Global Analysis of Riverine Fisheries and Ecosystems: Challenges and Policy Recommendations



SDG 14 is missing freshwater



Department of Economic and Social Affairs Sustainable Development

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Goals								
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Conserve and sustainably use the oceans, seas and marine resources for sustainable development



Freshwater ecosystems are highly threatened



Index merges: Local habitat disruption, Hydrological alteration, Chemical pollution, Invasions, & Fishing

Vorosmarty et al. 2010

Challenges:

1) Biodiversity

2) Food security



Lynch et al. 2016



Global Freshwater Biodiversity

Species diversity:

- amphibians
- crabs
- fish
- crayfish
- mammals
- reptiles



Collen et al. 2014

Climate Change Will Cause Extinctions

No dispersal



Maximal dispersal



Analysis of 11,500 fish species

Barbarossa et al. 2021

Climate Change Will Cause Extinctions

No dispersal





Barbarossa et al. 2021

Diversity of inland fisheries

Subsistence

Inle Lake Myanmar

Market



Aquarium



Recreation

Importance of fish: nutrition



1.39B people at risk of deficiency: Zn, Fe, vit. A, vit. B12, fatty acids (EPA & DHA)

Golden et al. 2016 Nature

Importance of fish: livelihoods

Workers Directly Employed in Capture Fisheries & Aquaculture in 2012

233_{Million}

For Every 1 Person Directly Employed At Least 3 Additional Jobs are Created in Activities that Support Fishing & Aquaculture

923_{Million}

Each Job Holder Provides for Three Dependents or Family Members, on Average. Fisheries & Aquaculture Support the Livelihoods of 13% of the World's Population

OURCE:

AO, 2012. The State of the World's Fisheries and Aquaculture 2012 AO, 2014. The State of World Fisheries and Aquaculture 2014.

4 x <u>4 x</u>

Statistics focus on marine fisheries

OceanHealthIndex.org

Freshwater fish = food security



regional peaks in SE Asia, India, China, W. Africa, Mexico
low catches at high latitudes

McIntyre et al. 2016 PNAS

Freshwater fish = food security



McIntyre et al. 2016 PNAS

Hidden harvests from rivers & lakes



Castnetting in the Ayerwaddy delta, Myanmar

Fluet-Chouinard et al. 2018 PNAS

Inland fisheries are threatened

River catches River threats (Vorosmarty et al. 2010)



McIntyre et al. 2016 PNAS

Mercury contamination is widespread



Aquaculture is primarily in freshwater



https://ourworldindata.org/rise-of-aquaculture

Aquaculture feeds use 2/3 of marine forage fish catch



Depletion of forage fish could undercut high-value marine fisheries

Cottrell et al. 2020 Nature Food

Aquaculture feeds use 2/3 of marine forage fish catch



Baetscher, McIntyre, Therkildsen et al. unpublished

Greenhouse gases from aquaculture are unknown



Problem: GHG emissions from aquaculture have been largely ignored, yet are likely due to high feed inputs

<u>Solution</u>: Experimentation to identify practices and inputs that lead to GHGs

Ma et al. 2018 Science of the Total Environment

Recommendations

1) Rivers, lakes, & wetlands need protection

2) Inland fisheries must be valued appropriately

3) Aquaculture development should be cautious

Climate change perspective



Both wild and farmed fish are GHG-efficient foods

MacLeod et al 2020

Hilborn et al. 2018

Efficiency requires internalizing waste streams



Problem: wastes from fish farming creates problems in natural ecosystems.

Solution: Poly-culture to grow low trophic-level species together with high trophic-level species

petraboeckmann.de

Challenge #2: Replacing wild fish



Environmental replacement cost?

Economic replacement costs



Face value of inland catch: \$35B Total replacement cost: \$200B Geography: consumers ≠ replacers

Cazcarro et al. in prep.

Balancing risks & benefits



Toxic mercury

Beneficial fatty acids

