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Are provisioning ecosystem services from rural aquaculture contributing to reduce hunger in Africa?

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ABSTRACT

Despite the recognised advantages of rural aquaculture, little research has been done to assess its direct and indirect impacts on food security and poverty mitigation, especially in Africa. The aim of this study is to provide a better understanding of the role of fish-farming systems and their scale, market structure and institutional mechanisms in improving rural aquaculture in Mozambique and Namibia and, consequently, livelihoods and human development in rural communities.

This study shows that rural households are strongly dependent on agriculture/aquaculture as their main source of food and income. In general, families making a living from fish farming as their main activity have improved their access to food and basic services. There has been a significant increase in fish consumption in households since they have been engaged in rural fish farming, and there has also been an increase in the frequency of fish consumption per week. This progress in food and nutrition security needs to be consolidated through fish-farming development policies. However, rural aquaculture is still a sector in the early stages of development and has to overcome limiting factors such as a lack of specialised technical knowledge, logistical infrastructure and difficulties in access to credit and markets.

1. Introduction

The global seafood supply has increased at an annual rate of 3.1% since 1961, while the world population has increased by 1.7% per year for the same period (FAO, 2010), due to the growing demand and the rising standards of living and prosperity in developing countries (Hall et al., 2011). It is well known that capture fisheries and aquaculture play an important role in the food security and livelihoods of millions of people. Aquaculture (the farming of aquatic animals and plants) is among the fastest growing food production sectors in the world and this trend is likely to continue (Hall et al., 2011). According to FAO (2014), world aquaculture production attained another all-time high of 90 million tonnes (live weight equivalent) in 2012 (US$144 billion), including 66 million tonnes of food fish (US$137 billion) and 23 million tonnes of aquatic algae (mostly seaweeds, US$6 billion).

Global food fish aquaculture production expanded at an average annual rate of 6.2% in the period 2000–2012 from 32.4 million to 66.6 million tonnes. In the same period, growth was relatively faster in Africa (11.7%) and Latin America and the Caribbean (10%) (FAO, 2014). In 2012, aquaculture set another all-time production high and now provides almost half of all fish for human food (FAO, 2014).

Aquaculture is therefore viewed as an important resource in the global fight against malnutrition and poverty, particularly in developing countries (Allison et al., 2009; Tacon et al., 2010; Outeiro and Villasante, 2013; Villasante et al., 2013a, 2013b; WorldFishCenter, 2014). This production pattern has been also projected to the future. Assuming a liner growth of 2 million

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tonnes per year similar to the observed recent trends in farmed fish, chicken and pig production, Hall et al. (2011) estimated that aquaculture production will grow from 60 million t in 2010 to 100 million t to 2050.

Nevertheless, like capture fisheries, the focus of aquaculture in economically developed countries has been essentially on the culture of high value, high trophic level-carnivorous species (Tacon et al., 2010; Hall et al., 2011). In addition, increasing pressures on forage fish from some developing countries (i.e., Chile and Peru) to feed Chinese aquaculture activities could put at risk the sustainability of key pelagic species for global seafood markets (Villasante et al., 2013) and the resilience of marine social–ecological systems (Tröell et al., 2014). As result of some of these anthropogenic pressures, prices of cultivated species are higher than prices of the same species when harvested from the sea (Villasante et al., 2013a).[1]

Although Africa is a continent rich in natural resources and has large areas of arable land, almost a third of its population suffers from malnutrition, and food insecurity is widespread. This study focuses on rural aquaculture and, more specifically on what Martínez Espinoza (1999) calls small-scale rural aquaculture, defining it as "*low-production medium-scale aquaculture, based on increasing natural water productivity, polycultures, and using alternative feed prepared with local or waste supplies*".

Although aquaculture is widely recognised as contributor to both poverty reduction and food security (Kassam, 2013; Villasante et al., 2013; Thilsted et al., 2014; WorldFishCenter, 2014), empirical evidence to support this hypothesis is still incomplete because a little number of studies has explicitly addressed it for developing countries (Muir et al., 2005; NEPAD, 2005; Kaliba et al., 2007; HLPE, 2014). For that reason, the specific objectives of this paper are to (a) assess rural aquaculture as a productive activity and its contribution to the achievement of the Millennium Development Goals (MDGs) by focusing on provisioning ecosystem services, (b) to characterise rural aquaculture and its role in the fight against hunger in socio-economic terms, and (c) to identify and analyse the main limiting factors (environmental, economic, social, cultural and institutional) in the development of rural aquaculture and their impacts on food security and fight against hunger.

This paper is organised as follows. Section 2 highlights the role of rural aquaculture to reduce hungry in Africa. Section 3 describes the institutional framework for the development of rural aquaculture, the current situation of hunger and malnutrition in Africa, and how rural aquaculture can contribute to reduce them. Section 4 presents the research methods used in this study and how the data collection was made. Section 5 shows the results by addressing key dimensions of the role of rural aquaculture to reduce hunger in Africa. Section 6 discusses the main implications of the results presented as well as the critical limitations stakeholders pointed out which are acting as barriers for the further development of rural aquaculture. Section 7 concludes the paper.

2. The role of rural aquaculture against hunger and malnutrition in Africa

The MDG are the specific objectives agreed on by the United Nations Member States to fight world poverty and to promote improvements in the fields of health, education, environment and equality by 2015 (MEA, 2005). There are eight goals, each with specific targets and indicators, to improve human well-being by 2015.

In this line, the Ecosystem Approach to Aquaculture should be to develop and manage the sector in a way that addresses the multiple needs and desires of societies, without jeopardising the options for future generations to benefit from the full range of ecosystem services provided by aquatic ecosystems (Soto et al., 2008). Developing aquaculture in the context of ecosystem functions and services is a challenge that involves defining ecosystem boundaries, estimating some carrying capacity and holding capacity and adapting farming according to it. This requires to consider ecosystem services to be preserved or guaranteed (Soto et al., 2008; Outeiro and Villasante, 2013).

Aquaculture activities can provide a wide range of provisioning, regulating, supporting and cultural ecosystem services (Allison et al., 2009; Villasante et al., 2013b; Tröell et al., 2014; Outeiro et al., 2015a, 2015b). Most of the research on aquaculture done by using the framework of ecosystem services was mainly focused on the provisioning services. Here, we only focus on provisioning ecosystem services (e.g., seafood products) because of the availability of the data only allowed us to focus on them at this stage.

Hunger and malnutrition are the world's most devastating problems and are inextricably linked to poverty. Undernourishment exists when caloric intake is below the minimum dietary energy requirement (MDER). The MDER is the amount of energy needed for light activity and to maintain a minimum acceptable weight for attained height. It varies by country and from year to year depending on the gender and age structure of the population.

A total of 842 million people in 2011–2013, or around one in eight people in the world, were estimated to be suffering from chronic hunger, regularly not getting enough food to conduct a normal life (Thilsted et al., 2014). The number of hungry people in the world is unacceptably high. The FAO estimated that in 2010 there were 925 million undernourished people in the world (distribution by region in Fig. 1). Of these people, 98% were in developing countries, where the undernourishment rate was 16% in 2010. Two thirds of them lived in just seven countries (Bangladesh, China, Democratic Republic of Congo, Ethiopia, India, Indonesia and Pakistan), and over 40% lived in China and India alone.

Although the region with the most under-nourished people continues to be Asia-Pacific, the highest proportion is in sub-Saharan Africa, with 30% in 2010. Undernourishment increased sharply from 2006 to 2009, when the number of hungry people passed the 1 billion mark owing to high food prices and the global economic crisis, but the number is estimated to have declined in 2010 as the global economy recovered. However, this value is still

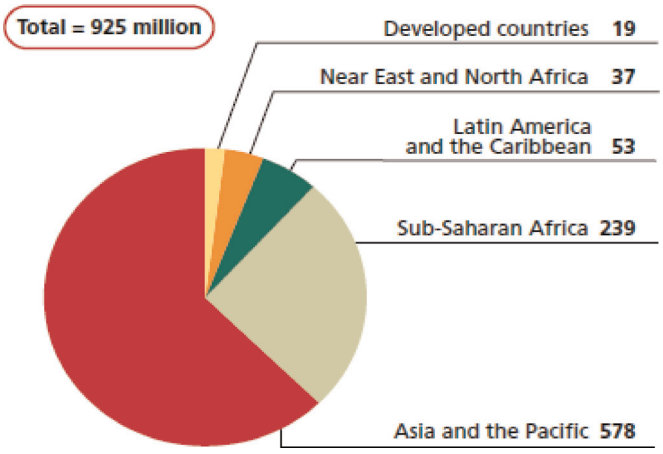

Fig. 1. Undernourishment in 2010 by region.

[1] For example, prices of aquaculture species in the Spanish seafood market are experiencing an increasing trend as the size of the commercialization channel (supermarkets and hypermarkets) is higher than traditional markets (Villasante et al., 2013).

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