Global Conference on Aquaculture 2010

Farming the waters for People and Food

22-25 September 2010, Phuket, Thailand

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Global Conference
on
Aquaculture 2010

Opening Keynote Address

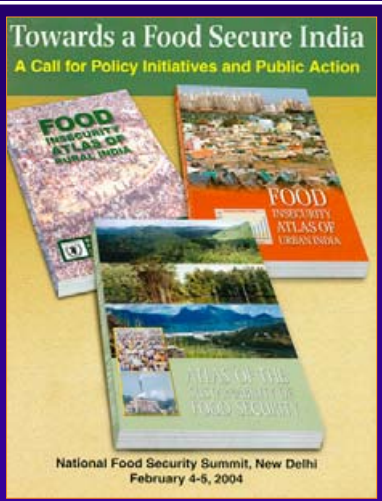
Aquaculture and Sustainable Nutrition Security in a Warming Planet

By
Professor M.S. Swaminathan
UNESCO Chair in Ecotechnology
Chairman, M S Swaminathan Research Foundation

22–25 September 2010, Phuket, Thailand

MSSRF / WFP : Food Insecurity Atlas

Hunger
Chronic
Hidden
Transient



Food Security
Availability
Access
Absorption

Awareness – Analysis - Action

Food and Water Security will be the greatest Victims of climate change

Impact of Climate on Fisheries

NEWS

VENUS CRATER DEBATE HEATS UP
Questions raised over dramatic geological change.
go.nature.com/WJSaiw

Cold blamed for Bolivia's mass fish deaths

With high Andean peaks and a humid tropical forest, Bolivia is a country of ecological extremes. But the unusually low winter temperatures experienced by the country's tropical region in July and August hit freshwater species hard, killing an estimated 6 million fish and thousands of alligators, turtles and river dolphins.

Scientists who have visited the affected rivers say the event is the biggest ecological disaster Bolivia has known. They are now scrambling to coordinate research into how it happened, and how quickly the ecosystem may recover.

"There's just a huge number of dead fish," says Michel Jégu, a researcher from the Institute for Developmental Research in Marseilles, France, who is currently working at the Noel Kempff Mercado Natural History Museum in Santa Cruz, Bolivia. "In the rivers near Santa Cruz there's about 1,000 dead fish for every 100 metres of river."

"There's just a huge number of dead fish."

Decomposing fish have polluted the waters of the Grande, Pirai and Ichilo rivers so badly that local authorities have had to provide alternative sources of drinking water for towns along the rivers' banks.

The blame lies with a mass of Antarctic air that settled over the Southern Cone of South America for most of July. Water temperatures in Bolivian rivers that normally register about 15 °C during the day fell as low as 4 °C.

"It is not unlikely that the extreme weather conditions in July might have been related to the El Niño–Southern Oscillation [ENSO]," says Fons Smolders, a fisheries scientist at Radboud University in Nijmegen, the Netherlands. "Although it is still debated whether ENSO is affected by climate change, it is generally accepted that climate change has the potential to increase the prevalence and severity of extremes such as heat waves, cold waves, storms, floods and droughts."

Cold weather can sometimes kill freshwater fish by reducing water mixing, starving the animals of oxygen, says Jégu. But Smolders, who has visited the affected area, suspects that additional factors may be involved. "Some of the fish that I saw had white spots that may indicate disease. The cold probably made them very susceptible to all kinds of infections," he says.

"When fish die, it's usually not a single stressor, but multiple stressors interacting," agrees Steven Cooke, an aquatic ecologist at Carleton University in Ottawa, Canada. "If cold shock or cooler temperatures are being implicated in mortality, there's probably something else going on as well."

Jégu and Smolders both plan to study the rivers and lakes affected, in part to assess whether controlled burning of farmland in the region raised pollution levels in the water. ■

Anna Petherick

See go.nature.com/bA5JQ1 for a longer version of this story.

Source : Nature, Vol 467, 2 Sept 2010

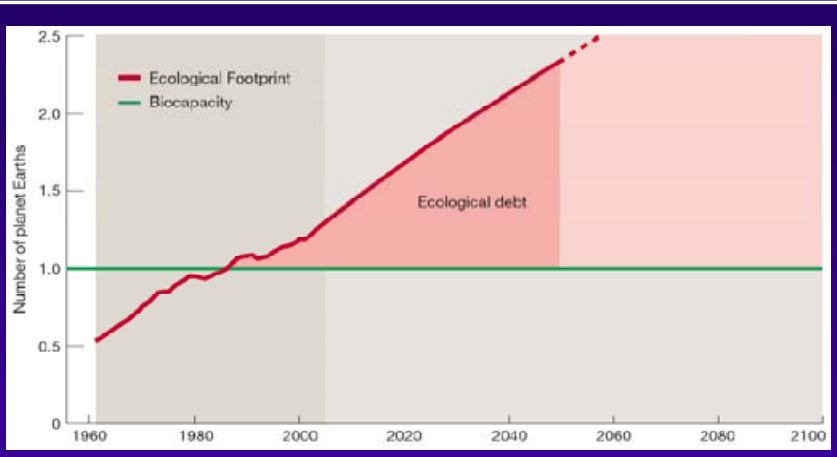
After the Oil – Need for More Bioremediation Research

Work on previous spills suggests oil can harm wildlife and linger in sediments for decades.

Gulf of Mexico

Source : Nature, Vol 467, 2 Sept 2010

Ecological Footprint



Annual deficit adds up to a global ecological debt

INDIA AND ECOLOGICAL DEBT

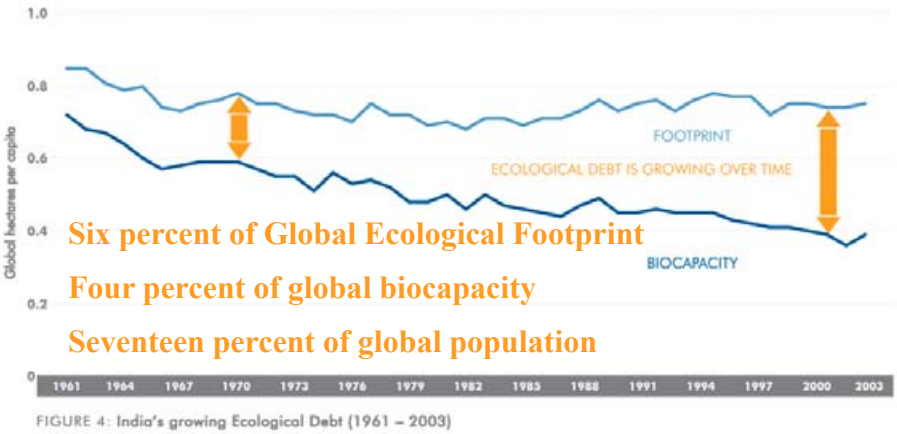


FIGURE 4: India's growing Ecological Debt (1961 – 2003)

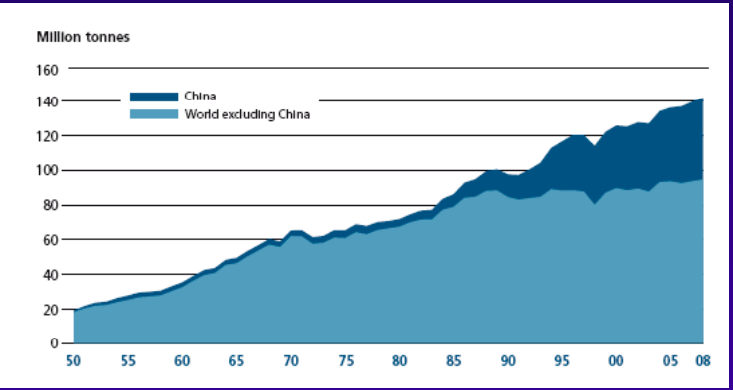
Six percent of Global Ecological Footprint

Four percent of global biocapacity

Seventeen percent of global population

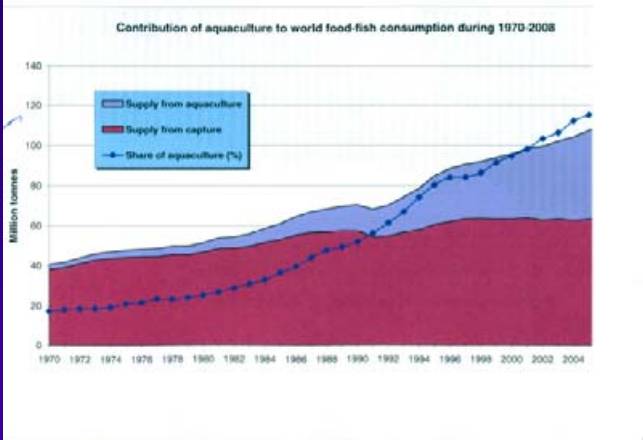
Source : Global Footprint Network, 2008

World Capture and Aquaculture Production

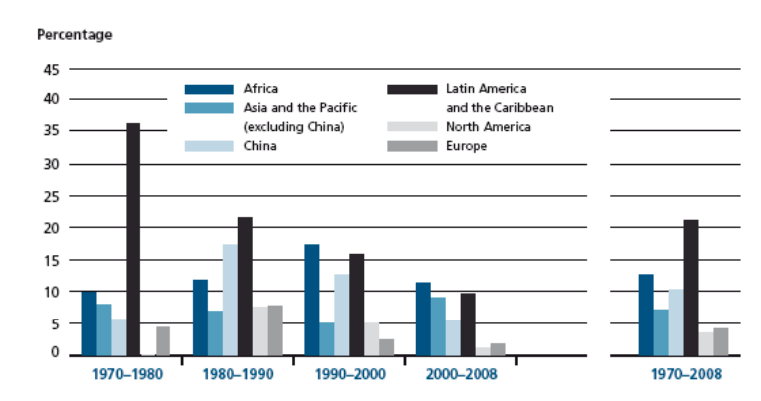


Source: FAO (in preparation)

Contribution of aquaculture vs capture of world food-fish supply (unit : Million tonnes)

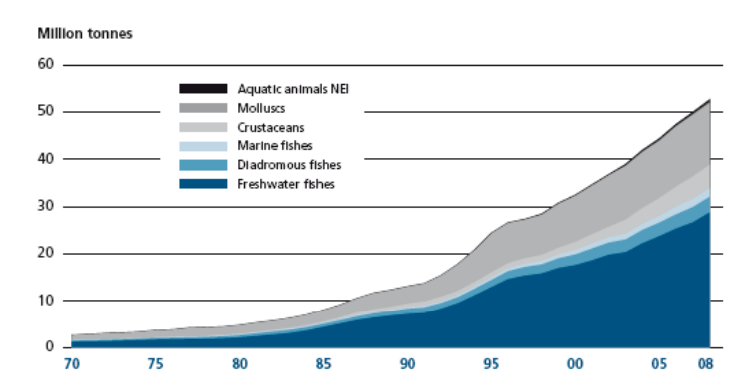


World Aquaculture Production
Annual Growth by Region since 1970



Source: FAO (in preparation)

Trends in World Aquaculture Production
Major Species Group



Source: FAO (in preparation)

Top 14 Aquaculture Producers by quantity and rate of growth

	Production			Average Annual Rate of growth		
	1990	2000	2008	1990-00	2000-08	1990-08
China	6,482	21,522	32,736	12.7	5.4	9.4
India	1,017	1,943	3,479	6.7	7.6	7.1
Vietnam	160	499	2,462	12.0	22.1	16.4
Indonesia	500	789	1,690	4.7	10.0	7.0
Thailand	292	738	1,374	9.7	8.1	9.0
Bangladesh	193	657	1,006	13.1	5.5	9.6
Norway	151	491	844	12.6	7.0	10.0
Chile	32	392	843	28.3	10.1	19.8
Philippines	380	394	741	0.4	8.2	3.8
Japan	804	763	732	-0.5	-0.5	-0.5
Egypt	62	340	694	18.6	9.3	14.4
Myanmar	7	99	675	30.2	27.1	28.8
USA	315	456	500	3.8	1.2	2.6
Republic of Korea	377	293	474	-2.5	6.2	1.3

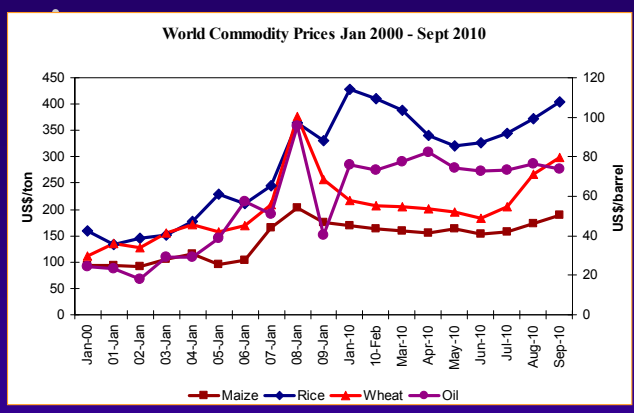
World Aquaculture Production by Environment

Environment	1990	1997	2000	2003	2008
Fresh water	7,620,418	16,136,892	18,471,971	22,039,411	31,486,051
Marine	4,151.007	9,626,991	11,833,004	14,142,479	16,990,899
Brackishwater	1,302,675	1,557,996	2,111,135	2,733,212	4,069,255
Total	13,074,100	27,321,879	32,416,110	38,915,102	52,546,205

Fishery Production per Fisher or Fish Farmer in 2008

Continent	Production (Capture+ aquaculture	Number of fishers and fish farmers	Production per person
	(Tonnes)	(No)	(Tonnes/year)
Africa	8 183 302	4 186 606	2.0
Asia	93 579 337	38 438 646	2.4
Europe	15 304 996	640 676	23.9
Latin America and the Caribbean	17 703 530	1 287 335	13.8
North America	6 170 211	336 926	18.3
Oceania	1 286 340	55 796	23.1
Total	142 287 124	44 945 985	3.2

Source: FAO (in preparation)



Impact of Oil and Commodity Prices

Food and Fuel
Most precious assets of the future

Source: International Commodity Database of FAO, and US Energy Information Administration (data updated as on 14/09/2010)

World Fish Price

Year	Price (US $/ton)
2000	992
2005	1105
2006	1183

Source : FAO

Maintaining Biosecurity in Aquaculture

- Transboundary Aquatic Animal Diseases
- Public Health Risks from the use of Veterinary Medicinal Products
- Biological invasions
- Climate Change Scenarios that will affect Biosecurity
- Eternal vigilance is the price of stable aquaculture

UN Climate Change Conference, 2009
Copenhagen Accord

- Recognizes the scientific view that the increase in global temperature should be below 2 deg C and agree to take action to meet this objective with equity as basis
- Enhanced action and international cooperation on adaptation, especially in least developed countries, small island states and Africa
- Annex I Parties of Kyoto Protocol commit to implement individually or jointly the quantified economy wide emission targets for 2020, to be submitted to the Secretariat by 31 January 2010 for compilation. This will be measured, reported and verified
- Non-Annex I Parties to the Convention will implement mitigation actions, including those to be submitted to the Secretariat by 31 January 2010.

Examples of Climate Impact

Indirect Ecological	Direct Physical	Indirect Socio-Economic
o Change in yield o Change in species distribution o Increased variability of catches o Changes in seasonality of production	o Damaged infrastructure o Damaged gear o Increased danger at sea o Loss/gain of navigation routes o Flooding of fishing communities	o Influx of migrant fishers o Increasing fuel costs o Reduced health due to disease o Relative profitability of other sectors o Resources available for management o Reduced security o Funds for adaptation

Source: FAO (in preparation)

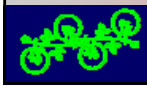
Building Climate-resilient Aquaculture

- Promotion of polyculture and fish-rice rotation in relevant areas
- Integrated water management for rice agriculture and brackish water aquaculture
- Integration of fish farming into farming systems that use low-quality water and/or saline water
- Traditional diversification – The use of multi-species is useful for adaptation to climate change
- Implementation of ecosystem approach to aquaculture (EAA) to address climate change

Contd..

Building Climate-resilient Aquaculture

- Development of innovative integrated farming systems where pond aquaculture increases diversity of farming options and resilience to drought
- Identification of new candidate species for aquaculture that are adapted to high or low temperatures and changed salinities and developing methods for managing these in farmed conditions
- Development of new strains of fish that are better adapted to conditions brought about through climate change, notably increased temperature, salinity and risk of disease



Breeding for Climate Change

Genetic mechanisms influence fitness and adaptation for

- Physiological stress and thermoregulatory control. Selection of species with effective thermoregulatory control will be needed. This calls for the inclusion of traits associated with thermal tolerance in breeding indices, and more consideration of genotype environment interactions (GxE) to identify animals most adapted to specific conditions
- Improve heat tolerance through manipulation of genetic mechanisms at cellular level

Use of genetic engineering to introduce genes for thermo and salinity tolerance and resistance to diseases into aquatic Species needs to be examined

National Biotechnology Regulatory Authority

The bottom line of our national agricultural biotechnology policy should be the economic well being of farm families, food security of the nation, health security of the consumer, biosecurity of agriculture and health, protection of the environment and the security of national and international trade in farm commodities"

(M S Swaminathan Panel 2004)

Mariculture

- Marine finfish breeding & culture – Sea bass, Cobia
- Mussel farming
- Ornamental Fish







Seabass (Lates calcarifer)

- Pond and cage culture practices recently initiated in Andhra Pradesh, Kerala, Maharashtra & Tamil Nadu
- Projected yield by 2015: 20,000tonnes from 4000ha
- Feed is the main constraint for seabass culture
- Slow sinking and sinking pellets (FCR 1.5) developed for nursery and grow-out culture of seabass


Seabass (Lates calcarifer)

Technique developed for round the year seed production

Commercial seed production exists

Annual seed production ~1.2 million fry per year

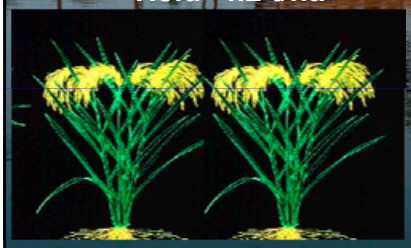
Fish culture (Etroplus suratensis) in cages in Vembanad Lake, Kumarakom, Kerala

Aquaculture Self-help Groups in Kumarakom
A Small Producer Management Revolution

Innovations in below sea level farming in Kuttanad

ONE RICE - ONE FISH

Punja season
November- February
Low chemical input or Organic
Yield- 4.2 t/ha



April- October
Monoculture – Giant Prawn
(*Macrobrachium rosenbergii*)
Polyculture* - Indian major carps or common carps or Silver carps and grass carps and Giant Prawn
Yield- Rice: 4.2 t/ha
Fish- Prawn: 480 kg;
Carp : 300 kg.

* Recommended practice

Low External Input Sustainable Aquaculture (LEISA)

- Herbivore based
- Based largely on indigenous species
- Management of water quality, feed and health care
- Sustainable brand name, like organic fishes

Low External Input Sustainable Aquaculture (LEISA) Fresh Water

Different Systems of LEISA

- Integrated farming with livestock (duck, poultry, pig) – fish production of 2.5-4.0 t/ha/yr, besides meat and eggs
- Application of biogas slurry at 80 lit/ha/day – 3-4 t/ha/yr
- Weed-based system of carp culture with grass carp as the main component (40-50%) - 3-4 tonnes/ha/yr without supplementary feed
- Besides conventional manures, farm yard manure and vermicompost are identified as potential inputs for such farming systems

Low External Input Sustainable Aquaculture (LEISA) Brackish Water

Improved Management – Traditional Farming

- Regulated tidal water exchange during culture
- Auto/selective stocking with disease free seeds
- Use of geolite, dolomite and LSP for better water quality
- Use of pellet feeds for regular feeding
- Routine sampling for monitoring the growth and survivability
- Applying some of the proven ITKs like use of neem extracts

Productivity

- Monoculture -0.7-1.2 tons/ha; polyculture – 0.8-1.5 tons/ha

Future Strategy for Increasing Productivity

- Defining site specific interventions to increase productivity
- Developing biosecurity protocols
- Diversification of the species in culture systems
- More research focus on polyculture with suitable species combination

Organic Shrimp Farming

- 30% of pond area is kept green with mangrove and other plants
- All organic inputs – vermicompost, yeast based preparations and organic feed
- Relies more on natural productivity of pond
- Production range of 1200-1400 kg/ha/crop from a low stocking of 6 pc/sq/m
- Cost of production reduces by 15-20# and organic shrimp fetches more price
- Sustainability, eco-friendly, holistic, integrated approaches to production

Crop-Livestock-Fish Farming System
Fresh Water

Chidambaram

Crop-Livestock-Fish Farming System
Brackish Water

Kendrapara, Orissa

Genetic Shield against Sea Level Rise

Mangrove Forests

US Patent No. 7,622,636 Issued on Nov. 24, 2009, Assigned to M.S. Swaminathan Research Foundation for Dehydrin Gene

US007622636B2

(12) **United States Patent**
Parida et al.

(10) **Patent No.: US 7,622,636 B2**
(45) **Date of Patent: Nov. 24, 2009**

(54) **DEHYDRIN GENE FROM *AVICENNIA MARINA* RESPONSIBLE FOR CONFERRING SALT TOLERANCE IN PLANTS**

(75) Inventors: **Ajay Parida**, Chennai (IN); **Preeti Mehta Angela**, Chennai (IN); **Gayatri Venkatraman**, Chennai (IN)

(73) Assignee: **M.S. Swaminathan Research Foundation**, Chennai (IN)

(*) Notice: Subject to any disclaimer, the te patent is extended or adjusted U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/997,725**

(22) PCT Filed: **Jul. 31, 2006**

(86) PCT No.: **PCT/IN2006/000270**

§ 371 (c)(1),

C12N 15/63 (2006.01)
C07H 21/00 (2006.01)

(52) **U.S. Cl.** **800/295**; 800/278; 800/306; 800/312; 800/317.4; 800/320; 800/320.1; 800/320.2; 435/468; 435/419; 536/23.1; 536/23.6; 536/24.1

(58) **Field of Classification Search** ..... None

1, Published Mar. 31, 2004).*

The present invention relates to a method of producing salt-stress tolerant plants by transforming the plants with an isolated nucleic acid sequences encoding a dehydrin (DHN) protein. The invention further provides a transgenic plant expressing the dehydrin gene of *Avicennia marina*. Using functional genomics, this gene was derived from large-scale EST sequencing of the cDNA library of the salt tolerant mangrove *Avicennia marina*.

Sea Water : A Social Resource

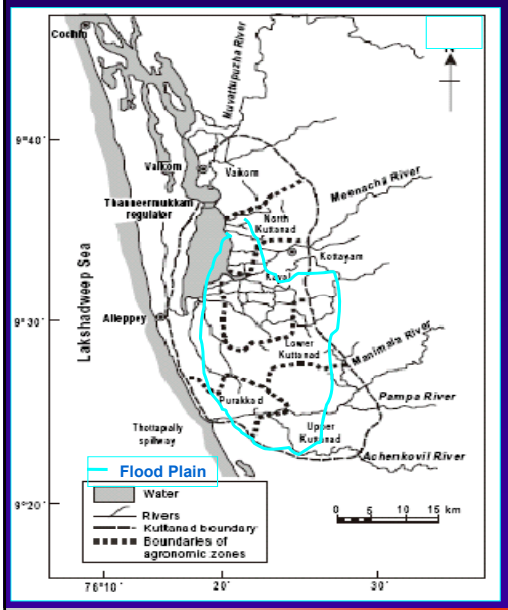
Dandi March(6 April 1930)

With nothing more than the salt of our sea, Gandhiji made colonial rule unacceptable in a non-violent manner that captured the imagination of the entire world. Gandhiji emphasised through this struggle that sea water is a public resource, which should be accessible to all.

Sea Water Farming

View of the Integrated Seawater farm near Chidambaram

Mangrove plantation



Kuttanad Wetland

Below Sea Level Farming

- Part of a huge estuarine region from Kayamkulam Lake to Kol Lands including the longest Vembanad Lake, occupying four districts.
- Uniqueness of this wetland is that its larger part is located down to 2.6 m below MSL
- Six rivers feed the estuary from south and east
- A unique ecosystem is supported by the round the year hydrological dynamics
- Kuttanad has 1,10,000 ha area, of which 50 % is reclaimed and 88 % is under agriculture
- The region has great scenic beauty and is an economic hub

Kuttanad – Below Sea Level Farming

Globally important Agricultural Heritage Site

Genetic Garden of HALOPHYTES

Obligatory halophytes	Facultative halophytes
Tolerate high concentration of sodium salts	Most of the species tolerate only moderate level of salinity
> 3 times of seawater salinity	Reproduction requires low saline condition
Even demand high NaCl for survival and reproduction	Mangroves
1560 species	60 species

Different modules of Artificial reef in Therespuram Village

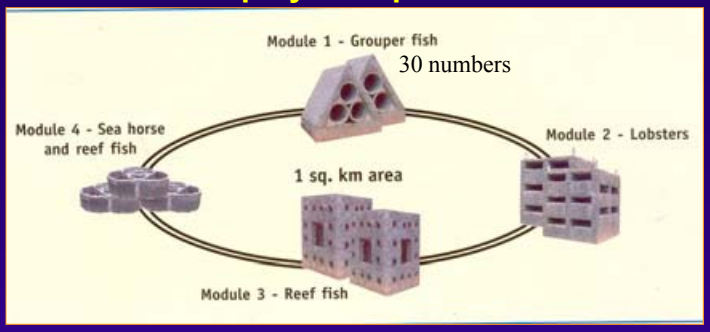
Groupe

Lobsters

Reef fish

Sea horse

Deployment pattern



Tribes of Andaman and Nicobar Islands

Jawaris

Nicobaris

Onge

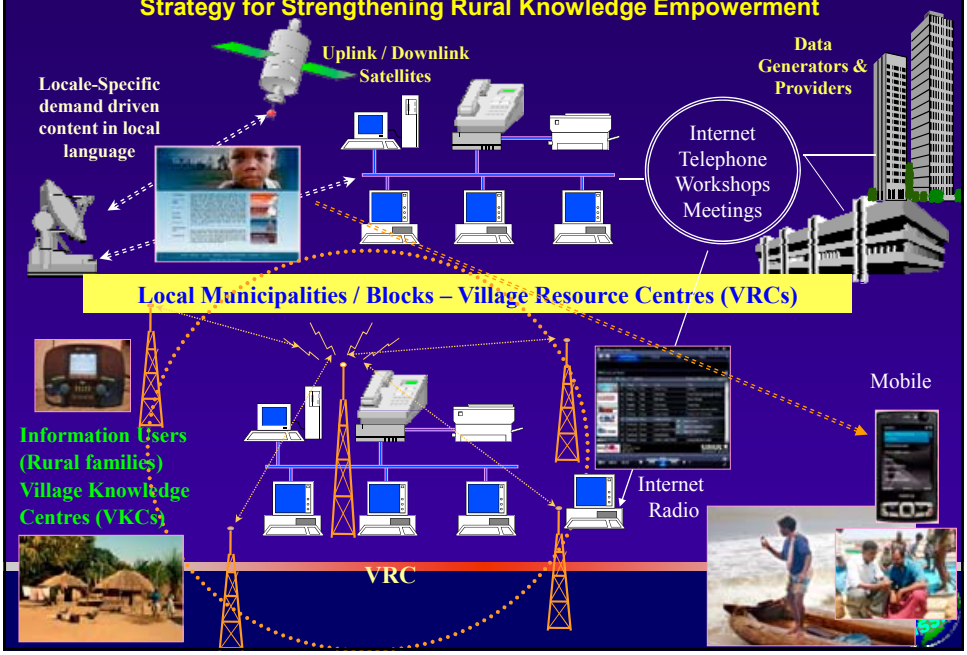
Endowed with Traditional Ecological prudence and wisdom

Tsunami early warning system : modern science plus traditional knowledge

- Tsunami warning
- Ongees tribe of Little Andaman
- Animal behaviour a few hours before the December 26, 2004 earthquake
- Nicobaris : when sea recedes, turn back and run to higher grounds
- *"giyangejebey"* in their dilect means solid earth becoming liquid (i.e.) tsunami
- Swarms of crabs rushing out of burrows
- Elephants and dogs becoming restive

Reaching the Unreached: Voicing the Voiceless

Strategy for Strengthening Rural Knowledge Empowerment



Information on Wave Height and location of fish shoal

Human Resource Development
Fish for All Centre at Poombuhar

From Capture or culture to consumption