

# **ANTIBIOTIC USE AND WASTE MANAGEMENT IN AQUACULTURE TO LIMIT EMERGENCE AND SPREAD OF ANTIBIOTIC RESISTANCE**

**B.K.MONDAL**

**Joint Director of Fisheries**

**&**

**General Manager (Tech.)**

**S.F.D.C, GOVT. OF WEST BENGAL**

## FOCUS

- The World population will reach more than 9 billion by 2050.
- To feed these numbers, Global food basket output i.e. Agricultural Crop, Livestock and **Aquaculture Production** are the sources of food, must increase by 60% from present levels.
- Right now 1 billion people are suffering from hunger and poverty.
- At present 578 million people live only in Asian Region.
- So it is necessitated to adapt intensive aqua farming for enhancing production and productivity.

# WORLD

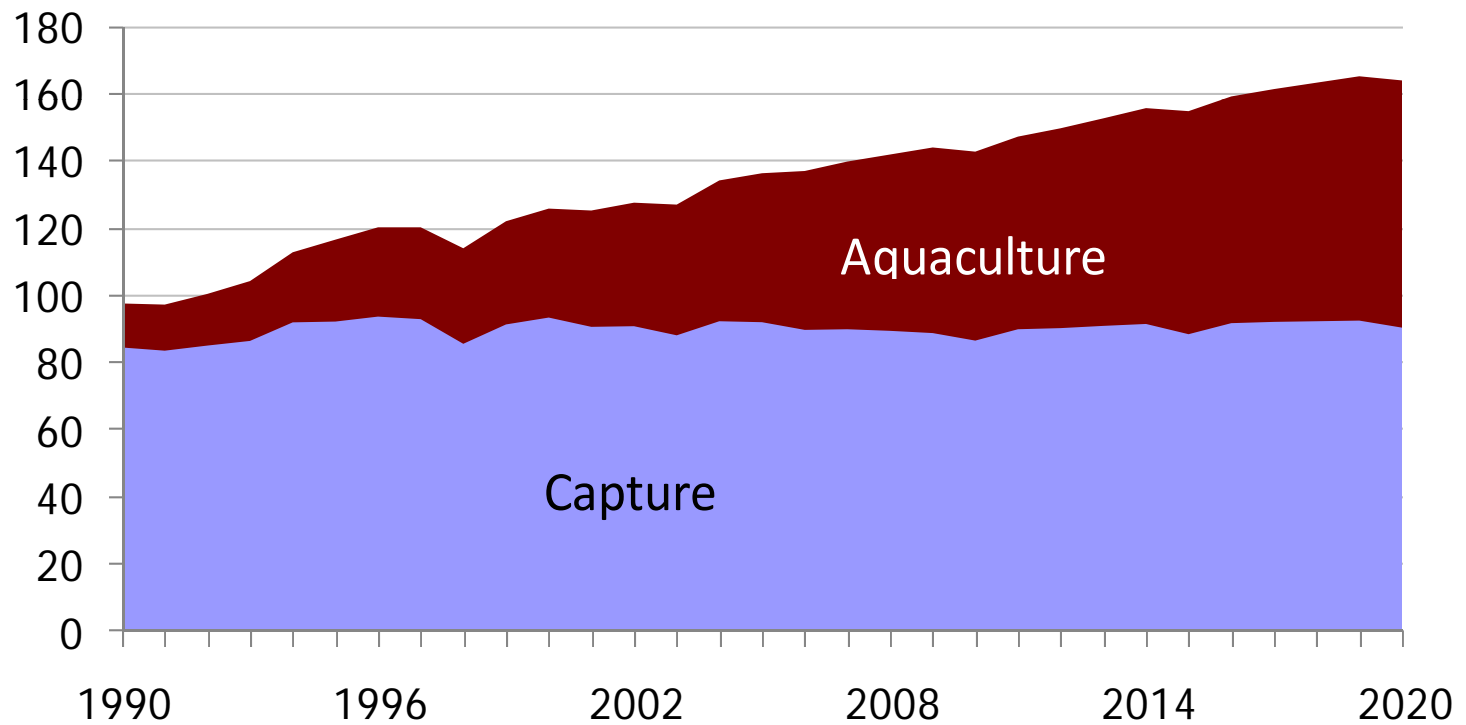
Top 10 Countries	Mill. Tons
China	56.10
Indonesia	8.06
India	<b>7.31</b>
Peru	7.26
Japan	5.60
USA	5.30
Chile	5.00
Philippines	4.71
Vietnam	4.32
Thailand	<b>3.86</b>
World Total	<b>156.37</b>

## Aquaculture Production

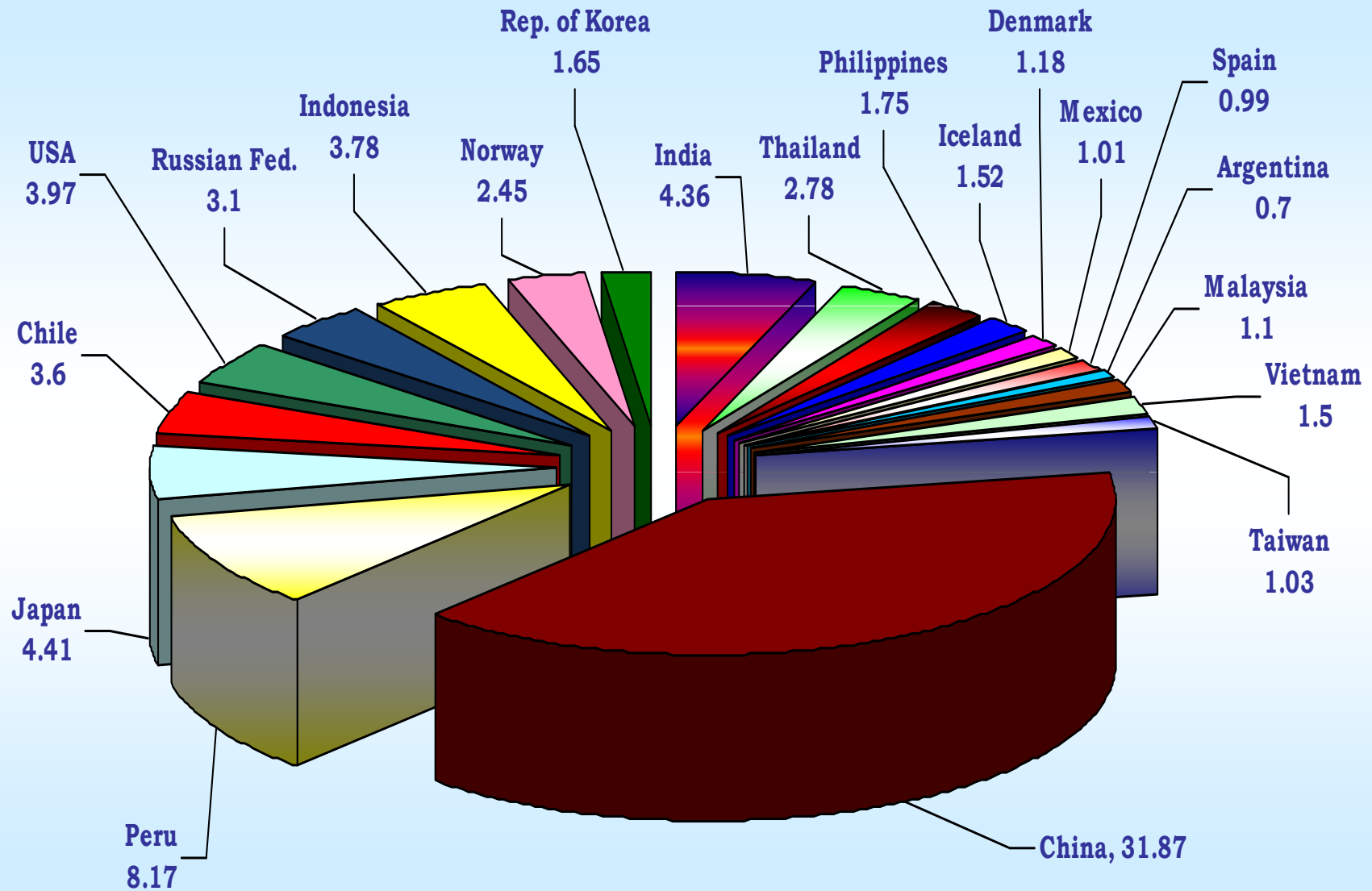
Some Top Countries	Mill. Tons
China	<b>34.43</b>
India	<b>3.13</b>
Vietnam	<b>1.65</b>
Thailand	<b>1.39</b>
Indonesia	<b>1.30</b>
Bangladesh	<b>0.89</b>
Chile	<b>0.84</b>
World Total	<b>50.331</b>

# TOTAL FISHERY PRODUCTION

million tonnes



# Percent Share of major Fish Producing Countries in World Fish Production (140 mmt)



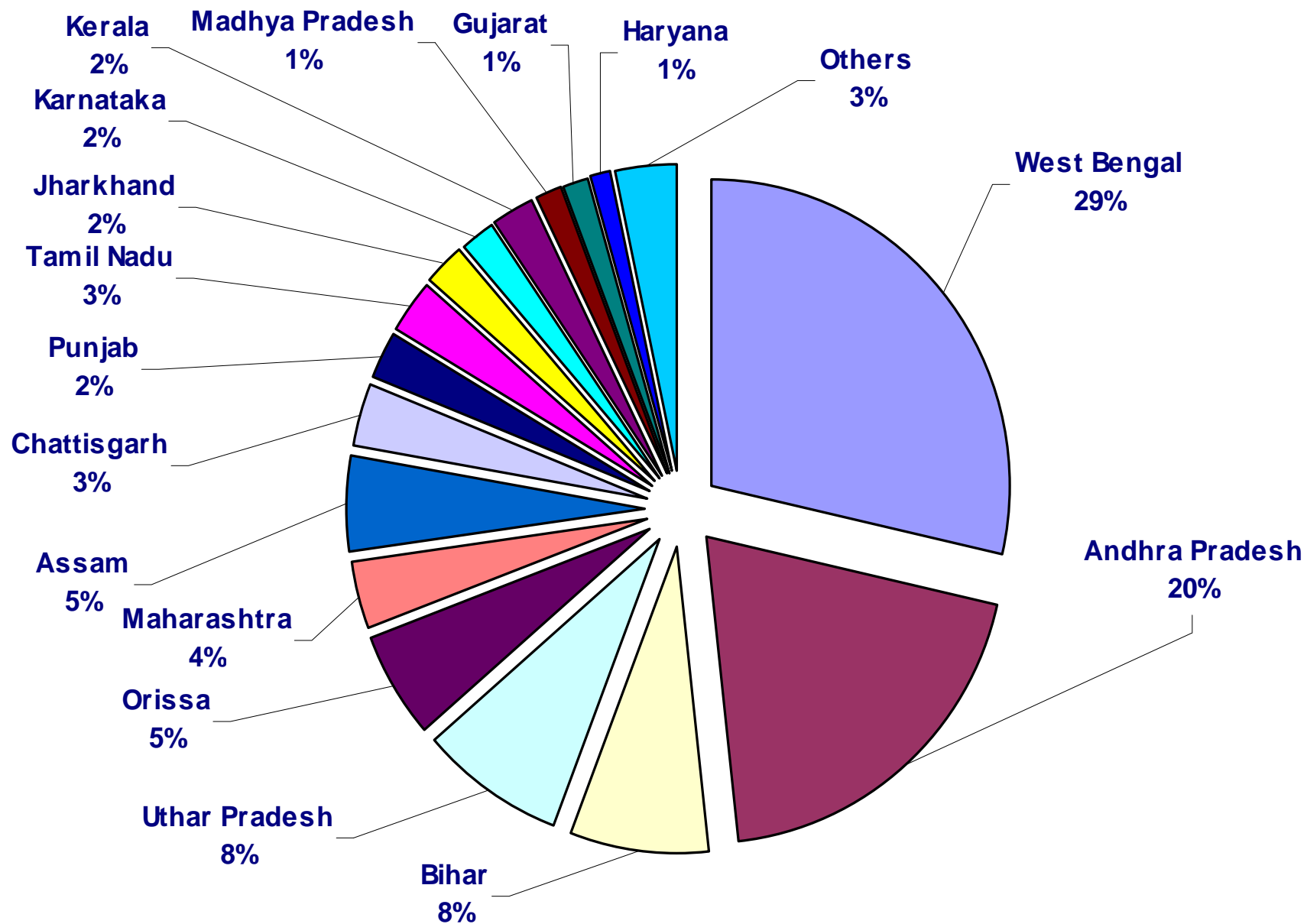
# **POSITION OF INDIAN FISHERIES - 2014**

<b>Global position</b>	<b>3rd in Fisheries and 2nd in Aquaculture</b>
<b>Contribution of Fisheries to GDP (%)</b>	<b>0.83</b>
<b>Contribution to Agril. GDP (%)</b>	<b>4.75</b>
<b>Per capita fish availability (Kg.)</b>	<b>9.0</b>
<b>Employment in the sector (million)</b>	<b>14.49</b>

# INDIAN FISHERIES RESOURCES

<b>Coast line</b>	<b>8,118 kms</b>
<b>EEZ</b>	<b>2.02 million sq. km</b>
<b>Continental Shelf</b>	<b>0.51 million sq. km</b>
<b>Rivers &amp; Canals</b>	<b>1,96 lakh kms</b>
<b>Reservoirs</b>	<b>29.07 lakh ha</b>
<b>Ponds and Tanks</b>	<b>24,40 lakh ha</b>
<b>Oxbow lakes &amp; Derelict waters</b>	<b>7.98 lakh ha</b>
<b>Brackishwater</b>	<b>12.40 lakh ha</b>

# State-wise Inland Fisheries Production





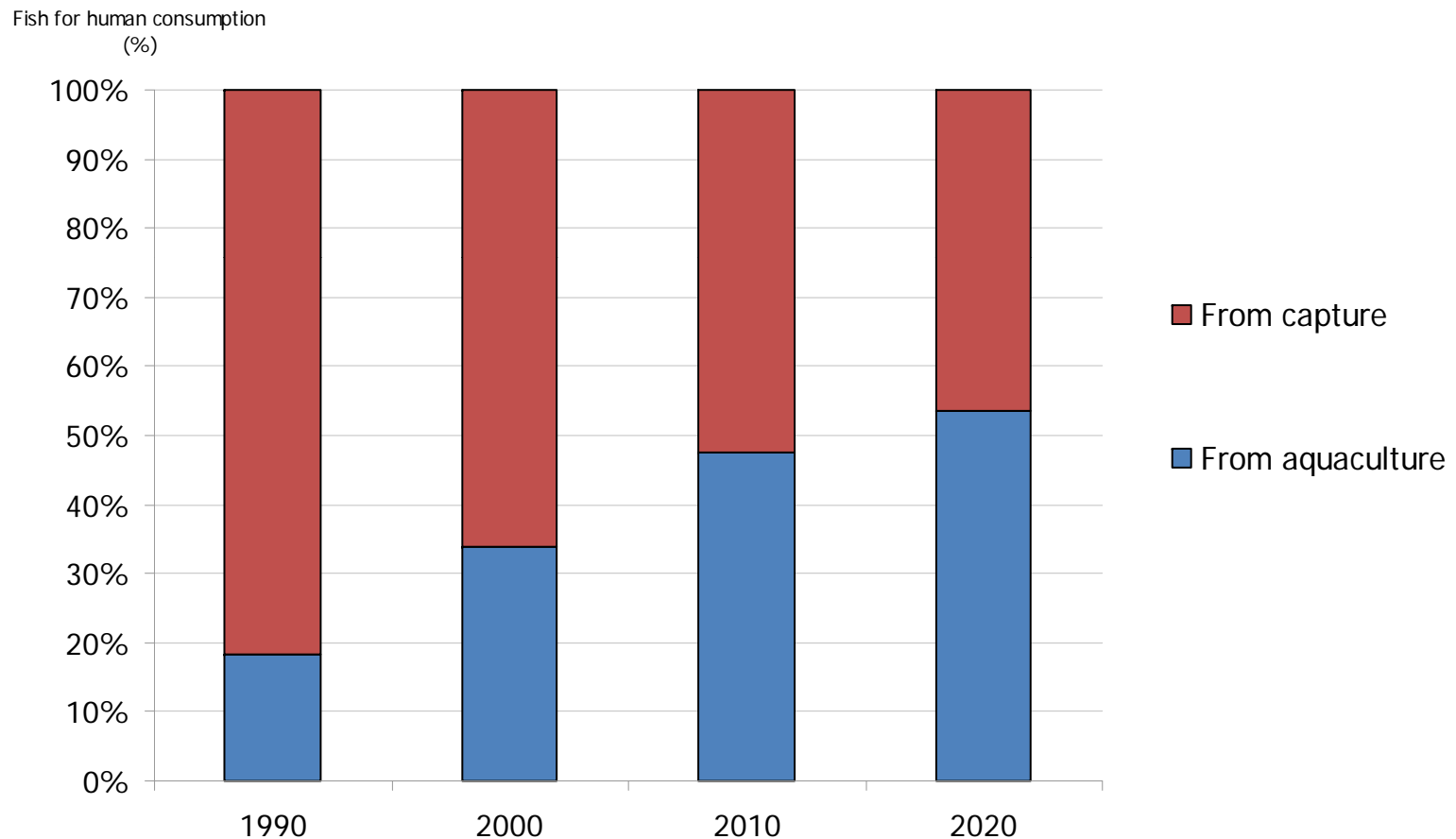
# Use of fisheries products in India

- Increase in Indian fish production mainly from aquaculture.
- Marine Exports –mainly from frozen shrimp, fish, cephalopods.
- Export is only about 10% of total fish production.
- Remaining 90% is consumed within the country.
- Consumption: 67 % is consumed in fresh form; 6 % is used for fish meal; 16 % used for drying and 7 % used for freezing.
- Inland fish produced (carps) are mainly for domestic markets.
- Increased fish production mainly from culture of *L. vannamei* in brackish water and *Pangasius* and *Mono-sex Tilapia* in fresh water.
- Increased production results in reduction/ variation in price and demand.

## Projections for 12<sup>th</sup> Five year Plan

Year	Targeted production (000 tonnes)			Average growth rate
	Marine	Inland	Total	
2012-13	3.389	5.814	9.203	5.71
2013-14	3.457	6.279	9.736	5.79
2014-15	3.526	6.781	10.307	5.87
2015-16	3.597	7.324	10.920	5.95
2016-17	3.669	7.910	11.579	6.02

# Increasing role of aquaculture in human consumption



Source: FAO

# List of some of the major available fish species in wastewater aquaculture ponds of EKW



*Labeo rohita*



*Labeo bata*



*Labeo calbasu*



*Cirrhinus mrigala*



*Catla catla*



*Ctenopharyngodon idella*



*Cyprinus carpio*



*Tilapia mosambica*



*Oreochromis niloticus*



*Pangasius pangasius*



*Puntius japonicus*





Sole (*Channa striatus*)



Lata (*Channa punctatus*)



Chyang (*Channa gachua*)



Singi (*Heteropneustes fossilis*)



Magur (*Clarias batrachus*)

# ANTIBIOTICS

- **Antibiotics** are drugs of natural or synthetic origin.
- This have the capacity to kill or inhibit the growth of micro-organisms.
- This are used as chemotherapeutic agents in the treatment of infectious diseases of humans, animals and plants.
- Discovery of new **antibiotics** revolutionized the treatment of serious diseases and restrict mortality significantly the human being of the World.

# ANTIBIOTICS IN AQUACULTURE

- Fish, as human food , are considered the best source of polyunsaturated fatty acids (predominantly- Omega-3 fatty acids), protein, iron, calcium and zinc.
- Due to explosive growth of population forced for intensive aquaculture to meet up the demand of food.
- Intensification of culture practices without basic perception of the intricate balance between host, pathogen and environment lead the outbreak of diseases in aquaculture.
- This is the turning point to indiscriminate use of Antibiotics in AQUACULTURE for more production.

- **Number of Antibiotics are being used in Aquaculture in an unscientific manner.**
- **Antibiotics use are an integral part of intensive aquaculture and mostly used as a prophylactic or therapeutic measure by farmers or by feed manufacturers.**
- **It effect's on the aquatic micro-flora, retention of harmful residues in aquatic animals and fishes and developed drug resistant bacteria and pathogens.**
- **This antimicrobial resistant bacteria/pathogens move from fish to humans via food, can lead to antibiotic resistance to the general population and causing treatment-resistant illness or even mortality.**



## **LIST OF ANTIBIOTICS AND OTHER PHARMACOLOGICALLY ACTIVE SUBSTANCES BANNED FOR USING IN AQUACULTURE IN INDIA**

<b>S.No</b>	<b>Antibiotics and other Pharmacologically active substances</b>	<b>Maximum Permissible Residual level in ppm</b>
<b>1.</b>	<b>Chloramphenical</b>	<b>Nil</b>
<b>2.</b>	<b>Nitrofurans including: Nifuratel,Nifuroxime,Nifuprazine, Nitrofurantoin,Nitrofurazone</b>	<b>Nil</b>
<b>3.</b>	<b>Neomycin</b>	<b>Nil</b>
<b>4.</b>	<b>Tetracycline</b>	<b>0.1</b>
<b>5.</b>	<b>Oxytetracycline</b>	<b>0.1</b>
<b>6.</b>	<b>Trimethoprim</b>	<b>0.05</b>
<b>7.</b>	<b>Oxolinic acid</b>	<b>0.3</b>
<b>8.</b>	<b>Nalidixic</b>	<b>Nil</b>
<b>9.</b>	<b>Sulphamethoxazole</b>	<b>Nil</b>
<b>10.</b>	<b>Aristolochia spp and preparations thereof</b>	<b>Nil</b>
<b>11.</b>	<b>Chloroform</b>	<b>Nil</b>

S.No	Antibiotics and other Pharmacologically active substances	Maximum Permissible Residual level in ppm
12.	Chlorpromazine	Nil
13.	Colchicine	Nil
14.	Dapsone	Nil
15.	Dimetridazole	Nil
16.	Metronidazole	Nil
17.	Ronidazole	Nil
18.	Ipronidazole	Nil
19.	Other nitroimidazoles	Nil
20.	Clenbuterol	Nil
21.	Diethylstilbestrol (DES)	Nil
22.	Sulfonamide drugs (except approved Sulfadimethoxine,Sulfabromomethazine,Sulfethoxypyridazine	Nil
23.	Fluroquinolones	Nil
24.	Glycopeptides	Nil

# **WATER POLLUTION AND HEAVY METALS IN AQUACULTURE**

- The universal problem is the environmental pollution specially in aqua media caused by Domestic, Industrial and Anthropogenic activities.
- It is a serious concern because this can be easily mixed in the food chain due to their bioaccumulation process.
- The accumulation of heavy metals in fish comes from water contaminated with heavy metals.
- Heavy metals entered in fish bodies by three ways- by gills, by digestive track and by body surface and spread to liver, kidney, nerves and flesh.

# **WATER CONTAMINATION BY HEAVY METALS**

- **MERCURY (Hg)**
- **LEAD (Pb)**
- **CADMIUM (Cd)**
- **CHROMIUM (Cr)**
- **NICKEL (Ni)**
- **ZINC (Zn)**
- **ARSENIC (As)**
- **COPPER (Cu)**

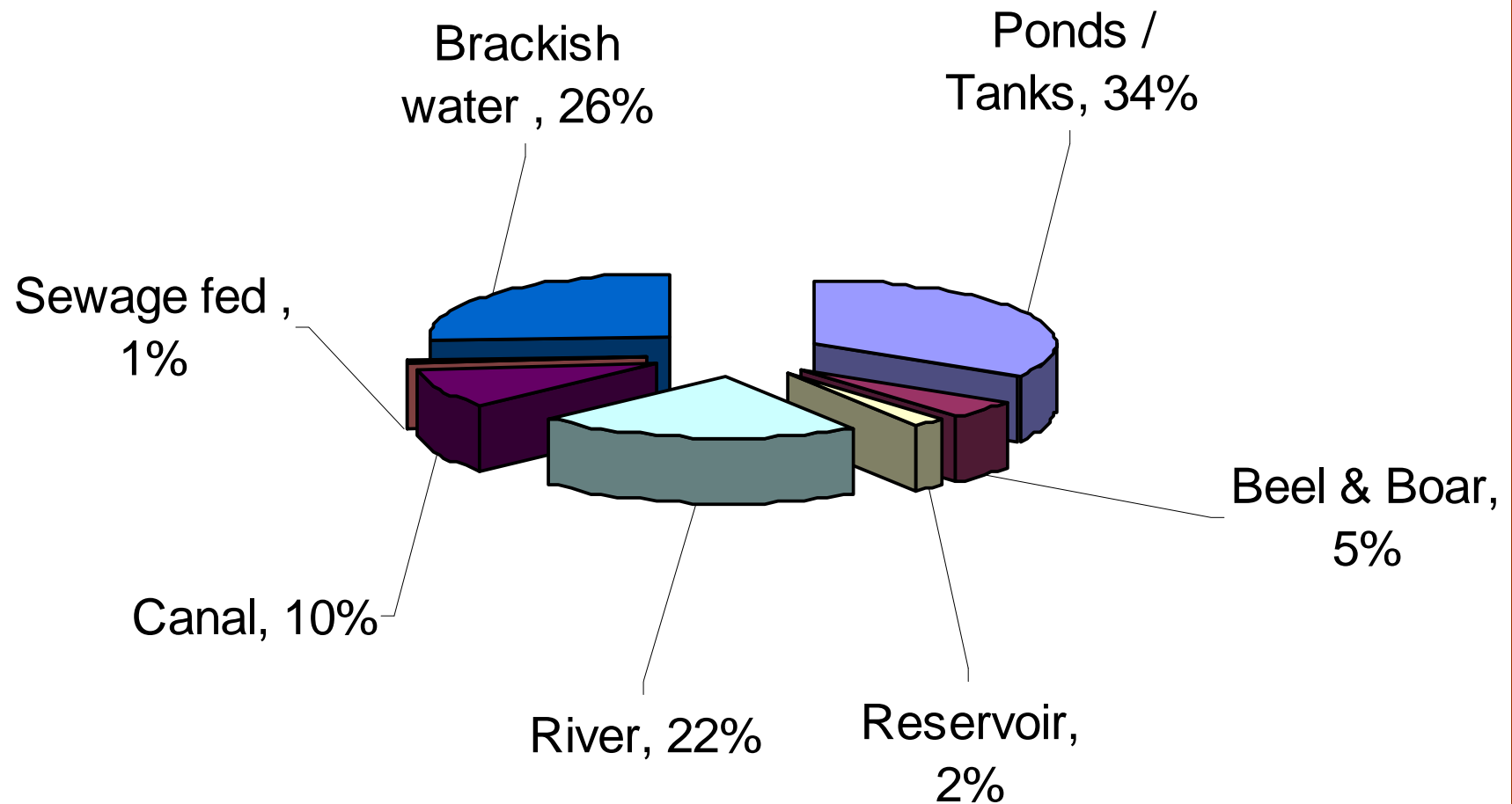
# **TOXIC EFFECTS ON FISH BY HEAVY METALS**

- **Cadmium ,Lead, Mercury, Arsenic, Chromium and Zinc accumulation in fishes/shrimps are directly from the surrounding water or by ingestion of food in environment/ factory feed considered for causing health hazards of fishes/shrimps.**
- **Damage of gills, kidney, poor reproductive capacity, hepatic dysfunction, affects on growth and lastly huge mortality observed.**

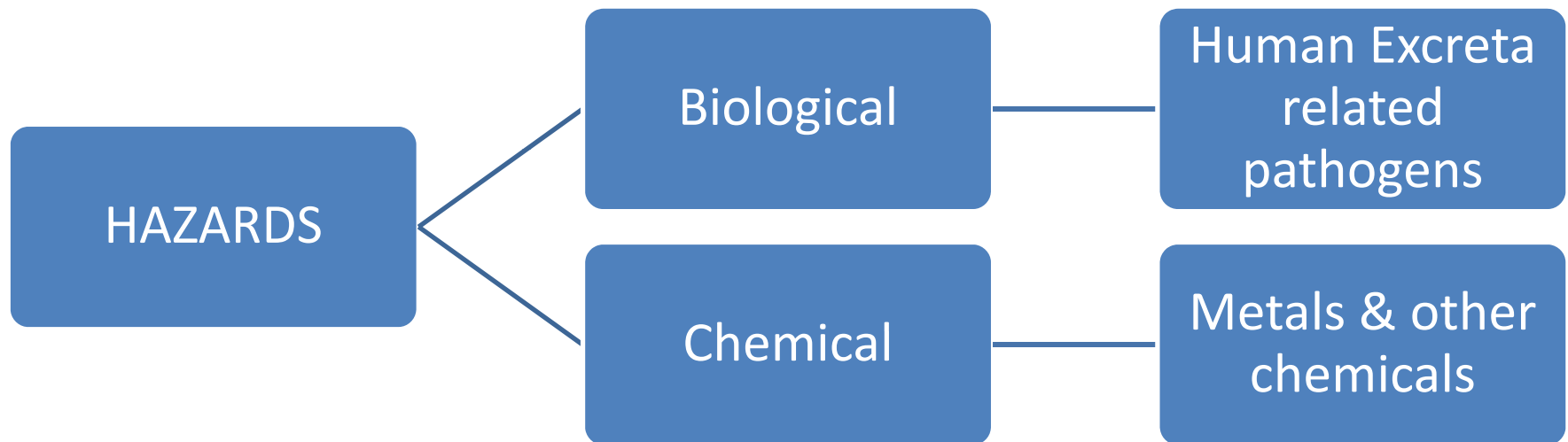
## POSSIBLE RISK ON HUMAN BY INTAKE OF CONTAMINATED FISHES/SHRIMPS

- Health problem caused by fishes/shrimps (accumulate heavy metals beyond permissible limit).
- Skin rashes, Upset stomach and cause ulcer, Respiratory problem, Damage of Kidney and Liver, Nerve problem, Alternation of genetic problem, Losses of immune system, Lungs cancer etc.

# Inland Fishery Sector In West Bengal



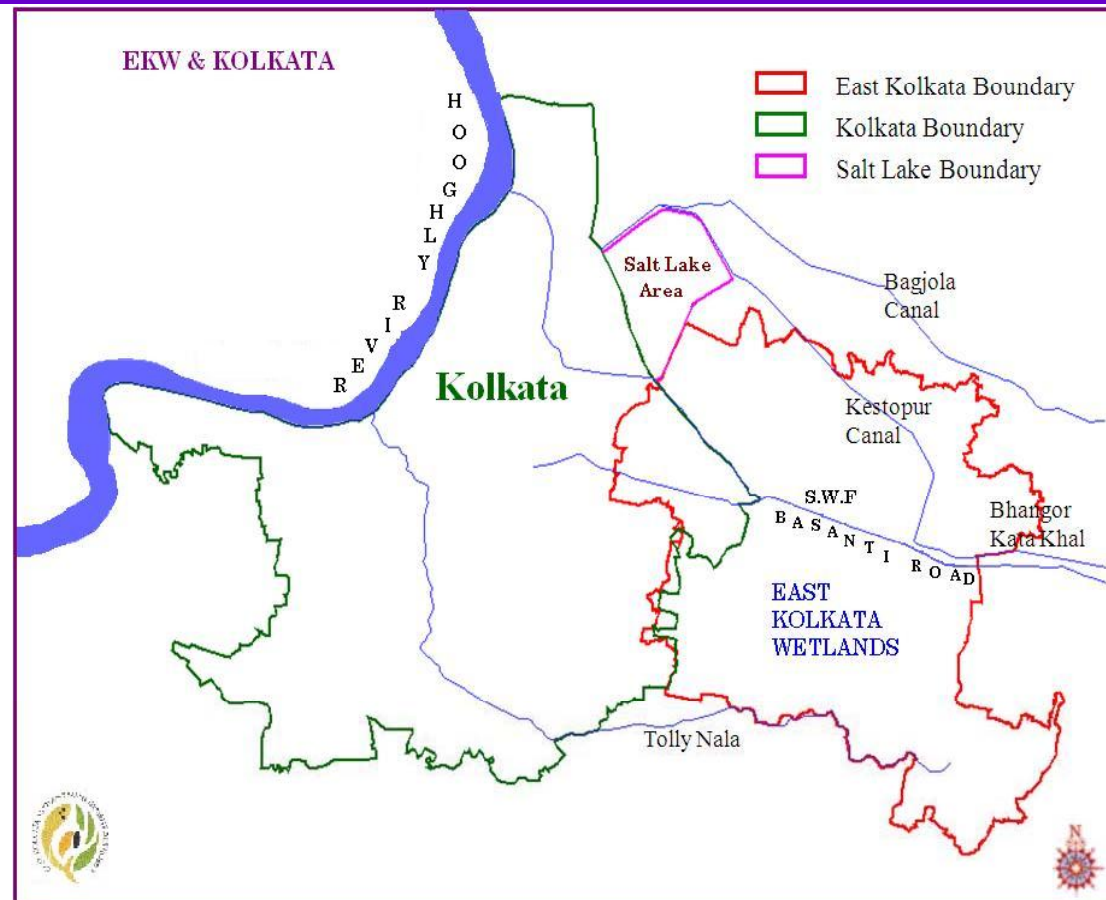
# Health Issues of waste fed fisheries in EKW

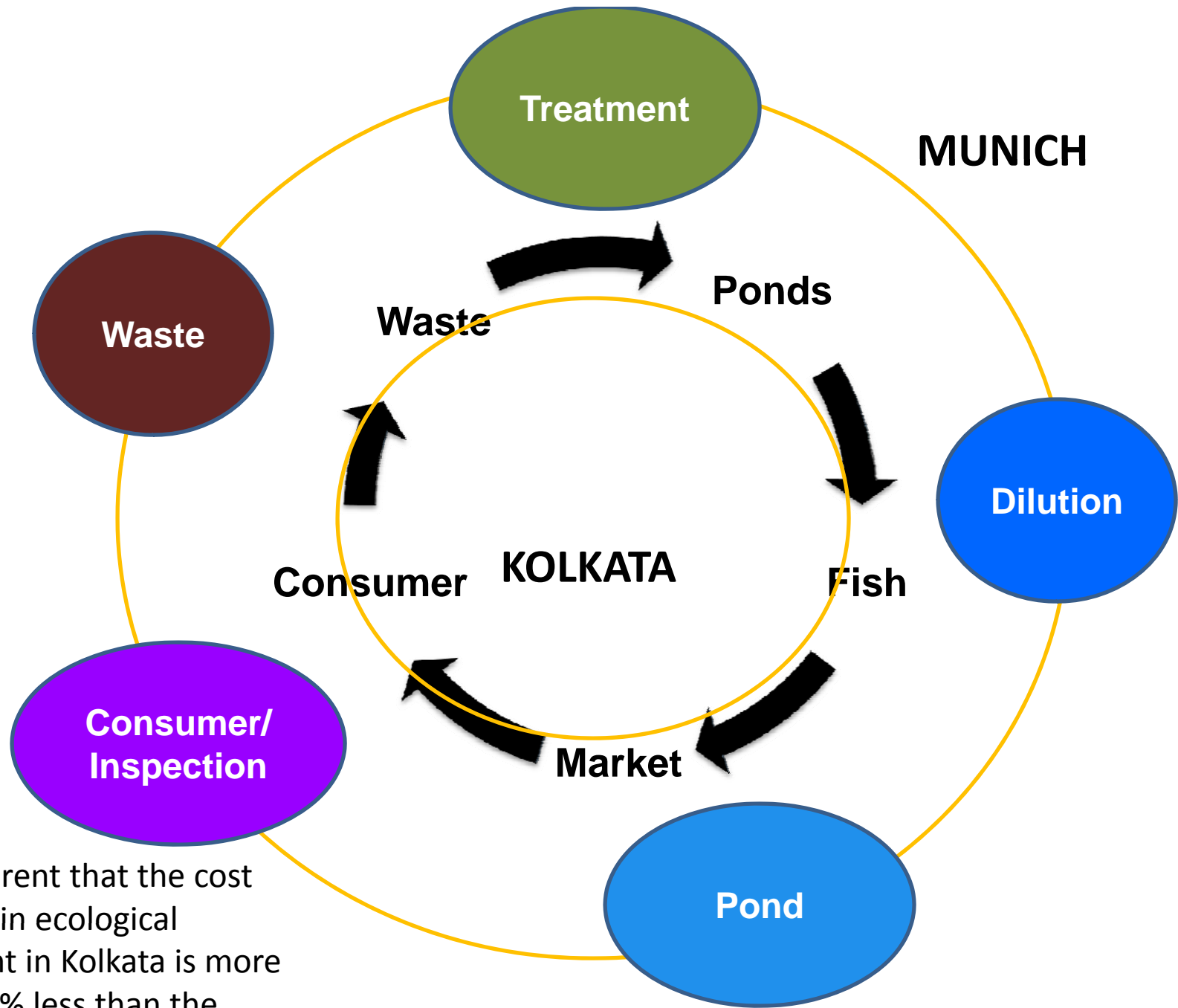




**The East Kolkata Wetlands** (22° 0' 27" N 88° 0' 27" E), are a complex of natural and human-made wetlands lying east of the city of Kolkata, West Bengal between the River Hooghly to the west and that of the River Bidyadhari, presently a derelict channel, to the east.

The wetlands cover 125 square kilometers, part of the mature delta of river Hooghly. The wetlands are 'interdistributary' marshes in the delta and include salt marshes and salt meadows, as well as sewage farms and settling ponds.





It is apparent that the cost involved in ecological treatment in Kolkata is more than 200% less than the traditional treatment.

# Human Excreta related pathogens

Micro-organism	Wastewater
Faecal coliforms (per 100ml)	$10^4$ – $10^9$
<i>Salmonella</i> spp. (per 100ml)	$10^6$ – $10^9$
Protozoan cysts (per litre) ( <i>Entamoeba histolytica</i> , <i>Giardia lamblia</i> and <i>Balantidium coli</i> )	978–1814
Helminth eggs (per litre)	70–3000



*Entamoeba histolytica*



*Giardia lamblia*



*Balantidium coli*

## Heavy metal levels in EKW

Adhikari et al. Environ Monit Assess (2009) 159:217

	Cd	Zn	Pb	Cu	Cr
Water (mg/L)	0.01-0.02 (permissible)	0.01-0.07 (permissible)	0.01-0.09 (permissible)	-	-
Fish (mg/kg)	0.04-0.30	0.50-1.20	0.09-0.85 (permissible)	0.25-0.90 (permissible)	0.04-0.70

**WHO Permissible Limit for Surface water:**

**Pb=0.10; Zn=5.0; Cd=0.02; Cr=0.05; Cu=1.0**

WHO (1996) Maximum acceptable limit of Pb - 0.002 g/kg fish  
Cu -0.03 g/kg fish

# WHO Guidelines

- Wastewater used in aquaculture should be free from flukes (trematodes) and tape worms (cestodes).
- Faecal coliform should be @  $\leq 10^3$ - $10^4$  / 100 ml to avoid penetration into edible fish tissue.
- Invasion of fish muscle by bacteria is very likely to occur when the fish are grown in ponds containing  $>10^4$ /100ml and  $>10^5$ /100ml faecal coliforms and salmonellae respectively.
- The potential for muscle invasion increases with the duration of exposure of the fish to the contaminated water.
- Even at lower contamination levels, high pathogen concentrations may be present in the digestive tract and the intraperitoneal fluid of the fish.

## Laws and Regulations

- India is a federal republic so as per the Constitution Central and State legislatures have the power to make Laws and Regulations for the interest of the Human and Country.
- Several key laws and regulations have adapted for Aquaculture and Fisheries like-
- Indian Fisheries Act (1897)
- Prevention of Cruelty to Animals Act (1960)
- Export (Quality Control and Inspection) Act(1963)
- Wild Life Protection Act (1972)
- Water (Prevention and Control of Pollution Act(1974)
- Environment (Protection) Act (1986)
- Coastal Aquaculture Authority Act (1995)

# ATTENTION

- In India numbers of Acts and Rules adapted for control the irregularities in Fisheries/Aquaculture by the Central and State Government but the implementation part is very poor.
- At present, there is no specific legislation to control the indiscriminate use of chemicals and drugs in Aquaculture/Fisheries.
- Rules are there only for exportable aquatic product for the Foreigners.
- What is the fate of Fish lovers and eaters of India ?

**Institutions responsible for sustainable  
intensification of aquaculture in India**  
**WHAT IS THE ROLE OF THESE INSTITUTES ?**

National Fisheries Development Board (NFDB)

Central Institute of Freshwater Aquaculture (CIFA)

Central Inland Fisheries Research Institute (CIFRI)

Central Institute of Brackish water Aquaculture (CIBA)

National Bureau of Fish Genetic Resources (NBFG)

Directorate of Cold Water Fisheries Research (DCFR)



