Food and Agriculture Organization of the United Nations

**GUIDELINES** for
SUSTAINABLE
AQUACULTURE

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# Restocking as a pathway for sustainable aquaculture

Ofer Berzak, Galidi Fish Farming Consultants

#FAO_GSA

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- Over 70% of the planet is water – with vast potential for food, livelihoods, and biodiversity.
- Capture fisheries have plateaued; aquaculture is central to future fish supply.
- Prevailing view: intensification and feeds = the main way forward.
- But under the right conditions, restocking (stock enhancement) can also be sustainable, viable, and beneficial.

**Restocking** - the release of hatchery-produced juveniles into natural or managed water bodies

# Examples of restocking programmes

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## Restoking – enhancement

**China:** Xiashan lake near Weifang.

- Lake size: 15,000 Hectares.
- Center of Reproduction and Nursery near the lake.
- Reproduce: Carp, Silver carp, Grass carp, Bighead carp.
- Grow the fingerlings until 15 - 25 gr in earth Pond.
- Restock / year 3 - 4 million fingerlings - 200 - 260 fish/ha.
- Production / year: 1500-2000 ton. (100 - 150 Kg/Ha).

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## **Uzbekistan:** Tudakul lake

- Lake size:  22,000 Hectares.
- Center of Reproduction and Nursery near the lake.
    - Reproduce: Carp, silver carp, Grass carp, Bighead carp.
    - Grow the fingerlings until 15 – 25 gr in the earth Pond.
- Restock / year 5 – 6 million fingerlings – 180 – 220 fish / Ha.
- Production / year: 1500 – 1800 ton. (70 – 80 Kg / Ha).

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**Israel:** Kineret lake.

- Lake size: 18,000 Hectares.
- Center of Reproduction and Nursery near the lake - Tilapia.
  - Grow the fingerlings until 15 gr in earth Pond.
- Restock / year: 5.5 million fingerlings
  - Tilapia: 5 million
  - Silver carp: 0.3 million (purchased)
  - *Mugil cephalus:* 0.2 million
- Production / year: 1700 – 2000 tonnes (100 – 120 kg / Ha).

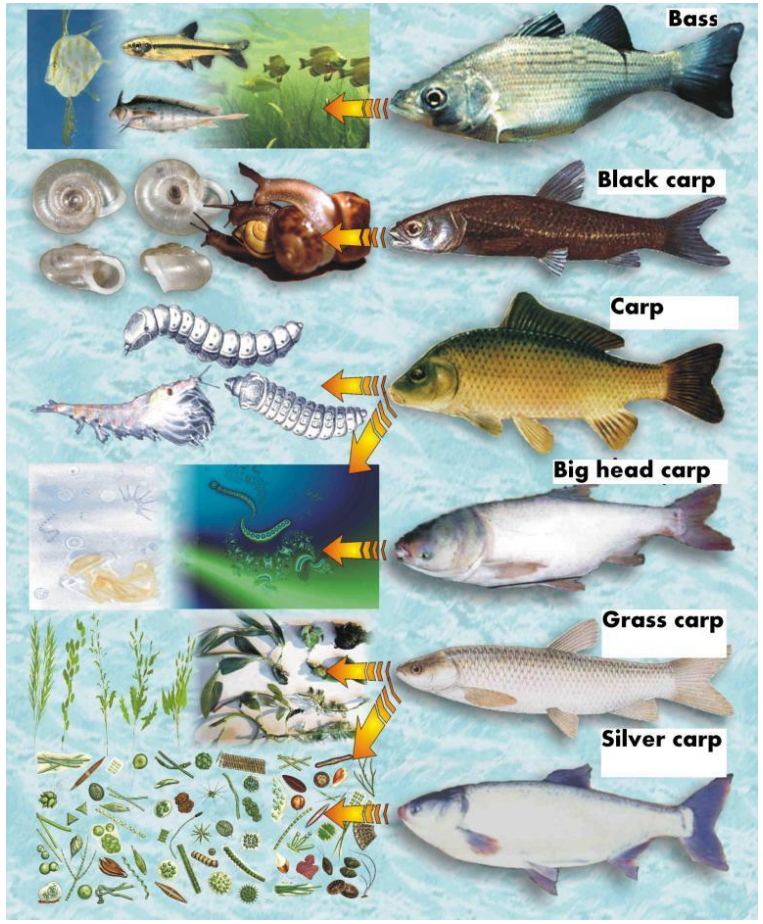
**Panama:** Lake Bayano

- Size: 35,500 Hectares.
- Restock: Brood Stock - Tilapia, carp - 25 years ago.
- Production: Fishing according to daily quotas of fish 400 gr
  - Tilapia 15 ton/day
  - Carp: 5 ton / day
  - Total: 7300 ton / year (200 kg/ha/year)

## Green solution – fish instead of chemicals:

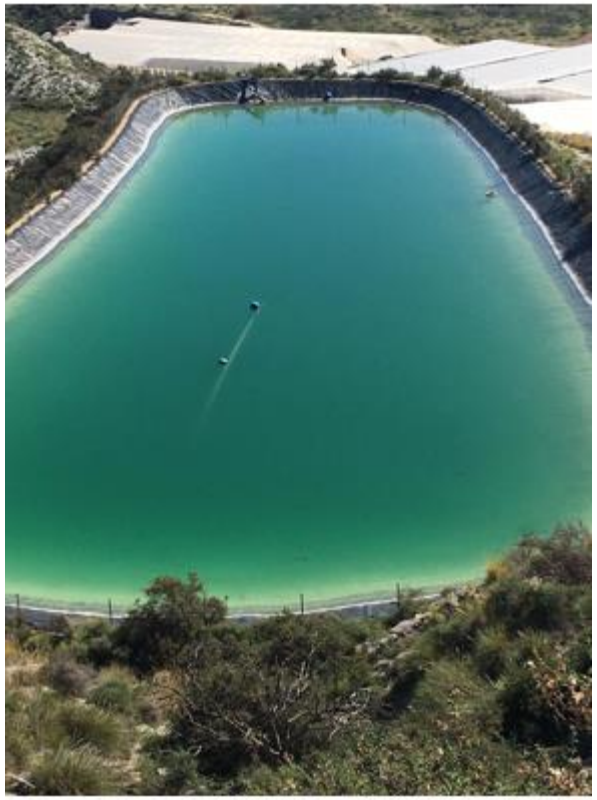
**Israel:** Harod Reservoir of irrigation:

- Size: 28 ha
- Restock: 1000 fish/ha
  - Hybrid (silver carp and bighead carp)
  - Mullet
  - Carp
- Growing time: 8 months (March to October)
- Production: 1063 kg/ha/year



**Spain** (different locations)

- Reservoir size: 28 Ha.
- Restock: Hybrid: 1000 fish/ha
    - Silver carp / Bighead carp: 500 fish/ha
    - Grass carp: 500 fish/ha
- Growing time: 8 months (March to October).
- Production: 600 kg/ha/year



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## **Texas (USA) –** Gulf of Mexico

- **Launch (1986):** Initiated after major declines in recreational fish harvests.
- **Approach:** Three species released annually; recovery observed within 2 years.
- **Scale:** 3 hatcheries producing ~25 million fry per year; daily monitoring ensures strong results.
- **Genetic management:** 25% of broodstock renewed each year to maintain healthy populations.
- **Education:** Children and youth engaged in learning about biodiversity and conservation.
- **Beyond the coast:** ~1 million fish released annually into inland lakes.



## Production and cost – Restocking

| Subject | Regular pond | Restocking |
|---|---|---|
| Investment / Kg | 1.5 $ | 0.35 $ |
| Cost production / Kg | 2.5 - 3 $ | 0.4 - 0.5 $ |
| Feed consumption / Kg | 2 $ | 0.2 $ |

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# Production - climatic zone

| Water temperature | Fish /Hectare/year | Kg /hectare/year |
|---|---|---|
| 5 - 15 degrees Celsius | 100 - 120 | 30 -40 Kg |
| 8 - 24 degrees Celsius | 180 - 220 | 70- 100 Kg |
| 15 - 30 degrees Celsius | 220 - 300 | 100 -150 Kg |
| 24 - 30 degrees Celsius | 300 - 400 | 150 – 250 Kg |

# Why restocking deserves more attention

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# Two fish with one hook

**Green solution**

- **Low nutrient footprint**
  - No reliance on excess feed
  - Reduced nutrient loading in waterbodies
- **Ecosystem health**
  - Supports natural food webs
  - Improves ecosystem balance
- **Biodiversity support**
  - Restores native species populations
  - Enhance aquatic biodiversity

**Economic viability:** When market prices are low due to competition or consumer preference, restocking may be more cost-effective than full feeding in captivity.

- **Uzbekistan's reservoir restocking programs:** more resilient and competitive than feed-based aquaculture.
- **Indonesia's Lake Toba:** restocking increased production from 28 kg/ha/year to 340 kg/ha/year.

Direct and indirect contributions to the economy

- **High-quality natural-grown fish**
  - Fish raised in clean, natural waters often command premium prices in local and niche markets.
  - Fish produced through restocking are considered wild fish. Many consumers prefer wild over farmed fish.

- **Recreational fisheries**
  - Restocking sustains sport and recreational fishing, which creates major economic spillovers through tourism, hospitality, gear sales, and services.
    - Example: In Texas (USA), 25 million fish of three species are released in the Gulf of Mexico annually, with year-round monitoring funded largely by sport fishing licenses. At $35 per year, licenses purchased by 1.2 million anglers generate about $40 million annually for the project – see more details in slide 10.


**July 2024: Celebration of the release of the 1 billionth fish**

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**Restocking facilitating aquatic genetic resource management**

- Conserving genetic diversity.
- Avoiding inbreeding or maladaptation.
- Supporting the long-term sustainability of fish populations.
- Driving breeding programs for underutilized or locally important species.

# Restocking ≠ “Release and Forget”

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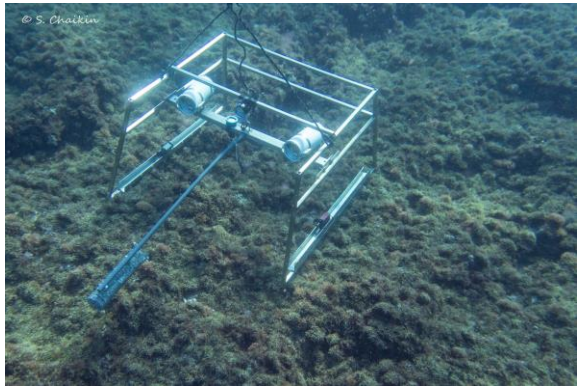
**Technical considerations**:

- Appropriate species and strains.
- Juveniles size at release.
- Timing, water quality, and location.
- Species mix and ecological balance.
- Healthy, disease-free stock.
- **Monitoring for continuous follow-up on results.**

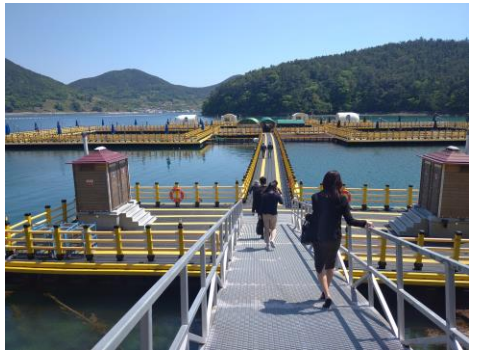


**Institutional requirements**:

- Hatcheries and laboratories for reliable seed production and disease testing.
- Quality assurance and liability systems
- Reliable delivery systems and logistics

## Governance models


- **Public hatcheries: traditional model**
  - Lithuania's five hatcheries manage 18 species, releasing 12 million fry annually into lakes and rivers and Sea.
  - South Korea's "FIRA" releases over 740 million marine juveniles and 50 million freshwater juveniles annually, integrating state and private hatcheries.
- **Private initiative**
  - Companies in Lithuania release fish into leased lakes and reservoirs under government guidelines.
- **Public-private partnership**
  - In Israel, the government purchases high-quality fingerlings from hatcheries for release, combining market discipline with public oversight.



# Way forward

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## Why restocking holds promise for Europe

- **Space & regulatory limits**
  Intensive aquaculture growth is constrained by licensing complexity, space competition, and strict environmental rules. Restocking provides a lower-footprint alternative.
- **Environmental & social benefits**
  Supports biodiversity conservation, ecosystem restoration, and recreational fisheries—priorities under the EU Green Deal and Biodiversity Strategy.
- **Economic development**
  Europe's food security does not depend on high-volume aquaculture. Low-volume, high-value restocking systems can deliver strong economic multipliers in the short term.
- **Consumer preferences**
  High-quality, naturally grown fish can help improve perceptions of aquaculture products.
- **Public funding & tradition**
  Many European governments already fund restocking for biodiversity and recreation, providing a strong base to build upon.

## Why international cooperation matters for restocking

- **Shared waters**
  Many rivers, lakes, and seas (e.g., Baltic, Mediterranean, Black Sea, Caspian sea) cross national borders. Restocking without coordination risks ecological imbalance.
- **Aligned policies**
  Countries need harmonized rules on species and strains to avoid conflicts, invasive species, or genetic risks.
- **Coordinated releases**
  Timing, location, and scale of fingerling release should be jointly planned for maximum effectiveness.
- **Shared data & monitoring**
  Exchange of information on stock survival, growth, and ecosystem impacts improves management and accountability.
- **Pooling resources**
  Regional collaboration can reduce costs, strengthen hatchery quality standards, and improve disease prevention.
- **Collective benefits**
  Joint efforts enhance biodiversity conservation, sustainable fisheries, and recreational opportunities across borders.

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## How the GSA Can Help Promote Restocking

- **Integrating restocking into strategies**
  Position restocking within national and regional aquaculture frameworks as a complementary approach to sustainable production.
- **Strengthening governance**
  Provide guidance on licensing, monitoring, and evaluation systems that ensure accountability and quality in restocking programmes.
- **Building technical capacity**
  Support hatchery management, genetic quality control, and disease-free seed production to underpin effective stock enhancement.
- **Sharing global practices**
  Document and disseminate successful case studies from Europe and beyond (e.g., Uzbekistan, Israel, South Korea) to guide adaptation.
- **Facilitating cooperation**
  Encourage cross-border coordination in shared waters, aligning species, release protocols, and monitoring efforts.
- **Enhancing visibility and support**
  Use GSA communication strategies to raise awareness of restocking's multiple benefits — environmental, economic, and social.

### FAO Guidelines for Sustainable Aquaculture (GSA)

**5.2 Integration of aquaculture with agriculture and other sectors**

5.2.4 Promote the integration of aquaculture with fisheries through culture-based fisheries and stock enhancement, especially in seasonal water bodies, while preserving ecosystems and biodiversity.

Food and Agriculture Organization of the United Nations | General Fisheries Commission for the Mediterranean

GUIDELINES ON
aquaculture restocking and stock enhancement

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## Closing remarks

- Restocking can deliver environmental, economic, and social benefits — but only if supported by robust technical, governance, and monitoring systems.
- Restocking deserves more attention, even thought it may not be the main driver of fish supply in the near future, but rather as a complementary and underappreciated pathway within sustainable aquaculture.
- Through the GSA process, we now have an opportunity to:
  - Learn from successful cases worldwide
  - Adapt practices to European realities
  - Make restocking a well-considered tool in the aquaculture toolbox
- **Thank you – I look forward to the discussion.**

# Galidi - Company Profile

"Galidi" is a company dealing with consultancy and management of fish farming projects in Israel and around the world (among other places in Venezuela, Ecuador, Colombia and Uzbekistan).

The company has 48 years of experience!

**The persons behind the name:**

**Berzak Ofer** - General Manager.

**Bejarano Isaac** - Ph.D Microbiologist.

**Gissis Ahikam** - Ms.C Fish Breeding.

**Feldlite Moti** - Ms.C Water Quality.

**Shapira Yechiam** - Ms.C Patolog.

**Omri Bar Sade** - Economist.