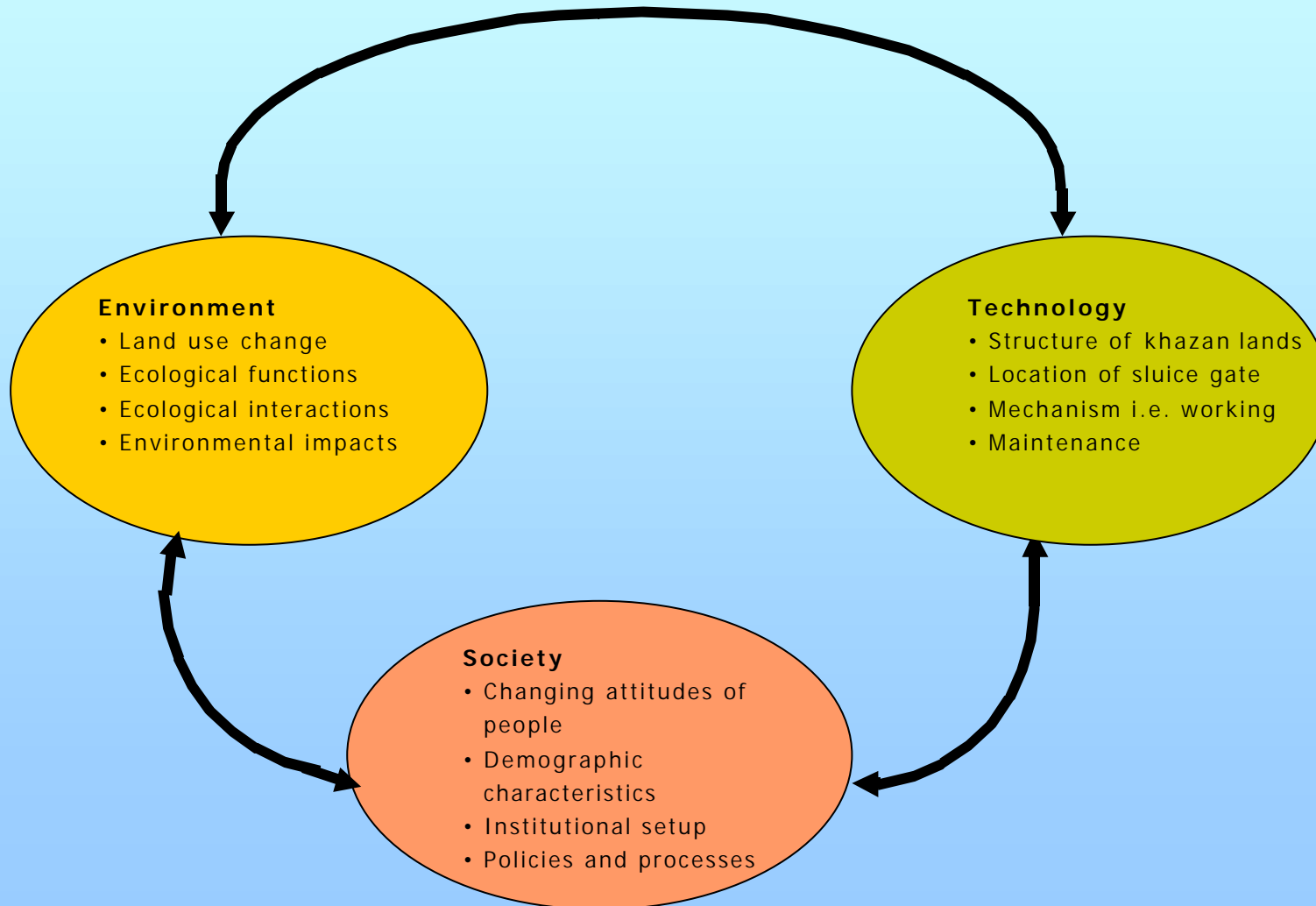


INTEREST - Interactions between Environment, Society and Technology

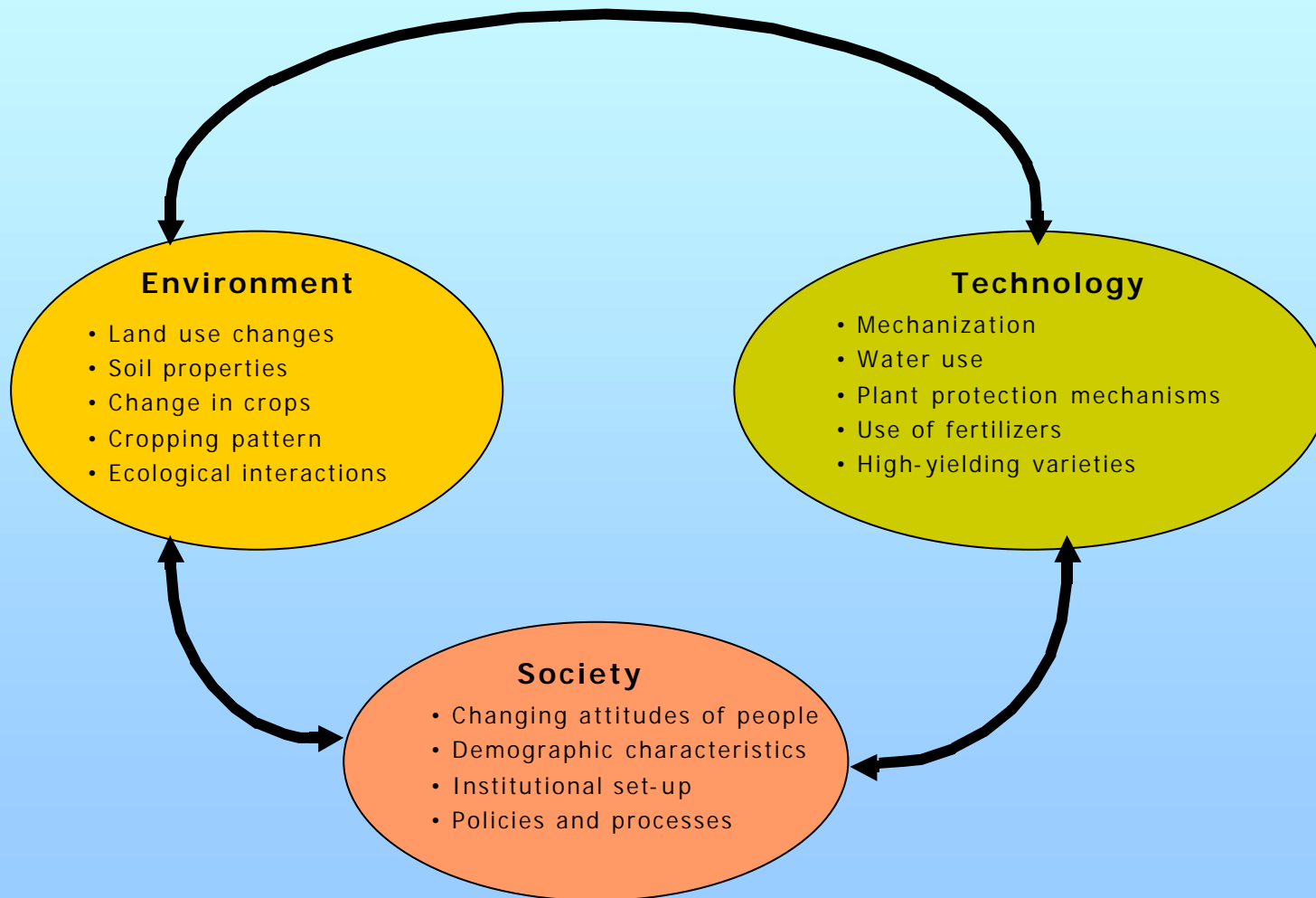
Three case studies using different ecosystems:

- Traditional Aquaculture – Goa
- Agriculture – Karnataka
- Bamboo forests – Haryana

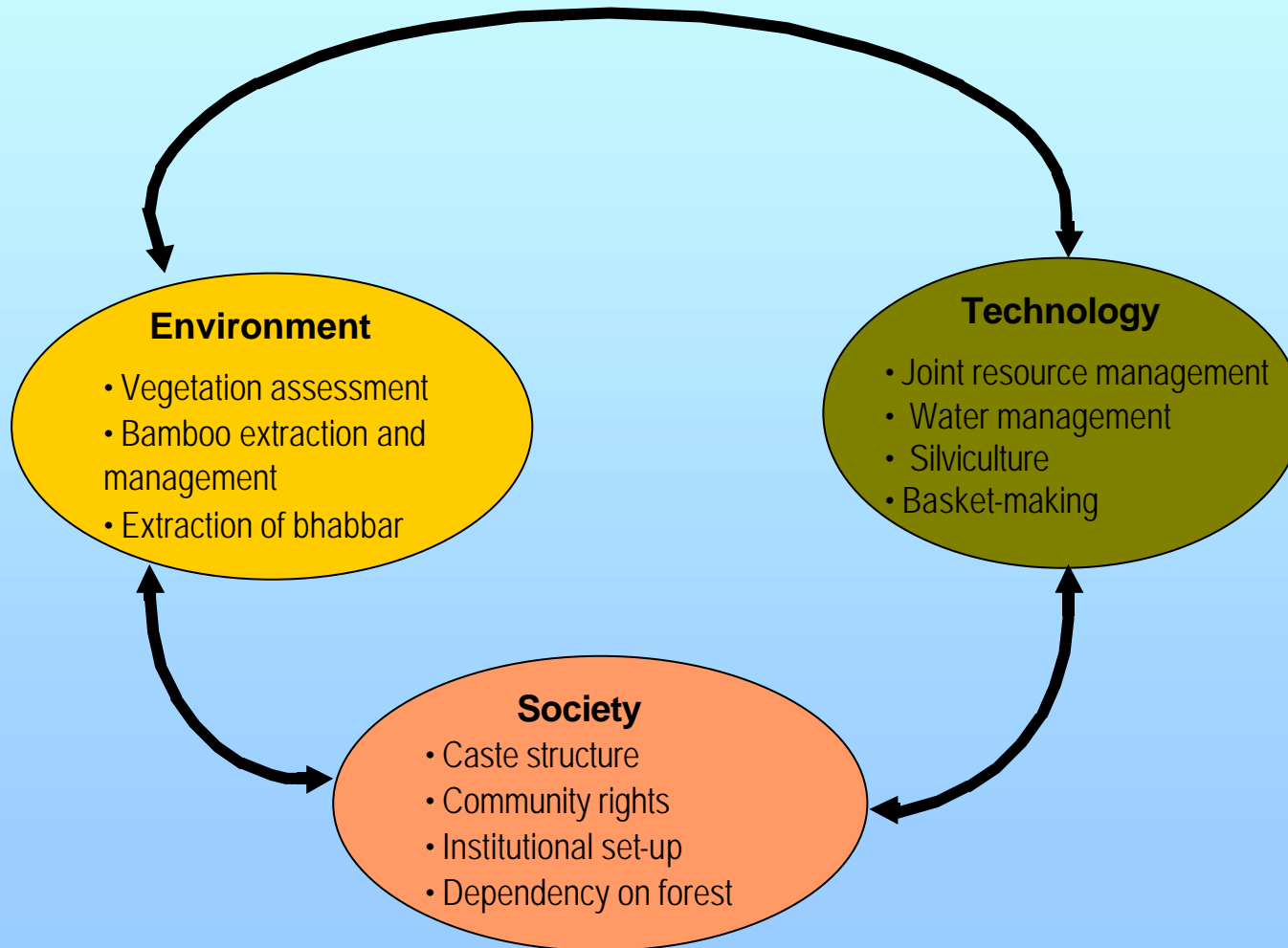
Interactions – traditional aquaculture ecosystem



Interactions – Agriculture ecosystem



Interactions – Bamboo forest ecosystem



Traditional aquaculture system

Case study of *khazan* ecosystem of Goa



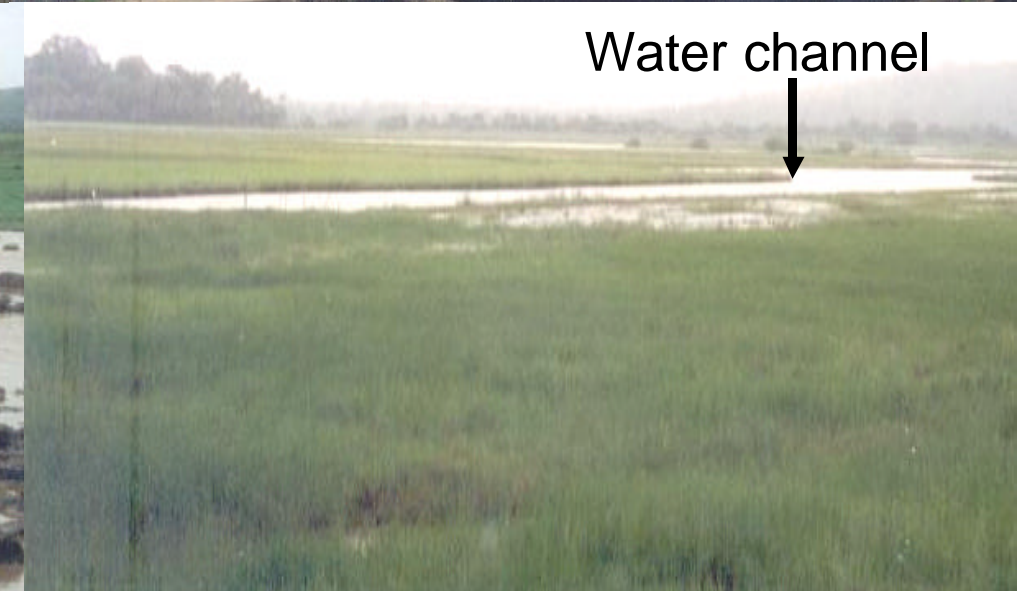
Sluice gate



Outer *bund*



Inner *bunds*



Water channel

Structure of the *khazan* ecosystem

Khazan lands in Goa are reclaimed flood plains protected from tidal ingress through a three-tier defence system:

- The inner *bunds* - mud and straw
- The outer *bunds* - laterite stones.
- The most remarkable feature - wooden sluice gate

At the end of the *khazan* lands is a depression, called '*poim*'

Maintenance of *khazan* farms

- Managed by *comunidade* system
- Tenants associations are responsible jointly for maintenance activities
- Fishing rights are leased through auction every year
- State government - 50% subsidy
- Maintenance activities require sanction from the state government

Traditional aquaculture activity

Different types of fish catch:

- In fields (*'khazans'*)
- Though sluice gates (*'manos'*)
- In ponds (*'khanni'*)

Study area – Divar Island

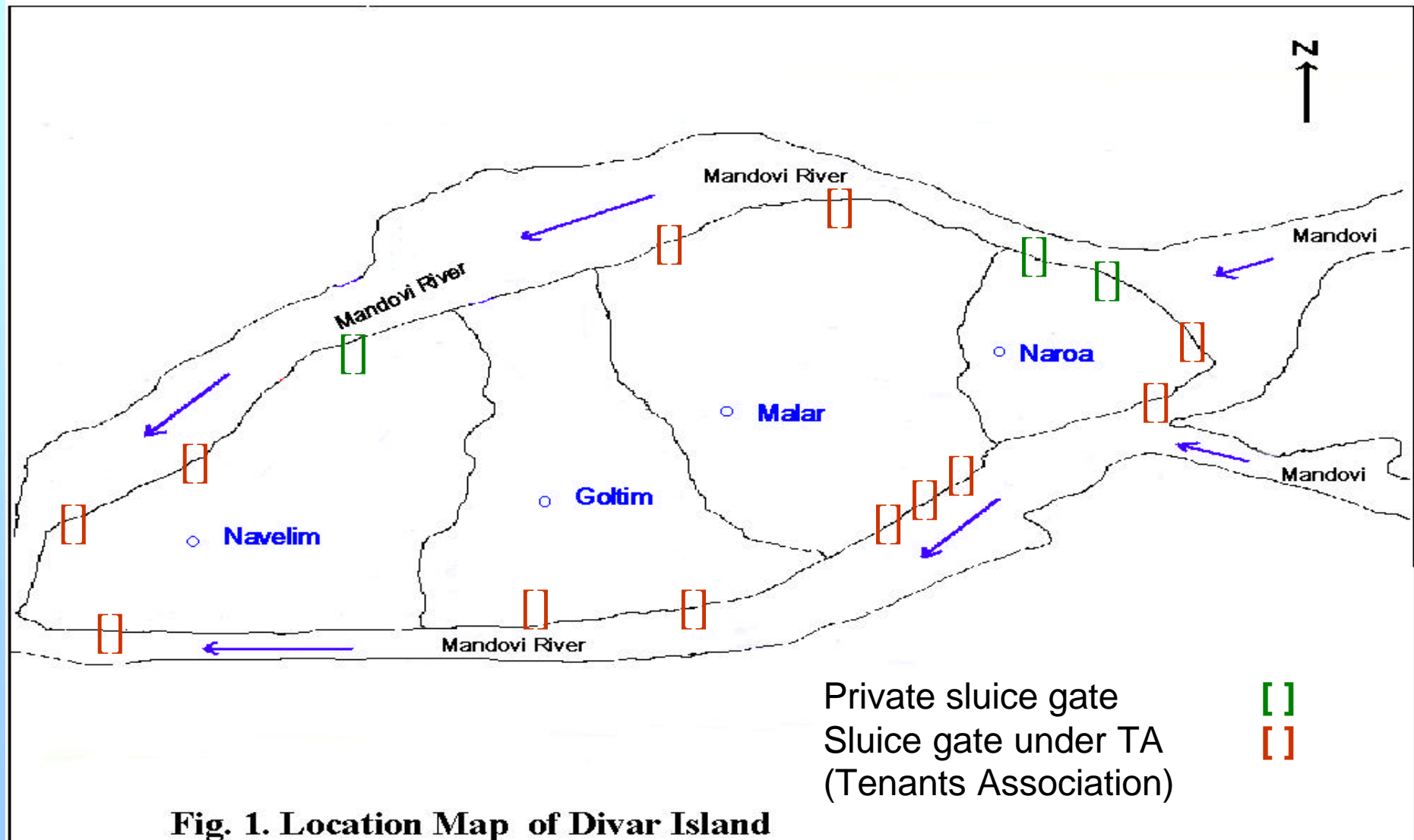


Fig. 1. Location Map of Divar Island

Total area of the island is 1756 ha across 4 villages

Profile of study

area	Divar Island
Area (sq. km)	17.56
Population (nos) 1991	5328
Population (average annual growth rate/annum)	0.81
Density (persons/sq km)	303.5
No of census villages	4
Literacy (%)	71
Workers as % of total population	29

Source: District Census Handbook, 1991

Land use details

	Total geographical area (ha)	% Gross cropped area (ha)	% Cultivable waste (including gaucher and grove) (ha)	% Area not available for cultivation (ha)
Navelim	694.71	51.15	3.19	45.67
Goltim	396.84	54.73	7.70	37.57
Malar	525.39	62.38	4.93	32.69
Naroa	138.77	53.63	5.06	41.31
All study villages	1755.71	55.51	4.87	39.61

Source: District Census Handbook, 1991

Literacy rates in the region (% share) Sex ratio (female population per 100 male population)

	1971	1981	1991
Navelim	49.6	63.8	77.2
Goltim	61.1	71.3	78.9
Malar	57.8	73.6	79.8
Narora	52.9	80.2	77.2
Total study area	56.8	71.1	78.6
Goa State	45.31	57.25	75.51

District census handbooks of North Goa

	1971	1981	1991
Navelim	1105	1050	1072
Goltim	1126	1125	1013
Malar	1196	1103	1017
Narora	1035	1064	1020
Total study area	1134	1095	1028
Goa State	989	975	967

District census handbooks of North Goa

Sectoral distribution of workforce (% share)

	Primary			Secondary			Tertiary		
	1971	1981	1991	1971	1981	1991	1971	1981	1991
Navelim	74	43	40	17	12	18	19	55	41
Goltim	49	47	22	16	0	20	35	52	58
Malar	70	58	35	9	2	19	22	40	47
Narora	58	61	43	9	0	17	33	39	40
Total study area	63	51	32	11	1	19	27	47	49
Goa State	49.34	28.57	32.29	17	3	22	34	68	46

District Census Handbooks of North Goa

Area (ha) of *comunidades* by type

	<i>Khazan</i> land	<i>Morod</i> land	Total
Goltim	119.7	28.2	147.9
Malar	178.3		178.3
Narora	19.7		19.7
Navelim	248.4		248.4
Divar Island	566.1	28.2	594.3

Note. *Morod* land are less fertile agricultural lands on terraced fields, or along the foothills or on the top of hills

Tenants associations and sluice gates in the study area

Tenant association	Sluice gates
Navelim Tenant Association	<i>Dhakti Manos</i> <i>Vodli Manos</i> <i>Sorpanche Manos</i>
Goltim Tenant Association	Khaphache Manos Piduche Manos
<i>Amboi Khazan</i>	Vhodli Manos Valienche Manos
Noi, Insoncio and Thor <i>Khazan</i> Tenants Association	Noi Manos Insoncio Manos Thor Manos
Narora <i>Khazan</i> Tenant Association	Tirthache Manos Borimche Manos

Details on sluice gates in St. Mathias (Malar and Naroa)

Name of Association	Sluice Gate	1999 Auction amount in Rs.	2003 Auction amount in Rs.
Amboi <i>Khazan</i> Tenant Association	Amboi	2,23,500	2,25,000
Naroa <i>Khazan</i> Association	Tirthhachi	80,100	1,03,000
	Borrim	30,300	60,000
Noi Insenho & Tor <i>Khazan</i> Tenant Association	Insenho	45,100	57,000
	Noi <i>Khazan</i>	55,300	42,000
	Thor		1,41,000
Vanxi Tenants Association	Vanxi	Dormant	

Source: Government of Goa

Details on sluice gates in Goltim Navelim

Name of Association	Sluice Gate	1999 Auction amount in Rs.	2003 Auction amount in Rs.
Goltim Tenants Association	Dakti	No auction Breaching of bunds	1,07,000
	Vadli		1,25,000
Navelim Tenants Association	Vadli bhat	No auction Breaching of bunds	1,05,000
	Khadbe /Cantorlachi		1,50,000
	Dhakti		

Source: Government of Goa

Rapid Rural Appraisal - Results

Villages	Fuel	Water use	Main activity	Main problems related to aquaculture	Perception about future
Navelim	Gas/fuelwood	Tap	Agriculture	Breaching of bunds, High price of auction	Unpredictable
Goltim	Gas/fuelwood	Tap	Agriculture	Breaching of bunds, High price of auction	Unpredictable
Malar	Gas/fuelwood	Tap	Agriculture, fishing	Fall in fish catch	Bad
Narora	Gas/fuelwood	Tap	Agriculture, fishing	Fall in fish catch, High price of auction	Don't know

Some important resources

Resources	Land	Estuarine fisheries	Mangroves
<i>Varieties</i>	Khazan/Morod	A number of species such as Prawns, crabs, and different types of fish	Ipal, Chipp
<i>Reported use</i>	Cultivation of paddy and other vegetables	Self consumption, dried and sold	Important ecosystem, fuel wood for domestic population
<i>Perception of change in status</i>	Reduced khazan lands	Reduced quantity, reduced size	Increased
<i>Reason for the change in status</i>	Salinisation of lands	Breaching of bunds	Salinisation of khazan fields
<i>Dependency on the resource for</i>	Employment, consumption	Employment, higher returns, consumption	Fuelwood, fodder, medicines

Inland fish catch (in MT) for Goa

Name of fish	1997	1998	1999	2000	2001
Prawns-Big	49	36	9	27	21
Prawns-Medium	218	172	86	132	93
Prawns-Small	717	691	560	681	474
Lady fish	32	106	72	107	173
Mulletts	118	164	205	268	337
Gerres	12	22	115	184	201
Cat fish	119	300	250	221	284
Anchovy	35	25	140	153	174
Pearl Spot	13	42	28	52	90
Ambasis	31	92	103	118	109
Crabs	61	154	202	189	213
Miscellaneous	603	1670	1594	1405	1544
Total	2008	3474	3364	3537	3713

Source: Fisheries department, Government of Goa.

List of PRA exercises

- Problem rating in Golti, Muddi, Malar central, Naroa, Lokalwada
- Transect walks
- Resource mapping
- Institutional mapping
- Seasonal calendar
- Tidal calendar
- Time lines
- Mapping of landscape changes

Problem rating in Divar

The findings are organized under the following headings

Major problems common to all 5 locations

- Availability of doctor
- Availability of water
- *Panchayat* functioning
- Salinisation of of agricultural fields
- Transport

Problems specific to coastal areas

- Sanitation facilities (toilets)
- Unemployment
- Inadequate and insufficient information of government schemes

Problems specific to central areas

- Power supply
- Garbage/solid waste disposal
- Lack of recreational facilities
- Stray dogs
- Telephone line
- Awareness of technology
- Information of government

Festival

Festivals	Jan	Feb	Mar	April	May	June	Jul	Aug	Sept	Oct	Nov	Dec
<i>Sarvajanik Haldi Kunkum</i>	Yellow											
<i>Sankranti</i>	Green											
<i>Divja 1st day</i>		Green										
<i>Natak</i>		Green										
<i>Satya Narayan Puja</i>		Green										
<i>Shivratri</i>			Cyan									
<i>Shigmo</i>			Cyan									
<i>Gudi Padva</i>				Cyan								
<i>Ram Navami</i>				Cyan								
<i>Narli Pornima</i>							Cyan	Cyan				
<i>Gokul Ashtmi</i>							Cyan	Cyan				
<i>Bonderan</i>							Cyan	Cyan				
<i>Sravan</i>							Yellow					
<i>Fugdi</i>								Green	Green			
<i>Nag panchami</i>								Green	Green			
<i>Ganesh Chaturti</i>									Yellow			
<i>Kojagiri</i>										Cyan		
<i>Navrathri</i>										Cyan		
<i>Dussera</i>										Cyan		
<i>Divali</i>										Cyan		
<i>Laxmi puja</i>										Cyan		
<i>Tulsi puja</i>										Cyan		
<i>Saraswati puja</i>										Green	Green	
<i>Padwa for the cattle</i>										Green	Green	

Colour keys:

- Festivals reported by agricultural communities
- Festivals reported by coastal communities
- Festivals reported common to both communities

Resource mapping and transect walks

Sluice gates- twelve operational

- Three in Navelim
- Two in Golti
- Five in Malar
- Two in Naroa

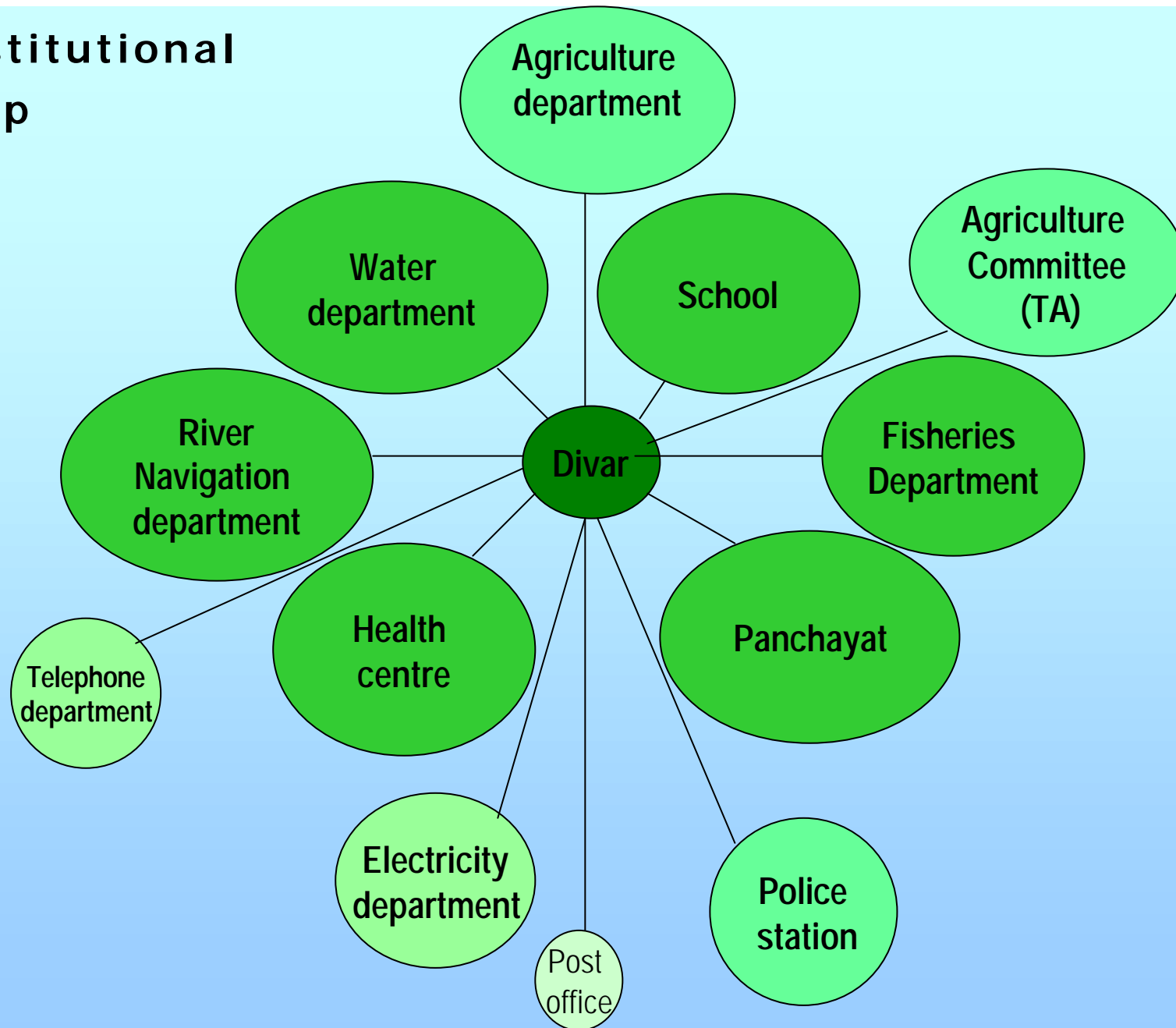
Wells

- One each at Muddi (*devanchi bany*), Malar central, Naroa near CME farm, Naroa Ferry, Lokalwada, Golti fields

Fields

- Golti-Navelim (Divar Ferry)
- Naroa (near railway bridge, *porne tirth*)
- Malar (Near *Panchayat*, Near Pleasure island)

Institutional map



Note: Colours indicate the level of interaction of the people of Divar with the various departments. The darker the colour, more the interaction with that department

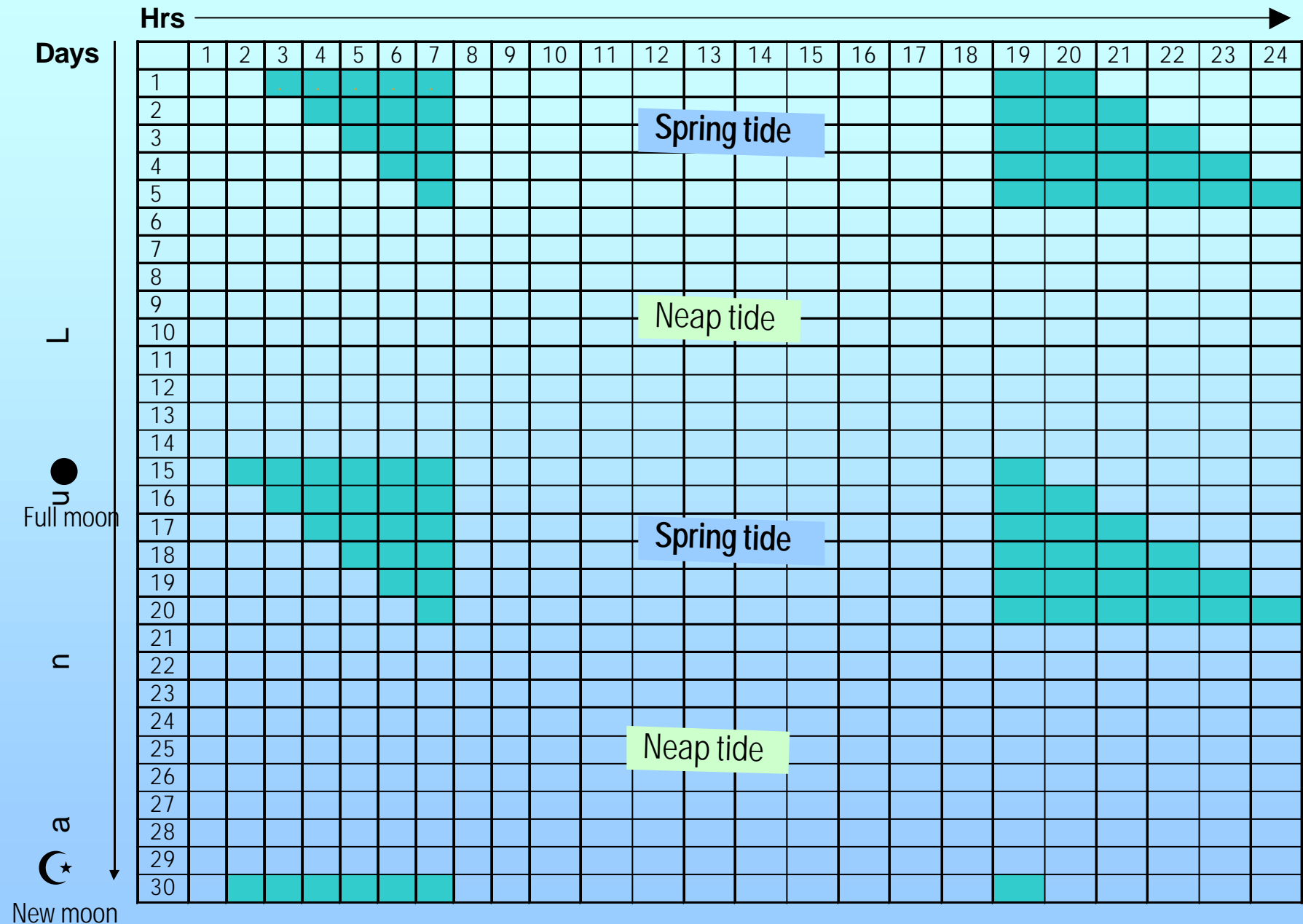
Seasonal calendar

	Jan	Feb	Mar	April	May	June	Jul	Aug	Sept	Oct	Nov	Dec
Activity/Month												
Soil prepartaion, bunding, sowing	Vegetable growing											Vegetable growing
Irrigationm land preparation, sowing	Vegetable growing	Vegetable growing										
Harvesting			Vegetable growing									
Use of machines for ploughing	Paddy cultivation	Paddy cultivation										
Ploughing						Paddy cultivation						
Sowing						Paddy cultivation	Paddy cultivation	Paddy cultivation				
Weeding						Paddy cultivation	Paddy cultivation	Paddy cultivation				
Transplating							Paddy cultivation	Paddy cultivation				
Use of fertilisers							Paddy cultivation	Paddy cultivation				
Cutting								Paddy cultivation	Paddy cultivation	Paddy cultivation		
Threshing									Paddy cultivation	Paddy cultivation	Paddy cultivation	
Auction	Traditional aquaculture											
Ban on fishing in the fields						Traditional aquaculture	Traditional aquaculture	Traditional aquaculture				
Closing of sluiceways							Traditional aquaculture	Traditional aquaculture	Traditional aquaculture			

Colour keys:

- Vegetable growing
- Paddy cultivation
- Traditional aquaculture

Fishing calendar

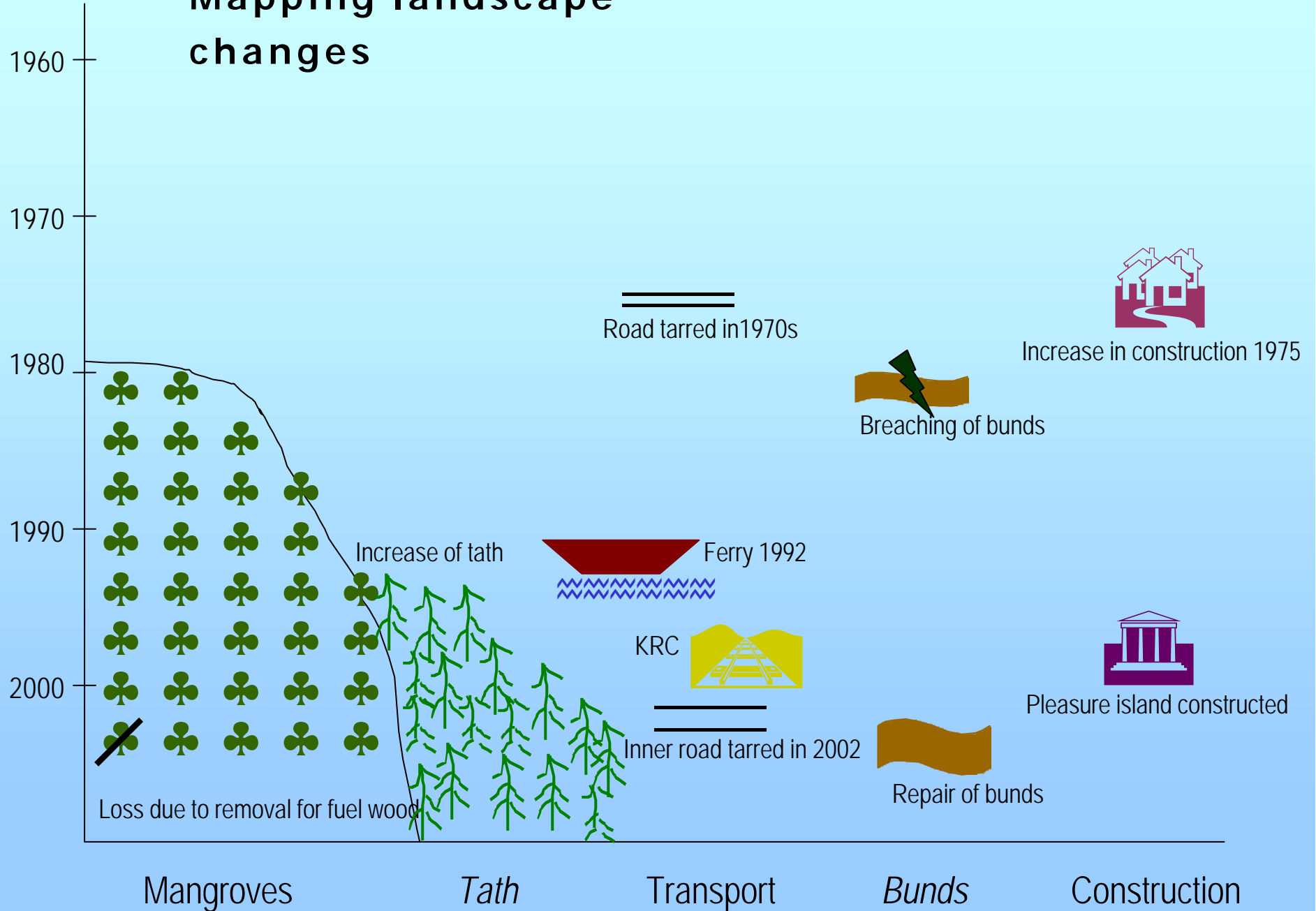


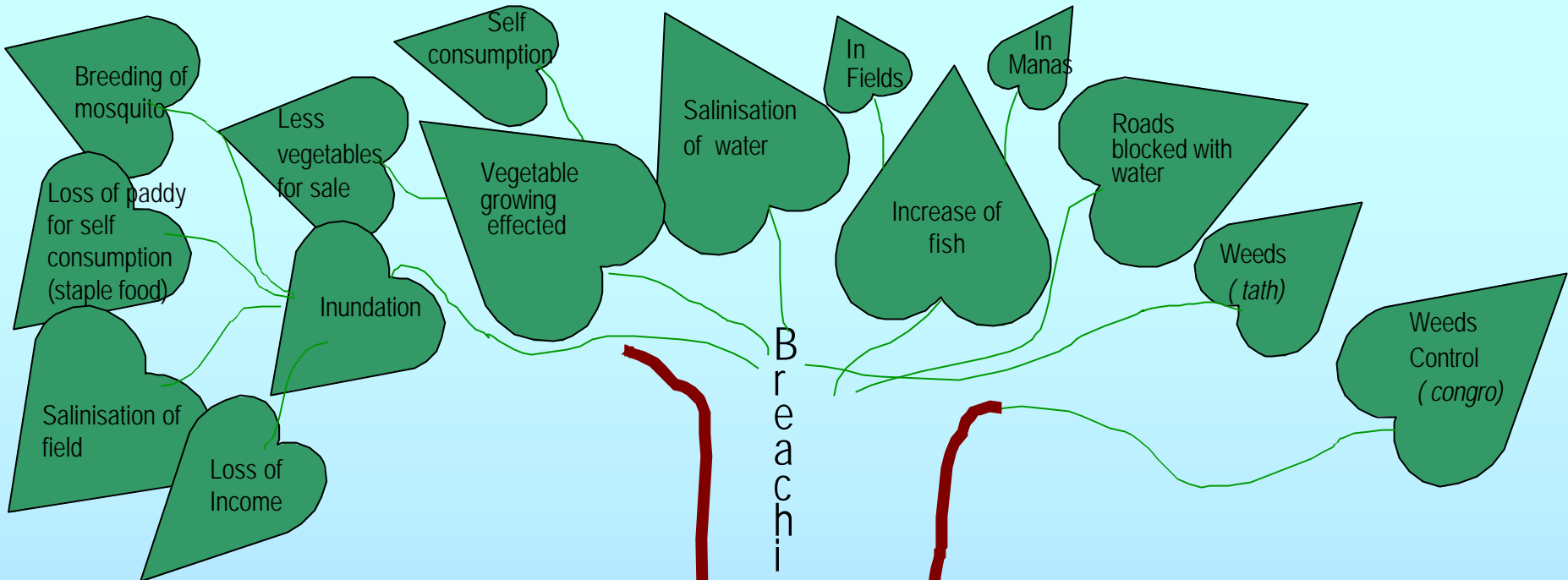
Note. More fish is caught during spring tides when there is fishing for about 7 hrs a day

Major events in Divar

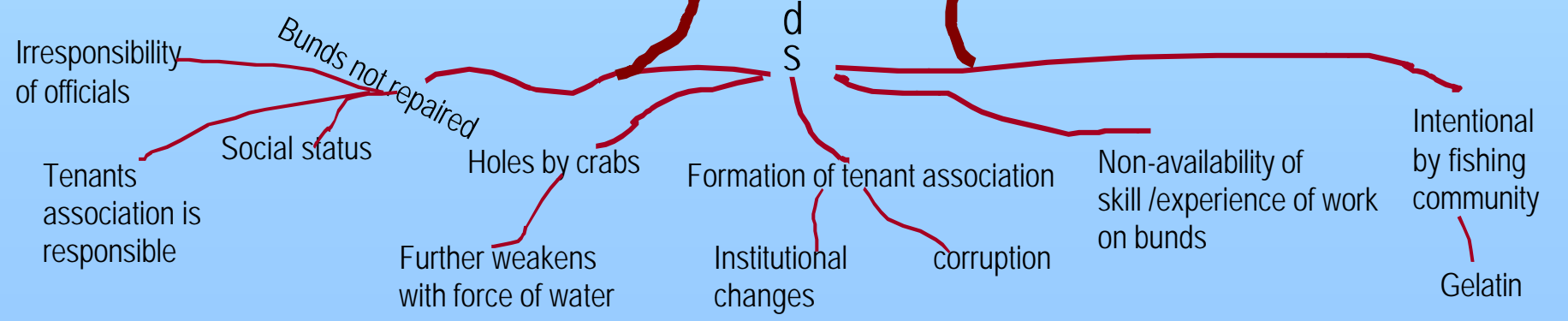
Pre Liberation	<p><i>Kutch</i> roads Good labour Well water used, good quality of water Ferry from Old Goa to <i>Goltim-Navelim</i> Commission appointed by the Portuguese government <i>Gaunkari</i> system existed Code of <i>Comunidade</i> was formed</p>
1960 Post Liberation	<p><i>Bous</i> system is abolished Inflation increased Fish catch is good Electrification of village <i>Panchayat</i> (local governance)</p>
1970	<p>Agricultural Tenancy Act 1971 Rules formed under Agricultural Tenancy Act 1975 Roads were tarred Canoe drowned, many people died Wells started to become saline, increased flooding in <i>Divar</i>, especially <i>Malar</i></p>
1980	<p>Breaching of <i>bunds</i> (1st incident), <i>Morcha</i> for repairs at the secretariat Increased salinity of agricultural fields Increase of mangroves in agricultural fields Tap water to the houses Infrastructure developments</p>
1990	<p>Goa Land Use Act 1991(Regulation) Ferry from <i>Ribandar</i> to <i>Navelim</i> Flooding increased in <i>Goltim-Navelim</i> Ferry and bus transport was stopped due to flooding and people had to walk Increase in fishing activity in fields (as saline water comes in) Outsiders coming for fish Outsiders coming for firewood Better transport Irregular / reduced rainfall In migration of people who had migrated out of <i>Divar</i> to other parts of India / World</p>
2000	<p><i>Morcha</i> against <i>Manashkar</i> <i>Khazan</i> Protection Bill passed <i>Bunds</i> repaired (better conditions)</p>

Mapping landscape changes

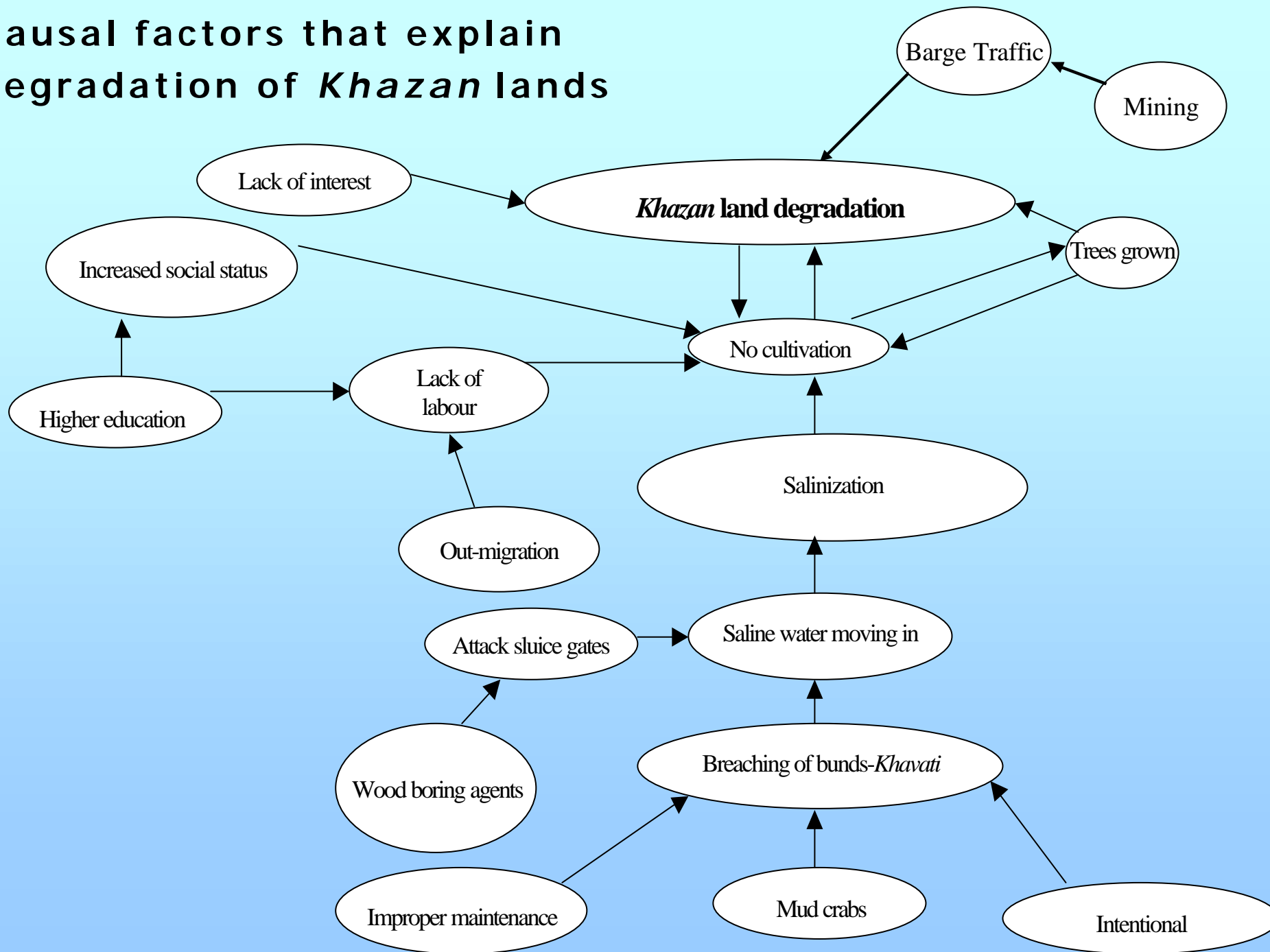




Problem tree



Causal factors that explain degradation of *Khazan* lands



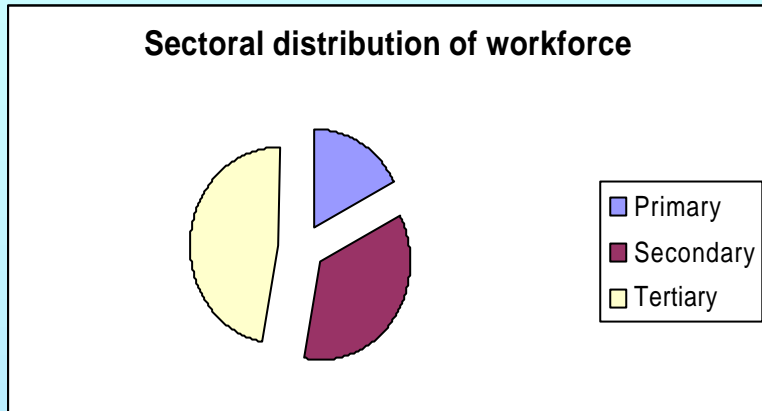
Household survey

- Classified villages into fishing and non-fishing hamlets
- Selected representative sample from these two groups giving higher weightage (4/1) to fishing hamlets as it is related to our objective
- Questionnaires were piloted and re-piloted
- A sample of 120 households were surveyed with final questionnaire

Analysis of household survey for traditional aquaculture activity

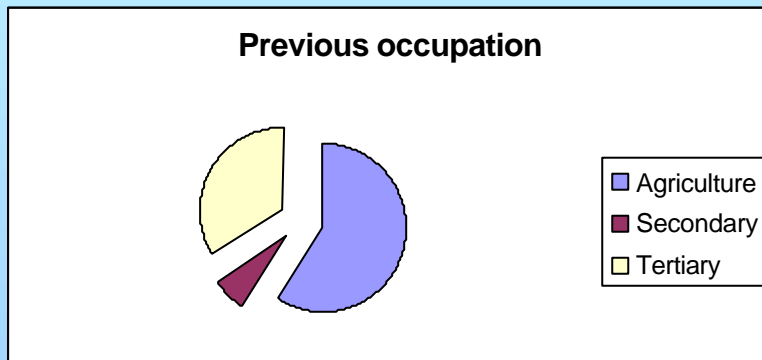
- Socio-economic characteristics
- Resource use
- Role of household in the activity
- Role of government
- Perceived environmental problems
- Perception of people towards protection of the activity

Socio-economic characteristics

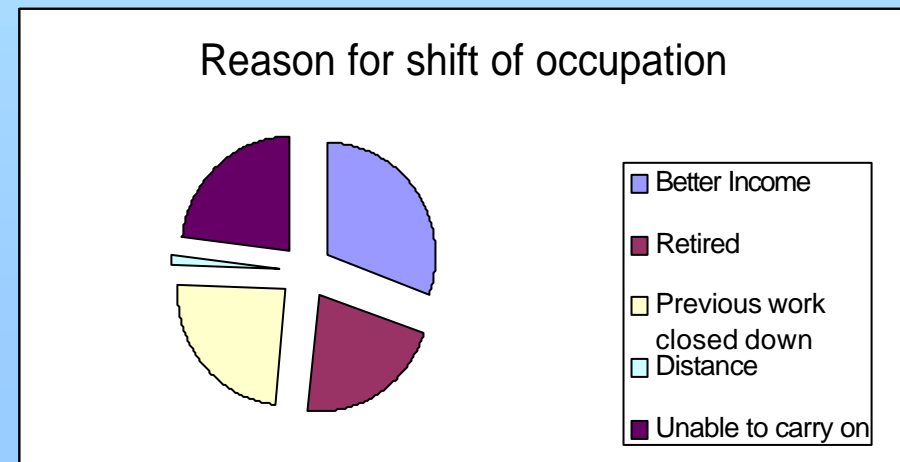


Sectoral distribution of workforce

- Tertiary sector has the highest share followed by Secondary
- Share of primary sector is lowest
- 1.46% reported to be in fishing
- Highest share of women in the tertiary sector



Occupational shift



16 % have reported to have changed their occupation

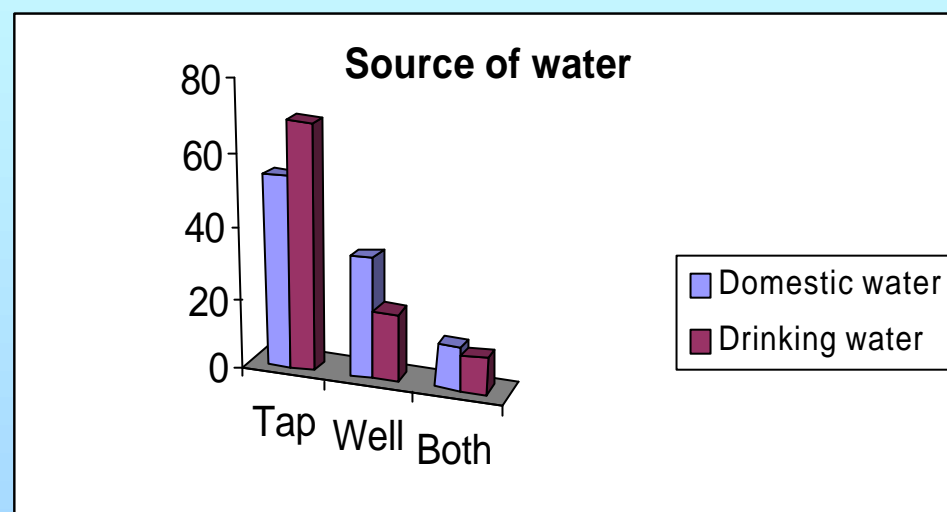
Resource use

Agricultural land

- 61.2% cultivate their agricultural land, 37% do not cultivate, 1% have both land that is cultivated as well as uncultivated
- 92% are not cultivating due to breaching of bunds
- Paddy is the main crop, vegetables grown as the second crop
- 88.1% cultivate only paddy, 11.9% cultivate both paddy and vegetables
- Varieties of paddy cultivated: *Jyoti* (HYV) – 32.3%, *Corgunt* –36.9% , both 26.2%, other varieties 4.6%

Water

the main sources of water are tap water and well water



Water quality

- 70% reported existence of bad water quality mainly well water
- Salinisation of well water
- None attribute salinisation to aquaculture activity

Involvement of households in aquaculture

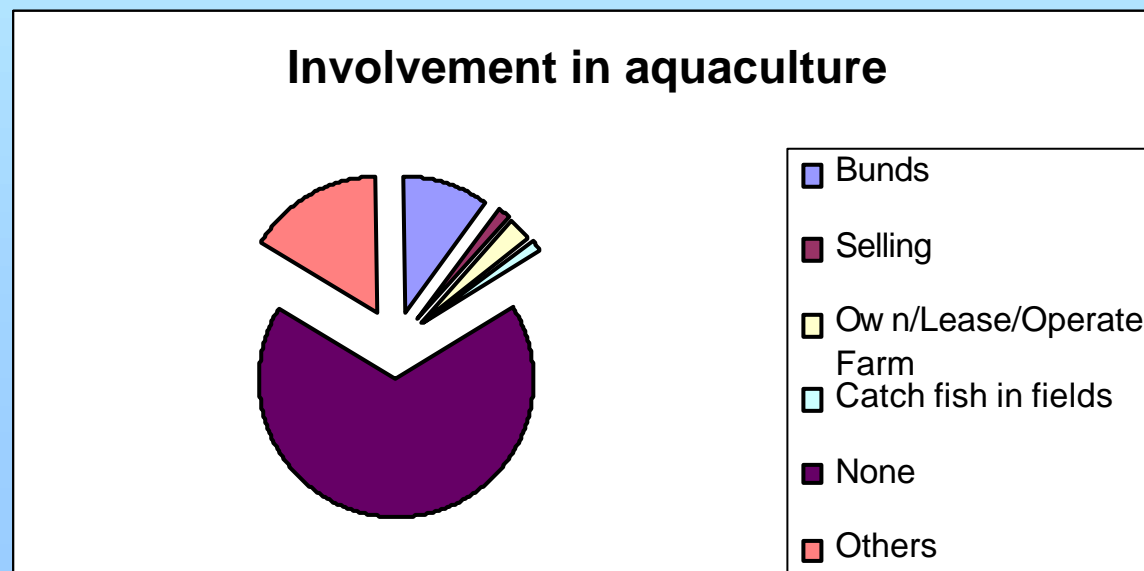
- 39% of the surveyed households have stake in aquaculture
- Majority of these are involved in catching and selling of fish
- Majority of these are in the age group of 21-50

Age wise break up of those with stake in aquaculture

Age	Total
Above 10 yrs and up to 20 yrs	5 (10.6%)
21 yrs to 30 yrs	10 (21.27%)
31 yrs to 40 yrs	11 (23.4%)
41 yrs to 50 yrs	13 (27.65%)
51 yrs to 60 yrs	5 (10.6%)
Above 60 yrs	3 (6.38%)
Total	47 (100%)

Role of household in aquaculture activity

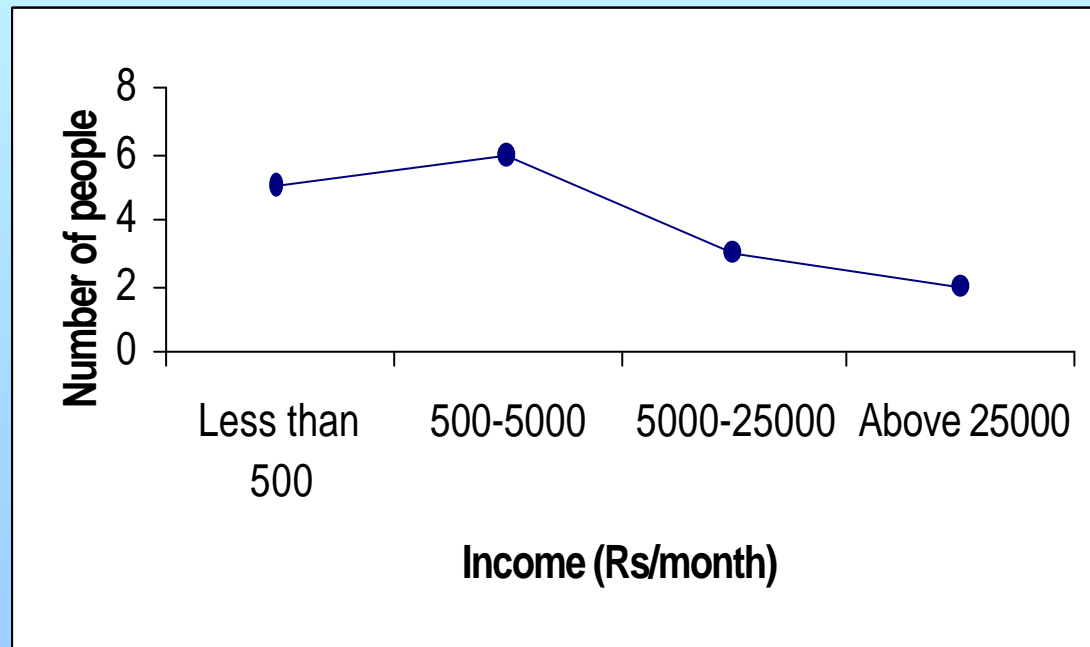
- 33% of households have role in sluice gates
- Majority are involved in catching and selling fish
- Large proportion of women involved in catching and mainly selling fish
- Majority have learnt to carry out the activity from the elders
- Only 27% interested in intensive aquaculture anticipating higher profits, 63% not interested due to high level of investments



Aquaculture activity in the region

Type of fish caught: Mulletts (41.4 % respondents), *Prawns* (27.6% respondents), Other varieties such as lady fish, prawns and cat fish. (31% respondents)

Returns from the activity



Profits:

57.9% reported very low profits

5.3% reported high profit (above 50,000)

Loss:

Of the very few people who reported a loss they attributed the same to fall in catch, breaching of *bunds* and high cost of labour

Auction for lease of fishing rights

- Sluice gates are acquired through auction only
- 14% of those households have participated in auctions at least once
- 76.5% of those that participated at the auction were successful
- All participants of the auction consider it a fair process
- All those auctioning are males
- Majority (42%) of those who participated at auctions are in the age group of 51-60 yrs
- Majority have bid successfully at auctions only once
- All the respondents were able to pay the amount decided at the auction in 4 installments over the year

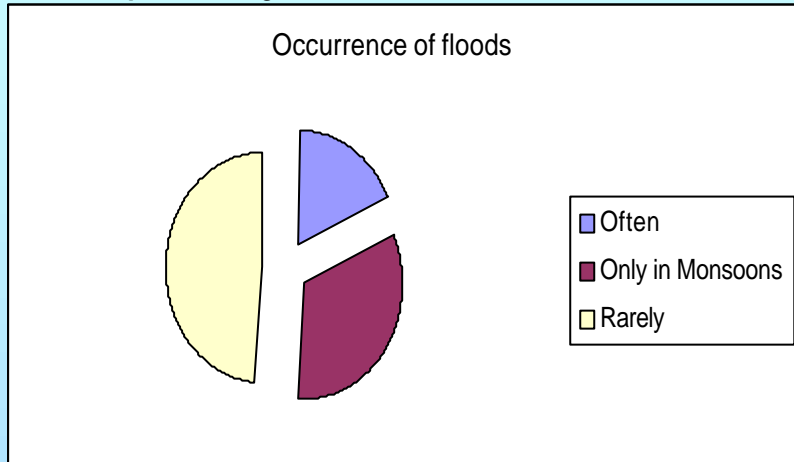
Role of Government in the activity

- **52 % of respondents consider the government to have a vital role:**
 - Auction & maintenance
 - In providing finance (30% of respondents)
- 78% of respondents reported no support from Government
- 15% of respondents reported no support of state subsidies
- 3.5% of respondents reported to have taken help from co-operatives

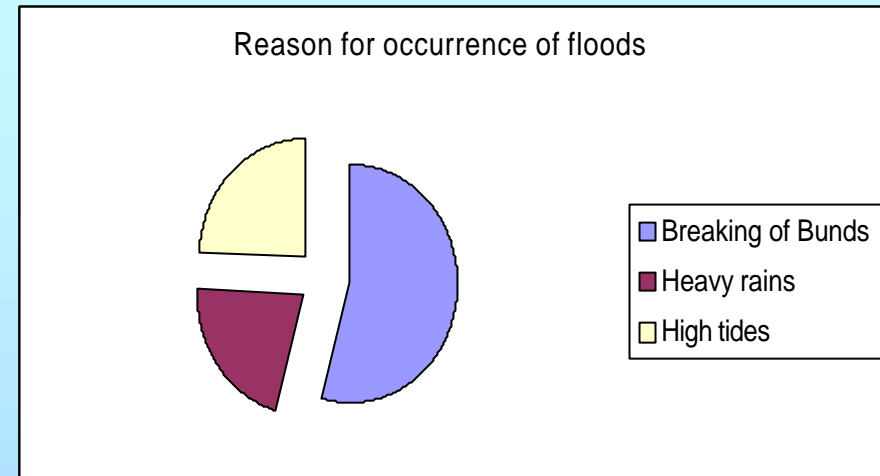
Perceived environmental problems existing in the villages:

Flooding

Frequency



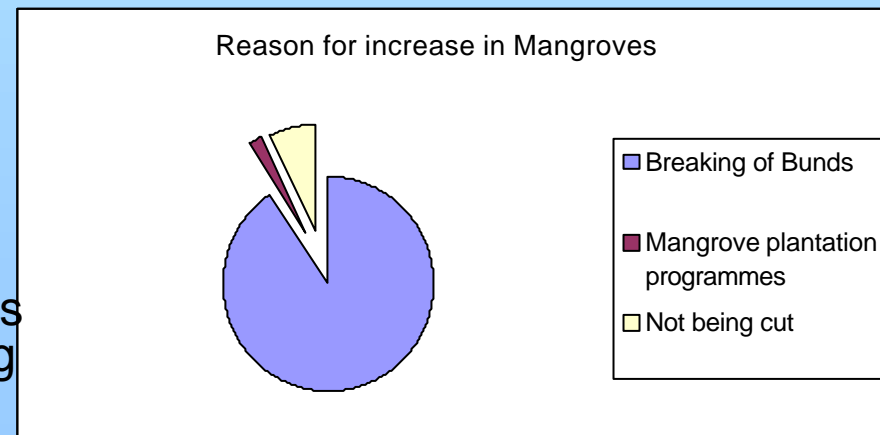
Reason



Mangroves

- 86% reported change in land under mangroves: of those reporting change
 - 91% reported **increase** for various reasons as shown in the graph
 - And remaining 9% reported that it has **decreased** as mangroves were being cut down for fuel wood

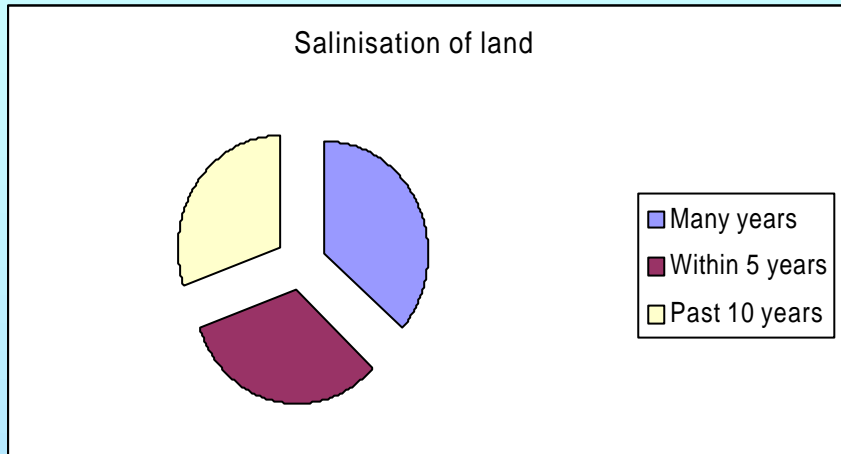
Reason



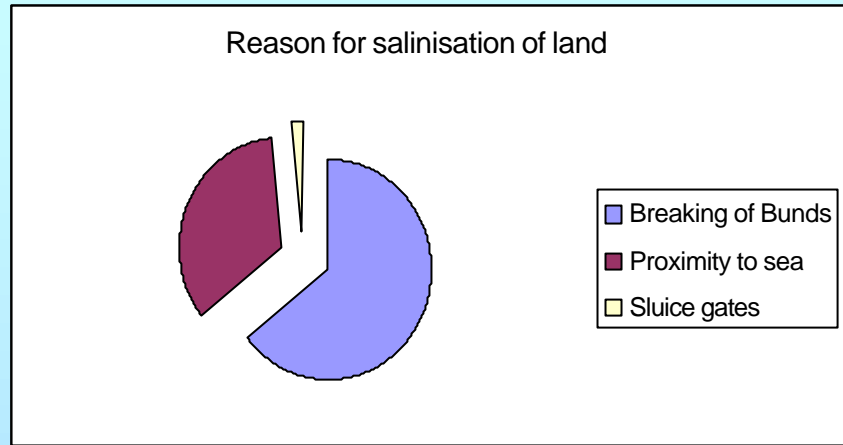
Salinisation of land

76.5% of respondents reported the existence of salinisation in this region

Since when ?



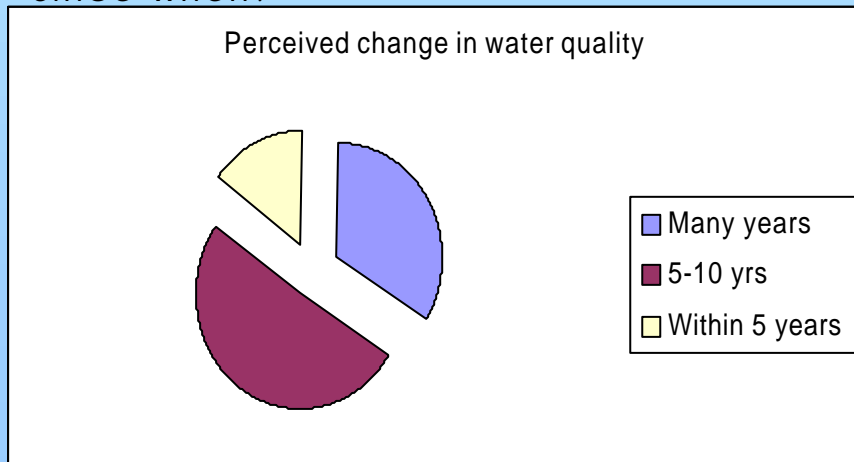
Reason



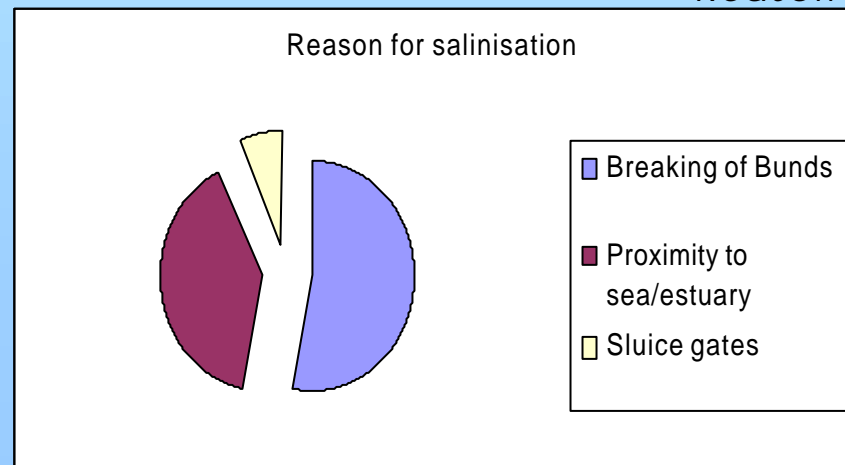
Salinisation of water

60% of respondents report salinisation of water

Since when?

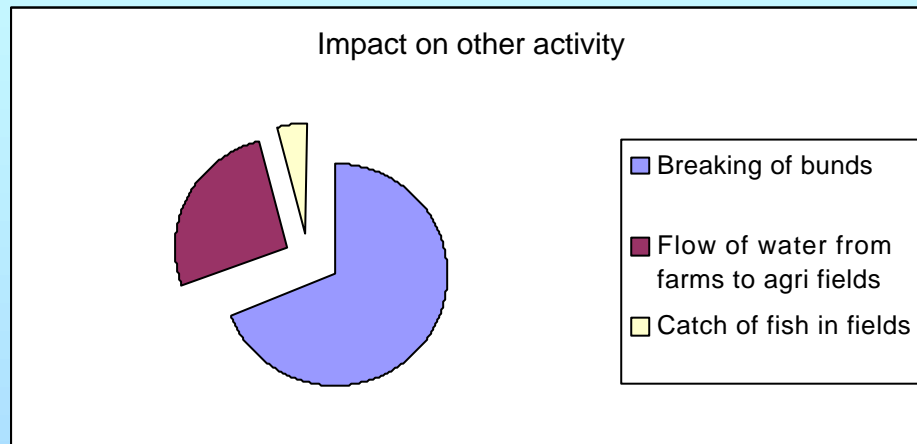


Reason



Perceived environmental problems associated with traditional aquaculture activity

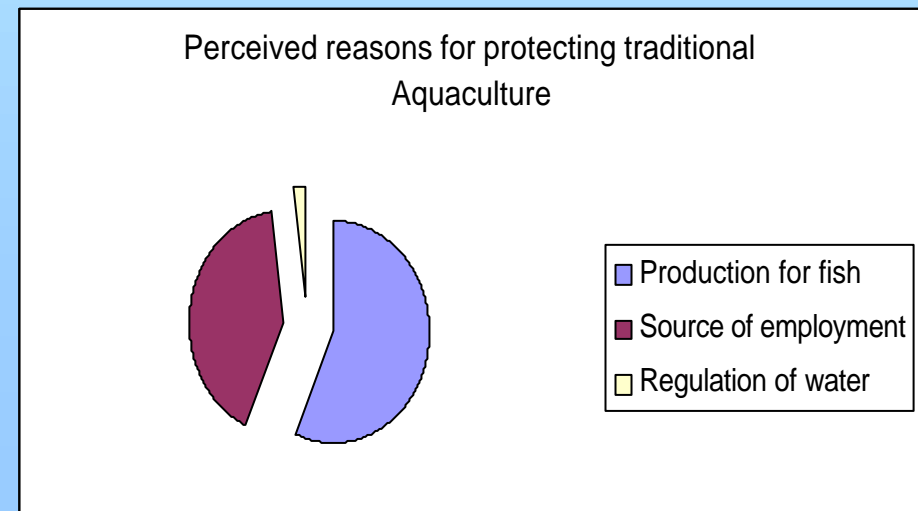
- 76% respondents reported that it had no effect on any other activity
- 24% reported effects on agricultural fields. These reported impacts were due to reasons listed in the figure below



Perception of people about the activity

Reasons for **positive** response

- 87% respondents felt it should be protected (positive response).
- 4% respondents felt it should not be protected as it caused the destruction of agricultural fields
- Remaining were indifferent

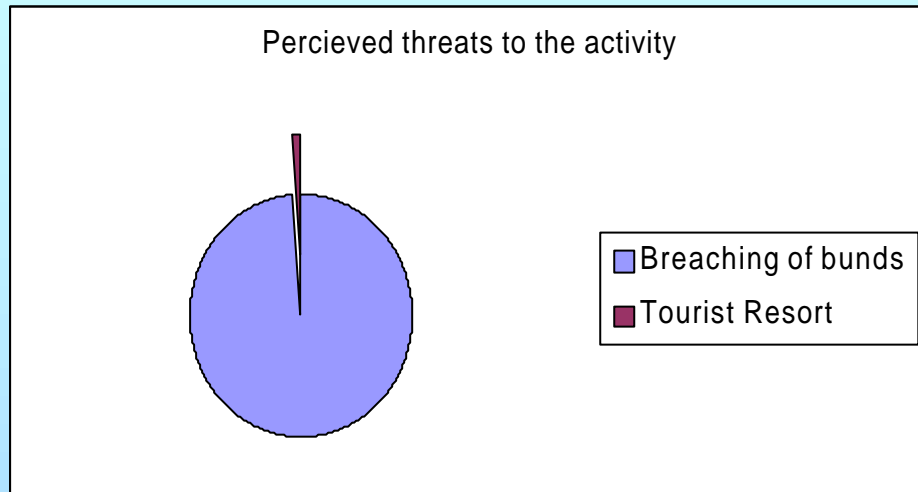


Changes in the activity over the years

	Increase	Decrease	No change	Do not know
People involved	51.7	7.5	15	25.8
Area	21.7	4.2	32.5	41.7
Productivity	13.3	21.7	10	55
Price of fish	37.5	1.7	5.8	55

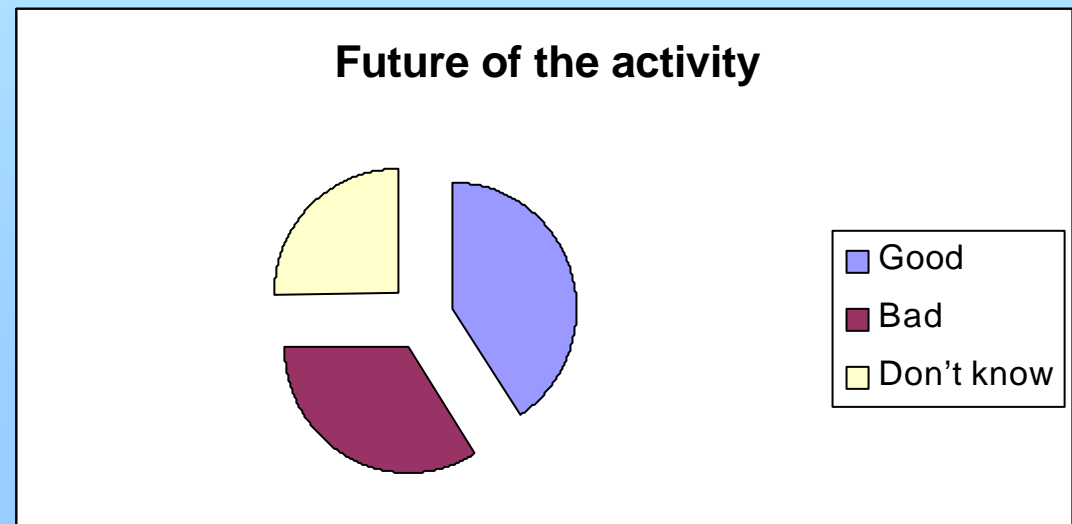
Numbers show percentage of respondents

Perceived threats to traditional aquaculture activity



- 95% respondents reported threats
- 5% reported no threats

Most respondents envisage good future



Concluding remarks

- Shift in workforce from primary to tertiary sector has been observed in the study area
- There is an increase in the number of people involved in traditional aquaculture activity, decrease in fish production, no change in area under activity and increase in price of fish over the years
- Non residents are allowed to bid at the auction resulting in high price of the lease at the auction
- Major issues associated with traditional aquaculture activity are
 - Breaching of bunds
 - Changes in institutional set-up
- No major environmental impacts of traditional aquaculture activity were reported
 - Majority perceive good future of the traditional aquaculture
 - Majority want to protect aquaculture and *khazan* ecosystem
- Other environmental issues of concern to the island community are:
 - Salinisation of fields
 - Salinisation of water
 - Land use change