, Bangladesh

COASTAL PEOPLE'S RESPONSE TO CYCLONE



Devastating cyclones & tidal surges along the coast



Cyclone classification

a) Low pressure system: maximum air speed 27 km/hour

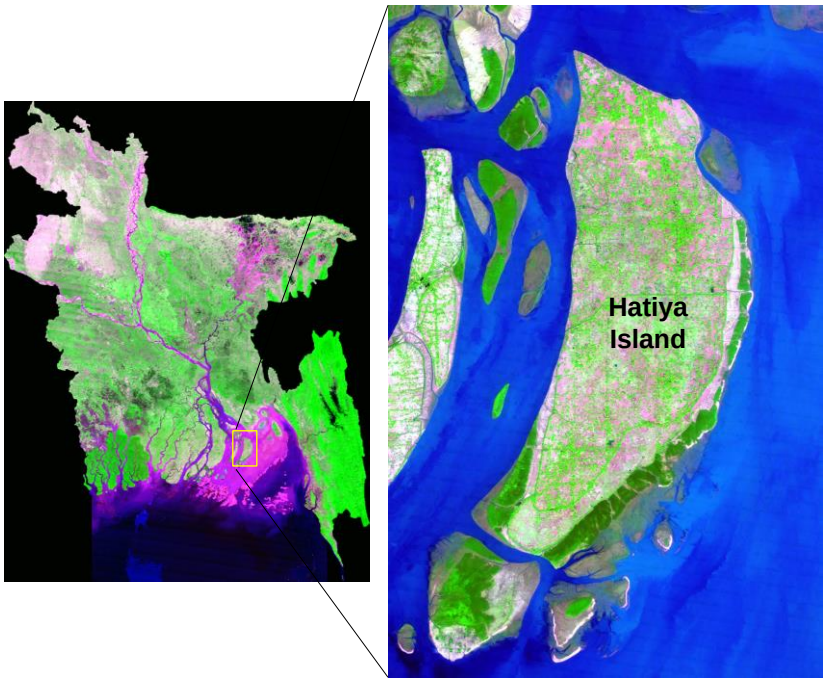
b) Depression: maximum air speed 59 km/hour

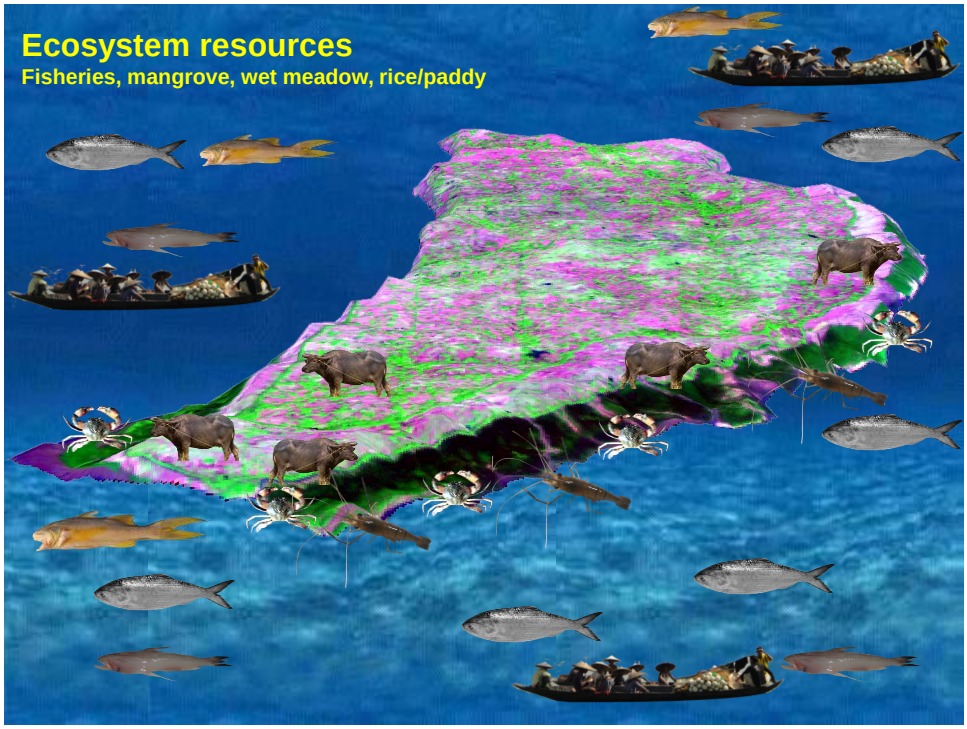
c) Cyclone: maximum air speed 113 km/hour

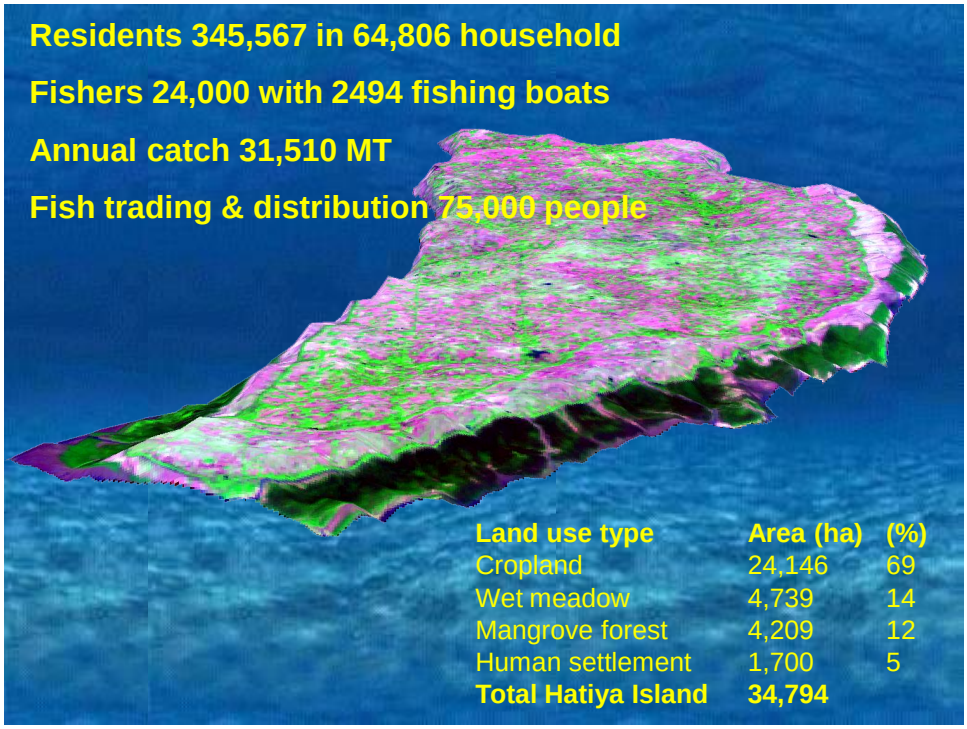
d) Devastating cyclone: maximum air speed >113 km/hour

Cyclone: 1970
November 12-13
Max. speed 241km/hr
Surge height 10m
Causality: 500,000
Damaged: 86.4 million US$

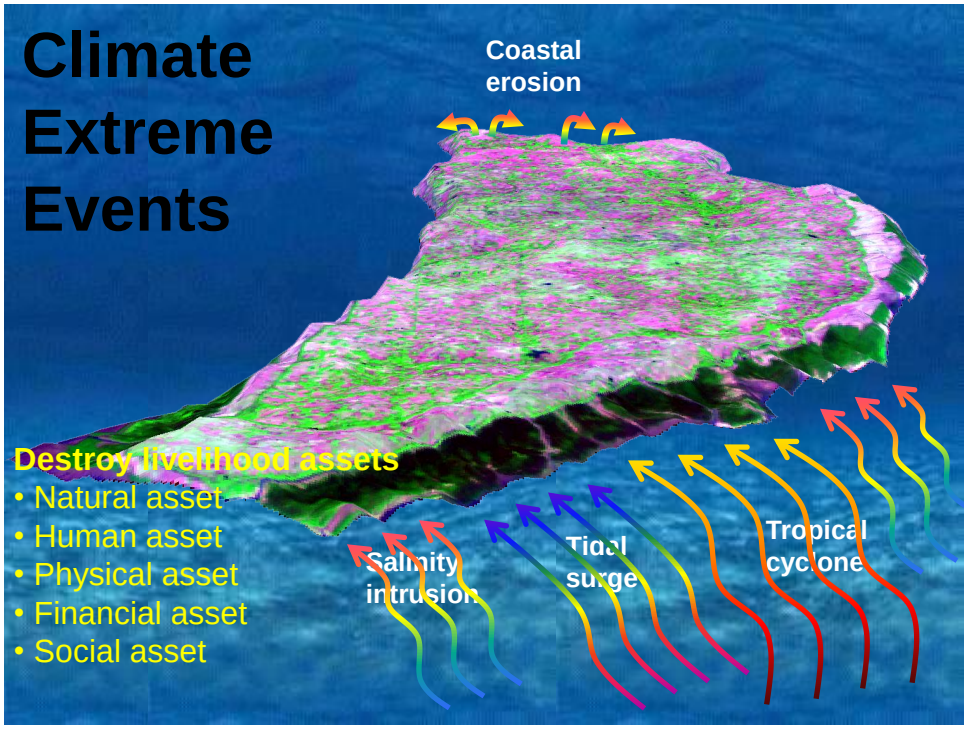
Cyclone: 1991
April 29
Max. speed 193km/hr
Surge height 6m
Causality: 150,000
Damaged: 1780 million US$



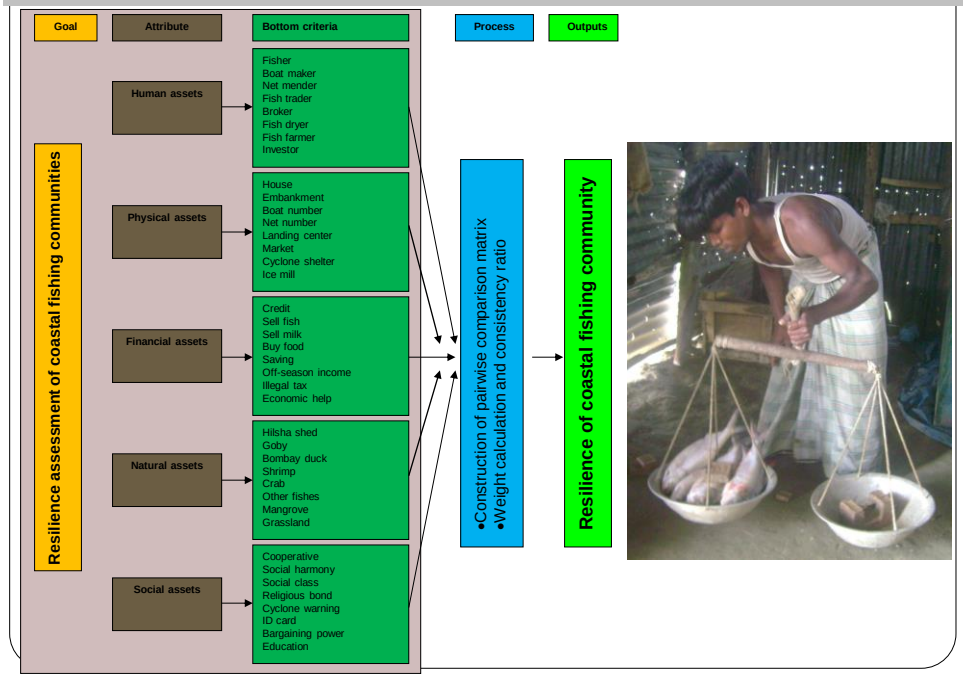




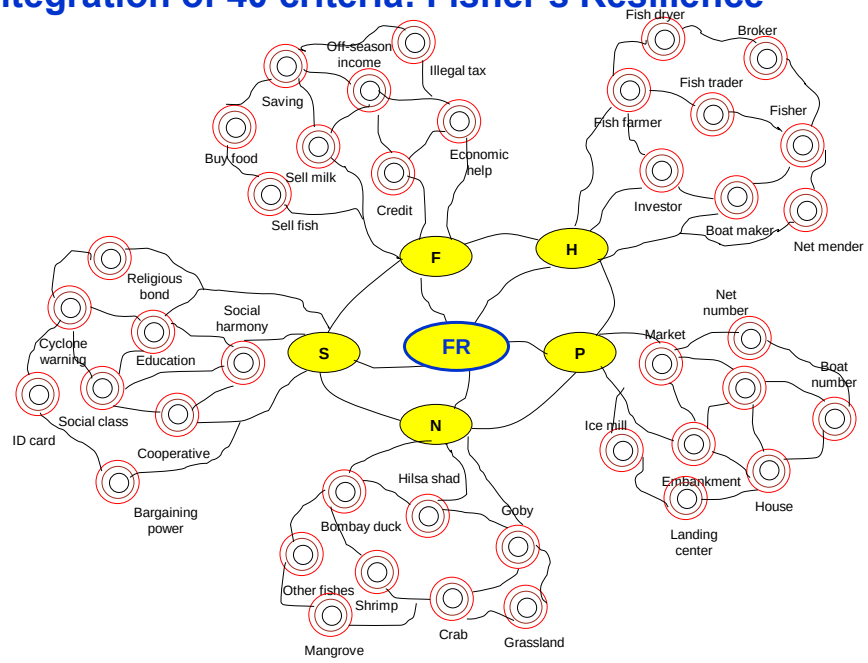
Land use type	Area (ha)	(%)
Cropland	24,146	69
Wet meadow	4,739	14
Mangrove forest	4,209	12
Human settlement	1,700	5
Total Hatiya Island	**34,794**	



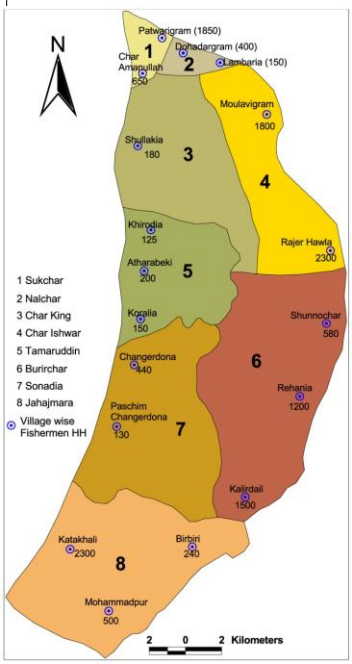
RESILIENCE ASSESSMENT OF COASTAL FISHER'S



Integration of 40 criteria: Fisher's Resilience



Characteristics of fishing villages



Characteristics	Villages
No embankment, no mangrove	Patwarigram, Dohadargram, Lambaria, Moulavigram, Char Amanullah and Shullakia
Only embankment, no mangrove	Khirodia, Atharabeki, Koralia, Changerdona and Paschim Changerdona
Both mangrove and embankment	Rajer Hawla, Shunnochar, Rehania, Kalirdail, Birbiri, Mohammadpur and Katakhali

	Weight
Human capital	
Fisher	0.024
Boat maker	0.120
Net mender	0.100
Fish trader	0.075
Broker	0.220
Fish dryer	0.166
Fish farmer	0.220
Investor	0.075
Consistency ratio (C.R) 0.0009	

	Weight
Physical capital	
House	0.094
Embankment	0.047
Boat number	0.038
Net number	0.031
Landing center	0.189
Market	0.128
Cyclone shelter	0.189
Ice mill	0.283
Consistency ratio (C.R) 0.0016	

	Weight
Financial capital	
Credit	0.058
Fish sell	0.029
Milk sell	0.116
Buy food	0.039
Saving	0.233
Off-season income	0.116
Illegal tax	0.175
Economic help	0.233
Consistency ratio (C.R) 0.0016	

	Weight
Natural capital	
Hilsha	0.027
Goby	0.057
Bombay duck	0.138
Shrimp	0.138
Crab	0.249
Other fishes	0.085
Mangrove	0.111
Grassland	0.194
Consistency ratio (C.R) 0.0012	

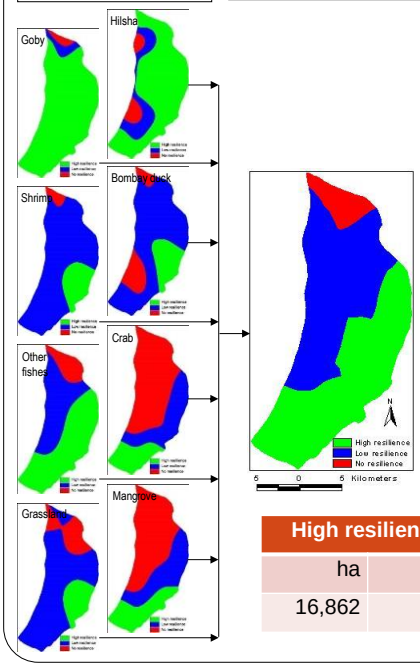
	Weight
Social capital	
Cooperative	0.120
Social harmony	0.049
Social class	0.058
Religious bond	0.039
Cyclone warning	0.162
ID card	0.360
Bargaining power	0.162
Education	0.049
Consistency ratio (C.R) 0.0019	

	Weight
Combine	
Human	0.157
Physical	0.197
Financial	0.275
Natural	0.052
Social	0.318
Consistency ratio (C.R) 0.0016	

Pair-wise comparison matrix

Criteria-wise resilience map

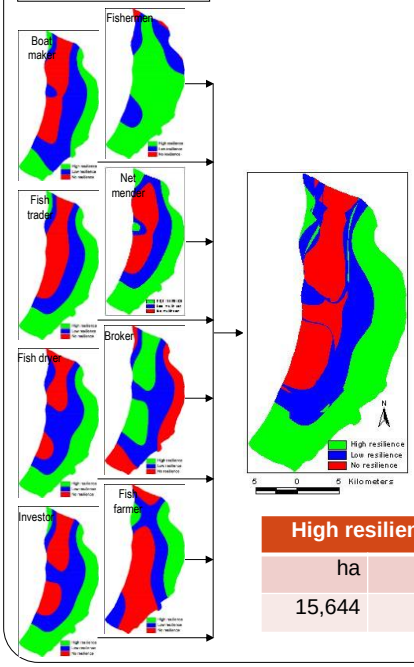
Resilience classification for natural assets



High resilience		Low resilience		No resilience	
ha	%	ha	%	ha	%
16,862	48	15,557	45	2,376	7

Criteria-wise resilience map

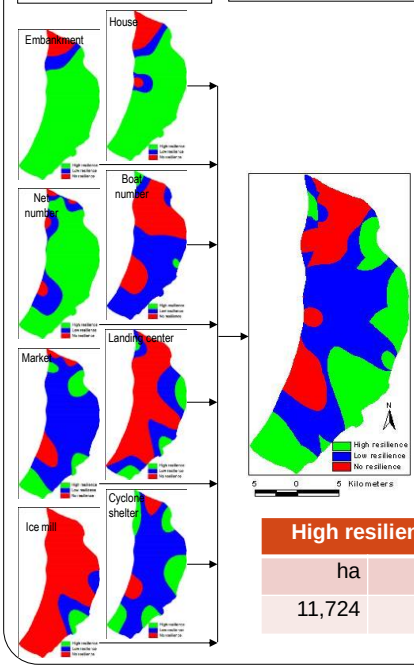
Resilience classification for human assets



High resilience		Low resilience		No resilience	
ha	%	ha	%	ha	%
15,644	45	9,789	28	9,361	27

Criteria-wise resilience map

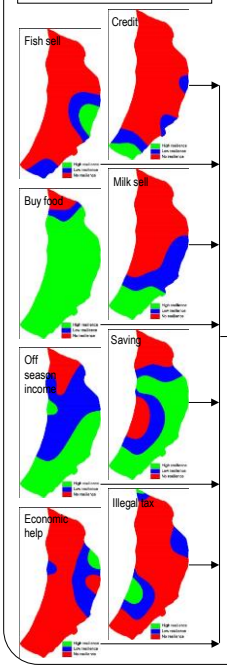
Resilience classification for physical assets

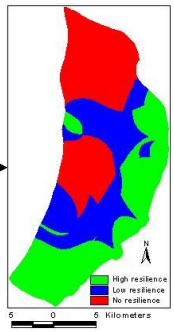


High resilience		Low resilience		No resilience	
ha	%	ha	%	ha	%
11,724	34	15,574	45	7,497	22

Criteria-wise resilience map

Resilience classification for financial assets

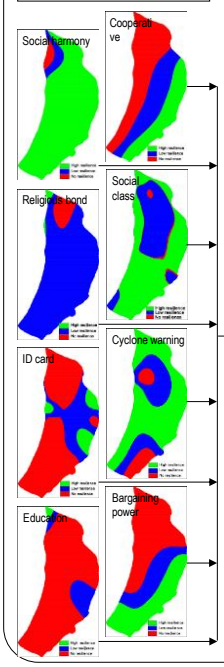


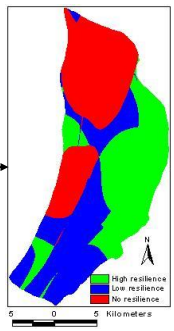


High resilience		Low resilience		No resilience	
ha	%	ha	%	ha	%
12,493	36	10,117	29	12,185	35

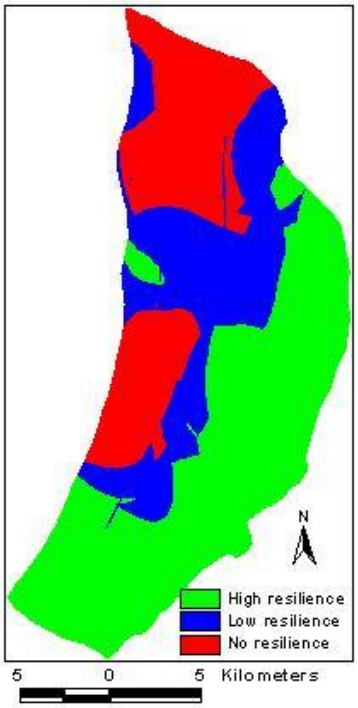
Criteria-wise resilience map

Resilience classification for social assets



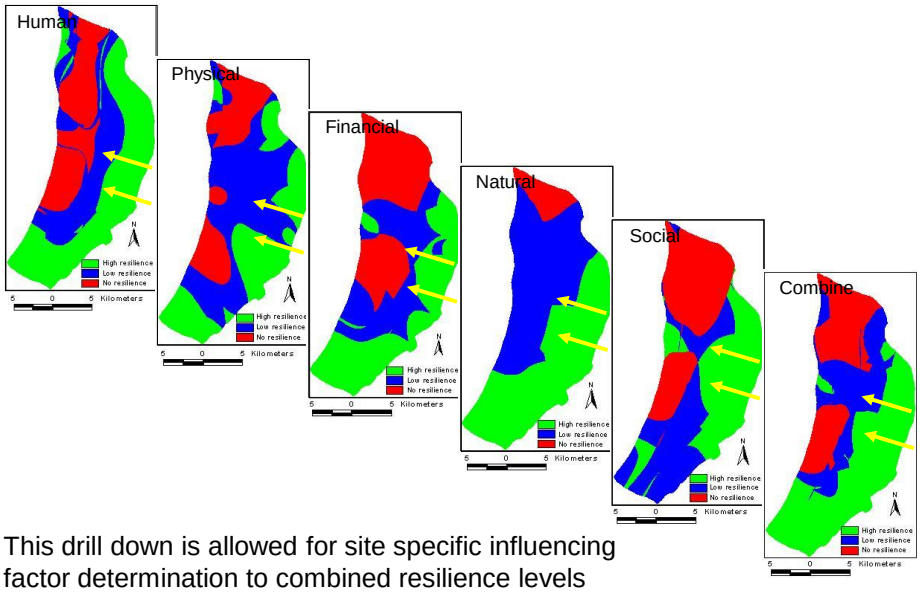


High resilience		Low resilience		No resilience	
ha	%	ha	%	ha	%
12,208	35	10,743	31	11,844	34



High resilience		Low resilience		No resilience	
ha	%	ha	%	ha	%
16,679	48	9,082	26	9,034	26

Down drilling



This drill down is allowed for site specific influencing factor determination to combined resilience levels

Cross-tabulation for error matrix

	Field reference data				
	No resilience (1)	Low resilience (2)	High resilience (3)	Row total	Field accuracy (FA)
Model data					
No resilience (1)	**9**	0	1	10	0.90
Low resilience (2)	1	**11**	0	12	0.92
High resilience (3)	0	1	**21**	22	0.95
Column total	10	12	22	44	
Model accuracy (MA)	0.90	0.92	0.95		

Diagonal sum (bold) =41; Overall kappa = 0.891; Kendall's Tau = 0.889

- Based on 44 field verification sites, 41 sites were correctly classified, obtaining an overall accuracy 93%
- Thus, 93% of the model output matched with the field verification data

Desired outcomes from resilience modeling

- ⇨ Cyclone resilient housing & community infrastructure
- ⇨ Support fishing equipments
- ⇨ Embankment construction
- ⇨ Mangrove affrestation

Community level adaptation options

On-farm training for food production

- Sustainable aquaculture (fish, prawn, crab)
- Livestock rearing (cow, buffalo, goat)
- Poultry farming (chicken, duck)
- Agriculture on dike slope

Off-farm training for cash income (women)

- Tailoring and embroidery
- Nursery (fruity, woody & medicinal plants)
- Cell-phone repairing