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Literature Review on the potential contribution of fish-related activities to food and nutritional security and poverty alleviation

Deliverable 2.1

SEVENTH FRAMEWORK PROGRAMME

Contents

Cover Photo:
Aquaculture in Haiti is still in an early stage of development but will be critical in improving the nutritional and food security of the local population (Photo Credit: C. Béné)

Introduction

The objective of this document is to review the literature that has been published so far on the potential contribution of fish-related activities (aquaculture and fisheries) to food and nutritional security and poverty alleviation. This body of literature –which is found essentially in the aquaculture/fisheries literature, but also for some parts in the nutrition literature- turns out to be relatively heterogeneous and scattered, relying on different types of indicators and data. This information, which has been generated by different methodologies, applied at various scale (household, community, national levels), offers therefore very limited possibility for rigorous comparison or aggregation across projects, location or countries.

In this report the task consisted in collating these analyses and producing the first comprehensive overview of the data and methods used to assess and quantify the role of aquaculture in improving food, nutrition and livelihood in Low Income and Food Deficient countries (LIFDCs). As part of this process, those different analyses were assessed and particular attention was paid to highlight not only the information generated but also the gap in knowledge where more research is needed.

Sixty five documents (peer-reviewed articles, project reports, international agencies' reports) were identified and reviewed. To maximize the range of the assessment, the review included both aquaculture and fisheries documents. The complete list of these documents is presented at the end of this document.

Key points of the review

- It is very difficult to separate poverty alleviation and food security in the literature because the key impacts on poverty alleviation are generally also used as indicators for food security (e.g. employment or income created as used as an indicator for food access). Very few papers/documents look at poverty alleviation without also looking at food or nutrition security, although there are a couple of papers that look at economic impacts without linking them strongly to either poverty or food security.
- The extent to which researchers collect their own data is largely defined by the scale at which the analysis is conducted: in the vast majority of the documents reviewed here, small-scale analyses (less than 500 households) are implemented with data that were

generated by the reserach (own data), while larger scale analyses use existing data. To some degree this dichotomy appears linked to whether the focus is on producers (small-scale, own data) or consumers (large-scale, existing data).

- Data challenges include small species of fish, informal internal and cross-border trade, and seasonality in consumption, all of which are often missed by FAO statistics.
- While fish are likely to have the most significant impact in terms of micronutrients, the majority of studies focus on fish protein.
- Beyond discussions about the positive or negative impacts of fish trade, much of the rest of the literature focuses strongly on possible positive outcomes from fisheries and aquaculture, but less on costs (e.g. cost of government support for aquaculture) and on possible negative impacts.

Areas covered by literature, methodologies and data used

Study type: Micro-studies on the extent to which pro-aquaculture projects improve incomes and consumption for participant households (ADB 2005, Bouis 2000, Dey et al 2006, 2010, Gupta et al 1999, Jahan et al 2010, Thompson et al 2005).

Methodologies: Usually using treatment vs control and/or before vs after.

Data Sources: Surveys using their own data, samples ranging from 60-300 households. Studies often linked closely to the project in hand.

Comments: Only Dey et al (2006, 2010) attempt to simulate possible impact of such projects on wider society, and arguably do it in a limited way (using a multi-commodity model). No one considers possible negative effects of lower fish prices (Stevenson and Irz 2009).

Study type: Micro-studies revealing the extent to which small-scale fisheries are aimed at self-consumption or as income-generators (Béné et al 2003, Béné et al 2009, Hori et al 2006).

Methodologies: Mixed methods using own data, combining use of descriptive statistics, statistical tests (e.g. analysis of variance and pairwise multiple comparison, Kruskal-Wallis used by Béné et al (2009) with qualitative methods (PRA, RRA).

Data Sources: Own surveys.

Study type: Micro-study assessing the contribution of small-scale fisheries to reducing malnutrition (Aiga et al 2009).

Methodologies: Bivariate and multivariate analyses.

Data sources: Own data, small sample (66 children) mainly using anthropometric data.

Comments: Also uses 21 background variables that can affect nutrition, thereby putting the effect of fish production in the broader context of factors that can influence it.

Study type: Micro-level studies revealing the extent to which poorer groups participate in and benefit from fisheries/aquaculture (Béné et al 2003, Irz et al 2007).

Methodologies: Mixed methods, Irz et al (2007) use a Gini decomposition exercise.

Data Sources: Own surveys

Study type: Macro-level studies on the relationship between trade and food security in developing countries (Kurien 2004, Béné et al 2010, Allison 2011)

Methodologies: Comparing data on export levels to local fish supply levels, regressing fish trade indicators with human development indicators in combination with 15 additional sets of socio-economic indicators (Béné et al 2010).

Data sources: FAO FISHSTAT (1976-2007).

Comments: FAO data likely to miss out informal cross-border trade or trade in small fish and other aquatic animals, methodologies do not allow for disaggregated impacts across income groups or impacts on consumption at different times in the year, data is on protein supply but not supply of other nutrients.

Study type: Case-studies on the relationship between trade and food security in developing countries (Abila and Jansen 1997, Geheb et al 2008).

Methodologies: Combination of qualitative and descriptive statistics (including anthropometric data), not using statistical tests.

Data sources: Own survey data.

Study type: National-level study on relationship between fish export prices and local food security (Rodriguez et al 2005).

Methodologies: Multi-commodity-model of the fisheries sector based on Dey's AsiaFish model (uses QUAIDS model).

Data Sources: Consumption data from 2000 (National Statistics Office) and production data from Bureau of Agricultural Research; population data used to derive national per capita consumption. Some of the data needed adjusting.

Comments: This is the only study that disaggregates the impacts of fish trade across different population groups and species.

Study type: Studies revealing the micro-nutrient value of fish (Roos et al 2007a, 2007b, 2007c, 2007d).

Methodologies: Scientific methods, some survey data and semi-structured interviews.

Data sources: Own surveys.

Comments: Useful for highlighting the potential nutrient contribution of fish to the poor, but at a very small scale.

Study type: Studies disaggregating consumption of fish at the national level across different income groups and different species of fish (Dey et al 2005, Garcia et al 2005, Bose and Dey 2007).

Methodologies: Multi-commodity model, three-stage budgeting network, quadratic almost ideal demand system (QUAIDS) model, regression analysis, Duncan's Multiple Range Test (DMRT).

Data sources: Household income and expenditure surveys (HIES), World Fish Center data (Dey et al) samples ranging from 5000 (Dey et al 2005) to 39,000 households (Garcia et al 2005).

Comments: Methodologies go the furthest in disaggregating impacts across different income groups and fish species at a national scale. Dey et al (2005) also believe the data they use (from Genetic Improvement of carp species in Asia) capture all species of fish and seasonal changes in consumption. Garcia et al study (2005) is on demand elasticities for different fish species across income groups.

Study type: Comparing the productivity, costs, and benefits across various types of cultivation and various intensities of production (Pionsumbun et al 2005).

Methodology: Using descriptive statistics.

Data source: Variety of Data collected in 1998–2001 by the Department of Fisheries (DOF), Thailand and the WorldFish Center.

Comments: Does not follow through and look at implications for poverty or food security.

Study type: Studies of the economic effects of fisheries/shrimp (Stanley 2003 and Farias Costa and Sampaio 2004 at national levels, Dyck and Sumaila 2010 at the global level).

Methodologies: Mixed quantitative methods (Stanley 2003) input-output matrix used to calculate indirect and induced jobs (Farias Costa and Sampaio), input-output methodology used by (Dyck and Sumaila 2010).

Data sources: Variety. Stanley et al (2003) mainly based on national household survey, Farias Costa and Sampaio include combination including their own data collected from 20 small, medium and large farms shrimp farms to find direct impacts and census data and Ministry of Agriculture to extrapolate them. Dyck and Sumaila (2010) use Global Trade Analysis Project at Purdue University.

Comments: Stanley's methodology is described by Stevenson and Irz (2009) as a 'qualitative approach on a country specific basis' and is seen as the best option for appraising aquaculture's contribution to a regional economy.

Study type: Studies modeling likely fish/mollusc availability in the future and implications of this (Bell et al 2009, Cooley et al 2012).

Methodologies: Comparing current consumption levels to population growth data.

Data sources: Bell uses HIES surveys, Cooley et al use combination of FAO FISHSTAT, + World Bank, CIA World Fact Book, IMF data sets + FAO food balance sheets for protein availability and seafood consumption data.

Comments: Modelled impacts are not disaggregated across different income groups.

Study type: Proposal of comprehensive methodology for answering many of the pertinent questions on aquaculture, but not small-scale fisheries (Hishamunda et al 2009).

Methodologies: Multiplier method, developing indicators to demonstrate aquaculture's contribution to a range of food security and poverty-related goals. This includes, for example, using an 'aquaculture employment multiplier', comprising of data on jobs created and labour income (assuming that jobs created for people with low education, and for women, will have greater impacts on food security), and this is used as the key contributor of aquaculture to both food access and poverty alleviation. Meanwhile contributions to short-term food security are done by looking at a) the extent to which aquaculture supply correlated to overall food supply, and b) whether or not they model that overall food supply would become more volatile in the absence of aquaculture

Data sources: Data from small number of farms (1-3) can be used as the basis of calculations on aquaculture's contributions to a number of indicators.

Comments: Authors explain the likelihood that required data will be accessible, and propose alternative methodologies in the case that it is not. The methodology is flexible enough to be used even when there are data gaps, although this may bring risks. For example, using data from small number of farms may be risky, as authors acknowledge that employment creation on farms varies significantly depending on the technology use. Moreover, this methodology is naturally more appropriate for formal sectors for which aquaculture farms may be more homogenous, and where data is more likely to be available than for informal, small-scale fisheries. Certain indicators are used to demonstrate contributions to a number of objectives. Using broad indicators to measure contributions to different objectives could risk excessive conflation of them (for example, conflating employment generation with poverty and food security). Assumptions are made that could lead to overestimations of the sector's contributions. For example, foreign exchange earnings are used to indicate the indirect contributions of the sector

to food security based on the assumption that all foreign exchange earnings will be spent on food. Meanwhile, other assumptions may be challenged and may not always be accurate (e.g. increasing a female labour force may increase burden on them, divert them from other activities contributing to food security). Not only that, as with most papers, the focus is on protein but not micro-nutrients. Finally, perhaps a more significant problem is that the methodology only seems to be set up to count positive changes from aquaculture, but not possible negative impacts that could occur, for example, through producers getting undercut by imports, land-use changes, jobs displaced or the cost of government support for industry development.

Study type: Studies demonstrating the extent of tradeoffs in prioritizing different objectives in aquaculture (El Gayar and Leung 2001, Martinez-Cordero and Leung 2004)

Methodologies: Multi-criteria decision making model.

Data sources: From aquaculture production systems.

Comments: Usefulness of the tool limited by limits of government's ability to manage aquaculture to that degree.

Study type: Regional study giving overview of production levels, consumption levels of fisheries (Hortle 2007).

Methodology: Descriptive statistics.

Data source: From over 20 different surveys.

Comments: Author notes a number of problems with data sources, the unknown accuracy of consumption data, underreporting of artisanal fisheries and informal trade.

Knowledge gaps

The impacts of pro-aquaculture interventions on consumers and non-beneficiary producers (who in theory should benefit from greater fish availability) are rarely considered. Similarly the impacts on other producers who could suffer from lower prices (as suggested by Stevenson and Irz (2009)) are not considered. The study by Dey et al (2006, 2010) from Malawi is the only study that looks at an aquaculture project's possible welfare effects on the rest of the economy.

Data Requirements

- Data must capture all types of fish species, and ideally, differentiate between them.
- Data should capture unofficial imports from neighbouring countries.
- It should show how access to and consumption of fish is distributed across different income groups in society.
- Ideally, data should capture seasonal changes in consumption that may be different. This might not be possible with available HIES.
- It should go beyond contributions of fish to protein supply and look at contributions to micro-nutrients, as this is where the impacts of fish are likely to be more significant.

Problems with existing data

- Data does not always capture the small species of fish that are consumed mostly by the poor, as well as other aquatic animals.
- Data does not record the informal trade and markets that may be most relevant for the poor.
- Most calculations usually made are for protein, rather than other micro-nutrients.
- Lack of surveys capturing consumption throughout the year.

Existing methodologies

Benefits derived from fish income

Aiga et al (2009), Bivariate and multivariate analyses based on cross-sectional survey of a small sample (66 children). The focus is on the nutritional statuses of children in fishing and non-fishing families using anthropometric measurements. They look at background variables that impact on nutrition (for example, cleanliness, breast-feeding practices.

Allison (2011) use FAO 1976-2007 data on relationship between export trade and national fish protein supply (not micro-nutrients). He does not conduct statistical tests. This is enough for providing a counter for the claim that fish trade reduces the supply of fish available in developing countries, but does not provide disaggregated analysis, or reveal the role of fish in poverty reduction or food security.

Bell et al (2009) use HIES data for fisheries' contribution to protein supply at national level.

Béné et al (2003) using own data: Small scale, qualitative, producer focused.

Béné et al (2009) use data collected from 43 fishing camps, using surveys, focus group discussions, and interviews. This includes records of peoples' incomes and expenditures in the previous year, and the authors then use statistical tests (an analysis of variance and pairwise multiple comparison, Kruskal-Wallis) to test correlations on the role of fisheries particularly regarding income generation.

Béné et al (2010) use data from FISHSTAT and a number conduct a number of statistical tests to assess claims on whether or not trade in fish increases or reduces fish supply in developing countries. They regress 4 development indicators against 5 fish trade indicators in combination with 15 additional sets of cross-sectional macro-economic indicators.

Gap – lack of disaggregation

Bose and Dey use HIES data from Bangladesh covering 7440 hh's to examine inequalities of consumption of different types of foodstuff, including different fish species. They use the Cost of Basic Needs measure of food and non-food poverty to estimate objective poverty, the difference between actual consumption and recommended levels of items to estimate subjective poverty, and then pseudo-Gini ratios to compare consumption of different food items. Large-scale,

consumer focused, disaggregated across income. It´s on expenditure rather than nutritional outcomes. I.e. assume that expenditure on those types of fish does lead to nutritional outcomes.

Bouis (2000) uses 4 survey rounds between 1996 and 1999 covering 110 hh's that adopted aquaculture technology, 110 deemed likely to access it, and 110 that were NGO members in villages where the technology had not been adopted, and 110 in villages where the NGO was not present, to assess the impact of aquaculture projects on income and own-consumption.

Dey et al use data from a microlevel database of 5,931 hh's from the World Fish Centre's 'Genetic improvement in carp production' project, using indicators on different species of fish protein as % of overall protein consumption, expenditure on fish protein as % of overall expenditure, and of expenditure on food, and of animal proteins by each quintile. Importantly, this dataset surveyed **the same people on a monthly (on average) basis for a year in order to take into account the seasonality of consumption habits**. Moreover, the authors believe that this survey data captures consumption of small and indigenous fish often missed by national statistics, as well as informal fish imports. It also disaggregates by different fish species, urban and rural, and in some countries, producers and non-producers. They first use regression analysis to show the impact of freshwater fish production on per capita consumption, and then do a **pairwise comparison using Duncan's Multiple Range Test (DMRT) to show differences in average per capita fish consumption between income quintiles**. With the exception of Bose and Dey (2007), this is the only attempt to seriously disaggregate across income groups and fish species.

Dey et al (2006, 2010) use data from a survey of 30 participants in pro-aquaculture interventions and a 'control' group of 30. They used econometric and parametric tests to test the impact of the project on adopters. This is also the only study that calculates the impacts of a pro-aquaculture project on non-participant consumers, and it does this using a multi-commodity model to estimate the likely lower prices from greater aquaculture productivity.

Hishamunda et al (2009) – Calculate contribution to food availability using protein supply based on data of quantity of protein produced, and the quality of it. Meanwhile indirect contributions are done via the net foreign exchange brought in by the sector, which is assumed to be spent on food, thereby contributing to food security. Food access is calculated by looking at aquaculture's contributions to labour income and employment (which is deemed to be a greater contributor if more employees are low-skilled, and if they are women, (who are assumed to be more dedicated to hh food security). Meanwhile contributions to short-term food security are done by looking at a) the extent to which aquaculture supply correlated to overall food supply, and b) whether or not they model that overall food supply would become more volatile in the absence of

aquaculture. Gap – Only looks at protein (not micro-nutrients) and does not look at disaggregated impacts.

Jahan et al (2010) use data from 225 farmers from the 2001-5 Development of Sustainable Aquaculture Project (DSAP) to calculate the impact of aquaculture projects on fish consumption (using a before/after, with/without trial), calculated in terms of annual per capita fish. They also make calculations for the consumption of other foodstuffs, and record the types of fish that are consumed.

Employment and multipliers

Hishamunda et al 2009 – Use an 'aquaculture employment multiplier' for impact on employment. It should be noted that this multiplier is then the main mechanism for assessing aquaculture's contribution to both food access and poverty alleviation. Data on the **total employment generated by aquaculture in a given time period is available from detailed employment statistics or comprehensive farm surveys**. If this is unavailable, they suggest using the scale of commercial aquaculture to estimate its contribution to employment. This would require knowing the output of commercial aquaculture, and the average labour-output ratio. In their examples, they often use data from just two or three examples of commercial farms to calculate impacts of aquaculture on GDP, employment, and labour income, suggesting that this data might not be hard to come by. These estimations also form the bedrock of calculations to calculate impacts on labour income. However these can vary across commercial farms, therefore detailed information regarding commercial aquaculture sectors in each country is required.

Hishamunda et al's methodology suggests that contributions to employment and labour income can be achieved if reliable data on a tiny sample of representative farms can be collected, but there may be a danger of over-estimating the homogeneity of the farms (they acknowledge that demand for labour on farms varies massively according to the technology being used), plus this may mean missing out the informal smaller-scale fisheries where the poorest people are employed, and for which data may be more heterogenous and less accessible.

Bouis 2000 using 4 survey rounds – small scale, producer focused.

Hori et al (2006) use T-tests and Anova on data from 104 of 183 households and 105 of 140 households in Svay Ear and Srey Rangit to assess the extent to which small scale fisheries are for self-consumption or cash-based.

Irz et al (2007) undertake a Gini decomposition exercise to disaggregate the extent to which aquaculture is pro-poor at the production end. In this, impacts on reduced inequality depend on three factors: the relative importance of the income source from aquaculture in overall inceom, the distribution of aquaculture income among all hh's, and the correlation between aquaculture income and total income across hh's. If the correlation is low, it suggests that those hh's deriving a large share of their income from aquaculture are not from the richer groups. They use data from 148 hh's randomly selected from five communities in the Philippines.

Jahan (2010) shows income increase in project intervention via a before-after with-without trial. Employment effects are captured via showing increase in man-days/ha in intervention farms compared to before the project, and a control. Labour productivity is found by dividing total production by total labour.

Tax revenues

Dey et al used multi-commodity model to estimate contribution of aquaculture development's contribution to GDP using data from small survey.

Hishamunda et al (2009) suggest tax contributions can be estimated by using the sector's value added or revenues and combining that with what is known about the nation's tax regime. To calculate contributions to foreign exchange, data on the value of export revenues and imported inputs will be necessary. Calculating the productivity of the sector requires the quantities and prices of aquaculture's outputs and inputs over time.

Own or existing data

Predominantly use own data: ADB 2005, Bouis 2000, Dey et al 2006, 2010, Gupta et al 1999, Jahan et al 2010, Thompson et al 2005 Béné et al 2003, Irz et al Aiga et al 2009 Abila and Jansen 1997, Geheb et al 2008 Roos et al 2007a, 2007b, 2007c, 2007c, 2007d

This group is comprised of a) small-scale studies focusing on producers, and b) Roos et al's small-scale studies focusing on nutritional value of small fish.

Predominantly existing data: Kurien 2004, Béné et al 2010, Allison 2011 Rodriguez et al 2005 Dey et al 2005, Garcia et al 2005, Bose and Dey 2007 Pionsumbun et al 2005 Stanley 2003 Hortle

2007 El Gayar and Leung 2001, Martinez-Cordero and Leung 2004 Bell et al 2009, Cooley et al 2012 Dyck and Sumaila 2010

This group is comprised of a) Macro studies looking at the impacts of trade on food security, b) macro studies looking at consumer expenditure and habits, c) regional studies of economic effects of fisheries and/or issues relating to productivity.

Mix data (own and exsting data): Farias Costa and Sampaio 2004, Hishamunda et al 2009 (they suggest this)

This group is comprised of those that collect (or advocate collecting) data on a small number of aquaculture farms, and then use existing data to extrapolate outwards, with a particular focus on jobs created, productivity, etc.

Therefore, whether or not researchers collect their own data depends on the scale they are looking at – those looking at small-scale collected their own data, those looking at a larger scale use existing data. To some degree, this leads studies of fish producers to collect their own data, presumably because producers are quite a small group of people, while studies on fish consumers use larger, existing datasets. There are however some clear exceptions such as the studies by Roos et al.

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