

SUSTAINABLE AQUACULTURE AND FISHERIES DEVELOPMENT IN BANGLADESH: COUNTRY NEEDS AND SECTORAL PRIORITIES

M. Gulam Hussain

Bangladesh Country Coordinator

Feed the Future Innovation Lab for Fish
Mississippi State University, USA

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PRESENTATION HIGHLIGHTS

- Importance of Fisheries and Aquaculture
- Present trend and scenario of aquaculture and fisheries production
- Contribution of some major fish species in aquaculture and fisheries production
- Concept of blue economy and opportunities & challenges of mariculture & marine fisheries
- Opportunities and challenges of blue/marine biotechnology
- Sectoral strategies and priorities in Govt. 7th five year plan and Bangladesh Delta Plan 2100

IMPORTANCE OF FISHERIES AND AQUACULTURE

The aquaculture and fisheries sector plays a role

- Rural employment
- Nutritional security
- Foreign exchange earnings
- Women empowerment

The sector provides

- Full-time and part-time employment to >17.7 m people and to 11 % rural people
- Contribute 3.6% of its national GDP, 2.8% from aquaculture alone
- Av. growth rate of fisheries 5.7%, aquaculture >8.2% (DoF 2017)
- BD ranks among the highest fish-consuming nations in the world 60% of animal food intake through fish (world av. 16.7%)



TOTAL FISH AND AQUACULTURE PRODUCTION TRENDS (2008-2017)

(Production in tonnes)

Year	Total fish production	Inland Open-water capture	Marine Capture	Aquaculture
2007-08	2563296	1060181	497573	1005542
2008-09	2701370	1123928	514644	1062801
2009-10	2899198	1029937	517282	1351979
2010-11	3061687	1054585	546333	1460769
2011-12	3261782	957095	578620	1726067
2012-13	3410254	961458	588988	1859808
2013-14	3548115	995805	595385	1956925
2014-15	3684245	1023991	599846	2060408
2015-16	3878324	1048242	626528	2203554
2016 - 17	4134434	1163606	637476	2333352

Total Fish Production
Increased: 2.56 to 4.13 mil. tons
Last 10 years

Total Aquaculture Production
Increased: 1.00 mt – 2.33 mil tons

Aquaculture contribute 56.4%
To total fish production

Among top 10 aquaculture
Producing countries BD ranked
to 5th position (FAO 2016)

Source DoF (2017)

GROUP WISE ANNUAL INLAND AND MARINE FISHERIES PRODUCTION (2006 – 2017)

Species/Group	2005-06		2009-10		2014-15		2016 - 2017	
	Tonnes	Percent	Tonnes	Percent	Tonnes	Percent	Tonnes	Percent
Indigenous carps	509995	21.90	692597	23.89	755074	20.50	811588	19.63
Exotic carps	257739	11.07	376006	12.97	363737	9.87	409801	9.91
Other carps	9303	0.40	64359	2.22	80997	2.20	100730	2.44
Pangas	-		-		406818	11.04	510097	12.34
Other catfish	34104	1.46	208972	7.20	64537	1.75	66646	1.61
Tilapia	-		-		347801	9.44	370017	8.95
Live fish	60292	2.60	101368	3.50	133512	3.62	127120	3.07
Snake head	101309	4.35	113989	3.93	69305	1.88	72991	1.77
Other inland fish	634829	27.26	575620	19.85	542711	14.73	598923	14.49
Hilsa	277123	11.90	313753	10.82	387211	10.51	496417	12.01
Shrimp/Prawn	211010	9.06	186418	6.43	230244	6.25	246774	5.97
All other marine fish	232841	10.00	266116	9.19	302296	8.21	323332	7.28
Total production	2328545		2899198		3684245		4134434	

Carps : 32 %

Pangus: 12.34%

Tilapia : 9 %

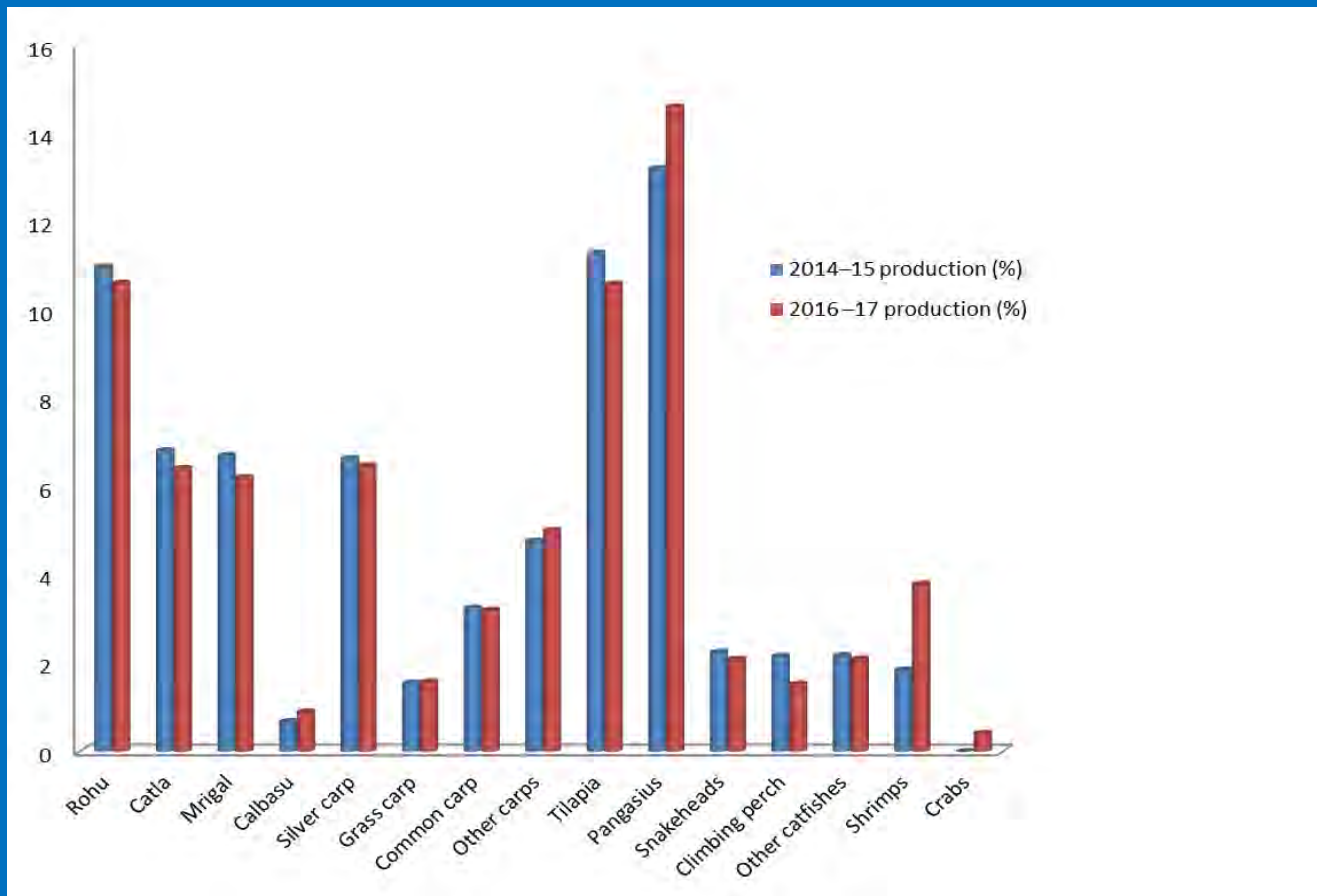
Shrimps: 6.0%

Other inland fish: 14.5%

Hilsa shad: 12 %

Other marine fish: 7.28%

SPECIES CONTRIBUTION TO TOTAL INLAND FISH PRODUCTION (2014 – 2015 & 2016 – 2017)



- **Carp species** all together are playing a dominating role,
- Followed by **pangasius** and **tilapia** in total inland fish production

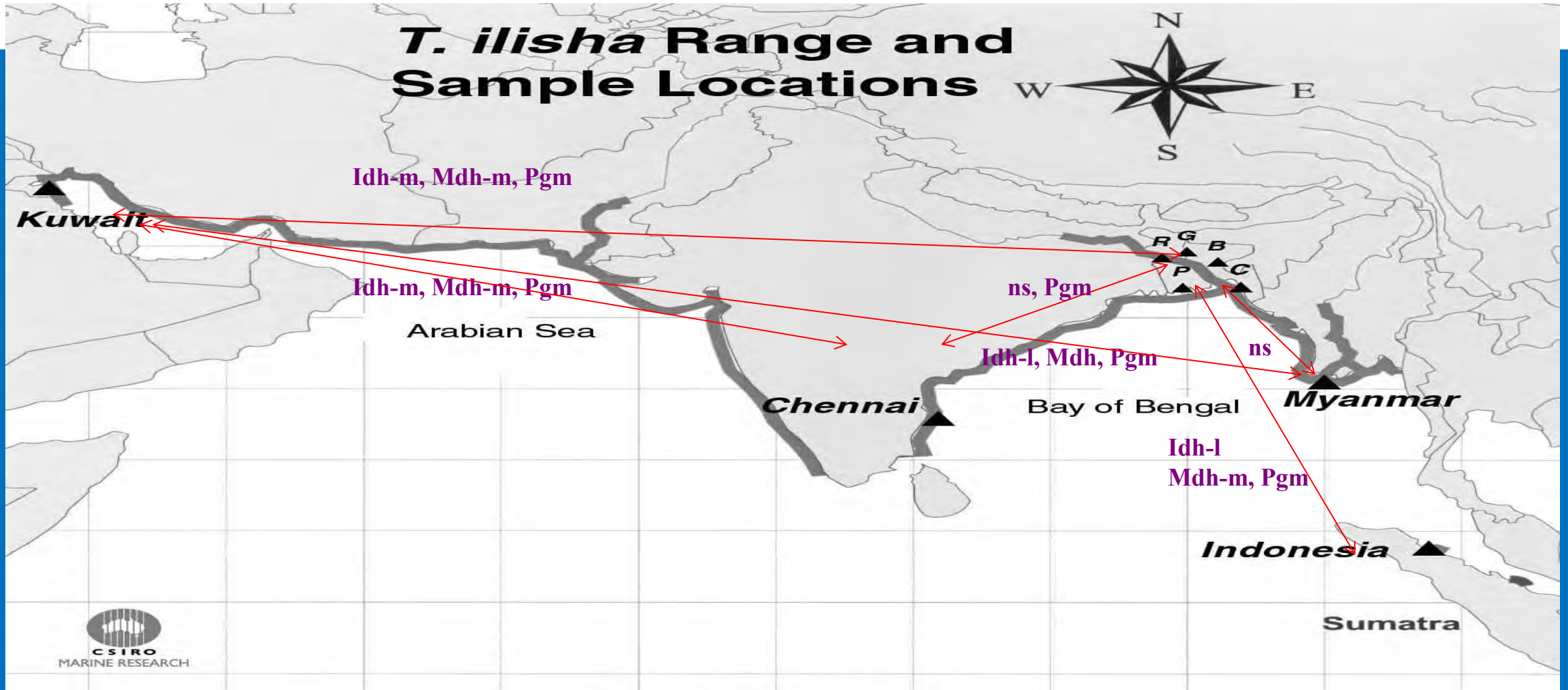
Source: FRSS 2017; DoF 2017

HILSA SHAD FISHERY SIGNIFICANT SUCCESS IN PRODUCTION



- Hilsa production increased from 0.2 mil. tons in 2000-2001 to 0.52 mil. tons in 2017 – 2018
- The main reason is due to implementation of Hilsa Management Action Plan formulated by BFRI and implemented by DoF since 2003
- Bangladesh contributes 50 – 60% of total global hilsa catch, 20 – 25% Myanmar; 15 – 20% India and 5 – 10% other countries
- GoB implementing ban on hilsa catch two times in a year 60 days in March and April; 22 days in October
- These regulations enhanced sustainable growth in hilsa production

Population Genetic Structure Study of Hilsa Shad using Allogzyme Markers (1980 - 1982)



This study revealed that the Bay of Bengal comprised a single population of hilsa shad.

TILAPIA PRODUCTION TRENDS (2005 – 2016)

- Tilapia Production increased from **19,268 tonnes** in 2005 to **377,346 tonnes** in 2016

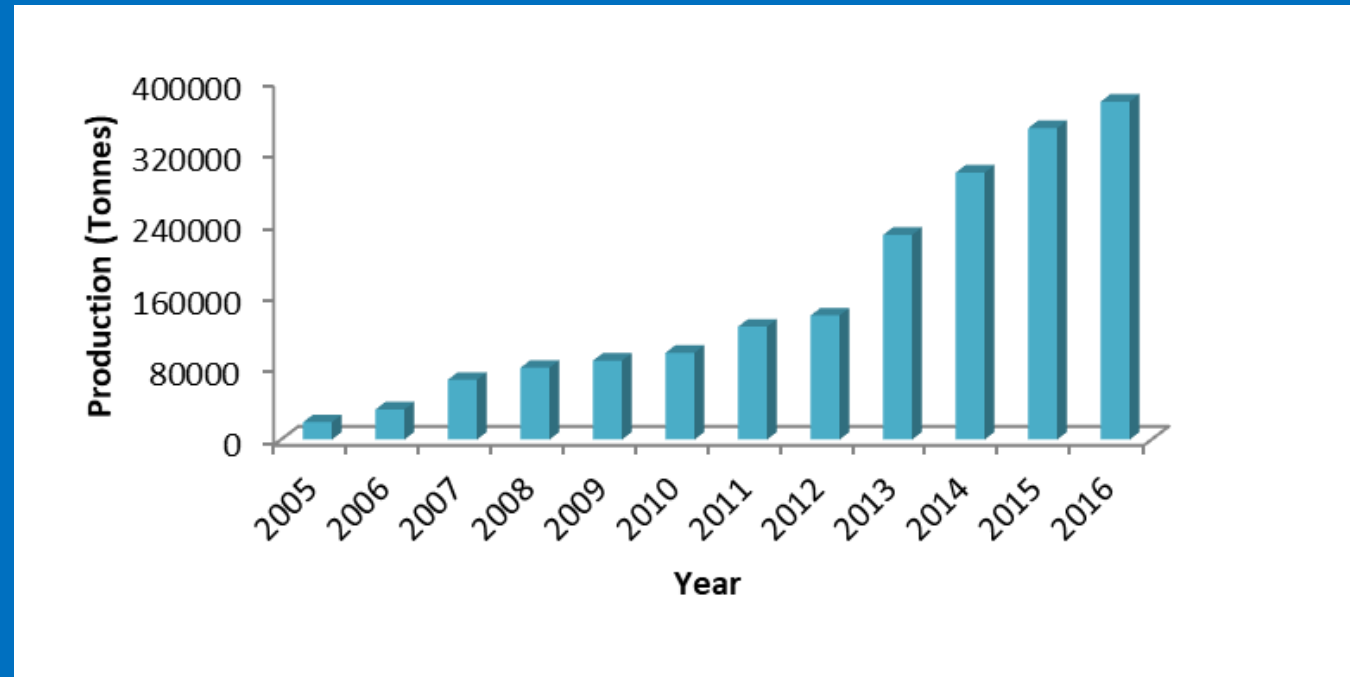
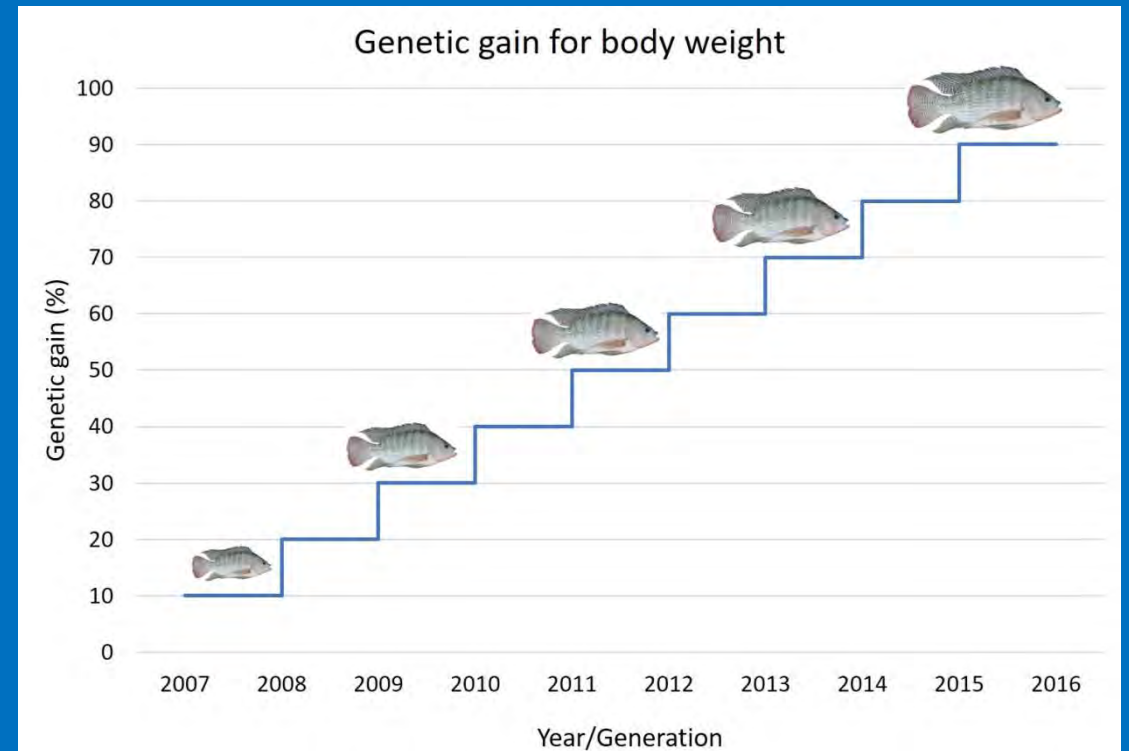
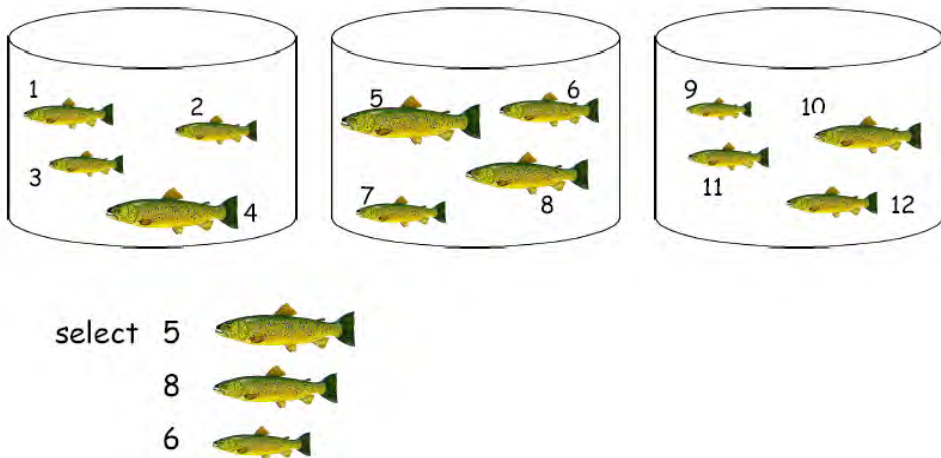


Figure 2. Tilapia production over the last 12 years (2005 – 2016) in Bangladesh (Hussain et al. 2017)

GENETIC STOCK IMPROVEMENT OF TILAPIA THROUGH FAMILY SELECTION

Family selection

selection on average family performance



Relative to the base population, the gain achieved after nine generations of selection was 36.6%, averaging 4% per year or generation

APPLICATION OF GENETICALLY IMPROVED TILAPIA STRAIN IN AQUACULTURE



GENETIC STOCK IMPROVEMENT OF SILVER BARB THROUGH FAMILY SELECTION

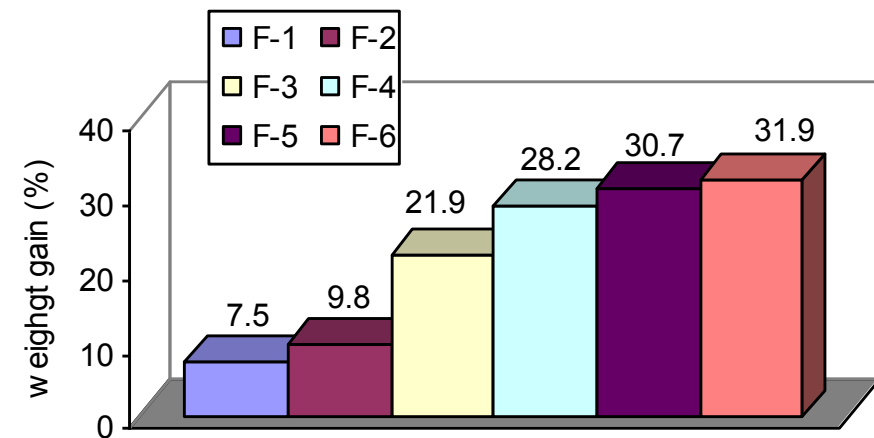
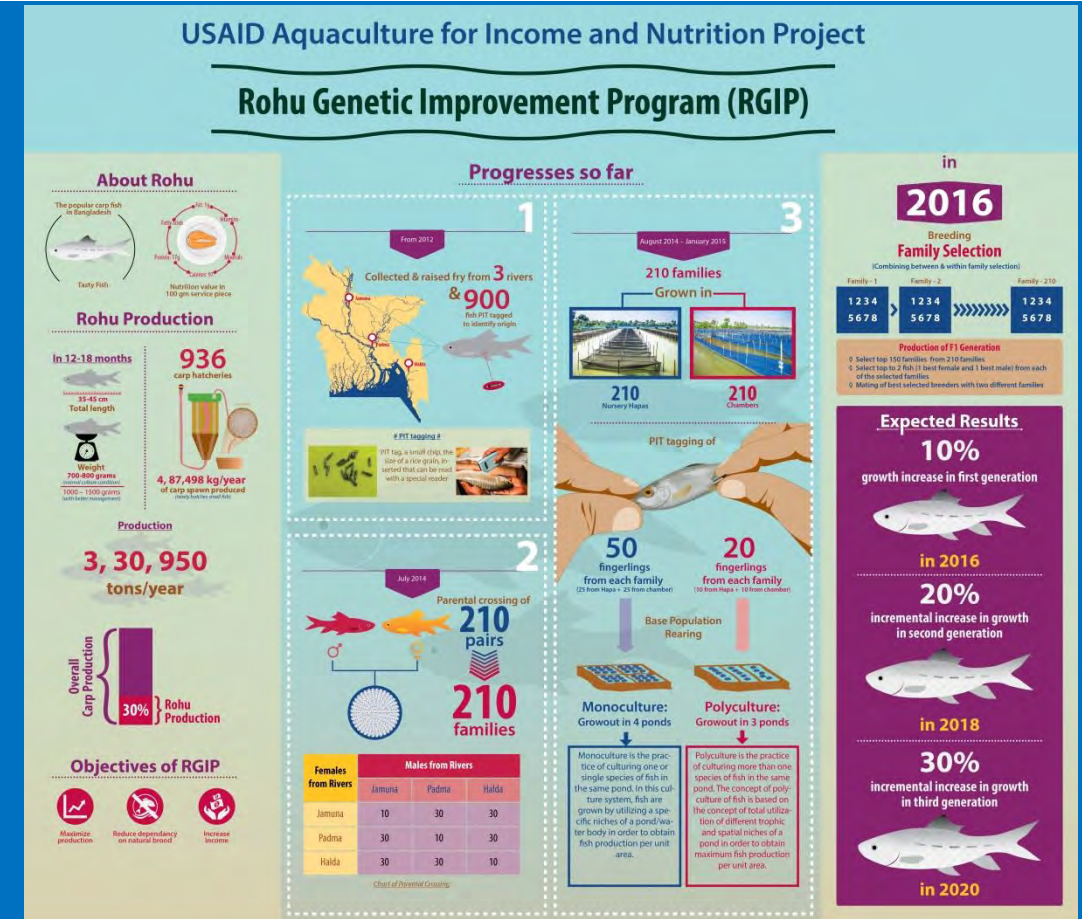


Fig.1. Cumulative genetic gain (%) in weight of selected over non selected *Barbodes gonionotus* in different generation

GENETIC STOCK IMPROVEMENT OF ROHU THROUGH FAMILY SELECTION

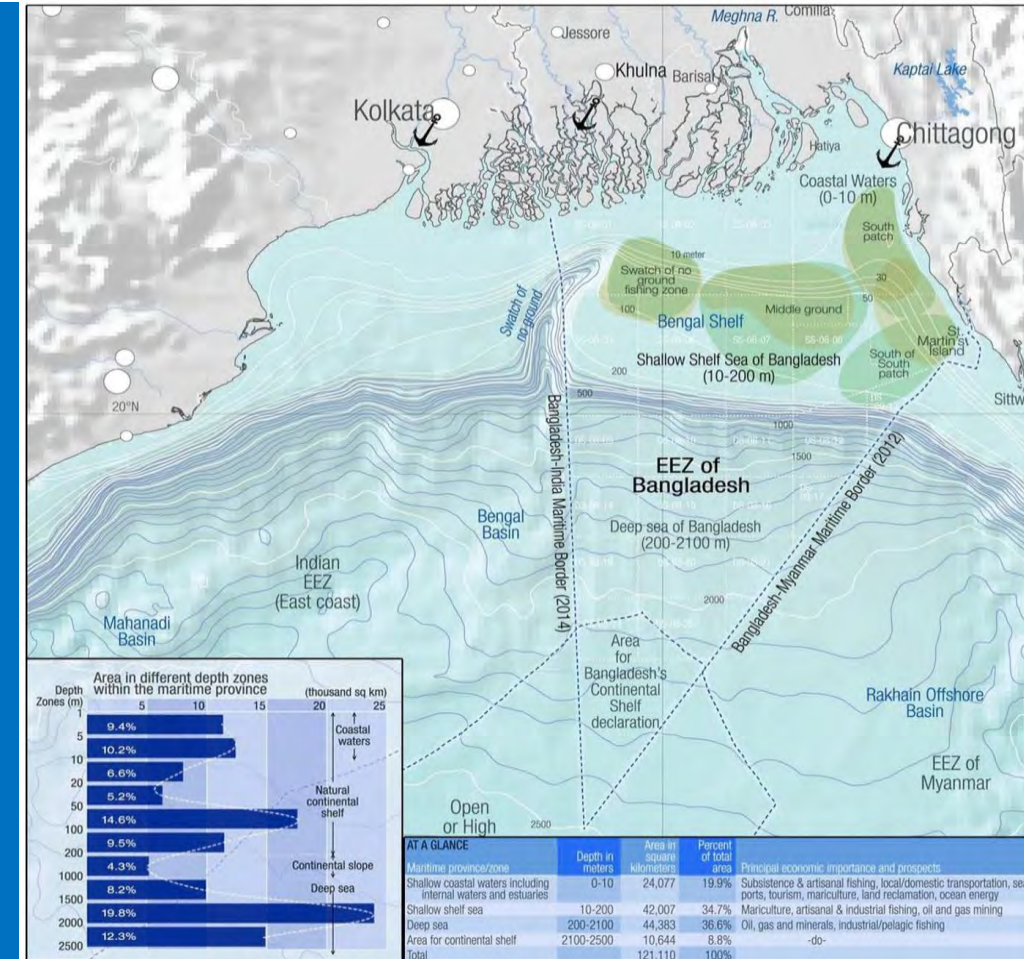


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BLUE ECONOMY AND MARINE FISHERIES IN BANGLADESH

- Blue economy discussion started after the settlement of maritime boundary delimitation dispute with Myanmar (14 March 2012) and India (07 July 2014)
- This allowed Bangladesh's sovereign rights over the living and nonliving resources of the Bay of Bengal
- Over 118,813 sq kms of territorial sea, 200 nautical miles (NM) of Exclusive Economic Zone (EEZ) and the continental shelf up to 354 NM from the Chittagong coast



THE BLUE ECONOMY AND THE SDGS

The UN adopted ocean development as part of 17 Sustainable Development Goals (SDGs) and their 17 targets

SDG 14 – by the name “Life Below Water”, which includes 10 targets

All these 10 targets covers all identified sectors of Blue Economy

14 LIFE BELOW WATER



SDG 14 TARGETS:

14.1 By 2025, prevent and significantly reduce marine pollution of all kinds

14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts

14.3 Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels

14.4 By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices

14.5 By 2020, conserve at least 10 per cent of coastal and marine areas

14.6 By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing

14.7 By 2020, increase the economic benefits to Small Island Developing States and least developed countries from the sustainable use of marine resources

Relevance of Blue Economy Sectors and Activities to SDG 14 Targets

Relevant SDG 14 Target	Blue Economy Sectors or Activity in Bangladesh
14.1 Prevent and significantly reduce all kinds of marine pollution,	Fisheries, Aquaculture, Desalination, Shipping & navigation, Coastal development, Tourism
14.2 Sustainable management to protect marine and coastal ecosystems	Fisheries, Aquaculture, Renewable energy, Seabed mining, Desalination, Shipping & navigation, Coastal development, Tourism, Ocean monitor & surveillance, MSP to conservation, Carbon sequestration.
14.3 Minimize and address the impacts of ocean acidification	Ocean monitor and Surveillance, MSP
14.4 Effectively regulate harvesting, and end overfishing, illegal, unreported and unregulated (IUU) fishing and destructive fishing practices	Fisheries, Ocean monitor and Surveillance, MSP
14.5 MSP to conserve at least 10 per cent of coastal and marine areas	Tourism, Ocean monitor and Surveillance, MSP, Carbon sequestration
14.6 Prohibit certain forms of fisheries subsidies	Fisheries
14.7 Increase the economic benefits to SIDS and LDCs	Fisheries, Aquaculture and Tourism
14 a Increase scientific knowledge	Marine Biotechnology, Renewable energy, Seabed mining, Desalination, Shipping & navigation, Ocean monitor & surveillance,
14 b Provides access for small-scale artisanal fishers to marine resources and markets	Fisheries
14 c Implementing international law	Marine Biotechnology, Shipping & navigation, Ocean monitor & surveillance, MSP

MAJOR OUTCOMES OF THE EU-BGD JOIN COLLABORATION ON BLUE ECONOMY

Key Experts: Dr. Pierre Failler, a France citizen
Dr. M. Gulam Hussain, Bangladesh

Project duration: August 2016 - July 2018

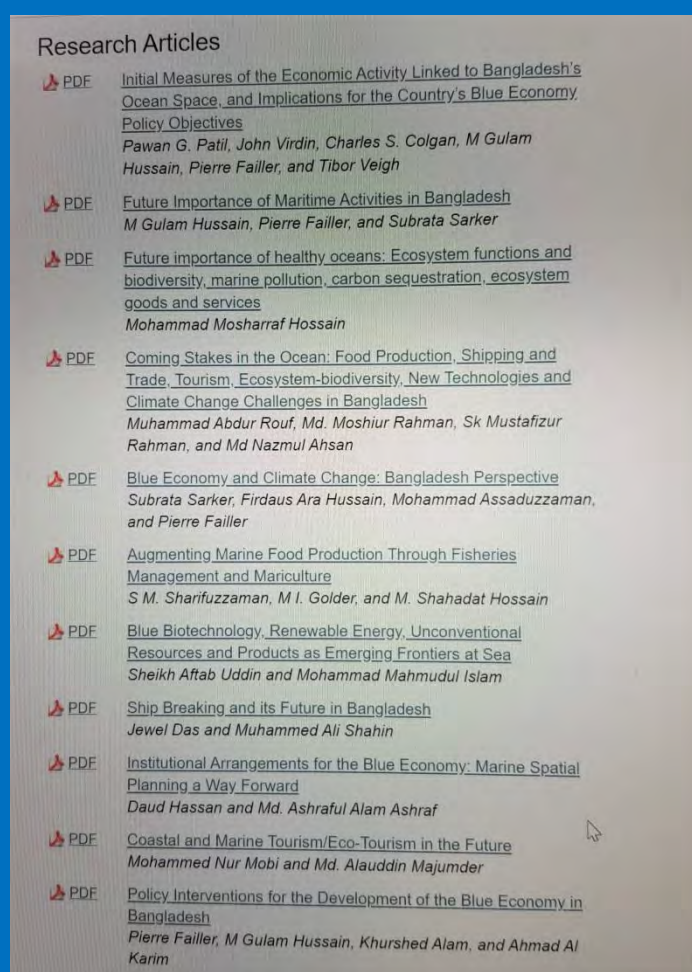
As per the ToR, Expert Mission addressed the 4 areas of investigation:

- **1. Institutional field** : Conducted all BE related ministries, dept. and intuitions/agencies
- **2. Policy and strategic planning field**: BE strategy formulated with 13 chapters
- **3. Academic and research field**: Related Univ & Res. Institutions
- **4. Workshops and events field**:

An estimated 8 regional & national workshop/seminars organized and 2 international workshops participated

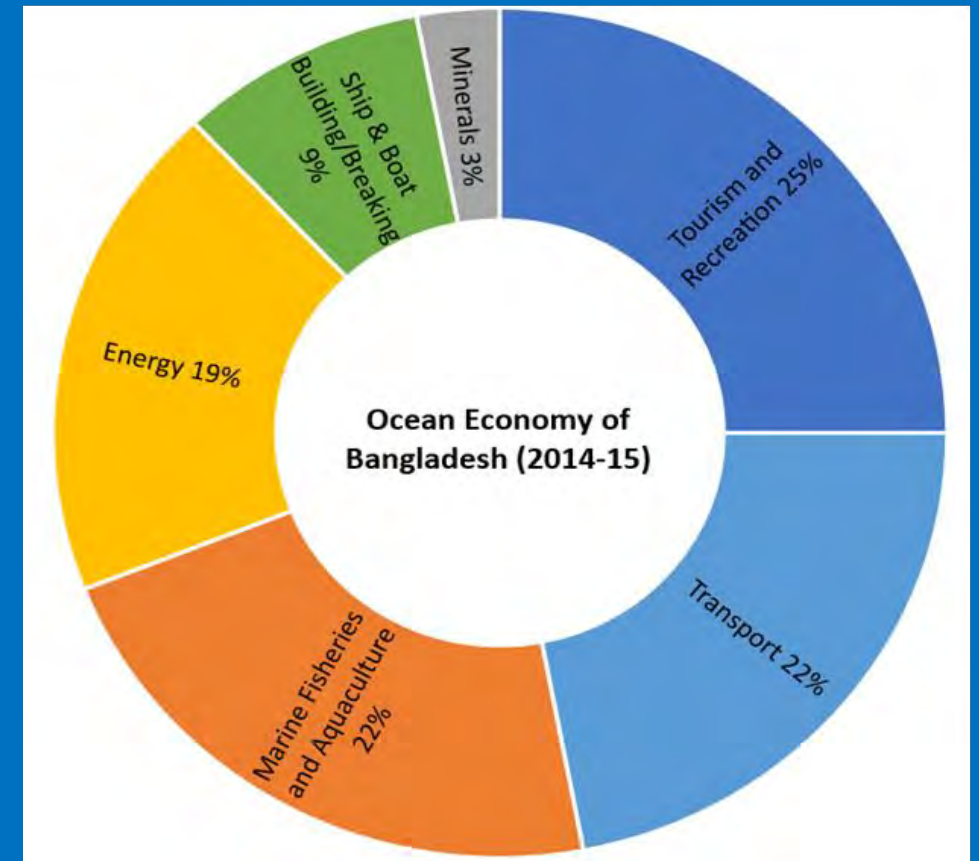


CURRENT INITIATIVES ON BLUE ECONOMY IN BANGLADESH A



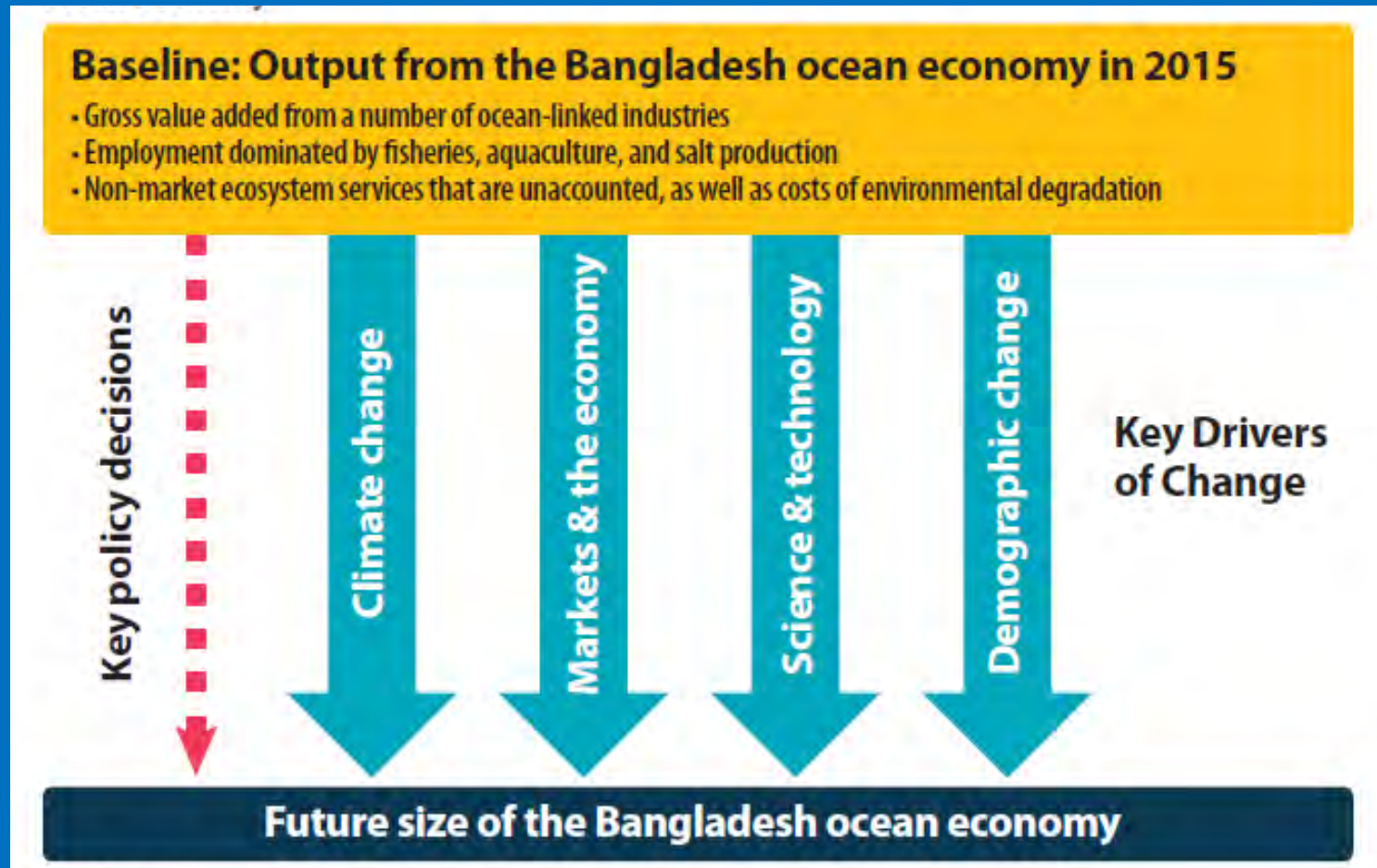
BANGLADESH OCEAN ECONOMY GROSS VALUE ADDED (GVA)

6.2 billion USD:
Total Bangladesh ocean
economy GVA



CHALLENGES AND OPPORTUNITIES

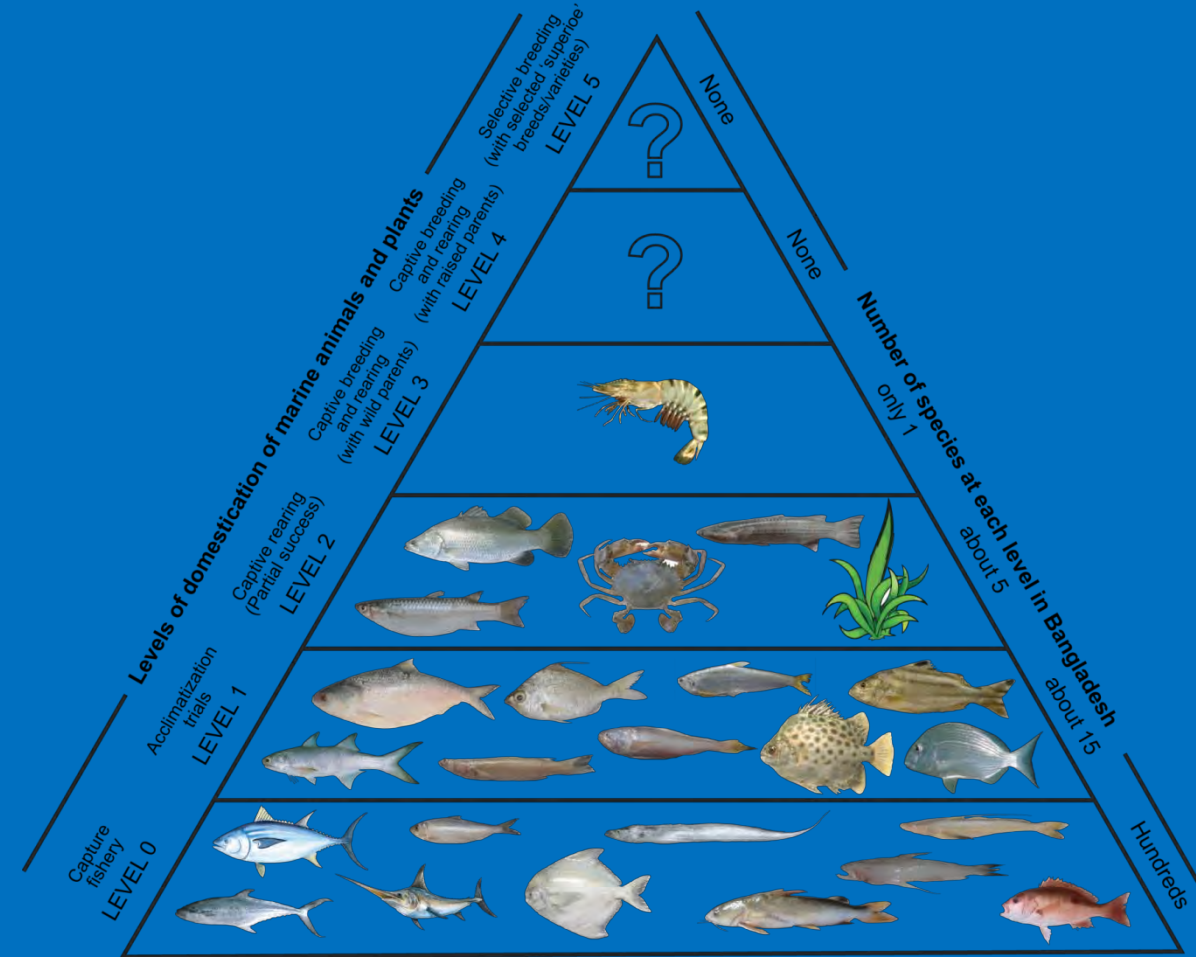
Employment dominated by fisheries, aquaculture and salt production



Source: P.G. Patil, J. Virdin, C.S. Colgan, M.G. Hussain, P. Failler, and T. Vegh (2018). *Toward a Blue Economy: A Pathway for Sustainable Growth in Bangladesh*. Washington, DC: The World Bank Group.

OPPORTUNITIES AND CHALLENGES FOR MARICULTURE DEVELOPMENT

- No major mariculture in Bangladesh over the last 40 years except the tiger shrimp farming, using traditional and improved extensive practices in the coastal areas
- China, Indonesia, Malaysia, Taiwan, Thailand, Singapore and Vietnam are ahead of finfish mariculture using hatchery produced seeds and formulated feeds
- So, there are enormous scopes for flourishing mariculture of both brackish and marine fish species as well as non-traditional marine species like seaweed, macro algae, shellfish (i.e., mussel, oyster etc.), sea urchin, sea cucumber etc.
- In view of that domestication of all these marine species are prerequisite



Source: Hossain et al. 2017

POTENTIAL SPECIES FOR MARICULTURE

Species/Group	Main locations/ areas for mariculture
Marine fin fish breeding and farming	
Sea bass (<i>Lates calcarifer</i>), Grey mullet (<i>Mugil cephalus</i>), Green back mullet (<i>Chelon subviridis</i>), Pomfret (<i>Pampus argenteus</i>), Hilsa (<i>Tenualosa ilisha</i>), saline tolerant tilapia and other species	Land-based brackishwater pond culture, cage culture and pen culture in inshore and offshore areas i.e ., Moheshkhali-kutubdia channel, Sonadia island and Dubla island
Marine shrimp broodstock domestication, and SPF seed production and farming	
Broodstock domestication, breeding and farming of <i>Penaeus monodon</i> , <i>P. indicus</i> , <i>P. merguensis</i>	Cox's Bazar, Satkhira, Khulna
Crab breeding and farming	
Mud crab, <i>Scylla serrata</i>	Shamnagar, Shatkira; Moheshkahi; Cox's Bazar
Mussel breeding and culture	
Clams (<i>Anadara</i>)	Chittagong, Moheshkhali, Kutubdia coast
Mussel (green mussel, <i>Perna viridis</i>)	St .Martin's Island, Moheshkhali, Kutubdia
Clam (<i>Meretrix meretrix</i>) and oyster (<i>Crassostrea madrasensis</i>)	Cox's Bazar, Sundarban mangrove
Pearly oyster (cklip, nei)	Cox's Bazar, Patuakhali
Culture of marine aquatic Plants	
a. Seaweeds Sargassum sp., Hypnea sp., Caulerpa sp .Ulva sp .and others.	St .Martin's, Cox's Bazar and Khulna
b. Marine micro algae Marine micro algae viz . <i>Skeletonema costatum</i> , <i>Thalassiosira</i> sp., <i>Chaetoceros gracilis</i> , <i>Tetraselmis</i> sp., <i>Nanochloropsis oculata</i> , <i>Chlorella</i> sp .etc.	Chittagong, Cox's Bazar, Dhaka, Khulna)can be used as live feed and biodiesel production by marine biotechnology(
Culture of marine coral and other non-traditional species	
Corals, sea cucumber, sea urchin etc.	St. Martin's Island



FUTURE AND CHALLENGES OF MARINE AQUACULTURE

- Establishment of hatcheries for seed production of marine species, important prerequisite
- Domestication of potential mariculture species
- Development of coastal earthen ponds /farms
- Development of inshore raceways
- Floating net cages at offshore areas
- Production of high quality feeds, most important
- Seaweed culture at reef flats, mangrove stakes/nets and long lines
- Seaweed culture at reef flats, mangrove stakes/nets and long lines
- Mariculture markets and products development
- Political and state owned commitment

MARICULTURE OPPORTUNITIES FOR FIN FISH CAGE CULTURE AND CRAB CULTURE



Source: Hossain et al. 2017

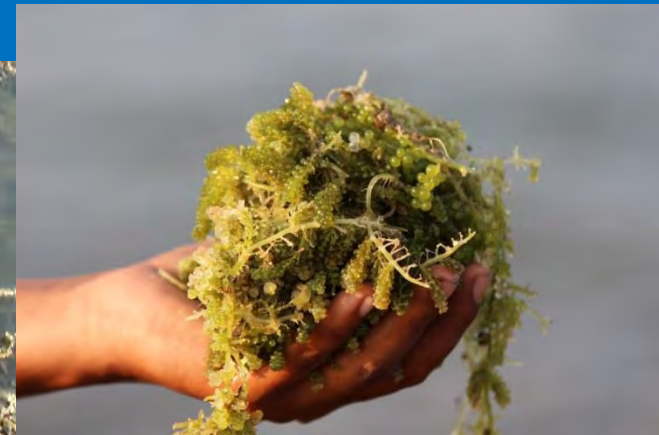
Suitable locations:

- Cage culture - Moheshkhali-kutubdia channel, Andermanik canal, Potualkali
- Crab culture: Shamnagar, Shatkhirā; Moheshkahi; Cox's Bazar



OPPORTUNITIES FOR SEA WEED CULTURE

- Seaweed culture could be widely initiated in this country for using as food items as well as for foreign exchange earnings
- 193 seaweed species including **19 commercially important species** are found in Bangladesh
- For the commercial culture of seaweeds, both reef flats and long line methods (as the most common practice) could be introduced in this country
- Naturally growing seaweeds are seen in the littoral and sub-littoral zones of St. Martin's Island to Sundarbans Mangrove forest, and are available from October to April throughout the whole Southern coast



FUTURE OF TUNA FISHING IN BANGLADESH

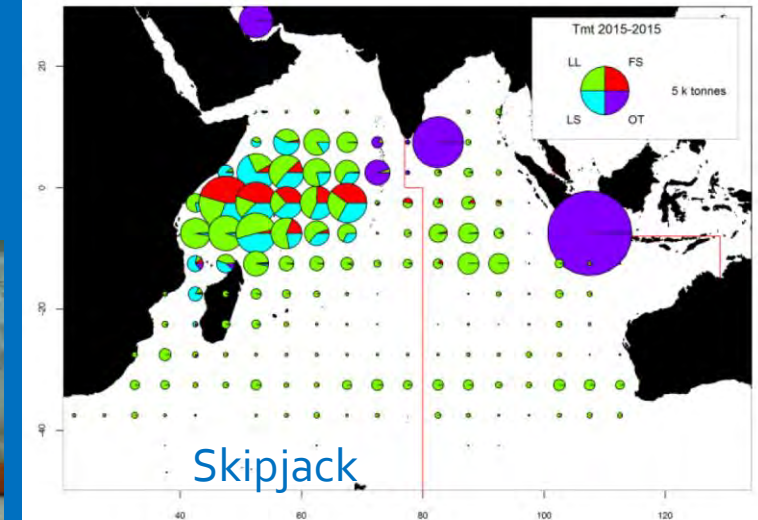
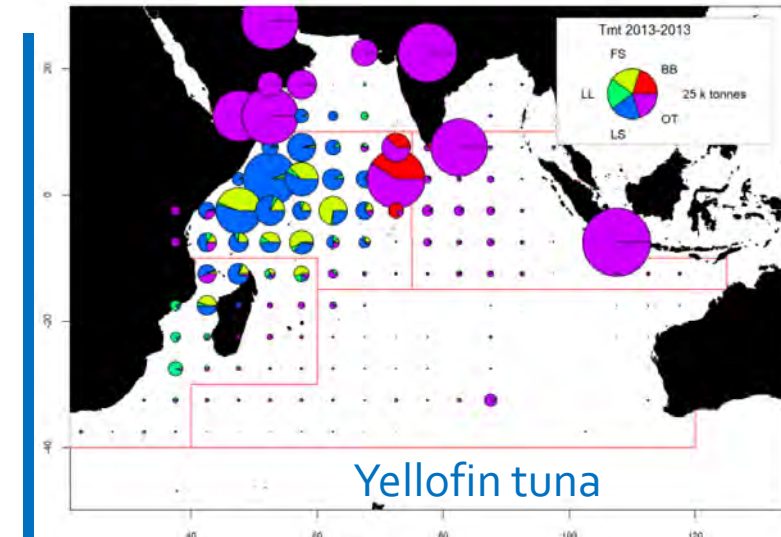
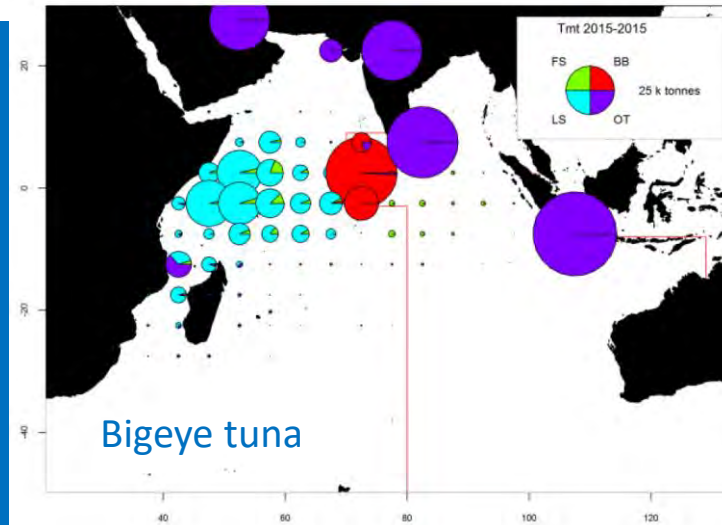
Global catch of tuna: around 5 million tonnes / year

7 major species

Estimated amount paid to fishers almost 10 billion US\$

End value around 33 billion US\$

One hook
One line and one fish at a time



CHALLENGES AND OPPORTUNITIES OF BLUE BIOTECHNOLOGY

The challenges and opportunities of Blue Biotechnology to Bangladesh

The Big challenges for Bangladesh Blue Biotechnology are to:

- ▶ Pursuing human health and well-being
- ▶ Sustainable supply of high quality food
- ▶ Evolving sustainable sources of energy alternatives to crude oil and gas
- ▶ New business products and processes with low green house gas emission
- ▶ Protection and management of marine environment

Marine species production

- Species cultivation/farming and new discovery
- Disease control and health monitoring
- Marine biosafety
- Mass production e.g. crabs, molluscs, seaweeds etc.

Organism-based Technology

- Bioprospecting
- Marine genome sequence and bioinformatics
- Metagenomics and other omics technologies

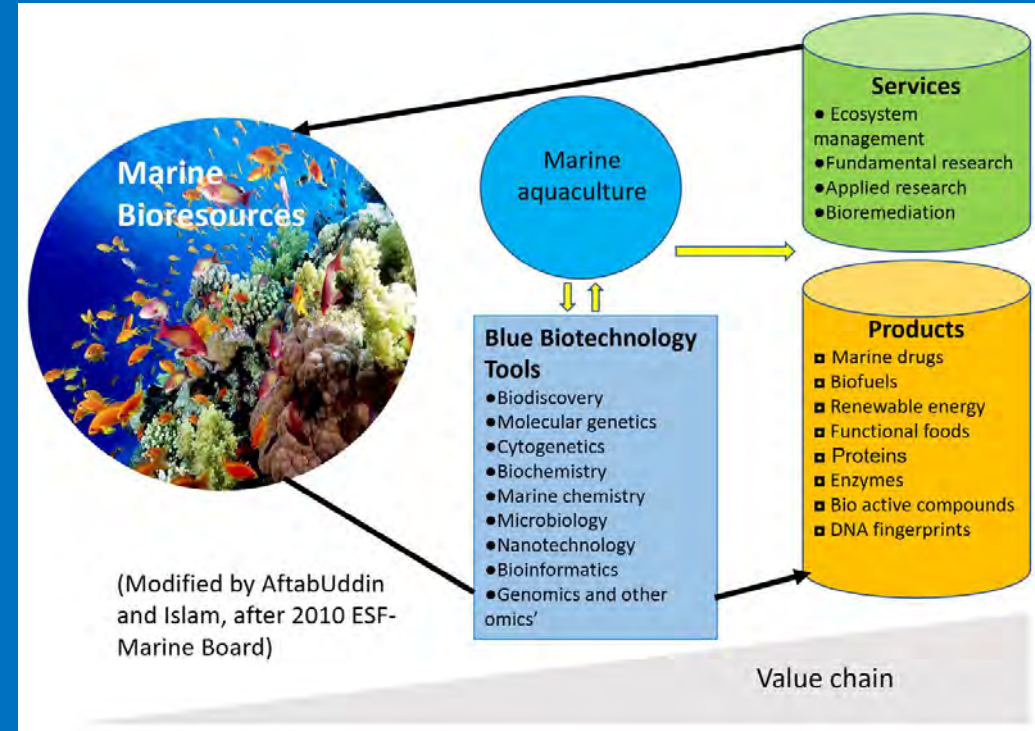
Opportunities

Innovative Products

- Drug discovery
- Health supplements, nutraceuticals
- Industrial ingredients
- Biofuels and bioenergy

Marine Protection and Management

- Monitoring environmental change
- Prevention and control pollution
- Biodiversity conservation and ecosystem recovery



APPLICATION OF BLUE BIOTECHNOLOGY

➤ In Marine Aquaculture

- Use of selective breeding, gene transfer & other molecular tools
- **Production of genetically improved & transgenic fish strains**
- **Isozyme & micro satellite DNA markers** have already been used for stock identification in hilsa shed
- **Genome sequencing technology** already been used for hilsa
- Use of nuclear based isotope signature technologies to detect trans-boundary sea fish products (ANSTO, Australia)



APPLICATION OF BLUE BIOTECHNOLOGY

➤ Pharmaceutical products

- Anti-cancer, anti-arthritis & anti-inflammatory drugs
- PUFA and Omega-3 from marine fish oil
- Other essential therapeutics



Pharma & biotech



FISHERY MANAGEMENT: TRASH FISH

NO REGULATION & ENFORCEMENT MEASURES BY THE RESPECTIVE MINISTRIES/DEPARTMENTS IN BANGLADESH



Need to Implement & Enforce existing policies and management Measures including IUU fishing



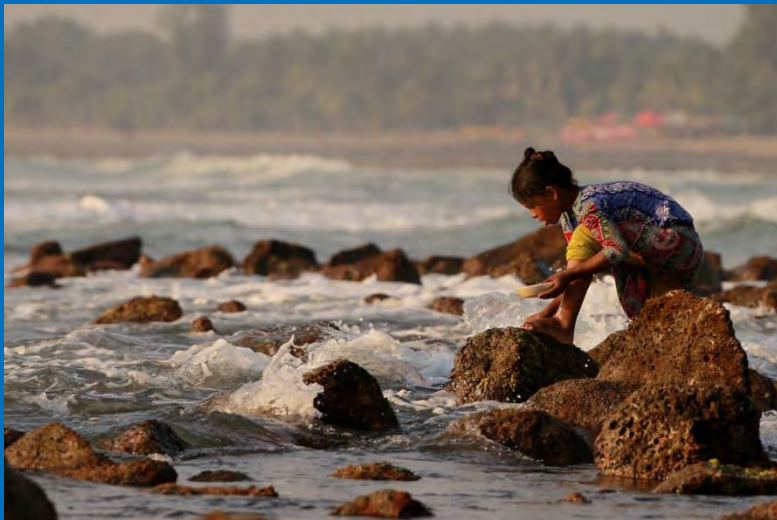
FISHERY VALUE CHAIN: SANITARY IMPROVEMENT

FISH VALUE ADDITION



MARINE COASTAL AND ECOSYSTEM PROTECTION

BE development relies on healthy marine and coastal ecosystems



FISHERY MONITORING AND RESEARCH

- MOFL/DoF already procured a modern survey vessel i.e. **R.V. Meen Shandhani**, which already initiated stock assessment survey under FAO technical assistance
- As per Government request, FAO supported the research vessel **Dr Fridtjof Nansen** the research survey conducted in Bangladesh waters in August 2018 for 2 weeks
- New initiatives to undertake to **explore new fishing grounds**



SECTORAL STRATEGIES AND PRIORITIES IN TWO GOVT. POLICY DOCUMENTS

1. 7th Fiver Year Plan, 2016 -2020 (2015), Govt. of Bangladesh:
 - The strategies emphasized for achieving the goals and objectives of
 - Open water fisheries management
 - Inland aquaculture
 - Shrimp and coastal aquaculture
 - Marine Fisheries and Exploring Blue Economy
2. Bangladesh Delta Plan 2100 (2018), Govt. of Bangladesh
 - The BDP 2100 develops an adaptive, holistic and long term strategic plan to steer the opportunities in overall aquaculture and fisheries sector



Email: hussain.mgulam@gmail.com



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