



# INTEGRATED MULTI-TROPHIC AQUACULTURE (IMTA) INNOVATION IN MARINE FISHERIES AND ITS POTENTIAL FOR ECONOMIC EMPOWERMENT



Dr. Linus K'osambo M.D.O. Senior Research Scientist - KIRDI

PRESENTED AT 2<sup>ND</sup> CALESTUS JUMA LEGACY SEMINAR 30<sup>TH</sup> NOVEMBER 2021

# BACKGROUND: ECONOMIC POTENTIAL AND NUTRITION

# **Introduction – Blue Economy Frontier**

- •Kenya: fish production deficit; over \$11.4 million imports from China
- •The situation will get worse:
  - ✓ rising population
  - ✓ dwindling fish in Lakes Victoria and Naivasha
- Indian Ocean Exclusive Economic Zone (EEZ) largely unexploited
- EEZ potential: 300,000 tonnes/year valued at about Sh75 billion.
- Blue Economy in EEZ = new investment and economic frontier

# **GLOBAL OMEGA-3 STATUS MAP** SHOWS LOW LEVELS FOR MOST OF THE WORLD



Kenya - Per Capita Consumption = 4.5 kg; Africa = 10 kg, Global = 20 kg.

Production deficit of 225,500 MT to reach African average

### WHAT IS IMTA CONCEPT?

### HOW CAN IT TAP THE POTENTIAL OF EEZ AND THE BLUE ECONOMY FOR ECONOMIC EMPOWERMENT?

# IMTA IN THE BLUE ECONOMY

- Waters rivers, lakes, dams, swamps, ocean (Marine Waters),
- Blue Economy Non-Traditional Marines Foods and Products



IMTA = Harmony & Natural Beauty

- Integrated Multi-Trophic Aquaculture (IMTA) innovation.
- IMTA = economic and environmental sustainability

# **IMTA Design 1: Seaweed and Fish Farming**

Two main species: Kappaphycus alvarezii (cottonii) and Eucheuma denticulatum (spinosum)







Seaweeds can be farmed around or in cages



# IMTA Design 2: Seaweeds, Lobsters and Fish



Higher productivity of seaweeds in IMTA system



High value lobsters can

fetch - KES 3,500 @

Seaweeds used to feed fish



### IMTA Design 3 – Sea Cucumber, Milkfish, Crabs, and Mangroves



Sea cucumber (*Holothuria scabra*) in ponds with fish – can also be farmed with seaweeds





Mangroves conserved and planted around the ponds (Silvo-aquaculture)

# **TECHNOLOGY TRANSFER INITIATIVES**

### Locally constructed cages at Kibokoni, Kilifi and Kijiweni, Kwale)



Development and utilization of local resources and capacities important for sustainability

# Economic Development Opportunities: Communities Initiatives

 Mariculture of acclamatized Tilapia (Oreochromis niloticus) and rabbit fish (Siganus argenteus).



Tsunza Community Cage – Mombasa County

Kibokoni Cage – Kilifi County

### **Business Plan and Economic Benefits**

Cash Flow Forecast	Year 1	Year 2	Year 3	Year 4	Year 5
<u>Inflows</u>					
Collection from cash sales	8,820,000	17,640,000	35,280,000	70,560,000	141,120,000
Grants					
Share Capital	500,000	-	-	-	-
Service provision fee	-	-	-	-	-
	9,320,000	17,640,000	35,280,000	70,560,000	141,120,000
Outflows					
Cost of Production	2,148,000	4,296,000	8,592,000	17,184,000	34,368,000
Overheads	39,000	78,000	156,000	312,000	624,000
Human Resources	2,004,000	3,000,000	6,000,000	12,000,000	24,000,000
Increase in Non-Cash Assets	2,325,601	2,186,935	6,696,567	10,927,451	24,176,170
Total Outflows	6,516,601	9,560,935	21,444,567	40,423,451	83,168,170
Net Cash Flow	2,803,399	8,079,065	13,835,433	30,136,549	57,951,830
Cash Balance	2,803,399	10,882,464	24,717,897	54,854,446	112,806,276
Cash Balance after Tax	441,000	10,000,464	22,953,897	51,326,446	105,750,276

### **OPPORTUNITIES AND FUTURE PROSPECTS**

#### **R&D Opportunities**

- Site selection Suitability mapping
- Infrastructure development
- Diversification and domestication of farmed species
- Affordable, sustainable feeds
- Availability of good quality seed Network of hatcheries
- Environmental Management



#### **Investment Opportunities**

- Cage farming of fin fish in deep sea
- Hatcheries, feed production, value addition and other value chain needs

# **Post Harvest Processing through Solar Power**

### Solar Cooling and Drying System – SolCoolDry System



IMTA supportted by technology ecosystem

## **DIVERSITY AND USES OF IMTA PRODUCTS**

### **Uses of Seaweed**



#### Research and Development Nexus for Economic Development



- 1. Chemical Engineering
- 2. Natural Products
- 3. Food Science
- 4. Mechanical, Material, Electrical, Civil

Engineering

- 5. Energy wave, wind, bio-ethanol, etc.
- 6. Paper industry
- 7. Biotechnology and Microbiology
- 8. Environment Research

# Seaweed Soap: Kibuyuni Kenya



 Seaweed Soap production and training of Kibuyuni Seaweed Farmers Group by KIRDI technical staff

# **Economic Importance of seaweeds**

### Cosmetics - other valued added products



### **IMTA AND ENERGY**

# Algae can power and fertilize



## **IMTA AND ENGINEERING OPPORTUNITIES**



#### **Marine Cages Design**







Marine Cages Commercialization, Maintenance and improvement

### **IMTA PRODUCTS - LEATHER**

### Fish Leather - expanded fishing industry



### **Marine Aqua-Lab – Seeking Partners**



#### A platform for:

- Research on marine technologies
- Commercialization and business incubation of Blue Technology Start-ups
- Ecotourism and environment protection awareness and initiatives

### CURRENT RESEARCH PROJECTS AND DEVELOPMENT INITIATIVES

• Commercialize mariculture of tilapia (*Oreochromis niloticus*) and rabbitfish (*Siganus argenteus*) in Kibokoni, Mwazaro and Kijiweni for better livelihoods of fisher communities in Kilifi and Kwale Counties

### (CO-MARIFISH PROJECT)

Development of Milkfish (*Chanos chanos*) and Kimarawali (*Stolephorus delecatulus*)
Solar Drying-Cooling Technology, Value Addition and Quality Assurance

### (SOLCOOLDRY PROJECT)

• Seaweeds, Amaranth and Finger Millet-Nutrients Fortified Bakery Products for Improved Health and Livelihoods in Kenya

### (SEA-FORT PROJECT)

• Aquaculture of Seaweeds and Fish: Opportunities for Blue Economic Empowerment and COVID-19 Resilience for Fisher Women in Kenya

### (BLUE-EMPOWERMENT PROJECT)

# **PARTNERS AND COLLABORATORS**













With support from



Federal Ministry of Food and Agriculture



1417

**Massachusetts Institute of Technology** 



by decision of the German Bundestag



ISE

Thank you!