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Inland capture fishery contributions to global food security and threats to their future

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ABSTRACT

Inland fish and fisheries play important roles in ensuring global food security. They provide a crucial source of animal protein and essential micronutrients for local communities, especially in the developing world. Data concerning fisheries production and consumption of freshwater fish are generally inadequately assessed, often leading decision makers to undervalue their importance. Modification of inland waterways for alternative uses of freshwater (particularly dams for hydropower and water diversions for human use) negatively impacts the productivity of inland fisheries for food security at local and regional levels. This paper highlights the importance of inland fisheries to global food security, the challenges they face due to competing demands for freshwater, and possible solutions.

1. Introduction

Food security occurs "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life" (World Health Organization, 2014). Thus, in order for a community to be food secure, people must have access both to an adequate supply (amount) of food as well as receive adequate nutrients from their food. The contribution of different food products to global food security primarily focuses on agriculture and aquaculture (Rosegrant and Cline, 2003). Unfortunately, these assessments often fail to account for the contribution of fisheries, particularly wild inland (freshwater) fisheries, to food security. Inland fisheries (fish harvested from freshwater) are globally distributed and have been reported to be a rich source of nutrients, such as protein and calcium, that are crucial to human health (Belton and Thilsted, 2014). In many communities inland fish are the primary animal protein source and a vital component in ensuring food and nutritional security at the local and regional levels, especially in developing countries.

This paper addresses wild capture fisheries in inland waters and does not specifically consider aquaculture. The Food and Agriculture Organization of the United Nations (FAO) defines aquaculture to be "the farming of aquatic organisms in inland and coastal areas, involving intervention in the rearing process to enhance production and the individual or corporate ownership of the stock being cultivated" (Crespi and Coche, 2008). Although aquaculture is a growing segment of fisheries, we view it as a competing sector that impacts wild inland fish production in terms of freshwater use and fish habitat. We acknowledge that often the distinction between culture and capture is not absolute. For instance, there are capture fisheries for early life-history stages in open access fisheries that are then grown out by the 'owners' of the fish and sold (Lovatelli and Holthus, 2008). Similarly, many open-access water-bodies are stocked with larvae or juveniles raised in hatcheries (Welcomme and Bartley, 1998), thus creating culture-based "wild" fisheries. The focus of this review is on wild fish production in non-confined aquatic ecosystems whose production is determined solely by the ecological processes of the aquatic environment (e.g. lakes and rivers).

Currently, due to inadequate assessment and, as a result, poor data availability, the importance of inland fisheries to global food security is likely portrayed as being much less than what it truly is (Miao et al., 2010), often leading decision makers to undervalue

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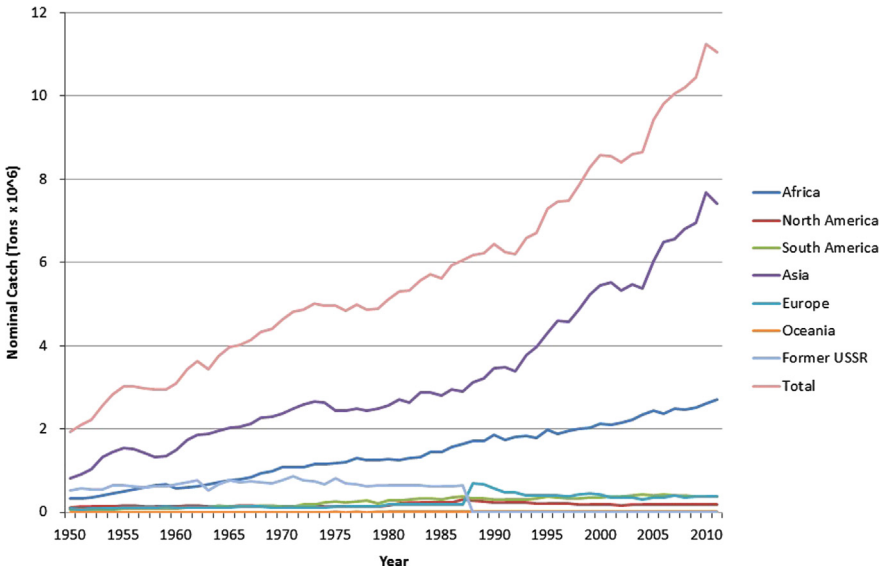

Fig. 1. Global and regional production of inland fisheries (FAO, 2014).

the importance of inland fisheries, particularly as a source of food security (Béné and Neiland, 2003). The goal of this paper is to highlight the importance of inland fisheries to global food security, outline the threats they face, and raise awareness of the benefits provided by wild capture inland fisheries.

2. Use and production of inland fisheries

2.1. Production of inland fisheries

Globally, only 156 of over 230 countries and territories reported inland capture fisheries production to FAO in 2010 (FAO, 2014). These data indicate that there has been an increase (about 6 fold since 1950) in the reported contribution of wild-capture inland fisheries to global food supply (Fig. 1).

Based on harvest numbers reported to FAO, inland fisheries production comes predominately from Africa and Asia (Fig. 1). Seventy-one Low-Income Food-Deficit Countries produce 80% – nearly 7 million tons – of the reported global inland capture fisheries output (FAO, 2012). Of the recorded harvested species, the most frequently harvested taxa in capture fisheries are cyprinids (family *Cyprinidae*) and tilapias (*Sarotherodon*, *Oreochromis*, and *Tilapia* spp.) (FAO, 2014).

The reported general expansion of inland capture fisheries could be, in part, a reflection of improved reporting in the major production areas of Asia and Africa rather than an actual increase in harvest (FAO, 2012). The high levels of inland fisheries production now recorded, and their contribution to local food security, have probably existed for some time (Welcomme et al., 2010), however, the lack of reliable data over time makes it difficult to discern trends in inland fisheries production. Although reported statistics seem to indicate production is increasing, actual production may be decreasing as inland fish populations are affected by overexploitation and habitat loss (Raby et al., 2011).

2.2. Problems with data concerning inland fisheries production

Inland fisheries production data is generally inaccurate and under-reported (Béné and Neiland, 2003; Jesús and Kohler, 2004; Welcomme, 2011). In the Ayeyarwaddy Division of Burma (Myanmar) for example, official statistics report inland production for 1999–2000 as 90,813 MT while household consumption studies suggest production is closer to 235,760 MT (Coates, 2002). Likewise, Hortle et al. (2008) found that in Cambodian rice paddies, direct monitoring of fish yield for one season (119 kg/ha/year) resulted in estimates that greatly exceeded previously reported yield estimates (25–62 kg/ha/year).

Obtaining more accurate information about inland fisheries production is inherently a difficult process because most inland fisheries activity is small-scale in nature, highly dispersed, and generally unreported to governmental agencies (Allan et al., 2005). In many artisanal and recreational fisheries throughout the world, there are no direct estimates of fish harvest as many of the fish captured in these areas are consumed directly or sold/bartered through local, informal markets (Bennett and Thorpe, 2006; Ronnback, 1999). As a result, even though these fishes are playing an important role in enhancing local food security, their importance is not being accurately reflected in the production values that are reported and thus are often invisible in policies and decisions regarding food security and water use.

Procedures that account for the unreported and unrecorded fish, in addition to traditional catch assessment methods (recording of catches at landing sites), are needed in order to provide a more complete representation of the benefits of inland fisheries. Doing so requires routine targeted surveys of household dynamics and food consumption studies, biological assessment related to environmental characteristics that effect fish production using both direct census methods and remote tools, intensification of catch assessment methodologies, and using local communities to support data collection and reporting (Beard et al., 2011; Bonar and Hubert, 2002). Large scale monitoring of inland fish harvest/yield data in most of the world is unrealistic given the cost associated with implementation given its highly dispersed nature among the world's many water bodies. However, other approaches to estimating fish yield may have the potential to produce better estimates than are currently generated officially by governments. For instance, numerous studies have shown a relationship between fisheries productivity and measures of primary production (Janjua et al., 2008; Ssanyu and Schagerl, 2010). Given the relationship between measures of primary production and fish productivity, at least for larger bodies of water, remote sensing based approaches to estimating measures of primary production (Brezonik et al., 2005) may offer a low-cost alternative to collecting data on potential fish yields. Although remote based approaches only allow an estimation of potential fish harvest, proper coupling with periodic on the ground