THE ROLE OF WHOLE GENOME SEQUENCE QUALITY AND SAFETY ASSURANCE OF FISHERY PRODUCTS IN INDONESIA

By
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GENOMTRAKR MEETING
College Park - Maryland USA, 24-25 October 2023
SPECIAL THANK YOU

- United States Food and Drug Administration
- University of Maryland – Joint Institute for Food Safety and Applied Nutrition
Introduction
INTRODUCTION

Total land wide: 1.9 million km\(^2\) (25%)

Total sea wide: 5.8 million km\(^2\) (75%)

Total islands: 17,504 islands

Offshore line: 99.149 Km (No. 2 of the largest offshore line in the world)

Total population: 272.68 million (Year 2021)

Fishery production (2021): 21.87 million ton
✓ Capture fishery: 7.22 million ton
✓ Aquaculture: 14.65 million ton

INDONESIA, A NATION BETWEEN TWO OCEANS
Indonesian fishery products are accepted in 171 Countries

“Indonesia feeding the world”

top export destination Economies
2022

MFQAA Bolstering the Indonesian Economic Recovery Through Export and Products Competitiveness Enhancement
## FISHERY PRODUCTS EXPORT COMMODITIES 2022

### TOP 10 EXPORT COMMODITIES

<table>
<thead>
<tr>
<th>Commodities</th>
<th>Volume (Kg)</th>
<th>Value (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seaweed</td>
<td>255.049.275</td>
<td>598.338.195</td>
</tr>
<tr>
<td>Shrimp (vannamae)</td>
<td>246.676.661</td>
<td>2.167.650.290</td>
</tr>
<tr>
<td>Tuna</td>
<td>203.177.298</td>
<td>931.594.030</td>
</tr>
<tr>
<td>Cephalopod</td>
<td>156.947.737</td>
<td>702.926.085</td>
</tr>
<tr>
<td>Snapper</td>
<td>22.325.663</td>
<td>100.906.467</td>
</tr>
<tr>
<td>Hairtail fish</td>
<td>19.924.214</td>
<td>37.936.712</td>
</tr>
<tr>
<td>Sarden</td>
<td>19.215.070</td>
<td>50.917.344</td>
</tr>
<tr>
<td>Surimi</td>
<td>17.643.327</td>
<td>49.286.247</td>
</tr>
<tr>
<td>Milkfish</td>
<td>14.111.793</td>
<td>20.698.765</td>
</tr>
<tr>
<td>Blue swimming crab</td>
<td>13.219.433</td>
<td>370.407.121</td>
</tr>
<tr>
<td>Others</td>
<td>259.129.214</td>
<td>1.046.635.864</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>1.227.419.686</strong></td>
<td><strong>6.077.297.120</strong></td>
</tr>
</tbody>
</table>

### TOP 10 EXPORT DESTINATION COUNTRIES

<table>
<thead>
<tr>
<th>Countries</th>
<th>Volume (Kg)</th>
<th>Value (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>407.887.949</td>
<td>1.127.846.602</td>
</tr>
<tr>
<td>The United States</td>
<td>241.177.925</td>
<td>2.295.261.203</td>
</tr>
<tr>
<td>ASEAN Countries</td>
<td>218.400.490</td>
<td>682.726.535</td>
</tr>
<tr>
<td>Japan</td>
<td>100.241.432</td>
<td>729.487.608</td>
</tr>
<tr>
<td>EU Countries</td>
<td>53.747.802</td>
<td>337.783.938</td>
</tr>
<tr>
<td>Chinese Taipei</td>
<td>40.918.465</td>
<td>133.360.492</td>
</tr>
<tr>
<td>Korea (South)</td>
<td>29.532.656</td>
<td>100.787.652</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>22.914.141</td>
<td>97.249.169</td>
</tr>
<tr>
<td>Australia</td>
<td>12.267.571</td>
<td>86.837.679</td>
</tr>
<tr>
<td>Hong Kong, China</td>
<td>9.349.100</td>
<td>73.072.866</td>
</tr>
<tr>
<td>Others</td>
<td>90.982.155</td>
<td>412.883.377</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>1.227.419.686</strong></td>
<td><strong>6.077.297.120</strong></td>
</tr>
</tbody>
</table>
The future looks bright

But how can we make the future brighter?
Present status of food safety capabilities (fishery)
MODERN SHRIMP FARMING IN INDONESIA
Target production 2 million ton/year in 2024

### Main Infrastructure:
- Production Ponds
- Reservoirs
- Water Intake
- Outlet Channels
- WWTP
- Laboratories
- Feed Warehouses
- Post-Harvest Buildings
- Ice Factory
- Generator Houses
- Pond Guard Houses
- Production Roads

### Supporting Infrastructure:
- Office Buildings
- Employee Mess
- Public Facilities
- Social Facilities
- Landscape
- Workshops
- Guardrails and Gates

### Financial Projection

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return of Investment Capital</td>
<td>IDR 283 Billion</td>
</tr>
<tr>
<td>IRR</td>
<td>28.1%</td>
</tr>
<tr>
<td>NPV (Rupiah/IDR)</td>
<td>IDR 679 Billion</td>
</tr>
<tr>
<td>Profit after Investment Back (20 Years)</td>
<td>IDR 929.115.475.288</td>
</tr>
<tr>
<td>PNBP (20 Years)</td>
<td>IDR 97.997.260.141</td>
</tr>
<tr>
<td>Regional Income (20 Years)</td>
<td>IDR 1,85%</td>
</tr>
</tbody>
</table>

### Multiplier Effect (2024)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Volume/YEAR</td>
<td>3.200 TON</td>
</tr>
<tr>
<td>Production Value/YEAR</td>
<td>IDR 208 BILLION</td>
</tr>
<tr>
<td>Production Cost/YEAR</td>
<td>IDR 125 BILLION</td>
</tr>
<tr>
<td>Net Profit/YEAR</td>
<td>IDR 83 BILLION</td>
</tr>
<tr>
<td>Labor</td>
<td>900 PEOPLE</td>
</tr>
<tr>
<td>Income / Month</td>
<td>IDR 4.800.000</td>
</tr>
</tbody>
</table>

### Main Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Area</td>
<td>100 HA</td>
</tr>
<tr>
<td>Production Area</td>
<td>40 HA</td>
</tr>
<tr>
<td>Productivity (HA / YEAR)</td>
<td>80 TON</td>
</tr>
<tr>
<td>Production Cost/KG</td>
<td>IDR 35.000 KG</td>
</tr>
<tr>
<td>Selling Price in 2022</td>
<td>IDR 65.000</td>
</tr>
<tr>
<td>Increasing Selling Price/YEAR</td>
<td>3 PERSEN</td>
</tr>
<tr>
<td>Increased Cost/YEAR</td>
<td>3 PERSEN</td>
</tr>
<tr>
<td>Investment Cost</td>
<td>IDR 250 BILLION</td>
</tr>
</tbody>
</table>

### Investment Back (20 Years)

- Government Perda No. 14 Tahun 2020
- Production Value- PAD IDR 929.115.475.288
- Production Value- X 1.85%
- Perda No. 14 Tahun 2020
- Production Value- PAD IDR 97.997.260.141
- Production Value- PAD IDR 929.115.475.288
- Production Value- PAD IDR 97.997.260.141
- Production Value- PAD IDR 929.115.475.288
- Production Value- PAD IDR 97.997.260.141
Total Hatchery: 748 units
- Big Scale: 155 Units
- Small Scale: 593 Units
- Production: 69 billion seeds/year
- Prod. Capacity: 138 billion seeds/year

Sumber
Data update of Domestic Marine & Fishery Office, 2021
PP 85 Tahun 2021 tentang PNBP
Aceh
FPU = 12; certificate = 40; 4

West Sumatera
FPU = 3; certificate = 4; 0

Central Kalimantan
FPU = 3; certificate = 2; 2

North Kalimantan
FPU = 1; certificate = 28; 13

Riau
FPU = 18; 17 certificate = 61; 22

Riau Archipelago
FPU = 72; 14 certificate = 181; 16

East Kalimantan
FPU = 9; 7 certificate = 22; 10

North Sulawesi
FPU = 48; 0 certificate = 118; 0

Bengkulu
FPU = 3; 0 certificate = 3; 0

West Sulawesi
FPU = 1; 0 certificate = 4; 0

Gorontalo:
FPU = 4; 0 certificate = 8; 0

South Sulawesi
FPU = 125; 23 certificate = 388; 32

Babel
FPU = 14; 5 certificate = 79; 7

Central Sulawesi
FPU = 8; 0 certificate = 16; 0

Banten
FPU = 48; 19 certificate = 222; 30

East Sulawesi
FPU = 14; 4 certificate = 47; 4

Jambi
FPU = 2; 1 certificate = 2; 1

South Sulawesi
FPU = 11; 9 certificate = 17; 10

DKI Jakarta
FPU = 108; 25 certificate = 520; 34

Central Sulawesi
FPU = 8; 0 certificate = 186; 4

North Sumatera
FPU = 73; 37 certificate = 6317; 51

West Sulawesi
FPU = 8; 5 certificate = 27; 5

Bali
FPU = 14; 5 certificate = 79; 7

Central Java
FPU = 84; 32 certificate = 312; 39

Makassar
FPU = 19; 2 certificate = 52; 2

Riau Archipelago
FPU = 3; 1 certificate = 3; 2

South Kalimantan
FPU = 11; 9 certificate = 17; 10

West Java
FPU = 62; 19 certificate = 188; 29

South Kalimantan
FPU = 11; 9 certificate = 17; 10

Yogyakarta:
FPU = 1; 0 certificate = 3; 0

East Java
FPU = 241; 70 certificate = 838; 110

Bali
FPU = 47; 3 certificate = 186; 4

East Java Tenggara
FPU = 12; 3 certificate = 62; 5

East Nusa Tenggara
FPU = 13; 1 certificate = 33; 1

East Java Tenggara
FPU = 12; 3 certificate = 62; 5

North Sulawesi
FPU = 48; 0 certificate = 118; 0

North Maluku
FPU = 9; 1 certificate = 21; 1

North Sumatera
FPU = 73; 37 certificate = 6317; 51

West智能
FPU = 1; 0 certificate = 3; 0

South Papua
FPU = 3; 0 certificate = 6; 0

Source: Pusat Pengendalian Mutu – BKIPM
Haccp.bkipm.kkp.go.id/h3

Fish Processing Unit (FPU) : 1.125
Shrimp FPU: 326
Product scope : 3.893
Shrimp product scope : 457

Updated: 19 February 2023

INDONESIA FISH PROCESSING UNIT AND SHRIMP

Mutual Recognition Arrangement
THE COMPETENCIES OF QUALITY ASSURANCE TESTING OF LAB UNDER MFQAA
[COMPLIANCE - ISO/IEC 17025:2017]

33 Testing Parameter of Quality & Safety Testing of Fishery Products

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Testing Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical</td>
<td>18</td>
</tr>
<tr>
<td>Food safety microbiology</td>
<td>10</td>
</tr>
<tr>
<td>Organoleptic</td>
<td>1</td>
</tr>
<tr>
<td>Molecular testing</td>
<td>4</td>
</tr>
</tbody>
</table>

87 Testing Parameter of Fish Disease/Quarantine Concern

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Testing Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virus</td>
<td>13</td>
</tr>
<tr>
<td>Bacteria</td>
<td>15</td>
</tr>
<tr>
<td>Parasite</td>
<td>51</td>
</tr>
<tr>
<td>Mycotic</td>
<td>8</td>
</tr>
</tbody>
</table>

Source: Center of System Standardization & Compliance, MFQAA - 2020
## ACCREDITED PARAMETERS ISO/IEC 17025:2017

### Virus
- TiLV
- Hepatitis A (HAV)
- DIV 1
- WSSV
- TSV
- IMNV
- KHV
- SVC
- CEV
- IHHNV
- CMNV
- YHV
- VHS
- VNN
- Megalocytivirus

### Fish Parasite
- EHP
- Perkinsus olseni
- Perkinsus sp.

### Food Borne Bacteria
- Escherichia coli
- Listeria monocyogenes
- Vibrio parahaemolyticus
- Escherichia coli Coliform
- Enterococci
- ALT
- Salmonella spp.
- Salmonella sp.
- Staphylococcus aureus
- Enterobacter aerogenes

### Chemical
- Ciguatoxin
- Pb
- Cd
- Hg
- ASP
- PSP
- Chloramphenicol
- Formalin
- As Total
- Fe
- Mn
- Zn

### Fish Bacteria
- NHP
- Aeromonas salmonicida
- Edwardsiella ictaluri
- Aeromonas hydrophila
- Streptococcus iniae
- AHPND
- Yersinia ruckeri
- Edwardsiella tarda

### Fungus
- Aspergillus flavus
- Aspergillus fumigatus
- Aphanomyces invadans

### Food Borne Parasites
- Anisakis sp.
- Gnathostoma sp.
SCOPE OR WORK
THE IMPLEMENTATION OF QUALITY & SAFETY OF FISH AND FISHERY PRODUCTS FROM UPSTREAM TO DOWNSTREAM

DG-AQUACULTURE
- STANDARD HATCHERY
- STANDARD FARMING
- STANDARD FEED & FISH DRUG
- NRMP, Monitoring Disease, feed, drug

DG-CAPTURE FISHERY
- VESSEL: Standard on board handling / HACCP, SKPI
- PORT/LANDING SITE: Standard GHdP, Inspection Unloading, SHTI, SSOP TPI

Supplier / Miniplant / warehouse
Cold Storage - Processing unit / Fish farm (establishment)
EXPORT AND DOMESTIC MARKET
DISTRIBUTION AND LOCAL MARKET

INSPECTION
- HACCP (Proc. unit)
- IKI/GQP (Fish farm)
- GHatchP

CERTIFICATION (HC)
- Fish health
- Quality & Safety fishery products

Quality Assurance System Verification Upstream-Downstream
Testing Lab Support / ISO IEC 17025

CERIFICATE OF FISH HEALTH, QUALITY & SAFETY OF FISHERY PRODUCTS

LEGEND:
= Process of Quality Control Certification
= Verification on System Implementation & Traceability
= Business process
= Role of PQIA in Quality Assurance Upstream-Downstream

Border Inspection
Airport / Seaport / Border
FISH DISEASE CONTROL AND SAFETY OF NATURAL RESOURCES
QUALITY & SAFETY ASSURANCE OF FISHERY PRODUCTS

Border Services
Airport / Seaport / State border

- Quality system recognition internationally (MRA/MoU /Equivalent) 39 Countries
- Products Acceptance 171 Countries
- Prevent production value loss and/or fishery natural biodiversity
- Export, Impor, Domestik Report
  - Data of operational
  - Data of Non tax revenue
  - Data of combating IUU export

39 Countries
171 Countries
OFFICIAL CONTROL
QUALITY & SAFETY OF FISH AND FISHERY PRODUCTS ASSURANCE SYSTEM
OFFICIAL CONTROL
HEALTH, QUALITY & SAFETY OF FISH AND FISHERY PRODUCTS ASSURANCE SYSTEM

Surveillance in fish processing unit and market
Aim

- Strategic intervention in the upstream level of fishery production as a prevention to minimize/reduce the impact of pathogen contamination in the supply chain (small scale fishery activities);
- Set minimum requirements for tuna handling facilities in small scale chain of production;
- Public Awareness Program: expanding easier information access for fishermen concerning food safety, sanitation and hygiene as well as good handling practices issues.
WGS knowledge strengthen food safety capabilities (fishery)
COOPERATION IS \textbf{THE KEY ROLE TO} SUPPORT ECONOMY'S FOOD SAFETY CAPABILITIES

WGS Technical Knowledge & Networking

Virtual In-Laboratory Training, Phase 3 of the Asia Pacific Economic Cooperation (APEC) Food Safety Cooperation Forum (FSCF), 2022

Easy to update knowledge and fill up the gap

international cooperation contact point

Technical harmonization

Lift up the strategic role of cooperation affairs/unit

Secretariat of global cooperation

Human resources in the cooperation affairs

Agent of Changes
COOPERATION IS THE KEY ROLE TO SUPPORT ECONOMY’S FOOD SAFETY CAPABILITIES

Virtual In-Laboratory Training, Phase 3 of the Asia Pacific Economic Cooperation (APEC) Food Safety Cooperation Forum (FSCF), 2022

WGS Technical Knowledge & Networking

DISSEMINATION OF WGS KNOWLEDGE

Strategy

“Bottom – Up” knowledge input
Mainstreaming WGS issues in an internalization program
Bilateral meeting with the international cooperation partner
Domestic expert level discussion
WGS AFFECT ECONOMY’S FOOD SAFETY CAPABILITIES

**Regular official control: Surveillance**

- Implementation of GMP/SSOP/HACCP
  - Comply
  - Non-Comply
  - Improvement
- Sampling for lab test
  - Positive
  - Negative
  - Investigation

**After gained WGS Knowledge**

- WGS
- Bioinformatics
- Report Analysis
- Health Risk Assessment
  - Map reads
  - Assembly
  - Quality metrics
  - Identification
  - Virulence profile
  - Typing/Signature sequence
- Reference Bank Data
- Multilateral Technical Cooperation

**Strengthen the**

- Traceability to support food safety surveillance and official control

**Strengthen and affect regulatory making**

**Reliability the implementation of quality & safety assurance system**

**Support system recognition internationally & expand product acceptance**

[kkp.go.id/bklpm]
After gained WGS Knowledge

Kkp.go.id/bk.ipm
IMPORTANT COMPONENT IN THE WORKSTREAM ON BUILDING WGS NETWORK

Gaining comprehensive WGS knowledge

International participation

Economic-level internalization

International support

Mentorship

WGS knowledge dissemination

Technical partnership

Training Benchmarking Simulation Partnership

Regulatory Action

INDONESIA – USA WHOLE GENOME SEQUENCE PARTNERSHIP UNDER
Shrimp – food safety Regulatory Partnership Agreement
WGS Activities With US FDA
U.S. FDA WGS lab assessment in Standard Testing Lab MFQAA, Jakarta (2022)
Testing and Diagnostic Laboratory
MFQAA Regional Office in Bali
1. Personnel
   • Officers: 49 persons
     ❖ Laboratory staff 16 persons
     ❖ Technical staff 18 persons
     ❖ Administration 15 persons
   • Laboratory supporting staff 5 persons
   • Technical supporting staff 17 persons

2. Activities and responsibilities of personnel
   • Technical implementation of MFQAA (official control)
     1. Fish diseases
     2. Food safety and quality assurance
   • Laboratory testing and diagnostic

Testing laboratory
based on ISO/IEC 17025:2017

Quality management system
based on ISO/IEC 9001:2015

Anti-bribery management systems
based on ISO/IEC 37001:2016

Inspection body
based on ISO/IEC 17020:2012
Scopes of Laboratory Testing (Food safety)

**Organoleptic test**
- Fresh fish
- Frozen fish
- Canned product
- Dried product

**Bacterial contamination in fish product**
- Total plate count
- Total coliform
- *E. coli*
- *Salmonella* spp.
- *Vibrio parahaemolyticus*
- *Vibrio cholera* (on-review)

**Bacterial contamination in water**
- Total plate count
- Total coliform
- *E. coli*
- *Salmonella* spp.
- *Enterococcus faecalis*

**Heavy metals in fish product**
- Lead (Pb)
- Cadmium (Cd)
- Mercury (Hg)

**Protein**
- Histamine in fish product
## Testing load (average in a year)

<table>
<thead>
<tr>
<th>Category</th>
<th>Items</th>
<th>Testing Load</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fish diseases</strong></td>
<td>Parasites ~200 testing</td>
<td>~200 testing</td>
</tr>
<tr>
<td></td>
<td>Total bacterial ~400 testing</td>
<td>~400 testing</td>
</tr>
<tr>
<td></td>
<td>Total viruses ~4200 testing</td>
<td>~4200 testing</td>
</tr>
<tr>
<td><strong>Food safety</strong></td>
<td><em>E. coli</em> and coliform ~750 testing</td>
<td>~750 testing</td>
</tr>
<tr>
<td></td>
<td><em>Salmonella</em> spp. ~750 testing</td>
<td>~750 testing</td>
</tr>
<tr>
<td></td>
<td><em>V. parahaemolyticus</em> ~550 testing</td>
<td>~550 testing</td>
</tr>
<tr>
<td></td>
<td><em>V. cholera</em> ~400 testing</td>
<td>~400 testing</td>
</tr>
<tr>
<td><strong>Heavy metal</strong></td>
<td>Pb ~350 testing</td>
<td>~350 testing</td>
</tr>
<tr>
<td></td>
<td>Cd ~350 testing</td>
<td>~350 testing</td>
</tr>
<tr>
<td></td>
<td>Hg ~350 testing</td>
<td>~350 testing</td>
</tr>
<tr>
<td><strong>Histamine</strong></td>
<td></td>
<td>~400 testing</td>
</tr>
<tr>
<td><strong>Organoleptic</strong></td>
<td></td>
<td>~2500 testing</td>
</tr>
<tr>
<td><strong>Water quality</strong></td>
<td></td>
<td>~200 testing</td>
</tr>
<tr>
<td><strong>Histopathology diagnostic</strong></td>
<td>100 samples</td>
<td>100 samples</td>
</tr>
</tbody>
</table>
## Facilities and Equipment

### Microbiology
- BSL-2 cabinet
- Ultrasonic water-bath
- Membrane-filter system
- Autoclave
- Incubator
- Stomacher
- Hot plate
- Micropipettes
- Freezer –20 °C
- Freezer –80 °C
- Digital microscope

### Biology molecular
- Thermal-cycler (PCR)
- real-time PCR
- RNA-workstation
- Thermo block
- Microwave
- UV-transilluminator
- Gel-electrophoresis
- Vortex
- Cold-centrifuge
- Micropipettes
- Freezer –20 °C

### Chemical
- Atomic Absorption Spectrophotometer
- UHPLC
- Depth-Microwave
- ELISA reader
- Fume hood
- Oven
- Refrigerator
- UV-spectrophotometer
- Water purifier
- Cold-centrifuge
## Facilities and Equipment

<table>
<thead>
<tr>
<th>Histopathology</th>
<th>Water quality</th>
<th>Supporting facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Tissue processor</td>
<td>• UV-vis spectrophotometer</td>
<td>• Organoleptic room</td>
</tr>
<tr>
<td>• Tissue embedding</td>
<td>• Chemical distilled</td>
<td>• Sterilizing room</td>
</tr>
<tr>
<td>• Water bath</td>
<td>• Water quality checker</td>
<td>• Acid room</td>
</tr>
<tr>
<td>• Microtome</td>
<td>• pH meter</td>
<td>• Storage room</td>
</tr>
<tr>
<td>• Digital-microscope</td>
<td>• Ozone sterilized</td>
<td>• Media preparation room</td>
</tr>
<tr>
<td>• Staining-hood</td>
<td>• Refractometer</td>
<td></td>
</tr>
<tr>
<td>• Refrigerator</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
WATER SAMPLING TRAINING FOR FOOD SAFETY CONCERN

• PREPARATION METHODS
WATER SAMPLING TRAINING FOR FOOD SAFETY CONCERN

• LABORATORY WORK FOR ISOLATION OF SALMONELLA
  Samples from the River:

1. Filter from MMS cassette submerged in BPW
2. Plated the incubated filter into enrichment TT and RV broth, incubated 42 °C
3. After 22 h, each broth streaking into XLD (Oxoid) and HE (Merck) medium, incubated 35 °C
4. After 24 h, pick up positive colony from BOTH XLD and HE medium and plated to TSA (Merck)
5. Single colony propagated into TSB (Merck) and confirmed by PCR of Salmonella spp. (Bioline)
6. Deep freezing stock of positive Salmonella spp. using BHI contain 25% of glycerol, kept -80 °C
7. Remain bacteria from TSB was using for DNA isolation using Presto™ gDNA Bacteria advanced kit (Geneaid)

    # TOTAL DNA Isolated 106 samples
WATER SAMPLING TRAINING FOR FOOD SAFETY CONCERN

• SAMPLING IN THE SHRIMP POND
WATER SAMPLING TRAINING FOR FOOD SAFETY CONCERN

• SAMPLING IN THE RIVER
WATER SAMPLING TRAINING FOR FOOD SAFETY CONCERN

• LABORATORY WORK FOR ISOLATION OF SALMONELLA AND VIBRIO
Thank You

Ministry of Marine Affairs & Fisheries

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